(國科會GRB編號)
PG9604-0335
(內政部計畫編號)
096301020300G1001

大屯火山群潛在岩漿庫
及微震觀測網長期監測計畫(五)

受 委 託 者：中國地球物理學會

計畫主持人：林正洪

研究人員：蒲新杰

研究助理：溫錦富、林瑞仁、王怡青

內政部營建署陽明山公園管理處委託研究報告

中華民國九十六年十二月

目 次

表 次

圖 次

摘　要

關鍵詞：大屯火山群、微震觀測網、微震

一、研究緣起

依據過去地質定年資料顯示大屯火山群已經沉寂長久，但是地表地熱與微震活動還是很明顯。此外，最近噴氣所含氦同位素之分析研究，證實部分大屯火山群之噴氣來自岩漿源，這強烈的暗示台灣北部地底下依舊存在有岩漿庫之可能性。故大屯火山群是否再度活動的可能性，不僅是一個值得研究的科學問題，更關係大台北附近民眾的生命財產安全。

二、研究方法與過程

本計劃於陽明山國家公園內設置一個共有十一個地震站微震觀測網，來監測七星山附近之火山地震活動。經由過去四年多仔細地分析每一測站連續之地震記錄，於七星山及大油坑附近之最上部地殼中(深度約一至五公里)，觀測到許多微小的地震活動。

三、重要發現

在這些微震中並發現有少許的群震現象，即有些微震常同時發生於很集中之小地區內。此外，仔細比較每一測站每天之連續地震記錄，也發現有異常的火山地震訊號，例如地震波形類似螺絲釘（Tornillos）及單頻水滴狀地震紀錄，及連續性暴發型之火山地震活動。初步定位顯示其來源亦落於七星山及大油坑附近地區之淺部地殼。這種訊號之來源與發生機制，一般可以用岩層裂縫內液體或氣體，因壓力突增或突減做造成之震動來解釋。

四、主要建議事項

雖然依目前之地震資料，無法清楚地判識這些群震現象與異常訊號之正確

之機制，但其特徵卻與一般活火山地區之岩漿或熱水活動相似，故很值得作更進一步之探討與研究。

目前，在立即可行之部分，建議政府相關部門能對大屯火山地區能持續作連續性之監測與研究。而陽明山國家公園目前除了持續進行地震監測之工作外，並建議其他相關單位也能加入更多不同領域之研究。此外，建議陽明山國家公園能考慮於管理站或遊客中心建立火山監測展示場，供民眾實際體驗並觀察地震振動情形。

而長期建議的部分，除了持續進行長期火山地震觀測之相關研究外，建議於未來研究中，適時加入地表變形長期監測研究及其他相關之研究，以探討岩漿庫存在之可能性。故建議國內政府地球科學相關機構，參與規劃中長期且跨領域之大屯火山監測與研究工作。

Abstract

Keywords: Tatun volcanoes、small-aperture seismic network、micro-earthquakes

1. Introduction

Although the Tatun volcanoes have been extinct for a long time based on the previous geological dating results, there are still a lot of geothermal and micro-earthquake activities near the surface. A recent study of Helium isotope ratios indicates some magma chambers might extist beneath the Tatun volcanoes. Therefore, it is not only an interestingly scientific topic but also strongly social impact if there is any potential volcanic activity in the Tatun area.

2. Methodology and Data Process

In this report micro-earthquakes in the Tatun volcanic area were detected by using a small-aperture seismic network that was composed of eleven seismic stations. The seismic monitoring results show that most of the micro-earthquakes were largely located beneath the Chih-Shin-Shan and Da-You-Kan areas at depths between 2 km and 5 km.

3. Results

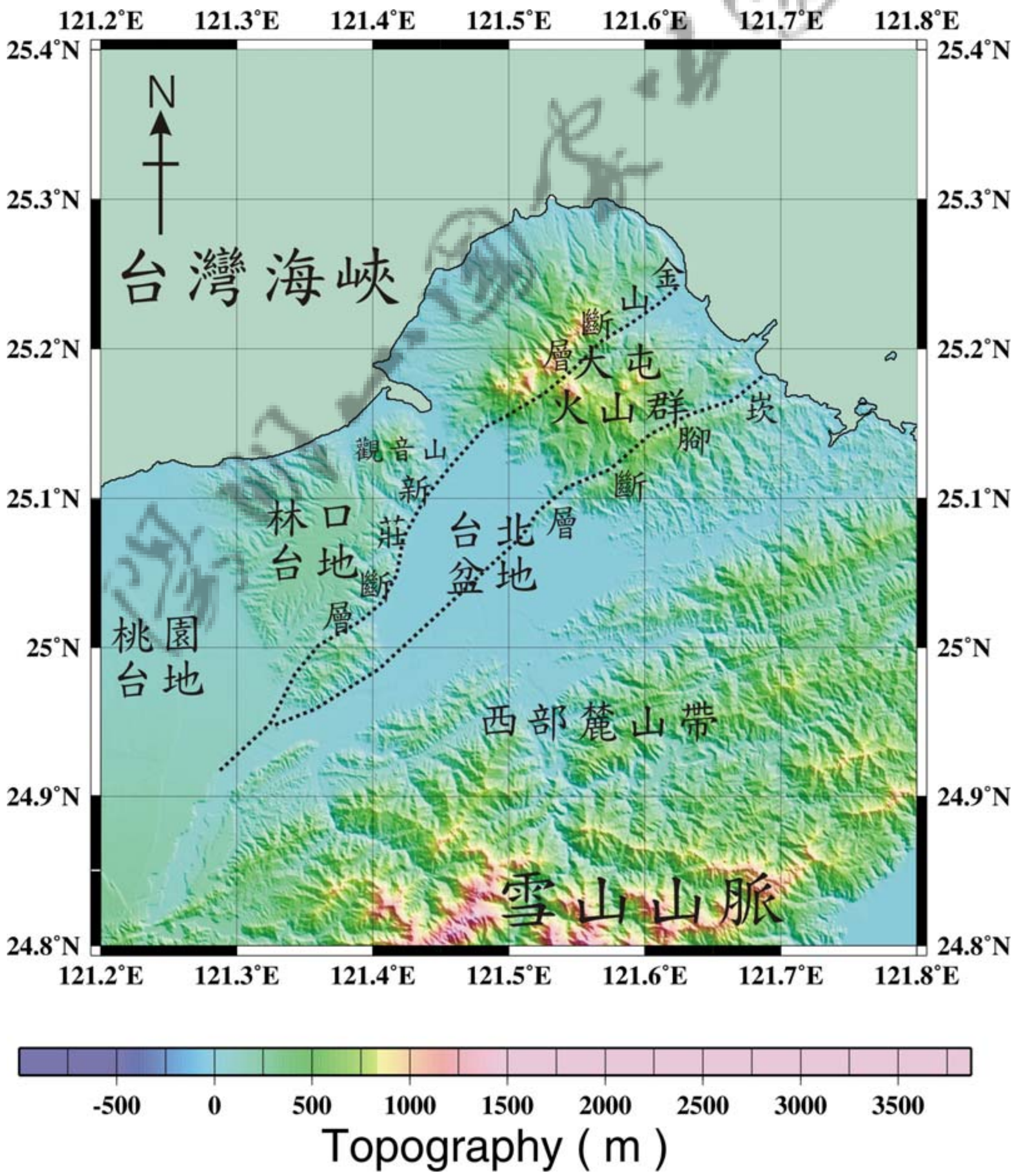
Among those micro-earthquakes, some swarms were also found. Besides, some continuous tremors such as Tornillos, harmonic and spasmodic signals were simultaneously observed from the seismic records at different stations. The possible sources for generating those volcanoseismic signals are also located beneath the Chih-Shin-Shan and Da-You-Kan areas. Although the exact mechanisms of generating those continuous tremors and swarms are still not be fully understood from seismic data recorded so far, those features were very similar to the signatures produced by either the magma chamber or other geothermal activity at the active volcanic areas in the world.

4. Suggestions

Some further investigations have to be done to improve the understanding of the mechanisms for generating the swarm and tremors in the Tatun volcanic area.

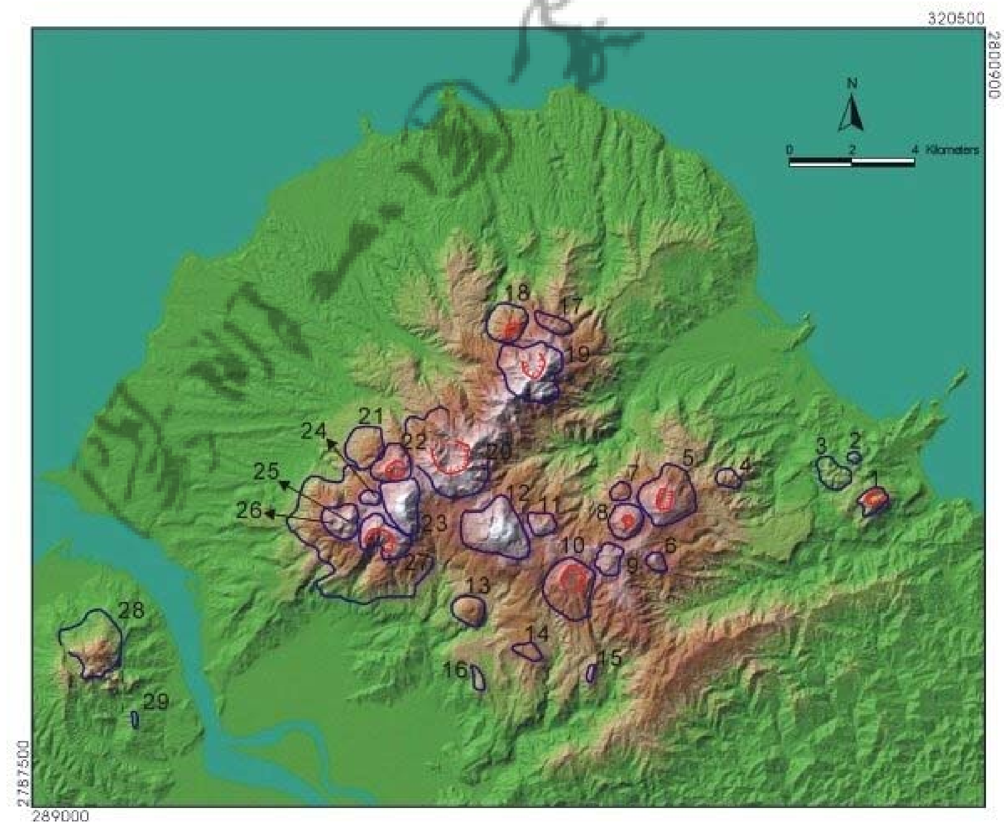
第一章　研究背景與目的

台灣島的最北端之大屯火山群是緊鄰於台北盆地的正北方 (圖一) 。大屯火山群之分佈範圍，大約涵蓋 250 平方公里面積。東南以崁腳斷層與漸新世沉積岩相隔，西南以淡水河與更新世台地分開，北面臨台灣海峽。大屯火山群也是台灣北部火山活動的中心位置。其四周還有相鄰的火山，東為基隆火山群，西南為觀音山，東北外海還有一群火山小島 (如花瓶嶼、棉花嶼及彭嘉嶼等)。



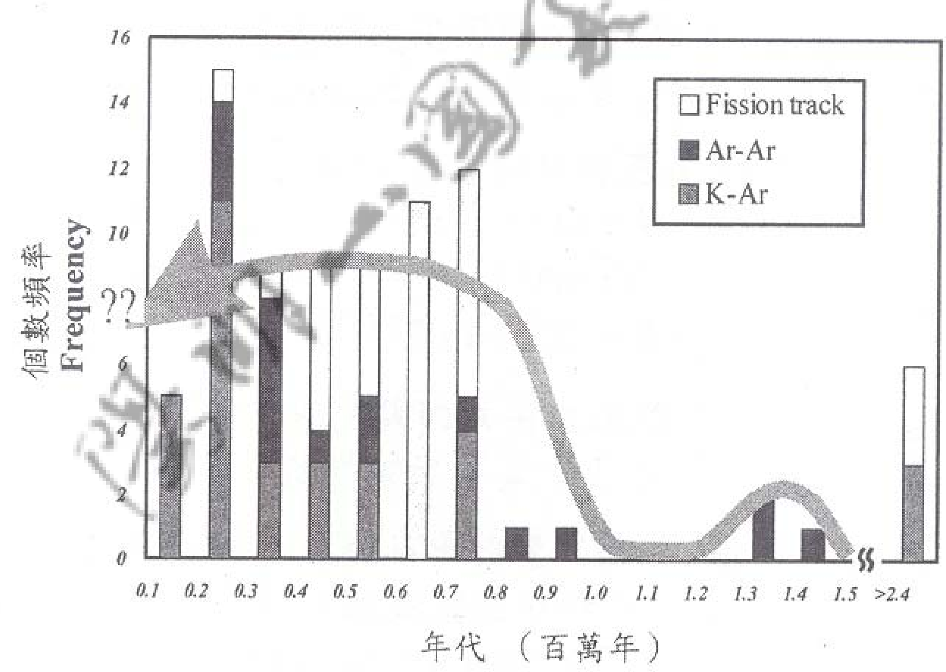
圖一　台灣北部之地形與主要地質構造區。

大屯火山群總共包括有二十幾座火山 (圖二)。主要包括竹子山、嵩山、小觀音山、菜公坑山、烘爐山、面天山、向天山、南大屯山、大屯山、紗帽山、七星山、七股山、內寮山、大尖山、大尖後山及磺嘴山。大屯火山地區有一條東北—西南走向的主要斷層通過，即爲金山斷層，其通過竹子山、小觀音山、和大屯山 (圖一)。而金山斷層往西南可連接至台北盆地西側的新莊斷層或山腳斷層。大屯火山群的火山活動噴發物覆蓋在中新世沉積岩上，火山體沿著東北—西南走向的金山斷層兩側分佈，據推測火山活動與金山斷層活動有關 (Yen et al., 1984)。

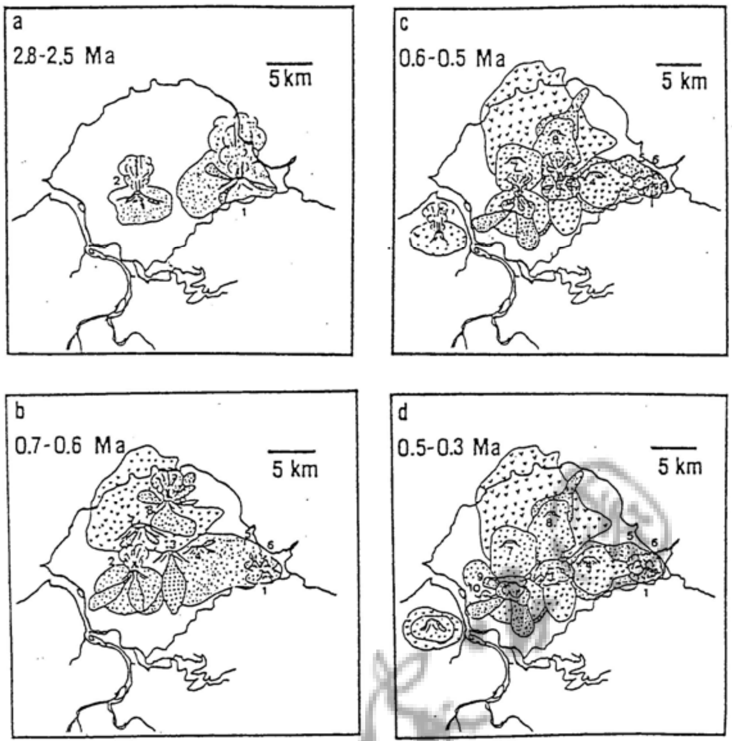


圖二　大屯火山地區之主要火山分佈：大屯山(23)，七星山(12)。

大屯火山群的噴發歷史，主要根據鉀氬（K-Ar）定年 (Juang and Bellon,1984; Tsao,1994)，及核飛跡定年 (Wang and Chen,1990)資料可知。基本上，大屯火山群的主要火山活動可分爲兩個階段 (圖三) 。第一階段大約在二百八十萬年左右開始。在二百五十萬年時，原始大屯山亦有活動，後來靜止一段相當長的時間。第二階段於九十萬年又開始活動，在七十萬年時，大屯火山群幾乎各亞群均有噴發，至三十萬年以後，整個大屯火山群的火山活動便慢慢地趨向停止 (圖四)。



圖三　大屯火山群定年分佈情形（楊，1999）。

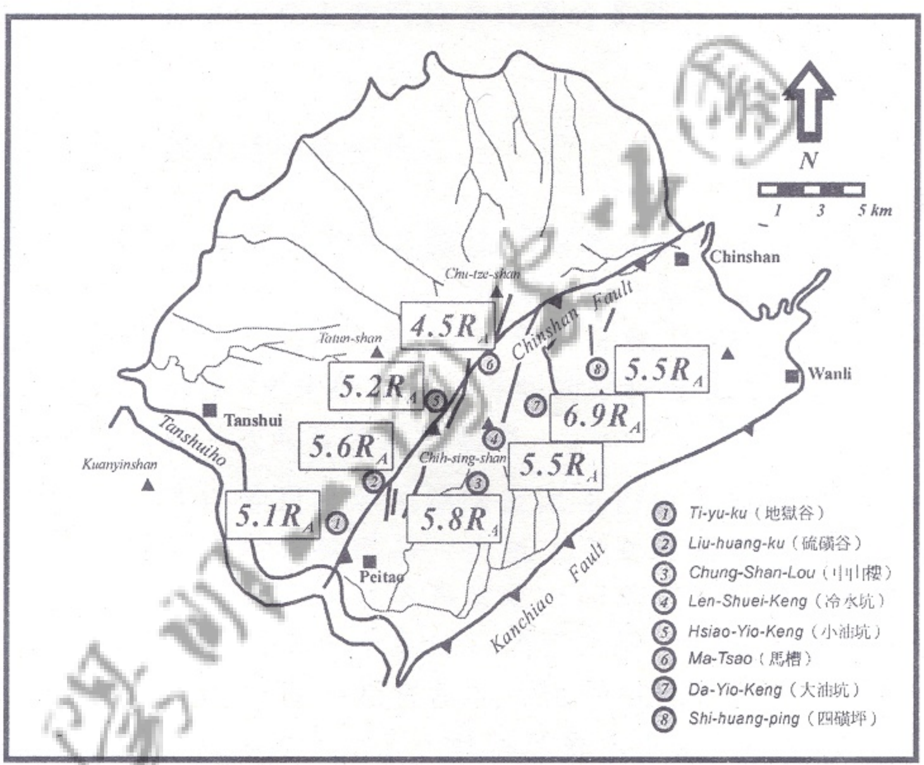


圖四　大屯火山群噴發歷史簡圖(Wang and Chen，1990)。

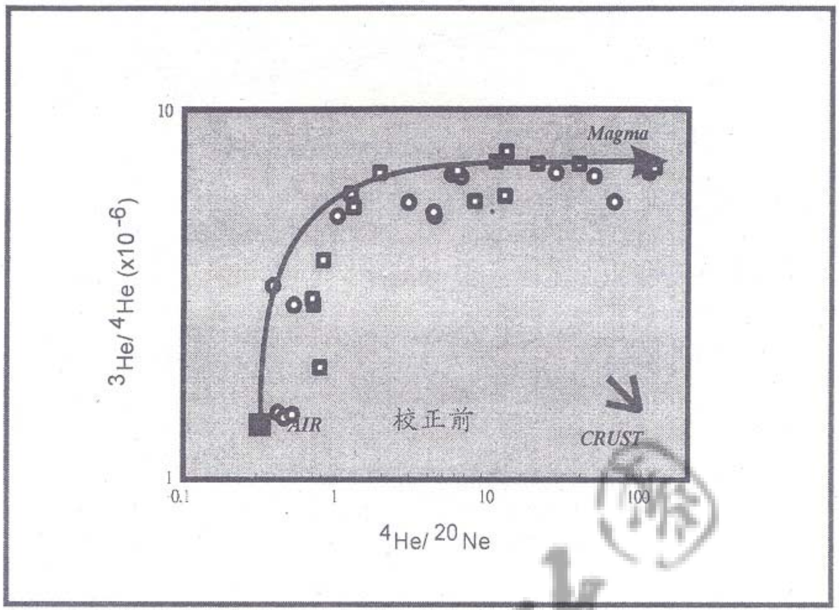
科學家一般認爲台灣北端火山群是琉球火山弧的西延 (Ho, 1982；Chen, 1983, 1990 及 Teng et al., 1992) 。也就是說大屯火山群主要可能生成原因，是因爲菲律賓海板塊向西北隱沒，所生成一系列的琉球火山弧，而台灣北端的火山活動正是在其最西端。然而，最近的地球化學資料也顯示，台灣北端火山群與真正琉球火山弧的產物並不相同 (Chen et al., 1994 及 1996)，因此我們可能需要重新思考大屯火山群是否爲琉球島弧的一部份。取而代之，根據大地構造應力的研究指出 (Suppe, 1984)，由於呂宋島弧與歐亞大陸碰撞，使台灣北部大地應力場在更新世晚期由擠壓轉變爲擴張。台灣北端的火山活動可能是因張力陷落造成正斷層，而後岩漿沿著斷層裂縫湧出所產生的火山活動 (Yen et al., 1984; Song et al., 1992)。如果這看法是比較接近事實的話，在研究大屯火山群是否有再活動的可能性時，需要特別留意整個區域是否還在繼續擴張中。火山形成的機制如果還繼續存在，再次的活動機會就無法排除了。

根據最近的地質調查顯示，大屯山最近的一次噴發大約是一、二十萬年前

(Song et al., 1996)。雖然這意味大屯火山群已經沉寂長久，但是地表地熱活動還是很明顯。此外，根據噴氣所含氦同位素之最近分析研究 (楊等, 1999)，顯示部分噴氣來自岩漿源 (圖五 a)，這強烈的暗示台灣北部地底下依舊存在有岩漿庫之可能性 (圖五 b)。故大屯火山群是否復活的可能性，不僅是一個值得研究的科學問題，更關係大台北附近民眾的生命財產安全。



圖五 （a）大屯山地區噴氣氦同位素特性分佈（楊，1999）。

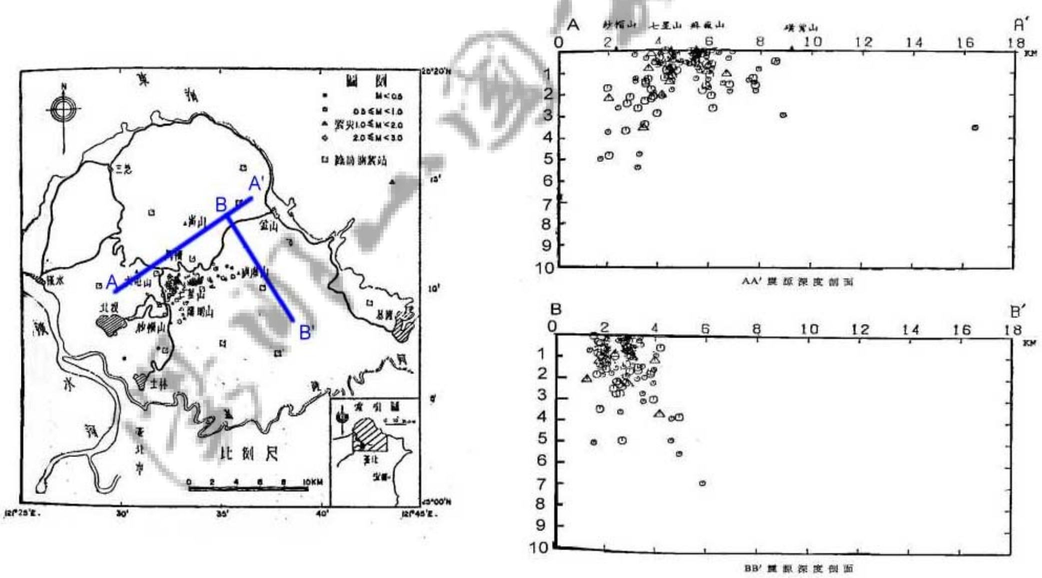


圖五 (b) 利用氦同位素特性判識其噴氣來源（楊，1999）。

利用科學方法瞭解火山體地下物質、情況的途徑有很多種。根據日本、美國、紐西蘭和菲律賓等國家，監測火山活動的經驗得知，除了地表的地質調查、溫泉水成份分析、氣體採集分析、岩石礦物定年研究外，利用地球物理的方法(微震觀測、震波測勘、重力、磁力測量、電磁波測勘、大地電阻法等)，推估地下構造也是近年來常被採用的方式。因爲火山如果復活，其岩漿流動必然會產生火山性的地震，也可能會改變地形、重力、地磁力、及地熱氣和溫泉水中化學物質的濃度。其中爲了瞭解地下岩層的物理性質，利用火山地區之地震活動資料，所獲得震源時空分佈與速度構造特性，並配合其他相關證據解釋，可以幫助我們了解大屯火區淺部地殼的地熱分佈、地下火成岩體的範圍、破裂岩層與融熔物質等。本計畫預期在大屯山地區，設立一個長期性地震觀測網系統，以精密的儀器，測量微小地震的時空分佈，及地震震源特性研究。希望透過地震分佈與震源特性之研究，辨識大屯山地區岩漿之存在與否。

大屯火山區地動監測與調查，最早始於民國 69 年，由中國石油公司探採研

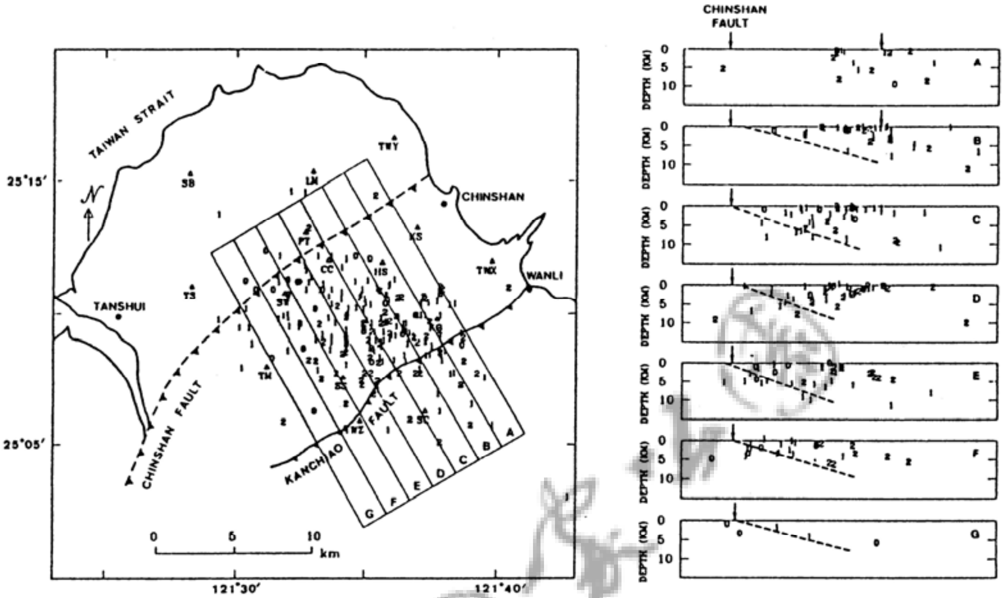
究中心，委託當時的中央研究院地球科學研究所籌備處（余等, 1980），以南起新北投、北至金山，以具有明顯地熱徵兆的狹長區塊為中心，設立了 13 高靈敏度的臨時測震網。經過了 35 天的完整記錄，觀測到了 131 個微震活動，其規模介於 0 ~ 2.1 之微震（圖六）。幾乎所有的地震都發生在紗帽山、燒庚寮、三重橋、磺嘴山之間東北向的狹長地帶。陳 (1985)利用該地震網的收到的地震時間，項配合重力波譜分析，亦對大屯火山區的地殼構造速度分層作了相關研究，並歸結出在 1.3 公里深的地方有一密度不連續，而 2.7 公里為花崗岩質層頂的平均深度。由於受到斷層影響，大體上由東南向西北漸深，而於兩斷層間形成凸區，且此區以馬槽為中心有一慢速薄層。



圖六　大屯山地區臨時地震站置及微震分佈（余等，1990）。

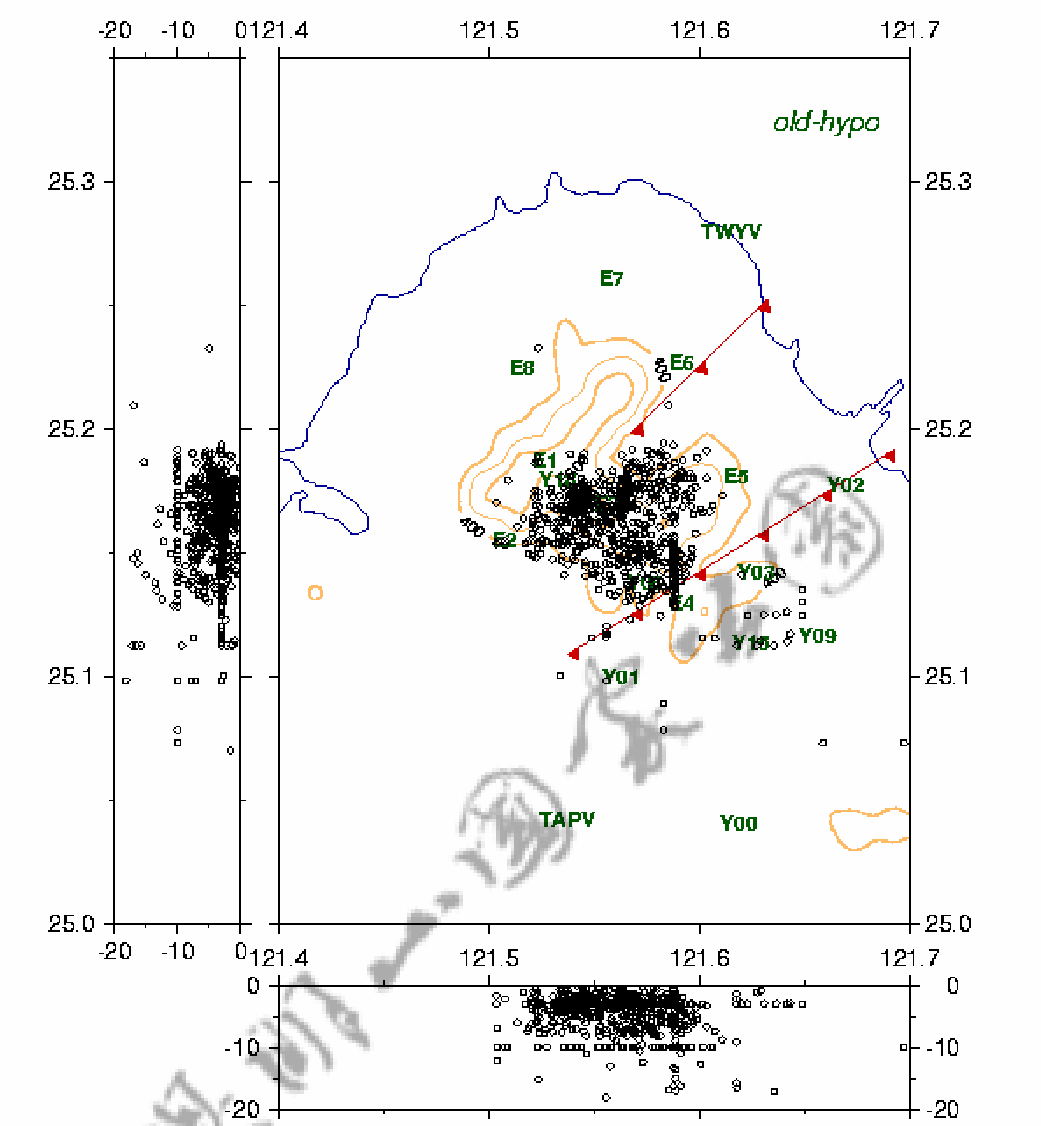
民國 76 年 8 月到 10 月間，中研院地球所再度以金山斷層、大屯火山群為研究對象，設了 12 個臨時測震站 (Chen et al., 1991)，在為期大約兩個月的觀測中，總共蒐集了 223 個地震（圖七)，大部分震源深度淺於 10 公里，將其震源深度繪於與金山斷層垂直的剖面，發現地震的發生應與大屯山及七星山的

地熱活動有關，分析其斷層面解亦發現多爲正斷層型態。



圖七　金山斷層附近之微震活動（Chen et al., 1991）。

最近幾年(民國 85 年到民國 90 年間) ，爲了解大屯火山群火山活動的可能性，由美國系統科技工程公司，再次委託中研院地球所及中央大學，進行包括微震、地形變動 (GPS)、重力、磁力及地球化學等項目之監測研究。其中微震研究再次說明，該地區之地震活動大多數是位於大屯山之東南側地區(葉等，1999)，而大屯火山地區正下方之地震活動較小(圖八)。由震源深度剖面圖約略可見一個往東南傾斜之地震帶，其傾角約 45°左右，震源深度分佈約從 2 公里到 7 公里。雖然此東南傾斜之地震帶特性與金山斷層相似，但由於目前金山斷層之傾角並不清楚，故兩者間很難作進一步之解釋。



圖八 大屯火山地區微震活動（葉等，1999）。

第二章　儀器設備

本計畫之測震網以監測大屯山地區火山活動所引起的地震爲主要目的，爲能蒐集微小之地震訊號，並連續觀測該地區之地震活動，本計畫之測震網採用高解析度的數位式地震記錄器，並以高效能個人電腦、PC-Based 的資料擷取系統作分析研究。本計畫所架設的臨時地震觀測網中之感應器(Sensors)有兩種速度型感應器，一爲短週期三向量速度型感應器，另一爲中長週期三向量速度型感應器。本計畫野外測站選用的地震記錄器爲日本東海測震公司發展之地震記錄器，其主要功能在將感震器的地動信號數位化。具有 24 位元的解析度，取樣率最高可達 250 次/秒。地震記錄與資料處理系統，包括三組磁碟陣列 (Disc-array)、數台個人電腦 (PC)及兩個工作站 (SUN-workstation)來進行地震資料之分析研究。本計畫微震監測系統的儀器主要元件之功能及特性介紹如下。

(一) 數位式地震記錄器

本計畫所架設的臨時地震觀測網中，其所使用的記錄器(Recorders)是由日本東京測震公司所設計生產的 SAMTAC801 連續記錄器 (圖九)，存放資料的記憶體是硬碟 (圖十)，因其容量高達 20 Gigabyte。硬碟優點在於連續資料的資料量龐大，高容量硬碟可減少前往蒐集資料的次數。觀測微小地震是本監測網的主要任務，爲避免在監測的過程中漏失任何有用的資訊，連續記錄方式就成爲較佳的選擇。

在本計畫中其配置及設定的狀況如下:

取樣率：100 次/秒

頻道數目：6 個，頻道 1、2、3 連接短週 (訊號主頻率爲 2 赫茲)速度地震計(L、V、T 方向)，頻道 4、5、6 連接中長週期(訊號週期可大至 30 秒)速度型地震計。

定時系統：利用全球定位系統(Global Position System)接收衛星時間信號，全球定位系統所獲得之時間作爲地震觀測網之標準時間系統。換言之，每一地震觀測站之時間系統均爲 GPS 時間。每小時

的 55 分~00 分會進行一次 GPS 時間修正，而儀器每小時的誤差量不會超過 0.005sec。在儀器的設定上，每隔 0.01 秒就會記錄一次。

圖九　日本東京測震公司所生產之短週期地震記錄器。

圖十　儲存地震記錄之電腦硬碟。

(二) 感應器

本計畫所架設的臨時地震觀測網中之感應器(Sensors)有兩種，一爲三向量短週期速度型感應器，訊號主頻率爲 2 赫茲 (圖十一) ，另一爲三向量中長週期速度型感應器 (訊號週期可大至 30 秒)。換言之，感應器部分，速度型感應器的最主要接收頻率是 2Hz，寬頻感應器的最小接收頻率約 0.033Hz。而在感應器的設置部分，本研究將這些感應器全部置入地表之下，其深度都在 50 cm 以上。本計畫使用速度型兩種感震裝置來檢測地震，速度型感震裝置由美國 Mark Products 公司製造的 L-3D 三向速度型感震計附加放大器及濾波器組成。重要特性有:

L-3d 速度型感震計：

自然頻率：2Hz

靈敏度：119.4 V/m/sec

線圈阻抗：5470Ω

線圈質量：72.8 克

最大位移：3.8 mm (p-p)

阻尼係數：0.46 (未接放大器時)

放大器輸入阻抗：22.6 K(可使 L-22 之阻尼爲 0.7)

放大器放大倍率：100

濾波器型式：單極低通濾波

濾波器截止頻率：9 Hz

圖十一　速度型地震感應計（L-3d）。

(三) 地震記錄與資料分析處理系統

利用個人電腦蒐集和處理資料是本計畫微地震監測網的特色之一。拜科技進步之賜，以往須仰仗大型電腦才能運作的即時地震資料蒐集系統，目前已可完全由廉宜的個人電腦取代。大屯火山群地區微震觀測網的地震記錄與資料處理系統，基本上是由根據中研院地球所，過去幾年在的工作經驗所設計。整体地震記錄與資料處理系統，包括三組磁碟陣列 (Disc-array)、數台個人電腦 (PC)及兩個工作站 (SUN-workstation)來進行地震資料之分析研究。其主要功能分別如下:

磁碟陣列 (Disc-array): 大量地震資料儲存系統

個人電腦 (PC): 地震資料擷取與資料處理系統

工作站 (SUN-workstation): 地震定位與資料處理系統

第三章 測站設置

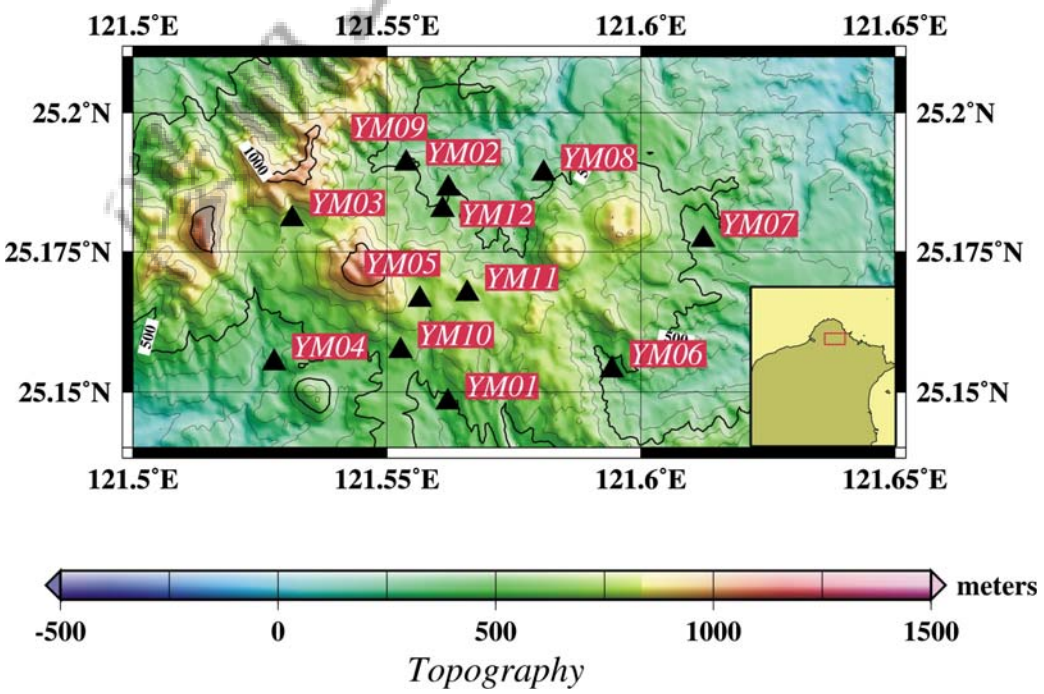
本年度除延續上年度已有的八個地震觀測站之地震網外，今年並增加了三個地震站來測量微小地震的時空分佈，並試圖由記錄之地震波型，辨識地震震源之種類，是否包括有岩漿活動造成之地震。主要工作包括規劃、儀器和電腦軟體的安裝與測試、發展儀器和電腦軟體操作的程序等工作。往後幾年，除了延續測量微小地震的時空分佈及地震震源之辨識工作，將依過去之結果，適當地增加地震觀測網之密度，以期推求大屯山地區地下構造特性，並辨認火山岩漿存在與否。主要工作包括進行資料收集、資料分析、專題研究、報告和儀器維修等工作。

(一) 微地震站之選定

地震站之選定是最重要且耗時之工作。由於主要大屯火山區屬於陽明山國家公園保護管理範圍，相關的法令規定、土地之地目、電力與電話配線等限制必須優先考量。又因為地震觀測站是以觀測微地震為主，因此測站要儘量避免人為與自然界的干擾，以提高儀器放大倍率。在測站均勻分佈的原則下，我們先在地圖上，標示出可能設置地震站的位置，然後攜帶儀器前往測試。經過分析比較後，依交通、電力配線狀況，及雜訊的高低排列設站地點的順序。經過多方面的努力交涉，終於在地主和陽明山國家公園管理處的同意下，在本計畫中，除了第一年度中已完成之竹篙嶺 (YM1)、七股 (YM2)、頂湖 (YM3)、湖山 (YM4)、冷水坑 (YM5) 等五個測震站外，並於第二年度中增加了溪底（YM6）、大坪（YM7）及八煙（YM8）新的三個地震站，另於民國 95 年 1 月份時將原先七股(YM2)站更換位置及重新設定其測站編號為後山(YM9)。今年分別於菁山、擎天崗馬槽增加三個地震站 YM10、YM11 和 YM12，測震站分佈情形，基本上是以七星山為中心(如圖十二所示)。測站相關的資料詳列於表一。

表一 大屯山地區微震測站

設站日期	站名	站碼	經度(E)	緯度(N)	高度(m)
92.05.13	竹篙嶺	YM01	121.5620	25.1482	488
92.05.13	七股	YM02	121.5621	25.1863	521
92.05.18	頂湖	YM03	121.5314	25.1809	702
92.05.16	湖山	YM04	121.5278	25.1552	401
92.06.02	冷水坑	YM05	121.5564	25.1665	740
92.09.09	溪底	YM06	121.5943	25.1538	445
92.09.09	大坪	YM07	121.6123	25.1771	456
92.09.08	八煙	YM08	121.5808	25.1890	342
95.01.10	後山	YM09	121.5538	25.1909	519
92.09.09	大坪	YM07	121.6123	25.1771	456
92.09.08	八煙	YM08	121.5808	25.1890	342
95.01.10	後山	YM09	121.5538	25.1909	519
96.04.03	菁山	YM10	121.5526	25.1573	622
96.06.07	擎天崗	YM11	121.5658	25.1675	772
96.06.07	馬槽	YM12	121.5609	25.1826	555



圖十二 陽明山國家公園內地形圖與地震觀測站分佈。

（二）測站平台

本地震觀測網之測站大多數位於陽明山國家公園內，爲遵照相關法令之規定，測站之建造以不破壞周圍環境爲主要原則。儀器平台爲一混凝土結構，其長寬各約 1.2 公尺，混凝土中鋪設有鐵絲網(圖十三 a)，以增強平台之承載能力。又爲增加平台與土壤(或岩石)的附著力，減低兩者的互制作用，在建造平台時均先清理過表土，並預先植入數根長約 45 公分的不銹鋼棒。平台中預留兩個圓孔，其直徑約三十公分(圖十三 b,c,d)，以放置感應器(Sensors)，其深度都在 50 cm 以上。

圖十三 （a）微震站水泥台之施工情形。

圖十三　(b) 微震站水泥台之施工情形。

圖十三　(c) 微震站感應器放置孔之施工情形。

圖十三 （d）微震站水泥台之施工完成情形。

(三) 測站站房

站房使用型號 41-2 號的 F.R.P(玻璃纖維)護蓋，其大小不僅能放置地震記錄器 (Recorder)、感應器 (Sensors) 及電磁設備等(如圖十四)，並容許工作人員方便於站房作業。該護蓋並採取適當的措施，以改善通風和防雨的功能。

圖十四　竹篙嶺微震站（YM01）之外觀。

(四) 電源來源

電源(Power)部分則有二種供電方式，一是交流電源(110 伏特)，是主要的電力來源（圖十五），另一電力來源則是電池(60 安培)，主要功能是做爲備用電力（圖十六）。

圖十五　七股微震站（YM02）所使用之電力來源裝置。

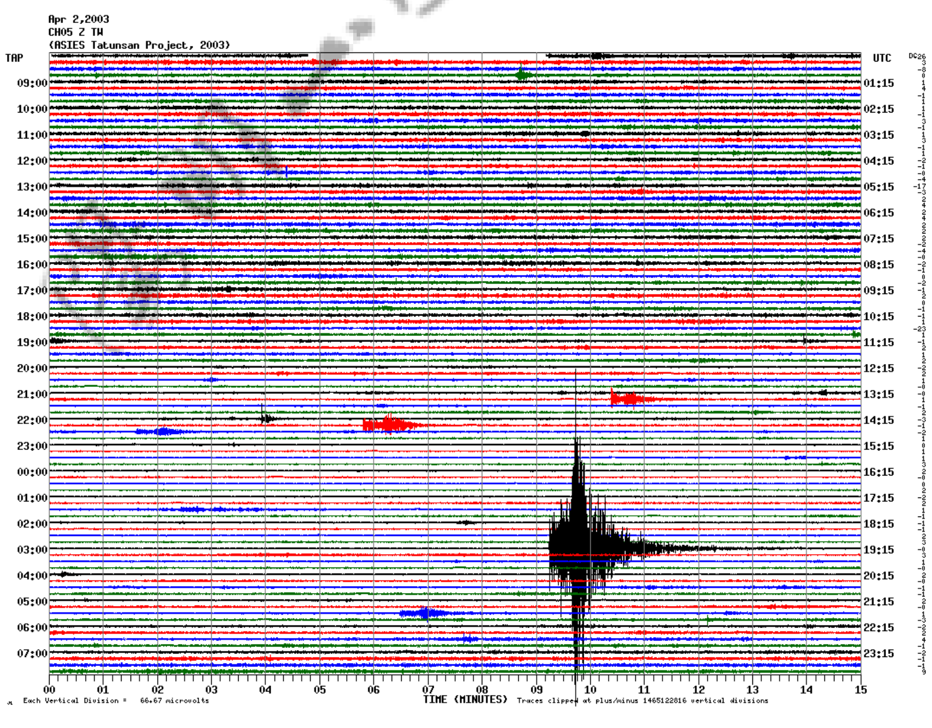
圖十六　一般微震站內維持地震儀器運作之主要電池。

第四章　資料處理

本研究的資料處理流程包括: (1)先從連續資料，全日波形的垂直方向波形圖中挑選可能爲地震的訊號。再將所有的測站的波形資料中，摘取同一段時間訊號，並轉換資料格式，以便進行地震波型分析。(2)利用套裝電腦軟體，來讀取每個地震在測震站記錄上的 P 波到達時間、S 波到達時間、P 波初動方向及地震總振動時間。(3)然後將每一地震在各測站所記錄之數據，輸入電子計算機程式，以計算各地震的發生時間、震央位置、震源深度及規模等。

(1) 地震訊號挑選與轉換

本研究的資料處理流程，先從將野外蒐集之磁碟中之連續地震資料，傳至個人電腦(PC)。然後利用電腦軟體，將每天連續地震資料整理儲存。

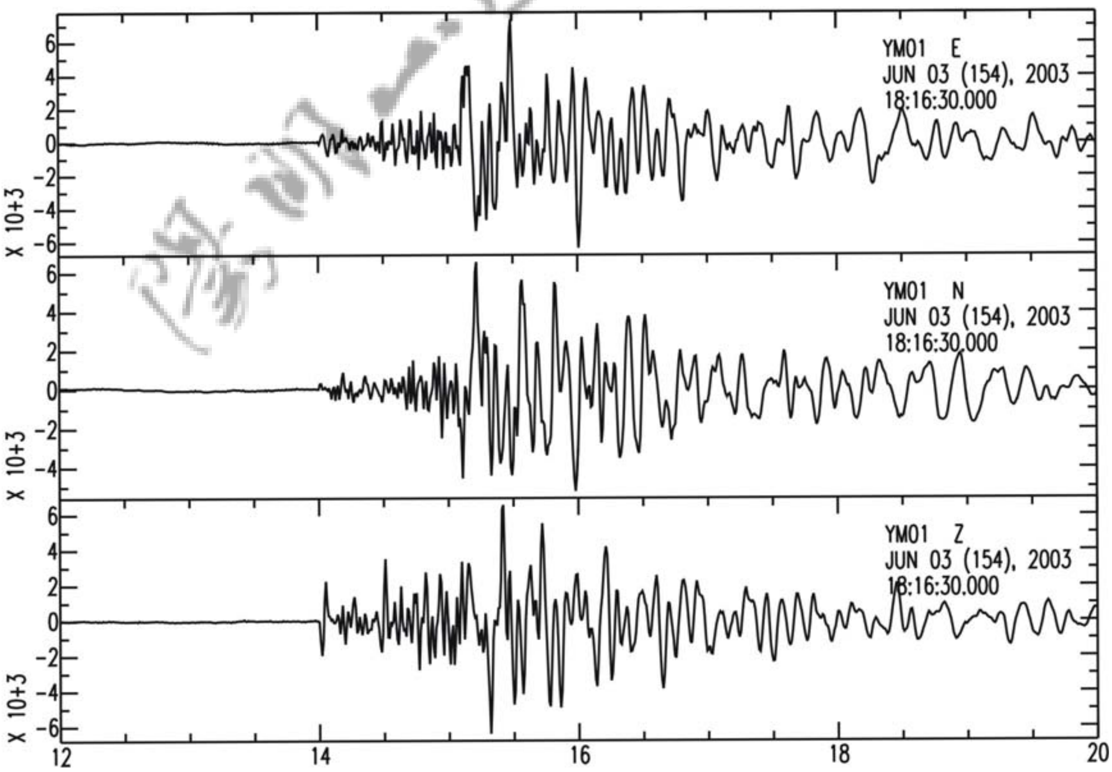


圖十七　冷水坑微震站（YM05）於民國九十二年四月二日所記錄之垂直向地振動訊號。

利用全日波形的 Z 方向波形圖中（圖十七），挑選可能為地震的訊號，再將所有的測站摘取同一段時間訊號，並將各測站的波形資料，傳遞至工作站(SUN-workstation)，以便往後進行挑選 P 波、S 波的工作及地震定位。

(2) 地震訊號讀取

本研究直接利用電腦工作站上套裝電腦軟體(SAC)中所提供之程式(PPK)，來讀取每個地震在每一測震站記錄上的 P 波到達時間、S 波到達時間、P 波初動方向及地震總振動時間。由於地震資料為三向量數位記錄(圖十八)，此套裝軟體可提供合適的濾波、局部放大、及向量旋轉等非常有效資料處理步驟，選讀地震波到達時間時，P 波可精確至 0.01 秒。實際上之作業過程，所有 P 波、S 波及總振動時間，均直接從電腦螢幕來讀取。



圖十八　竹篙嶺微震站(YM01)於民國九十二年六月三日所記錄之一個地震記錄。

(3) 地震定位原理

將每一地震在各測站所記錄之數據，輸入電子計算機程式，以計算各地震的發生時間、震央位置、震源深度及規模等。地震之定位以利用 P 波和 S 波到達之時間爲主，我們採用李及納氏 (Lee & Lahr, 1972) 之電腦程式 (HYPO 71)，其可同時求得微震之發震時間、震央位置、震源深度、地震規模、震波自震源傳至各測站之方位角、出射角(take off angle) 及震源距離等。其主要原理在逐步調整一假定之震源及發震時間，使震波到達時間之殘餘值（觀測到達時間－理論到達時間）趨於極小。當調整向量 (Adjustment Vector) 小於某一規定值時，其震源位置和發震時間即爲所求。

其原理是利用下列變量進行運算：

不變量：第 i 個地震站的坐標位置(x_i, y_i, z_i)。

第 i 個地震站觀測到的波相到時T_i。

可變量：發震時間 t。

震源位置(x, y, z)。

應變量：理論到時t_i。

觀測與理論震波到時差$R_i = T_i - t_i$。

當R_i很小，由泰勒展開式忽略高次項可得：

$$R_i = dt + \frac{\partial t_i}{\partial x}dx + \frac{\partial t_i}{\partial y}dy + \frac{\partial t_i}{\partial z}dz + e_i \tag{1}$$

設 $\frac{\partial t_i}{\partial x} = a_i \quad \frac{\partial t_i}{\partial y} = b_i \quad \frac{\partial t_i}{\partial z} = c_i$

（1）式中的e_i是第 i 個測站的近似誤差量（approximation error)，將（1）式移項後可得：

$$e_i^2 = \left(R_i - a_i dx - b_i dy - c_i dz - dt\right)^2 \tag{2}$$

一般在進行地震定位時都不會只一個測站，而若有 n 個測站，測站數大於未知數（可變量數目），則用最小平方法（least square method）可得到未知數最佳解。即

$$\sum_{i=1}^{n} e^2 = f(\varepsilon) = \sum_{i=1}^{n}\left(\left(R_i - a_i dx - b_i dy - c_i dz - dt\right)^2\right) \Rightarrow \min \tag{3}$$

$\varepsilon = (x, y, z, t)$ 四個變數

而 $\dfrac{df(\varepsilon)}{d\varepsilon} = 0$ 爲在獲得極值時的必要條件，

故把（3）式分別對 dx 、 dy 、 dz 、 dt 做偏微分可得：

$$\left.\begin{aligned}
&\sum_{i=1}^{n} a_i^2 dx + \sum_{i=1}^{n} a_i b_i dy + \sum_{i=1}^{n} a_i c_i dz + \sum_{i=1}^{n} a_i dt = \sum_{i=1}^{n} a_i R_i \\
&\sum_{i=1}^{n} a_i b_i dx + \sum_{i=1}^{n} b_i^2 dy + \sum_{i=1}^{n} b_i c_i dz + \sum_{i=1}^{n} b_i dt = \sum_{i=1}^{n} b_i R_i \\
&\sum_{i=1}^{n} a_i c_i dx + \sum_{i=1}^{n} a_i c_i dy + \sum_{i=1}^{n} c_i^2 dz + \sum_{i=1}^{n} c_i dt = \sum_{i=1}^{n} c_i R_i \\
&\sum_{i=1}^{n} a_i dx + \sum_{i=1}^{n} b_i dy + \sum_{i=1}^{n} c_i dz + \sum_{i=1}^{n} dt = \sum_{i=1}^{n} R_i
\end{aligned}\right\} \tag{4}$$

利用矩陣的方式可得到四個未知數 dx 、 dy 、 dz 、 dt 的解，再利用所得的四個未知數，配合起始的震源位置得到新的修正後坐標 $(x+dt, y+dy, z+dz)$，再以新的坐標代入計算，經過多次疊代（iteration）後，一直修正到此震源解與前一個震源解的 $\sqrt{dx^2+dy^2+dz^2} \le 0.05$ 公里及 $dt \le 0.1$ 秒範圍內，就算是已收斂，即得到定位出的震源位置及發震時間。

此程式所需輸入的資料包含初達 P 波或 S 波的到時、加權值、波相初動型態、

地震的終了時間。而上述的加權值是指在挑選波相的到時值，挑選者對於其所挑選到時的正確性，可提供程式進行加權運算。而波相初動型態是指 P 波的初動爲上或下動，此部分和定位並無相關，其主要目的在提供後續運算震源機制時使用的。同樣的，地震的終了時間則是被利用來計算地震規模（Md）。

(4)速度構造模式

利用 HYPO71 程式計算震源位置，尚須給予地殼地震波速度的構造模式，本計畫使用的模式是根據林與葉（1989）所求得之大屯山地區之地下構造，其一維的模式如表二。

表二 大屯山地區的一維速度構造

深度(公里)	P 波速度(km/sec)	S 波波速(km/sec)	Vp/Vs
-1.0~1.0	3.79	2.13	1.78
1.0~2.0	4.07	2.29	1.78
2.0~3.0	4.55	2.56	1.78
3.0~5.0	5.12	2.88	1.78
5.0~7.0	5.39	3.03	1.78
7.0~9.0	5.98	3.36	1.78
9.0~17.0	6.10	3.43	1.78
17.0~36.0	6.70	3.76	1.78
36.0 以下	7.80	4.38	1.78

地殼構造模式中的 S 波速度直接由 P 波速度除以 1.78 來獲得。由於各個測震站的標高不盡相同，故各測震站之地震波到達時間須作高度修正，其修正公式爲

$$\delta t = \frac{H}{V}$$

式中δt 爲延遲時間修正量，H 爲測震站標高，V 爲表層岩石之地震波平均速度。本研究採用 3790 公尺/秒作爲表層岩石的地震波平均速度。

本計畫根據各測震站之震央距離和總振動時間資料，依 Lee et al. (1972) 之經驗公式來計算地震規模 (Md)，其公式爲：

$$Md = -0.87 + 2.0\ \log\tau + 0.0035\Delta$$

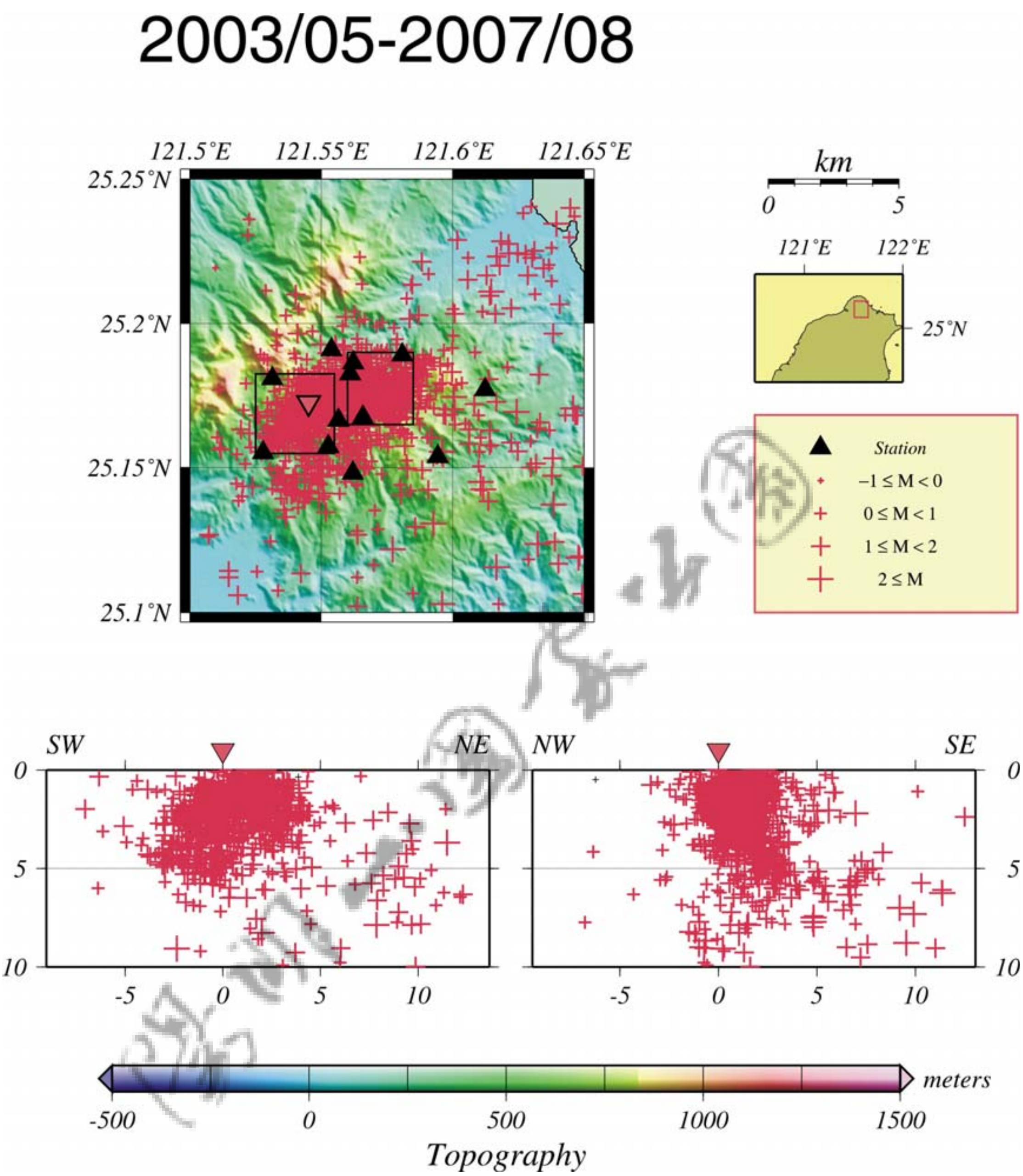
式中τ爲總振動時間（以秒爲單位），Δ爲測震站到震央的距離（以公里爲單位）。

第五章　分析討論

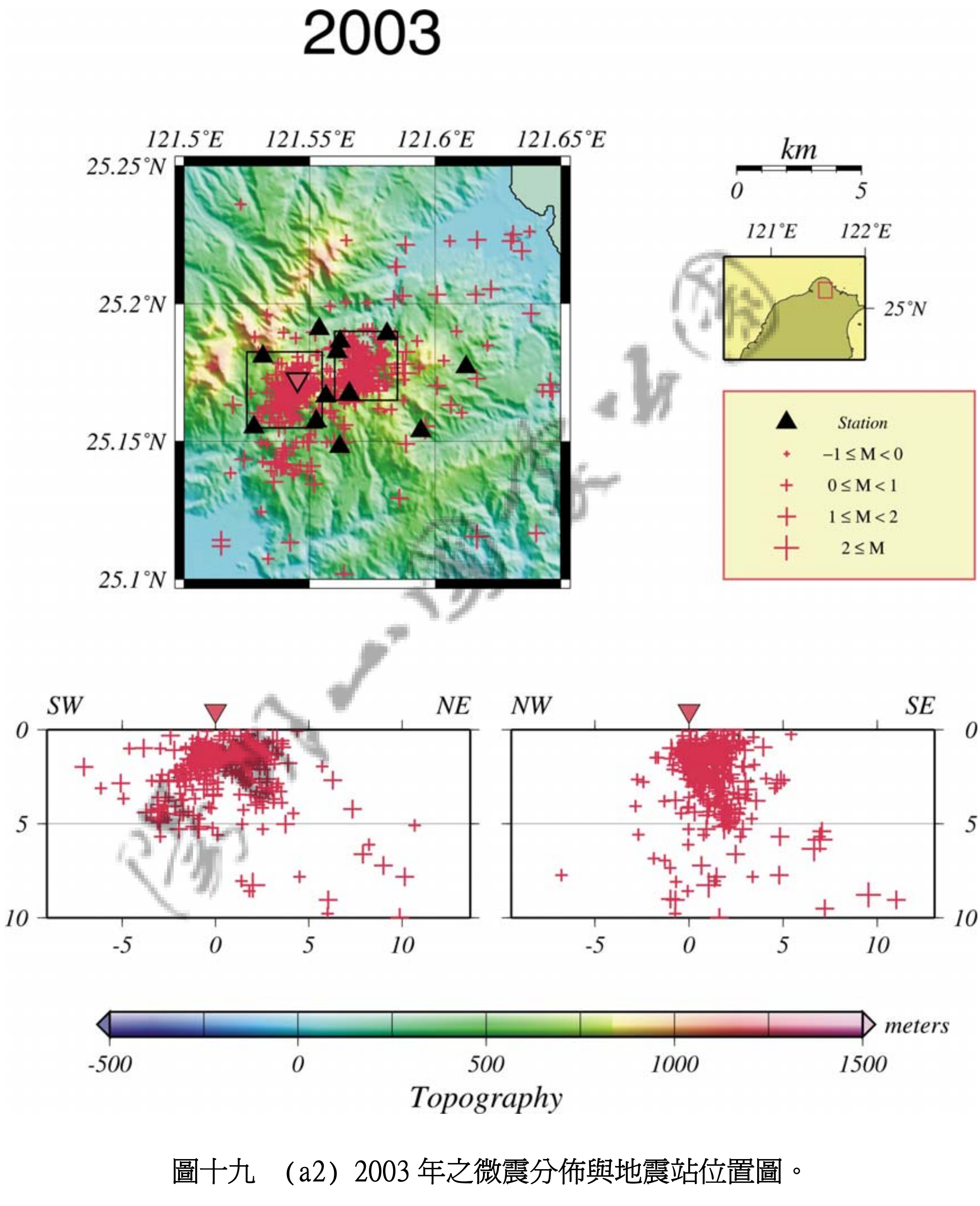
本年度計劃執行中利用大屯山地區個地震站所組成之小型微震網，來監測陽明山國家公園內之微震活動。微震網設置基本上是以七星山附近爲微震監測範圍（圖十二）。所以本計劃所測得之微震，當然以七星山附近爲主。也就是說，本微震網無法對遠離本小型微震網之地震完成定位工作。本計劃自 92 年 5 月份起至今，已觀測到數百個相當可信賴的地震記錄，並進行微震分析與討論。此外，本計劃利用大容量的磁疊所觀測之連續地震記錄，除了提供上述一般局部地區性的地震偵測外之功能外，連續地震記錄又可發揮其偵測振幅較不明顯之低頻，或連續性的其他可能訊號之能力。特別是在火山活躍地區，常有所謂較長週期之地動訊號，例如與岩漿活動有關之振動（Tremors）或單頻與多頻之振盪（Harmonic vibrations）等。

(一) 微震空間分佈

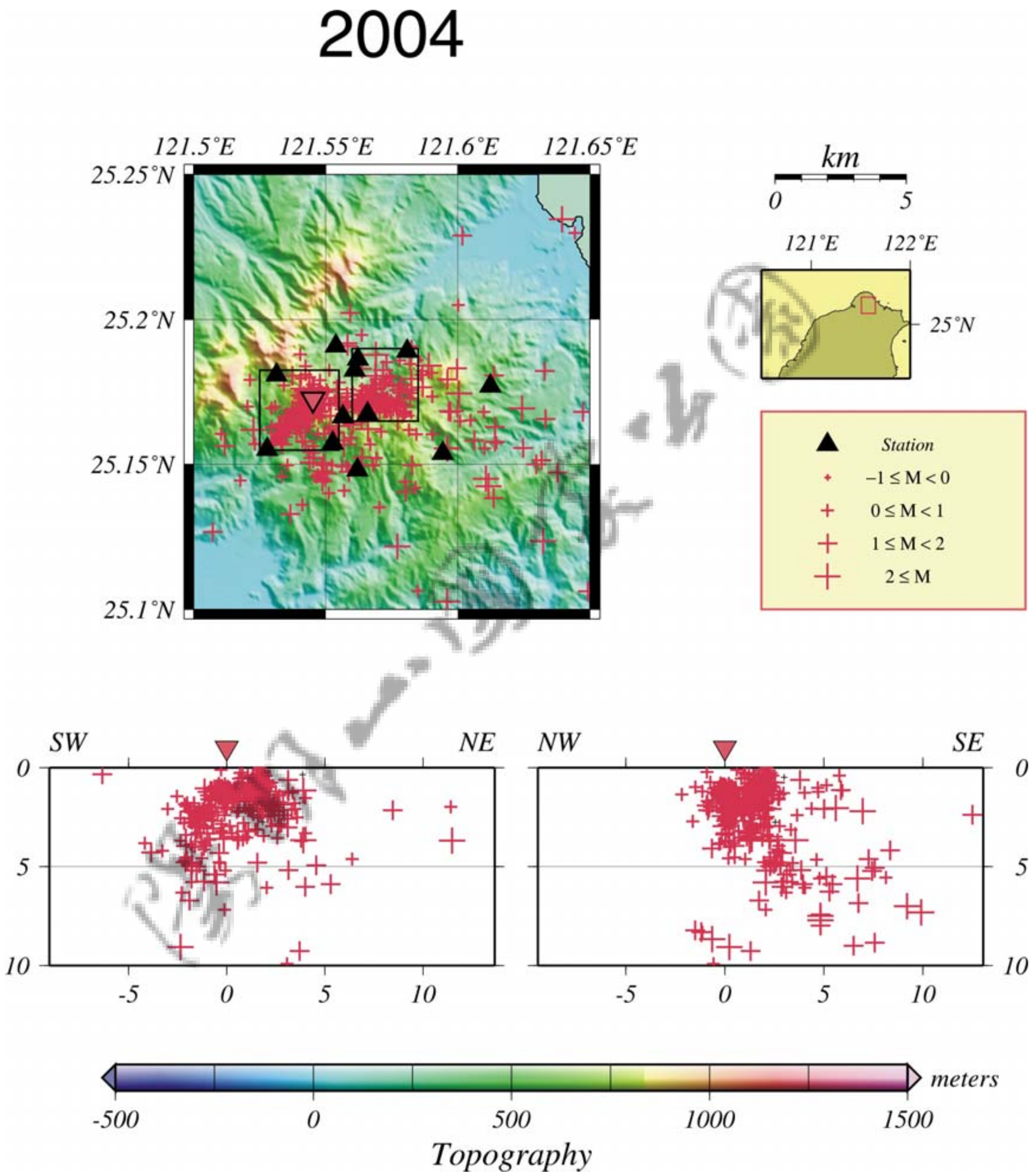
依據目前本計劃所測得之微震活動（圖十九 (a)及附錄），可明顯地發現，大多數微震活動範圍，分佈於微震網內。大多數微震深度分佈範圍均小於 5 公里。其中，約略有兩群微震較爲集中。第一群微震位於七星山下方，其深度僅約約 1 至 3 公里上下(圖十九 (b))，明顯地，此群微震屬於網內震，故其定位品質相當可靠，微震個數相較於另一群位在大油坑附近的微震，活動明顯的比較不活躍。至於在大油坑附近的微震，除了微震活躍外，微震的分佈範圍甚至是從淺於深度 1 公里的部分就有明顯的活動 (圖十九 (b))。從長期的監測中，可以發現陽明山底下的微震活動是有週期性的。細分來看，七星山底下，每個月的微震活動個數起伏較小，較爲穩定，但還是隱約可看出其週期性(約 6~7 個月)；反之，在大油坑底下，每個月的微震活動個數起伏較大(圖十九 (c))，且可以約略看出，每當七星山微震活躍之時，大油坑的微震個數在當月也幾乎是屬於相對的活動高峰期。另外，比較同時期中央氣象局在陽明山鞍部雨量站所監測之雨量資料(圖二十))與本研究每月的地震活動個數(圖十九(c))，並無發



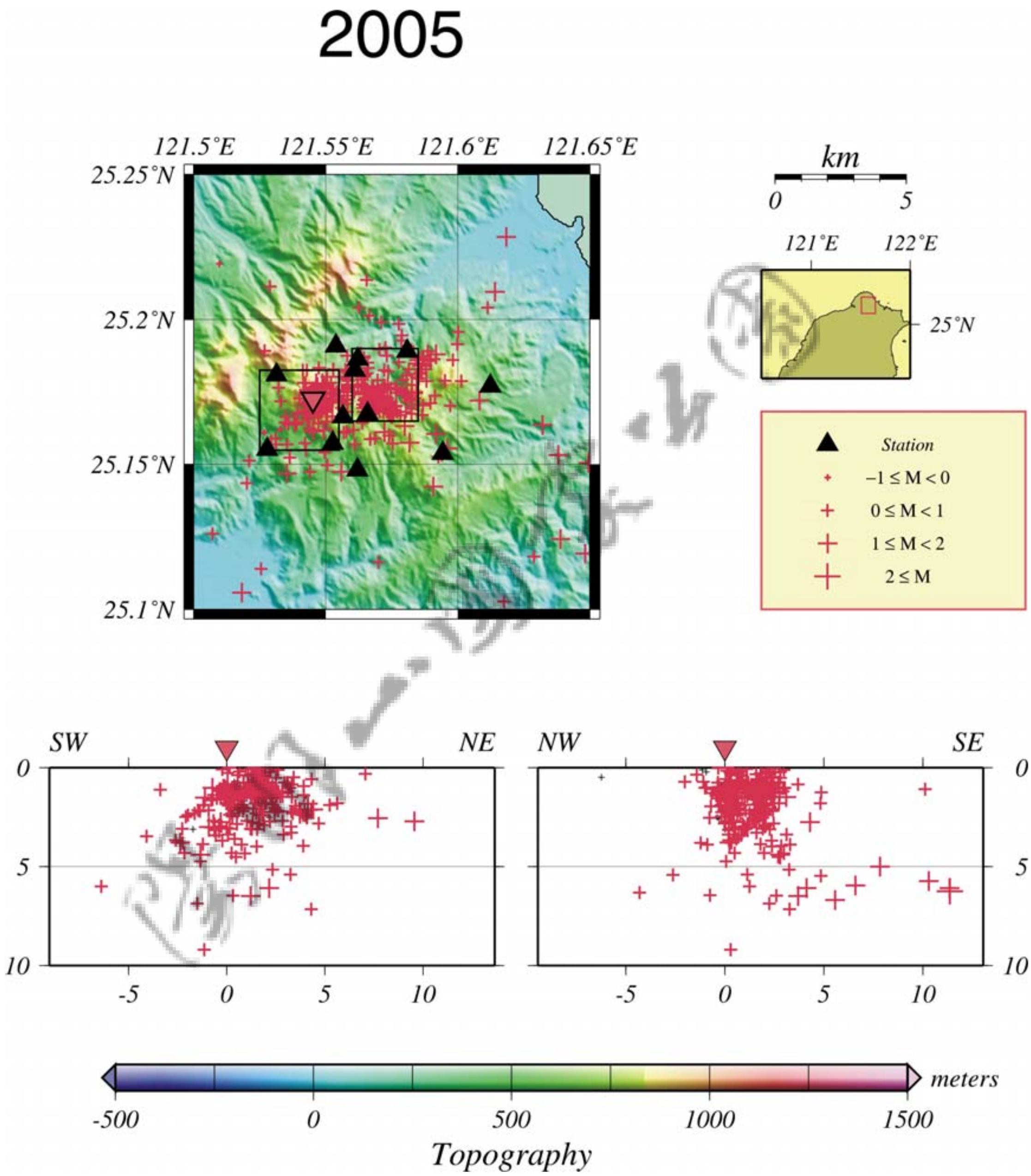
圖十九 （a1）2003 年 5 月至 2007 年 8 月間之微震分佈與地震站位置圖(倒三角形表示七星山的位置，十字符號表示震源的位置，地形圖中，左邊的黑框表示在七星山附近的地震群，右邊的黑框表示在大油坑附近的地震群)。



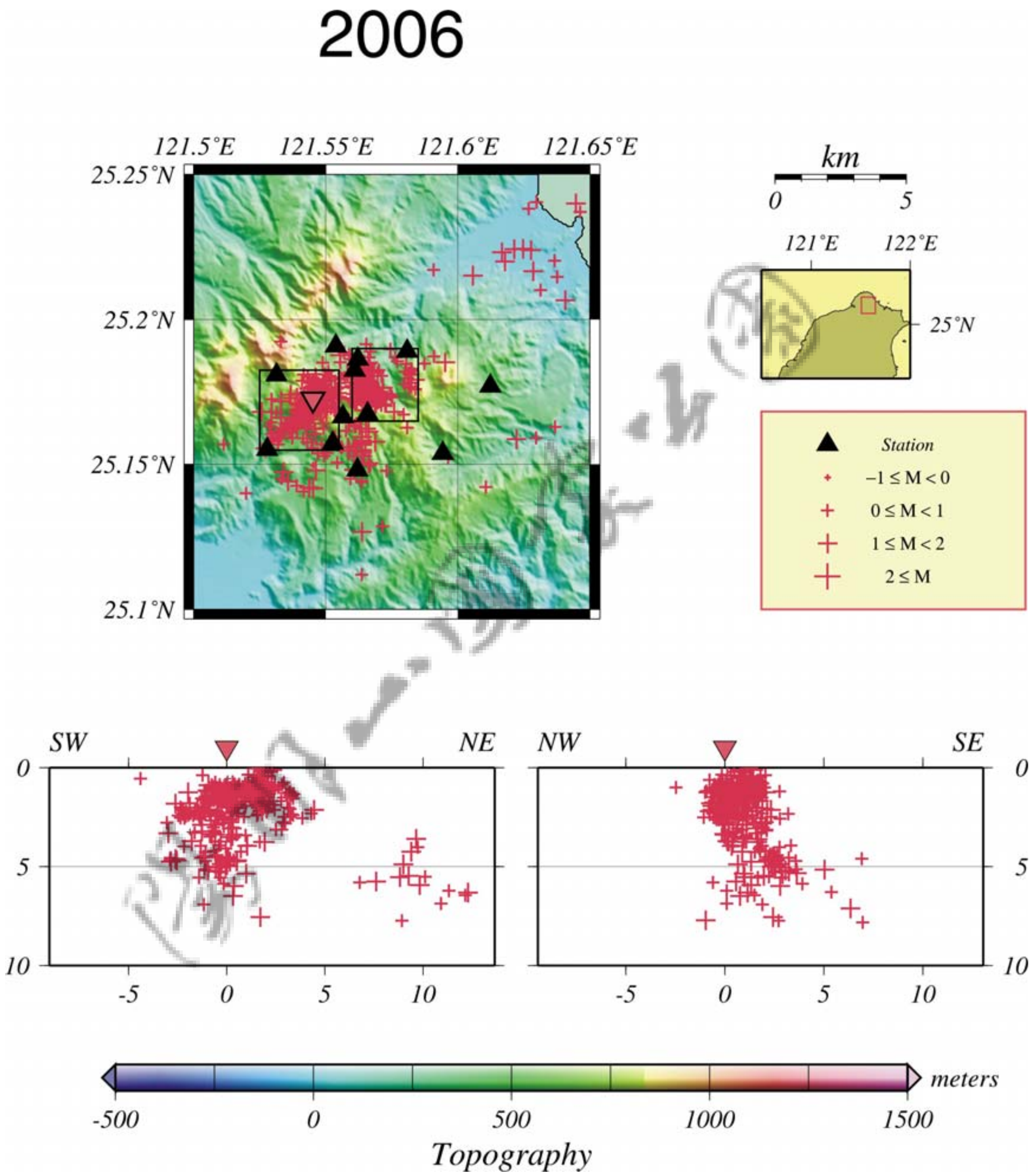
圖十九 （a2）2003 年之微震分佈與地震站位置圖。



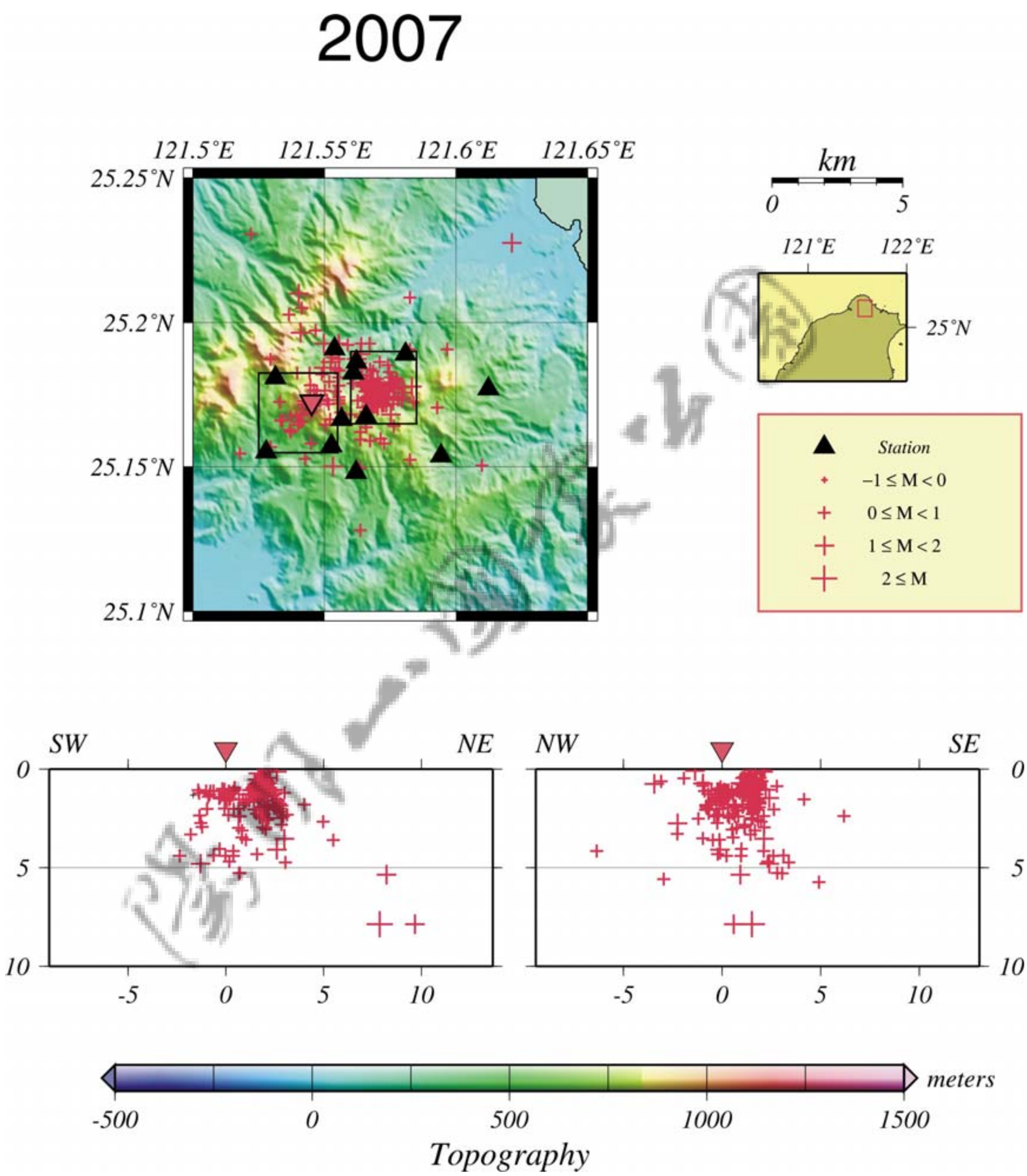
圖十九 （a3）2004 年之微震分佈與地震站位置圖。



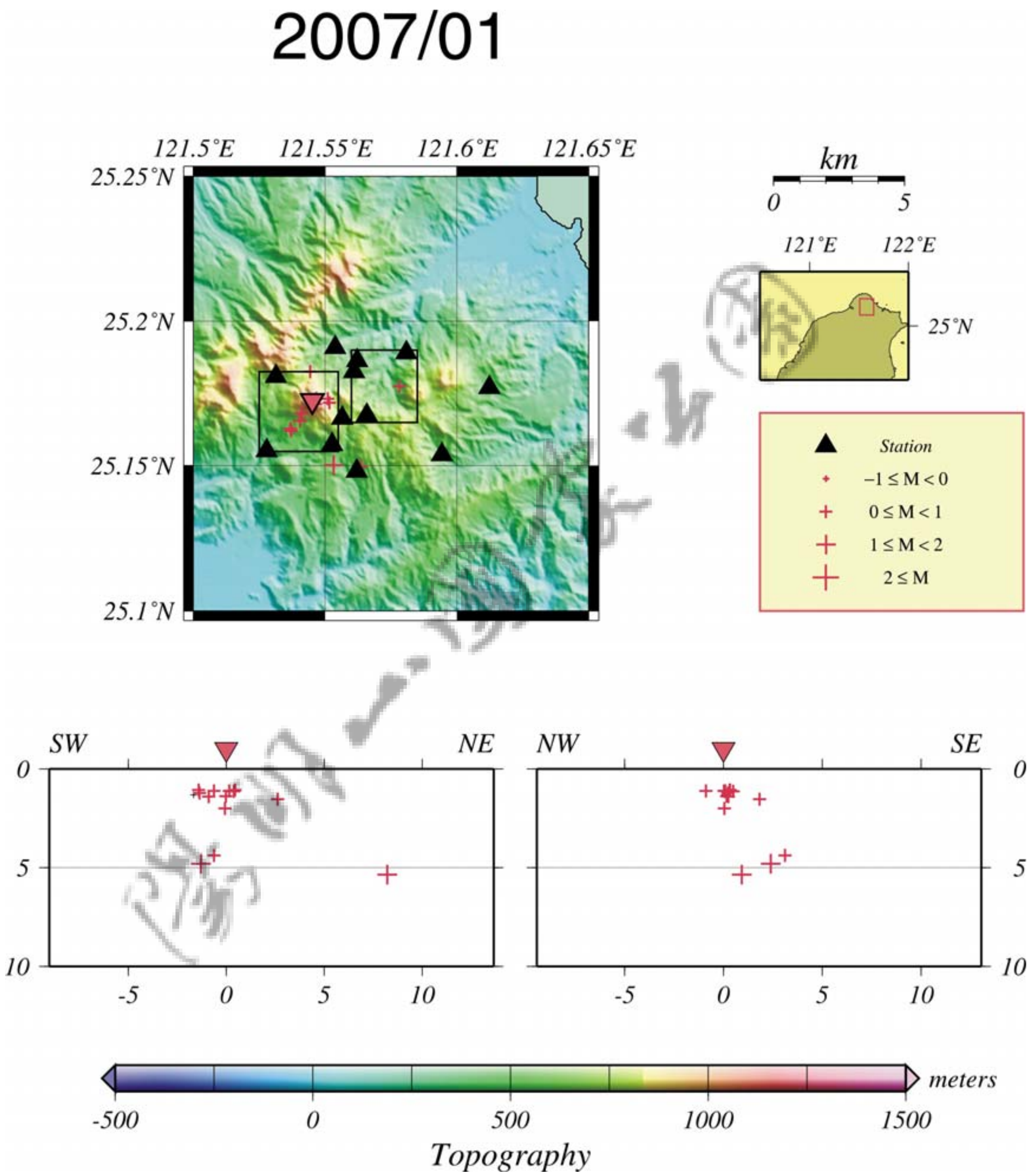
圖十九 （a4）2005 年之微震分佈與地震站位置圖。



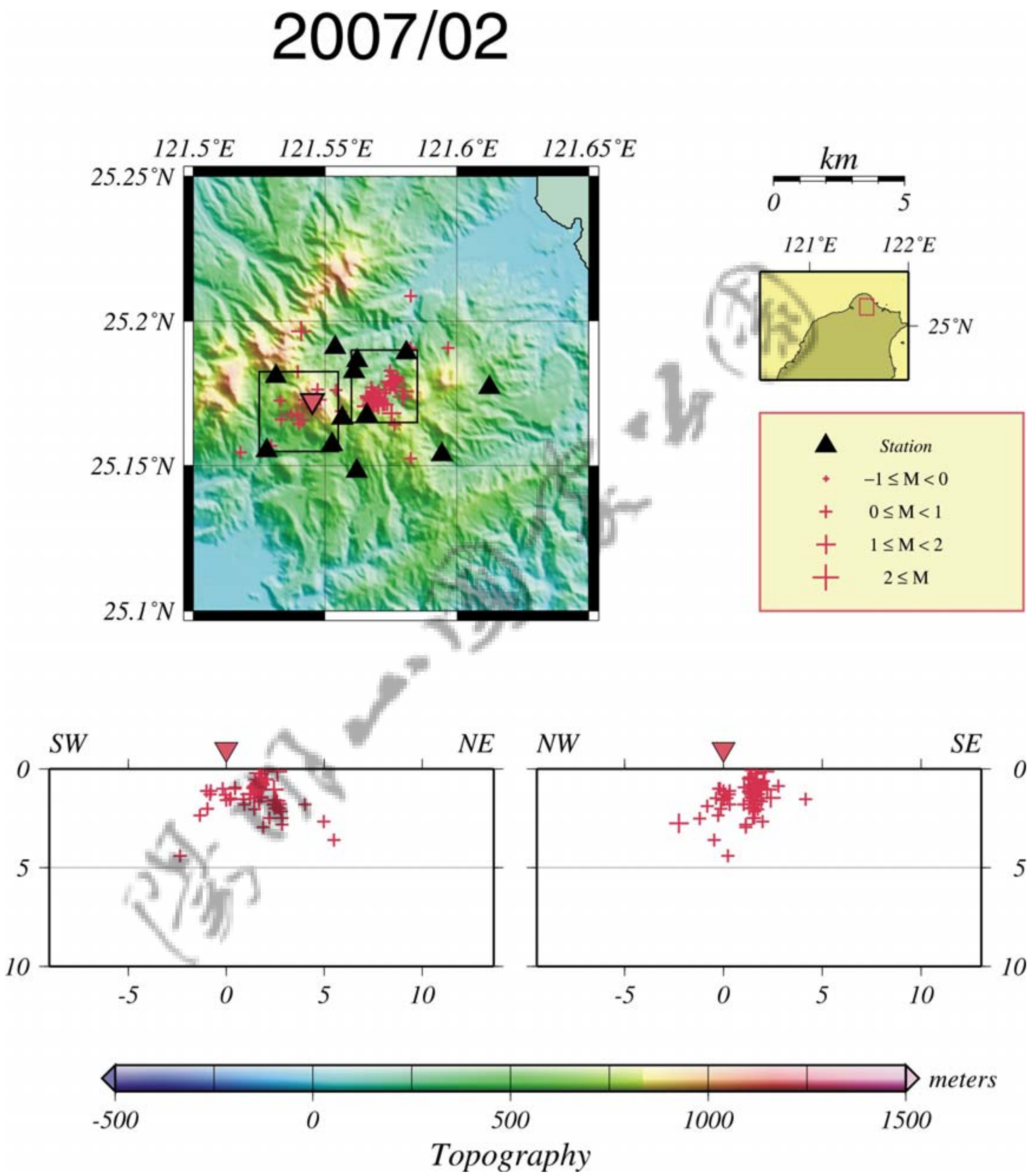
圖十九 （a5）2006 年之微震分佈與地震站位置圖。



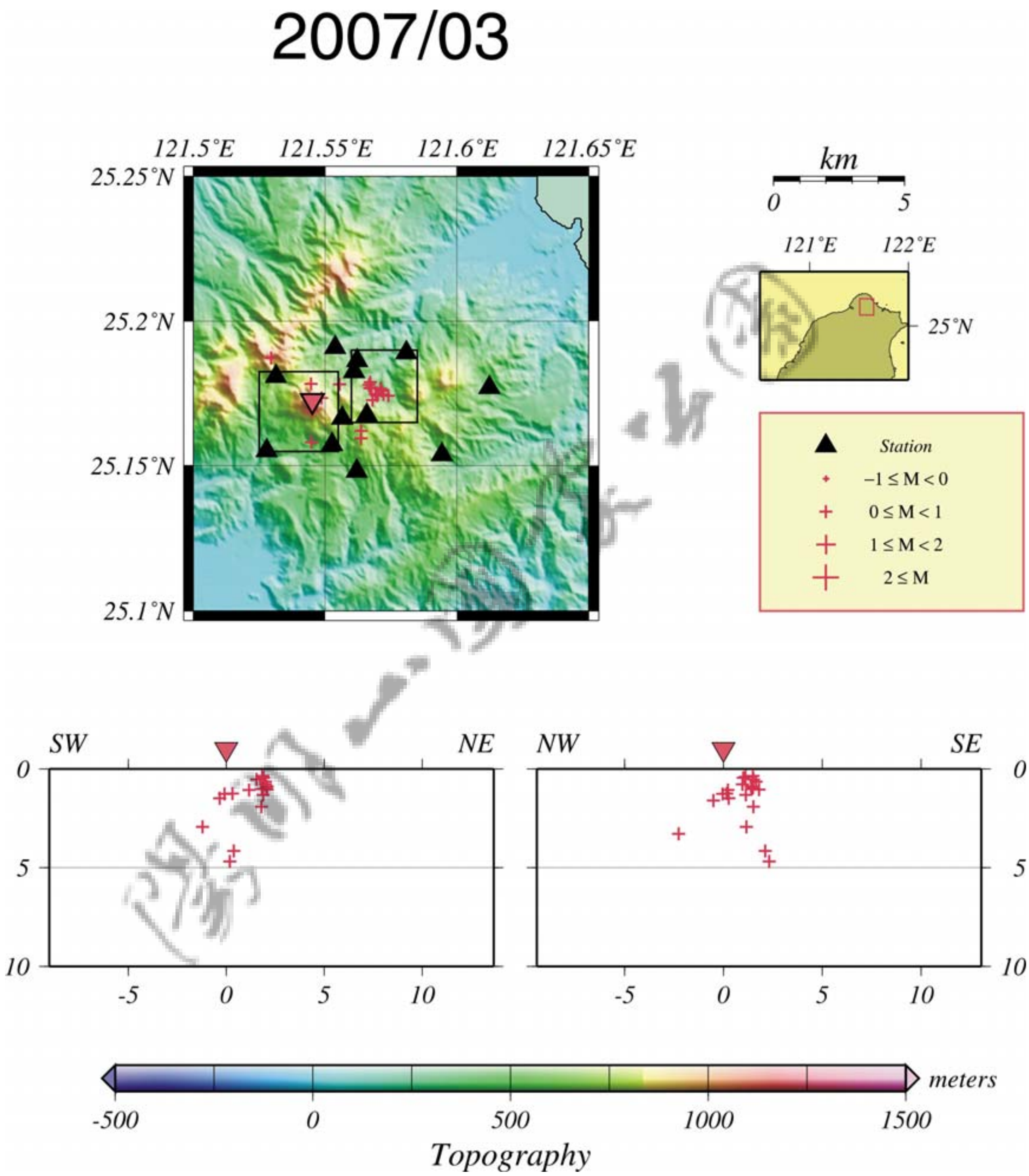
圖十九 （a6）2007 年之微震分佈與地震站位置圖。



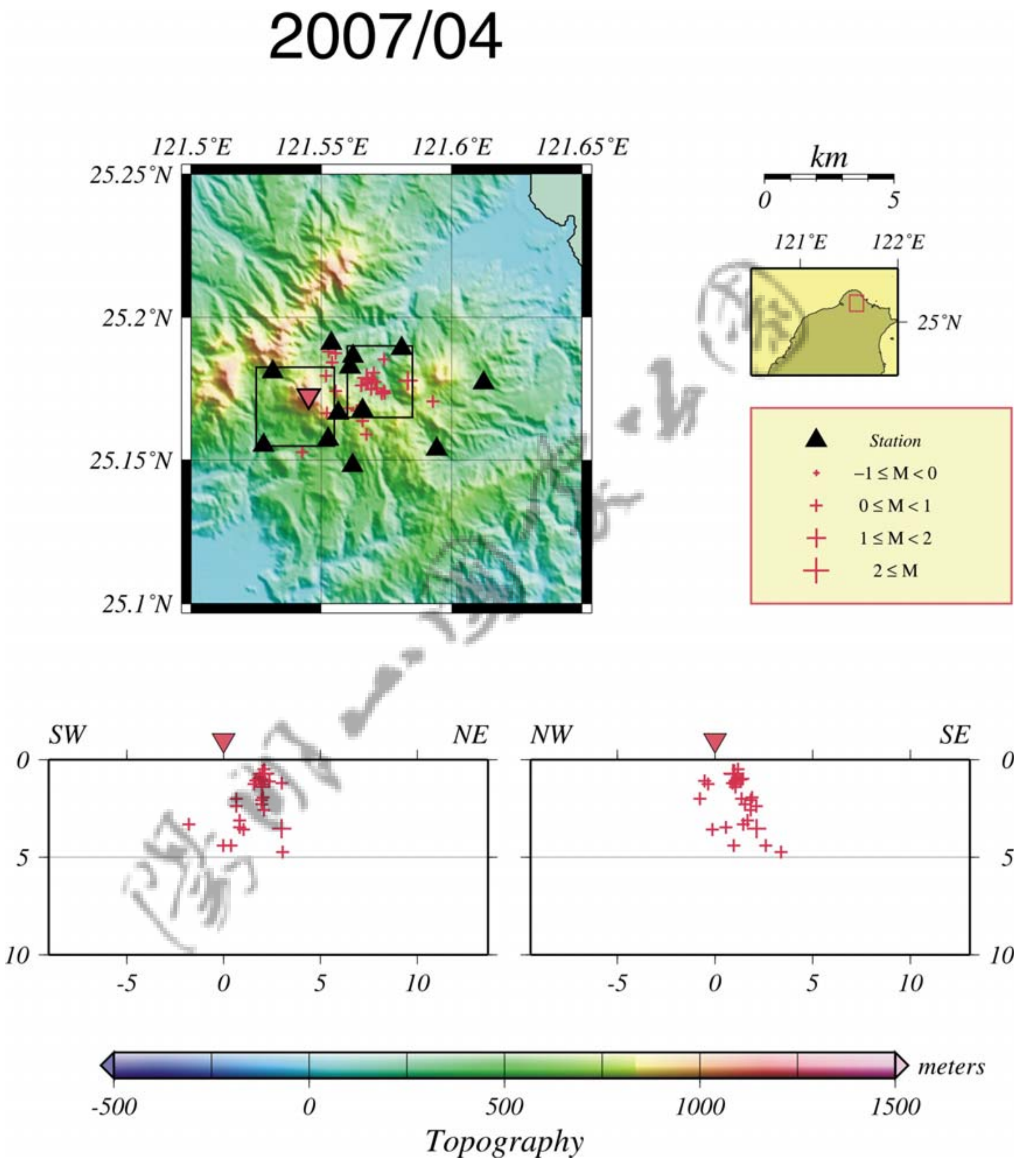
圖十九　(a7) 2007 年 1 月之微震分佈與地震站位置圖。



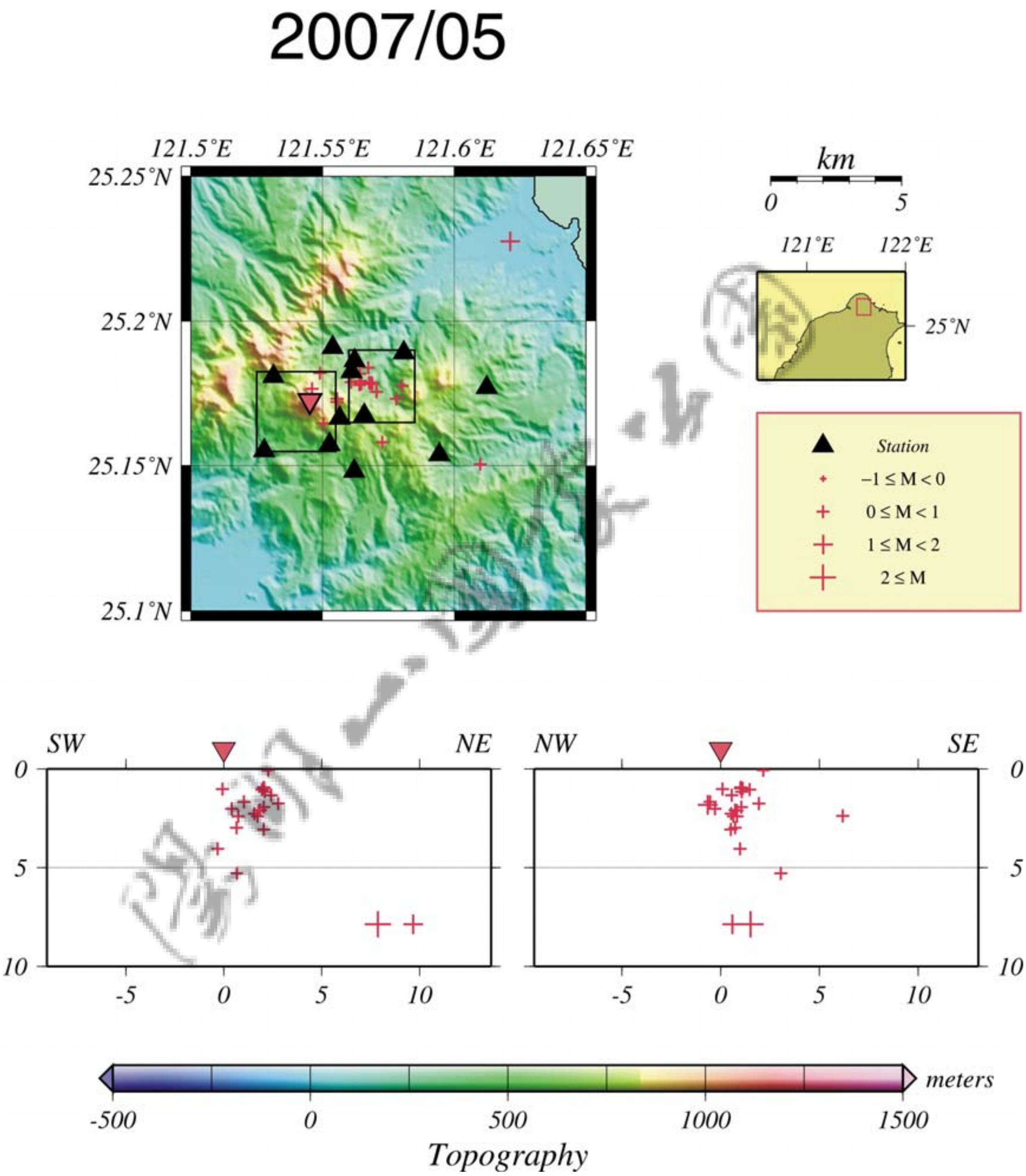
圖十九 (a8) 2007 年 2 月之微震分佈與地震站位置圖。



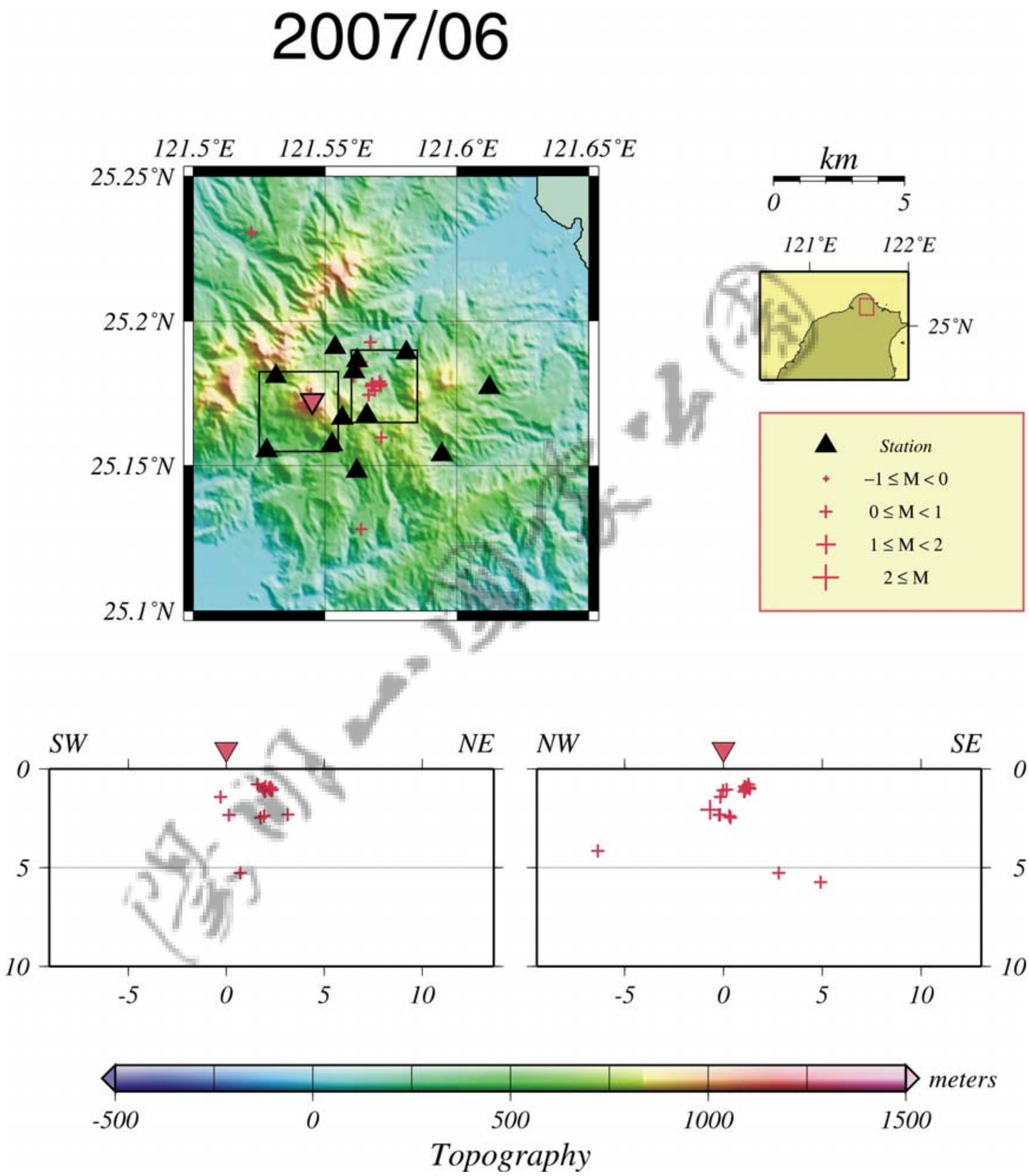
圖十九　(a9) 2007 年 3 月之微震分佈與地震站位置圖。



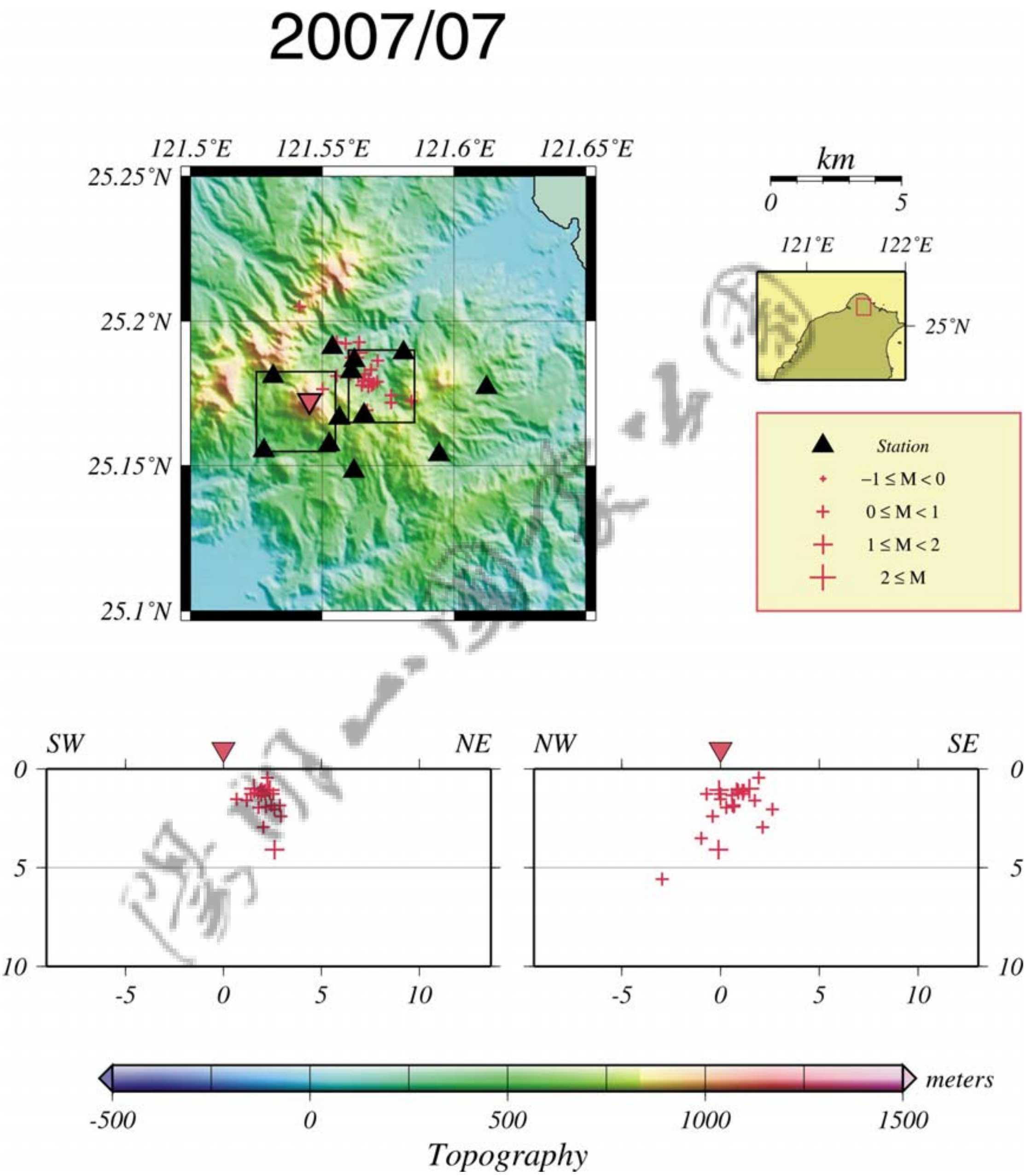
圖十九 （a10）2007 年 4 月之微震分佈與地震站位置圖。



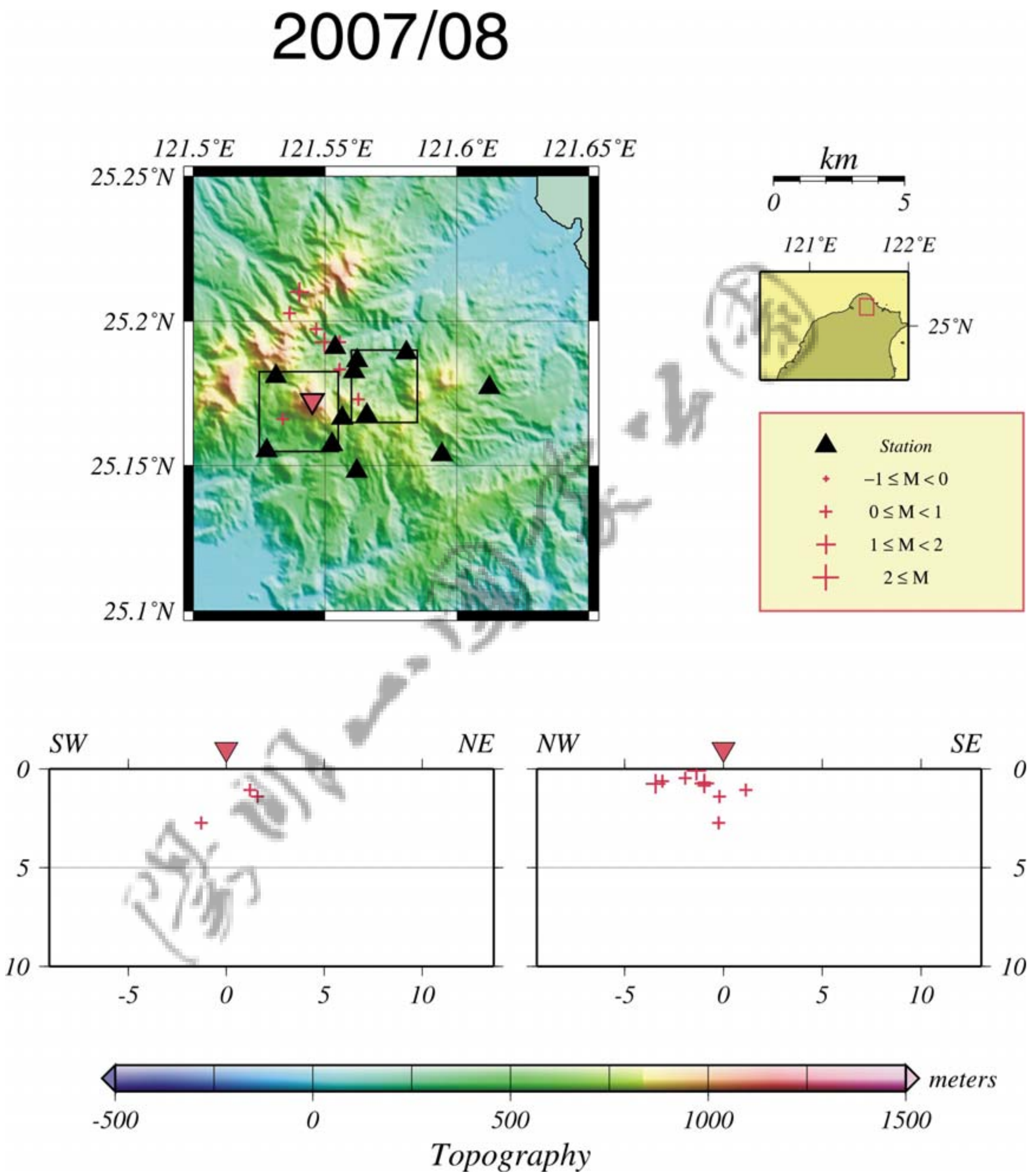
圖十九 （a11）2007 年 5 月之微震分佈與地震站位置圖。



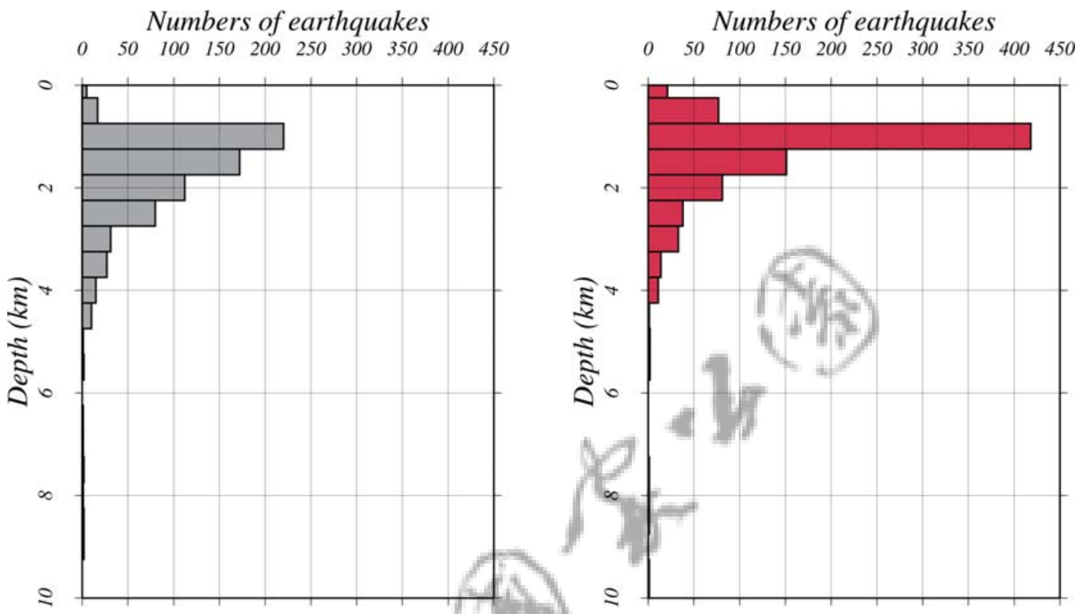
圖十九 （a12）2007 年 6 月之微震分佈與地震站位置圖。



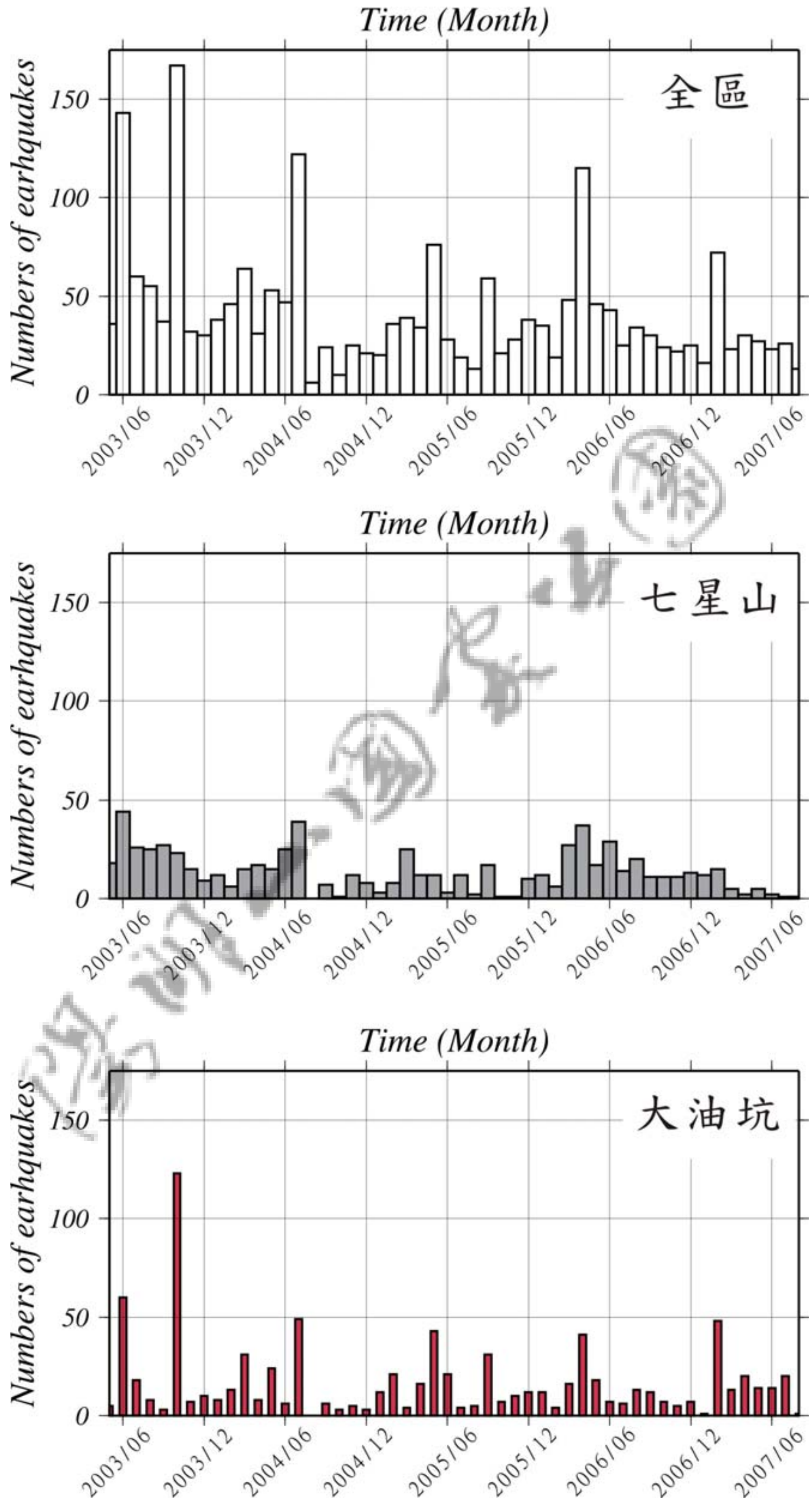
圖十九　(a13) 2007 年 7 月之微震分佈與地震站位置圖。



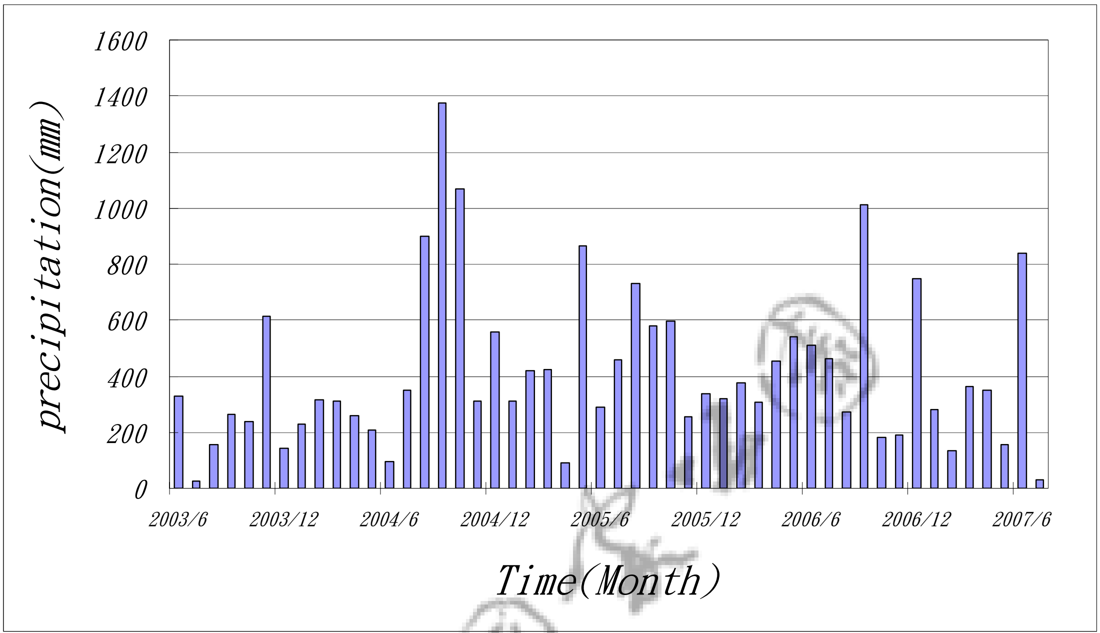
圖十九 **(a14) 2007 年 8 月之微震分佈與地震站位置圖。**



圖十九 (b) 分別表示在七星山(左圖)和大油坑(右圖)底下的微震個數與深度的統計圖。



圖十九　(c) 地震的個數與時間的統計。分別計算在研究區域中(上圖)、七星山(中圖)和大油坑(下圖)底下，每個月的微震個數統計圖。



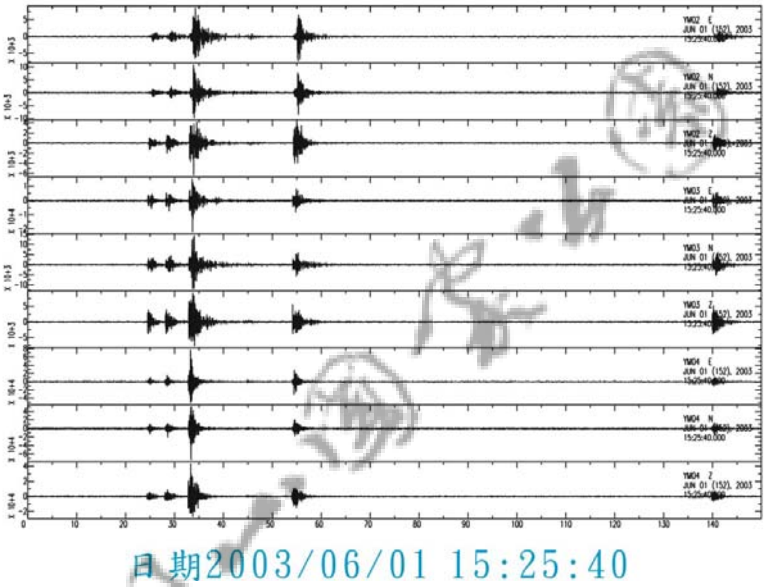
圖二十　中央氣象局在陽明山鞍雨量站所監測之雨量隨時間之分佈圖。

現彼此有明顯的相關性。

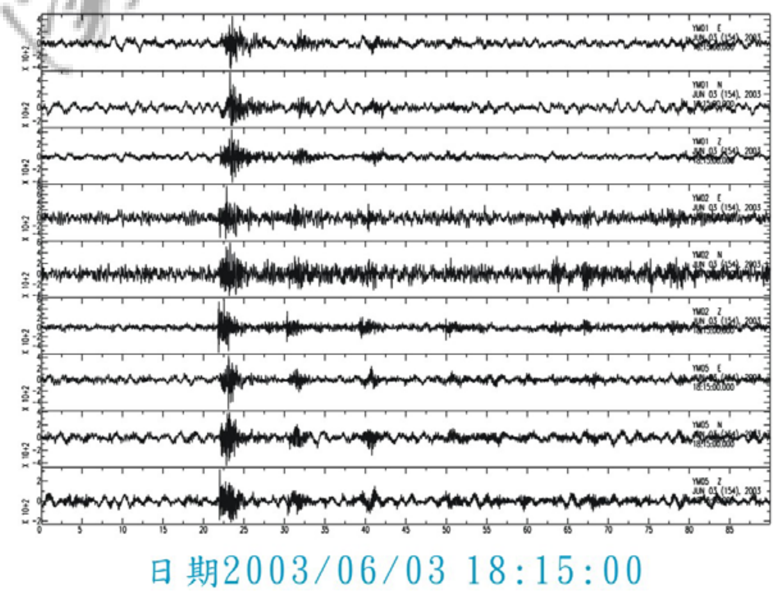
(二) 群震特性

除了微震之空間分佈外，仔細觀察連續地震記錄，驚訝地發現部份地震記錄，偶有連續發生微震的特性（如圖二十一)。例如民國 92 年 6 月 1 日 15 時 25 分的地震記錄中，每個微震站均可發現有幾個微小之地震訊號。此外，民國 92 年 6 月 3 日及 6 月 8 日均有類似之情形。經由仔細地定位分析後，發現這些微震大多數之震源均集中於兩處，第一處是位於七星山之東北側，也就是七股與大油坑附近，其深度大約爲 3 至 4 公里左右。另一處震源集中地區落於七星山正下方，其深度僅約 1 至 2 公里左右。這些在時間上與空間上集中分佈之微震，即代表著一般所稱之群震（Swarm）現象。雖然群震與一般所謂之餘震（Aftershock)，在時空上均有集中之現象相同，但群震現象則無明顯的主震

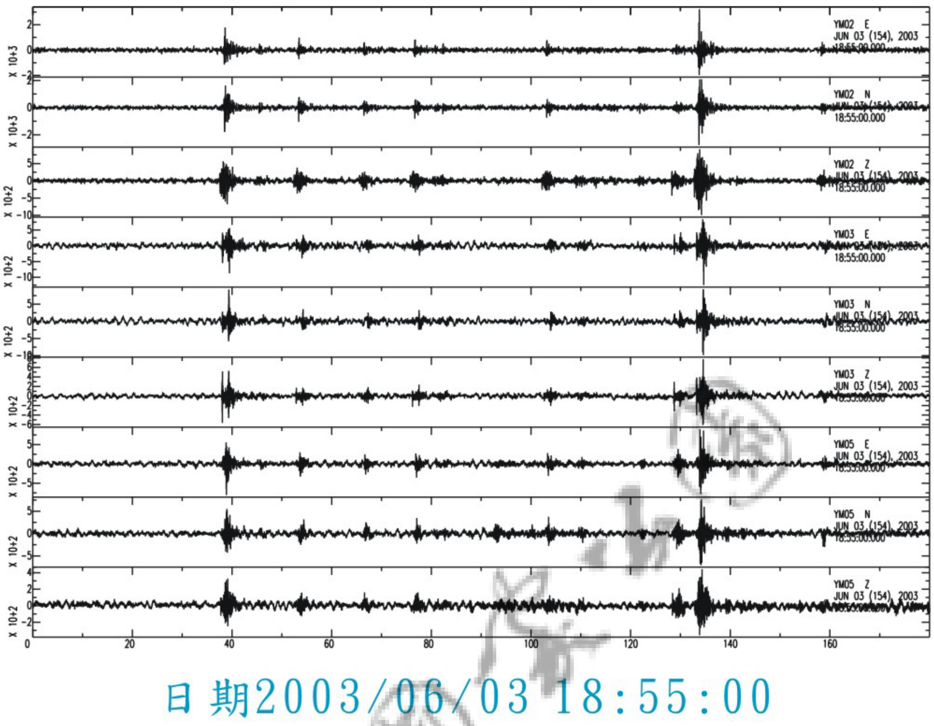
（Main shock）。換言之，餘震是指於主震後，在短時間內於主震附近，所發生之較小規模之地震群。反之，群震並無主震發生，但卻於特定區域內，所發生大小相近之地震群。兩者之構造背景與意義截然不同。一般而言，在火山地區或地熱活動較為明顯的地區，常會有群震現象。群震發生的主要機制，可能與火山地區岩漿或熱水活動有關。



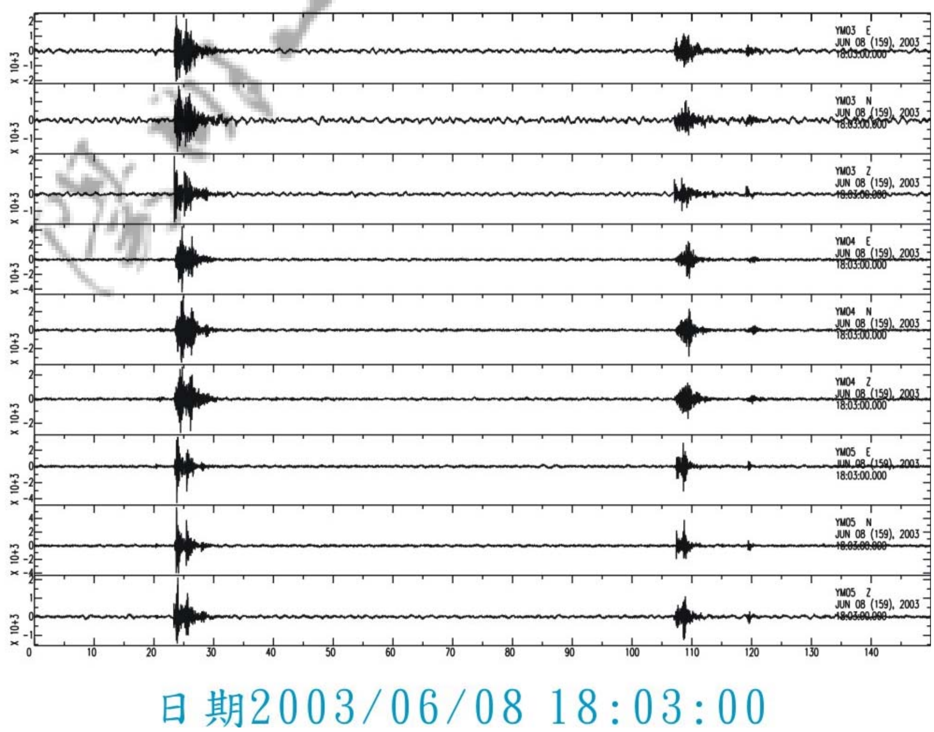
圖二十一 （a）民國九十二年六月一日群震現象之地震記錄。



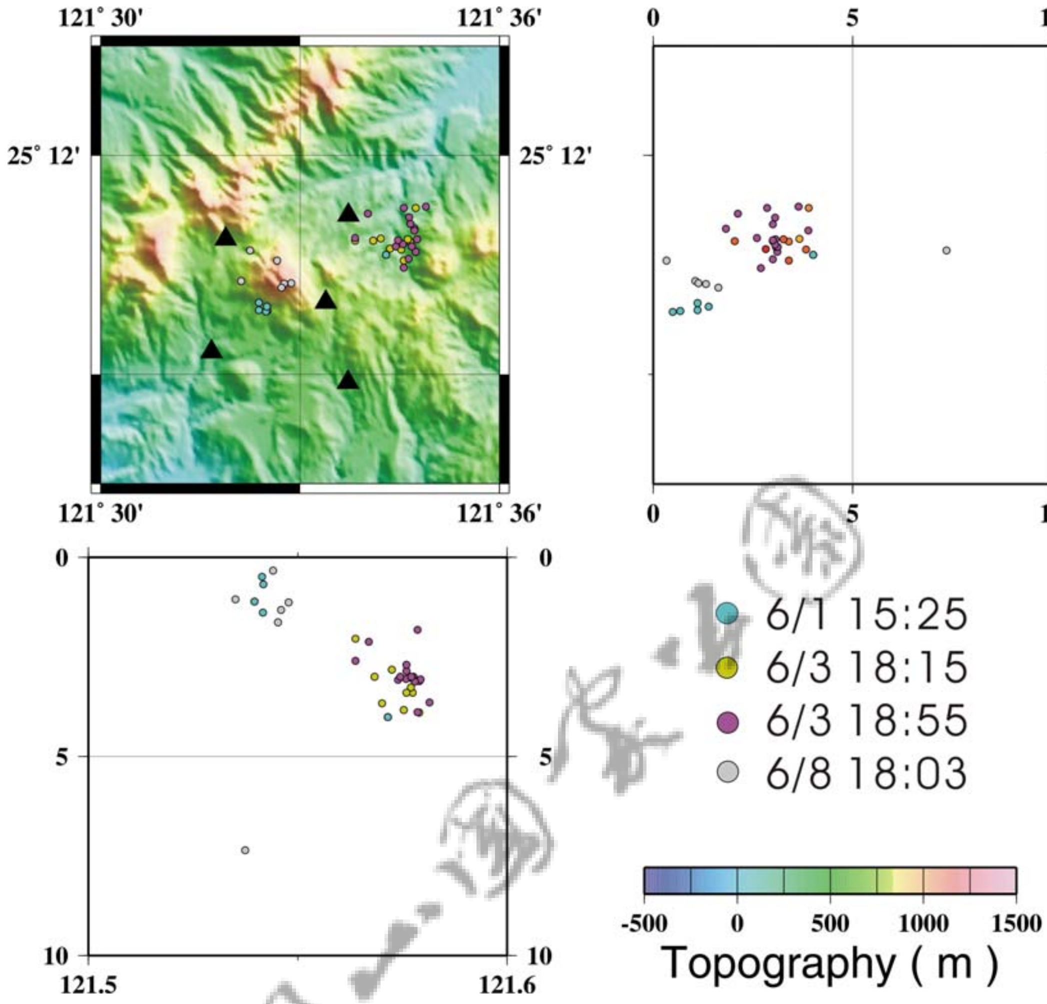
圖二十一 （b）民國九十二年六月三日群震現象之地震記錄。



圖二十一 (C)民國九十二年六月三日另一群震之地震記錄。



圖二十一 (d)民國九十二年六月八日群震現象之地震記錄。

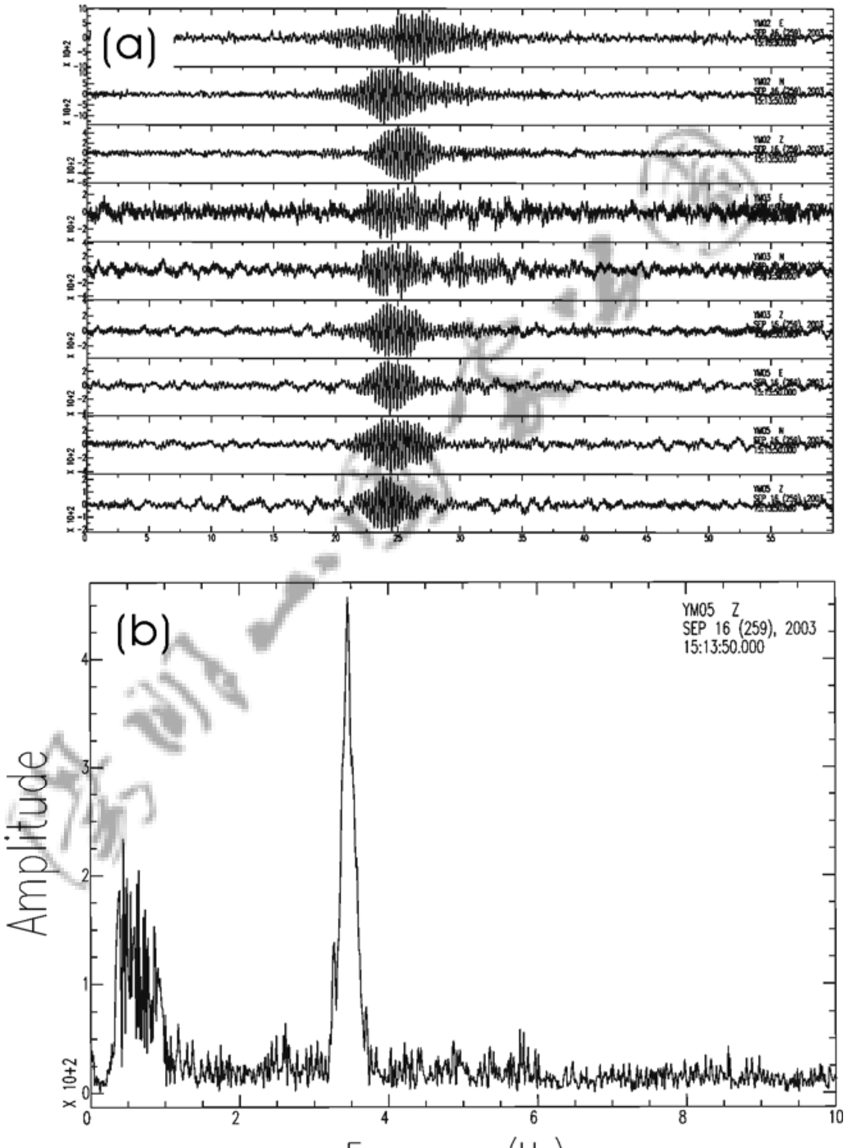


圖二十二　群震震源分佈與大屯山地區地形。

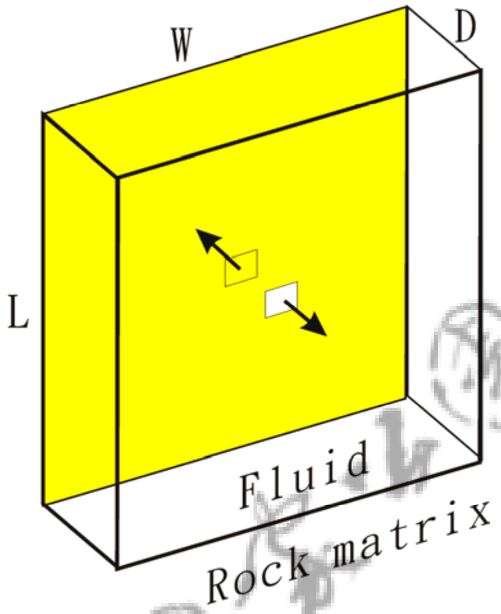
(三) 單頻火山地震訊號（Monochromatic tremors）

仔細分析本計劃之微震監測網之連續記錄中，亦可發現一些波形非常特殊之訊號（圖二十三(a)）。其地震波之波包形狀類似水滴狀（Drop），其振動時間很短，僅約十秒左右。從這些地震訊號中，並無法判識其 P 波與 S 波之到達，故有別於一般所謂之構造地震（tectonic earthquake）所產生之地震波。並且這些水滴狀之地震訊號之頻率組成也很特殊，似乎主要為某種單一頻率所組成。經由一般頻譜分析法，即快速傅利葉轉換法（Fast Fourier Transfer）計算所得（圖二十三(b)），可更清楚看出這些水滴狀之地震訊號之主要頻率落於 3.4 赫斯附近。根據全世界其他國家火山地區之觀測與研究經驗，一般認為這些單頻水滴狀之地震訊號之產生原因，最可能是由液態或氣態物質共振所引起。初步推斷

可能與岩層裂縫中液態或氣態物質(圖二十四)，突然增加或減少壓力所造成之振動有關。



圖二十三　(a) 單頻水滴狀火山地震訊號 (b)地震訊號之主要頻率落於 3.4 赫斯(Hz)附近。



圖二十四　一個填滿液態或氣態之岩石裂縫因壓力突然增加或減少而產生振盪現象之物理模型。

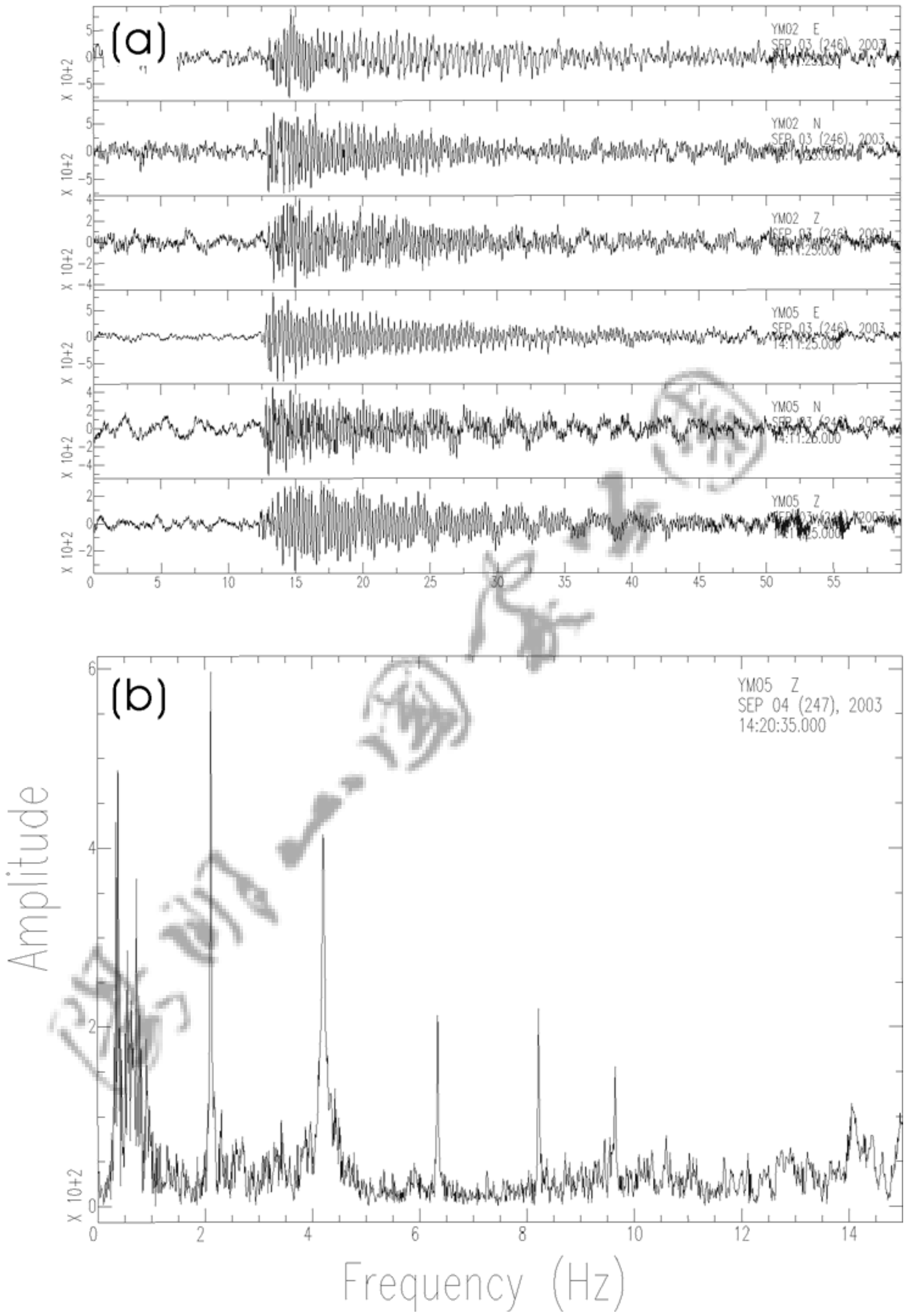
(四) 多頻火山地震訊號（Multichromatic tremors）

除了上述單頻火山地震訊號外，本研究中也發現另一種更爲重要之記錄。其地震波形之外觀類似螺絲釘一樣（圖二十五）。一般火山地震學家以西班牙文之螺絲釘（Tornillos）稱之。這些螺絲釘狀之火山地震訊號之振動時間，明顯大於單頻水滴狀火山地震訊號，可長達數十秒。同樣地仔細分析這些螺絲釘狀之火山地震訊號，可清楚發現，其主要頻率從 2㎐到 15㎐中包括有好幾個。訊號中之最大能量落於 2.1㎐左右，其次爲 4.2㎐、6.3㎐、8.3㎐及 9.6㎐。仔細比較這些訊號之頻率，似乎約略成等差級數。這現象與一般地震非常不同(圖二十六)。根據一般火山地震觀測之經驗，這些螺絲釘狀之火山地震訊號，極可能代表該火山活躍性很強。並且，曾於中美洲之有些火山噴發前，常可發現這些所謂螺絲釘狀之地震記錄（Tornillos）。故大屯山地區亦有類似之記錄，非常值得我們注

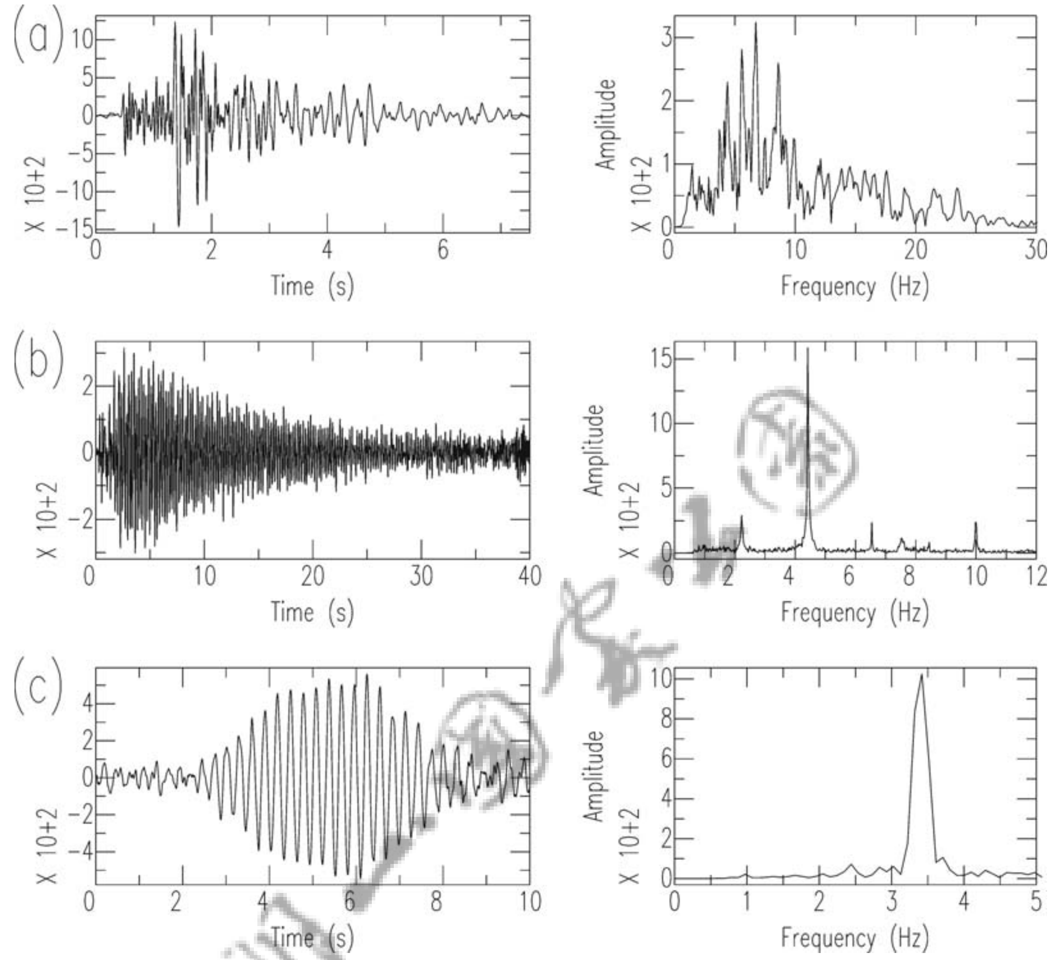
意與深入研究探討。

爲了更進一步瞭解這些單頻及多頻火山地震訊號之產生機制，本計畫利用一個簡單之物理模型來作計算與對比。假設這些異常訊號爲一個填滿液態或氣態之岩石裂縫，因壓力突然增加或減少而產生之振盪現象。利用一種特殊之計算方式（Sompi Method，Kumagai and Chouet，2000），可正確地估算岩石裂縫物質之黏滯性，或一般地震學中常用之 Q 值大小（圖二十七）。估算結果顯示大屯火山地區所記錄之火山訊號之 Q 值均大於 200 以上。依據前人之物理模擬結果（如圖二十八）（Kumagai and Chouet，2000）推斷岩石裂縫之物質中，含有霧狀般之微小粒子爲最合適之解釋，一般認爲這些微小粒子可能爲火山灰。更詳細之討論可參見本研究團隊今年（2005）發表於國際著名期刊（Geophysical Research Letters，Vol.32, L10313）。

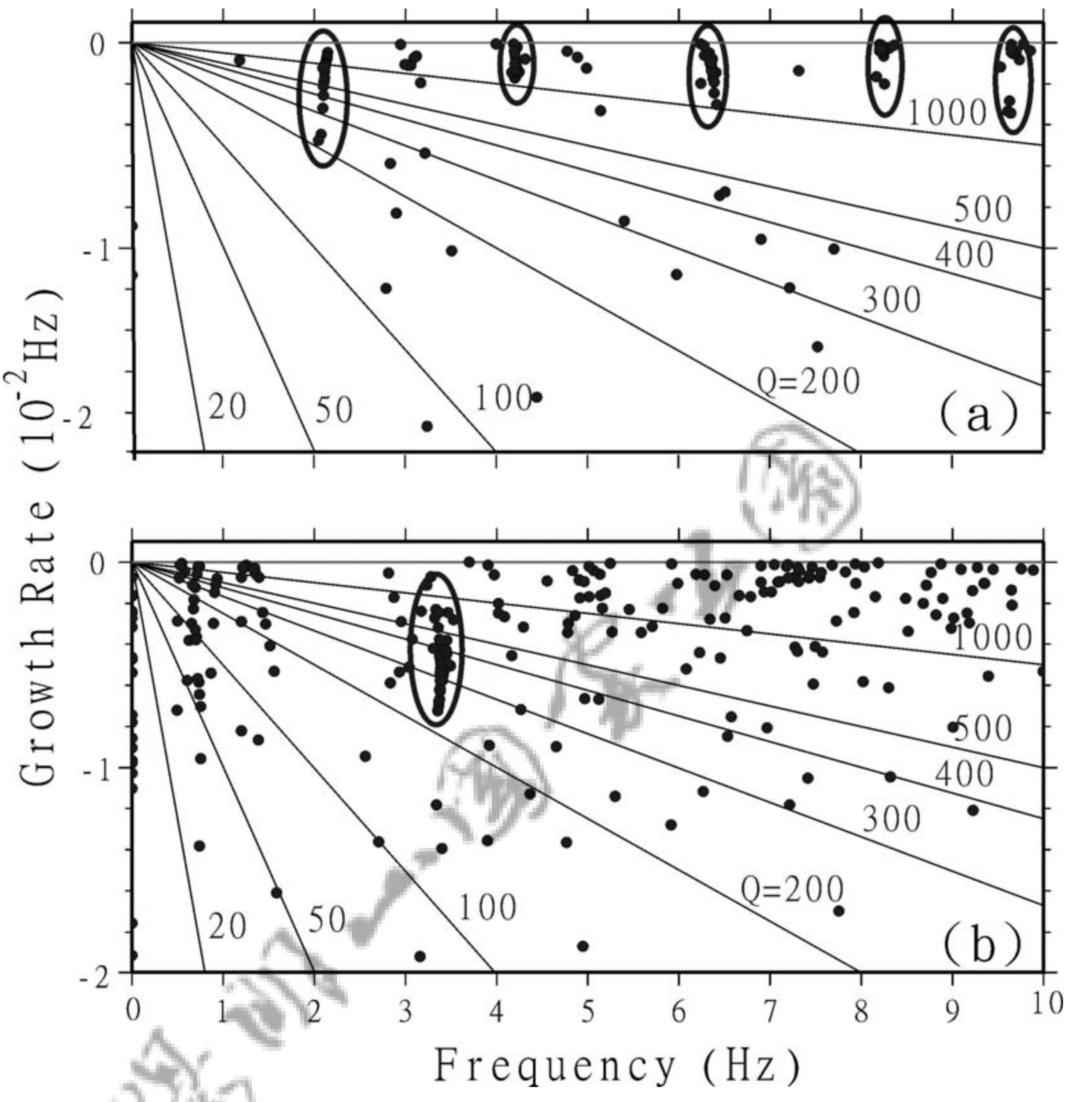
同時本計畫亦對多頻火山地震訊號（Tornillos）之來源進行討論，首先讀取各測站之初始到達波時間，利用一般定位程式來判斷震源之來源，其結果顯示其來源位於七星山與大油坑之間，深度約爲 1.5 公里左右（如圖二十九）。



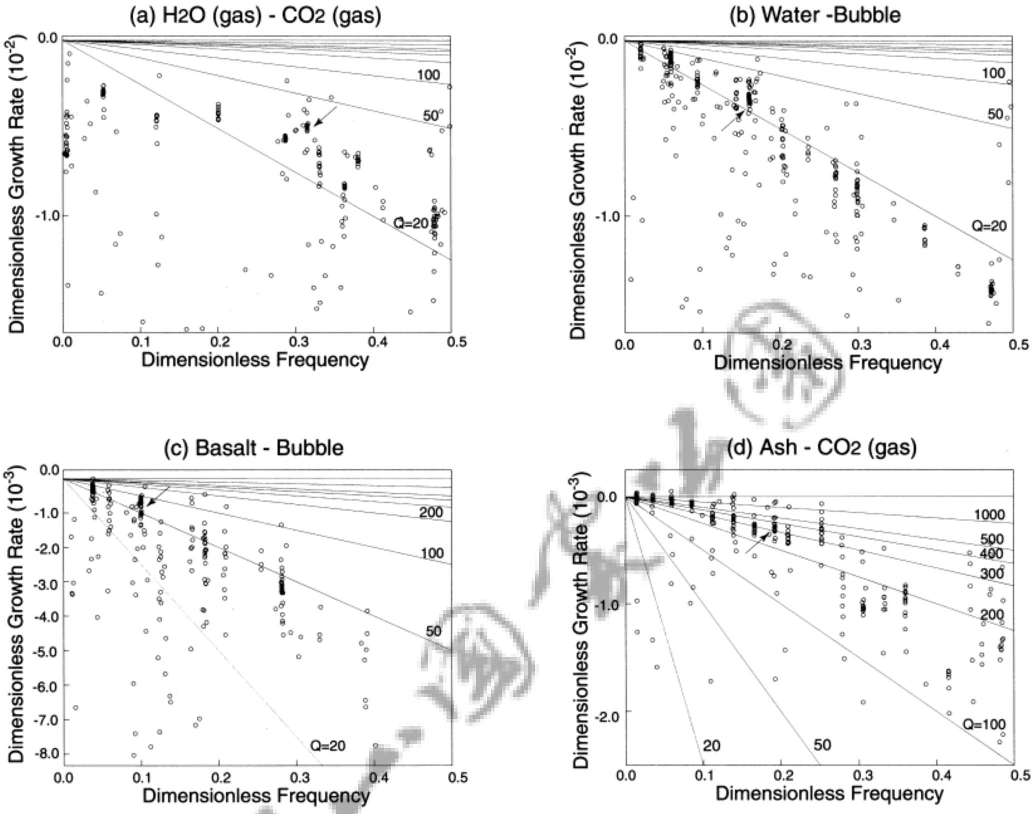
圖二十五 (a) 螺絲釘狀之火山地震訊號（Tornillos）及 (b) 其頻譜分析。



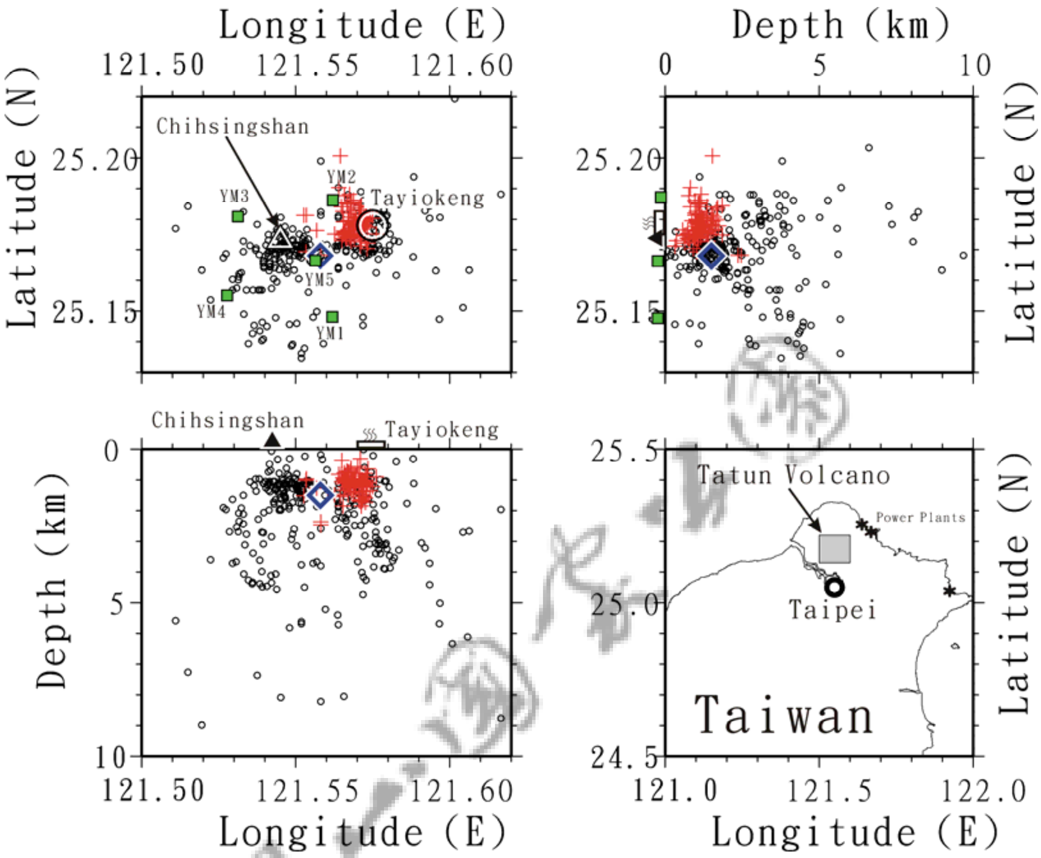
圖二十六　地震之波形與其頻率分佈（a）一般典型微震、（b）螺絲釘狀之火山地震訊號及（c）水滴狀之地震訊號。



圖二十七 火山地震波形中之（a）水滴狀之地震訊號及（b）螺絲釘狀之火山地震訊號之Q值分佈。



圖二十八　岩石裂縫中四種不同組成物質模擬火山地震波形中之Q值分佈情形
(Kumagai and Chouet, 2000)。



圖二十九 七星山附近之火山地震活動分佈情形包括微震(小圓圈)、連續性爆炸型地震(十字形)及多頻螺絲釘狀訊號(菱形)。

(五) 連續爆發性火山地震訊號（Continuously spasmodic bursts）

根據過去大屯山觀測經驗，除了有些一般性之群震現象外，本研究也發現另一種更爲強烈且連續性之爆發性火山地震訊號（圖三十 a）。這種持續超過二十分鐘之火山地震訊號爲上佰個連續發生之爆發性振動所組成。仔細分析每一個單獨振動記錄，亦可清楚判識其 P 波與 S 波到達時間（圖三十 b）。連續性爆發式火山地震活動，經過仔細分析後，其來源大約落於大油坑下方之岩層內（圖二十九）。

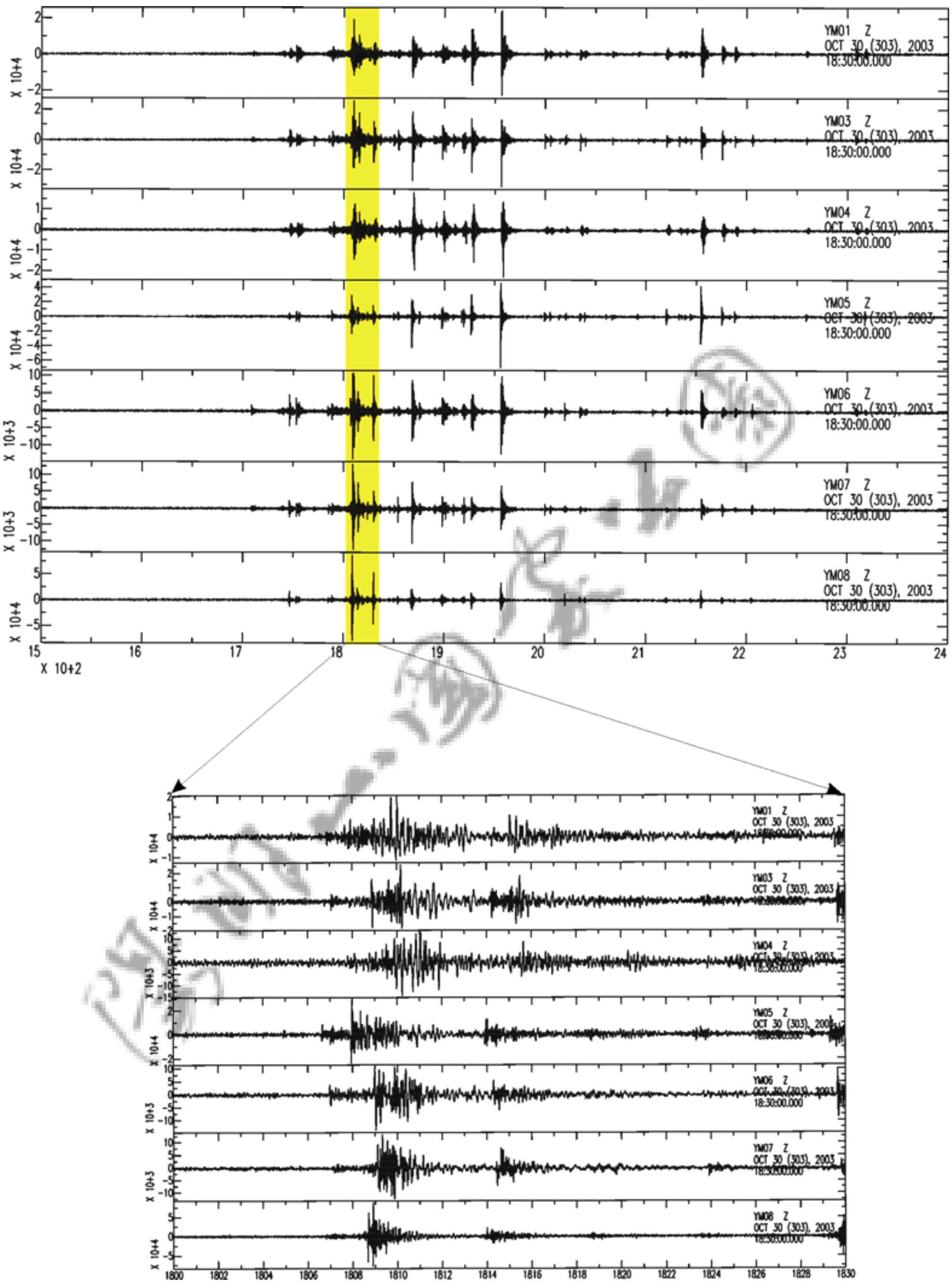
(六) 超長週期火山地震訊號（Very-Long-Period Volcanic Earthquake）

大屯山地區也曾記錄到非常長週期之火山地震訊號，其最長週期可高達 20 至 30 秒(圖三十一)。這些訊號可經由低頻率通(Low-pass-filter)或從速度地震波直接積分所獲得之地動位移波震波來判識。超長週期火山地震亦是一般活火山常見之一種訊號，可能與火山下岩漿庫或其高壓液態或氣態之活動有關。

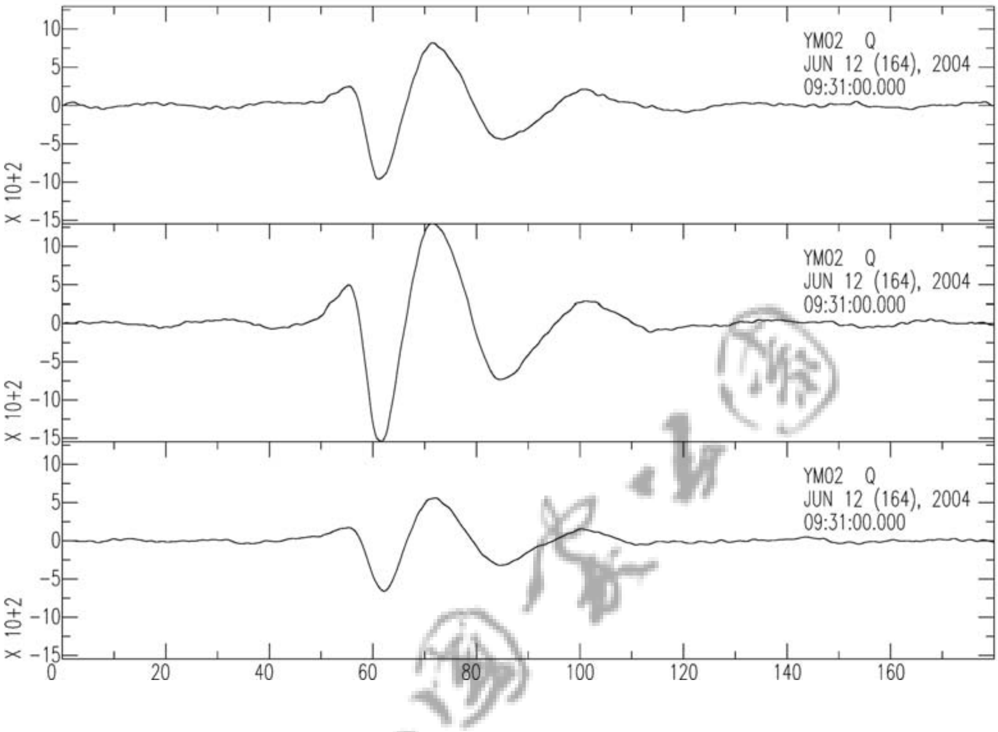
陽明山國家公園內之大屯火山群經由過去五年的地震觀測，可明顯地發現許多不同型式的火山地震活動。首先本研究於這幾年內總共觀測並定位了兩千餘個微震，大部份微震集中於七星山與大油坑下方之淺部地殼。主要地震深度約爲一至四公里。這些微震爲一般活火山地區通稱之火山構造型地震，基本上均可發現其 P 波與 S 波之到時。故可正確地決定其位置與深度。這些地震中也包括了一些群震現象(常於短時間內發生於局部之小地區中)。整體而言，七星山下之微震深度約比大油坑下之微震深度略淺些。除了這些典型之火山構造型地震外，過去幾年內，大屯山地區亦觀測到一些非構造型之火山地震訊號，例如單頻水滴狀火山地震、多頻螺絲狀火山地震、連續爆發型振動及超長週期(~30 秒)之火山振動訊號，這些均是全世界其他活火山常可觀測到之火山地震活動特徵。綜合所有地震觀測之結果，並考慮地表地熱和地球化學等之證據，陽明山國家公園內的大屯火山群之特性，與其他活火山非常相近，故認爲仍有岩漿庫可能存在於大屯山地區。除了(1)加強相關之火山監測研究外，(2)政府與相關學術單位，更須進一步評估未來潛在火山活動之規模與可能之影響範圍，(3)並且規劃如何有效地應付

可能之災害與減少對國家社會的衝擊。此三個基本步驟，也就是今年 2007 年 11 月 18~23 日於日本島原市舉行第五屆城市火山國際會議中，各國火山學者的共同一項建議與結論。

過去一年中，經由陽明山國家公園處之積極努力與協調下，目前台灣兩個主要地球科學相關之政府單位均高度表示參與未來大屯山之監測與研究工作。中央氣象局規劃將現有之地震站，建置爲即時觀測站，以求達成即時監測之目的。另外，中央地質調查所也積極支持並擴大相關之地球科學研究計劃。預期未來台灣對大屯火山之瞭解與監測功能，將有很大之改進，最終以期達到減低大台北地區可能之地質災害的目的。



圖三十　(a) 連續爆發性火山地震訊號及 (b) 其局部放大之波形。



圖三十一　超長週期火山地震訊號(Very-Long-Period Volcanic Earthquake)。

第六章　結　論

一、　本計劃過去五年內於大屯山所設置之微震網所觀測之地震記錄顯示，陽明山國家公園內之七星山及大油坑附近，有明顯的微震活動存在，大多數之微震震源深度均集中於二至五公里附近。一般而言七星山地區之微震震源深度小於大油坑附近震源深度。

二、　仔細分析連續地地震記錄，並經地震定位後，更發現有些微震，常在短時間內發生於很小的地區內，這現象與一般火山地熱區所觀測之群震現象相同。

三、　比較每日之連續地震記錄，常可發現有些不尋常的連續振動訊號。例如地震波形類似螺絲釘狀（Tornillos）、單頻水滴狀之震動訊號及超長週之地震活動。目前雖無法正確地判識其振動之機制，初步推斷可能與岩層裂縫中液態或氣態物質，突然增加或減少壓力所造成之振動，這些現象與國外其他火山地區，所觀測之岩漿相關活動類似。故很值得於未來研究，作更進一步探討。

第七章　建 議

一、立即可行建議

主辦機關：行政院內政部營建署陽明山國家公園管理處
協辦機關：行政院國家科學委員會、行政院經濟部中央地質調查所

□保育研究資料庫之彙整及建立

具體作法：本計畫過去幾年仔細觀測與分析結果顯示，大屯山地區之七星山與大油坑附近，淺部地殼有相當活躍的微震活動與群震現象。此外，部份地震站也觀測到一些火山地震振動現象。這些特性一般反應火山地區之液態物質作用有關，所謂液態物質可能是岩漿庫或熱水活動。根據過去地球化學有關氦同位素之觀測成果，也建議大屯火山群地底深處，存有岩漿庫之可能性。綜合所有地震觀測之結果，並考慮地表地熱和地球化學等之證據，陽明山國家公園內的大屯火山群之特性，與其他活火山非常相近，故認爲仍有岩漿庫可能存在於大屯山地區。除了(1)加強相關之火山監測研究外，(2)政府與相關學術單位，更須進一步評估未來潛在火山活動之規模與可能之影響範圍,(3)並且規劃如何有效地應付可能之災害與減少對國家社會的衝擊。故建議政府相關部門，對大屯火山地區能持續作連續性之監測與研究。而陽明山國家公園除了持續進行地震監測之工作，並建議其他相關單位如國科會、中央地質調查所也能加入更多不同領域之研究。

□展館主題呈現

具體作法：目前之研究發現陽明山國家公園內的火山活動之徵兆活躍，建議陽明山國家公園能考慮以火山監測爲主題，於管理站或遊客中心建立展示場。目的在於讓民眾能更實際的體驗並了解一般火山與大屯山地區的火山活動情況，期望讓民眾對大屯山地區的火山活動能有更多的了解和較正面的心態面對之。

二、中長期建議

主辦機關：國家科學委員會
協辦機關：行政院內政部營建署陽明山國家公園管理處、中國地球物理學會、中央研究院地球科學研究所、行政院交通部中央氣象局、行政院經濟部中央地質調查所、各大學院校相關科系

□保育研究資料庫之彙整及建立

具體作法：除了持續進行長期火山地震觀測之相關研究外，建議於未來研究中，適時加入地表變形長期監測研究及其他相關之研究，以探討岩漿庫存在之可能性。故建議國內政府地球科學相關機構，參與規劃中長期且跨領域之大屯火山監測與研究工作。

附 錄 一: 微震震源參數與相關地震定位資料(共 2154 筆)

年	月	日	時	分	秒	經度(E)	緯度(N)	深度	Mag	No	Dmin	GAP	RMS	ERH	ERZ	Q
2003	5	18	5	5	32.51	121.5512	25.1670	1.95	1.02	6	2.3	155	0.11	0.5	0.6	2
2003	5	18	21	37	35.28	121.5223	25.1537	3.6	0.2	6	0.6	278	0.03	0.3	0.3	3
2003	5	19	13	49	57.09	121.5597	25.1587	5.22	0.4	8	1.2	163	0.08	0.8	0.6	2
2003	5	19	22	28	50.1	121.5687	25.1732	1.19	0.22	8	1.6	218	0.07	0.4	0.5	3
2003	5	21	1	34	0.66	121.5412	25.1678	1.1	0.5	8	1.7	101	0.05	0.2	0.5	2
2003	5	21	1	34	12.06	121.5422	25.1697	0.07	0.11	8	1.6	97	0.1	0.3	15.5	3
2003	5	21	1	34	20.81	121.5450	25.1718	1.94	0.11	6	1.7	176	0.02	0.2	0.2	2
2003	5	22	3	10	44.96	121.5330	25.1825	1.5	0.82	8	0.2	219	2.14	7.9	10.3	4
2003	5	25	11	31	32.44	121.5518	25.1685	5.61	0.36	5	2.2	211	0.02	0.7	0.4	3
2003	5	25	13	24	46.5	121.5397	25.1642	2.06	0.43	6	1.6	152	0.03	0.2	0.3	2
2003	5	26	1	1	13.75	121.5607	25.1668	1.33	0.38	5	2.1	172	0.06	1	1.7	3
2003	5	27	10	54	10.72	121.5422	25.1573	4.35	0.84	7	1.5	144	0.06	0.7	0.7	2
2003	5	28	15	9	10.99	121.5595	25.1663	1.5	0.63	6	2	166	0.06	0.4	0.6	2
2003	5	28	18	3	1.81	121.5530	25.0978	0.23	0.73	7	5.6	329	0.34	1.6	29.5	4
2003	5	28	18	57	15.8	121.5433	25.1670	1.31	0.23	8	1.9	96	0.07	0.3	0.5	2
2003	5	28	20	22	26.41	121.5637	25.1020	5.4	1.13	7	5.1	329	0.16	2.6	2.3	4
2003	5	28	21	7	47.11	121.5478	25.1688	0.87	0.61	6	2.1	196	0.03	0.1	0.2	3
2003	5	29	3	21	27.87	121.5403	25.1715	1.26	0.26	7	1.4	104	0.03	0.1	0.3	2
2003	5	29	4	52	42.28	121.5335	25.1075	3.12	0.99	5	5.3	321	0.06	1.3	3	3
2003	5	29	11	30	5	121.5422	25.1133	2.85	1.08	6	4.3	324	0.11	1.5	0.7	3
2003	5	29	19	9	49.13	121.5490	25.1392	2.76	1.42	5	1.6	286	0.05	0.8	0.5	3
2003	5	29	19	35	23.14	121.5450	25.1765	1.15	0.5	7	1.5	129	0.06	0.4	0.6	2
2003	5	30	2	9	7.88	121.5438	25.1595	4.56	1	5	1.7	129	0.02	0.3	0.5	3
2003	5	30	13	49	53.6	121.5442	25.1700	1.39	0.1	8	1.8	98	0.05	0.2	0.4	2
2003	5	30	21	6	8.84	121.5480	25.1663	0.99	0.23	6	2.3	112	0.04	0.1	0.7	2
2003	5	30	23	32	47.05	121.5397	25.1895	1.5	0.67	6	1.3	237	0.03	0.4	0.2	3
2003	5	30	23	32	47.11	121.5447	25.1635	0.78	0.74	4	2.3	290	0.01			3
2003	5	31	4	21	53.21	121.5638	25.1642	1.83	0.43	5	1.8	190	0.2	0.3	0.5	3
2003	5	31	5	38	52.77	121.5450	25.1715	0.97	0.62	5	2.4	183	0.02	0.1	0.4	3
2003	5	31	6	26	46.23	121.5568	25.1707	1.87	0.69	4	1.8	151	0.04			3
2003	5	31	9	15	39.15	121.5638	25.1637	1.88	0.45	6	1.7	190	0.18	0.2	0.2	3
2003	5	31	10	8	49.81	121.5587	25.1705	0.33	0.86	6	1.8	160	0.07	0.3	3	3
2003	5	31	18	3	5.48	121.5712	25.1690	2.49	0.53	6	2.1	228	0.03	0.3	0.3	3
2003	5	31	19	31	18.59	121.5657	25.1727	8.05	0.68	5	1.6	201	0.03	0.9	0.4	3
2003	5	31	20	28	39.06	121.5638	25.1723	1.1	0.85	6	1.6	190	0.05	0.2	0.3	3

2003	5	31	21	10	52.08	121.5530	25.1713	1.1	0.96	5	1.9	154	0.01	0.1	0.2	3
2003	6	1	2	53	59.14	121.5437	25.1723	1.17	0.64	8	1.6	103	0.05	0.1	0.2	2
2003	6	1	15	15	28.51	121.5402	25.1680	1.05	0.6	8	1.7	107	0.07	0.3	0.6	2
2003	6	1	15	15	55.02	121.5418	25.1645	0.68	0.7	8	1.7	102	0.06	0.2	1	2
2003	6	1	15	21	43.97	121.5415	25.1643	0.49	1.05	8	1.7	103	0.07	0.2	1.5	2
2003	6	1	15	26	3.68	121.5415	25.1655	1.12	0.2	8	1.8	99	0.07	0.2	0.5	2
2003	6	1	15	26	7.3	121.5407	25.1653	1.05	0.43	8	1.7	102	0.07	0.3	0.5	2
2003	6	1	15	26	12.06	121.5397	25.1663	1.11	0.63	8	1.7	109	0.08	0.3	0.6	2
2003	6	1	15	26	23.95	121.5413	25.1652	0.75	0.39	8	1.8	99	0.09	0.2	1.1	2
2003	6	1	15	26	33.24	121.5398	25.1643	1.32	1.08	8	1.6	105	0.08	0.3	0.5	2
2003	6	1	15	27	59.06	121.5417	25.1655	1.39	1.08	8	1.8	98	0.08	0.3	0.5	2
2003	6	3	10	25	38.61	121.5330	25.1678	1.42	0.62	6	1.4	153	0.02	0.1	0.1	2
2003	6	3	14	38	31.83	121.5722	25.1720	1.69	0.32	8	1.7	234	0.08	0.2	0.2	3
2003	6	3	17	45	40.2	121.5767	25.1798	3.12	0.44	7	1.6	267	0.02	0.2	0.2	3
2003	6	3	18	4	26.19	121.5797	25.1813	3.25	0.54	8	1.9	278	0.04	0.4	0.3	3
2003	6	3	18	11	22.27	121.5775	25.1803	3.4	0.43	8	1.7	270	0.05	0.4	0.4	3
2003	6	3	18	13	23.37	121.5725	25.1787	2.82	0.92	10	1.3	248	0.07	0.4	0.3	3
2003	6	3	18	15	20.69	121.5770	25.1808	3.27	0.53	8	1.6	270	0.03	0.2	0.2	3
2003	6	3	18	15	38.21	121.5702	25.1810	3.67	0.22	7	1	246	0.05	0.5	0.4	3
2003	6	3	18	16	42.54	121.5715	25.1773	4.01	1.34	10	1.4	240	0.08	0.6	0.5	3
2003	6	3	18	19	22.18	121.5638	25.1805	2.04	0.5	9	0.7	197	0.09	0.5	0.6	3
2003	6	3	18	20	42.89	121.5760	25.1762	2.12	0.53	6	1.8	256	0.04	0.4	0.5	3
2003	6	3	18	20	52.52	121.5753	25.1785	3.83	0.51	8	1.6	259	0.04	0.4	0.3	3
2003	6	3	18	20	58.02	121.5790	25.1880	3.9	0.38	6	1.7	320	0.03	0.4	0.3	3
2003	6	3	18	52	35.39	121.5787	25.1828	3.89	0.51	8	1.7	280	0.05	0.5	0.5	3
2003	6	3	18	54	30.96	121.5787	25.1833	1.82	0.22	8	1.7	282	0.08	0.5	0.5	3
2003	6	3	18	54	39.37	121.5638	25.1812	2.6	0.17	5	0.6	221	0.06	1.3	0.6	3
2003	6	3	18	55	36.32	121.5802	25.1820	3.69	0.39	8	1.9	281	0.03	0.3	0.2	3
2003	6	3	18	55	51.3	121.5750	25.1908	3.28	0.19	6	1.4	319	0	0.1	0	3
2003	6	3	18	56	4.28	121.5827	25.1743	3.35	0.17	6	2.5	309	0.03	0.4	0.3	3
2003	6	3	18	56	14.71	121.5760	25.1880	2.86	0.22	7	1.4	295	0.04	0.4	0.3	3
2003	6	3	18	56	41.07	121.5793	25.1808	3.07	0.31	5	1.8	306	0.01	0.2	0.1	3
2003	6	3	18	57	7.18	121.5740	25.1792	3.08	0.31	8	1.4	256	0.03	0.3	0.2	3
2003	6	3	18	57	36.63	121.5670	25.1867	2.12	0.47	5	0.5	300	0.02	0.3	0.2	3
2003	6	3	18	58	9.3	121.5773	25.1858	3.05	0.3	6	1.5	312	0.01	0.2	0.1	3
2003	6	3	18	59	11.72	121.5780	25.1792	3.12	0.32	6	1.8	301	0.03	0.4	0.3	3
2003	6	3	18	59	15.23	121.5790	25.1780	3.11	0.16	5	1.9	302	0	0	0	3
2003	6	3	21	1	6.55	121.6467	25.1682	9.5	1.08	8	8.8	332	0.16	3.4	2.9	4

2003	6	3	23	48	17.67	121.5677	25.1647	1.87	0	5	1.2	211	0.18	0.1	0.1	3
2003	6	3	23	48	20.25	121.5688	25.1708	1.17	0.59	7	1.3	217	0.04	0.5	0.3	3
2003	6	4	16	33	38.72	121.5370	25.1698	0.96	0.48	10	1.4	125	0.06	0.2	0.5	2
2003	6	4	16	33	53.04	121.5382	25.1683	0.96	0.46	10	1.5	118	0.05	0.1	0.3	2
2003	6	4	19	8	11.52	121.5502	25.1715	1.52	0.83	8	0.9	143	0.09	0.4	0.6	2
2003	6	5	21	57	36.55	121.5728	25.1682	4.27	0.94	8	1.7	234	0.13	1.5	0.9	3
2003	6	6	6	0	11.4	121.5928	25.1865	0.06	0.61	4	3.1	306	0.11			3
2003	6	6	16	9	11.96	121.5582	25.1990	3.8	0.59	6	1.5	341	0.09	4.2	0.7	4
2003	6	6	17	59	28.73	121.5670	25.1880	2.77	0.64	8	0.5	289	0.06	0.5	0.4	3
2003	6	6	22	4	47	121.5602	25.1717	0.66	0.37	8	0.7	169	0.07	0.1	0.2	2
2003	6	6	23	52	22.02	121.5110	25.1770	5.58	0.82	6	4.7	317	0.08	3.6	3.6	4
2003	6	7	5	0	19.91	121.5697	25.1747	1.13	0.59	6	1.5	226	0.08	2	1.4	3
2003	6	7	6	19	47.15	121.5670	25.1727	2.82	0.76	6	1.3	208	0.01	0.2	0.1	3
2003	6	7	12	9	30.57	121.5420	25.1707	4.12	0.67	6	1.5	269	0.01	0.4	0.1	3
2003	6	7	16	26	16.09	121.5582	25.1840	8.57	0.78	6	0.5	232	0.04	4.7	0.5	4
2003	6	7	17	50	24.13	121.5518	25.1718	1.76	0.73	7	0.8	137	0.1	0.5	0.6	2
2003	6	7	20	43	47.41	121.5638	25.1712	1.3	0.71	7	0.9	190	0.08	0.4	0.6	3
2003	6	8	0	32	27.26	121.5662	25.1728	2.24	0.27	8	1.2	204	0.11	0.2	0.1	3
2003	6	8	3	18	56.58	121.5378	25.1568	2.29	1.03	10	1	148	0.09	0.4	0.5	2
2003	6	8	3	24	55.85	121.5390	25.1568	2.7	0.74	10	1.1	148	0.03	0.2	0.2	2
2003	6	8	9	12	46.27	121.5195	25.1633	8.99	1.14	10	1.2	255	0.09	1.4	0.7	3
2003	6	8	10	40	38.63	121.5752	25.1692	0.22	0.35	6	1.9	244	0.06	1.1	8.9	4
2003	6	8	11	4	11.14	121.5490	25.1768	1.74	0.33	6	1.4	128	0.05	0.3	0.5	2
2003	6	8	18	3	24.75	121.5442	25.1760	0.33	0.07	9	1.4	126	0.11	0.2	2.1	2
2003	6	8	18	3	22.61	121.5460	25.1707	1.32	0.26	10	1.2	96	0.08	0.3	0.4	2
2003	6	8	18	4	58.21	121.5352	25.1713	1.06	0.21	8	1.1	137	0.15	0.2	0.3	3
2003	6	8	18	4	45.25	121.5375	25.1783	7.36	0.71	9	0.7	136	0.06	0.9	0.5	2
2003	6	8	18	8	30.26	121.5478	25.1708	1.13	0.29	8	1	97	0.04	0.1	0.2	2
2003	6	8	18	8	22.75	121.5453	25.1698	1.63	0.51	10	1.2	92	0.05	0	0.1	2
2003	6	8	18	21	33.24	121.5447	25.1690	1.12	0.9	10	1.2	88	0.05	0.2	0.3	1
2003	6	8	18	29	22.73	121.5452	25.1807	8.08	0.94	7	1.4	159	0.07	1.1	1.1	3
2003	6	8	18	54	45.44	121.5458	25.1702	1.02	0.08	9	1.1	94	0.03	0.1	0.2	2
2003	6	8	18	54	7.8	121.5470	25.1715	1.14	0.59	10	1.1	100	0.03	0.1	0.2	2
2003	6	8	19	19	36.99	121.5455	25.1733	0.96	0.35	10	1.3	109	0.1	0.2	0.6	2
2003	6	8	22	8	16.94	121.5412	25.1732	0.73	0.24	8	1.3	105	0.07	0.1	0.5	2
2003	6	8	22	37	49.72	121.5520	25.1693	1.93	0.87	9	0.5	96	0.14	0.5	0.7	2
2003	6	9	7	24	36.53	121.5665	25.1725	1.1	0.85	9	1.2	205	0.1	0.5	0.5	3
2003	6	9	11	57	41.9	121.5773	25.1618	3.44	0.94	8	2.2	255	0.05	0.5	0.4	3

2003	6	9	12	1	17.46	121.5937	25.1767	0.76	0.84	7	3.3	297	0.04	0.7	2.2	3
2003	6	9	13	20	57.75	121.6843	25.1667	3.06	1.12	7	12.5	341	0.17	2.7	250	4
2003	6	9	13	30	49.32	121.5637	25.1733	1.15	0.58	6	1	229	0.07	0.6	0.6	3
2003	6	9	13	47	43.53	121.5638	25.1725	2.33	0.63	5	1	190	0.01	0.3	0.1	3
2003	6	9	14	33	27.61	121.5875	25.1723	0.68	0.53	5	3	283	0	0.1	0.3	3
2003	6	9	14	36	16.48	121.5638	25.1712	1.01	0.68	8	0.9	190	0.05	0.3	0.3	3
2003	6	9	15	40	31.55	121.5707	25.1753	1.03	0.72	9	1.5	232	0.23	1.1	1.1	3
2003	6	9	15	45	43.25	121.5707	25.1742	2.74	0.85	8	1.6	230	0.14	0.5	0.6	3
2003	6	9	17	56	6.01	121.5712	25.1713	1.46	0.8	9	1.6	228	0.07	0.4	0.4	3
2003	6	9	18	10	50.26	121.5433	25.1383	1.01	0.68	7	2.2	286	0.23	0.7	0.9	3
2003	6	9	18	33	42.46	121.6428	25.1682	5.7	0.99	7	8.4	331	0.2	3.6	4.3	4
2003	6	9	19	50	47.57	121.4902	25.1682	2.83	0.51	5	6.7	327	0.13	5.4	16	4
2003	6	9	19	50	24.74	121.5388	25.1783	0.97	0.72	4	2.2	303	0.02			3
2003	6	9	20	49	21.54	121.5440	25.1703	1.07	1.19	10	1.3	93	0.05	0.2	0.3	2
2003	6	9	21	9	55.96	121.6163	25.2033	4.22	1.11	8	5.8	328	0.1	1.4	1.8	3
2003	6	9	21	12	22.08	121.6382	25.1965	13.16	1	8	7.7	333	0.23	7.3	4.6	4
2003	6	9	22	27	45.77	121.5582	25.1682	15.09	0.89	6	0.2	159	0.14	6.1	2.3	4
2003	6	9	22	33	52.02	121.5365	25.1742	3.76	1.01	5	2.2	284	0.01	0.4	0.2	3
2003	6	10	2	20	32.72	121.5638	25.1880	5.29	0.46	4	0.2	320	0.32			4
2003	6	10	2	55	44.24	121.6107	25.1603	0.24	0.47	4	5.1	314	0			3
2003	6	10	14	8	0.94	121.6345	25.2190	13.75	1.33	7	8.1	335	0.32	11.1	7.1	4
2003	6	10	18	49	35.13	121.5842	25.2133	9.77	0.92	8	3.7	321	0.55	11	5.7	4
2003	6	10	18	59	41.43	121.6222	25.2053	6.62	1.13	8	6.4	330	0.08	1.2	1.1	3
2003	6	10	19	10	43.26	121.5638	25.1880	4.16	0.94	4	0.2	335	0.14			3
2003	6	10	19	21	29.88	121.6578	25.1880	5.33	0.89	7	9.7	337	0.24	7.7	20.1	4
2003	6	10	19	37	13.75	121.5465	25.1682	1.17	0.48	10	1	88	0.08	0.3	0.5	1
2003	6	10	21	0	7.46	121.5885	25.1492	5.68	1.18	7	2.7	300	0.08	1.4	1	3
2003	6	10	21	28	56.91	121.5712	25.1723	1.37	0.77	6	1.6	230	0.03	0.8	0.5	3
2003	6	10	22	30	3.4	121.4837	25.1848	1.91	0.88	5	7.6	332	0	0.2	0.4	3
2003	6	10	23	25	40.16	121.5875	25.1650	1.87	0.95	7	3.1	281	0.04	0.5	0.5	3
2003	6	14	1	7	4.32	121.5628	25.1712	2.29	0.36	8	0.8	185	0.12	0.2	0.2	3
2003	6	14	21	20	26.92	121.5773	25.1702	0.98	0.14	5	2.1	253	0.02	0.4	0.7	3
2003	6	14	21	21	0.57	121.5635	25.1712	1.41	0.57	8	0.9	188	0.04	0.2	0.2	3
2003	6	14	22	46	41.69	121.5428	25.1605	1.72	0.5	10	1.5	124	0.06	0.2	0.3	2
2003	6	15	18	0	48.54	121.5755	25.1765	2.08	0.58	6	1.7	255	0.05	1.7	1.2	3
2003	6	17	13	25	16.99	121.5475	25.1498	3.72	0.69	6	1.5	189	0.09	1.6	1	3
2003	6	18	6	28	22.96	121.5503	25.1525	0.99	0.21	6	1.3	165	0.07	0.1	0.3	2
2003	6	18	12	21	43.25	121.5362	25.1423	4.17	0.19	5	1.6	253	0.02	0.5	0.3	3

2003	6	18	16	31	27.02	121.5927	25.1307	6.33	2.09	9	3.7	319	0.23	3.3	2	4
2003	6	18	16	36	39.22	121.5637	25.1498	3.17	1.56	7	0.2	224	0.17	1.6	2.1	3
2003	6	18	16	53	26.94	121.5508	25.1412	1.08	1.07	6	1.4	248	0.04	0.4	0.5	3
2003	6	18	20	14	7.08	121.5640	25.1793	1.24	0.55	7	0.8	197	0.02	0.1	0.1	3
2003	6	19	3	48	51.44	121.5428	25.1697	1.75	0.8	8	1.7	94	0.08	0.2	0.3	2
2003	6	19	8	41	44.05	121.5808	25.1703	0.82	0.47	6	2.5	264	0.02	0.3	0.9	3
2003	6	19	16	17	42.32	121.5615	25.1682	1.61	1.13	7	0.5	177	0.05	0.5	0.3	2
2003	6	19	20	5	53.92	121.5670	25.1720	1.21	1.11	9	1.2	208	0.1	0.5	0.5	3
2003	6	20	4	56	7.73	121.6208	25.1848	2.59	0.35	7	5.9	324	0.19	2.6	6.1	4
2003	6	20	4	56	12.76	121.5748	25.1718	1.47	1.2	7	1.9	245	0.07	0.9	0.6	3
2003	6	21	2	33	23.22	121.5885	25.1825	5.02	1.08	8	2.7	296	0.12	1.5	1.8	3
2003	6	21	10	6	8.13	121.5460	25.1580	1.04	0.4	8	1.4	136	0.08	0.3	0.6	2
2003	6	22	9	1	42.96	121.5413	25.1652	2.63	0.26	6	1.7	162	0.01	0.1	0.1	2
2003	6	22	22	4	38.49	121.5637	25.1472	4.73	0.38	6	0.2	302	0.09	1.8	1	3
2003	6	27	16	5	15.62	121.5385	25.1653	1.86	0.67	10	1.6	114	0.07	0.3	0.3	2
2003	6	27	16	27	13.86	121.5650	25.1708	1.01	0.51	8	1	196	0.07	0.3	0.3	3
2003	6	27	16	27	24.34	121.5665	25.1710	1.19	0.6	7	1.1	205	0.04	0.3	0.2	3
2003	6	28	21	50	18.55	121.5365	25.1682	1.99	0.44	10	1.5	128	0.18	0.6	0.8	2
2003	6	29	6	19	28.67	121.5960	25.1530	2.7	0.61	6	3.5	304	0.21	3.3	3	4
2003	6	29	19	6	52.22	121.5652	25.1762	1.01	0.56	6	1.2	201	0.01	0.3	0.2	3
2003	6	29	19	9	18.29	121.5455	25.1785	1.33	0.67	7	1.7	208	0.06	0.5	0.5	3
2003	6	29	19	34	58.1	121.5707	25.1715	1.05	0.58	5	1.5	226	0.01	0.2	0.1	3
2003	6	29	19	35	5.25	121.5797	25.1608	2.7	0.32	5	2.3	264	0.26	1.4	0.9	3
2003	6	30	13	5	51.9	121.5550	25.1717	1.61	0.43	7	0.6	141	0.05	0.2	0.4	2
2003	6	30	13	6	1.67	121.5582	25.1717	1.1	1.05	8	0.6	158	0.09	0.5	0.5	2
2003	6	30	13	7	11.97	121.5673	25.1717	2.24	0.2	8	1.2	210	0.11	0.3	0.3	3
2003	6	30	13	7	14.21	121.5685	25.1687	1.47	0.05	8	1.2	214	0.03	0.2	0.2	3
2003	6	30	13	7	16.46	121.5802	25.1695	0.32	0.05	6	2.4	262	0.03	0.6	4.3	3
2003	6	30	13	7	19.04	121.5655	25.1702	1.62	0.56	8	1	199	0.1	0.5	0.5	3
2003	6	30	21	50	35.67	121.5582	25.1753	2.14	0.43	8	1	154	0.15	0.3	0.4	2
2003	7	1	11	36	15.74	121.5395	25.1640	1.08	0.51	10	1.5	106	0.07	0.2	0.4	2
2003	7	1	11	46	50.42	121.5373	25.1682	1.67	0.6	6	1.9	279	0.04	1.1	0.9	3
2003	7	1	13	12	51.03	121.5692	25.1732	1.75	1.14	6	1.5	221	0.1	0.6	0.4	3
2003	7	1	14	59	32.04	121.5727	25.1703	1.25	0.71	7	1.7	234	0.05	0.6	0.5	3
2003	7	1	16	33	48.25	121.5635	25.1722	1.49	1.06	7	0.9	189	0.07	0.8	0.6	3
2003	7	1	16	33	58.64	121.5682	25.1643	2.37	1.08	8	1.2	213	0.11	1.1	0.9	3
2003	7	2	1	0	32.29	121.5690	25.1747	1.78	0.93	8	1.5	222	0.09	0.2	0.2	3
2003	7	2	1	47	28.8	121.5737	25.1737	1.6	1.14	6	1.8	242	0.04	1.2	0.7	3

2003	7	2	5	4	10.8	121.5295	25.1602	2.27	1.04	8	0.6	168	0.05	0.3	0.3	2
2003	7	2	5	11	30.98	121.5295	25.1590	2.16	0.05	6	0.5	163	0.02	0.2	0.1	2
2003	7	2	6	28	9.53	121.5402	25.1550	2.44	0.72	8	1.2	162	0.04	0.2	0.3	2
2003	7	2	18	14	27.59	121.5638	25.1693	0.02	0.27	6	1.9	190	0.13	1	105	4
2003	7	3	2	29	19.15	121.5412	25.1737	0.95	0.96	6	1.3	192	0.04	0.3	0.5	3
2003	7	3	3	11	24.87	121.5582	25.1602	2.34	0.55	6	0.7	302	0.1	1.1	1	3
2003	7	3	13	54	51.08	121.6085	25.1900	1.96	0.65	6	4.7	320	0.11	1.5	1.1	3
2003	7	3	17	55	55.36	121.5460	25.1703	1.01	0.41	6	1.1	196	0.01	0	0.1	3
2003	7	3	17	55	52.1	121.5392	25.1712	0.64	0.27	7	1.3	186	0.04	0.2	0.6	3
2003	7	3	18	39	21.96	121.5858	25.1295	18.78	1.14	7	3.2	331	0.1	5.3	1.5	4
2003	7	3	21	28	44.75	121.5458	25.1753	1.07	0.42	8	1.5	141	0.03	0.1	0.2	2
2003	7	4	6	11	0.42	121.6700	25.2337	5.83	1.36	7	12.1	342	0.25	6.6	14.6	4
2003	7	4	6	38	43.81	121.5582	25.1835	2.63	1.44	6	0.5	226	0.09	3.9	0.8	4
2003	7	4	12	6	17.9	121.5370	25.1710	1.15	0.53	10	1.2	124	0.13	0.2	0.3	2
2003	7	6	5	3	29.77	121.5313	25.1427	2.72	0.5	6	1.4	267	0.02	0.3	0.2	3
2003	7	8	19	51	49.82	121.5452	25.1730	1.04	0.31	5	1.4	261	0.02	0.4	0.3	3
2003	7	9	17	7	41.21	121.5677	25.1720	1.24	0.32	6	1.3	211	0.07	0.7	0.4	3
2003	7	9	23	7	34.88	121.5695	25.1682	1.07	0.54	4	1.3	282	0.01			3
2003	7	10	10	21	15.91	121.5465	25.1735	1.07	0.6	6	1.3	257	0.02	0.3	0.2	3
2003	7	10	15	19	52.66	121.5665	25.1742	2.31	0.25	8	1.3	207	0.14	0.1	0.1	3
2003	7	11	3	39	45.96	121.5722	25.1713	1.23	0.01	8	1.7	233	0.06	0.3	0.2	3
2003	7	11	19	44	57.74	121.5723	25.1770	3.86	0.23	8	1.5	243	0.09	0.9	0.6	3
2003	7	11	19	45	41.57	121.5737	25.1750	3.55	0.82	10	1.7	244	0.06	0.4	0.3	3
2003	7	11	19	49	59.51	121.5722	25.1733	3.47	0.68	8	1.7	235	0.07	0.7	0.5	3
2003	7	11	20	41	23.16	121.5752	25.1745	3.3	0.27	8	1.9	249	0.06	0.6	0.4	3
2003	7	13	7	55	17.84	121.5433	25.1712	1.07	0.09	7	1.4	168	0.02	0.1	0.1	2
2003	7	14	8	33	59.68	121.5447	25.1747	1.01	0.47	12	1.5	148	0.03	0.1	0.1	2
2003	7	15	2	24	20.89	121.5437	25.1380	5.69	0.5	10	2.2	261	0.06	0.5	0.4	3
2003	7	16	7	51	24.13	121.5392	25.1663	0.81	0.57	10	1.7	111	0.05	0.1	0.5	2
2003	7	16	9	11	10.04	121.5400	25.1475	0.32	1.66	6	2.2	259	0.19	1.5	11.5	4
2003	7	16	10	39	0.82	121.5422	25.1720	1.17	0.56	10	1.5	100	0.05	0.1	0.2	2
2003	7	16	13	11	22.5	121.5305	25.1498	2.4	0.37	4	3.2	268	0.36			4
2003	7	16	13	11	28.88	121.5428	25.1623	1.2	0.98	5	1.5	202	0.15	0.6	0.5	3
2003	7	16	18	27	9.04	121.5582	25.1682	10.93	1.03	7	0.2	159	0.24	5.5	2.1	4
2003	7	17	18	34	22.01	121.5670	25.1735	1.82	0.88	9	1.3	209	0.1	0.3	0.3	3
2003	7	18	7	1	38.13	121.5612	25.1728	1.19	0.69	8	0.8	174	0.08	0.2	0.3	2
2003	7	18	15	12	50.61	121.5425	25.1730	1.04	0.78	8	1.4	163	0.02	0.1	0.1	2
2003	7	18	18	13	36.08	121.5237	25.1435	0.98	1.31	6	3.9	288	0.09	0.9	3.2	3

2003	7	18	22	17	0.74	121.6458	25.1705	5.84	2.44	10	8.6	332	0.22	2.6	3.5	4
2003	7	19	14	19	53.53	121.5445	25.1762	1.46	0.96	8	1.4	141	0.07	0.3	0.4	2
2003	7	19	18	52	23.4	121.5492	25.1500	1.01	0.09	6	1.3	233	0.06	0.5	0.4	3
2003	7	19	19	5	51.85	121.5430	25.1768	1.19	0.63	7	1.3	142	0.04	0.2	0.3	2
2003	7	19	19	5	57.76	121.5437	25.1692	1.51	0.61	8	1.3	123	0.11	0.6	0.7	2
2003	7	19	21	59	32.41	121.5410	25.1753	1.29	1.39	10	1.2	118	0.05	0.2	0.3	2
2003	7	26	0	57	40.82	121.5405	25.1403	2.76	0.59	10	2.1	254	0.09	0.6	0.5	3
2003	7	28	14	59	54.23	121.5447	25.1397	4.5	0.57	8	2	254	0.03	0.3	0.2	3
2003	7	28	16	55	20.61	121.5685	25.1732	2.96	0.28	8	1.4	217	0.09	0.7	0.5	3
2003	7	28	17	3	1.85	121.5390	25.1642	1.27	0.3	8	1.5	109	0.03	0.2	0.2	2
2003	7	30	8	49	9.1	121.5440	25.1753	1.28	0.2	10	1.4	120	0.1	0.3	0.6	2
2003	7	30	17	11	42.1	121.5643	25.1715	2.32	0.19	8	1	193	0.1	0.1	0.1	3
2003	7	31	19	9	59.72	121.5448	25.1740	1.44	0.06	8	1.4	150	0.04	0.2	0.3	2
2003	7	31	19	10	28.18	121.5407	25.1747	1.05	0.24	10	1.2	113	0.05	0.2	0.3	2
2003	8	1	3	20	57.8	121.5282	25.1880	2.78	0.59	7	3.4	273	0.08	2.1	2.5	3
2003	8	1	16	53	38.09	121.5798	25.1780	2.62	1.05	7	2	271	0.06	0.5	0.6	3
2003	8	2	17	50	17.47	121.5478	25.1715	1.85	0.71	10	1	100	0.07	0.1	0.1	2
2003	8	4	19	55	26.86	121.5427	25.1703	1.05	1.13	10	1.4	94	0.06	0.2	0.3	2
2003	8	5	16	41	40.39	121.5550	25.1660	2.81	0.77	9	0.2	92	0.05	0.4	0.3	2
2003	8	6	9	33	58.71	121.5518	25.1347	3.77	1.12	6	1.8	304	0.05	0.7	0.5	3
2003	8	6	11	29	43.08	121.5315	25.1612	2.08	0.23	6	2.2	244	0.03	0.8	0.7	3
2003	8	8	3	58	45.73	121.5330	25.1728	2.12	0.37	8	0.9	154	0.12	0.7	0.7	2
2003	8	8	3	58	49.58	121.5265	25.1673	1.9	0.37	7	1.4	204	0.03	0.2	0.2	3
2003	8	8	20	1	37.6	121.5402	25.1692	1.74	0.71	10	1.6	107	0.1	0.3	0.4	2
2003	8	10	10	10	29.8	121.5468	25.1707	1.22	0.83	9	1.1	96	0.06	0.3	0.5	2
2003	8	10	16	49	43.5	121.5462	25.1727	1.52	0.97	10	1.2	106	0.05	0.1	0.2	2
2003	8	10	18	33	16.97	121.5497	25.1682	1.16	0.47	8	0.7	156	0.12	0.6	0.7	2
2003	8	11	12	47	55.88	121.5470	25.1725	2.02	0.87	8	1.2	149	0.06	0.3	0.4	2
2003	8	14	7	27	27.18	121.5582	25.1722	1.72	0.49	6	0.6	179	0.02	0.7	0.2	2
2003	8	14	22	1	25.72	121.5622	25.1710	1.08	0.52	8	0.8	180	0.05	0.2	0.3	3
2003	8	15	0	36	20.61	121.5405	25.1613	3.2	0.33	10	1.4	118	0.08	0.4	0.5	2
2003	8	16	6	13	23.7	121.5457	25.1717	1.27	0.69	10	1.2	101	0.06	0.2	0.4	2
2003	8	16	16	22	30.73	121.5372	25.1705	1.36	1.06	10	1.3	124	0.08	0.3	0.4	2
2003	8	17	9	19	19.22	121.5438	25.1767	1.17	0.68	7	1.3	140	0.02	0.1	0.2	2
2003	8	17	20	43	37.34	121.5690	25.1707	1.82	0.64	8	1.3	218	0.09	0.1	0.1	3
2003	8	17	20	46	12.15	121.5697	25.1702	1.27	1.22	8	1.4	221	0.06	0.1	0.1	3
2003	8	18	1	20	54.46	121.5452	25.1657	1.99	0.54	4	1.1	160	0.02			3
2003	8	18	11	52	16.22	121.5655	25.1733	1.08	0.89	8	1.2	200	0.01	0	0	3

2003	8	18	16	35	43.1	121.5307	25.1245	3.67	0.46	8	3.4	305	0.08	0.8	0.7	3
2003	8	18	17	12	41.26	121.5582	25.1720	1.14	0.19	6	0.6	179	0.03	0.6	0.2	2
2003	8	18	18	51	52.37	121.5412	25.1750	1.33	0.02	6	1.2	182	0.02	0.1	0.2	3
2003	8	19	10	59	12.5	121.5383	25.1435	4.38	0.79	10	1.7	243	0.08	0.6	0.4	3
2003	8	20	3	58	37.02	121.5390	25.1403	3.98	0.68	8	2	256	0.08	0.9	0.7	3
2003	8	20	4	4	53.09	121.5392	25.1463	4.48	1.1	10	1.5	226	0.07	0.5	0.4	3
2003	8	20	6	22	5.14	121.5407	25.1450	4.46	1.03	10	1.7	230	0.07	0.6	0.4	3
2003	8	20	6	27	25.09	121.5358	25.1353	4.39	1.02	8	2.3	278	0.03	0.3	0.2	3
2003	8	20	6	44	38.16	121.5435	25.1478	4.06	0.74	7	1.8	208	0.05	0.5	0.4	3
2003	8	20	9	18	38.42	121.5360	25.1427	4.33	0.54	7	2.7	277	0.08	1.2	1.1	3
2003	8	20	16	19	17.58	121.5347	25.1393	4.27	0.74	8	1.9	268	0.08	0.8	0.6	3
2003	8	20	22	4	53.66	121.5827	25.1617	0.4	0.79	6	2.6	302	0.07	1.4	7.9	4
2003	8	21	17	4	53.77	121.5690	25.1743	2.12	0.39	8	1.5	221	0.11	0.1	0.1	3
2003	8	21	20	59	34.73	121.5450	25.1738	1.59	1.05	10	1.4	112	0.08	0.1	0.2	2
2003	8	23	14	35	17.04	121.5467	25.1720	1.57	0.53	10	1.2	102	0.08	0.3	0.4	2
2003	8	25	16	13	23.37	121.5720	25.1750	0.98	0.8	7	1.6	237	0.21	1.7	2.2	3
2003	8	26	13	20	59.85	121.5185	25.1385	1.01	0.75	6	4.5	299	0.07	0.9	4.6	3
2003	8	26	13	27	32.79	121.5482	25.1643	1.5	0.31	6	0.9	175	0.28	0.3	0.2	3
2003	8	27	4	20	18.56	121.5582	25.1682	2.22	0.55	8	0.2	159	0.18	0.6	0.6	3
2003	8	27	19	50	59.97	121.5428	25.1688	1.13	0.61	10	1.4	94	0.05	0.2	0.3	2
2003	8	29	14	0	53.84	121.5410	25.1683	1.04	1.26	10	1.6	103	0.07	0.2	0.4	2
2003	8	29	20	6	37.42	121.5437	25.1668	2.39	0.66	8	1.3	130	0.03	0.2	0.2	2
2003	8	29	23	14	33.11	121.5382	25.1662	2.42	0.97	10	1.6	116	0.08	0.3	0.4	2
2003	8	30	11	6	16.64	121.5540	25.1618	2.69	0.99	10	0.6	126	0.06	0.3	0.3	2
2003	8	30	18	15	41.82	121.6303	25.2227	9.98	1.41	10	8	335	0.07	1.3	1.1	3
2003	8	30	18	48	48.67	121.5845	25.2135	9.05	1.25	8	3.8	321	0.13	2.5	1.5	3
2003	8	31	9	13	27.56	121.5638	25.1762	2.49	0.77	8	1.1	192	0.13	0.9	0.8	3
2003	8	31	16	6	12.41	121.6167	25.2232	7.23	1.36	8	6.8	332	0.09	1.5	1.5	3
2003	8	31	16	37	9.09	121.5870	25.2028	11.59	1.36	8	3.1	316	0.09	2.2	1	3
2003	8	31	16	56	25.63	121.6310	25.2252	7.82	1.34	8	8.2	335	0.03	0.5	0.5	3
2003	8	31	17	19	34.48	121.5882	25.2213	10.21	1.41	8	4.7	326	0.09	2.2	1.5	3
2003	9	1	2	21	16.15	121.5582	25.1682	0.19	0.48	6	0.2	159	0.07	1.3	1.9	3
2003	9	2	1	8	19.66	121.5332	25.1490	4.07	0.79	4	2.9	265	0			3
2003	9	2	12	9	34.94	121.5313	25.1602	2.68	0.59	10	0.6	148	0.05	0.3	0.3	2
2003	9	2	12	9	30.48	121.5317	25.1622	2.35	0.01	9	0.9	153	0.04	0.2	0.3	2
2003	9	3	4	57	7.15	121.5652	25.1725	2.24	1.43	8	1.1	198	0.12	0.3	0.2	3
2003	9	4	17	30	33.16	121.6167	25.1155	8.77	2.03	7	6.6	331	0.12	5.2	3.1	4
2003	9	6	14	30	33.48	121.5415	25.1697	1.05	0.78	10	1.6	100	0.05	0.2	0.3	2

2003	9	7	8	9	50.62	121.5568	25.1498	3.67	0.93	5	0.6	172	0.11	3.1	2.1	4
2003	9	7	12	33	17.55	121.5323	25.1625	1.92	0.72	10	0.9	148	0.06	0.3	0.3	2
2003	9	7	13	51	48.98	121.6403	25.1167	9.04	1.13	9	8.6	336	0.12	2	2.1	3
2003	9	17	4	8	39.25	121.5513	25.1705	1.44	0.54	14	0.7	93	0.08	0.2	0.3	2
2003	9	11	15	13	52.52	121.5693	25.1742	1.03	0.07	10	1.5	159	0.1	0.4	0.5	2
2003	9	13	1	53	47.7	121.5435	25.1703	1.27	0.32	14	1.4	94	0.07	0.2	0.3	2
2003	9	13	9	31	23.93	121.5285	25.1555	2.69	0.14	10	0.1	135	0.12	0.7	0.6	2
2003	9	13	9	32	6.43	121.5362	25.1568	3.39	0.2	9	0.9	147	0.16	1.1	1	3
2003	9	13	16	19	11.07	121.5340	25.1568	2.76	0.35	12	0.6	145	0.09	0.4	0.4	2
2003	9	13	16	19	6.69	121.5308	25.1575	2.54	0.28	6	0.4	132	0.01	0.1	0.1	2
2003	9	14	11	33	55.53	121.6058	25.2227	6.11	0.99	16	4.5	294	0.08	0.6	0.5	3
2003	9	14	21	41	34.19	121.5372	25.1568	3.75	0.33	12	1	148	0.13	0.7	0.6	2
2003	9	15	6	6	54.26	121.5467	25.1752	1.62	0.38	10	1.4	120	0.08	0.3	0.4	2
2003	9	17	4	3	28.31	121.5515	25.1690	1.5	0.31	11	0.6	87	0.05	0.2	0.2	1
2003	9	17	4	3	32.53	121.5520	25.1712	1.32	0.78	14	0.7	94	0.07	0.2	0.3	2
2003	9	17	4	3	43.14	121.5510	25.1693	1.1	0.52	12	0.6	88	0.04	0.1	0.2	1
2003	9	17	4	5	21.01	121.5537	25.1705	1.14	0.37	12	0.5	89	0.08	0.2	0.3	1
2003	9	17	4	8	34.41	121.5520	25.1712	1.4	0.47	16	0.7	94	0.09	0.2	0.3	2
2003	9	17	4	9	17.03	121.5512	25.1717	1.07	0.27	10	0.8	140	0.07	0.2	0.3	2
2003	9	17	4	8	39.25	121.5513	25.1705	1.44	0.54	14	0.7	93	0.08	0.2	0.3	2
2003	9	17	13	56	15.33	121.5497	25.1700	1.17	0.57	11	0.8	92	0.05	0.1	0.3	2
2003	9	17	13	57	9.11	121.5503	25.1702	1.26	0.59	14	0.7	92	0.09	0.2	0.3	2
2003	9	17	13	59	31.56	121.5478	25.1682	1.93	0.43	10	0.9	87	0.09	0.2	0.3	1
2003	9	17	14	27	21.91	121.5475	25.1682	1.55	0.16	9	0.9	87	0.07	0.2	0.3	1
2003	9	17	14	27	15.45	121.5432	25.1642	1.05	0.05	7	1.4	194	0.05	0.3	0.3	3
2003	9	17	14	41	23.01	121.5503	25.1702	1.3	0.89	15	0.7	92	0.07	0.2	0.3	2
2003	9	17	16	23	21.6	121.5502	25.1690	1.23	0.53	16	0.7	88	0.07	0.2	0.3	1
2003	9	17	19	16	35.96	121.5745	25.1700	0.96	0.52	8	1.8	191	0.03	0.2	0.5	3
2003	9	19	6	13	45.22	121.5503	25.1698	3.15	0.79	5	0.7	318	0.03	0.6	0.3	3
2003	9	19	19	25	16.34	121.6063	25.1633	2.67	1.27	12	1.6	207	0.11	0.6	0.6	3
2003	10	1	6	34	52.05	121.5637	25.1547	4.18	0.36	12	0.7	101	0.15	0.9	0.7	2
2003	10	2	7	0	46	121.5400	25.1612	1.75	0.24	12	1.4	119	0.08	0.3	0.4	2
2003	10	2	7	2	19.99	121.5437	25.1682	2.14	0.55	10	1.3	179	0.03	0.1	0.2	2
2003	10	2	11	34	37.03	121.5492	25.1700	1.7	0.24	8	0.8	152	0.07	0.1	0.1	2
2003	10	8	20	11	46.71	121.5663	25.1720	1.86	0.21	8	1.2	152	0.08	0.2	0.2	2
2003	10	8	23	11	41.36	121.5753	25.1702	0.95	0.17	8	1.9	194	0.03	0.1	0.3	3
2003	10	9	2	11	25.48	121.5330	25.1960	2.64	0.56	10	1.7	284	0.52	3.6	2.7	4
2003	10	9	2	18	6.87	121.5297	25.1823	6.84	0.35	9	3.2	303	0.38	4.4	2.8	4

2003	10	9	4	38	9.33	121.5647	25.2230	4.07	0.41	10	4.1	329	0.07	0.9	0.6	3
2003	10	9	6	46	6.3	121.5667	25.1737	1.68	0.24	12	1.3	110	0.12	0.4	0.5	2
2003	10	9	11	18	32.14	121.5445	25.1875	6.95	0.48	8	1.8	289	0.06	1.3	0.6	3
2003	10	9	14	0	41.13	121.5780	25.1863	10.23	0.52	8	0.4	158	0.07	2.2	0.6	3
2003	10	9	16	53	13.29	121.6035	25.1793	7.83	0.58	10	2.5	295	0.11	1.3	0.9	3
2003	10	10	14	55	34.78	121.6237	25.2587	7.23	0.78	6	10.1	349	0.25	22.6	14.7	4
2003	10	10	17	4	9.43	121.5730	25.2003	4.44	0.43	10	1.5	265	0.3	2.3	1.7	3
2003	10	11	3	39	26.49	121.5438	25.1682	1.04	0.31	12	1.3	89	0.08	0.2	0.4	1
2003	10	11	12	25	10.13	121.5717	25.1682	5.02	0.77	8	1.5	229	0.18	2.1	1.4	3
2003	10	11	17	0	14.15	121.5717	25.1723	1.33	0.39	10	1.7	173	0.07	0.3	0.4	2
2003	10	12	18	4	11.23	121.5363	25.1662	2.02	0.67	10	1.5	128	0.07	0.3	0.4	2
2003	10	12	18	7	51.82	121.5410	25.1692	1.84	0.42	10	1.6	102	0.05	0.2	0.3	2
2003	10	12	18	4	11.23	121.5363	25.1662	2.02	0.67	10	1.5	128	0.07	0.3	0.4	2
2003	10	12	18	7	51.82	121.5410	25.1692	1.84	0.42	10	1.6	102	0.05	0.2	0.3	2
2003	10	13	5	11	58.61	121.5225	25.2360	7.74	0.84	8	6.8	334	0.21	5.9	4.6	4
2003	10	15	13	12	46.48	121.5777	25.1722	1.02	0.19	10	1.9	201	0.09	0.4	0.5	3
2003	10	15	22	53	40.55	121.5448	25.1767	1.25	0.62	6	1.4	155	0.01	0.1	0.1	2
2003	10	16	11	33	37.01	121.5840	25.1768	1.57	0.67	8	1.4	229	0.1	0.7	0.8	3
2003	10	16	19	51	20.45	121.5428	25.1587	2.4	0.15	8	1.6	135	0.02	0.1	0.2	2
2003	10	17	19	27	14.03	121.5392	25.1655	1.45	0.47	10	1.6	111	0.06	0.2	0.3	2
2003	10	17	20	2	19.32	121.5388	25.1645	1.65	0.31	10	1.5	110	0.06	0.2	0.3	2
2003	10	17	20	2	6.96	121.5373	25.1637	1.54	0.09	8	1.3	117	0.03	0.1	0.2	2
2003	10	17	20	2	6.94	121.5353	25.1623	1.61	0.07	6	1.1	132	0	0	0	2
2003	10	17	20	2	19.32	121.5373	25.1637	1.62	0.1	8	1.3	117	0.03	0.1	0.2	2
2003	10	17	20	2	6.94	121.5353	25.1623	1.61	0.07	6	1.1	132	0	0	0	2
2003	10	17	20	2	19.32	121.5373	25.1637	1.62	0.1	8	1.3	117	0.03	0.1	0.2	2
2003	10	18	17	28	45.65	121.5668	25.1735	1.24	0.71	12	1.3	89	0.08	0.2	0.4	1
2003	10	19	14	57	34.88	121.5582	25.1612	11.26	1.25	6	0.6	336	0	0.4	0	3
2003	10	20	9	9	12.74	121.5657	25.1848	1.37	0.04	8	0.4	138	0.04	0.2	0.2	2
2003	10	20	9	8	41.5	121.6795	25.2160	6.84	0.95	12	8	336	0.06	0.7	0.3	3
2003	10	20	9	9	12.74	121.5657	25.1848	1.37	0.04	8	0.4	138	0.04	0.2	0.2	2
2003	10	20	9	8	41.5	121.6795	25.2160	6.84	0.95	12	8	336	0.06	0.7	0.3	3
2003	10	20	11	35	36.61	121.6770	25.2345	7.16	0.87	10	9.1	338	0.08	2.3	2	3
2003	10	21	6	21	42.68	121.5700	25.1703	1	1.16	6	1.4	222	0.02	0.1	0.1	3
2003	10	21	6	21	37.04	121.5650	25.1693	0.81	0.41	8	0.9	129	0.07	0.3	0.7	2
2003	10	21	6	21	42.68	121.5700	25.1703	1	1.16	6	1.4	222	0.02	0.1	0.1	3
2003	10	21	6	21	37.04	121.5650	25.1693	0.81	0.41	8	0.9	129	0.07	0.3	0.7	2
2003	10	21	14	8	40.09	121.5462	25.1668	1.5	0.2	8	1	174	0.04	0.2	0.3	2

2003	10	24	2	8	50.15	121.5428	25.1735	1.27	1.07	8	1.4	159	0.03	0.2	0.2	2
2003	10	24	8	3	55.28	121.5462	25.1413	3.6	0.55	10	1.8	235	0.11	0.9	0.8	3
2003	10	24	8	16	8.44	121.5447	25.1498	4.54	0.47	8	1.8	193	0.1	1.7	0.7	3
2003	10	25	13	48	13.57	121.5733	25.1742	1.42	0.44	10	1.8	177	0.1	0.4	0.5	2
2003	10	25	15	4	35.52	121.5662	25.1718	1.05	0.37	8	1.7	140	0.07	0.3	0.5	2
2003	10	30	18	59	4.94	121.5672	25.1795	1.11	0.43	10	1.7	140	0.08	0.2	0.3	2
2003	10	30	18	59	12.24	121.5657	25.1762	0.97	0.05	12	1.4	129	0.08	0.1	0.4	2
2003	10	30	19	1	6.78	121.5673	25.1767	1.05	0.47	10	1.6	128	0.05	0.1	0.2	2
2003	10	30	19	1	37.04	121.5702	25.1765	0.56	0.92	8	1.8	166	0.03	0.1	0.5	2
2003	10	30	19	2	6.03	121.5678	25.1750	0.72	0.68	12	1.5	120	0.04	0	0.2	2
2003	10	30	19	2	35.4	121.5708	25.1735	0.8	0.79	10	1.6	149	0.05	0.1	0.4	2
2003	10	30	19	3	18.5	121.5705	25.1763	1.55	0.44	14	1.8	120	0.07	0.2	0.3	2
2003	10	30	19	3	24.25	121.5680	25.1753	0.74	0.42	12	1.5	121	0.04	0.1	0.3	2
2003	10	30	19	3	38.47	121.5688	25.1787	1.14	0.74	10	1.8	179	0.06	0.2	0.5	2
2003	10	30	19	3	58.72	121.5680	25.1748	0.67	0.25	12	1.5	120	0.03	0	0.2	2
2003	10	30	19	4	25.93	121.5688	25.1750	0.97	0.07	14	1.6	119	0.06	0.1	0.3	2
2003	10	30	19	3	53.84	121.5682	25.1742	0.95	0.39	14	1.4	117	0.04	0.1	0.2	2
2003	10	30	19	5	19.07	121.5678	25.1745	1.17	0.66	10	1.5	119	0.09	0.3	0.4	2
2003	10	30	19	5	54.05	121.5667	25.1738	0.71	1.04	12	1.3	118	0.04	0.1	0.2	2
2003	10	30	19	6	14.71	121.5660	25.1762	0.98	0.53	12	1.4	128	0.05	0.1	0.3	2
2003	10	30	19	6	27.41	121.5680	25.1747	0.62	0.42	12	1.5	119	0.08	0.2	0.7	2
2003	10	30	19	6	43.55	121.5710	25.1838	1.7	0.4	8	1.2	154	0.11	0.2	0.2	2
2003	10	30	19	7	6.39	121.5673	25.1820	0.97	0.18	10	1.6	152	0.06	0.2	0.4	2
2003	10	30	19	7	38.4	121.5658	25.1752	1.01	0.43	12	1.3	124	0.07	0.1	0.3	2
2003	10	30	19	8	27.5	121.5678	25.1745	0.99	0.56	12	1.4	118	0.05	0.1	0.3	2
2003	10	30	19	9	45.37	121.5670	25.1765	0.73	0.37	10	1.5	127	0.04	0.1	0.2	2
2003	10	30	19	10	28.73	121.5688	25.1853	1.11	0.02	8	1.3	168	0.07	0.3	0.3	2
2003	10	30	19	10	35.97	121.5680	25.1785	1.07	0.28	12	1.7	134	0.07	0.2	0.3	2
2003	10	30	19	10	41.78	121.5662	25.1758	1.23	0.04	8	1.4	142	0.07	0.3	0.4	2
2003	10	30	19	10	47.79	121.5673	25.1737	0.77	0.23	12	1.3	117	0.03	0.1	0.2	2
2003	10	30	19	11	0.62	121.5655	25.1792	1.05	0.26	10	1.7	141	0.2	0.5	0.7	3
2003	10	30	19	11	14.38	121.5662	25.1753	0.89	0.06	10	1.4	124	0.07	0.2	0.5	2
2003	10	30	19	11	25.76	121.5710	25.1712	0.32	0.08	8	1.6	173	0.1	0.3	2.4	3
2003	10	30	19	12	10.81	121.5670	25.1797	1.48	0.25	8	1.7	142	0.07	0.4	0.4	2
2003	10	30	19	12	32.05	121.5692	25.1790	1.05	0.16	12	1.6	134	0.04	0.1	0.2	2
2003	10	30	19	12	40.38	121.5713	25.1845	1.85	0.26	12	1.1	158	0.1	0.1	0.2	2
2003	10	30	19	12	54.11	121.5705	25.1832	1.67	0.17	10	1.2	152	0.11	0.3	0.4	2
2003	10	30	19	17	25.01	121.5688	25.1783	1.07	0.77	12	1.7	132	0.06	0.1	0.3	2

2003	10	30	19	20	47.52	121.5667	25.1853	1.09	0.37	10	1.5	172	0.11	0.4	0.5	2
2003	10	30	19	21	13.4	121.5735	25.1722	0.64	0.41	10	1.8	122	0.09	0.2	1.1	2
2003	10	30	19	22	48.97	121.5720	25.1808	1.18	0.04	8	1.3	135	0.04	0.2	0.2	2
2003	10	30	19	22	55.17	121.5658	25.1877	0.76	0.2	8	1.5	186	0.05	0.1	0.3	3
2003	10	30	19	24	40.08	121.5648	25.1842	0.82	0.37	12	1.7	168	0.07	0.2	0.6	2
2003	10	30	19	26	7.15	121.5675	25.1882	1.17	0.16	10	1.3	189	0.08	0.3	0.4	3
2003	10	30	19	26	57.4	121.5722	25.1778	1.23	0.21	10	1.5	120	0.06	0.1	0.2	2
2003	10	30	19	28	20.78	121.5673	25.1820	1.02	0.1	8	1.6	152	0.04	0.2	0.2	2
2003	10	30	19	28	30.41	121.5722	25.1783	1.53	0.38	10	1.5	122	0.07	0.1	0.1	2
2003	10	30	19	29	25.99	121.5715	25.1782	1.38	0.2	8	1.5	138	0.07	0.1	0.1	2
2003	10	30	19	29	31	121.5695	25.1795	0.87	0.09	8	1.5	135	0.07	0.1	0.3	2
2003	10	30	19	30	32.1	121.5685	25.1788	1.03	0.36	12	1.7	134	0.06	0.1	0.2	2
2003	10	30	19	30	51.28	121.5717	25.1768	1.63	0.04	10	1.6	118	0.14	0.5	0.7	2
2003	10	30	19	31	11.9	121.5727	25.1733	0.79	0.02	6	1.8	161	0.02	0.1	0.4	2
2003	10	30	19	31	36.54	121.5678	25.1743	1.06	0.02	10	1.4	118	0.04	0.1	0.2	2
2003	10	30	19	32	40.32	121.5687	25.1797	1.22	0.02	10	1.6	137	0.04	0.1	0.2	2
2003	10	30	19	32	53.85	121.5697	25.1803	1.25	0	10	1.5	139	0.04	0.1	0.2	2
2003	10	30	19	36	9.09	121.5653	25.1748	1.85	0.08	6	1.3	166	0.01	0	0	2
2003	10	30	19	36	11.84	121.5718	25.1798	1.66	0.09	10	1.4	130	0.1	0.3	0.3	2
2003	10	30	19	36	15.41	121.5705	25.1793	1.07	0.04	10	1.5	132	0.03	0.1	0.1	2
2003	10	30	19	36	48.15	121.5690	25.1740	1.15	0.2	12	1.5	114	0.07	0.1	0.2	2
2003	10	30	19	36	25.7	121.5705	25.1777	1.02	0.15	10	1.6	124	0.04	0.1	0.2	2
2003	10	30	19	36	25.67	121.5713	25.1787	1.19	0.08	10	1.5	126	0.04	0.1	0.2	2
2003	10	30	19	39	48.71	121.5668	25.1852	1.09	0.35	10	1.5	171	0.09	0.3	0.4	2
2003	10	30	19	40	25.05	121.5657	25.1760	1.05	0.12	8	1.4	186	0.06	0.3	0.3	3
2003	10	30	19	44	40.1	121.5715	25.1788	1	0.17	12	1.5	127	0.08	0.2	0.2	2
2003	10	30	19	43	46.96	121.5688	25.1862	1.17	0.03	8	1.2	174	0.08	0.3	0.3	2
2003	10	30	19	43	25.42	121.5680	25.1728	1.39	0.32	8	1.3	157	0.08	0.3	0.4	2
2003	10	30	19	48	20.7	121.5653	25.1750	0.93	0.04	10	1.3	125	0.05	0.1	0.3	2
2003	10	30	19	49	45.63	121.5568	25.1763	1.27	0.43	8	2.6	139	0.03	0.1	0.2	2
2003	10	30	19	49	55.2	121.5688	25.1782	1.12	0.4	12	1.7	131	0.06	0.2	0.3	2
2003	10	30	19	51	5.74	121.5762	25.1752	0.9	0.01	6	1.6	157	0.02	0.1	0.1	2
2003	10	30	19	51	25.1	121.5533	25.1693	1.01	0.13	6	0.4	194	0.02	0.4	0.2	3
2003	10	30	19	51	47.09	121.5728	25.1798	1.15	0.09	8	1.3	134	0.02	0.1	0.1	2
2003	10	30	19	56	53.71	121.5653	25.1827	1.11	0.17	6	1.7	160	0.05	0.2	0.3	2
2003	10	30	20	0	29.5	121.5717	25.1793	1.55	0.21	10	1.4	129	0.07	0	0	2
2003	10	30	20	0	42.26	121.5678	25.1827	1.01	0	8	1.5	155	0.04	0.2	0.2	2
2003	10	30	20	6	26.87	121.5733	25.1773	1.08	0.22	12	1.5	115	0.05	0.1	0.2	2

2003	10	30	20	7	1.18	121.5723	25.1798	1.01	0.15	10	1.3	129	0.03	0.1	0.1	2
2003	10	30	20	9	57.85	121.5713	25.1727	1.09	0.43	10	1.6	116	0.07	0.2	0.4	2
2003	10	30	20	9	57.85	121.5713	25.1727	1.09	0.54	10	1.6	116	0.07	0.2	0.4	2
2003	10	30	20	11	17.93	121.5697	25.1790	1.09	0.12	10	1.6	133	0.05	0.2	0.2	2
2003	10	30	20	9	19.17	121.5730	25.1907	1.29	0.14	4	0.8	352	0.12			3
2003	10	30	20	12	21.32	121.5645	25.2007	1.53	0.17	8	2.1	242	0.16	1.1	1.1	3
2003	10	30	20	13	10.11	121.5717	25.1790	1	0.05	10	1.4	127	0.08	0.3	0.4	2
2003	10	30	20	17	46.18	121.5527	25.1813	1.51	0.17	6	1.7	165	0.22	0.4	0.5	3
2003	10	30	20	16	15.15	121.5657	25.1755	1.33	0.05	12	1.4	126	0.05	0.1	0.2	2
2003	10	30	20	20	34.11	121.5682	25.1735	0.94	0.5	10	1.4	115	0.04	0.1	0.3	2
2003	10	30	20	18	38.72	121.5707	25.1828	1.27	0.37	8	1.2	150	0.14	0.6	0.8	2
2003	10	30	20	22	55.37	121.5662	25.1743	1.08	0.47	12	1.3	121	0.06	0.1	0.2	2
2003	10	30	20	33	31.2	121.5682	25.1860	0.96	0.08	8	1.3	175	0.06	0.1	0.2	2
2003	10	30	20	34	39.29	121.5712	25.1768	1.08	0.36	10	1.7	164	0.05	0.2	0.3	2
2003	10	30	20	35	23.28	121.5692	25.1775	1.15	0.19	12	1.7	127	0.07	0.2	0.3	2
2003	10	30	20	38	52.14	121.5535	25.1813	0.97	0.5	6	1.7	258	0.04	0.3	0.3	3
2003	10	30	20	38	42.83	121.5727	25.1807	1.58	0.04	10	1.2	131	0.08	0.2	0.2	2
2003	10	30	20	42	18.76	121.5720	25.1783	1.05	0.15	12	1.5	123	0.04	0.1	0.2	2
2003	10	30	20	43	37.27	121.5707	25.1817	1.14	0.03	8	1.3	143	0.04	0.2	0.2	2
2003	10	30	20	46	42.91	121.5717	25.1777	1.46	0.09	10	1.6	121	0.07	0.1	0.1	2
2003	10	30	20	51	7.7	121.5742	25.1822	1.35	0.07	8	1	133	0.03	0.2	0.2	2
2003	10	30	20	51	57.03	121.5730	25.1842	1.36	0.07	8	0.9	151	0.04	0.3	0.2	2
2003	10	30	20	52	18.84	121.5663	25.1737	0.99	0.11	10	1.3	118	0.07	0.2	0.5	2
2003	10	30	20	54	38.69	121.5680	25.1850	1.07	0.08	8	1.4	168	0.07	0.2	0.2	2
2003	10	30	20	56	16.69	121.5650	25.1737	1.05	0.24	12	1.2	120	0.06	0.2	0.3	2
2003	10	30	20	58	25.8	121.5728	25.1795	1.02	0.61	10	1.3	125	0.06	0.2	0.3	2
2003	10	30	21	3	14.32	121.5650	25.1730	0.36	0.37	8	2.4	118	0.05	0.1	1.2	2
2003	10	30	21	3	48.47	121.5627	25.1752	1.48	0.25	6	1.1	197	0.08	0.3	0.2	3
2003	10	30	21	3	58.77	121.5677	25.1772	1.27	0.06	10	1.6	129	0.06	0.2	0.3	2
2003	10	30	21	5	6.44	121.5727	25.1778	1.74	0.01	10	1.5	119	0.07	0.2	0.2	2
2003	10	30	21	3	14.28	121.5732	25.1703	0.91	0.06	6	1.7	184	0.03	0.3	0.7	3
2003	10	30	21	10	52.23	121.5582	25.1682	2.46	0.05	6	0.2	233	0.06	1	0.4	3
2003	10	30	21	13	16.95	121.5718	25.1798	1.09	0.02	12	1.4	130	0.06	0.2	0.2	2
2003	10	30	21	22	31.23	121.5688	25.1758	1.42	0.03	8	1.6	142	0.06	0.3	0.3	2
2003	10	30	21	31	51.61	121.5728	25.1793	1.15	0.01	8	1.3	168	0.04	0.2	0.2	2
2003	10	30	21	33	35.44	121.5715	25.1800	1.19	0.17	10	1.4	132	0.09	0.3	0.4	2
2003	10	30	21	44	21.36	121.5722	25.1792	1.12	0.06	10	1.4	126	0.08	0.3	0.4	2
2003	10	30	21	44	4.33	121.5680	25.1807	1.37	0.17	8	1.6	144	0.03	0.2	0.2	2

2003	10	30	21	45	18.06	121.5687	25.1780	1.22	0.5	12	1.7	131	0.05	0.1	0.2	2
2003	10	30	21	45	29.82	121.5722	25.1782	1.17	0.13	8	1.5	139	0.11	0.5	0.6	2
2003	10	30	21	52	36.5	121.5713	25.1907	1.31	0.11	8	1	206	0.03	0.2	0.2	3
2003	10	30	21	58	54.6	121.5688	25.1772	1.09	0.22	10	1.7	126	0.06	0.2	0.4	2
2003	10	30	22	10	17.7	121.5750	25.1803	1.21	0.24	8	1.1	161	0.09	0.3	0.4	2
2003	10	30	22	44	25.89	121.5640	25.1903	0.81	0.13	6	1.7	203	0.01	0.1	0.2	3
2003	10	30	23	1	23.26	121.5582	25.1682	2.36	0.16	6	0.2	233	0.07	1.1	0.5	3
2003	11	1	2	59	23.46	121.5835	25.2017	17.21	1.8	12	1.4	247	0.16	2.7	1	4
2003	11	1	21	42	28.13	121.5360	25.1623	1.59	0.7	8	1.1	122	0.04	0.2	0.3	2
2003	11	3	17	47	39.81	121.6377	25.2262	5.08	0.94	10	6	320	0.08	0.8	0.6	3
2003	11	4	4	19	53.59	121.5840	25.1880	1.77	1.15	12	0.3	183	0.1	0.3	0.4	3
2003	11	4	16	47	8.24	121.5490	25.1640	2.13	0.81	9	0.8	114	0.08	0.4	0.6	2
2003	11	4	19	18	54.31	121.5490	25.1745	0.53	2.26	14	1.2	132	0.22	0.4	1.9	2
2003	11	4	19	44	30.8	121.7192	25.2872	14.27	2.95	14	16.3	342	0.54	11.1	10.6	4
2003	11	6	5	27	41.65	121.5660	25.1758	1.04	2.15	12	1.4	167	0.22	0.7	0.9	3
2003	11	11	11	57	22.94	121.5665	25.1743	1.18	2.12	16	1.3	60	0.13	0.3	0.5	1
2003	11	11	23	13	14.91	121.5418	25.1690	1.07	2.2	11	1.5	98	0.11	0.3	0.5	2
2003	11	12	2	46	23.41	121.5798	25.1715	0.03	1.81	10	1.9	212	0.13	0.5	39.4	4
2003	11	12	2	54	21.37	121.6967	25.2077	11.8	3.08	16	9.1	340	0.4	5.4	3.3	4
2003	11	12	8	30	2.24	121.4102	25.4090	2.7	3.58	16	28.1	344	0.86	13.8	7.1	4
2003	11	14	10	15	11.75	121.5385	25.1617	1.86	1.11	10	1.3	114	0.07	0.3	0.3	2
2003	11	14	11	30	54.25	121.5458	25.1648	2.46	1.18	16	1.1	101	0.09	0.3	0.4	2
2003	11	14	11	31	36.7	121.5442	25.1678	2.88	1.51	15	1.3	89	0.09	0.3	0.4	1
2003	11	14	12	25	11.17	121.5410	25.1682	1.31	2.3	11	1.6	103	0.08	0.3	0.4	2
2003	11	14	22	7	45.59	121.5880	25.1748	0.59	2.53	14	1.7	109	0.08	0.1	0.7	2
2003	11	15	20	43	35.42	121.5395	25.1412	4.92	1.81	14	1.9	247	0.1	0.6	0.5	3
2003	11	15	21	16	52.27	121.5368	25.1418	4.67	2.2	12	1.7	252	0.07	0.5	0.4	3
2003	11	16	19	52	5.23	121.5678	25.1783	8.26	2.34	12	1.1	142	0.15	1.9	0.9	3
2003	11	17	14	42	6.3	121.5387	25.1630	0.91	2.36	10	1.4	108	0.09	0.2	0.6	2
2003	11	18	8	21	3.69	121.5872	25.1782	0.57	2.4	14	1.4	120	0.08	0.2	0.8	2
2003	11	19	22	27	19.79	121.5427	25.1620	1	2.15	12	1.5	115	0.07	0.2	0.4	2
2003	11	20	15	51	6.71	121.5413	25.1635	2.04	2.21	15	1.6	107	0.11	0.3	0.4	2
2003	11	20	16	11	55.93	121.5377	25.1633	1.56	2.33	12	1.3	114	0.07	0.2	0.3	2
2003	11	21	0	10	21.5	121.5522	25.1555	5.16	2	11	1.3	139	0.17	1	0.9	3
2003	11	21	3	57	34.27	121.5387	25.1417	4.8	2.48	15	1.8	247	0.09	0.5	0.4	3
2003	11	23	17	29	34.56	121.5697	25.1752	1.02	2.29	16	1.4	68	0.16	0.3	0.6	2
2003	11	28	2	15	25.47	121.5717	25.1720	1.19	0.75	8	1.6	174	0.06	0.3	0.4	2
2003	11	28	18	21	8.89	121.5432	25.1577	2.63	0.91	6	1.6	154	0.02	0.3	0.3	2

2003	11	29	4	34	23.76	121.5503	25.1748	1.34	1.97	10	1.1	178	0.05	0.2	0.3	2
2003	12	1	1	35	30.47	121.5742	25.1705	0.96	0.66	8	1.8	188	0.03	0.1	0.4	3
2003	12	1	6	48	44.16	121.5537	25.1607	1.43	1.54	10	0.7	120	0.09	0.4	0.4	2
2003	12	1	10	1	12.64	121.5775	25.1685	1	1.38	4	2.1	302	0.02			3
2003	12	5	20	30	9.64	121.5658	25.1698	0.95	1.46	14	1	100	0.07	0.1	0.3	2
2003	12	6	0	20	0.49	121.5960	25.1555	17.06	1.9	6	0.2	188	3.87	0.8	0.1	4
2003	12	6	3	48	0.39	121.5147	25.1120	1.97	1.7	8	6.2	330	0.24	28.4	55.6	4
2003	12	6	4	13	35.67	121.6007	25.2033	2.7	1.36	8	3.1	284	1.54	21.3	16.1	4
2003	12	6	5	14	20.55	121.5703	25.1752	1	1.29	10	1.5	100	0.06	0.2	0.4	2
2003	12	6	10	39	56.1	121.5688	25.1682	1.23	1.62	4	1.3	280	0.03			3
2003	12	7	9	23	23.07	121.5148	25.0465	10.2	1.68	8	12.1	332	0.09	3.2	4.5	4
2003	12	7	16	25	52.23	121.5353	25.1608	3.02	1.92	6	1	204	0.29	4.5	2.8	4
2003	12	7	19	45	27.12	121.5717	25.1720	1.07	1.62	8	1.6	174	0.04	0.2	0.2	2
2003	12	8	3	1	25.29	121.6008	25.1702	0.93	1.61	10	1.4	144	0.08	0.2	0.7	2
2003	12	14	18	36	12.28	121.5725	25.1702	0.9	1.11	6	1.7	182	0.04	0.3	0.7	3
2003	12	15	3	52	11.97	121.5523	25.1897	0.97	1.47	6	2.6	281	0.11	1.6	3.3	3
2003	12	15	13	39	21.71	121.5473	25.1783	1.75	1.36	8	1.6	213	0.12	0.7	0.8	3
2003	12	16	4	14	20.71	121.5598	25.1498	5.28	1.47	11	0.3	150	0.1	0.9	0.6	2
2003	12	16	16	2	48.38	121.5347	25.1647	2.21	0.76	6	1.3	231	0	0	0	3
2003	12	16	23	17	11.14	121.5637	25.1560	3.45	1.13	7	0.9	126	0.35	3.5	2.7	3
2003	12	17	0	47	6.18	121.5690	25.1703	1.17	1.07	10	1.3	138	0.09	0.3	0.5	2
2003	12	17	5	44	15.29	121.5715	25.1720	0.89	1.2	10	1.6	138	0.05	0.2	0.5	2
2003	12	19	5	48	3.32	121.5147	25.1143	14.82	1.71	11	4.7	315	0.12	2.7	1.1	4
2003	12	24	17	16	25.29	121.5347	25.1602	4.37	1.61	12	0.9	184	0.08	0.7	0.4	3
2003	12	24	17	26	10.58	121.5377	25.1550	5.29	1.47	8	1	164	0.09	1.2	0.6	3
2003	12	24	19	39	53.83	121.5722	25.1710	0.93	1.44	6	1.7	178	0.02	0.1	0.3	2
2003	12	26	15	6	3.95	121.5500	25.1775	1.36	1.53	12	1.4	206	0.09	0.3	0.4	3
2003	12	28	0	40	23.17	121.5495	25.1498	2.58	1.5	8	1.3	187	0.11	0.7	0.6	3
2003	12	29	14	47	46.43	121.5375	25.1695	2.21	1.41	9	1.9	212	0.1	0.6	0.7	3
2003	12	29	18	14	3.7	121.5487	25.1682	3.52	1.51	12	0.8	179	0.08	0.4	0.4	2
2003	12	31	10	27	42.58	121.6165	25.1728	7.73	1.81	12	0.6	268	0.19	1.9	1.1	3
2004	1	1	21	6	8.61	121.6825	25.1182	6.67	2.87	12	9.6	332	1.13	13.7	16.9	4
2004	1	2	1	32	0.27	121.5477	25.1657	1.73	1.84	12	0.9	172	0.2	0.8	1	3
2004	1	3	15	56	21.7	121.6383	25.1372	7	2.27	10	4.8	310	0.08	0.9	0.4	3
2004	1	3	15	57	1.74	121.5568	25.1568	5.79	2.58	12	1.1	115	0.39	2.9	1.9	3
2004	1	4	11	59	57.67	121.5422	25.1580	2.35	1.61	6	1.5	159	0.02	0.2	0.2	2
2004	1	4	13	13	36.65	121.5375	25.1687	1.6	1.56	6	1.8	244	0.02	0.2	0.2	3
2004	1	4	18	6	33	121.5713	25.1725	0.64	2.07	12	1.6	141	0.11	0.3	1.2	2

2004	1	5	7	43	23.66	121.5637	25.1707	3.21	0.91	12	0.9	156	0.38	1.5	1.7	3
2004	1	5	7	43	29.96	121.5073	25.1267	0.34	1.45	8	3.8	322	2.95	19.3	181	4
2004	1	5	23	33	44.82	121.6395	25.2345	3.7	2.14	10	6.9	334	0.06	0.6	1.1	3
2004	1	6	5	9	28.45	121.5747	25.1698	2.1	2.28	10	1.9	117	0.25	0.3	0.5	2
2004	1	8	17	48	16.14	121.5690	25.1878	1.86	2.36	13	1.2	186	0.06	0.2	0.2	3
2004	1	8	19	32	49.99	121.6870	25.1203	9.28	2.46	12	9.8	334	0.36	5.8	5.3	4
2004	1	9	17	34	6.17	121.5542	25.1612	3.31	0.18	14	0.6	104	0.13	0.6	0.5	2
2004	1	9	17	34	9.65	121.5542	25.1633	3.61	2.12	13	0.4	96	0.12	0.6	0.6	2
2004	1	10	4	30	55.4	121.5295	25.1568	9.06	2.74	8	0.2	142	0.57	13.6	5.1	4
2004	1	10	22	32	32.32	121.5637	24.8908	6.44	2.49	14	28.5	344	0.1	33.7	69.7	4
2004	1	11	5	24	4.3	121.4078	24.9435	7.49	2.45	14	26.4	346	0.46	9.4	202	4
2004	1	11	15	29	7.15	121.5890	25.1840	1.15	2.33	13	1	164	0.13	0.4	0.5	2
2004	1	12	16	48	3.05	121.5405	25.1737	1.65	1.13	8	1.2	106	0.1	0.5	0.6	2
2004	1	12	16	47	58.4	121.5400	25.1682	1.21	0.16	8	1.6	124	0.09	0.4	0.6	2
2004	1	15	2	16	22.82	121.5678	25.1763	2.08	1.65	15	1.2	70	0.08	0.2	0.3	1
2004	1	15	13	7	21.79	121.6117	25.1425	2.21	2.23	14	2.2	276	0.16	0.8	1.3	3
2004	1	15	18	31	17.71	121.5730	25.1703	0.74	2.02	10	1.7	183	0.06	0.2	0.6	3
2004	1	21	9	0	36.69	121.5578	25.1495	3.95	0.69	16	0.4	173	0.37	1.5	1.5	3
2004	1	21	9	0	51.45	121.5177	25.1445	3.83	0.62	8	1.6	294	0.13	1.3	1	3
2004	1	22	21	28	35.26	121.5227	25.1618	8.66	2.38	14	0.9	237	0.33	3.2	1.6	4
2004	1	23	3	6	38.44	121.5690	25.1715	1.03	2.33	11	1.4	96	0.06	0.2	0.3	2
2004	1	25	6	48	43.59	121.5442	25.1722	1.16	2.25	9	1.4	103	0.04	0.2	0.3	2
2004	1	26	0	51	35.15	121.6005	25.1745	3.67	2.35	14	1.2	127	0.33	1.8	1.5	3
2004	1	26	16	29	36.63	121.5960	25.1555	7.43	1.85	7	0.2	188	2.16	4.3	2.1	4
2004	1	27	17	26	51.1	121.5437	25.1742	1.29	2.17	10	1.4	114	0.06	0.2	0.3	2
2004	1	27	21	17	38.86	121.6243	25.1693	2.05	2.41	11	1.5	304	0.85	3.8	6.6	4
2004	1	29	1	9	45.88	121.6107	25.1450	5.6	2.29	14	1.9	272	0.3	2.1	1.4	4
2004	1	29	4	42	59.9	121.5690	25.1742	1.86	2.45	14	1.5	63	0.08	0.2	0.3	1
2004	1	29	6	39	21.06	121.5660	25.1622	3.48	2.61	12	1.1	130	0.14	0.7	0.8	2
2004	1	29	23	57	50.4	121.5355	25.1640	2.96	2.29	15	1.2	129	0.06	0.3	0.2	2
2004	1	30	22	36	54	121.5438	25.1688	1.13	2.33	16	1.3	89	0.05	0.1	0.2	1
2004	2	1	2	26	58.06	121.5867	25.1767	1.21	1.79	11	1.5	112	0.09	0.2	0.4	2
2004	2	1	4	57	1.02	121.6475	25.1682	4.62	1.59	9	3.7	328	0.33	5.4	3	4
2004	2	1	7	54	14.26	122.0790	25.1653	1.5	0.52	4	48.9	360				4
2004	2	1	15	26	45.6	121.5672	25.1740	1.13	1.21	16	1.4	61	0.09	0.2	0.3	1
2004	2	1	20	15	35.47	121.5637	25.0960	11.21	2.28	14	5.8	303	0.68	8.6	6.6	4
2004	2	2	5	26	50.73	121.5250	25.0752	2.32	2.34	8	8.9	323	0.45	5.5	4.2	4
2004	2	2	18	35	12.67	121.5803	25.1405	2.1	1.09	6	2.1	243	0.54	1.3	1.7	4

2004	2	3	2	50	45.13	121.5330	25.1625	2.15	0.66	6	2	237	0.02	0.5	0.4	3
2004	2	3	8	45	12.64	121.5960	25.1793	6.02	1.44	6	2.8	295	0.31	20	10.8	4
2004	2	4	7	9	13.83	121.5597	25.1592	7.18	0.87	12	0.9	141	0.23	1.7	1.4	3
2004	2	6	7	39	39.24	121.5825	25.1907	3.31	0.39	6	0.2	324	0.07	0.9	0	3
2004	2	6	11	52	43.71	121.5960	25.1555	22.39	2.42	6	0.2	188	6.15	15.1	1.6	4
2004	2	8	1	3	53.85	121.4428	25.1642	6.51	1.97	6	9.1	340	0.8	75.6	89.4	4
2004	2	10	17	54	42.98	121.5478	25.1790	1.01	0.98	10	1.6	154	0.08	0.2	0.4	2
2004	2	11	15	47	40.87	122.0537	24.6568	1.5	2.53	14	72	354	0.35		983	4
2004	2	12	7	5	47.09	121.5827	25.1498	10.22	1.66	10	1.3	196	0.44	6.1	3	4
2004	2	14	7	45	54.14	121.2812	24.9808	1.5	2.24	6	33.9	358	2.7			4
2004	2	15	21	10	0.9	121.6247	25.1557	6.85	1.79	11	2.7	290	0.11	1	0.7	3
2004	2	15	22	19	4.62	121.5732	25.1700	0.55	1.43	6	1.7	184	0.06	0.4	1.6	3
2004	2	16	7	29	34.74	121.6922	25.1555	6.26	1.98	8	8.4	340	0.68	18.6	17.1	4
2004	2	16	18	56	10.4	121.6323	25.1235	7.32	2.04	12	6.3	307	0.4	4.1	3.8	4
2004	2	16	19	8	36.23	121.6297	25.1500	5.07	1.87	13	3.5	298	0.15	1	0.8	3
2004	2	16	21	27	57.6	121.5637	25.1498	5.4	1.7	14	0.2	141	0.09	0.5	0.4	2
2004	2	17	8	14	47.64	121.5335	25.1568	3.96	1.3	10	0.6	144	0.08	0.5	0.4	2
2004	2	18	20	23	4.07	121.7270	24.4187	5.32	2.64	10	82.5	354	0.24			4
2004	2	19	8	12	38.23	121.5960	25.1555	7.7	2.31	6	0.2	188	3.74	7.8	2.4	4
2004	2	19	23	28	20.14	121.5543	25.1730	1.72	1.89	12	0.8	126	0.13	0.4	0.6	2
2004	2	20	21	11	17.59	121.5412	25.1710	1	1.83	6	1.5	178	0.02	0.3	0.2	2
2004	2	22	16	8	4.08	121.5783	25.1775	2.85	1.53	14	1.3	97	0.08	0.3	0.3	2
2004	2	22	16	11	35.1	121.5732	25.1708	0.71	1.72	6	1.7	183	0.04	0.3	0.7	3
2004	2	22	18	45	45.1	121.5733	25.1697	0.42	1.35	6	1.7	186	0.07	0.5	2.6	3
2004	2	22	22	49	56.31	121.5718	25.1718	0.97	1.3	6	1.7	175	0.03	0.2	0.4	2
2004	2	23	10	38	58.29	121.5582	25.1908	1.78	1.77	8	0.6	272	0.28	2.3	1.6	3
2004	2	23	11	57	50.11	121.5712	25.1718	0.91	1.66	10	1.6	103	0.07	0.2	0.6	2
2004	2	23	21	29	4.95	121.5682	25.1743	1.06	1.61	14	1.5	92	0.08	0.2	0.4	2
2004	2	24	0	37	23.52	121.5825	25.1795	2.58	1.97	14	1.1	104	0.08	0.3	0.4	2
2004	2	24	1	15	59.53	121.5825	25.1795	3.03	1.86	14	1.1	104	0.07	0.3	0.3	2
2004	2	24	9	14	18.55	121.5688	25.1805	2.22	2.21	12	0.9	98	0.07	0.3	0.3	2
2004	2	26	6	29	1.11	121.5717	25.1825	1.75	1.92	12	1.1	118	0.1	0.3	0.4	2
2004	2	27	20	15	11.54	122.2497	25.1555	1.5	2.62	12	64.3	357	1.55			4
2004	2	28	0	51	39.38	121.5330	25.9062	1.5	2.64	10	79.8	356	2.34	160	14.4	4
2004	2	28	11	19	16.16	121.6227	25.3193	3.25	2.2	10	15.8	333	0.63	6	74.2	4
2004	2	28	16	19	40.8	121.5403	25.1697	2.02	1.77	12	1.5	106	0.07	0.2	0.3	2
2004	2	29	2	29	32.86	121.5960	25.1555	12.3	2.09	6	0.2	188	1.84	93.6	16.2	4
2004	2	29	13	34	4.26	121.5960	25.1027	10.47	2.08	8	5.7	315	0.25	5.5	3.7	4

2004	2	3	15	53	22.41	121.5637	25.1830	1.63	1.76	8	3.9	228	0.2	1.2	2.6	3
2004	3	1	2	37	43.39	121.5672	25.1728	1.02	0.84	14	1.3	63	0.07	0.2	0.3	1
2004	3	1	4	20	10.3	121.5680	25.1728	1.24	1.23	12	1.3	100	0.07	0.2	0.3	2
2004	3	1	14	46	11.54	121.5403	25.1880	2.72	0.32	8	2.2	295	0.07	0.7	0.5	3
2004	3	1	17	5	38.76	121.6618	25.1443	7.67	1.59	12	6.2	326	0.79	8.7	7.6	4
2004	3	2	0	14	22.2	121.7395	25.1555	5.8	1.56	14	13	347	0.47	7.4	12.2	4
2004	3	3	11	39	28.49	121.5635	25.1708	2.17	0.77	10	0.9	142	0.1	0.2	0.2	2
2004	3	3	14	8	27.35	121.5670	25.1730	1.07	0.92	14	1.3	63	0.08	0.2	0.3	1
2004	3	3	16	52	49.55	121.5657	25.1718	1.17	1.81	15	1.1	63	0.07	0.2	0.2	1
2004	3	3	16	52	49.55	121.5657	25.1718	1.17	1.07	15	1.1	63	0.07	0.2	0.2	1
2004	3	3	17	30	0.82	121.5582	25.1918	20.84	1.09	10	0.7	212	0.17	6.4	1.2	4
2004	3	3	17	54	30.52	121.5637	25.1742	20.58	0.73	8	1.1	137	0.27	16	2.3	4
2004	3	3	17	56	3.03	121.5732	25.1682	0.31	0.71	10	1.7	189	0.15	0.4	3.3	3
2004	3	3	22	48	37.37	121.5630	25.1717	1.19	0.34	6	0.9	185	0.02	0.4	0.2	3
2004	3	3	22	48	40.35	121.5415	25.1685	1.6	0.27	6	1.5	269	0.1	0.8	0.6	3
2004	3	3	22	48	44.86	121.5118	25.1563	1.91	1.11	8	4.6	317	0.32	2.7	1.8	4
2004	3	3	23	39	49.77	121.5700	25.1710	1.05	0.03	6	1.4	222	0.02	0.4	0.3	3
2004	3	4	0	21	31.44	121.5680	25.1732	1.15	0.38	12	1.4	92	0.09	0.2	0.5	2
2004	3	4	4	33	50.92	121.4978	25.2522	6.13	1.02	8	9.8	339	0.29	6.2	10.3	4
2004	3	4	11	15	23.71	121.5667	25.1725	1.04	0.61	14	1.2	63	0.07	0.2	0.3	1
2004	3	4	11	15	9.14	121.5860	25.1860	0.36	0.44	6	0.6	292	0.13	0.9	1.5	3
2004	3	4	11	15	11.36	121.5602	25.1758	1.16	0.53	6	1.1	171	0.11	1.3	0.9	3
2004	3	4	11	15	13.37	121.5775	25.1682	2.76	0.02	6	2.1	257	0.2	0.6	0.4	3
2004	3	4	13	19	42.92	121.4992	25.1787	11.3	0.71	5	5.9	324	0.22	41.9	24.3	4
2004	3	4	14	58	42.66	121.5473	25.1662	1.34	0.36	10	0.9	95	0.08	0.2	0.4	2
2004	3	4	19	23	37.64	121.5503	25.1757	2.18	0.46	6	1.2	246	0.13	3.4	1.6	4
2004	3	4	21	50	37.07	121.5662	25.1737	1.07	0.57	12	1.3	87	0.08	0.2	0.3	1
2004	3	4	22	49	30.26	121.6780	25.2008	7.62	1.09	14	7.1	336	0.14	1.5	1.1	3
2004	3	5	7	5	19.05	121.5647	25.1707	1.15	0.55	10	1	131	0.04	0.1	0.2	2
2004	3	5	13	40	0.22	121.5695	25.1725	0.98	0.17	8	1.5	164	0.04	0.2	0.4	2
2004	3	6	3	23	53.83	121.5777	25.1757	2.01	1.78	14	1.5	75	0.06	0.2	0.2	1
2004	3	6	7	15	16.34	121.5778	25.1755	1.83	1.38	15	1.5	75	0.06	0.2	0.2	1
2004	3	6	7	15	38.88	121.5730	25.1853	2.39	0.59	8	0.9	156	0.05	0.4	0.3	2
2004	3	6	7	15	13.02	121.5825	25.1747	1.4	0.13	6	1.6	257	0.06	0.8	0.7	3
2004	3	9	11	59	34.08	121.5450	25.1775	1.38	0.83	7	1.4	136	0.06	0.4	0.5	2
2004	3	10	7	54	16.86	121.5800	25.1440	1.03	0.34	6	1.8	231	0.09	1.4	0.7	3
2004	3	12	1	46	3.03	121.5347	25.1638	2.54	0.56	6	1.2	134	0.02	0.2	0.2	2
2004	3	12	5	3	18.75	121.5357	25.1642	2.49	0.26	6	1.3	137	0.04	0.4	0.4	2

2004	3	12	5	5	8.86	121.5452	25.1692	2.84	0.44	8	1.9	156	0.08	0.5	0.6	2
2004	3	12	12	4	54.51	121.5407	25.1797	1.68	0.21	5	1	154	0.02	0.3	0.2	3
2004	3	12	17	49	52.71	121.5363	25.1660	2.59	0.58	6	1.5	144	0.03	0.3	0.3	2
2004	3	13	20	4	50.03	121.6893	25.2400	6.42	1.07	12	10.4	337	0.1	1.2	1.9	3
2004	3	15	21	22	34.38	121.5488	25.1742	1.75	0.64	11	1.2	137	0.09	0.3	0.5	2
2004	3	22	15	57	23.73	121.5742	25.1698	1	1.76	8	1.8	189	0.04	0.2	0.5	3
2004	3	23	3	36	42.55	121.5453	25.1733	1.24	0.25	6	1.4	176	0.02	0.2	0.2	2
2004	3	23	19	20	2.18	121.5410	25.1685	1.04	0.96	10	1.6	103	0.09	0.3	0.5	2
2004	3	24	3	38	35.2	122.3618	25.1788	1.5	2.57	16	75.6	357	0.59	36.2	2.5	4
2004	3	24	12	30	12.65	121.5960	25.1555	7.48	2.12	8	0.2	188	2.33	2.7	1.2	4
2004	3	24	22	40	15.65	122.4708	25.0855	1.5	2.55	16	87.2	357	0.26	655	586	4
2004	3	25	16	44	5.18	121.5665	25.1728	1.01	0.32	12	1.2	88	0.07	0.2	0.3	1
2004	3	27	5	44	13.77	121.5742	25.1710	0.78	0.35	8	1.8	187	0.04	0.2	0.5	3
2004	3	27	17	53	56.38	121.5305	25.1583	1.84	0.48	8	0.4	143	0.04	0.2	0.3	2
2004	3	27	17	54	42.96	121.5320	25.1598	2.19	0.7	8	0.7	139	0.03	0.2	0.2	2
2004	3	27	19	40	6.15	121.6002	25.2050	4.62	0.81	6	4.4	337	0.02	0.5	0.4	3
2004	3	27	19	40	28.87	121.5825	25.1907	1.53	0.4	10	0.2	218	0.12	0.8	0.5	3
2004	3	28	16	48	14.64	121.5428	25.1728	1.06	0.62	10	1.5	105	0.07	0.2	0.4	2
2004	3	29	8	25	26.59	121.5423	25.1838	1.2	0.27	7	1.2	189	0.22	1.4	1.2	3
2004	3	29	15	7	40.55	121.5630	25.1737	1.18	0.24	6	1	223	0.04	0.4	0.3	3
2004	3	29	21	26	37.92	121.5663	25.1720	1.32	0.13	12	1.2	106	0.07	0.2	0.3	2
2004	3	29	21	26	39.73	121.5728	25.1725	1.47	0.11	12	1.8	178	0.08	0.2	0.3	2
2004	3	29	21	26	44.31	121.5825	25.1668	0.5	0.2	6	2.5	273	0.12	1.4	7.1	4
2004	3	29	21	26	47.22	121.5638	25.1770	1.56	0.03	6	1.1	160	0.17	1.8	1.4	3
2004	3	30	3	0	13.65	121.5673	25.1740	1.04	1.38	16	1.4	61	0.06	0.1	0.2	1
2004	3	30	21	2	10.6	121.6493	25.1062	2.38	1.83	15	7.7	319	0.51	3.2	1.9	4
2004	3	31	16	44	38.23	121.5735	25.1723	1.16	0.06	10	1.8	181	0.04	0.2	0.2	3
2004	4	1	5	39	39.35	121.5442	25.1730	1.02	0.44	6	1.4	184	0.02	0.2	0.2	3
2004	4	2	17	50	37.05	121.5455	25.1682	1.1	1.32	14	1.1	88	0.1	0.2	0.4	1
2004	4	2	21	1	29.64	121.5588	25.1475	5.75	1.01	14	0.3	206	0.12	0.7	0.6	3
2004	4	3	14	30	17.05	121.5448	25.1748	1.42	0.92	10	1.5	118	0.08	0.2	0.3	2
2004	4	3	14	30	27.56	121.5478	25.1765	1.16	1.07	16	1.4	126	0.09	0.2	0.3	2
2004	4	6	19	39	7.72	121.5385	25.1655	1.39	0.4	10	1.6	114	0.1	0.3	0.5	2
2004	4	6	19	39	7.74	121.5377	25.1647	1.23	0.43	10	1.5	117	0.08	0.3	0.5	2
2004	4	7	13	24	13.81	121.5442	25.1695	1.53	0.48	10	1.3	121	0.06	0.2	0.3	2
2004	4	7	13	46	54.33	121.5448	25.1712	1.21	0.54	12	1.3	98	0.11	0.3	0.5	2
2004	4	7	14	8	53.94	121.5447	25.1728	2.12	0.81	12	1.4	106	0.14	0.5	0.6	2
2004	4	7	15	48	25.94	121.5342	25.1772	8.31	0.37	8	0.5	131	0.07	1.4	0.5	2

2004	4	9	17	0	38.76	121.5390	25.1638	2.1	0.16	8	1.5	108	0.03	0.1	0.2	2
2004	4	10	1	22	34.72	121.5405	25.1655	1.87	0.14	6	1.7	160	0.04	0.3	0.4	2
2004	4	11	1	7	13.74	121.5528	25.1612	1.14	0.29	6	1.7	206	0.06	2.1	1.8	3
2004	4	12	11	47	23.39	121.6443	25.2298	1.98	0.8	14	6.7	324	0.2	1.9	2.8	3
2004	4	14	15	3	42.16	121.5428	25.1632	1.94	0.37	12	1.4	109	0.13	0.4	0.6	2
2004	4	17	13	26	53.64	121.5520	25.1712	1.06	0.42	10	0.7	139	0.06	0.2	0.3	2
2004	4	20	4	34	34.08	121.5407	25.1685	0.93	0.11	10	1.6	104	0.08	0.2	0.6	2
2004	4	21	10	24	18.89	121.5330	25.1638	2.26	0.69	14	1.1	146	0.11	0.4	0.5	2
2004	4	22	17	48	13.26	121.5797	25.1677	1.55	0.08	6	2.1	227	0.19	0.1	0.2	3
2004	4	22	17	55	59.19	121.5802	25.1682	1.57	0.21	6	2.1	224	0.18	0.1	0.2	3
2004	4	22	18	0	2.47	121.5795	25.1675	1.59	0.19	6	2.1	228	0.18	0.2	0.2	3
2004	4	22	18	6	27.52	121.5800	25.1680	1.56	0.16	6	2.1	225	0.18	0.1	0.2	3
2004	4	22	18	26	15.65	121.5803	25.1683	1.59	0.2	6	2.1	223	0.18	0.1	0.2	3
2004	4	22	18	51	38.95	121.6147	25.1575	1.16	0.03	6	2.1	265	0.07	0.6	0.6	3
2004	4	22	18	56	34.3	121.5800	25.1683	1.58	0.24	6	2.2	224	0.18	0.2	0.2	3
2004	4	23	22	43	39.89	121.5780	25.1858	2.14	0.45	6	0.4	244	0.02	0.2	0.2	3
2004	4	24	2	11	55.49	121.5960	24.4730	1.5	2.46	6	75.4	358	0.09			4
2004	4	27	10	8	18.54	121.5960	24.5093	1.5	2.78	6	71.4	358	2.67			4
2004	4	28	21	31	21.85	121.5707	25.1777	1.38	0.61	6	1.6	261	0.07	0.7	0.7	3
2004	4	30	16	4	23.76	121.6330	25.1822	5.52	1.12	6	5	313	0.1	907	895	4
2004	5	2	4	25	7.58	121.5710	25.1613	3.65	0.84	5	2.5	268	0.01	0.2	0.2	3
2004	5	3	2	33	23.02	121.6102	25.1555	0.41	0.27	4	1.6	258	0.12			3
2004	5	3	8	0	44.49	121.5692	25.1795	1.57	0.33	6	1.6	270	0.01	0.1	0.1	3
2004	5	4	14	3	31.7	121.5960	25.1555	7.97	1.41	8	0.2	188	2.26	5.4	2.3	4
2004	5	4	21	12	20.42	121.5417	25.1748	1.22	0.44	7	1.2	157	0.05	0.1	0.2	2
2004	5	5	14	37	55.5	121.5658	25.1710	1.02	0.29	6	1.1	201	0.01	0.2	0.2	3
2004	5	5	15	48	54	121.5690	25.1732	1.21	0.09	12	1.5	64	0.08	0.2	0.4	1
2004	5	5	20	3	11.23	121.5665	25.1732	1.01	0.2	13	1.3	62	0.07	0.2	0.3	1
2004	5	6	0	56	46.75	121.5678	25.1710	1.02	0.89	16	1.2	68	0.08	0.1	0.2	1
2004	5	6	14	7	23.33	121.5443	25.1720	1.13	0.06	8	1.4	161	0.02	0.1	0.1	2
2004	5	7	10	16	40.2	121.5667	25.1727	1.38	0.97	12	1.2	88	0.06	0.1	0.1	1
2004	5	7	19	4	46.21	121.5447	25.1703	1.02	0.73	7	1.3	166	0.02	0.1	0.1	2
2004	5	9	10	5	58.53	121.5647	25.1697	1.06	1.51	12	0.9	66	0.07	0.2	0.2	1
2004	5	9	19	13	46.36	121.5327	25.1600	2.57	0.62	10	0.7	134	0.08	0.4	0.4	2
2004	5	9	19	13	57.16	121.5320	25.1607	2.75	0.57	10	0.7	143	0.06	0.4	0.3	2
2004	5	10	14	4	42.56	121.5848	25.1063	5.55	0.86	6	5.2	307	0.09	1.9	2.3	3
2004	5	11	22	40	41.37	121.5477	25.1700	1.76	0.18	6	1	193	0.08	0.2	0.2	3
2004	5	12	8	57	53.83	121.5723	25.1780	2.96	0.7	14	1.4	83	0.09	0.2	0.3	1

2004	5	12	9	4	6.01	121.5745	25.1805	2.2	0.1	15	1.1	97	0.08	0.3	0.3	2
2004	5	12	9	21	3.67	121.5730	25.1795	2.42	0.12	9	1.3	129	0.06	0.3	0.4	2
2004	5	13	8	48	13.28	121.5675	25.1720	1.05	0.32	12	1.3	91	0.05	0.1	0.2	2
2004	5	13	8	48	26.3	121.5820	25.1728	1.19	0.15	12	1.8	85	0.23	0.4	1	2
2004	5	15	18	30	36.16	121.5648	25.1725	1.67	0.61	14	1.1	65	0.07	0.2	0.3	1
2004	5	15	21	14	25.9	121.5743	25.1703	0.47	0.12	8	1.9	190	0.04	0.2	1	3
2004	5	16	7	55	16.26	121.5810	25.1755	2.16	0.63	12	1.5	87	0.05	0.2	0.3	1
2004	5	16	14	28	13.09	121.5825	25.1757	2.96	0.6	12	1.5	93	0.07	0.2	0.3	2
2004	5	16	14	28	18.54	121.5637	25.1947	9.92	0.37	7	0.9	281	0.13	2.5	1.3	3
2004	5	17	13	13	49.53	121.5637	25.0345	6.5	1.26	4	12.6	358	0.2			3
2004	5	18	17	6	49	121.5460	25.1725	1.74	0.57	15	1.3	105	0.07	0.2	0.3	2
2004	5	19	1	9	30.48	121.5475	25.1738	1.46	0.31	13	1.2	111	0.09	0.3	0.3	2
2004	5	19	5	28	2.81	121.6853	25.1932	12.41	0.77	8	7.6	337	0.08	1.6	1.1	3
2004	5	19	6	33	16.89	121.5475	25.1685	1.47	0.1	10	0.9	87	0.1	0.4	0.5	1
2004	5	19	9	37	23.89	121.5433	25.1695	1.22	0.71	16	1.4	91	0.09	0.2	0.3	2
2004	5	19	9	44	16.01	121.5448	25.1710	1.82	0.82	14	1.3	97	0.09	0.3	0.4	2
2004	5	19	11	12	47.14	121.5960	25.1555	32.83	1.32	8	0.2	188	0.41	24.6	3	4
2004	5	20	13	38	10.86	121.5840	25.1420	0.89	0.33	4	2.3	251	0.08			3
2004	5	20	14	41	40.76	121.5435	25.1543	2.99	0.73	14	1.6	163	0.07	0.3	0.2	2
2004	5	20	17	35	2.14	121.5452	25.1563	2.91	0.58	14	1.6	147	0.08	0.3	0.3	2
2004	5	20	18	10	44.6	121.5455	25.1540	3.29	0.49	13	1.8	162	0.07	0.3	0.3	2
2004	5	21	5	29	14.25	121.5733	25.1705	0.93	0.4	8	1.7	184	0.03	0.1	0.4	3
2004	5	21	9	13	6.86	121.5960	25.1555	12.44	1.58	5	0.2	188	1.84	8.5	1.3	4
2004	5	21	11	21	39.25	121.5722	25.1682	0.76	0.22	8	1.6	184	0.03	0.2	0.6	3
2004	5	21	11	40	24.12	121.5768	25.1718	2.5	0.67	12	2	71	0.06	0.2	0.3	1
2004	5	22	21	15	19.29	121.5440	25.1757	1.04	0	7	1.4	123	0.04	0.2	0.4	2
2004	5	23	3	17	6.39	121.5678	25.1728	1.28	0.24	12	1.3	64	0.06	0.2	0.3	1
2004	5	23	22	18	1.29	121.5680	25.1497	4.82	0.36	13	0.6	174	0.08	0.5	0.3	2
2004	5	24	3	39	53.34	121.5717	25.1712	0.57	0.4	9	1.6	79	0.05	0.2	0.9	1
2004	5	25	3	40	14.71	121.5682	25.1737	1.17	0.31	14	1.4	63	0.09	0.2	0.3	1
2004	5	25	10	18	41.03	121.5778	25.1747	1.76	0.55	14	1.6	75	0.07	0.2	0.3	1
2004	5	25	20	3	44.67	121.5655	25.1708	1.13	0.09	11	1	85	0.08	0.2	0.3	1
2004	5	26	19	45	30.31	121.5405	25.1712	1.27	0.34	10	1.4	104	0.08	0.3	0.4	2
2004	5	26	21	47	36.74	121.5455	25.1777	1.32	0.61	10	1.5	136	0.08	0.3	0.4	2
2004	5	26	22	39	18.86	121.5843	25.1603	2.39	0.37	5	2.6	183	0.01	0.2	0.2	3
2004	6	1	10	54	43.85	121.6378	25.1472	4.18	1.36	16	4.2	309	0.24	1.5	1.3	3
2004	6	1	21	17	36.45	121.5593	25.2022	8.22	1.54	12	1.8	266	0.14	1.3	1	3
2004	6	7	20	5	39.89	121.5438	25.1802	0.74	0.19	8	1.3	157	0.12	0.4	1.3	2

2004	6	8	11	35	47.57	121.5965	25.1685	0.63	1.2	8	1.6	128	0.1	0.4	1.5	2
2004	6	10	2	57	51.01	121.5405	25.1613	2.1	0.8	10	1.5	118	0.06	0.2	0.3	2
2004	6	10	9	50	30.6	121.6135	25.1383	5.23	1.02	10	2.6	283	0.14	1.5	1.1	3
2004	6	10	19	42	50.53	121.5453	25.1697	1.06	1.18	16	1.2	92	0.12	0.3	0.4	2
2004	6	11	9	58	4.94	121.5308	25.1700	2.01	0.93	10	1.2	172	0.08	0.4	0.4	2
2004	6	12	9	32	25.51	121.5475	25.1670	0.11	0.58	8	0.9	168	0.06	0.2	2.4	3
2004	6	12	9	32	46.53	121.5453	25.1718	1.72	1	8	1.3	158	0.09	0.2	0.2	2
2004	6	12	9	33	5.75	121.5467	25.1722	1.2	1.28	8	1.2	152	0.03	0.1	0.2	2
2004	6	12	9	35	5.03	121.5387	25.1677	1.04	0.86	10	1.6	115	0.05	0.2	0.3	2
2004	6	12	9	35	15.08	121.5372	25.1653	1.04	1.01	10	1.5	121	0.09	0.3	0.5	2
2004	6	12	9	41	0.82	121.5410	25.1708	1.08	0.59	8	1.5	179	0.05	0.2	0.3	2
2004	6	12	9	41	15.24	121.5232	25.1570	0.78	0.44	6	2.8	273	0.1	0.9	3.1	3
2004	6	12	11	44	22.47	121.5438	25.1745	0.96	0.46	10	1.4	115	0.05	0.1	0.3	2
2004	6	13	20	21	17.88	121.5715	25.1708	0.14	0.96	8	1.6	176	0.05	0.2	3.7	3
2004	6	13	21	10	45.62	121.5330	25.1582	1.77	0.55	10	0.6	126	0.04	0.2	0.2	2
2004	6	13	21	7	31.99	121.5332	25.1578	1.83	0.26	10	0.6	131	0.07	0.3	0.3	2
2004	6	13	21	7	51	121.5333	25.1573	1.95	0.48	10	0.6	136	0.07	0.3	0.3	2
2004	6	15	9	36	9.67	121.5485	25.1667	3.2	0.73	15	0.8	92	0.12	0.4	0.5	2
2004	6	15	9	36	4.23	121.5668	25.1568	2.96	0.08	6	1.1	215	0.03	1.2	0.4	3
2004	6	16	3	10	42.66	121.5570	25.1583	4.77	0.89	12	0.9	107	0.13	0.8	0.6	2
2004	6	16	12	58	32.29	121.5792	25.1667	1.35	0.81	8	2.3	259	0.34	2	2.6	4
2004	6	17	2	19	17.08	121.5690	25.1705	0.97	0.94	12	1.3	96	0.08	0.2	0.6	2
2004	6	18	11	40	18.23	121.5612	25.1697	2.81	0.79	12	0.6	118	0.14	0.6	0.6	2
2004	6	18	16	5	20.25	121.5483	25.1740	1.66	0.76	10	1.2	112	0.06	0.1	0.2	2
2004	6	20	5	4	42.09	121.6140	25.1578	1.13	1.32	10	2	262	0.38	1.8	2	4
2004	6	20	21	55	55.56	121.5902	25.1817	3.72	0.95	16	1.2	152	0.09	0.4	0.4	2
2004	6	21	10	7	57.28	121.5862	25.1808	1.8	0.93	13	1	130	0.05	0.2	0.2	2
2004	6	21	21	52	37.42	121.6140	25.1630	5.9	1.72	14	1.6	249	0.13	0.9	0.6	3
2004	6	22	9	18	50.51	121.5487	25.1730	3.31	0.52	14	1.1	106	0.07	0.3	0.3	2
2004	6	22	9	54	22.83	121.5492	25.1703	1.43	0.82	16	0.9	94	0.12	0.3	0.5	2
2004	6	22	14	21	15.19	121.5638	25.4428	3.33	1.45	14	28.2	344	0.51	9.1	5.2	4
2004	6	23	0	52	11.14	121.5378	25.1650	1.97	0.47	11	1.5	116	0.05	0.2	0.2	2
2004	6	23	0	57	11.24	121.5380	25.1647	1.97	0.57	16	1.5	115	0.09	0.3	0.3	2
2004	6	23	21	33	52.75	121.6008	25.1650	2.06	0.66	13	1.4	167	0.1	0.4	0.5	2
2004	6	24	7	43	42.72	121.5998	25.1685	1.27	0.7	6	1.6	146	0.05	0.3	0.5	2
2004	6	24	7	52	21.45	121.5742	25.1800	3.55	0.89	6	1.2	249	0.05	0.7	0.6	3
2004	6	25	9	47	14.04	121.5375	25.1805	8.3	1.11	10	0.6	162	0.16	2	1.1	3
2004	6	25	9	47	24.4	121.4942	25.2043	4.35	1.17	10	4.6	318	0.18	1.8	1.8	3

2004	6	26	1	22	49.57	121.5405	25.1753	1.05	0.9	12	1.1	117	0.07	0.2	0.3	2
2004	6	26	11	8	44.01	121.5315	25.1608	2.22	1.07	10	0.7	149	0.03	0.1	0.1	2
2004	6	26	11	11	6.38	121.5337	25.1615	2.32	0.95	8	0.9	134	0.07	0.4	0.5	2
2004	6	26	19	33	43.73	121.5418	25.1715	1.08	1	10	1.5	97	0.06	0.2	0.3	2
2004	6	29	18	47	56.08	121.5667	25.1725	3.11	0.84	12	1.2	152	0.25	1.1	1.2	3
2004	6	29	23	5	37.53	121.5333	25.1458	2.1	0.42	6	1.2	247	0.33	0.2	0.2	4
2004	7	1	10	34	22.44	121.5582	25.1682	1.61	0.48	12	0.2	125	0.21	0.7	0.9	2
2004	7	1	10	34	53.3	121.5723	25.1727	1.27	0.42	12	1.7	176	0.1	0.3	0.5	2
2004	7	1	10	35	5.68	121.5727	25.1710	1.01	0.92	8	1.7	181	0.03	0.1	0.2	3
2004	7	5	18	5	6.72	121.5743	25.1700	0.27	1.01	10	1.8	190	0.07	0.2	2	3
2004	7	5	18	43	41.37	121.5453	25.1522	1.96	1.16	8	1.7	176	0.06	0.3	0.4	2
2004	7	5	20	2	53.99	121.5365	25.1330	4.28	1.4	10	2.6	284	0.07	0.5	0.4	3
2004	7	6	4	27	31.39	121.5708	25.1708	1.05	1.01	6	1.5	227	0.01	0.3	0.2	3
2004	7	6	4	29	10.05	121.5725	25.1703	1.07	0.77	6	1.7	234	0.03	0.7	0.6	3
2004	7	6	4	35	48.27	121.5533	25.1720	1.19	0.96	8	0.7	132	0.06	0.2	0.4	2
2004	7	6	6	23	21.37	121.5662	25.1708	1	1.03	6	1.1	203	0.01	0.2	0.2	3
2004	7	6	8	6	44.52	121.5867	25.1822	2.51	0.97	6	2.5	293	0.05	2.2	2.1	3
2004	7	6	8	8	2.77	121.5582	25.1682	2.24	0.98	8	0.2	159	0.07	0.4	0.5	2
2004	7	6	8	12	43.14	121.5773	25.1650	4.81	1.5	8	2.1	252	0.08	0.8	0.6	3
2004	7	6	8	23	42.32	121.5795	25.1700	0.76	1	6	2.3	260	0.02	0.5	1.4	3
2004	7	6	10	46	24.07	121.5783	25.1705	0.93	0.72	6	2.2	256	0.02	0.3	0.7	3
2004	7	6	10	46	31.5	121.5745	25.1695	1.05	0.51	6	1.9	242	0.06	1.8	1.7	3
2004	7	6	13	21	18.56	121.5662	25.1717	2.19	1.07	8	1.1	203	0.11	0.2	0.2	3
2004	7	6	13	23	49.21	121.4865	25.1812	4.89	1.33	6	7.2	330	0.03	1.6	2.9	3
2004	7	6	14	51	56.35	121.5633	25.1717	1.58	0.3	6	0.9	187	0.06	0.8	0.3	3
2004	7	6	15	54	49.57	121.5643	25.1682	1.16	0.76	8	0.8	192	0.1	0.5	0.5	3
2004	7	6	16	20	21.35	121.5783	25.1715	0.82	0.79	6	2.3	258	0.02	0.4	0.9	3
2004	7	6	16	38	28.94	121.5768	25.1703	0.97	1.18	6	2.1	251	0.02	0.3	0.7	3
2004	7	6	17	16	30.91	121.5438	25.1633	2.18	0.92	8	1.3	195	0.02	0.1	0.2	3
2004	7	6	19	29	42.84	121.5972	25.1682	5.18	1.41	8	4.1	298	0.11	1.4	1.1	3
2004	7	7	1	22	52.35	121.5755	25.1770	1.89	0.88	6	1.7	255	0.09	2.4	1.5	3
2004	7	7	2	56	47.8	121.6098	25.1682	1.22	0.89	10	5.2	313	0.19	1.2	2.7	3
2004	7	7	19	55	33.59	121.6137	25.1807	5.9	1.25	6	5.2	318	0.03	2.4	2.4	3
2004	7	7	22	35	59.97	121.6062	25.1583	6.26	1.22	6	4.6	311	0.04	2.4	2	3
2004	7	7	23	44	24.74	121.5582	25.1735	2.03	0.97	6	0.8	184	0.1	1.1	0.4	3
2004	7	8	3	37	15.41	121.5213	25.1792	1.35	0.82	6	3.8	309	0.24	2.3	4.7	3
2004	7	8	10	35	23.2	121.5732	25.1732	1.76	0.76	6	1.8	239	0.05	1.4	0.9	3
2004	7	8	18	32	53.6	121.4865	25.1927	2.93	1.19	6	7.6	332	0.22	42.4	80.5	4

2004	7	8	18	59	17.77	121.5267	25.2548	6.99	1.26	6	8.4	352	0.19	9.2	1.3	4
2004	7	8	22	11	57.14	121.6017	25.2290	2.16	1.14	6	6.2	344	0.2	7.2	21.8	4
2004	7	9	2	28	32.17	121.5815	25.1618	3.13	0.98	6	2.5	268	0.03	1.3	1	3
2004	7	9	20	25	34.24	121.5733	25.1698	0.02	0.58	6	1.7	237	0.04	0.4	34.8	4
2004	7	10	4	46	28.7	121.5432	25.1735	1.07	0.74	10	1.4	109	0.05	0.2	0.3	2
2004	7	10	4	46	36.72	121.5427	25.1710	1.4	0.65	6	1.5	204	0	0	0	3
2004	7	10	5	15	22.25	121.5690	25.1707	1	0.8	6	1.3	218	0.02	0.2	0.2	3
2004	7	10	7	23	38.33	121.5698	25.1702	1.02	0.75	6	1.4	222	0.02	0.3	0.2	3
2004	7	10	16	47	31.56	121.5760	25.1703	0.16	0.37	8	2	248	0.1	0.7	7.7	4
2004	7	10	16	50	6.88	121.5693	25.1703	1.02	0.15	6	1.4	219	0.02	0.1	0.1	3
2004	7	10	18	7	12.59	121.5470	25.1605	3.64	0.73	8	1.2	135	0.04	0.3	0.3	2
2004	7	10	18	13	29.72	121.5718	25.1705	1.15	0.7	6	1.6	231	0.02	0.3	0.3	3
2004	7	10	19	15	58.98	121.5755	25.1700	0.41	1.05	6	2	246	0.05	0.7	3.6	3
2004	7	10	20	43	0.69	121.5712	25.1702	1.01	0.63	6	1.5	227	0.02	0.3	0.3	3
2004	7	10	23	42	9.05	121.5745	25.1700	0.95	0.71	6	1.9	242	0.04	0.5	1	3
2004	7	11	1	27	14.27	121.5715	25.1715	1.01	0.07	6	1.6	230	0.02	0.1	0.1	3
2004	7	11	1	27	17.74	121.5203	25.1700	0.97	0.24	6	3.7	307	0.09	2.8	10.9	4
2004	7	11	1	34	8.4	121.5582	25.1745	3.53	0.9	6	0.9	186	0.03	1.1	0.3	3
2004	7	11	3	13	26.4	121.5678	25.1718	1.36	0.23	6	1.3	212	0.01	0.3	0.2	3
2004	7	11	9	4	15.61	121.5692	25.1705	1.04	0.71	6	1.3	218	0.02	0.2	0.2	3
2004	7	11	9	4	12.34	121.5622	25.1722	1.27	0.07	6	0.8	180	0.01	0.2	0.1	2
2004	7	11	12	23	56.59	121.5770	25.1707	1.09	0.81	6	2.1	252	0.05	0.3	0.3	3
2004	7	11	12	43	35.98	121.5678	25.1710	1	0.08	6	1.2	211	0.01	0.1	0.1	3
2004	7	11	12	43	40.72	121.4860	25.1788	1.21	0.74	6	7.2	330	0.04	0.5	5.5	4
2004	7	11	12	43	51.84	121.5710	25.1707	1.04	0.7	6	1.5	227	0.01	0.2	0.1	3
2004	7	11	14	18	18.82	121.5402	25.1762	4.09	1.01	6	2	279	0.02	0.7	0.3	3
2004	7	12	3	27	27.49	121.5903	25.1735	1.29	0.81	8	3.2	289	0.07	1.4	2.3	3
2004	7	12	4	38	35.93	121.5685	25.1723	1.3	0.9	6	1.4	216	0.01	0.4	0.2	3
2004	7	12	4	40	33.85	121.5710	25.1712	1.01	1.09	6	1.6	228	0.02	0.2	0.2	3
2004	7	12	16	54	35.27	121.5602	25.1637	1.61	1.05	8	1.7	170	0.2	0.2	0.4	3
2004	7	12	23	10	25.85	121.5623	25.1687	0.76	0.85	6	2	182	0.02	0.1	0.4	3
2004	7	12	23	13	4.51	121.5583	25.1712	0.52	0.7	6	1.7	159	0.05	0.3	1.7	2
2004	7	13	1	13	36.42	121.5638	25.1753	1.51	0.91	5	1.2	191	0.05	0.8	0.6	3
2004	7	13	3	41	28.39	121.5558	25.1690	1.03	0.74	8	2	146	0.13	0.5	1.1	2
2004	7	13	11	11	49	121.5590	25.1642	1.53	0.6	6	1.8	163	0.22	0.3	0.5	3
2004	7	13	12	26	26.79	121.6317	25.1515	8.84	1.89	8	7	328	0.04	0.7	0.6	3
2004	7	14	15	27	17.37	121.5353	25.1663	2.45	1.37	8	1.4	135	0.09	0.5	0.7	2
2004	7	14	15	27	45.03	121.5382	25.1662	3.32	1.2	8	1.6	116	0.04	0.3	0.3	2

2004	7	14	15	28	2.98	121.5383	25.1640	3.07	0.23	8	1.4	112	0.06	0.4	0.5	2
2004	7	14	15	28	32.39	121.5353	25.1672	3.83	0.27	6	1.5	143	0.05	0.7	0.5	2
2004	7	14	15	28	34.08	121.5360	25.1645	3.73	0.11	6	1.3	139	0.04	0.5	0.4	2
2004	7	14	15	28	37.22	121.5390	25.1638	3.96	0.21	6	1.5	149	0.05	0.7	0.6	2
2004	7	14	15	28	40.94	121.5313	25.1585	3.39	0.29	6	0.5	136	0.05	0.6	0.5	2
2004	7	14	15	28	48.61	121.5353	25.1632	2.47	0.11	6	1.2	134	0.01	0.1	0.1	2
2004	7	14	15	28	52.76	121.5332	25.1608	3.41	0.06	6	0.8	135	0.04	0.4	0.4	2
2004	7	14	15	28	58.81	121.5345	25.1643	2.87	0.4	6	1.2	137	0.01	0.1	0.1	2
2004	7	14	15	29	16.01	121.5323	25.1637	3.38	0.68	6	1.1	151	0.02	0.3	0.2	2
2004	7	14	15	29	39.48	121.5552	25.1783	2.14	0.33	4	2.4	252	0.02			3
2004	7	14	15	30	50.15	121.5338	25.1603	3.99	0.39	6	0.8	128	0.04	0.5	0.4	2
2004	7	14	15	31	22.29	121.5350	25.1595	2.79	0.33	6	0.9	124	0.03	0.3	0.3	2
2004	7	14	15	31	53.85	121.5388	25.1642	2.31	0.72	8	1.5	109	0.05	0.3	0.4	2
2004	7	14	15	37	59.33	121.5362	25.1623	2.72	0.17	6	1.2	134	0.02	0.2	0.2	2
2004	7	14	15	39	21.83	121.5295	25.1568	2.56	0.39	8	0.2	142	0.1	0.6	0.7	2
2004	7	14	15	39	13.74	121.5398	25.1625	2.18	0.66	8	1.5	110	0.05	0.2	0.4	2
2004	7	14	15	40	1.89	121.5337	25.1597	2.57	0.21	8	0.8	124	0.06	0.3	0.4	2
2004	7	14	16	5	39.7	121.5327	25.1608	2.26	0.38	8	0.8	139	0.1	0.5	0.6	2
2004	7	14	16	11	12.14	121.5103	25.1605	11.39	0.93	6	1.9	295	0.05	1.9	0.7	3
2004	7	14	23	21	25.74	121.5485	25.1498	1.81	0.45	6	1.4	188	0.05	0.4	0.4	3
2004	7	15	1	14	20.18	121.5402	25.1673	2.62	0.56	8	1.7	107	0.04	0.2	0.3	2
2004	7	15	9	58	22.99	121.5583	25.1715	0.25	0.57	8	1.7	158	0.06	0.2	2.7	3
2004	7	16	17	21	27.87	121.5695	25.1717	2.05	1	6	1.8	220	0.08	0.7	0.8	3
2004	7	17	9	32	9.83	121.5705	25.1680	2.04	1.24	8	2.2	224	0.1	0.6	0.7	3
2004	7	17	9	32	39.67	121.5792	25.1762	2.91	0.6	6	2	265	0.03	0.3	0.3	3
2004	7	18	7	47	7.27	121.5670	25.1738	1.61	1.13	8	1.5	209	0.06	0.3	0.4	3
2004	7	18	9	17	13.13	121.5487	25.1683	2.4	0.21	7	2.2	115	0.25	0.7	1	2
2004	7	18	17	8	4.76	121.5473	25.1757	1.03	0.51	8	1.7	122	0.1	0.4	0.8	2
2004	7	18	17	59	42.71	121.5412	25.1578	2.68	0.44	6	1.4	140	0.02	0.1	0.1	2
2004	7	20	3	16	19.34	121.5390	25.1607	2.32	0.68	6	1.3	140	0	0	0	2
2004	7	20	16	1	57.55	121.5720	25.1777	2.37	0.9	8	1.4	243	0.11	0.6	0.8	3
2004	7	20	16	2	13.97	121.5477	25.1695	1.24	0.75	8	2.1	110	0.05	0.2	0.5	2
2004	7	20	16	8	50.62	121.5497	25.1708	1.03	0.65	8	2.1	118	0.02	0	0.1	2
2004	7	20	20	35	20.19	121.5577	25.1703	0.26	0.83	8	1.8	156	0.07	0.2	3	3
2004	7	22	19	45	46.56	121.5638	25.1703	0.39	0.9	7	1.8	190	0.12	0.6	3.4	3
2004	7	23	16	23	47.95	121.5348	25.1613	3.99	0.57	6	1	127	0.05	0.7	0.5	2
2004	7	23	16	23	53.81	121.5295	25.1568	3.68	0.27	6	0.2	142	0.05	0.5	0.4	2
2004	7	23	17	52	19.56	121.5523	25.1498	5	0.89	6	1	183	0.03	0.6	0.3	3

2004	7	26	11	48	45.45	121.5637	25.1647	3.66	0.91	10	1.8	153	0.07	0.3	0.4	2
2004	7	26	12	48	5.57	121.5513	25.1620	2.24	0.51	8	1.9	123	0.06	0.3	0.5	2
2004	7	27	2	36	4.66	121.5730	25.1700	0.79	0.45	6	2.1	184	0.03	0.1	0.3	3
2004	7	27	11	59	8.6	121.5295	25.1630	3.87	0.65	6	0.9	221	0.07	0.8	0.7	3
2004	7	27	21	53	15.71	121.5638	25.1720	0.8	0.56	8	1.6	142	0.1	0.3	1.2	2
2004	7	27	23	15	21.94	121.5698	25.1727	1.35	0.65	10	1.7	165	0.14	0.5	0.8	2
2004	7	28	2	9	48.93	121.5723	25.1695	2.54	0.72	6	2.1	182	0.12	0.2	0.2	3
2004	7	28	5	32	18.25	121.5638	25.1727	0.94	0.77	10	1.5	140	0.11	0.3	0.9	2
2004	7	28	5	40	42.62	121.5717	25.1702	0.91	0.15	6	2	178	0.03	0.1	0.2	2
2004	7	28	13	17	44.6	121.5492	25.1498	3.38	0.55	10	1.3	187	0.14	0.7	0.8	3
2004	7	29	4	9	58.06	121.5407	25.0715	0.22	1.13	5	8.8	338	0.18	2.4	63.2	4
2004	7	30	22	4	17.67	121.5423	25.1742	1.5	0.31	8	1.3	112	0.03	0.1	0.2	2
2004	7	31	15	21	7.06	121.5427	25.1655	2.23	0.63	10	1.9	98	0.1	0.4	0.6	2
2004	7	31	15	59	50.24	121.5518	25.1668	2	0.63	10	2.3	104	0.09	0.3	0.6	2
2004	8	16	1	29	43.44	121.8212	25.0648	5.07	2.14	10	27.7	349	0.09	85.1	177	4
2004	8	18	10	30	12.24	121.5998	25.1832	4.94	1.12	8	1.4	189	0.13	1.4	0.9	3
2004	8	18	23	14	19.52	121.6507	25.1490	12.66	1.39	10	5	320	0.08	1.5	0.9	3
2004	8	18	23	16	37.57	121.6048	25.1652	4.64	0.94	8	1.5	217	0.09	0.9	0.7	3
2004	8	18	23	26	27.74	121.7212	25.1298	7	1.6	14	12.2	342	0.27	3.1	309	4
2004	8	19	17	12	30.53	121.5440	25.1507	6.71	1.01	10	1.7	188	0.12	1.2	0.7	3
2004	9	1	5	17	29.49	121.5687	25.1727	1.06	1.09	10	1.4	111	0.2	0.6	1	2
2004	9	9	14	5	19.1	121.5355	25.1498	1.45	0.63	4	2.7	259	0.05			3
2004	9	9	21	32	39.13	121.5423	25.1810	0.23	0.64	4	1.1	243	0.06			3
2004	9	10	14	2	7.57	121.5465	25.1703	1.34	1.09	8	1.9	112	0.12	0.5	1	2
2004	9	10	14	37	33.58	121.5513	25.1825	1.2	0.36	6	2	172	0.05	0.4	0.7	2
2004	9	10	20	56	1.76	121.5303	25.1583	2.8	0.21	6	0.4	147	0.01	0.2	0.1	2
2004	9	13	19	1	55.23	121.5652	25.1740	0.97	1.07	5	2.3	143	0.01	0.1	0.3	3
2004	9	14	18	51	7.4	121.5683	25.1758	2.16	1.46	5	1.9	151	0.09	0.5	0.9	3
2004	9	16	5	56	27.75	121.5433	25.1700	1	0.45	10	1.4	106	0.15	0.5	1	2
2004	9	17	10	15	39.51	121.5672	25.0948	12.38	1.69	12	5.9	303	0.14	2.1	1.5	3
2004	9	17	10	28	58.71	121.5935	25.0928	6.67	1	10	6.8	305	0.42	5.9	5.2	4
2004	9	17	13	33	45.36	121.5512	25.1400	6.32	0.47	8	1.4	280	0.06	0.7	0.4	3
2004	9	19	15	45	28	121.6725	25.0852	0.75	1.87	6	11	333	0.93	10.5	3.8	4
2004	9	21	9	55	50.8	121.5570	25.1410	5.77	0.77	11	0.9	244	0.13	1.2	0.6	3
2004	9	21	10	27	43.05	122.1017	25.1788	1.5	1.9	5	49.3	357	0.09	20.8	1.8	4
2004	9	21	11	6	40.68	121.5703	25.1352	5.61	0.29	5	1.7	287	0	0.1	0.1	3
2004	9	23	7	22	24.39	121.5818	25.1847	2.09	0.54	9	0.5	116	0.03	0.2	0.2	2
2004	9	23	12	11	52.42	121.5725	25.1685	1.71	0.45	9	1.6	185	0.08	0.5	0.8	3

2004	9	25	18	37	5.32	121.5692	25.1522	5.19	0.84	12	0.8	182	0.15	0.9	0.8	3
2004	9	27	13	50	14.68	121.6140	25.5167	1.5	1.97	11	36.5	348	0.31	243	226	4
2004	9	27	19	12	26.13	122.1740	24.9940	5.17	1.8	7	60.2	355	0.08	594		4
2004	9	28	7	48	35.34	121.5295	25.1693	2.18	0.34	8	1.3	182	0.04	0.2	0.3	3
2004	9	29	14	40	3.73	121.5725	25.1785	1.99	0.66	12	1.4	122	0.08	0.3	0.3	2
2004	9	30	19	34	9.03	121.5368	25.1662	2.51	0.87	8	1.5	125	0.04	0.2	0.3	2
2004	10	9	14	8	29.51	121.6333	25.1657	8.99	1.86	6	2.5	330	0.1	3.2	1.4	4
2004	10	12	14	22	2.86	121.6400	25.2522	7.19	1.73	14	8.8	324	0.08	0.9	0.8	3
2004	10	12	14	23	9.18	121.6448	25.2527	7.65	1.59	12	9	326	0.07	0.9	0.8	3
2004	10	21	20	35	55.48	121.5450	25.1750	1.31	0.91	8	1.5	145	0.04	0.2	0.3	2
2004	10	22	6	10	8.92	121.5623	25.1725	0.78	0.43	6	0.9	184	0.06	0.4	0.6	3
2004	10	23	14	12	30.78	121.5537	25.0892	14.22	1.6	12	7.8	309	0.11	2.3	1.6	3
2004	10	23	14	16	8.56	121.5197	25.0465	5.83	1.2	8	12	343	0.06	0.9	2.1	3
2004	10	23	14	50	10.92	121.5657	25.1682	1.31	1	10	0.9	156	0.19	0.6	0.8	3
2004	10	24	7	43	16.65	121.5262	25.0582	9.48	1.21	8	10.6	341	0.04	0.8	1	3
2004	10	29	9	34	39.08	121.5637	25.1742	1.68	1.07	10	1.1	137	0.09	0.2	0.3	2
2004	11	2	6	37	7.4	121.7633	24.9672	3.65	1.99	10	26.8	348	0.3	6.7	4.7	4
2004	11	2	7	25	4.18	121.7753	24.9715	5.62	2.07	10	27.2	348	0.41	159	330	4
2004	11	4	15	16	7.38	121.5485	25.1752	1.36	0.85	8	1.8	118	0.08	0.3	0.6	2
2004	11	4	16	9	35.8	121.5482	25.1682	1	0.6	8	2.2	113	0.02	0.1	0.2	2
2004	11	8	11	36	31.39	121.3885	24.6817	7.57	2.13	6	54.6	356	0.08	25.4	121	4
2004	11	8	16	11	30.93	121.5432	25.1645	1	0.76	12	1.9	103	0.09	0.3	0.5	2
2004	11	8	16	16	24.35	121.5422	25.1658	1.5	0.76	12	1.9	97	0.09	0.3	0.5	2
2004	11	8	16	16	33.96	121.5427	25.1653	1.03	0.4	8	1.9	99	0.04	0.2	0.4	2
2004	11	11	20	21	27.33	121.5423	25.1720	1.27	0.35	8	1.5	100	0.06	0.2	0.4	2
2004	11	13	11	8	53.22	121.5505	25.1750	1.2	0.37	10	1.7	115	0.07	0.2	0.5	2
2004	11	13	13	13	8.49	121.5562	25.1493	4.14	0.67	10	0.6	180	0.11	0.7	0.7	3
2004	11	15	11	27	51.17	121.9242	25.1555	0.72	1.71	10	33.3	353	0.21	732	598	4
2004	11	18	5	35	31.97	121.5493	25.1607	3.07	0.63	12	1.9	117	0.07	0.3	0.4	2
2004	11	20	16	51	0.04	121.5637	25.1525	4.32	1.11	12	0.5	112	0.09	0.5	0.5	2
2004	11	21	7	42	34.26	121.5542	25.1758	1.49	1.08	8	1.4	229	0.04	0.2	0.2	3
2004	11	21	21	35	29.23	121.5903	25.1603	6.07	0.73	8	3.2	289	0.02	0.2	0.1	3
2004	11	22	22	53	12.31	121.5557	25.1712	0.55	0.81	12	1.8	87	0.22	0.4	3	2
2004	11	24	17	17	54.74	121.5543	25.1608	1.57	0.7	12	1.6	105	0.26	0.4	0.7	2
2004	11	26	4	50	31.06	121.5665	25.1713	0.56	1.34	12	1.7	88	0.11	0.2	1.5	1
2004	11	27	15	18	40.31	121.5655	25.1720	1.34	0.98	10	1.6	98	0.07	0.2	0.4	2
2004	11	27	15	22	19.96	121.5657	25.1715	1.27	0.9	10	1.7	98	0.08	0.2	0.4	2
2004	11	27	17	6	10.35	121.5823	25.1872	9.27	1.32	12	0.2	199	0.12	1.1	0.7	3

2004	11	29	13	42	26.75	121.5602	25.1703	1.17	1.14	12	1.8	75	0.09	0.2	0.5	1
2004	11	30	14	31	43.38	121.5370	25.1637	4.58	0.62	10	1.3	119	0.1	0.6	0.6	2
2004	11	30	14	31	49.86	121.5335	25.1568	4.54	0.73	8	0.6	144	0.07	0.6	0.5	2
2004	12	9	12	29	4.87	121.5512	25.1705	1.15	0.97	10	2.1	100	0.09	0.3	0.6	2
2004	12	10	8	22	27.2	121.5440	25.1693	1.45	0.65	6	1.8	173	0.05	0.1	0.2	2
2004	12	11	16	36	9.09	121.5675	25.1693	2.19	0.77	6	2	209	0.1	0.9	1.1	3
2004	12	12	5	11	26.61	121.5493	25.1505	5.2	1.32	8	1.3	181	0.07	0.6	0.5	3
2004	12	12	16	43	2.76	121.5435	25.1678	1.08	1.07	8	1.9	97	0.05	0.2	0.4	2
2004	12	16	17	2	26.4	121.5498	25.1447	4.9	0.99	8	1.3	226	0.06	0.5	0.4	3
2004	12	16	19	38	40.32	121.5463	25.1457	4.66	0.8	8	1.6	219	0.06	0.5	0.4	3
2004	12	20	10	26	29.44	121.5428	25.1708	1.27	0.86	8	1.6	95	0.03	0.1	0.2	2
2004	12	20	14	9	28.04	121.5402	25.1728	1.47	0.97	8	1.3	102	0.02	0.1	0.2	2
2004	12	21	10	35	41.07	121.5470	25.1465	4.54	0.83	8	1.5	214	0.05	0.4	0.4	3
2004	12	21	10	37	12.36	121.5412	25.1362	4.21	0.45	6	2.5	270	0.03	0.5	0.4	3
2004	12	21	10	37	22.15	121.5505	25.1468	4.86	1.36	8	1.2	210	0.07	0.6	0.5	3
2004	12	21	10	39	16.14	121.5487	25.1477	4.97	1.4	8	1.3	204	0.08	0.6	0.5	3
2004	12	21	12	20	46.37	121.5487	25.1442	4.78	1.03	8	1.4	228	0.08	0.7	0.5	3
2004	12	21	15	32	19.44	121.5488	25.1453	4.91	0.77	8	1.4	221	0.06	0.5	0.4	3
2004	12	26	1	35	55.68	121.5405	25.1680	2.68	1.48	8	1.7	105	0.04	0.2	0.3	2
2004	12	26	2	20	33.66	121.5600	25.1718	3.22	1.18	8	1.6	168	0.07	0.4	0.6	2
2004	12	26	8	45	59.55	121.5673	25.1772	3.45	0.94	6	1.2	217	0.02	0.3	0.3	3
2004	12	27	13	8	51.08	121.5772	25.1217	10.38	2.27	6	3.3	334	0.11	3.8	1.6	4
2004	12	29	8	48	10.31	121.5442	25.1725	1.4	1.14	8	1.6	105	0.04	0.1	0.3	2
2004	12	29	12	56	38.97	121.5433	25.1722	1.49	0.98	8	1.6	102	0.03	0.1	0.2	2
2005	1	18	1	21	40.45	121.5657	25.1728	1.47	0.6	10	1.2	148	0.13	0.4	0.6	2
2005	1	18	18	0	12.01	121.5407	25.1675	1.02	1.22	11	1.6	104	0.06	0.2	0.4	2
2005	1	21	13	7	59.24	121.5695	25.1725	1.31	0.31	10	1.5	98	0.07	0.2	0.4	2
2005	1	21	17	20	25.04	121.5748	25.1715	2.92	0.96	10	1.9	172	0.09	0.4	0.5	2
2005	1	25	0	55	8.54	121.5575	25.1827	2.83	0.93	12	0.6	143	0.09	0.4	0.4	2
2005	1	25	0	55	17.71	121.5553	25.1803	2.75	0.83	10	1	134	0.08	0.4	0.4	2
2005	1	28	1	37	42.45	121.5525	25.1667	3.05	0.93	10	0.4	152	0.07	0.4	0.4	2
2005	1	30	18	7	33.85	121.5458	25.1683	2.75	1.15	12	1.1	88	0.07	0.3	0.3	1
2005	1	30	21	45	55.22	121.5693	25.1717	0.75	0.91	12	1.4	97	0.09	0.2	0.7	2
2005	1	30	22	14	35.02	121.5653	25.1747	1.02	0.91	12	1.3	84	0.1	0.3	0.4	1
2005	1	30	22	24	48.55	121.5895	25.1857	2.53	0.99	12	0.9	240	0.1	0.4	0.4	3
2005	1	30	22	32	5.24	121.5670	25.1717	1.35	1.04	10	1.2	143	0.09	0.3	0.5	2
2005	1	30	23	7	16.27	121.5657	25.1713	1.1	0.93	10	1.1	136	0.06	0.2	0.3	2
2005	1	30	23	7	32.18	121.5765	25.1702	1.44	0.4	6	2	250	0.06	1.1	1	3

2005	1	30	23	7	47.88	121.5678	25.1723	1.15	0.53	6	1.3	213	0.03	0.7	0.5	3
2005	1	31	0	23	15.37	121.5653	25.1705	1.03	0.67	8	1	133	0.02	0.1	0.1	2
2005	1	31	12	42	16.66	121.5750	25.1673	1	1.13	8	1.9	198	0.03	0.2	0.4	3
2005	1	31	13	27	35.33	121.5817	25.1575	6.48	1.25	6	2.2	274	0.02	0.9	0.3	3
2005	1	31	14	17	40.61	121.5685	25.1732	1.23	0.86	6	1.4	109	0.04	0.2	0.5	2
2005	1	31	14	29	24.41	121.5568	25.1737	2.04	0.92	12	0.8	104	0.17	0.6	0.8	2
2005	2	4	1	33	38.43	121.5693	25.1703	0.29	0.91	8	1.4	168	0.12	0.6	4.2	3
2005	2	4	15	29	12.6	121.5678	25.1690	1.3	1.03	10	1.2	92	0.16	0.6	1	2
2005	2	6	1	25	48.41	121.5492	25.1618	3.03	1.22	12	0.9	112	0.06	0.3	0.4	2
2005	2	6	1	26	11.86	121.5352	25.1468	12.23	1.23	8	2.7	305	0.06	1.6	0.6	3
2005	2	6	1	27	28.6	121.5425	25.1550	2.32	0.35	6	1.5	160	0.03	0.3	0.3	2
2005	2	7	21	22	38.77	121.5675	25.1732	1.03	1.08	10	1.3	104	0.06	0.2	0.3	2
2005	2	7	23	1	22.99	121.5650	25.1742	1.09	1.13	12	1.2	83	0.09	0.2	0.4	1
2005	2	8	1	30	8.16	121.5707	25.1718	0.85	0.99	10	1.5	102	0.07	0.2	0.6	2
2005	2	8	11	12	35.21	121.5655	25.1708	1.12	0.73	8	1	134	0.04	0.1	0.2	2
2005	2	8	14	29	35.85	121.5675	25.1722	1.07	1.24	10	1.3	101	0.05	0.1	0.2	2
2005	2	8	16	29	57.48	121.5705	25.1718	0.97	0.95	10	1.5	101	0.07	0.2	0.6	2
2005	2	8	16	58	45.73	121.5733	25.1700	0.87	0.88	8	1.7	185	0.03	0.1	0.4	3
2005	2	10	16	53	2.46	121.5472	25.1642	3.43	0.93	12	1	103	0.08	0.3	0.4	2
2005	2	10	16	53	12.34	121.5452	25.1615	3.01	1.01	12	1.3	117	0.1	0.4	0.5	2
2005	2	12	8	42	56.42	121.5497	25.1718	1.24	1.04	12	0.9	100	0.07	0.2	0.3	2
2005	2	14	16	4	17.07	121.4845	25.1723	1.43	1.07	6	7.3	330	0.04	1	6.4	4
2005	2	15	12	5	31.17	121.5645	25.1722	1.01	0.79	6	1	194	0.02	0.3	0.2	3
2005	2	15	13	10	0.78	121.5698	25.1705	1.01	1.08	6	1.4	222	0.01	0.2	0.2	3
2005	2	15	14	0	45.63	121.5700	25.1710	1.07	1.08	6	1.5	223	0.01	0	0	3
2005	2	15	15	36	28.86	121.5688	25.1722	1.41	1.07	6	1.4	218	0.03	0.6	0.4	3
2005	2	15	18	59	3.48	121.5673	25.1710	1.02	1.21	8	1.2	142	0.03	0.1	0.2	2
2005	2	15	20	31	28.81	121.5700	25.1718	1.18	1.1	10	1.5	99	0.06	0.2	0.3	2
2005	2	15	23	34	38.53	121.5697	25.1728	1.18	1.06	10	1.5	98	0.07	0.2	0.4	2
2005	2	17	23	12	37.31	121.5647	25.1752	0.73	1.06	12	1.3	82	0.06	0.1	0.3	1
2005	2	19	10	3	10.88	121.5853	25.1848	2.33	1.31	14	0.6	211	0.09	0.3	0.4	3
2005	2	19	10	10	3.19	121.5897	25.1863	1.83	1.04	12	0.9	244	0.06	0.2	0.3	3
2005	2	19	10	29	22.92	121.5865	25.1840	2.24	1.24	14	0.8	213	0.09	0.4	0.4	3
2005	2	21	20	50	19.22	121.5658	25.1852	1.28	0.94	10	0.4	145	0.05	0.2	0.2	2
2005	2	22	12	40	32.16	121.5662	25.1730	1.18	1.23	12	1.2	87	0.09	0.2	0.4	1
2005	2	22	15	4	47.53	121.5698	25.1713	0.91	1.12	10	1.4	99	0.08	0.2	0.7	2
2005	2	22	23	20	21.49	121.5582	25.1725	1.51	0.63	12	0.7	95	0.16	0.5	0.7	2
2005	2	23	17	4	20.29	121.5917	25.1880	2.12	1.28	8	3	308	0.06	0.4	0.4	3

2005	2	24	18	28	25.57	121.5845	25.1707	0.52	0.97	6	2.8	275	0.04	0.9	4.7	3
2005	2	24	23	2	4.68	121.5460	25.1753	2.46	0.81	12	1.4	121	0.18	0.5	0.6	2
2005	2	27	3	36	37.83	121.5463	25.1770	0.98	0.9	6	1.5	147	0.06	0.1	0.2	2
2005	2	28	13	13	24.44	121.5383	25.1647	1.51	1.04	10	1.5	113	0.06	0.2	0.3	2
2005	3	5	13	5	29.52	121.5275	25.1555	3.67	0.84	8	0	225	0.03	0.3	0.2	3
2005	3	5	13	7	30.22	121.5295	25.1568	3.78	1.15	12	0.2	142	0.1	0.6	0.5	2
2005	3	5	13	8	53.5	121.5358	25.1638	4.73	0.8	11	1.3	126	0.07	0.4	0.4	2
2005	3	5	13	12	20.29	121.5312	25.1568	3.81	0.95	12	0.4	134	0.1	0.6	0.5	2
2005	3	5	20	14	13.94	121.5237	24.7533	6.84	1.86	7	43.9	352	0.15	237	493	4
2005	3	7	5	2	26.58	121.5452	25.1712	1.04	0.01	7	1.2	161	0.04	0.1	0.1	2
2005	3	7	19	15	46.27	121.5960	25.1555	1.81	0	5	0.2	267	0.07	3.9	5.1	4
2005	3	8	2	20	17.8	121.5255	25.1140	13.85	0.98	8	5.3	320	0.16	4.8	2.2	4
2005	3	8	15	58	10.28	121.5560	25.1475	4.39	1.01	12	0.6	204	0.14	0.8	0.7	3
2005	3	9	17	40	4.92	121.5578	25.1613	1.57	0.86	8	0.6	155	0.19	1.1	1.1	3
2005	3	15	12	13	18.58	121.5763	25.1700	0.48	0.39	5	2	249	0.01	0.3	1.1	3
2005	3	16	1	7	47.97	121.5465	25.1703	1.09	1.73	9	1.1	94	0.07	0.3	0.4	2
2005	3	16	9	59	25.06	121.5688	25.1710	1.04	0.24	6	1.3	217	0.01	0.1	0.1	3
2005	3	16	13	19	31.12	121.5418	25.1710	1.07	0.57	6	1.5	207	0.02	0.2	0.2	3
2005	3	17	1	16	25.06	121.5463	25.1703	1.63	0.67	12	1.1	95	0.07	0.1	0.2	2
2005	3	20	12	50	31.85	121.5502	25.1712	1.11	0.38	9	0.8	96	0.04	0.2	0.3	2
2005	3	21	22	21	1.24	121.5422	25.1573	2.15	0.43	7	1.5	144	0.03	0.3	0.3	2
2005	3	23	3	25	27.43	121.5330	25.1718	2.54	0.44	10	1	155	0.06	0.3	0.3	2
2005	3	23	23	45	13.29	121.5548	25.0698	11.65	2.28	12	8.7	333	0.09	1.8	1.4	3
2005	3	27	6	40	50.01	121.5913	25.1737	1.03	0.61	8	2	258	0.05	0.4	0.6	3
2005	3	27	6	43	7.75	121.5868	25.1703	0.12	0.66	6	2.2	242	0.01	0.1	1.2	3
2005	3	28	6	49	59.29	121.5478	25.1710	0.92	0.84	10	1	97	0.06	0.1	0.2	2
2005	3	28	16	33	19.54	121.5452	25.1757	1.21	0.66	12	1.5	123	0.09	0.2	0.4	2
2005	3	28	16	38	13.97	121.5648	25.1808	1.3	0.2	10	0.7	124	0.04	0.2	0.2	2
2005	3	28	16	38	53.98	121.5585	25.1880	2.52	0.08	8	0.4	193	0.17	0.6	0.5	3
2005	3	28	16	33	19.51	121.5448	25.1752	1.42	1.19	12	1.5	120	0.1	0.3	0.4	2
2005	3	29	13	55	56.3	121.5428	25.1683	1.37	1.33	12	1.4	94	0.08	0.3	0.4	2
2005	3	29	15	21	30.64	121.5465	25.1780	1.09	1.31	12	1.6	138	0.08	0.2	0.4	2
2005	3	30	6	43	39.61	121.5500	25.1717	1.92	0.97	12	0.9	99	0.12	0.4	0.5	2
2005	3	30	19	8	13.02	121.5488	25.1693	1.01	0.49	8	0.8	155	0.03	0.1	0.2	2
2005	3	30	19	7	35.72	121.5502	25.1695	1.91	0.31	10	0.7	90	0.07	0.1	0.1	1
2005	3	30	19	8	46.69	121.5690	25.1682	1.14	0.15	6	1.3	217	0.06	0.6	0.4	3
2005	3	30	19	8	49.46	121.5488	25.1702	0.99	0.41	8	0.9	153	0.08	0.1	0.2	2
2005	3	30	19	9	15.59	121.5553	25.1737	1.26	0.5	10	0.8	117	0.15	0.5	0.7	2

2005	3	30	19	12	14.78	121.5502	25.1682	1.82	0.16	8	0.7	155	0.14	0.4	0.5	2
2005	3	30	19	13	27.92	121.5497	25.1693	1.78	0.3	8	0.8	152	0.08	0.1	0.1	2
2005	3	30	19	19	6.99	121.5520	25.1742	1.67	0.33	12	1	108	0.16	0.5	0.6	2
2005	3	30	19	19	29.49	121.5485	25.1732	2.31	0.79	12	1.1	108	0.15	0.4	0.5	2
2005	3	30	19	32	40.2	121.5507	25.1700	1.48	0.53	12	0.7	91	0.16	0.5	0.7	2
2005	4	3	4	8	47.91	121.632	25.1635	5.96	1.38	7	5.9	318	0.15	4.7	7.1	4
2005	4	3	20	39	40.17	121.5548	25.1695	0.71	-0.01	7	0.4	171	0.19	0.8	3.6	3
2005	4	4	11	30	51.22	121.5482	25.17083	1.1	0.78	10	1	97	0.07	0.2	0.5	2
2005	4	4	13	52	30.28	121.9642	25.11617	2.84	1.59	9	39.5	353	0.08	226.4	265.1	4
2005	4	5	15	33	23.53	121.5747	25.0965	8.02	0.55	10	5.9	331	0.08	1.2	1.2	3
2005	4	7	0	27	25.21	121.55	25.1725	1.28	1.18	12	0.9	102	0.07	0.2	0.4	2
2005	4	7	13	36	50.51	121.5728	25.17117	1.01	0.35	8	1.7	181	0.04	0.2	0.3	3
2005	4	8	0	12	33.43	121.545	25.17067	1.07	1.75	9	1.8	95	0.05	0.2	0.3	2
2005	4	8	0	14	7.03	121.5495	25.17283	1.3	1.09	9	2	105	0.08	0.3	0.6	2
2005	4	8	15	15	20.15	121.572	25.17733	2.72	0.69	10	1.4	163	0.1	0.5	0.5	2
2005	4	8	18	42	53.05	121.5825	25.17283	1.28	1.06	8	1.8	222	0.05	0.4	0.5	3
2005	4	8	20	16	33.88	121.5843	25.17467	1.29	0.27	7	1.6	230	0.08	0.6	0.8	3
2005	4	11	11	4	6.32	121.5528	25.17617	2	0.38	12	1.1	116	0.12	0.3	0.4	2
2005	4	14	9	9	14.79	121.5448	25.17183	1.1	0.42	10	1.3	101	0.07	0.2	0.4	2
2005	4	15	8	11	45.93	121.5542	25.17517	2.19	0.42	10	1	119	0.15	0.7	0.7	2
2005	4	15	11	33	47.41	121.5738	25.17033	0.82	0.34	8	1.8	187	0.03	0.2	0.5	3
2005	4	15	12	26	45.47	121.5753	25.15717	3.9	0.48	10	1.7	174	0.1	0.6	0.7	2
2005	4	15	17	20	47.35	121.574	25.171	0.49	0.53	8	1.8	186	0.07	0.3	1.7	3
2005	4	15	18	30	50.7	121.5727	25.17183	1.1	0.63	8	1.7	179	0.03	0.2	0.2	2
2005	4	16	19	11	8.86	121.5698	25.171	0.81	0.47	10	1.4	116	0.08	0.3	0.9	2
2005	4	16	21	4	15.97	121.547	25.17383	1.17	0.77	14	1.2	111	0.12	0.3	0.5	2
2005	4	17	1	2	25.24	121.5728	25.17033	0.94	0.63	8	1.7	182	0.02	0.1	0.3	3
2005	4	18	15	57	14.03	121.5678	25.17317	1.6	0.86	10	1.4	156	0.08	0.2	0.3	2
2005	4	21	14	45	26.04	121.5698	25.17233	0.97	0.84	12	1.5	89	0.07	0.2	0.5	1
2005	4	21	16	15	52.03	121.568	25.17217	1	0.47	10	1.3	110	0.06	0.2	0.3	2
2005	4	22	4	49	30.34	121.5735	25.16933	1.05	0.65	10	1.7	129	0.07	0.2	0.4	2
2005	4	22	23	15	34.94	121.535	25.1665	1.88	0.7	8	1.4	137	0.07	0.3	0.4	2
2005	4	23	14	35	10.65	121.543	25.174	1.06	0.82	8	1.4	156	0.06	0.3	0.4	2
2005	4	23	22	10	32.41	121.5687	25.159	4.51	0.6	16	1.4	107	0.08	0.3	0.3	2
2005	4	23	22	26	1.71	121.5435	25.16567	2.68	0.7	12	1.3	98	0.08	0.3	0.4	2
2005	4	26	21	31	10.2	121.568	25.17217	1.53	0.47	10	1.3	98	0.07	0.3	0.4	2
2005	4	27	11	48	43.17	121.568	25.17183	1.58	0.47	12	1.3	97	0.08	0.2	0.3	2
2005	4	27	22	16	50.32	121.5827	25.1725	1.28	0.69	10	1.8	156	0.12	0.4	0.7	2

2005	4	30	7	30	56.87	121.57	25.11617	10.35	0.78	10	4.8	299	0.14	2.2	1.5	3
2005	5	3	0	49	59.26	121.5515	25.17417	2.06	1.13	14	1	109	0.1	0.3	0.4	2
2005	5	3	1	47	7.42	121.5433	25.17483	1.17	0.67	13	1.4	117	0.11	0.3	0.4	2
2005	5	3	11	11	2.59	121.5458	25.16733	3.06	1.25	14	1.1	91	0.12	0.5	0.5	2
2005	5	3	18	47	45.02	121.5452	25.17633	0.98	0.7	6	1.5	157	0.06	0.1	0.2	2
2005	5	5	13	11	32.34	121.5878	25.18283	2.36	0.64	12	1	151	0.09	0.3	0.4	2
2005	5	7	17	52	48.78	121.5712	25.17517	1.44	0.53	11	1.5	102	0.09	0.3	0.4	2
2005	5	8	11	37	28.51	121.5582	25.171	1.88	0.87	14	0.5	82	0.14	0.4	0.5	1
2005	5	9	16	23	56.3	121.5723	25.17717	1.37	0.56	14	1.4	94	0.14	0.4	0.5	2
2005	5	13	16	48	44.7	121.5745	25.17583	1.13	0.55	10	1.6	99	0.18	0.6	1.2	2
2005	5	13	18	3	47.5	121.5907	25.14233	6.7	1.06	8	4.4	316	0.1	2.1	1.7	3
2005	5	13	19	31	40.73	121.5758	25.16867	1.09	0.26	5	2	251	0.03	0.1	0.1	3
2005	5	13	19	31	40.96	121.5757	25.16683	0.24	0.26	6	1.9	257	0.04	0.4	3.2	3
2005	5	13	19	36	19.44	121.5098	25.21917	0.49	-0.14	5	6.4	334	0.16	1.5	18.3	4
2005	5	13	20	26	30.66	121.5733	25.17033	0.81	0.32	6	1.8	236	0.04	0.2	0.5	3
2005	5	13	20	39	17.54	121.5478	25.17683	1	-0.07	4	1.4	271	0.02			3
2005	5	13	20	31	30.63	121.5723	25.16117	1.19	1.02	7	1.7	275	0.1	0.8	0.8	3
2005	5	13	20	35	22.48	121.577	25.16817	1.8	0.94	5	2.1	169	0.22	0.7	0.7	3
2005	5	13	20	44	9.42	121.5522	25.17567	2.08	-0.2	4	1.1	244	0.09			3
2005	5	13	20	55	1.65	121.5752	25.17117	1.07	-0.15	5	2	238	0.02	0.2	0.3	3
2005	5	13	21	13	14.58	121.5703	25.16817	2.06	0.61	9	1.4	139	0.15	0.8	1	2
2005	5	14	12	25	42.59	121.5543	25.19067	3.89	0	6	0.9	209	0.14	2	1.4	3
2005	5	15	14	22	1.9	121.5433	25.17117	1.18	0.56	8	1.4	110	0.03	0.1	0.2	2
2005	5	15	17	9	53.24	121.5693	25.17333	1.1	0.72	11	1.5	109	0.1	0.3	0.5	2
2005	5	15	17	11	29.21	121.5745	25.16533	2.1	-0.11	6	1.8	260	0.23	0	0	3
2005	5	16	7	49	38.13	121.5668	25.15867	6.46	0.49	12	1.4	164	0.29	2.5	1.5	3
2005	5	16	9	42	58.71	121.5783	25.167	0.73	0.44	7	2.2	196	0.05	0.3	1.4	3
2005	5	16	13	11	20.99	121.5445	25.17233	0.82	-0.05	6	1.4	104	0.04	0.3	0.9	2
2005	5	16	13	20	15.13	121.5745	25.16983	1.13	0.69	4	1.9	241	0.02			3
2005	5	16	20	36	48.86	121.5665	25.17067	0.34	0.63	5	1.1	210	0.04	0.2	1.4	3
2005	5	16	21	38	42.11	121.5737	25.17033	0.8	0.26	6	1.8	236	0.04	0.2	0.6	3
2005	5	17	12	6	44.77	121.561	25.15683	3.68	0.86	13	1.2	171	0.15	0.7	0.8	3
2005	5	17	20	32	34.32	121.5563	25.07233	12.74	1.36	14	8.4	317	0.08	1.5	1	3
2005	5	18	0	26	58.02	121.5183	25.10583	10.78	1.24	5	7.7	331	0.13	6.9	8	4
2005	5	18	3	25	51.16	121.5202	25.1435	3.46	0.57	5	4.5	320	0.07	1.4	1.7	3
2005	5	18	6	42	6.7	121.5927	25.15267	5.46	0.76	4	4	309	0			3
2005	5	18	6	46	40.26	121.5667	25.173	1.48	-0.07	7	1.3	108	0.1	0.7	1.2	2
2005	5	19	2	18	38.96	121.596	25.1555	11.8	1.36	7	0.2	188	1.62	2.9	1.1	4

2005	5	19	4	4	3.46	121.58	25.16333	1.49	1.06	4	2.4	314	0.18			3
2005	5	19	5	28	57.46	121.5668	25.17217	1.1	0.29	10	1.2	113	0.05	0.2	0.3	2
2005	5	19	17	31	22.06	121.5698	25.173	1.29	0.59	10	1.5	111	0.05	0.2	0.3	2
2005	5	20	14	13	15.55	121.5737	25.16817	0.36	-0.27	6	1.7	247	0.04	0.2	0.9	3
2005	5	21	5	51	22.56	121.5605	25.16183	3.09	0.13	11	0.7	153	0.14	0.6	0.9	2
2005	5	21	10	1	21.05	121.5582	25.16817	2.84	0.74	11	0.2	109	0.08	0.3	0.3	2
2005	5	21	14	11	25.57	121.5868	25.18717	2.43	0.34	9	0.6	186	0.03	0.1	0.2	3
2005	5	21	14	15	38.49	121.5853	25.187	2.41	0.34	8	0.5	177	0.04	0.2	0.2	2
2005	5	21	23	41	35.36	121.614	25.2095	2.56	1	9	3.6	294	0.06	0.4	0.5	3
2005	5	22	23	34	19.72	121.5697	25.1735	1.09	0.51	9	1.5	109	0.05	0.2	0.4	2
2005	5	23	10	47	47.52	121.5718	25.16817	0.06	0.49	6	1.6	242	0.04	0.4	9.7	4
2005	5	23	11	12	42.29	121.5705	25.1735	1.16	0.39	6	1.6	210	0.04	0.4	0.4	3
2005	5	23	14	24	49.68	121.573	25.17033	0.72	0.69	6	1.7	234	0.03	0.2	0.5	3
2005	5	23	18	8	22.74	121.5503	25.17683	1.43	0.77	8	1.3	131	0.09	0.5	0.5	2
2005	5	23	19	51	55.63	121.5632	25.18717	2.25	1.15	10	0.1	186	0.15	0.7	0.7	3
2005	5	23	20	12	58.5	121.5733	25.1705	0.79	0.49	6	1.8	235	0.04	0.3	0.6	3
2005	5	23	20	13	58.8	121.5347	25.1645	2.21	0.49	8	1.2	136	0.06	0.3	0.4	2
2005	5	23	20	24	1.09	121.5653	25.1715	1.05	0.51	12	1	115	0.09	0.3	0.3	2
2005	5	23	20	32	58.72	121.5415	25.17817	1.95	0.76	6	1.1	156	0.09	0.2	0.1	2
2005	5	24	17	34	7.66	121.5622	25.17683	2.32	0.9	6	1.1	153	0.16	0.3	0.2	3
2005	5	25	7	49	38.65	121.5732	25.1715	1.08	0.42	6	1.8	230	0.03	0.1	0.2	3
2005	5	25	7	49	43.34	121.5715	25.17183	1.05	0.43	6	1.6	223	0.05	0.3	0.4	3
2005	5	25	13	48	1.59	121.5668	25.17383	1.16	0.83	12	1.3	89	0.13	0.3	0.6	1
2005	5	25	19	7	2.73	121.5715	25.171	0.98	0.94	6	1.6	227	0.03	0.2	0.4	3
2005	5	25	20	23	50.66	121.5715	25.17183	1.01	0.5	6	1.6	223	0.02	0.2	0.2	3
2005	5	25	20	40	19.94	121.5743	25.16983	0.97	-0.04	6	1.8	241	0.02	0.2	0.3	3
2005	5	25	20	40	28.07	121.5715	25.17267	1.28	0.14	6	1.7	218	0.02	0.2	0.2	3
2005	5	25	21	5	11.62	121.5715	25.17117	1.01	0.61	6	1.6	226	0.04	0.4	0.4	3
2005	5	26	17	55	50.29	121.5982	25.186	2.82	0.78	12	1.7	203	0.09	0.4	0.4	3
2005	5	27	12	5	15.55	121.5722	25.1825	1.28	0.62	12	1.1	118	0.1	0.3	0.4	2
2005	5	27	12	27	19.12	121.5767	25.17483	1.29	0.53	10	1.6	160	0.16	0.7	0.9	3
2005	5	28	19	19	18.03	121.566	25.172	1.18	1.4	12	1.1	87	0.08	0.2	0.4	1
2005	5	28	19	40	25.57	121.5732	25.16817	0.26	0.58	6	1.7	245	0.05	0.2	1.7	3
2005	5	29	10	42	43.23	121.5518	25.17183	1.42	0.81	12	0.8	97	0.07	0.2	0.3	2
2005	5	30	0	49	24.35	121.577	25.16817	0.05	0.52	6	2.1	255	0.03	0.3	10.3	4
2005	5	30	15	50	11.75	121.5803	25.16817	1.8	0.78	6	2.3	264	0.23	0.3	0.3	3
2005	5	30	16	49	13.99	121.5713	25.1725	1.31	0.77	14	1.6	68	0.14	0.3	0.6	1
2005	5	30	20	23	42.86	121.5697	25.177	1.01	0.93	10	1.3	95	0.11	0.4	0.7	2

2005	5	30	21	5	39.02	121.5865	25.167	5.16	0.73	8	1.7	117	0.08	0.8	0.6	2
2005	6	1	12	52	6.58	121.5687	25.1732	1.02	0.56	10	1.4	109	0.05	0.2	0.3	2
2005	6	2	6	43	3.62	121.5650	25.1702	1.12	0.54	6	0.9	131	0.03	0.2	0.2	2
2005	6	2	15	43	14	121.5468	25.1778	1.21	0.68	12	1.6	140	0.08	0.3	0.3	2
2005	6	3	1	0	33.82	121.5683	25.1718	0.93	1.06	16	1.3	67	0.07	0.1	0.4	1
2005	6	3	3	46	49.35	121.5870	25.1863	2.12	0.33	11	0.7	176	0.06	0.2	0.3	2
2005	6	3	3	54	22.03	121.5842	25.1860	2.2	0.66	12	0.5	154	0.06	0.2	0.2	2
2005	6	4	4	23	15.27	121.5843	25.1812	2.31	0.9	12	0.9	121	0.05	0.2	0.2	2
2005	6	5	13	11	41.22	121.5673	25.1720	1.05	0.83	14	1.2	65	0.06	0.1	0.2	1
2005	6	5	14	17	46.99	121.5288	25.2113	6.32	0.74	8	4.3	325	0.29	4.5	2.6	4
2005	6	5	14	33	54.43	121.5638	25.1643	1.59	0.44	10	0.8	215	0.26	1.2	1.3	3
2005	6	5	15	23	14.88	121.5657	25.1752	0.91	0.22	12	1.3	95	0.13	0.3	0.7	2
2005	6	5	19	12	50.27	121.5672	25.1735	1.25	0.17	12	1.3	106	0.09	0.2	0.3	2
2005	6	5	21	40	10.47	121.5662	25.1725	1.08	0.07	10	1.6	159	0.1	0.4	0.6	2
2005	6	6	5	34	35.66	121.5688	25.1740	1.01	0.25	12	1.5	105	0.08	0.2	0.3	2
2005	6	6	6	35	25.22	121.5757	25.1682	2.1	0.13	8	1.9	190	0.24	0.5	0.8	3
2005	6	7	13	49	35.73	121.5677	25.1750	1.36	0.55	12	1.4	99	0.1	0.3	0.4	2
2005	6	7	14	56	24.51	121.5698	25.1745	1.33	0.32	12	1.5	104	0.06	0.2	0.3	2
2005	6	7	15	35	57.96	121.5678	25.1752	1.24	0.54	12	1.4	99	0.09	0.3	0.4	2
2005	6	7	15	36	5.37	121.5740	25.1717	1.22	0.1	6	1.9	233	0.06	0.7	0.7	3
2005	6	7	16	20	9.19	121.5695	25.1737	1.13	0.63	14	1.5	107	0.1	0.2	0.4	2
2005	6	7	17	39	48.13	121.5690	25.1720	0.99	0.45	12	1.4	116	0.13	0.3	0.8	2
2005	6	10	12	6	1.94	121.5733	25.1698	1.04	0.23	8	1.7	179	0.05	0.2	0.4	2
2005	6	10	13	26	25.24	121.5702	25.1747	1.3	0.41	10	1.5	103	0.1	0.3	0.6	2
2005	6	10	14	6	49.07	121.5808	25.1717	0.94	0.44	10	1.9	111	0.24	0.4	1.5	2
2005	6	11	8	2	1.67	121.5707	25.1750	1.2	0.56	14	1.5	68	0.11	0.3	0.5	1
2005	6	18	20	27	52.01	121.5390	25.1638	9.21	0.76	15	1.5	108	0.14	1.3	0.7	2
2005	6	18	22	35	2.31	121.5497	25.1542	3.87	0.55	12	1.4	155	0.1	0.6	0.5	2
2005	6	22	16	49	53.77	121.5478	25.1745	1.55	0.62	14	1.2	115	0.12	0.4	0.5	2
2005	7	2	5	32	48.15	121.5790	25.1753	1.37	0.82	10	2.1	141	0.23	0.5	1.1	3
2005	7	4	9	25	19.49	121.5452	25.1738	1.11	0.97	15	1.4	112	0.14	0.3	0.6	2
2005	7	5	3	39	6.48	121.5998	25.1915	1.88	0.9	12	1.9	240	0.19	0.8	0.8	3
2005	7	5	4	4	31.68	121.6002	25.1957	1.81	0.94	12	2.1	252	0.18	0.8	0.9	3
2005	7	5	4	4	41.45	121.6113	25.2040	0.32	0.46	10	3	286	0.36	2.1	15.1	4
2005	7	5	12	58	24.47	121.5505	25.1648	2.96	0.88	12	2.2	97	0.19	0.7	0.9	2
2005	7	5	14	33	32.54	121.5550	25.1725	2.13	0.85	14	0.7	94	0.22	0.7	0.9	2
2005	7	13	19	17	44.47	121.5505	25.1803	0.99	0.93	6	1.7	161	0.05	0.3	0.8	2
2005	7	16	18	33	12.14	121.5465	25.1730	1.17	0.99	12	1.2	149	0.05	0.2	0.3	2

2005	7	19	14	7	21.16	121.5488	25.1780	1.39	1.1	12	1.5	136	0.1	0.4	0.4	2
2005	7	19	16	53	12.37	121.5772	25.1760	2.02	0.86	14	1.5	73	0.05	0.2	0.2	1
2005	7	20	5	55	38.41	121.5645	25.1868	2.14	0.79	9	1.7	183	0.07	0.4	0.4	3
2005	7	21	21	3	37.57	121.5455	25.1763	1.96	0.97	12	1.5	154	0.1	0.5	0.3	2
2005	7	23	10	31	29.56	121.5472	25.1750	1.3	1.09	15	1.3	139	0.08	0.2	0.3	2
2005	7	23	12	38	56.79	121.5442	25.1747	1.23	0.75	8	1.5	172	0.04	0.2	0.2	2
2005	7	28	9	32	21.18	121.5423	25.1782	1.28	0.75	6	1.2	152	0.01	0.1	0.1	2
2005	7	28	22	33	7.74	121.5660	25.1833	1.55	0.7	10	0.5	117	0.04	0.2	0.2	2
2005	7	29	21	11	1.25	121.5467	25.1682	1.08	0.7	12	1	167	0.07	0.1	0.2	2
2005	7	31	14	59	3.58	121.5483	25.1720	2.38	0.75	10	1	147	0.06	0.3	0.3	2
2005	8	1	18	3	34.09	121.5887	25.1890	2.14	0.54	8	0.8	209	0.11	0.6	0.7	3
2005	8	5	2	24	48.16	121.5682	25.1722	0.94	0.98	12	1.3	93	0.07	0.1	0.4	2
2005	8	7	20	0	47.87	121.5428	25.1825	1.02	0.84	8	1.2	177	0.09	0.5	0.5	2
2005	8	9	0	36	10.34	121.5475	25.1742	1.65	0.98	13	1.2	141	0.12	0.4	0.5	2
2005	8	12	16	1	40.72	121.5582	25.1773	3.12	0.8	10	1.2	143	0.23	1.1	1.3	3
2005	8	21	22	46	6.08	121.6495	25.1505	10.01	1.89	14	4.8	320	0.18	2	1.2	3
2005	8	25	9	46	57.07	121.5072	25.1262	5.99	0.89	14	3.8	311	0.11	0.8	0.8	3
2005	8	25	18	13	47.2	121.5363	25.1523	3.09	0.49	6	2.6	251	0.02	0.5	0.4	3
2005	8	27	19	33	28.54	121.5825	25.1675	1.05	0.78	12	2.4	154	0.07	0.2	0.4	2
2005	8	29	15	30	7.51	121.5740	25.1600	4.34	0.53	12	1.8	114	0.12	0.6	0.6	2
2005	8	30	15	57	23.92	121.5640	25.1707	1.01	0.66	6	0.9	190	0.02	0.3	0.2	3
2005	8	30	17	50	56.56	121.5767	25.1702	0.82	0.63	6	2.1	251	0.03	0.5	1.1	3
2005	8	30	19	3	42.65	121.5655	25.1708	1.03	0.54	6	1	199	0.02	0.2	0.1	3
2005	9	1	11	2	11.86	121.542	25.1675	3.15	0.82	16	1.5	97	0.13	0.5	0.5	2
2005	9	1	11	3	42.83	121.5353	25.15683	2.4	0.76	12	0.8	147	0.12	0.5	0.5	2
2005	9	1	11	6	55.58	121.5267	25.161	2.57	-0.04	6	0.7	202	0.02	0.2	0.2	3
2005	9	2	13	0	52.3	121.5675	25.172	1.01	0.4	12	1.3	109	0.06	0.2	0.3	2
2005	9	2	18	12	0.93	121.5712	25.17083	0.58	0.47	8	1.6	175	0.09	0.4	1.7	2
2005	9	3	14	2	53.74	121.5825	25.16917	0.23	0.45	6	2.6	269	0.03	0.6	6.2	4
2005	9	3	22	25	21.7	121.5423	25.1755	1.34	0.89	12	1.3	121	0.08	0.3	0.4	2
2005	9	3	23	17	47.35	121.5448	25.176	1.03	0.6	6	1.5	159	0.04	0.2	0.3	2
2005	9	4	15	37	20.45	121.5728	25.17	0.54	0.53	8	1.7	183	0.05	0.2	0.9	3
2005	9	6	4	19	4.25	121.5663	25.1705	1.06	0.63	10	1.1	101	0.07	0.1	0.2	2
2005	9	9	15	31	19.46	121.552	25.17817	1.03	0.92	14	1.4	149	0.1	0.3	0.4	2
2005	9	10	15	42	21.34	121.5402	25.17283	1.55	0.56	6	1.3	159	0.07	0.2	0.2	2
2005	9	10	20	19	14.98	121.5438	25.1625	2.15	0.62	10	1.4	112	0.08	0.3	0.4	2
2005	9	10	20	22	40.28	121.5582	25.17667	3.09	0.69	12	1.1	169	0.22	1.1	1.2	3
2005	9	13	7	21	49.49	121.5858	25.18167	1.93	0.35	8	1	132	0.09	0.4	0.6	2

2005	9	14	0	24	15.35	121.5712	25.17317	1.4	0.66	10	1.7	146	0.1	0.4	0.6	2
2005	9	16	18	48	32.33	121.5483	25.17517	1.06	0.56	12	1.3	135	0.13	0.4	0.6	2
2005	9	18	13	6	26.53	121.5952	25.17883	3.96	0.61	8	1.7	205	0.07	0.7	0.5	3
2005	9	19	2	44	42	121.544	25.1475	4.31	0.55	6	1.8	253	0.02	0.3	0.2	3
2005	9	19	3	42	32.95	121.5852	25.17967	2.22	0.63	10	1.1	118	0.05	0.2	0.3	2
2005	9	19	20	41	10.68	121.5395	25.16767	1.65	0.72	10	1.7	124	0.07	0.3	0.4	2
2005	9	20	5	1	23.83	121.6185	25.2285	2.71	1.1	14	5.7	307	0.09	0.6	0.4	3
2005	9	20	9	49	56.51	121.543	25.16567	1.6	0.73	13	1.4	97	0.14	0.4	0.6	2
2005	9	20	11	49	58.31	121.5487	25.1745	1.59	0.66	14	1.2	131	0.13	0.4	0.5	2
2005	9	24	2	55	58.31	121.5727	25.17083	0.94	0.24	6	1.7	181	0.02	0.2	0.5	3
2005	9	24	5	28	4.22	121.5693	25.173	0.96	0.47	8	1.5	153	0.08	0.3	0.8	2
2005	9	24	5	35	35.67	121.5722	25.17033	2.4	0.63	10	1.6	128	0.32	0.9	1.4	3
2005	9	24	5	35	49.87	121.564	25.1695	2.7	0.47	6	0.8	234	0.21	0.6	0.5	3
2005	9	24	9	7	27.42	121.5698	25.17467	1.04	0.99	12	1.6	115	0.12	0.3	0.5	2
2005	9	24	9	7	48.16	121.5725	25.1695	0.17	0.58	6	1.6	183	0.06	0.5	5.5	4
2005	9	24	10	2	39.8	121.58	25.174	1.28	0.73	10	1.7	112	0.22	0.5	0.9	2
2005	9	24	13	8	36.23	121.5657	25.16933	1	0.34	6	1	229	0.03	0.2	0.2	3
2005	9	24	13	12	42.91	121.5687	25.1715	0.94	0.41	8	1.3	147	0.1	0.3	1	2
2005	9	24	15	5	22.61	121.5705	25.1735	2.4	0.68	8	1.6	203	0.2	0.8	1	3
2005	9	24	16	4	56.61	121.5697	25.17267	1.14	0.89	8	1.5	149	0.07	0.3	0.5	2
2005	9	24	16	42	6.87	121.5582	25.1795	1.8	0.78	6	1.5	239	0.17	1.8	1.2	3
2005	9	24	16	44	36.09	121.5322	25.1765	3.79	0.91	6	2.7	298	0.04	0.6	0.6	3
2005	9	24	16	49	54.56	121.5728	25.1705	0.99	0.54	6	1.7	182	0.02	0.2	0.4	3
2005	9	24	16	55	15.42	121.5413	25.1825	0.72	0.57	8	2.3	235	0.14	0.7	2.8	3
2005	9	24	21	49	44.01	121.5643	25.16817	1.07	0.63	6	0.8	150	0.12	1.3	1.2	3
2005	9	25	22	58	1.59	121.5495	25.1775	1.28	0.53	6	3.3	258	0.06	0.8	1.3	3
2005	9	26	20	5	0.14	121.5268	25.18917	5.42	0.87	6	3.9	308	0.07	2	1.8	3
2005	9	26	20	19	59.23	121.5733	25.17283	1.77	0.96	6	1.8	180	0.09	1	0.8	2
2005	9	26	21	3	12.59	121.572	25.17333	2.4	0.03	8	1.7	200	0.23	1	1.3	3
2005	9	26	21	3	15.83	121.5807	25.175	1.27	0.86	10	1.6	111	0.25	0.6	1.1	2
2005	9	26	21	25	23.13	121.5683	25.17367	0.94	0.73	8	1.4	160	0.1	0.3	1	2
2005	9	26	22	11	28.27	121.5508	25.171	4.31	0.58	10	0.8	211	0.22	2.3	1.5	3
2005	9	26	22	28	40.81	121.568	25.17267	1	0.63	8	1.3	156	0.06	0.2	0.5	2
2005	9	27	9	27	56.76	121.567	25.174	0.85	0.53	6	1.4	168	0.05	0	0.1	2
2005	9	27	10	26	52.85	121.5663	25.17317	0.96	0.51	6	1.2	167	0.06	0.3	0.8	2
2005	9	27	10	28	2.69	121.5663	25.17333	1.17	0.24	6	1.2	167	0.02	0.1	0.2	2
2005	9	27	10	28	7.63	121.5473	25.18333	6.45	0.68	6	2.1	286	0.04	0.6	0.4	3
2005	9	27	10	35	41.56	121.594	25.15333	1.24	0.47	6	3.2	256	0.32	0.2	0.5	4

2005	9	27	12	31	58.01	121.5735	25.17767	1.86	0.74	8	1.5	156	0.19	0.9	1.2	3
2005	9	27	13	4	56.64	121.5763	25.1765	1.15	0.65	8	1.5	137	0.2	0.8	1.4	3
2005	9	27	14	30	39.85	121.5972	25.17017	0.85	0.78	8	1.7	126	0.22	0.7	2.6	2
2005	9	28	23	51	19.5	121.5542	25.1735	1.13	0.83	8	0.8	254	0.07	0.4	0.4	3
2005	9	29	21	29	38.75	121.5705	25.173	0.61	0.58	6	1.6	147	0.02	0.1	0.5	2
2005	9	29	23	33	53.63	121.5742	25.16733	3.97	0.61	8	1.8	140	0.05	0.3	0.3	2
2005	10	3	18	28	38.48	121.5525	25.17133	3.6	0.95	14	0.7	137	0.09	0.4	0.4	2
2005	10	3	19	42	42.31	121.568	25.17317	1	0.84	13	1.4	64	0.08	0.2	0.3	1
2005	10	5	15	41	59.58	121.5737	25.182	1.46	0.62	12	1.1	110	0.44	1.4	1.7	3
2005	10	5	20	20	22.19	121.6478	25.11883	6.24	2.16	14	6.6	320	0.48	4.4	4.3	4
2005	10	5	20	21	15.5	121.639	25.12433	5.73	1.07	12	5.6	313	0.56	4.9	4.7	4
2005	10	6	18	29	29.96	121.638	25.15333	4.99	1.05	6	3.7	310	0.09	1.4	1.3	3
2005	10	7	17	24	39.26	121.6482	25.11933	6.1	1.44	14	6.6	320	0.49	4.1	3.9	4
2005	10	8	9	54	4.81	121.6595	25.11433	3.21	1.1	6	8.4	325	0.23	3.7	39.6	4
2005	10	9	23	49	49.54	121.6255	25.03533	28.11	1.26	8	14.1	334	0.34	16.6	9.8	4
2005	10	14	15	9	14.92	121.521	25.15133	1.12	0.79	6	3.4	283	0.01	0.1	0.1	3
2005	10	14	23	50	37.11	121.5882	25.17867	0.5	0.59	12	1.4	127	0.24	0.6	2.8	2
2005	10	15	10	16	21.34	121.6553	25.20133	9.46	0.92	10	5.1	330	0.22	3.1	1.9	4
2005	10	15	18	35	3.55	121.5777	25.1985	0.58	0.41	6	4.1	310	0.2	1.5	10.7	4
2005	10	16	19	11	19.85	121.571	25.199	1.41	0.33	8	1.5	278	0.26	1.8	1.4	3
2005	10	16	19	38	26.24	121.5843	25.175	1.47	0.46	10	1.6	98	0.21	0.7	1.2	2
2005	10	17	5	58	38.57	121.5807	25.18067	0.75	0.61	8	2.9	219	0.24	1.1	4.8	3
2005	10	20	5	25	16.81	121.6288	25.11817	1.09	0.67	6	5.3	311	0.1	1.1	4.5	3
2005	10	20	7	5	45.53	121.5897	25.17117	3.38	0.95	12	2	98	0.3	1.3	1.6	2
2005	10	20	7	19	23.09	121.5777	25.18533	5.4	0.59	10	0.5	173	0.22	1.6	1.3	3
2005	10	21	11	19	13.58	121.5792	25.17917	2.7	0.58	8	2.7	239	0.46	2.7	3.1	4
2005	10	21	17	31	23.63	121.5703	25.18967	1.2	0.61	8	2.9	253	0.28	1.3	2.3	3
2005	11	1	13	24	45.53	121.5918	25.1605	6.08	1.35	10	0.8	113	0.28	2.3	1.7	2
2005	11	3	13	8	25.05	121.5638	25.18033	0.75	0.49	8	1.7	149	0.18	0.6	2.2	3
2005	11	3	13	20	19.41	121.5655	25.21367	0.71	0.81	6	5	293	0.25	1.6	12.1	4
2005	11	3	17	41	3.18	121.541	25.06967	25.8	1.39	12	8.9	324	0.38	12.2	5.6	4
2005	11	4	21	18	45.96	121.5815	25.18283	3.28	0.49	8	0.7	212	0.57	3.3	3.1	4
2005	11	4	21	38	13.48	121.5647	25.18033	0.38	0.75	8	1.7	149	0.24	0.6	4.5	3
2005	11	5	7	49	56.33	121.5653	25.176	0.85	0.94	12	1.4	129	0.24	0.5	1.7	2
2005	11	6	20	27	46.55	121.5657	25.1815	0.75	0.43	6	1.9	277	0.31	1.8	4.1	4
2005	11	7	22	16	29.54	121.5582	25.1875	0.75	0.51	6	2.3	280	0.44	3.9	9.9	4
2005	11	10	2	31	37.99	121.6083	25.172	2.76	1.14	12	0.7	180	0.25	1.2	1.1	3
2005	11	10	11	15	18.68	121.5582	25.17583	0.88	0.67	8	1	251	0.28	1.6	2	3

2005	11	11	8	37	57.54	121.5747	25.17633	1	0.7	14	1.5	108	0.28	0.6	1.6	2
2005	11	11	9	5	7.12	121.5732	25.1875	0.9	0.55	8	2.9	278	0.23	2	6.3	4
2005	11	11	14	15	1.3	121.5735	25.16817	3.12	0.73	14	1.7	90	0.32	1.1	1.4	2
2005	11	14	17	56	17.13	121.5582	25.17517	0.38	1.03	8	1	250	0.31	1.3	2.9	4
2005	11	14	18	19	13.06	121.5582	25.17217	0.75	0.58	8	0.6	242	0.27	1	1	3
2005	11	15	20	42	28.3	121.556	25.17167	0.19	0.72	8	0.6	235	0.23	1	2.7	3
2005	11	16	12	25	21.25	121.5582	25.1795	0.75	0.73	8	1.4	260	0.34	1.3	2.3	4
2005	11	17	8	43	29.51	121.5582	25.175	0.75	0.72	8	1	249	0.27	1.3	1.6	3
2005	11	18	20	54	22.77	121.5582	25.17367	0.09	0.57	8	0.8	246	0.18	1	7.5	4
2005	11	20	4	4	15.67	121.5788	25.1945	2.4	0.5	6	3.8	306	0.45	1.7	2.9	4
2005	11	21	4	56	3.74	121.5827	25.17733	0.75	0.67	12	1.3	164	0.28	0.9	2.6	3
2005	11	21	13	45	15.55	121.5473	25.17267	0	0.75	8	1.1	187	0.34	1.3	464.1	4
2005	11	24	11	52	22.56	121.5637	25.17767	0.75	0.74	10	1.4	138	0.22	0.6	2.1	3
2005	11	25	19	2	2.11	121.5582	25.1775	1.07	0.75	8	1.2	255	0.31	1.9	1.8	4
2005	11	27	13	44	44.24	121.5862	25.1815	2.1	0.72	12	1	198	0.41	1.4	1.4	4
2005	11	30	2	46	52.67	121.5582	25.16817	1.3	0.4	8	0.2	233	0.3	1.7	1.6	3
2005	11	30	2	46	59.73	121.5582	25.16817	1.24	0.57	8	0.2	233	0.3	1.6	1.6	3
2005	12	2	14	20	34.88	121.6175	25.10267	13.81	0.97	8	6.1	325	0.25	9.2	3.9	4
2005	12	3	1	47	53.68	121.5825	25.17367	2.18	0.58	12	1.7	157	0.21	0.8	1	3
2005	12	3	13	27	9.2	121.5507	25.14983	6.87	0.52	6	1.2	185	0.08	1.7	0.7	3
2005	12	4	15	11	15.66	121.5517	25.174	0.38	0.68	8	1	220	0.27	1.1	3	3
2005	12	5	20	21	44.57	121.5845	25.18	2.98	0.61	10	1.1	181	0.47	1.7	1.9	4
2005	12	7	6	56	20.41	121.5637	25.17933	0.38	0.46	10	1.6	146	0.19	0.5	3.5	3
2005	12	7	10	16	37.36	121.5675	25.17633	0.76	0.44	12	1.6	126	0.22	0.4	1.8	2
2005	12	7	10	17	46.92	121.568	25.177	0.73	0.4	12	1.6	128	0.21	0.4	1.8	2
2005	12	7	19	53	56.99	121.5472	25.17183	3.37	0.17	6	1.9	208	0.02	0.2	0.2	3
2005	12	7	19	54	9.07	121.5727	25.19033	1.5	0.6	10	3.1	256	0.29	1.6	2.6	3
2005	12	7	19	54	21.04	121.5327	25.162	3.12	-0.06	6	0.9	144	0.02	0.3	0.2	2
2005	12	7	19	54	42.09	121.5485	25.16817	0.92	0.26	8	0.8	154	0.3	1.2	2.2	3
2005	12	7	19	54	50.11	121.5522	25.17467	1.8	-0.12	8	1	226	0.07	0.4	0.4	3
2005	12	7	19	54	52.9	121.5447	25.16817	1.18	0.2	8	1.2	142	0.33	1.4	2.1	3
2005	12	7	19	54	57.22	121.5482	25.16817	0.94	0.26	8	0.9	153	0.31	1.2	2.3	3
2005	12	9	20	19	22.43	121.5582	25.182	0.16	0.24	6	1.7	267	0.41	3.1	25.1	4
2005	12	9	20	20	14.02	121.5638	25.17917	0.63	0.67	10	1.6	145	0.24	0.6	2.6	3
2005	12	10	2	31	21.84	121.5733	25.1715	1.27	0.69	12	1.8	112	0.22	0.6	1.2	2
2005	12	11	9	2	45.57	121.5655	25.16817	1.38	0.64	8	0.9	257	0.24	1.5	1.3	3
2005	12	11	21	51	46.97	121.5568	25.161	1.3	0.55	6	1.5	209	0.16	0.3	0.4	3
2005	12	12	22	43	49.53	121.5473	25.16817	0.08	0.42	8	0.9	150	0.29	0.9	15.6	3

2005	12	13	10	43	39.12	121.5585	25.17883	1.51	0.51	6	2.8	260	0.02	0.2	0.2	3
2005	12	14	1	11	37.97	121.5505	25.16883	0.27	0.4	8	0.7	170	0.29	0.7	2.5	3
2005	12	15	5	16	44.18	121.531	25.159	2.5	0.48	6	0.5	144	0.03	0.3	0.3	2
2005	12	15	13	28	25.91	121.6013	25.17867	7.16	0.83	12	2.4	255	0.21	1.8	1.3	3
2005	12	16	3	7	36.36	121.5528	25.18283	0.03	0.53	6	1.8	307	0.13	1.1	50.6	4
2005	12	16	9	16	59.73	121.5608	25.175	0.43	0.71	10	1	130	0.2	0.5	2.5	2
2005	12	18	10	50	11.89	121.5622	25.1775	0.38	0.73	10	1.4	139	0.23	0.6	3.9	3
2005	12	21	3	7	30.35	121.5627	25.204	0.36	0.63	8	2.5	279	0.22	2.2	14.4	4
2005	12	23	16	34	28.42	121.554	25.191	0.22	-0.18	8	2.7	241	0.13	0.8	9.4	4
2005	12	23	16	34	28.32	121.554	25.19367	0.12	-0.16	8	2.8	249	0.13	0.7	16	4
2005	12	24	7	30	4.87	121.5697	25.179	0.07	0.88	8	1.6	167	0.28	1.2	23.1	3
2005	12	26	0	34	1.25	121.5665	25.20133	1.01	0.89	6	2	299	0.22	2.3	2.1	3
2005	12	26	0	34	6.99	121.5825	25.19067	1.5	-0.18	6	0.2	329	0.41	3.4	2.2	4
2005	12	27	11	44	8.77	121.5763	25.26067	5.47	1.02	6	10.6	344	0.1	3	7.3	4
2005	12	27	18	3	38.61	121.5588	25.18133	0.75	0.81	8	1.7	202	0.21	0.9	2.1	3
2005	12	29	9	4	53.37	121.5612	25.18233	0.25	0.58	6	1.8	272	0.3	1.7	10	4
2005	12	31	14	36	36.2	121.5787	25.19267	0.93	0.61	6	3.7	304	0.3	3.2	12.9	4
2006	1	3	19	49	55.09	121.5667	25.17383	0.96	0.47	14	1.3	118	0.07	0.1	0.4	2
2006	1	6	14	11	38.62	121.5772	25.1855	2.49	0.58	14	0.5	139	0.09	0.3	0.3	2
2006	1	6	14	11	50.61	121.5763	25.187	2.35	0.21	10	0.5	162	0.07	0.3	0.3	2
2006	1	9	1	23	13.17	121.5472	25.17817	1.18	0.87	8	1.6	213	0.12	0.6	0.8	3
2006	1	9	1	23	3.62	121.5417	25.181	1.17	0.74	6	2.2	291	0.08	0.9	1	3
2006	1	9	21	8	9.22	121.548	24.947	7.09	1.55	14	22.3	341	0.14	1.6	157.6	4
2006	1	10	15	56	42.82	121.5393	25.16417	2.25	0.57	8	1.5	107	0.02	0.1	0.1	2
2006	1	10	23	5	23.43	121.6107	25.14217	4.61	0.42	10	2.1	275	0.16	1.5	1	3
2006	1	10	23	58	19.11	121.5293	25.1645	2.13	0.43	8	1	178	0.03	0.2	0.2	2
2006	1	12	2	19	20.01	121.5413	25.16867	0.74	0.47	8	1.7	111	0.1	0.3	1.3	2
2006	1	12	2	19	51.96	121.5408	25.16967	1.02	0.48	8	1.6	109	0.09	0.3	0.7	2
2006	1	16	5	33	8.22	121.6268	25.23817	6.87	0.99	16	6.9	316	0.09	0.7	0.7	3
2006	1	16	8	10	55.59	121.6298	25.2405	6.22	0.93	16	7.2	318	0.08	0.6	0.7	3
2006	1	16	21	34	56.52	121.5963	25.15233	10.73	0.63	14	0.3	232	0.12	1.3	0.7	3
2006	1	20	10	54	53.56	121.532	25.15683	3.97	0.6	10	0.5	139	0.08	0.6	0.4	2
2006	1	21	20	48	39.35	121.539	25.1705	2.37	0.23	10	1.4	113	0.1	0.4	0.6	2
2006	1	26	2	37	1.75	121.546	25.1605	2.11	0.48	8	1.3	122	0.05	0.3	0.4	2
2006	1	27	20	27	4.31	121.5443	25.16817	1.3	0.72	16	1.2	88	0.1	0.2	0.3	1
2006	1	27	20	27	17.77	121.5433	25.1705	1.82	0.33	12	1.4	91	0.05	0.2	0.2	2
2006	1	27	20	29	15.78	121.5412	25.16817	1.02	0.44	10	1.6	102	0.05	0.1	0.3	2
2006	1	28	22	22	52.43	121.6602	25.1455	7.12	1.3	16	6	326	0.6	5	3.2	4

2006	1	28	22	41	18.6	121.6368	25.163	7.82	0.97	14	2.9	314	0.13	1.1	0.7	3
2006	1	29	4	29	29.37	121.5675	25.174	1.04	0.27	14	1.4	75	0.05	0.1	0.2	1
2006	1	29	21	52	17.93	121.6297	25.15917	11.42	0.79	10	2.7	301	0.13	1.9	0.9	3
2006	1	30	15	28	30.54	121.5817	25.18117	1.26	0.56	14	0.9	103	0.04	0.1	0.1	2
2006	1	30	15	36	6.36	121.5807	25.18083	1.52	1.05	16	0.9	96	0.08	0.2	0.3	2
2006	1	30	15	35	40.27	121.5817	25.18167	1.41	0.77	14	0.8	105	0.03	0.1	0.1	2
2006	1	30	15	35	48.73	121.5812	25.17967	1.3	0.5	14	1	97	0.07	0.2	0.3	2
2006	1	30	15	37	39.65	121.5823	25.18283	1.32	0.42	14	0.7	114	0.05	0.2	0.2	2
2006	1	30	15	37	50.81	121.5825	25.183	1.56	0.6	14	0.7	116	0.05	0.1	0.2	2
2006	1	30	15	40	29.52	121.5825	25.18233	1.43	0.51	14	0.8	114	0.04	0.1	0.2	2
2006	1	30	20	33	49.77	121.6168	25.22317	4.88	1.01	16	5.1	304	0.09	0.5	0.6	3
2006	1	30	20	35	23.66	121.6215	25.22417	4.24	1.05	14	5.3	308	0.08	0.5	0.6	3
2006	1	30	22	9	43.71	121.618	25.22	5.53	1.01	16	4.8	303	0.07	0.5	0.4	3
2006	1	31	15	30	14.26	121.5825	25.181	1.22	0.68	16	0.9	109	0.08	0.2	0.3	2
2006	2	1	16	24	39.6	121.5637	25.07067	11.56	1	16	8.6	316	0.14	1.5	1.4	3
2006	2	2	13	5	20.64	121.5555	25.17817	1.21	0.59	16	1.3	76	0.1	0.2	0.3	1
2006	2	4	11	7	39.29	121.6882	25.13983	6.77	1.27	16	8.7	336	0.63	5.9	2.4	4
2006	2	7	0	31	16.68	121.5452	25.1725	1.05	0.77	8	1.7	125	0.04	0.1	0.2	2
2006	2	7	7	38	49.85	121.566	25.17367	1.1	0.36	14	1.2	74	0.06	0.1	0.3	1
2006	2	10	19	21	16.22	121.5647	25.1855	1.88	0.65	14	1.2	138	0.06	0.2	0.2	2
2006	2	10	19	21	53.02	121.5638	25.184	1.88	0.68	16	1.3	124	0.09	0.3	0.3	2
2006	2	13	15	23	38.49	121.5715	25.12867	6.29	0.57	12	2.4	285	0.19	1.7	1	3
2006	2	13	16	36	21.36	121.561	25.16317	3.62	0.6	16	0.6	79	0.11	0.4	0.4	1
2006	2	14	14	17	26.96	121.5682	25.17217	0.98	0.56	14	1.3	93	0.08	0.1	0.5	2
2006	2	17	11	33	23.56	121.591	25.18717	2.32	0.77	15	1	196	0.06	0.2	0.2	3
2006	2	18	12	46	56.61	121.5315	25.161	1.79	0.75	16	0.7	150	0.1	0.3	0.3	2
2006	2	19	22	52	23.25	121.5437	25.17183	1.05	0.64	12	1.4	88	0.12	0.3	0.6	1
2006	2	21	11	47	34.75	121.5577	25.16167	4.08	0.71	14	0.5	93	0.15	0.7	0.7	2
2006	2	21	11	56	20.95	121.5417	25.14067	4.55	0.45	10	2.1	244	0.1	0.7	0.6	3
2006	2	25	18	28	12.98	121.551	25.18217	1.21	0.58	10	1	146	0.11	0.4	0.6	2
2006	2	26	4	56	4.6	121.5462	25.18117	1.49	0.67	8	1.3	126	0.07	0.4	0.4	2
2006	2	26	4	58	10.86	121.533	25.19233	1	0.62	8	1.3	267	0.44	2.7	2	4
2006	2	28	18	16	2.19	121.5483	25.17333	3.4	0.86	16	1.1	80	0.16	0.5	0.6	2
2006	3	2	11	37	4.18	121.5433	25.17233	2.79	1.06	16	1.5	88	0.15	0.4	0.5	1
2006	3	2	11	37	23.9	121.5605	25.17167	3.43	0.53	12	0.7	137	0.27	1.2	1.4	3
2006	3	2	11	37	39.27	121.5388	25.1665	2.2	0.34	6	1.7	156	0.07	0.5	0.6	2
2006	3	5	5	27	44.4	121.5437	25.17633	2.62	0.64	12	1.3	101	0.17	0.7	0.7	2
2006	3	5	5	39	5.08	121.5555	25.18017	1.68	0.45	8	1.2	177	0.1	0.6	0.6	2

2006	3	5	5	46	3.88	121.5372	25.16333	2.24	0.62	10	1.3	117	0.11	0.5	0.7	2
2006	3	5	5	50	35.61	121.5482	25.1775	2.36	0.9	16	1.5	98	0.12	0.4	0.5	2
2006	3	5	5	51	11.2	121.5403	25.17083	1.75	-0.02	10	1.4	105	0.17	0.6	0.9	2
2006	3	5	6	14	59.55	121.5432	25.17317	2.58	0.7	14	1.5	88	0.17	0.5	0.7	2
2006	3	5	7	33	41.56	121.552	25.16933	2.63	0.63	16	0.5	81	0.16	0.5	0.7	2
2006	3	5	20	8	5.35	121.5497	25.181	1.1	0.78	16	1.2	112	0.16	0.4	0.5	2
2006	3	8	10	34	40.23	121.6463	25.23717	6.45	0.94	14	7.5	326	0.14	1.2	1.4	3
2006	3	12	13	19	16.43	121.565	25.17433	1.05	0.33	12	1.2	83	0.22	0.5	1	2
2006	3	13	23	59	5	121.5492	25.1625	2.88	0.32	10	0.9	109	0.09	0.5	0.5	2
2006	3	14	0	57	17.49	121.5522	25.18	0.35	0.42	10	1.2	108	0.21	0.5	3.1	2
2006	3	14	2	8	23.12	121.5488	25.18517	2.14	0.37	8	0.8	144	0.26	1.2	1.3	3
2006	3	14	22	59	36.44	121.5452	25.17067	1.3	0.4	12	1.2	83	0.09	0.3	0.4	1
2006	3	19	16	16	54.31	121.5445	25.1675	2.44	0.62	14	1.2	90	0.1	0.3	0.4	2
2006	3	19	23	7	49.33	121.5522	25.176	1.43	0.33	16	1.1	81	0.09	0.2	0.3	1
2006	3	20	16	37	23.69	121.5478	25.1765	3.38	0.31	8	1.7	192	0.13	1	1.2	3
2006	3	20	21	23	52.42	121.5463	25.16883	2.47	0.46	10	2	92	0.13	0.5	0.8	2
2006	3	22	14	32	58.54	121.5815	25.17667	3.14	0.54	16	1.4	92	0.07	0.2	0.3	2
2006	3	22	14	36	25.22	121.584	25.176	2.5	0.23	10	1.5	128	0.04	0.1	0.2	2
2006	3	22	15	37	17.19	121.5823	25.17683	2.75	0.46	15	1.3	96	0.05	0.1	0.2	2
2006	3	22	17	45	53.24	121.5825	25.17817	2.82	0.42	14	1.2	100	0.06	0.2	0.3	2
2006	3	24	9	50	32.58	121.5443	25.17283	1.23	0.71	16	1.4	83	0.09	0.2	0.4	1
2006	3	24	14	48	36.65	121.5437	25.17617	1.3	1.41	12	1.3	100	0.09	0.3	0.4	2
2006	3	25	8	47	49.68	121.533	25.16617	2.47	1.21	10	1.3	151	0.09	0.4	0.5	2
2006	3	25	8	48	46.56	121.5382	25.16333	0.38	0.81	8	1.4	112	0.07	0.2	1.2	2
2006	3	26	2	45	0.06	121.5637	25.17333	1	0.88	13	1	80	0.07	0.1	0.4	1
2006	3	26	10	50	44.78	121.5437	25.1655	1.17	1.22	16	1.3	98	0.12	0.3	0.5	2
2006	3	26	17	50	5.12	121.5673	25.17433	0.86	1.26	16	1.4	77	0.09	0.2	0.6	1
2006	3	29	13	30	21.16	121.566	25.17417	0.95	1.37	16	1.3	76	0.1	0.2	0.5	1
2006	3	29	17	27	17.16	121.5638	25.1745	1.74	1.15	12	1.2	80	0.06	0.2	0.3	1
2006	3	29	18	17	7.22	121.567	25.17533	0.94	1.01	16	1.4	80	0.09	0.1	0.5	1
2006	3	30	2	0	17.04	121.567	25.17667	1.09	1.11	12	1.5	87	0.08	0.1	0.3	1
2006	3	30	2	2	45.55	121.5368	25.174	1.79	1.31	12	0.9	120	0.1	0.3	0.4	2
2006	3	30	5	15	32.62	121.548	25.16817	1.42	1.27	14	0.9	87	0.17	0.4	0.8	2
2006	3	30	5	26	41.39	121.5415	25.1705	2.3	1.06	10	1.5	99	0.18	0.7	0.9	2
2006	3	30	8	3	46.66	121.5648	25.176	1.27	0.97	12	1.3	108	0.12	0.3	0.6	2
2006	3	30	12	38	27.45	121.5502	25.16817	1.59	1.01	12	0.7	86	0.15	0.4	0.6	2
2006	3	30	14	53	51.64	121.5483	25.17533	1.34	1.14	16	1.3	88	0.13	0.3	0.5	1
2006	3	30	21	49	53.07	121.5532	25.16983	6.49	1.33	14	0.5	139	0.34	2	1.5	3

2006	3	31	5	27	55.98	121.5645	25.17983	1.73	1.11	10	1.6	110	0.11	0.3	0.4	2
2006	3	31	7	19	17.28	121.5595	25.17283	5.35	1.08	10	0.8	71	0.26	1.4	1.8	2
2006	3	31	15	39	45.69	121.6448	25.24	6.31	1.71	16	7.7	325	0.09	0.8	0.9	3
2006	3	31	21	14	30.35	121.5663	25.17883	0.41	1.25	14	1.7	95	0.11	0.2	1.5	2
2006	3	31	21	14	37.13	121.5635	25.172	1.53	0.45	8	0.9	140	0.19	0.4	0.5	3
2006	4	2	3	1	33.97	121.5627	25.17667	1.82	0.89	8	1.3	128	0.14	0.6	0.7	2
2006	4	2	5	36	52.43	121.5682	25.17433	0.93	1.14	14	1.5	117	0.1	0.2	0.6	2
2006	4	2	6	14	39.81	121.5653	25.176	1.26	0.76	12	1.4	128	0.09	0.2	0.3	2
2006	4	2	6	56	28.18	121.5677	25.17383	0.85	1.1	12	1.4	117	0.05	0.1	0.3	2
2006	4	2	7	13	37.11	121.5555	25.17333	1.69	0.71	8	0.8	183	0.18	0.5	0.5	3
2006	4	2	7	33	9.89	121.568	25.17433	1.42	1.1	12	1.4	117	0.1	0.2	0.4	2
2006	4	2	9	2	44.48	121.5662	25.17617	0.72	0.86	16	1.5	83	0.09	0.2	0.6	1
2006	4	2	20	43	51.91	121.5652	25.17583	1.31	1.17	14	1.4	82	0.13	0.3	0.5	1
2006	4	2	23	23	7.55	121.5392	25.16617	0.9	1.03	7	1.7	115	0.03	0	0.2	2
2006	4	4	21	2	40.95	121.537	25.161	2.19	0.63	6	1.1	134	0.02	0.2	0.2	2
2006	4	4	23	7	18.49	121.5497	25.17533	1.47	0.7	10	1.2	131	0.07	0.3	0.4	2
2006	4	5	1	38	46.31	121.5667	25.17517	0.9	1.09	14	1.4	80	0.08	0.1	0.5	1
2006	4	5	15	2	29.49	121.5657	25.17533	0.75	0.71	10	1.3	142	0.09	0.2	0.8	2
2006	4	6	12	9	13.8	121.5698	25.17433	0.73	0.75	14	1.6	75	0.17	0.3	1.4	2
2006	4	7	2	14	49.97	121.5678	25.17417	0.53	0.89	10	1.4	92	0.1	0.2	1.3	2
2006	4	7	12	25	37.95	121.5657	25.17433	0.91	0.98	12	1.3	85	0.16	0.3	1	2
2006	4	7	21	26	35.78	121.5403	25.17017	1.54	0.81	10	1.5	105	0.11	0.4	0.6	2
2006	4	8	20	48	25.58	121.566	25.177	0.52	0.7	14	1.5	87	0.13	0.3	1.4	1
2006	4	9	4	13	56.44	121.5653	25.1775	0.96	1.21	16	1.5	89	0.11	0.2	0.7	1
2006	4	9	8	11	0.44	121.547	25.15383	5.56	0.95	8	1.6	161	0.11	1.7	0.7	3
2006	4	9	8	25	34.31	121.5543	25.15067	4.5	0.89	12	0.8	171	0.1	0.6	0.5	2
2006	4	9	10	23	30.7	121.5637	25.166	4.24	0.97	10	0.7	133	0.11	0.8	0.7	2
2006	4	9	11	57	22.8	121.5593	25.145	4.56	0.95	8	0.4	215	0.08	1	0.6	3
2006	4	9	12	5	51.4	121.5613	25.17683	1.14	1.13	14	1.3	82	0.17	0.4	0.7	2
2006	4	9	19	7	25.83	121.5722	25.17267	1.39	0.7	12	1.7	107	0.18	0.5	0.9	2
2006	4	9	20	27	7.14	121.541	25.17117	1.38	1.06	14	1.5	101	0.13	0.4	0.6	2
2006	4	9	20	53	0.94	121.5598	25.177	1.21	0.86	12	1.2	82	0.07	0.2	0.3	1
2006	4	10	4	3	35.19	121.5335	25.1625	2.19	0.74	6	1	139	0.02	0.2	0.2	2
2006	4	10	14	3	7.29	121.5432	25.172	1.46	0.9	10	1.5	89	0.17	0.5	0.8	2
2006	4	11	12	22	54.84	121.565	25.17733	0.93	1.08	14	1.5	87	0.09	0.2	0.6	1
2006	4	12	6	30	36.43	121.5445	25.1735	1.44	1.16	10	1.4	205	0.13	0.5	0.7	3
2006	4	13	5	21	20.66	121.5667	25.17717	0.49	1.46	16	1.6	88	0.12	0.2	1.3	1
2006	4	13	18	49	1.84	121.5623	25.17967	1.04	0.92	14	1.5	95	0.15	0.4	0.6	2

2006	4	13	19	4	21.33	121.5648	25.17717	0.16	0.94	12	1.5	87	0.19	0.4	6.2	2
2006	4	14	23	6	38.32	121.5515	25.1805	0.68	0.99	10	1.2	107	0.14	0.3	1.1	2
2006	4	15	6	40	49.42	121.5673	25.17567	0.78	1.07	14	1.5	81	0.09	0.2	0.7	1
2006	4	15	6	40	59.71	121.567	25.17467	1.22	0.64	10	1.4	89	0.08	0.2	0.3	1
2006	4	15	6	41	15.82	121.5617	25.17767	2.43	0.05	10	1.3	122	0.14	0.2	0.2	2
2006	4	16	7	21	23.13	121.5682	25.18183	0.12	1.19	10	1.8	194	0.1	0.3	5.8	4
2006	4	17	12	10	15.92	121.561	25.17817	0.94	0.85	12	1.4	134	0.16	0.4	1.1	2
2006	4	17	15	45	25.21	121.5623	25.17783	0.54	0.85	12	1.4	87	0.19	0.4	1.8	2
2006	4	17	17	58	27.31	121.5198	25.14	0.55	0.67	6	1.9	296	0.06	0.5	1.3	3
2006	4	17	20	19	35.47	121.5557	25.156	4.21	0.88	11	1.1	124	0.14	0.7	0.7	2
2006	4	18	1	43	18.86	121.5453	25.17817	2.32	1.23	11	1.4	109	0.2	0.7	0.9	2
2006	4	18	1	43	52.64	121.5505	25.179	1.44	1.25	10	1.4	98	0.19	0.7	1.1	2
2006	4	18	1	44	47.44	121.5508	25.17167	0.88	1.15	9	0.8	120	0.12	0.3	0.9	2
2006	4	18	1	45	12.34	121.5485	25.17033	0.95	1.12	9	0.9	114	0.14	0.4	1	2
2006	4	18	1	45	28.4	121.5473	25.17117	1.02	0.74	8	1.1	176	0.04	0.1	0.2	2
2006	4	18	1	53	35.72	121.5518	25.1735	1.01	0.93	10	0.9	128	0.09	0.3	0.5	2
2006	4	18	1	57	32.98	121.567	25.17467	0.76	1.04	10	1.4	120	0.05	0.1	0.3	2
2006	4	18	4	54	27.51	121.5425	25.1655	0.88	0.85	8	1.4	119	0.08	0.2	0.8	2
2006	4	18	5	0	42.69	121.5425	25.16767	1.01	0.94	10	1.4	96	0.08	0.3	0.4	2
2006	4	18	5	1	33.24	121.5113	25.15683	1.25	0.78	6	1.7	297	0.06	0.5	0.5	3
2006	4	18	5	4	48.12	121.5667	25.172	0.76	0.77	8	1.2	157	0.03	0.1	0.3	2
2006	4	18	5	54	54.22	121.5445	25.17517	2.02	1.28	10	1.5	132	0.16	0.6	0.8	2
2006	4	18	13	18	14.6	121.549	25.1705	1.08	0.93	7	0.9	177	0.04	0.2	0.3	2
2006	4	18	15	37	27.51	121.5647	25.17383	1.22	1.38	12	1.2	121	0.08	0.1	0.2	2
2006	4	18	15	38	6.6	121.5682	25.17333	0.96	0.83	8	1.4	156	0.05	0.2	0.4	2
2006	4	18	15	52	57	121.5483	25.17417	1.07	1.24	14	1.2	130	0.1	0.3	0.4	2
2006	4	18	17	40	39.34	121.571	25.173	0.73	0.9	6	1.6	169	0.02	0.2	0.5	2
2006	4	18	18	4	9.2	121.5287	25.16333	1.4	0.7	5	0.9	182	0.05	0.6	0.7	3
2006	4	19	1	3	41.01	121.5462	25.1715	1.13	0.94	8	1.2	173	0.04	0.2	0.2	2
2006	4	19	9	56	0.43	121.5463	25.17883	1.1	1.12	7	1.5	225	0.02	0.1	0.1	3
2006	4	20	5	47	12.58	121.5628	25.16233	4.66	0.84	8	1.6	134	0.08	0.6	0.6	2
2006	4	20	14	15	30.08	121.5597	25.17233	1.94	0.82	6	0.7	247	0.11	0.7	0.4	3
2006	4	21	0	36	12.85	121.5638	25.17483	0.8	0.76	9	1.2	126	0.09	0.2	0.9	2
2006	4	21	1	37	51.79	121.5718	25.17433	3.76	1.22	8	1.8	169	0.25	0.4	0.5	3
2006	4	21	7	30	37.99	121.5428	25.16317	1.46	1	8	1.4	109	0.06	0.2	0.3	2
2006	4	21	11	41	16.4	121.5585	25.15583	4.54	1.32	14	0.9	111	0.11	0.6	0.5	2
2006	4	21	11	41	21.24	121.5637	25.15667	4.97	1.52	14	1	94	0.11	0.6	0.5	2
2006	4	21	11	45	49.26	121.5662	25.15033	5.25	1.01	10	0.5	158	0.04	0.4	0.3	2

2006	4	21	11	46	45.05	121.5663	25.16133	4.74	1.28	12	1.1	90	0.07	0.4	0.4	2
2006	4	21	11	50	57.64	121.5637	25.15833	4.52	1.06	13	1.1	89	0.08	0.4	0.4	1
2006	4	21	15	13	31.37	121.5653	25.16233	4.69	1.05	11	1	87	0.09	0.5	0.5	1
2006	4	21	15	13	41.84	121.5645	25.153	5.55	0.86	6	0.6	126	0.05	0.9	0.4	2
2006	4	21	15	13	46.67	121.5668	25.14983	3.94	0.71	8	0.5	168	0.15	1.6	1	3
2006	4	23	6	18	55.65	121.5615	25.15633	4.7	0.98	12	0.9	91	0.09	0.5	0.5	2
2006	4	24	3	0	56.75	121.5555	25.17667	3.95	1.36	16	1.1	73	0.25	0.9	1	2
2006	4	24	3	2	0.98	121.557	25.18867	1.49	0.12	8	0.4	232	0.23	1.4	1.2	3
2006	4	24	3	3	7.48	121.5453	25.14983	3.24	-0.18	6	1.7	241	0.05	1.3	0.8	3
2006	4	24	3	7	59.69	121.5668	25.18883	0.86	0.13	12	1.3	224	0.28	0.9	2	3
2006	4	24	3	15	14.42	121.561	25.1635	2.75	0.36	8	0.6	162	0.14	1.1	0.9	3
2006	4	24	3	15	58.23	121.5562	25.15583	3.17	0.07	8	1	123	0.08	0.7	0.5	2
2006	4	24	3	20	10.55	121.5595	25.18633	0.81	0.23	10	0.8	224	0.15	0.6	0.9	3
2006	4	24	3	21	10.89	121.565	25.155	2.57	0.18	6	0.8	126	0.03	0.4	0.3	2
2006	4	24	23	1	45.05	121.564	25.177	0.62	0.42	12	1.4	85	0.4	0.7	3.1	2
2006	4	24	23	30	37.26	121.5555	25.18533	2.12	0.49	16	0.6	96	0.31	1	1	3
2006	4	25	8	25	18.7	121.5745	25.18983	1.34	0.75	12	3.1	213	0.21	0.8	1.8	3
2006	4	25	16	18	6.14	121.5403	25.16617	1.65	0.81	8	1.6	118	0.03	0.2	0.2	2
2006	4	25	16	18	23.74	121.5413	25.16633	1.66	0.79	8	1.5	121	0.04	0.2	0.3	2
2006	4	25	16	43	44.18	121.5392	25.16467	1.2	0.63	8	1.6	108	0.02	0.1	0.1	2
2006	4	25	16	43	45.82	121.5378	25.1645	1.65	0.92	8	1.5	116	0.03	0.1	0.2	2
2006	4	25	16	43	59.28	121.5385	25.16417	1.15	0.5	6	1.5	111	0.05	0.3	0.4	2
2006	4	25	18	18	54.23	121.5545	25.15667	3.02	0.86	12	1.1	125	0.13	0.6	0.6	2
2006	4	25	19	27	22.09	121.5662	25.174	1.01	1.05	14	1.3	119	0.08	0.2	0.3	2
2006	4	25	22	24	16.6	121.5587	25.15483	4.99	1.34	14	0.8	115	0.1	0.6	0.4	2
2006	4	25	22	26	6.03	121.5687	25.15783	5.98	1	10	1.3	116	0.08	0.7	0.5	2
2006	4	25	22	26	14.36	121.5637	25.14433	4.72	0.87	10	0.5	217	0.13	1.1	0.7	3
2006	4	25	22	26	21.86	121.5637	25.153	5.05	1.62	14	0.6	109	0.09	0.5	0.4	2
2006	4	25	23	3	13.33	121.5637	25.15417	4.87	1.15	11	0.7	103	0.1	0.6	0.6	2
2006	4	26	6	24	9.37	121.5458	25.177	1.01	1.25	8	1.5	211	0.05	0.3	0.3	3
2006	4	26	9	18	52.9	121.5637	25.1575	4.92	1.46	14	1	92	0.1	0.5	0.4	2
2006	4	26	15	12	26.97	121.5608	25.14817	5.21	1.23	11	0.1	193	0.09	0.7	0.5	3
2006	4	26	17	54	35.43	121.5405	25.16883	1.35	1.12	8	1.6	134	0.07	0.2	0.2	2
2006	4	27	19	57	23.09	121.57	25.17517	1	1.02	12	1.7	160	0.1	0.2	0.7	2
2006	4	27	20	21	50.17	121.5637	25.15717	4.57	1.28	16	1	93	0.15	0.6	0.6	2
2006	4	27	21	31	7.08	121.569	25.175	2.2	1.04	10	1.6	156	0.14	0.2	0.3	2
2006	4	27	21	54	38.4	121.5357	25.14417	3.32	1.17	6	2.7	273	0.06	1.8	1.8	3
2006	4	28	11	5	9.08	121.5405	25.16867	1.17	0.81	12	1.6	105	0.07	0.2	0.3	2

2006	4	28	11	5	22.03	121.5423	25.16717	1.06	0.74	11	1.4	96	0.08	0.2	0.4	2
2006	4	28	11	5	32.92	121.5422	25.168	1.15	1.13	14	1.4	97	0.09	0.2	0.4	2
2006	4	28	11	5	46.29	121.5415	25.16717	1.14	1.04	13	1.5	100	0.07	0.2	0.4	2
2006	4	30	5	9	21.85	121.5448	25.173	1.11	0.9	8	1.4	155	0.03	0.2	0.2	2
2006	4	30	12	41	30.35	121.5743	25.17417	0.73	0.97	6	2	251	0.02	0.6	1.6	3
2006	5	1	17	7	25.94	121.5463	25.17267	1.11	0.85	16	1.2	80	0.11	0.3	0.5	1
2006	5	4	18	29	9.56	121.5668	25.17717	1.3	1.03	14	1.6	87	0.11	0.2	0.4	1
2006	5	5	13	13	38.63	121.5295	25.15683	2.53	0.9	8	0.2	142	0.05	0.4	0.3	2
2006	5	6	6	7	24.15	121.5425	25.16433	3.48	0.8	12	1.4	110	0.1	0.5	0.5	2
2006	5	6	11	22	5.82	121.5752	25.17317	0.99	0.79	6	2	253	0.03	0.6	1.3	3
2006	5	7	15	49	2.44	121.5672	25.176	1.42	1.02	16	1.5	83	0.12	0.2	0.4	1
2006	5	8	9	55	29.83	121.5698	25.174	1.11	0.78	8	1.6	162	0.07	0.3	0.4	2
2006	5	8	12	56	29.02	121.5472	25.16967	1.13	1.01	10	1	95	0.1	0.3	0.6	2
2006	5	8	15	37	44.47	121.5587	25.1645	3.07	1.15	16	0.3	82	0.12	0.4	0.5	1
2006	5	8	21	16	27.07	121.5608	25.1765	1.48	0.64	8	1.2	135	0.09	0.3	0.3	2
2006	5	8	21	30	1.32	121.5545	25.1735	1.69	0.76	12	1.9	69	0.09	0.3	0.5	1
2006	5	8	23	3	57.02	121.5588	25.18783	1.82	0.79	14	0.6	142	0.08	0.3	0.3	2
2006	5	9	16	21	28.19	121.6962	25.22483	9.54	1.61	10	10	337	0.07	0.9	1.1	3
2006	5	10	21	22	55.59	121.5295	25.15683	2	0.8	6	0.2	142	0.05	0.4	0.4	2
2006	5	10	21	22	59.85	121.5325	25.16067	2.32	0.5	6	0.8	139	0.02	0.2	0.2	2
2006	5	10	21	24	4.99	121.5342	25.16083	2.42	0.75	8	0.9	128	0.01	0.1	0.1	2
2006	5	11	0	12	20.03	121.539	25.16333	2.32	0.78	6	1.4	148	0.02	0.2	0.2	2
2006	5	12	2	55	28.51	121.5485	25.17333	2.23	0.7	8	1.9	138	0.16	0.8	1.3	3
2006	5	12	9	49	51.87	121.5455	25.17367	1.17	1.12	15	1.4	84	0.09	0.2	0.4	1
2006	5	13	1	9	31.37	121.551	25.17533	0.99	0.82	12	1.1	87	0.11	0.2	0.6	1
2006	5	13	3	4	53.77	121.5455	25.17633	2.23	0.8	8	1.5	125	0.15	0.8	1.2	2
2006	5	13	6	40	43.74	121.5572	25.18	1.06	0.77	6	1.3	188	0.05	0.4	0.5	3
2006	5	14	15	15	21.35	121.5638	25.16867	1.12	0.76	10	0.8	147	0.27	0.6	0.9	3
2006	5	14	16	34	56.13	121.566	25.1785	0.45	1.03	14	1.6	94	0.12	0.2	1.4	2
2006	5	16	2	32	36.89	121.5418	25.17467	1.01	0.81	6	1.3	179	0.01	0.1	0.1	2
2006	5	19	17	26	18.76	121.5678	25.1755	0.93	1.18	12	1.5	91	0.05	0.1	0.3	2
2006	5	20	21	40	0.16	121.5542	25.1745	1.27	0.9	6	1.8	166	0.06	0.4	0.7	2
2006	5	21	15	38	53.94	121.5652	25.1765	0.91	0.73	10	1.4	137	0.07	0.2	0.6	2
2006	5	21	19	44	12.63	121.5715	25.1765	0.12	1.09	6	1.9	245	0.1	3.8	54.5	4
2006	5	22	4	8	7.02	121.534	25.14733	4.76	1	10	1.1	236	0.11	0.9	0.6	3
2006	5	22	18	13	58.27	121.5657	25.1835	0.22	0.96	12	1.5	123	0.14	0.4	4.2	2
2006	5	22	18	14	0.14	121.566	25.18517	0.89	1.03	14	1.4	136	0.11	0.3	0.7	2
2006	5	22	18	14	11.02	121.5663	25.187	0.99	0.93	14	1.3	152	0.12	0.3	0.6	2

2006	5	23	8	53	27.3	121.562	25.18567	1.03	0.9	12	1	133	0.14	0.4	0.6	2
2006	5	23	8	53	31.83	121.5653	25.1915	0.75	0.47	6	1.2	290	0.03	0.3	0.4	3
2006	5	23	15	41	13.91	121.5595	25.18083	1.72	1.04	8	1.3	203	0.08	0.5	0.5	3
2006	5	24	19	20	49.59	121.5662	25.1775	0.95	0.86	16	1.6	89	0.16	0.3	0.9	2
2006	5	25	0	51	3.73	121.5337	25.1625	2.17	0.97	6	1	138	0.02	0.2	0.2	2
2006	5	26	11	21	17.41	121.5667	25.17817	0.25	0.97	12	1.6	97	0.13	0.3	2.8	2
2006	5	27	19	27	33.46	121.5513	25.17883	0.79	0.89	11	1.4	94	0.21	0.5	1.5	2
2006	5	28	19	9	33.72	121.5555	25.17467	2.49	0.72	14	0.9	69	0.25	0.7	1	2
2006	5	30	6	54	37.67	121.567	25.176	0.89	0.83	14	1.5	101	0.24	0.5	1.5	2
2006	5	30	18	17	25.12	121.5333	25.14517	2.77	0.67	8	1.2	250	0.04	0.3	0.3	3
2006	5	30	20	32	1.67	121.5555	25.18767	1.07	1.02	8	0.4	158	0.13	0.7	0.7	2
2006	5	30	20	34	37.62	121.5632	25.18333	0.89	0.92	12	1.3	118	0.21	0.5	1.5	2
2006	5	30	21	53	10.01	121.5555	25.17667	3.94	0.87	12	1.1	129	0.23	1.3	1.2	2
2006	6	1	10	41	53.46	121.5505	25.154	6.92	0.99	6	1.3	208	0.11	2.5	1.2	3
2006	6	1	10	55	8.79	121.539	25.14267	4.66	0.83	10	1.8	244	0.08	0.7	0.5	3
2006	6	2	5	33	0.32	121.5452	25.14167	4.7	1.06	10	1.8	236	0.1	0.8	0.6	3
2006	6	3	11	52	45.75	121.5295	25.15817	2.36	0.54	8	0.4	158	0.01	0.1	0.1	2
2006	6	3	11	53	11.26	121.5302	25.1595	2.45	0.86	6	0.5	157	0	0	0	2
2006	6	3	11	53	13.99	121.5295	25.158	2.07	0.83	6	0.4	156	0.03	0.2	0.2	2
2006	6	3	11	53	29.68	121.5295	25.1605	2.2	0.43	8	0.6	169	0.03	0.2	0.2	2
2006	6	3	12	4	27.91	121.5295	25.1585	2.14	0.92	6	0.4	159	0.03	0.3	0.3	2
2006	6	3	12	27	12.89	121.53	25.15883	2.55	0.88	6	0.5	155	0	0	0	2
2006	6	3	13	54	11.39	121.5298	25.15917	2.5	0.96	6	0.5	158	0.01	0.1	0.1	2
2006	6	3	21	26	15.72	121.5437	25.142	4.63	1.23	10	2	237	0.1	0.8	0.6	3
2006	6	4	20	17	26.35	121.5462	25.148	1.24	1.05	6	1.6	204	0.03	0.3	0.3	3
2006	6	4	23	23	5.68	121.5582	25.1815	0.41	1.03	8	1.7	222	0.07	0.5	2.2	3
2006	6	5	0	23	18.05	121.5443	25.1695	3.73	1.05	8	1.3	171	0.1	1.2	0.7	3
2006	6	12	2	10	10.35	121.5667	25.17683	0.99	1.09	14	1.5	86	0.1	0.2	0.6	1
2006	6	13	16	21	29.84	121.5648	25.17467	1.04	1.53	16	1.2	77	0.14	0.3	0.4	1
2006	6	17	7	28	45.96	121.5798	25.17783	1.68	0.97	14	1.2	87	0.07	0.2	0.3	1
2006	6	18	8	13	39.74	121.544	25.16417	0.86	0.93	6	1.9	169	0.08	0.4	1.5	2
2006	6	20	1	47	59	121.546	25.17033	1.08	1.32	16	1.1	81	0.11	0.2	0.4	1
2006	6	21	2	1	39.66	121.5687	25.174	0.91	0.95	14	1.5	75	0.08	0.2	0.5	1
2006	6	21	2	34	26.04	121.5703	25.17283	0.98	1.09	8	1.6	167	0.03	0.1	0.2	2
2006	6	21	22	44	19.29	121.5637	25.12667	5.15	1.11	12	2.4	286	0.27	1.9	1.4	3
2006	6	23	16	53	6.62	121.545	25.17267	1.85	1.09	16	1.3	81	0.1	0.3	0.4	1
2006	6	24	11	59	50.06	121.543	25.17	1.41	1	10	1.4	174	0.08	0.3	0.5	2
2006	6	24	12	2	29.63	121.5433	25.16883	1.39	1.11	15	1.3	92	0.11	0.3	0.4	2

2006	6	25	3	50	1.22	121.549	25.17883	1.23	0.88	12	1.4	126	0.1	0.3	0.4	2
2006	6	25	22	26	58.65	121.5538	25.16817	3.51	1.06	14	0.3	82	0.1	0.4	0.4	1
2006	6	26	12	2	5.49	121.5462	25.1795	1.02	1.02	11	1.5	131	0.1	0.3	0.4	2
2006	6	26	13	26	17.93	121.5697	25.17233	0.8	1.05	10	1.5	98	0.04	0.1	0.4	2
2006	6	26	14	6	57.96	121.5395	25.16817	3.36	1.08	10	1.6	126	0.1	0.5	0.5	2
2006	6	27	0	48	31.14	121.533	25.161	3.71	1.03	10	0.8	137	0.17	1.1	0.9	3
2006	6	27	1	20	19.08	121.5377	25.16583	1.77	0.91	8	1.5	119	0.05	0.2	0.3	2
2006	6	27	7	54	54.07	121.5343	25.16183	2.23	0.97	8	1	130	0.02	0.1	0.2	2
2006	6	27	7	55	2.21	121.5272	25.1555	1.83	1.01	5	2.8	266	0	0	0	3
2006	6	27	8	7	41.32	121.5258	25.16817	7.71	1.06	8	1.5	209	0.24	3.7	2	4
2006	6	27	8	10	39.06	121.5702	25.1825	3.14	0.99	7	2.2	235	0.11	1.3	1.3	3
2006	6	27	8	11	35.31	121.536	25.162	2.03	1.24	6	1.1	133	0.01	0.1	0.1	2
2006	6	27	8	12	52.51	121.5375	25.1635	2.88	1.04	13	1.3	116	0.09	0.4	0.4	2
2006	6	27	8	13	1.79	121.539	25.16233	3.22	1.31	16	1.4	111	0.1	0.4	0.4	2
2006	6	27	8	25	41.69	121.5423	25.16783	3.26	0.72	10	1.4	185	0.08	0.5	0.5	3
2006	6	27	8	25	47.99	121.5323	25.1595	2.4	0.9	6	0.7	133	0.01	0.1	0.1	2
2006	6	27	23	18	9.38	121.541	25.16883	3.37	1.6	16	1.6	102	0.13	0.5	0.5	2
2006	6	27	23	21	10.53	121.5352	25.16383	2.45	0.9	6	1.2	134	0.01	0.1	0.1	2
2006	7	2	1	41	27.4	121.5665	25.171	0.87	1.2	15	1.1	66	0.09	0.2	0.6	1
2006	7	4	13	24	17.76	121.6547	25.2445	8.24	1.27	12	8.6	330	0.05	0.6	0.7	3
2006	7	4	15	53	13.49	121.668	25.24083	8.55	1.88	16	9	333	0.1	1	1	3
2006	7	4	22	19	7.89	121.5675	25.18183	1.06	1.14	16	1.6	113	0.07	0.2	0.3	2
2006	7	8	0	20	41.4	121.6057	25.21517	5.75	1.38	14	3.8	288	0.08	0.6	0.6	3
2006	7	10	5	25	37.1	121.541	25.17883	1.94	0.97	10	1	121	0.09	0.4	0.5	2
2006	7	13	2	49	47.36	121.5682	25.18233	1.02	0.63	8	1.5	153	0.05	0.2	0.4	2
2006	7	13	3	2	9.42	121.5617	25.17233	0.9	1.08	6	2.7	252	0.05	0.3	1	3
2006	7	13	19	54	6.05	121.5277	25.15683	2.42	0.83	6	0.2	191	0.02	0.2	0.1	3
2006	7	15	18	58	16.94	121.5682	25.17333	0.91	0.8	8	1.4	156	0.04	0.1	0.2	2
2006	7	20	8	9	32.62	121.5422	25.16633	1.4	1.03	8	1.4	124	0.09	0.4	0.5	2
2006	7	20	13	59	23.61	121.5433	25.1715	1.46	1.08	11	1.4	90	0.05	0.2	0.3	1
2006	7	22	10	26	30.28	121.5465	25.17183	1.03	0.86	12	1.2	118	0.1	0.3	0.5	2
2006	7	22	15	15	40.22	121.533	25.17183	2.21	1.02	12	1	155	0.12	0.5	0.5	2
2006	7	22	17	9	21.47	121.5615	25.155	5.29	0.92	14	0.8	94	0.09	0.5	0.4	2
2006	7	22	21	44	36.41	121.5313	25.168	2.51	0.97	14	1.4	166	0.08	0.4	0.3	2
2006	7	23	18	34	13.47	121.545	25.15567	2.43	0.66	6	1.7	153	0.07	0.7	0.7	2
2006	7	25	14	59	23.1	121.5418	25.16817	0.93	0.82	6	1.8	174	0.06	0.3	1.1	2
2006	7	26	2	40	57.2	121.5453	25.16767	1.32	0.74	6	2	186	0.04	0.3	0.4	3
2006	7	26	15	4	55.47	121.5518	25.1705	1.77	0.89	12	0.6	78	0.1	0.2	0.3	1

2006	7	26	15	6	1.95	121.5497	25.16817	1.73	0.74	10	0.7	96	0.09	0.1	0.1	2
2006	7	26	15	39	10.6	121.5498	25.16817	1.34	0.7	12	0.7	86	0.08	0.2	0.3	1
2006	7	28	10	4	55.41	121.6807	25.21617	5.84	1.32	14	8.1	334	0.12	1.1	1.4	3
2006	7	30	9	34	0.51	121.5425	25.171	1.22	0.9	10	1.5	94	0.09	0.2	0.4	2
2006	7	30	18	34	0.24	121.5688	25.17167	1.02	0.79	16	1.4	68	0.13	0.3	0.5	1
2006	8	1	12	21	37.64	121.5652	25.18017	1.64	0.77	16	1.7	102	0.09	0.2	0.3	2
2006	8	1	12	22	17.85	121.5648	25.17683	3.76	0.97	14	1.4	85	0.11	0.4	0.5	1
2006	8	1	21	28	21.16	121.546	25.16217	2.67	0.78	13	1.2	113	0.11	0.4	0.5	2
2006	8	3	21	0	32.12	121.568	25.172	1.23	0.63	14	1.3	69	0.08	0.2	0.3	1
2006	8	5	6	38	33.92	121.5697	25.18167	1.15	0.79	14	1.4	111	0.08	0.2	0.3	2
2006	8	7	12	16	9.11	121.5402	25.16617	2.33	0.99	12	1.7	161	0.07	0.3	0.3	2
2006	8	7	20	38	59.63	121.5428	25.17217	1.28	0.84	10	1.5	91	0.06	0.1	0.2	2
2006	8	7	23	40	36.5	121.5662	25.17333	1	0.84	16	1.2	73	0.06	0.1	0.2	1
2006	8	8	0	21	11.18	121.5487	25.17283	1.01	0.77	12	1.1	78	0.09	0.2	0.4	1
2006	8	10	0	43	7.09	121.5405	25.168	1.04	0.87	10	1.6	105	0.04	0.1	0.2	2
2006	8	11	19	52	53.63	121.5668	25.17033	1.06	0.78	12	1.1	82	0.07	0.2	0.4	1
2006	8	12	13	18	13	121.546	25.1725	1.48	0.83	10	1.2	153	0.09	0.3	0.4	2
2006	8	13	10	30	46.68	121.5643	25.17383	0.81	0.77	12	1.1	81	0.07	0.1	0.3	1
2006	8	14	17	43	37.06	121.546	25.17417	1.18	0.86	10	1.4	106	0.07	0.2	0.4	2
2006	8	16	18	21	18.08	121.565	25.18133	1.18	0.94	16	1.5	109	0.14	0.3	0.5	2
2006	8	16	19	24	59.65	121.5465	25.178	2.04	1.21	16	1.6	105	0.1	0.3	0.4	2
2006	8	16	19	28	14.61	121.5447	25.16767	1.09	0.99	14	1.2	90	0.1	0.3	0.5	1
2006	8	17	15	18	29.86	121.5525	25.173	1.78	0.83	13	0.8	72	0.07	0.2	0.3	1
2006	8	17	15	19	9.85	121.5467	25.1695	1.59	0.95	16	1	83	0.11	0.3	0.4	1
2006	8	17	15	19	14.09	121.5472	25.16933	1.63	0.91	15	1	84	0.12	0.3	0.4	1
2006	8	17	17	4	44.48	121.543	25.17233	1.08	0.86	12	1.5	90	0.07	0.2	0.3	2
2006	8	18	14	19	30.14	121.568	25.172	1.1	0.7	16	1.3	69	0.11	0.2	0.4	1
2006	8	20	20	53	21.14	121.5373	25.15917	3.28	0.97	10	1.1	129	0.12	0.7	0.7	2
2006	8	21	6	24	51.44	121.5612	25.1705	1.17	0.94	6	2.4	196	0.03	0.3	0.4	3
2006	8	21	9	18	25.71	121.5347	25.164	2.17	0.95	10	1.2	134	0.14	0.6	0.7	2
2006	8	22	16	22	21.77	121.5437	25.16867	1.27	0.78	12	1.3	91	0.09	0.2	0.4	2
2006	8	24	16	45	50.21	121.545	25.174	1.25	0.94	10	1.4	100	0.08	0.3	0.4	2
2006	8	26	20	4	7.93	121.5802	25.182	2.02	0.73	14	0.8	94	0.09	0.3	0.3	2
2006	8	26	20	9	45.26	121.5407	25.167	1.02	0.54	10	1.6	104	0.06	0.2	0.4	2
2006	8	26	20	9	47.57	121.5392	25.16917	1.52	0.87	10	1.5	112	0.08	0.2	0.3	2
2006	8	28	13	30	20.04	121.5412	25.16883	1.08	0.97	10	1.6	101	0.07	0.2	0.4	2
2006	8	29	20	20	16.58	121.6247	25.22433	3.61	1.35	16	5.4	311	0.09	0.5	0.8	3
2006	8	30	10	10	54.94	121.568	25.17267	0.97	0.77	10	1.3	157	0.08	0.2	0.6	2

2006	8	30	13	8	3.27	121.5705	25.173	0.67	0.62	16	1.6	70	0.12	0.2	0.9	1
2006	9	2	20	50	34.46	121.5477	25.17583	1.66	0.93	12	1.4	134	0.07	0.2	0.3	2
2006	9	3	15	2	7.38	121.5447	25.15767	2.2	0.66	6	1.5	150	0.03	0.2	0.2	2
2006	9	4	9	49	32.93	121.5953	25.18533	2.14	1.25	8	1.5	193	0.22	1.3	1.4	3
2006	9	4	10	13	22.45	121.546	25.17633	1.16	1.2	12	1.5	97	0.08	0.2	0.4	2
2006	9	5	18	5	41.97	121.5455	25.17267	1.03	0.66	8	1.3	154	0.07	0.3	0.5	2
2006	9	5	20	0	5.17	121.5467	25.16817	2.26	0.86	10	1	88	0.12	0.2	0.2	1
2006	9	8	18	49	35.28	121.571	25.17033	0.81	0.78	12	1.5	121	0.07	0.1	0.5	2
2006	9	10	1	29	27.23	121.5873	25.18483	2.56	0.77	12	0.8	164	0.11	0.5	0.4	2
2006	9	10	1	30	3.9	121.585	25.17917	2.1	0.88	15	1.2	116	0.07	0.2	0.3	2
2006	9	12	1	5	22.8	121.4457	25.12133	12.39	1.53	8	9.1	336	0.25	7	5.6	4
2006	9	12	20	6	44.47	121.6587	25.11267	15.05	1.42	16	7.9	323	0.24	3.6	2.2	4
2006	9	16	19	31	6.36	121.5475	25.1725	1.54	0.76	10	1.1	148	0.07	0.2	0.4	2
2006	9	21	5	32	19.76	121.5665	25.17433	0.65	1.1	14	1.3	76	0.06	0.1	0.3	1
2006	9	21	18	15	54.96	121.5505	25.16917	3.06	0.98	8	0.7	167	0.05	0.5	0.4	2
2006	9	22	10	59	0.82	121.5513	25.17383	1.83	0.94	14	1	132	0.13	0.4	0.5	2
2006	9	23	16	6	15.06	121.7087	25.22217	6.76	1.23	12	10.9	339	0.09	1.1	0.4	3
2006	9	24	1	55	53.41	121.7017	25.19983	8.01	1.34	10	9.3	339	0.13	1.9	2.1	3
2006	9	24	4	0	3.5	121.687	25.19983	10.55	1.35	10	7.9	336	0.22	3.5	3.1	4
2006	9	24	11	16	14.29	121.5478	25.17267	1.07	0.79	10	1.1	147	0.09	0.3	0.5	2
2006	9	25	10	42	46.41	121.543	25.1715	2.65	0.9	8	1.5	168	0.02	0.2	0.2	2
2006	9	26	8	52	27.01	121.543	25.17517	1.02	0.9	6	1.3	173	0.02	0.1	0.2	2
2006	9	29	3	32	24.5	121.566	25.18167	1.87	0.95	14	1.6	112	0.07	0.2	0.3	2
2006	9	29	17	25	5.32	121.5602	25.17433	1.5	0.88	12	0.9	81	0.17	0.5	0.8	2
2006	9	29	20	12	17.6	121.5725	25.17067	0.99	0.84	8	1.7	181	0.03	0.1	0.3	3
2006	9	29	20	53	50.6	121.5688	25.1725	0.92	0.85	10	1.4	95	0.06	0.1	0.5	2
2006	9	29	21	17	14.03	121.5658	25.17283	0.76	0.9	12	1.2	86	0.1	0.2	0.6	1
2006	9	30	12	59	38.4	121.576	25.16817	7.55	1.29	12	2	85	0.28	2.1	1.6	2
2006	9	30	13	8	40.15	121.5692	25.17283	0.87	1.16	14	1.5	71	0.09	0.2	0.6	1
2006	9	30	13	25	6.53	121.5658	25.17133	1.59	1.08	12	1.1	86	0.08	0.2	0.3	1
2006	9	30	14	5	25.19	121.5673	25.17483	0.91	1.13	12	1.4	90	0.1	0.2	0.7	1
2006	10	1	13	52	26.72	121.5668	25.174	1.04	0.34	14	1.3	75	0.08	0.1	0.3	1
2006	10	2	20	28	25.55	121.5808	25.16267	2.33	0.51	10	2.5	230	0.23	1	1.2	3
2006	10	3	9	32	53.49	121.5403	25.16883	1.2	0.28	8	1.6	190	0.04	0.2	0.2	3
2006	10	6	2	40	49.81	121.5673	25.1725	0.79	0.29	12	1.3	90	0.09	0.2	0.6	2
2006	10	6	12	20	49.6	121.6377	25.21467	4.03	0.76	14	4.9	319	0.05	0.4	0.4	3
2006	10	7	17	40	44.41	121.5543	25.17617	1.01	0.8	8	1.1	254	0.03	0.2	0.1	3
2006	10	9	22	16	19.56	121.5637	25.14383	5.14	0.51	12	0.5	219	0.22	1.2	1.2	3

2006	10	12	9	14	22.64	121.5805	25.18467	2.4	0.52	16	0.5	102	0.13	0.4	0.5	2
2006	10	12	21	27	20.6	121.5748	25.17367	2.04	0.24	14	1.8	67	0.18	0.5	0.7	2
2006	10	13	5	27	20.4	121.5487	25.17717	1.19	0.44	12	1.4	126	0.11	0.3	0.4	2
2006	10	14	15	59	22.7	121.5432	25.17483	1.99	0.24	10	1.4	93	0.12	0.5	0.6	2
2006	10	15	14	56	35.1	121.5728	25.17017	0.38	0.53	8	1.7	183	0.15	0.6	3.2	3
2006	10	17	14	10	4.17	121.5425	25.16883	1.22	0.36	12	1.4	95	0.1	0.3	0.4	2
2006	10	19	20	48	52.02	121.5687	25.17	0.94	0.63	16	1.3	71	0.1	0.2	0.5	1
2006	10	20	7	17	47.58	121.5712	25.1805	1.04	0.65	14	1.4	102	0.1	0.2	0.4	2
2006	10	21	13	36	22.58	121.5548	25.169	2.09	0.62	16	0.3	78	0.22	0.6	0.8	2
2006	10	22	9	1	16.67	121.5493	25.153	3.95	0.67	16	1.4	164	0.17	0.7	0.7	3
2006	10	22	9	4	30.76	121.5605	25.15283	4.43	0.61	16	0.5	111	0.16	0.7	0.7	2
2006	10	27	9	12	33.35	121.5433	25.16483	1.15	0.58	14	1.3	101	0.12	0.3	0.5	2
2006	10	28	11	34	14.66	121.5295	25.16817	1.76	0.52	10	1.4	181	0.09	0.4	0.5	3
2006	10	28	11	34	54.14	121.5295	25.1725	2.52	0.57	10	0.9	186	0.09	0.4	0.5	3
2006	10	29	6	50	30.77	121.5445	25.1725	0.95	0.73	14	1.4	84	0.11	0.2	0.7	1
2006	10	29	14	58	3.1	121.5495	25.17217	1.02	0.46	12	0.9	75	0.13	0.3	0.6	1
2006	10	31	12	10	48.2	121.6367	25.22033	5.52	0.73	11	6.6	321	0.09	0.9	1.1	3
2006	11	4	7	57	1.6	121.5445	25.16983	1.06	0.49	14	1.3	86	0.14	0.3	0.6	1
2006	11	4	7	56	58.69	121.5465	25.17217	0.56	-0.08	14	1.2	77	0.15	0.3	1.3	1
2006	11	6	19	41	46.75	121.5428	25.17017	1.57	0.15	12	1.4	93	0.23	0.7	1	2
2006	11	7	19	16	2.62	121.5613	25.16317	3.02	0.53	14	0.6	78	0.08	0.3	0.4	1
2006	11	9	21	52	18.44	121.5662	25.17117	1.1	0.34	12	1.1	87	0.14	0.3	0.6	1
2006	11	10	8	4	7.8	121.5665	25.1735	0.04	0.36	14	1.3	88	0.12	0.2	16.9	2
2006	11	12	16	43	43.82	121.6285	25.21667	5.46	1.6	14	5.7	317	0.37	2.7	3	4
2006	11	12	18	36	57.53	121.6313	25.21017	7.74	0.9	14	5.6	316	0.2	1.7	1.5	3
2006	11	12	19	7	54.73	121.6278	25.224	5.93	1.07	14	6.1	320	0.2	1.6	1.8	3
2006	11	15	13	52	9.23	121.5908	25.21717	5.81	0.6	14	3.3	301	0.28	1.8	1.5	3
2006	11	15	19	3	33.8	121.5485	25.15683	4.26	0.6	14	1.3	140	0.14	0.6	0.6	2
2006	11	15	19	22	22.01	121.5425	25.16683	1.67	0.4	14	1.4	95	0.2	0.5	0.7	2
2006	11	17	10	18	52.97	121.544	25.16817	1.09	0.72	14	1.3	89	0.1	0.2	0.4	1
2006	11	17	22	28	9.25	121.5432	25.18033	0.63	0.54	8	1.2	129	0.12	0.4	1.6	2
2006	11	18	20	1	48.37	121.5672	25.17183	1.48	0.37	14	1.2	90	0.11	0.2	0.4	2
2006	11	20	2	25	8.31	121.5425	25.1665	1.07	0.82	14	1.4	95	0.1	0.3	0.4	2
2006	11	20	12	7	23.95	121.5685	25.173	1.08	0.28	12	1.4	94	0.07	0.1	0.3	2
2006	11	22	10	9	43.54	121.549	25.16417	1.84	0.61	14	0.8	102	0.14	0.4	0.6	2
2006	11	22	10	10	7.28	121.5535	25.15967	2.19	0.21	12	0.8	113	0.21	0.7	0.9	2
2006	11	22	19	40	30.16	121.6408	25.20667	5.34	1.06	14	6.3	320	0.48	3.5	4	4
2006	11	24	17	39	52.47	121.5392	25.17417	1.04	0.46	10	1.1	105	0.08	0.3	0.4	2

2006	11	30	10	3	11.66	121.569	25.17	0.46	0.55	11	1.3	95	0.11	0.2	2	2
2006	12	1	18	50	20.32	121.5555	25.17933	1.46	0.68	16	1.3	79	0.12	0.3	0.4	1
2006	12	1	18	53	5.98	121.5597	25.177	1.19	0.11	14	1.2	79	0.15	0.4	0.7	2
2006	12	1	22	42	4.53	121.5362	25.16433	1.56	0.42	8	1.3	126	0.08	0.4	0.5	2
2006	12	3	3	51	29.46	121.5417	25.17117	0.86	0.11	6	1.5	189	0.07	0.5	1.3	3
2006	12	7	15	12	45.94	121.5363	25.173	1.12	0.65	8	1	140	0.09	0.4	0.5	2
2006	12	8	5	19	35.31	121.5472	25.17367	1.01	0.51	10	1.2	127	0.08	0.2	0.4	2
2006	12	10	17	8	28.55	121.5503	25.17283	1.1	0.95	10	0.9	125	0.2	0.6	1	2
2006	12	12	15	21	25.75	121.6223	25.15867	7.11	1.3	12	2.9	310	0.29	2.4	1.6	3
2006	12	16	5	33	12.14	121.573	25.14783	5.86	0.58	14	1.1	199	0.12	0.7	0.6	3
2006	12	16	8	49	8.92	121.5497	25.17017	1.2	0.75	14	0.8	80	0.13	0.3	0.6	1
2006	12	16	8	48	45.6	121.5535	25.176	1.11	0.76	14	1.1	78	0.18	0.4	0.7	2
2006	12	17	18	4	40.22	121.5637	25.112	12.31	0.88	12	4	289	0.21	2.8	1.6	4
2006	12	19	3	6	19.92	121.5635	25.1795	1.79	0.27	12	1.6	96	0.15	0.4	0.6	2
2006	12	19	3	12	37.1	121.5667	25.18467	2.13	0.57	12	1.5	133	0.05	0.2	0.2	2
2006	12	19	3	45	17.91	121.5645	25.18133	2.24	0.44	12	1.5	108	0.09	0.3	0.4	2
2006	12	19	23	36	16.33	121.5437	25.16817	1.35	0.42	12	1.3	91	0.14	0.4	0.6	2
2006	12	20	1	19	24.53	121.5403	25.17217	1.68	0.56	8	1.3	176	0.07	0.2	0.3	2
2006	12	21	16	58	53.05	121.5795	25.16717	1.19	0.53	14	2.1	132	0.24	0.6	1.2	2
2006	12	26	17	53	16.45	121.5653	25.18117	1.08	0.6	10	1.6	124	0.11	0.4	0.6	2
2006	12	26	17	54	12.09	121.5673	25.1805	1.3	0.53	10	1.7	133	0.13	0.4	0.6	2
2006	12	27	4	20	39.08	121.5415	25.159	2.29	0.71	14	1.4	133	0.11	0.3	0.4	2
2006	12	27	4	20	45.19	121.543	25.15767	2.61	0.67	12	1.6	141	0.1	0.4	0.4	2
2006	12	27	7	32	13.45	121.549	25.17367	1.46	0.56	14	1.1	80	0.15	0.4	0.5	1
2006	12	27	11	4	34.65	121.5688	25.17083	0.8	0.51	14	1.3	95	0.16	0.3	1.1	2
2006	12	30	23	22	16.07	121.5455	25.172	0.94	0.38	12	1.3	81	0.07	0.1	0.4	1
2007	1	2	9	35	38.34	121.5478	25.1695	2.3	0.28	14	0.9	83	0.15	0.5	0.6	2
2007	1	2	10	17	14.4	121.5368	25.16283	1.23	0.28	10	1.2	117	0.1	0.4	0.5	2
2007	1	2	10	26	45.96	121.5372	25.162	1.07	0.43	8	1.2	113	0.03	0.1	0.2	2
2007	1	9	6	14	39.88	121.5467	25.17333	1.11	0.5	14	1.2	82	0.09	0.2	0.4	1
2007	1	12	12	10	53.41	121.5782	25.17733	1.54	0.52	12	1.3	136	0.12	0.4	0.6	2
2007	1	16	15	57	40.21	121.5333	25.162	1.31	-0.02	8	0.9	139	0.1	0.5	0.6	2
2007	1	16	15	57	42.45	121.5405	25.1655	1.41	0.17	6	1.7	160	0.06	0.4	0.7	2
2007	1	17	14	26	56.01	121.551	25.17317	1.06	0.5	12	0.9	83	0.19	0.5	0.9	2
2007	1	20	9	1	45.54	121.5443	25.1825	1.12	0.59	12	1.3	144	0.22	0.7	1	3
2007	1	21	13	5	19.69	121.613	25.21667	5.36	1.12	14	4.5	311	0.07	0.5	0.5	3
2007	1	24	23	7	5.86	121.5517	25.17183	1.13	0.74	18	0.8	70	0.13	0.3	0.4	1
2007	1	24	23	7	0.81	121.5463	25.17133	1.37	0.3	14	1.1	79	0.11	0.3	0.4	1

2007	1	26	10	10	17.75	121.5412	25.16817	1.11	0.4	14	1.6	102	0.08	0.2	0.3	2
2007	1	29	8	4	48.38	121.5452	25.17183	1.99	0.53	14	1.3	82	0.17	0.5	0.6	2
2007	1	29	8	20	2.52	121.5637	25.14983	4.37	0.89	18	0.2	141	0.23	0.9	0.8	3
2007	1	29	11	2	4.5	121.5533	25.15017	4.79	1.01	18	0.8	177	0.13	0.6	0.5	2
2007	2	2	14	17	5.19	121.5688	25.17383	1.39	0.74	18	1.5	74	0.13	0.2	0.5	1
2007	2	2	20	7	54.02	121.5472	25.17633	1	0.48	15	1.4	95	0.09	0.2	0.4	2
2007	2	4	5	5	25.06	121.568	25.1715	1.32	0.36	18	1.3	67	0.07	0.1	0.2	1
2007	2	4	9	38	15.91	121.5482	25.17283	1.48	0.89	18	1.1	79	0.16	0.3	0.5	2
2007	2	4	9	38	26.93	121.5467	25.1735	1.56	0.35	18	1.3	83	0.16	0.4	0.5	2
2007	2	4	14	0	9.9	121.5675	25.1705	0.96	0.72	18	1.2	68	0.1	0.1	0.5	1
2007	2	5	12	44	11.36	121.5672	25.17267	0.83	0.44	18	1.3	71	0.12	0.2	0.7	1
2007	2	5	13	4	28.32	121.5698	25.171	0.94	0.36	16	1.4	70	0.11	0.2	0.7	1
2007	2	6	15	49	52.27	121.5677	25.1725	0.94	0.37	16	1.3	108	0.11	0.2	0.7	2
2007	2	6	17	37	12.48	121.5712	25.17333	0.25	0.35	11	1.7	169	0.07	0.2	2	2
2007	2	8	0	57	5.57	121.5667	25.17233	1.5	0.45	14	1.2	107	0.07	0.1	0.2	2
2007	2	8	3	12	39.53	121.5178	25.15467	1.5	0.84	10	3.2	286	1.78	7.7	9.6	4
2007	2	8	7	20	12.36	121.5703	25.176	0.06	0.98	15	1.7	107	0.19	0.4	16.2	3
2007	2	8	12	21	14.24	121.5703	25.1725	0.71	1.02	12	1.5	167	0.1	0.2	0.9	2
2007	2	8	12	21	36.31	121.5727	25.17517	0.53	0.08	6	1.7	198	0.04	0	0.2	3
2007	2	8	12	21	43.32	121.5722	25.1715	0.91	0.35	11	1.7	178	0.1	0.3	0.9	2
2007	2	8	13	0	50.98	121.5677	25.17367	1.12	0.16	14	1.4	91	0.08	0.2	0.3	2
2007	2	8	13	0	54.02	121.5657	25.174	1.15	0.45	14	1.2	85	0.12	0.2	0.5	1
2007	2	8	13	30	20.26	121.5753	25.16817	1.47	1.19	12	1.9	198	0.12	0.4	0.6	3
2007	2	8	15	29	27.69	121.5562	25.16883	0.94	0.59	14	0.3	117	0.21	0.4	0.9	2
2007	2	8	15	33	59.57	121.5688	25.17483	1.42	0.85	12	1.6	155	0.12	0.4	0.7	2
2007	2	8	15	43	14.98	121.5735	25.17117	0.63	0.9	12	1.8	184	0.08	0.2	0.6	3
2007	2	8	16	33	6.2	121.5795	25.17383	1.05	1.23	12	1.7	208	0.13	0.5	0.7	3
2007	2	8	17	2	48.61	121.5663	25.1735	0.93	0.66	12	1.3	149	0.07	0.2	0.6	2
2007	2	8	17	19	8.42	121.5718	25.17117	1.65	0.96	14	1.6	176	0.08	0.2	0.2	2
2007	2	8	17	22	49.54	121.5688	25.17233	1.16	0.85	17	1.4	69	0.07	0.1	0.3	1
2007	2	8	17	30	27.44	121.5703	25.17117	0.97	1.14	11	1.5	170	0.05	0.1	0.5	2
2007	2	8	19	9	11.86	121.5825	25.1525	1.54	0.22	10	2.1	259	0.33	0.9	1.1	4
2007	2	8	19	9	26.89	121.5697	25.17067	1.07	0.89	11	1.4	169	0.07	0.2	0.4	2
2007	2	8	20	56	17.91	121.569	25.17383	0.79	1	18	1.5	74	0.09	0.1	0.6	1
2007	2	8	21	46	9.38	121.568	25.17567	0.48	0.86	17	1.5	82	0.09	0.1	1	1
2007	2	8	21	49	39.46	121.58	25.17567	0.14	1.13	7	2.6	268	0.08	1.8	33.5	4
2007	2	8	21	52	36.91	121.5702	25.17217	0.22	1	7	1.5	235	0.05	0.9	6.1	4
2007	2	8	22	22	31.87	121.5657	25.1705	1.28	1.1	8	1	216	0.03	0.5	0.3	3

2007	2	9	0	43	10.75	121.7408	25.204	6.95	1.34	10	18.9	345	0.36	171.2	354.7	4
2007	2	9	9	58	30.72	121.5422	25.17283	0.99	0.95	8	1.4	165	0.07	0.3	0.5	2
2007	2	9	21	44	56.41	121.5372	25.1675	2.02	0.38	10	1.6	124	0.09	0.4	0.5	2
2007	2	10	17	26	28.13	121.5725	25.17117	0.81	0.92	10	1.7	180	0.04	0.1	0.2	2
2007	2	11	20	7	24.2	121.5675	25.177	2.96	0.84	14	1.6	100	0.09	0.3	0.3	2
2007	2	11	22	55	42.07	121.5672	25.17267	1.01	0.8	12	1.3	154	0.04	0.1	0.2	2
2007	2	12	9	4	24.72	121.5692	25.17233	1.12	0.79	12	1.4	163	0.05	0.2	0.3	2
2007	2	12	9	4	17.3	121.5658	25.17333	0.53	0.39	6	2.2	176	0.05	0.1	0.7	2
2007	2	13	16	0	36.34	121.5687	25.17067	2.05	0.95	15	1.3	95	0.11	0.3	0.5	2
2007	2	13	16	21	59.45	121.5677	25.17133	1.26	1.05	16	1.2	92	0.07	0.2	0.3	2
2007	2	13	23	30	44.86	121.5295	25.15683	4.39	0.88	12	0.2	142	0.09	0.7	0.4	2
2007	2	16	12	4	49.78	121.5445	25.173	1.58	0.88	13	1.4	83	0.07	0.2	0.3	1
2007	2	19	11	33	56.84	121.541	25.1965	2.76	1.39	18	1.4	253	0.44	1.6	1.5	4
2007	2	19	11	57	2.9	121.5397	25.1825	2.51	0.7	4	0.9	201	0.01			3
2007	2	20	18	47	47.4	121.5333	25.166	2.35	0.77	11	1.3	149	0.03	0.2	0.2	2
2007	2	23	6	23	31.22	121.54	25.1645	1.12	0.37	12	1.5	104	0.07	0.2	0.2	2
2007	2	23	6	23	35.39	121.5413	25.16567	1.29	0.75	12	1.5	100	0.11	0.3	0.5	2
2007	2	23	17	12	36.78	121.533	25.1725	1.89	0.89	6	0.9	244	0.16	1.5	1.3	3
2007	2	24	16	9	48.66	121.5758	25.17833	1.6	0.66	16	1.3	81	0.08	0.2	0.3	1
2007	2	24	16	11	28.97	121.5747	25.18283	2.83	0.66	14	0.9	109	0.1	0.4	0.4	2
2007	2	24	16	10	58.45	121.5752	25.181	2	0.26	16	1.1	95	0.09	0.2	0.3	2
2007	2	24	16	11	3.4	121.5763	25.16417	0.86	0.31	6	2.8	283	0.05	0.8	2.7	3
2007	2	24	16	11	44	121.5825	25.19067	1.8	0.38	4	0.2	312	0.02			3
2007	2	24	16	13	48.72	121.5745	25.17833	2.01	0.65	18	1.3	84	0.09	0.2	0.3	1
2007	2	24	16	13	56.09	121.5773	25.18067	2.48	0.62	16	1	85	0.13	0.4	0.5	1
2007	2	24	16	14	12.59	121.5777	25.18	2.16	0.22	10	1.1	186	0.1	0.5	0.5	3
2007	2	24	16	14	26.28	121.5825	25.20867	3.59	0.52	8	2.2	305	0.19	2.1	1.5	3
2007	2	24	16	16	4.14	121.5747	25.1775	1.83	0.74	18	1.4	81	0.1	0.2	0.3	1
2007	2	24	16	16	12.31	121.5748	25.179	1.62	1.1	17	1.3	86	0.07	0.2	0.2	1
2007	2	24	16	17	2.93	121.5757	25.179	1.77	1.22	17	1.2	84	0.07	0.2	0.2	1
2007	2	24	16	19	56.47	121.5758	25.17933	1.96	0.59	16	1.2	85	0.07	0.2	0.3	1
2007	2	24	16	40	40.9	121.5767	25.177	1.58	0.67	13	1.4	74	0.07	0.2	0.3	1
2007	2	24	16	41	33.07	121.573	25.17633	2.5	0.65	18	1.6	79	0.08	0.2	0.3	1
2007	2	25	10	36	42.7	121.5455	25.17167	1.31	0.81	10	1.3	96	0.03	0.1	0.1	2
2007	2	25	13	21	41.13	121.5967	25.19067	2.67	0.7	12	1.6	223	0.16	0.7	0.8	3
2007	2	25	18	45	26.66	121.5395	25.16767	1.11	0.73	13	1.7	111	0.06	0.2	0.3	2
2007	2	26	10	11	30.06	121.5542	25.17617	1.81	0.91	10	1.1	167	0.11	0.5	0.5	2
2007	2	28	21	30	56.85	121.5682	25.175	0.43	0.81	16	1.5	79	0.09	0.2	1.3	1

2007	3	1	2	20	42.48	121.5742	25.17617	1.13	0.5	14	1.6	115	0.08	0.2	0.4	2
2007	3	5	22	54	10.38	121.5295	25.18717	3.3	0.54	8	2.5	257	0.43	3.6	3.2	4
2007	3	7	11	2	38.05	121.5715	25.17583	0.95	0.5	12	1.7	165	0.09	0.2	0.7	2
2007	3	8	0	8	16.26	121.5555	25.17817	1.06	0.45	10	1.4	104	0.25	0.8	1.6	2
2007	3	8	22	12	9.33	121.574	25.17417	1.04	0.49	12	1.8	180	0.09	0.2	0.4	2
2007	3	9	0	54	34.54	121.5722	25.17467	0.65	0.53	12	1.8	171	0.08	0.2	0.8	2
2007	3	12	6	14	34.07	121.57	25.17483	0.36	0.56	16	1.6	77	0.09	0.2	1.6	1
2007	3	14	14	45	6.54	121.5697	25.17417	1.91	0.3	8	2	161	0.07	0.3	0.5	2
2007	3	15	21	10	54.13	121.5667	25.178	0.44	0.65	16	1.6	134	0.12	0.2	1.5	2
2007	3	16	4	41	23.31	121.571	25.17667	0.88	0.57	14	1.7	120	0.06	0.1	0.4	2
2007	3	16	10	56	10.56	121.5672	25.17883	0.77	0.48	12	1.7	137	0.09	0.2	0.8	2
2007	3	18	16	21	30.23	121.567	25.17683	0.41	0.48	16	1.6	129	0.11	0.2	1.3	2
2007	3	20	18	48	12.18	121.5637	25.1595	4.7	0.87	18	1.1	86	0.11	0.4	0.4	1
2007	3	20	19	9	3.59	121.5637	25.162	4.16	0.61	18	0.9	80	0.13	0.4	0.5	1
2007	3	22	22	24	40.4	121.5448	25.15817	2.93	0.71	17	0.8	136	0.07	0.3	0.2	2
2007	3	23	3	2	28.54	121.5677	25.177	1.31	0.85	18	1.6	87	0.11	0.2	0.4	1
2007	3	23	21	11	1.92	121.5665	25.075	10.49	0.95	10	8.1	321	0.05	0.9	1	3
2007	3	25	23	45	47.97	121.5487	25.1735	1.25	0.72	18	1.1	80	0.09	0.2	0.3	1
2007	3	26	19	29	35.78	121.5448	25.16883	1.49	0.66	18	1.2	86	0.12	0.3	0.4	1
2007	3	27	4	4	13.57	121.5442	25.17217	1.27	0.62	14	1.4	85	0.09	0.2	0.4	1
2007	3	27	11	44	26.01	121.5447	25.17833	1.6	0.41	8	1.4	120	0.05	0.3	0.3	2
2007	3	29	21	28	18.4	121.568	25.17267	0.54	0.72	18	1.3	70	0.12	0.2	1.1	1
2007	3	30	21	48	23.88	121.5692	25.17483	1.02	0.6	16	1.6	78	0.11	0.2	0.4	1
2007	4	2	1	34	21.74	121.5723	25.1765	2.56	0.22	14	1.6	81	0.16	0.5	0.7	2
2007	4	7	1	5	41.11	121.5677	25.17967	0.72	1.18	20	1.4	100	0.12	0.2	0.6	2
2007	4	11	10	37	32.54	121.5692	25.17483	0.98	0.47	18	0.9	78	0.11	0.2	0.5	1
2007	4	12	21	39	51.38	121.5427	25.15283	3.31	0.76	19	1.1	175	0.15	0.6	0.5	2
2007	4	12	21	44	12.46	121.56	25.16817	2.01	0.44	15	0.6	84	0.1	0.3	0.4	1
2007	4	12	21	44	22.17	121.5637	25.16733	3.12	0.46	8	1.6	149	0.07	0.4	0.5	2
2007	4	13	11	54	31.02	121.5693	25.178	0.5	0.43	16	1.2	101	0.1	0.1	0.7	2
2007	4	15	13	23	31.55	121.5675	25.17867	0.74	1.45	20	1.2	95	0.1	0.1	0.5	2
2007	4	20	11	50	38.5	121.5707	25.17733	1.02	0.82	10	1.1	156	0.2	0.8	1	3
2007	4	20	18	12	29.33	121.5677	25.17833	1.27	0.5	22	0.8	93	0.15	0.3	0.4	2
2007	4	20	18	56	37.21	121.5675	25.17683	0.89	0.65	22	0.9	86	0.13	0.2	0.5	1
2007	4	20	19	53	32.41	121.5678	25.17717	0.96	0.66	22	0.9	88	0.16	0.2	0.6	2
2007	4	21	4	53	10.55	121.5653	25.17617	1.06	0.87	18	0.8	80	0.12	0.2	0.4	1
2007	4	21	5	5	38.46	121.5675	25.17817	1.41	0.74	18	0.8	93	0.15	0.3	0.5	2
2007	4	21	5	35	1.34	121.5702	25.1805	1.11	0.83	18	0.9	104	0.15	0.4	0.5	2

2007	4	21	16	59	51.51	121.5522	25.1665	4.39	0.73	18	0.4	66	0.18	0.7	0.7	2
2007	4	24	18	38	48.73	121.5673	25.159	4.4	0.79	22	0.9	102	0.12	0.4	0.4	2
2007	4	25	6	5	18.75	121.5742	25.17417	2.57	0.51	18	1.6	70	0.2	0.5	0.7	2
2007	4	25	6	50	23.1	121.5832	25.17783	3.54	1.04	21	1.3	102	0.26	0.7	0.9	2
2007	4	25	12	16	26.24	121.5713	25.17517	2.29	0.44	20	1	77	0.18	0.4	0.6	2
2007	4	25	12	20	46.33	121.5732	25.17333	2.07	0.78	21	1	69	0.16	0.3	0.5	2
2007	4	25	12	39	5.56	121.5658	25.16367	2.37	0.17	14	1	177	0.31	1.1	1.2	3
2007	4	25	14	14	13.99	121.5742	25.18533	1.21	0.29	14	1.4	176	0.13	0.4	0.7	2
2007	4	25	14	33	54.09	121.5928	25.1705	4.74	0.73	20	1.9	106	0.29	1.1	1	2
2007	4	25	21	53	58.92	121.5743	25.1735	1.94	0.71	20	1.1	68	0.17	0.4	0.5	2
2007	4	26	11	9	59.88	121.5542	25.18417	1.25	0.68	14	0.8	96	0.22	0.6	0.8	2
2007	4	28	2	34	33.3	121.5555	25.17417	3.47	0.51	22	0.8	68	0.33	1	1	2
2007	4	28	21	15	49.3	121.5555	25.18733	1.1	0.78	18	0.4	108	0.22	0.6	0.6	2
2007	4	29	20	3	1.5	121.5528	25.188	2.01	0.72	18	0.3	127	0.29	0.9	0.9	2
2007	4	30	17	16	32.45	121.5518	25.1795	3.58	0.74	22	1	95	0.27	0.8	0.8	2
2007	5	3	8	57	19.82	121.5462	25.17217	1.61	0.67	18	1.8	78	0.2	0.4	0.7	2
2007	5	3	20	30	43.49	121.546	25.17667	2.02	0.55	21	1.5	99	0.17	0.4	0.5	2
2007	5	3	20	57	4.17	121.5453	25.1715	1.02	0.37	10	1.7	93	0.12	0.4	0.7	2
2007	5	6	9	29	34.78	121.5727	25.15817	5.28	0.79	20	1.5	122	0.08	0.3	0.3	2
2007	5	6	9	36	26.91	121.5503	25.16467	4.04	0.81	20	0.7	98	0.16	0.5	0.6	2
2007	5	8	5	47	40.4	121.5555	25.172	2.97	0.71	20	0.6	64	0.18	0.5	0.6	2
2007	5	9	15	8	42.05	121.5677	25.17867	0.97	0.6	18	0.8	95	0.14	0.2	0.6	2
2007	5	9	16	37	32.72	121.5802	25.17767	1.76	0.97	12	1.3	207	0.1	0.4	0.4	3
2007	5	10	12	24	44.88	121.5525	25.18633	1.83	1.24	22	0.5	120	0.18	0.4	0.5	2
2007	5	12	6	30	45.08	121.5673	25.18383	1.34	0.37	14	0.7	169	0.25	0.8	0.9	3
2007	5	12	10	28	7.16	121.5705	25.1755	1.05	0.57	14	1	100	0.18	0.5	0.8	2
2007	5	15	14	59	32.04	121.5555	25.17317	2.39	0.47	20	1.2	66	0.23	0.5	0.7	2
2007	5	17	9	47	23.52	121.549	25.182	1.67	0.56	22	1.1	120	0.3	0.6	0.8	2
2007	5	17	17	54	12.39	121.5017	25.3175	7.71	0.83	13	15	342	0.29	4.9	15.4	4
2007	5	18	4	1	7.43	121.5688	25.17833	0.98	0.51	22	0.9	92	0.16	0.2	0.5	2
2007	5	18	6	10	4.71	121.578	25.17317	0.07	0.5	11	1.4	201	0.09	0.3	7.7	4
2007	5	18	15	56	14.39	121.6098	25.1505	2.37	0.54	8	1.6	262	0.15	1	0.9	3
2007	5	22	15	52	21.66	121.6213	25.2275	7.87	1.41	16	5.6	310	0.49	3.9	3.2	4
2007	5	22	15	54	2.69	121.6147	25.211	7.86	2.1	22	3.8	294	0.29	1.8	1.4	3
2007	5	24	12	27	37.14	121.5687	25.17867	1.15	0.46	22	0.9	95	0.26	0.5	0.7	2
2007	5	25	8	36	54.58	121.5642	25.18183	3.07	0.9	22	0.3	110	0.34	1	1	3
2007	5	28	10	53	57.51	121.5678	25.17867	0.94	0.59	22	0.8	95	0.22	0.3	0.7	2
2007	5	29	14	30	21.47	121.5608	25.17883	2.26	0.49	22	0.4	58	0.41	1	1.1	2

2007	5	29	14	32	25.02	121.5647	25.17833	2.11	0.79	22	0.6	92	0.28	0.6	0.7	2
2007	5	29	14	32	6.7	121.5643	25.17933	2.08	0.42	18	0.5	97	0.37	1	1.1	3
2007	5	29	19	14	42.3	121.568	25.1785	1.93	0.34	20	0.8	94	0.32	0.7	0.9	3
2007	5	29	19	14	48.67	121.564	25.178	2.39	0.21	22	0.6	85	0.25	0.6	0.7	2
2007	6	6	19	2	53.94	121.569	25.17733	1.04	0.91	20	1	93	0.09	0.2	0.3	2
2007	6	6	21	6	33.72	121.5447	25.17467	2.33	0.52	17	1.5	90	0.14	0.4	0.5	2
2007	6	7	21	42	53.12	121.542	25.17167	1.43	0.6	18	1.5	96	0.2	0.4	0.7	2
2007	6	10	22	26	4.47	121.5637	25.18583	1.04	0.58	20	0.5	139	0.13	0.3	0.4	2
2007	6	15	17	26	49.2	121.4882	25.27433	13.07	1.41	10	11.4	342	0.22	6.5	6.4	4
2007	6	17	4	22	11.39	121.5713	25.15983	5.27	0.66	17	1.6	110	0.1	0.5	0.4	2
2007	6	18	1	56	27.7	121.5637	25.128	5.74	0.77	22	2.2	263	0.3	1.5	1.2	4
2007	6	18	16	4	1.77	121.562	25.1865	1.09	0.37	16	0.5	141	0.2	0.5	0.7	3
2007	6	19	4	54	58.47	121.5707	25.179	0.94	0.44	20	1.1	95	0.16	0.3	0.6	2
2007	6	21	15	17	4.98	121.5785	25.04167	22.45	1.31	16	11.9	325	0.17	4.1	2.8	4
2007	6	21	15	26	3.49	121.5608	25.181	2.46	0.49	22	0.2	62	0.27	0.7	0.8	2
2007	6	21	15	27	15.47	121.5617	25.1825	2.38	0.83	22	0.1	110	0.25	0.6	0.7	2
2007	6	21	19	42	42.69	121.568	25.17817	0.89	0.59	22	0.8	92	0.22	0.3	0.8	2
2007	6	23	15	18	12.35	121.5498	25.18433	2.06	1.07	16	0.8	131	0.3	0.9	1	2
2007	6	24	2	59	6.78	121.522	25.23067	4.15	0.88	8	5.4	329	0.21	2.7	3.7	4
2007	6	24	3	29	43.15	121.5672	25.19267	2.32	0.83	14	1.3	204	0.35	1.5	1.3	4
2007	6	24	9	26	24.64	121.5688	25.176	0.99	0.6	17	1	82	0.21	0.4	1	2
2007	6	24	10	34	3.58	121.5712	25.17767	1	0.84	18	1.2	87	0.21	0.4	0.7	2
2007	6	24	11	27	54.33	121.5665	25.1745	0.78	0.56	20	0.8	74	0.32	0.5	1	2
2007	6	24	22	30	42.38	121.5677	25.17783	1.15	0.87	16	0.8	91	0.2	0.4	0.7	2
2007	6	25	12	15	4.18	121.5712	25.17817	0.93	0.77	22	1.1	90	0.2	0.3	0.8	2
2007	6	29	5	15	23.73	121.5678	25.17833	1.14	0.57	20	0.8	93	0.23	0.5	0.6	2
2007	6	30	0	28	20.25	121.5677	25.1775	1.02	0.53	22	0.9	89	0.27	0.5	0.7	2
2007	7	1	15	32	17.03	121.5727	25.17767	1	0.61	20	1.3	85	0.26	0.5	0.7	2
2007	7	1	16	4	58.23	121.5688	25.17783	1.13	0.82	22	0.9	90	0.34	0.6	0.9	3
2007	7	5	12	19	11.12	121.5675	25.17317	1	1.3	20	0.7	70	0.16	0.2	0.6	2
2007	7	7	13	51	33.4	121.5838	25.17233	2.04	0.33	10	1.9	101	0.11	0.4	0.7	2
2007	7	8	9	55	46.79	121.5762	25.17183	2.96	0.7	20	1.1	71	0.17	0.4	0.6	2
2007	7	10	2	30	46.1	121.5708	25.179	1.09	0.63	17	1.1	97	0.12	0.3	0.4	2
2007	7	10	3	22	36.85	121.5502	25.1765	1.53	0.61	18	1.3	89	0.15	0.3	0.5	2
2007	7	11	22	3	40.12	121.565	25.17783	1.23	0.5	14	0.7	124	0.18	0.5	0.7	2
2007	7	12	2	58	22.23	121.571	25.18633	1.85	0.74	12	1	148	0.18	0.7	0.7	3
2007	7	12	17	5	15.19	121.5555	25.181	1.27	0.51	14	0.6	83	0.23	0.6	0.9	2
2007	7	13	16	57	34.13	121.5677	25.18	1.09	0.74	20	0.7	102	0.2	0.4	0.5	2

2007	7	14	8	15	9.47	121.5623	25.18733	1.06	1.46	20	0.6	149	0.19	0.5	0.5	3
2007	7	15	1	33	8.21	121.5555	25.19267	3.52	0.69	14	0.2	217	0.27	1.3	1.2	3
2007	7	15	3	57	7.03	121.5675	25.17717	1.1	0.35	14	0.9	143	0.2	0.5	0.7	3
2007	7	15	4	56	19.16	121.5658	25.17933	1.03	0.65	18	0.6	98	0.2	0.4	0.5	2
2007	7	17	7	22	47.83	121.5762	25.17433	0.45	0.6	18	1.3	69	0.21	0.4	2.4	2
2007	7	17	8	50	8.79	121.567	25.16917	1.6	0.7	11	0.2	144	0.1	0.3	0.3	2
2007	7	17	9	27	19.85	121.5637	25.18067	1.33	0.61	15	0.3	104	0.25	0.7	0.9	2
2007	7	17	9	42	37.78	121.5607	25.18167	1.96	0.48	16	0.1	129	0.27	0.9	0.9	2
2007	7	17	10	21	23.03	121.5662	25.18167	1.91	0.7	15	0.5	112	0.28	0.9	0.9	2
2007	7	17	17	14	46.58	121.5413	25.205	5.57	0.89	16	2	306	0.1	0.7	0.5	3
2007	7	18	14	41	36.24	121.5695	25.1785	1.26	0.71	20	1	93	0.17	0.3	0.5	2
2007	7	20	18	22	36.31	121.5588	25.19217	1.27	0.68	15	0.5	202	0.38	1.1	1.2	4
2007	7	20	18	32	0.88	121.564	25.19267	2.4	0.61	18	1	204	0.34	1	1.1	4
2007	7	29	2	28	35.17	121.5638	25.189	4.09	1.05	18	0.8	182	0.4	1.5	1.5	4
2007	7	30	17	32	34.76	121.5685	25.18317	1.85	0.68	20	0.8	122	0.35	0.8	1	3
2007	8	3	20	15	2.79	121.5555	25.1835	4.31	0.85	18	0.6	88	0.45	2	1.7	2
2007	8	6	6	11	51.96	121.5555	25.19267	0.85	0.57	16	0.2	237	0.52	1.6	1.5	4
2007	8	6	18	24	25.77	121.5627	25.173	1.07	0.79	8	1	190	0.11	0.7	0.6	3
2007	8	10	20	25	36.85	121.5555	25.19267	0.73	1.09	20	0.2	237	0.44	1.1	1.2	4
2007	8	11	17	0	12.53	121.5497	25.19267	0.08	1.17	20	0.5	250	0.47	1.1	8	4
2007	8	11	17	10	45.05	121.5403	25.21	0.75	1	16	2.5	312	0.55	2.5	8.1	4
2007	8	12	18	56	47.08	121.5555	25.18333	1.4	0.55	18	0.6	163	0.54	1.6	1.5	4
2007	8	12	19	25	25.16	121.5365	25.20267	0.62	0.87	18	2.2	307	0.64	2.7	8.7	4
2007	8	17	19	44	18.46	121.5555	25.19267	0.68	0.91	20	0.2	237	0.48	1.1	1.3	4
2007	8	24	5	33	37.59	121.5467	25.19717	0.46	0.76	18	1	292	0.68	2.2	5.2	4
2007	8	25	4	55	56.15	121.534	25.16617	2.74	0.81	18	1.4	210	0.21	1	0.7	3
2007	8	25	18	6	4.48	121.5627	25.27283	3.24	1.5	18	9.1	329	0.83	5.9	67	4
2007	8	29	14	47	37.09	121.5645	25.27317	3.53	1.41	18	9.2	329	0.84	6	31.9	4

Mag: 地震的規模。

NS:參與定位的觀測資料個數(P 加 S 的各數)。

Dmin:最接近震央之測站的震央距。

GAP:最大方位角夾角。

RMS:觀測與理論到時的方均根值。

Erh:水平誤差量。

Erz:垂直誤差量。

Q:定位品質(1-4 表示之，1 代表最佳，4 代表最差)

陽明山國家公園96年委託研究計畫「大屯火山群潛在岩漿庫及微震觀測網長期監測計畫(五)」評審會會議紀錄

一、時間：96年4月16日(星期一) 上午9時30分

二、地點：本處二樓會議室

三、主持人：詹副處長德樞　　　　記錄：鄭文良

四、出列席單位及人員：

楊委員潔豪 清雲科技大學校長	楊潔豪
羅委員偉 國立台北科技大學資源工程研究所	請假
詹委員德樞	詹德樞
韓委員志武	韓志武
叢委員培芝	叢培芝

廠商代表

中國地球物理學會	林正洪

五、受託單位報告：（略）

六、討論：（略）

七、結論：

（一）本案審查委員所提之下列意見，請計畫主持人列入研究計畫參考。

1. 未來研究可運用大地電磁測深法(MT)與本案研究方法搭配。
2. 具有等差級數微震訊號的產生,值得進一步探討。
3. 可考慮區隔日、夜地震訊號的解析。
4. 請協助本處遊客中心地震儀器的配置與相關解說資訊的提供。
5. 本案是本研究議題的第5年，也是階段性的最後一年，建請在期末研究報告中能有5年研究成果總結的詳細呈現,並提供國外火山研究的發展成果、合作管道與解說系統之資訊。

（二）本案為「大屯火山群潛在岩漿庫及微震觀測網長期監測計畫(五)」經4位出席委員審查結果：一致評選為「合格」，通過審查。

~以下空白~

陽明山國家公園 96 年委託研究計畫
「大屯火山群潛在岩漿庫及微震觀測網長期監測計畫（五）」
期中報告會議紀錄

一、時間：96年7月31日(星期二) 下午14時
二、地點：本處二樓會議室
三、主持人：詹德樞副處長　　　　　記錄：鄭文良
四、出列席單位及人員：

清雲科技大學 楊潔豪校長	楊潔豪
國立台北科技大學科材料及資源工程系羅偉教授	羅偉
郭步雲處長	
詹德樞副處長	詹德樞
陳昌黎秘書	
企劃經理課	黃琡珺
工務建設課	韓志武
解說教育課	陳彥伯
觀光遊憩課	董人維
建管小組	吳啟弘
小油坑管理站	呂理昌
擎天崗管理站	
龍鳳谷管理站	
陽明書屋管理站	
資訊室	
人事室	
會計室	
秘書室	

保育研究課	叢培芝　鄭文良

研究團隊代表：

中國地球物理學會	林正洪　林瑞仁

五、受託單位報告：(略)

六、討論：(略)

七、結論：

（一）有關評審委員及本處同仁意見請參考修正。

1. 可探討七星山與大屯山區域地震次數統計不一致現象的可能原因。
2. 地震頻次請另呈現以「日」為單位的分析，並區隔日、夜地震訊號的解析。
3. 請探討金山斷層與火山岩漿庫所造成地震之差異。
4. 請釐清研究區內屬崩塌地地層滑動所造成的地震現象。
5. 期末報告請提供其他火山研究方法的介紹。
6. 請提供對比於本研究之各火山活躍地區之地震訊號紀錄。
7. 請分析降雨（雨量）與地震頻次之相關程度。

（二）請受託單位於近日內儘速至GRB網站登錄相關資料。

（三）請依合約規定進度辦理並進行申請撥款項事宜。

八、散會。

陽明山國家公園 96 年委託研究計畫
「大屯火山群潛在岩漿庫及微震觀測網長期監測計畫（五）」
期末報告會議紀錄

一、時間：96年11月29日(星期四) 下午15時
二、地點：本處二樓會議室
三、主持人：詹德樞副處長　　　　記錄：鄭文良
四、出列席單位及人員：

清雲科技大學 楊潔豪校長	楊潔豪
國立台北科技大學科材料及資源工程系羅偉教授	羅偉
郭步雲處長	
詹德樞副處長	詹德樞
陳昌黎秘書	
企劃經理課	
工務建設課	
解說教育課	陳彥伯
觀光遊憩課	
建管小組	
小油坑管理站	呂理昌
擎天崗管理站	
龍鳳谷管理站	
陽明書屋管理站	
資訊室	詹銘炫
人事室	
會計室	
秘書室	

保育研究課	叢培芝　鄭文良

研究團隊代表：

中國地球物理學會	林正洪　林瑞仁

五、受託單位報告：(略)

六、討論：

審議意見	修正說明
1.建議透過立體透視表現(4度空間)方式，例如以動力與磁力方式一起研究，建構地層下岩漿庫的可能空間影像。	感謝指導 建議列為與管理處合作的未來研究調查方向。
2.研究期能與楊燦堯教授的火山氣體研究計畫做資料的整合，將會有更好成果呈現。	感謝指導 將嘗試整合彼此研究資料尺度,並累積更多資料後達到現象的分析、解釋。
3.可提供國內外各研究機構所出版之解說海報、摺頁供陽管處展示與解說需要。	感謝指導 將視陽管處需要密切配合。
4.建議是否進一步設立研究站為目標，用以延續資料之搜集與提供陽管處環境教育需求。	感謝指導 將協商氣象局在設置即時監測系統時,能另分線提供陽管處展示需要。
5.建議將5年內對國、內外期刊雜誌所發表之文章列為報告附錄。	感謝指導 將於正式結案報告時增列。

七、結論：

（一）本案審查「合格」。有關與會學者及本處同仁意見請參考修正。

（二）請受託單位於近日內儘速至GRB網站登錄相關資料。

（三）委託研究報告書請依「內政部研究計畫作業要點」格式修正，並依依合約書規定提送成果報

告等過處辦理結案事宜。

八、散會。

~以下空白~

附錄五：本研究近年內發表之文章

Konstantinou, K. I., C.H. Lin and W.Z. Liang (2007), Seismicity characteristics of a potentially active Quarternary volcano: the Tatun Volcano Group, northern Taiwan, J. Volcanol. and Geothermal Res., 160 (3-4), pp. 300-318. (SCI)

Lin, C.H. K. I. Konstantinou, H.C. Pu, C.C. Hsu, Y.M. Lin, S.H. You and Y.P. Huang (2005), Preliminary results of seismic monitoring at Tatun volcanic area of northern Taiwan, Terr. Atm. Ocean, 16, 3, 563-577. (SCI).

Lin, C.H. K. I. Konstantinou, W.T. Liang, H.C. Pu, Y.M. Lin, S.H. You and Y.P. Huang (2005), Preliminary analysis of volcanoseismic signals recorded at the Tatun volcano group, northern Taiwan, Geophysical Research Letters, Vol. 32, No.10, L10313. doi:10.1029/2005GL022861. (SCI)

Available online at www.sciencedirect.com
ScienceDirect
Journal of Volcanology and Geothermal Research 160 (2007) 300 – 318
Journal of volcanology and geothermal research
www.elsevier.com/locate/jvolgeores

Seismicity characteristics of a potentially active Quaternary volcano: The Tatun Volcano Group, northern Taiwan

Konstantinos I. Konstantinou [a,*], Cheng-Horng Lin [b], Wen-Tzong Liang [b]

[a] *Institute of Geodynamics, National Observatory of Athens, P.O. Box 20048, 118 10, Athens, Greece*
[b] *Institute of Earth Sciences, Academia Sinica, P.O. Box 1-55, Taipei, 115 Taiwan, ROC*

Received 18 May 2006; received in revised form 5 September 2006; accepted 14 September 2006
Available online 21 November 2006

Abstract

The Tatun Volcano Group (TVG) is located at the northern tip of Taiwan, near the capital Taipei and close to two nuclear power plants. Because of lack of any activity in historical times it has been classified as an extinct volcano, even though more recent studies suggest that TVG might have been active during the last 20 ka. In May 2003 a seismic monitoring project at the TVG area was initiated by deploying eight three-component seismic stations some of them equipped with both short-period and broadband sensors. During the 18 months observation period local seismicity mainly consisted of high frequency earthquakes either occurring as isolated events, or as a continuous sequence in the form of spasmodic bursts. Mixed and low frequency events were also present during the same period, even though they occurred only rarely. Arrival times from events with clear P-/S-wave phases were inverted in order to obtain a minimum 1D velocity model with station corrections. Probabilistic nonlinear earthquake locations were calculated for all these events using the newly derived velocity model. Most high frequency seismicity appeared to be concentrated near the areas of hydrothermal activity, forming tight clusters at depths shallower than 4 km. Relative locations, calculated using the double-difference method and utilising catalogue and cross-correlation differential traveltimes, showed insignificant differences when compared to the nonlinear probabilistic locations. In general, seismicity in the TVG area seems to be primarily driven by circulation of hydrothermal fluids as indicated by the occurrence of spasmodic bursts, mixed/low frequency events and a *b*-value (1.17 ± 0.1) higher than in any other part of Taiwan. These observations, that are similar to those reported in other dormant Quaternary volcanoes, indicate that a magma chamber may still exist beneath TVG and that a future eruption or period of unrest should not be considered unlikely.

Keywords: Taiwan; Seismicity; Dormant volcano; Earthquake location; Tatun

1. Introduction

Volcanic activity can pose a severe threat to nearby densely populated areas and to sensitive facilities such as nuclear power plants (Tilling, 1989; McBirney and Godoy, 2003). Mitigation of volcanic hazards can usually be achieved by a coordinated volcano monitoring program that encompasses a number of multidisciplinary (geophysical, geodetic, geochemical) techniques in order to detect any early signs of unrest. Many such programs have been already implemented in developed countries like Japan or the United States but most of them are restricted to volcanoes that have erupted in historical times. However, one major problem in volcanological research is the distinction between a volcano that is capable of erupting after a long repose time and one that is not. This problem, beyond its

* Corresponding author.
E-mail address: kkonst@gein.noa.gr (K.I. Konstantinou).

0377-0273/$ - see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.jvolgeores.2006.09.009

academic interest, is a highly practical one since many volcanoes belonging to this category are situated next to large cities and/or critical sites around the world.

The Tatun Volcano Group (hereafter called TVG) consists of a number of Quaternary volcanoes that are located at the northern tip of Taiwan, just 15 km north of the capital Taipei and close to two nuclear power plants. In addition to that, the unique natural beauty of the area and the fact that it has been declared a national park, attracts tens of thousands of visitors every year. Its lack of eruptions during historical times was used as the main argument to suggest that it is by now an extinct volcano. In this paper we present a detailed description of the seismicity characteristics of TVG as they stem from its monitoring by a local seismic network for a period of 18 months. These observations are then used in order to draw useful conclusions about the volcano–hydrothermal system at TVG and to perform a comparison between these characteristics and those observed in other Quaternary volcanoes. Finally, a first attempt is made to address the status of this volcano (dormant versus extinct) and to consider the resulting implications.

1.1. Tectonic and volcanological setting

The island of Taiwan was formed as the result of the collision between the Luzon arc carried by the Philippine Sea Plate (PSP) and the continental shelf of the Eurasian Plate (EUP) as proposed by numerous authors (see for example Wu et al., 1997 and references therein) (Fig. 1a). The oblique subduction of the PSP beneath EUP at a present rate of 8.2 cm yr^{-1} (Yu et al., 1997) is responsible for the formation of the Ryukyu subduction zone extending to the east of Taiwan. To the north, the Okinawa Trough (OT), the backarc basin of the Ryukyu trench, is in the process of opening as demonstrated by both GPS measurements at the Ryukyu islands and normal faulting earthquakes occurring offshore NE Taiwan (Kao and Jian, 2001). The combination of all these processes generates a complicated geotectonic environment that has attracted the attention of many geoscientists.

Volcanism in northern Taiwan is believed to be related solely to the Ryukyu subduction zone, thus being a part of the Ryukyu volcanic arc (Teng, 1996). However, more recent studies suggest that it may actually be the result of

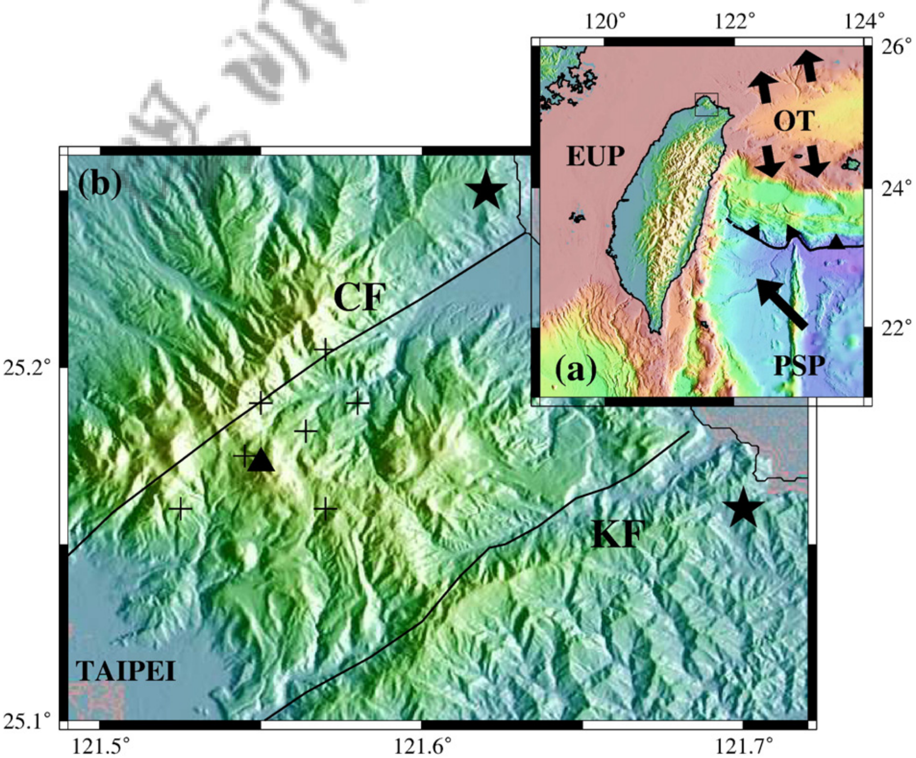


Fig. 1. (a) Map showing the regional tectonic setting and relative motion between the Philippine Sea plate (PSP) and the Eurasian plate (EUP) indicated by an arrow, as well as the opening of the Okinawa Trough (OT) backarc basin. The square in northern Taiwan shows the area of interest. (b) Map showing the area of the Tatun Volcano Group (TVG). The thick line to the south indicates the Kanchiao fault (KF), while that in the north the Chinshan fault (CF). The triangle represents the peak of the Chihsinshan volcanic cone (1120 m), the crosses indicate the place of hot spring/fumarole activity after Yang et al. (1999) and the stars show the positions of the two nuclear power plants. Part of the Taipei sedimentary basin can be seen at the lower left corner of the map.

post-collisional lithospheric extension due to the opening of the OT (Wang et al., 1999). The most prominent manifestation of this volcanism is TVG, a group of multivent Quaternary volcanoes built on a late Tertiary sedimentary basement and enclosed by two thrust fault systems, the Chinshan and Kanchiao faults (Fig. 1b). Based on fission track K–Ar/Ar–Ar radiometric dating of 80 volcanic rock samples compiled by Song et al. (2000a), the eruptive activity of TVG seems to consist of three main stages: an early eruptive stage of andesitic lava effusion between 2.8–2.5 Ma followed by a quiescent period; sparse volcanic activity that produced small amounts of lava and pyroclastic material between 1.5–0.8 Ma; and finally a major eruptive stage with the production of large amounts of andesitic lava and only few pyroclastic breccias between 0.8–0.3 Ma. Volcanic activity appears to have ceased at about 0.2 Ma ago, a date that has been used as an argument for suggesting that TVG is by now extinct.

The nearby Taipei sedimentary basin has recorded these episodes of volcanic activity through the deposition of the eruptive products, allowing us to have a more detailed picture of the eruptive behaviour of TVG. The products found in the Taipei basin strata include volcanoclastic material in fluvial deposits, lahar deposits, tuffaceous sediments and volcanic glasses stemming from ash deposits (Song and Lo, 1995; Chen et al., 1995a,b; Tsao et al., 2001). Taking into account the relative quantities of these products and of andesitic lava, it appears that the eruptive style of TVG was mainly effusive or ‘silent’ rather than explosive (Song et al., 2000a). However, the most important finding in the Taipei basin deposits is the presence of ash in sedimentary formations that are younger than about 20 ka along with grains of charcoals (Chen and Lin, 2000, 2002). The mineral chemistry analysis of the ash indicates that the most probable source is TVG, while the age of the charcoals derived from ^{14}C dating suggests that they represent *in situ* deposition materials. It is speculated that the charcoals originated from forest fires that were triggered by the volcanic eruptions. On the other hand, the measurement of the $^{3}He/^{4}He$ isotope ratio of fumarolic gas showed that more than 60% of the He composition comes from a deep magmatic source beneath TVG (Yang et al., 1999). It is therefore concluded that volcanism at TVG during the last few thousands years might have been continuous and in the form of small scale eruptions.

1.2. Previous geophysical studies

Tomographic imaging studies for the whole of Taiwan have shown the existence of abnormally low P-wave velocities around the area of TVG (Roecker et al., 1987; Rau and Wu, 1995; Ma et al., 1996; Kim et al., 2005a). Even though low resolution did not permit the delineation of any specific low velocity bodies in the upper crust, the authors speculated that some percentage of melt may still be present beneath TVG. In a smaller scale study over northern Taiwan, Chen et al. (2002) used data from the national seismographic network maintained by Taiwan’s Central Weather Bureau (hereafter called CWB), in order to obtain three-dimensional images of body wave attenuation. The results showed high P- and S-wave attenuation at the first 15 km beneath TVG ($Q \sim 90$–200) that the authors tentatively interpreted as resulting from a partially molten body. Two seismic experiments covering the broader area of TVG and northern Taiwan were performed in 1989–1990 (Chen and Yeh, 1991; Chen et al., 1995a,b) and in 1996–2000 (Yeh et al., 1998) by deploying three-component short period seismometers. Unfortunately, the data analysis in both studies was limited in identifying only tectonic events and not volcanoseismic signals. Also, the resulting earthquake locations appeared quite diffuse, not allowing any interpretation of the hypocentral distribution.

More recently Kim et al. (2005b) studied the seismicity around TVG using seismic data recorded by various regional networks (the Taiwan Telemetered Seismic Network operating from 1973 until 1991, the Taiwan Seismic Network operating from 1991 until now and the Broadband Array in Taiwan for Seismology operating from 1996 until now). The authors observed the repeating occurrence of several swarms that consisted of numerous small earthquakes not reported in the CWB catalogue. Even though the exact location of these events was not possible due to the small number of available arrival times, it was suggested that this activity is related to subsurface volcano–hydrothermal processes. In support of this conclusion, Kim et al. (2005b) also report a *b*-value for the TVG area equal to 1.22 that is in accordance with *b*-values observed in other volcanic areas around the world.

Gravity and magnetic surveys over the broader area of TVG were carried out simultaneously and their results were reported by Yang et al. (1994). The gravity survey showed that for the upper 4 km, predominantly high, positive anomalies were present and were interpreted as being caused by the density contrast between the volcanic and surrounding sedimentary rocks. The magnetic survey results also showed mostly magnetic highs except from certain areas where fumarolic activity is quite strong. This correlation was believed to be the result of the extensive hydrothermal alteration of rocks so that ferromagnesian minerals may have been partially or completely weathered out.

2. Data collection and analysis

In May 2003 the Institute of Earth sciences, Academia Sinica, initiated a project for seismic monitoring of TVG funded by the National Research Council of Taiwan and the Yangminshan National Park. During the first stage of the project five seismic stations were installed, four of them equipped with both a short period three-component sensor (Lennartz LE3D) and a broadband one (Guralp CMG-3T). The instruments were recording data continuously at a sampling interval of 100 samples s^{-1} while absolute timing was provided by GPS receivers. The seismic stations of this small aperture array were distributed around the Chihsinshan volcanic cone which appeared to exhibit the highest seismicity in the TVG area during the last seismic experiment (Yeh et al., 1998). In early September 2003 the second stage of the project commenced and three additional short period three-component seismometers were installed in the nearby area of Tayiokeng where most of the present day hydrothermal activity is observed. Fig. 2 shows the position of the eight seismic stations in the Chihsinshan–Tayiokeng area and Table 1 gives some details for each station separately. A preliminary analysis of the data recorded during the first stage of the project has been published by Lin et al. (2005a,b). This work will be focused on the period between October 2003 and February 2005, when all 8 stations were operational.

Table 1
List of seismic stations deployed at the TVG area for the period between September 2003 until February 2005

Station	Lat (°N)	Lon (°E)	Elev (km)	Sensor type
YM01	25.1481	121.5620	0.488	Le3D/CMG-3T
YM02	25.1863	121.5621	0.521	Le3D/CMG-3T
YM03	25.1809	121.5314	0.702	Le3D/CMG-3T
YM04	25.1552	121.5278	0.401	Le3D/CMG-3T
YM05	25.1665	121.5564	0.740	Le3D
YM06	25.1538	121.5943	0.445	Le3D
YM07	25.1771	121.6123	0.456	Le3D
YM08	25.1890	121.5808	0.342	Le3D

Seismic data were usually retrieved once per month during regular network maintenance and our analysis started each time by creating a daily drumplot of the vertical components for each station. Using this plot the recorded signals were first grouped in three main categories: namely teleseismic, regional and local events. Teleseismic events were identified after consulting the NEIC (National Earthquake Information Centre) database, while the same procedure was followed for the regional events using the seismicity catalogue provided by CWB. In this way, local earthquakes and other

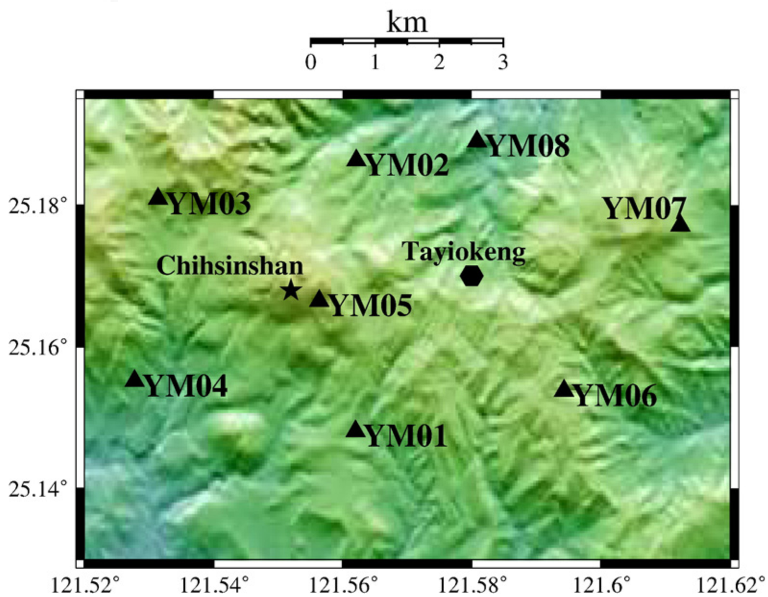


Fig. 2. Map showing the station distribution during the seismic monitoring experiment (see also Table 1). The star indicates the peak of the Chihsinshan volcanic cone and the polygon the centre of the Tayiokeng area.

volcanoseismic signals were isolated and stored every month for further analysis. These signals were classified into different groups by using a simple scheme based on the observed frequency content and waveform appearance (McNutt, 1996). Propagation effects are usually quite severe around volcanic areas and may lead to biased classification of signals, if the source–receiver distance is large and/or the signal is recorded at only a few stations. In order to avoid these complicating factors, we classified signals that were recorded clearly by at least five stations, looking carefully for time or frequency domain characteristics present at all available stations.

A description of each group resulting from this classification scheme is given below:

(1) *High frequency earthquakes*. They are characterised in the time domain by impulsive P-wave onsets and clear S-wave phases, while in the frequency domain most of the energy is concentrated in the band 1–20 Hz (Fig. 3). Of course they are similar to tectonic earthquakes observed in non-volcanic areas worldwide. Most of the seismicity observed during the 18 months of monitoring described in this study is in this category.

(2) *Spasmodic bursts*. These are continuous seismic signals of varying duration (20 s to 15 min) that consist of numerous high frequency earthquakes occurring very closely in time (Fig. 4). This kind of seismicity was quite common in the TVG area and two of the longest duration spasmodic bursts occurred between October 28–30, 2003.

(3) *Mixed frequency earthquakes*. These events have a sharp P-wave onset, no clear S-wave phase and they consist of a high frequency (up to 40 Hz) initial part, followed by a later low frequency (~5 Hz) harmonic coda (Fig. 5). Eight mixed frequency events were observed in the period between February and June 2004.

(4) *Low frequency earthquakes*. Two kinds of these events were observed in the TVG area: tornillo events have a characteristic decaying waveform that looks like a screw in a cross-section ('tornillo' is the Spanish word for screw). Their duration extends up to 40 s and consist of discrete frequencies at 2.2, 4.2, 6.2, 8.2 and 9.6 Hz (Fig. 6a). Monochromatic events have smaller durations (15–20 s) and most energy is concentrated around 3.4 Hz (Fig. 6b). Low frequency signals were

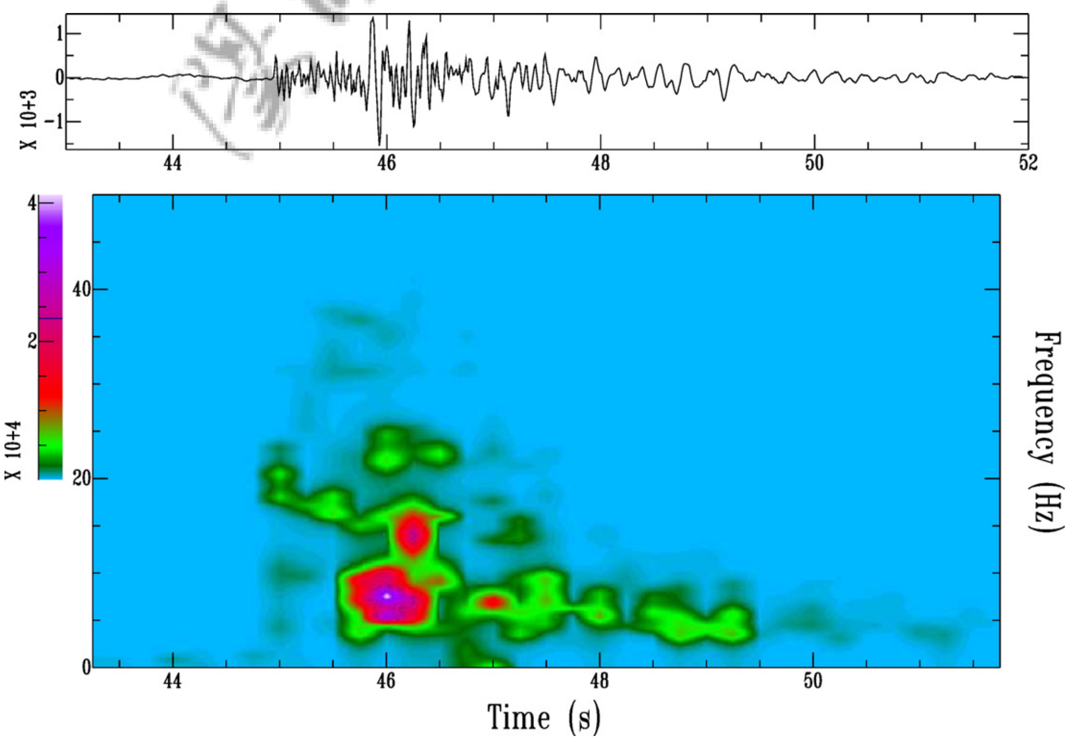


Fig. 3. Vertical velocity waveform and corresponding spectrogram for a high frequency event that occurred at September 9, 2003 11:07:43.8 (GMT) (M_L 1.0). The signal was recorded at station YM05 by a short-period sensor. The spectrogram was calculated for a 0.5 s window and 50% overlap using the technique of Goldstein and Minner (1996).

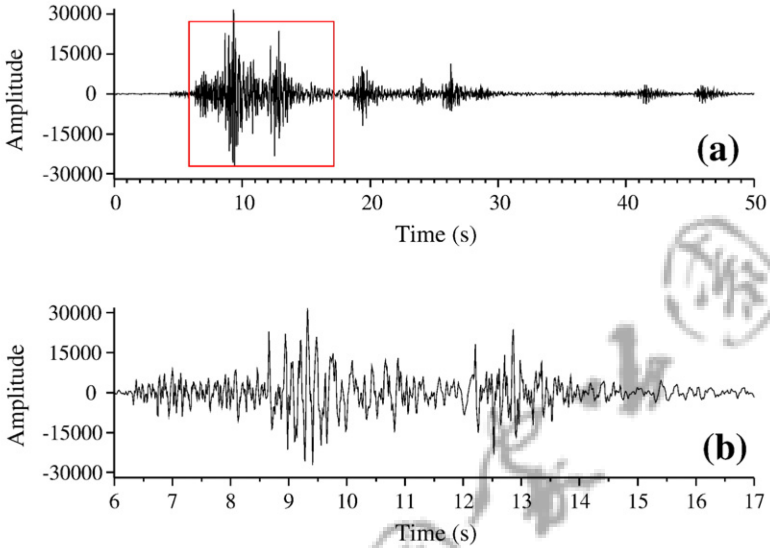


Fig. 4. (a) Vertical velocity waveform of a spasmodic burst that occurred in October 28, 2003 recorded by the short-period sensor of station YM05, (b) enhanced section of the highlighted part of the waveform shown in (a), where it can be seen that spasmodic bursts consist of ordinary high frequency events.

observed in the TVG area only in early September 2003 and consisted of 3 tornillo and 2 monochromatic events. After that period no other low frequency signal was detected, while occasionally some monochromatic signals could be seen just above noise level at the stations around Tayiokeng.

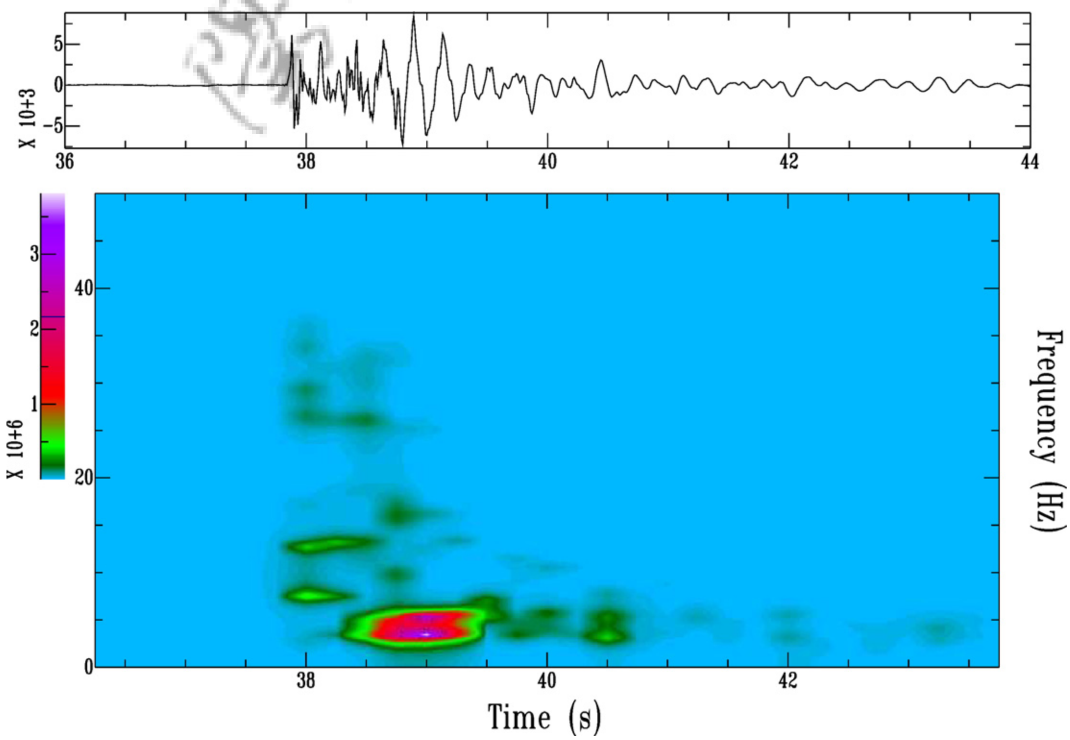


Fig. 5. Vertical velocity waveform and corresponding spectrogram for a mixed frequency event that occurred at April 2, 2004 17:50:37.17 (GMT) (M_L 1.0). The signal was recorded at station YM03 by a short-period sensor. The spectrogram was calculated the same way as in Fig. 3.

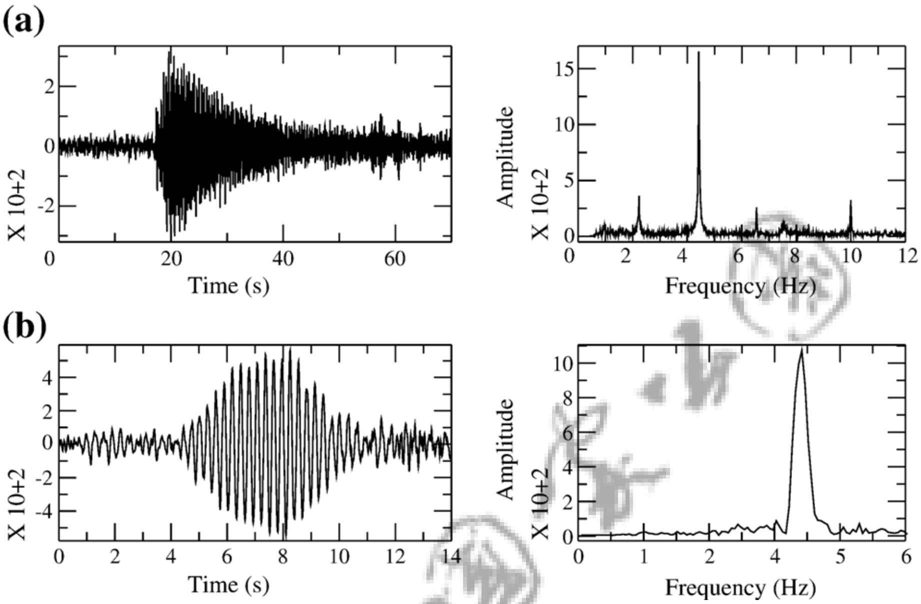


Fig. 6. Vertical velocity waveforms and corresponding amplitude spectra for (a) a tornillo event and (b) a monochromatic event recorded by short-period sensors at stations YM05 and YM02 respectively (see text for more details).

Lin et al. (2005a) analysed these signals using the Sompi method (Kumagai and Chouet, 2000 and references therein) in order to determine the frequency and quality factor of the underlying oscillations. Their results showed that a crack filled with an ash–gas or water droplet–gas mixture are the most likely candidates for explaining the large quality factors (250–1000) of these signals. These two mixtures are stable under different physical conditions (pressure and temperature) and therefore at different depths (Molina et al., 2004). Unfortunately, the authors had no constrained hypocentral locations for these low frequency events that would allow them to decipher which one is the most likely mixture.

Subsequently and for the purpose of source location, we use the short-period wave-forms to manually pick a total of 211 events (144 high frequency events, 59 events belonging to spasmodic bursts and 8 mixed frequency events). For high frequency or spasmodic burst events at least five P- and one S-phase pick was required for selection, while at least five P-phases was the requirement for the mixed frequency events. Fig. 7 shows the temporal distribution of all events that were included in the final dataset.

We also estimated the local magnitude (M_L) of these events by measuring on a standard Wood–Anderson simulated trace their maximum peak-to-peak amplitude on the horizontal components at each station. An attenuation function derived for the Taiwan area and for epicentral distances smaller than 80 km was used in these calculations (see Shin, 1993). This procedure resembles the one used by CWB for local magnitude estimation, therefore our M_L estimates are directly comparable to those found in the CWB catalogue. In fact, for 10 events that were common in both seismicity catalogues we found that our magnitude values are in

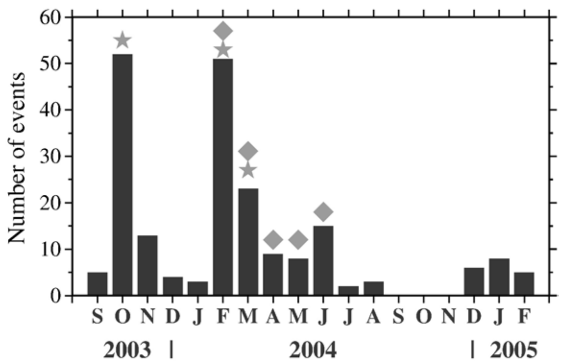


Fig. 7. Histogram showing the temporal variation of the number of picked events per month for the whole of the observation period. The stars on top of some bars indicate the occurrence during that month of a series of spasmodic bursts. The diamonds represent the occurrence of mixed frequency events. The almost zero number of events from July to December 2004 is due to network problems that did not allow a continuous recording of data at all stations.

Table 2
Velocity model used for initial earthquake locations

Depth (km)	V_P (km s^{-1})
1.0	4.07
2.0	4.55
3.0	5.12
5.0	5.39
7.0	5.98
9.0	6.10
17.0	6.70

good agreement with those published by CWB (differences smaller than 0.1 units). The largest magnitude observed in the TVG dataset is 2.78 for an event that occurred in February 24 2004, while five more events in our dataset had a magnitude of 2 or greater. The estimation of the *b*-value for the high frequency earthquakes (either isolated or occurring as spasmodic bursts), yields a value of 1.17 (±0.1) for a completeness magnitude threshold of 1. This value is similar to those estimated previously for the TVG area by Wang (1988) (~1.33) and by Kim et al. (2005b) (~1.22).

3. Absolute earthquake locations

3.1. Method outline

We chose to apply a probabilistic nonlinear method for earthquake locations, by using the freely available software package NONLINLOC (Lomax et al., 2000). The algorithm implemented in this package follows the probabilistic formulation of inversion suggested by Tarantola and Valette (1982). A probabilistic solution can be expressed as *a posteriori* Probability Density Function (PDF) provided that the errors in the observations (phase picks) and in the forward problem (traveltime calculation) are Gaussian. There are several ways that such *a posteriori* PDF can be computed and for the purpose of our study we selected the Oct-Tree sampling algorithm (Lomax and Curtis, 2001) that uses recursive subdivision and sampling of cells in 3D to generate a cascade of sampled cells. A comparison between probabilistic earthquake locations obtained by NONLINLOC and those obtained by traditional linear algorithms exhibits three major differences. First, the nonlinear location algorithm is less sensitive to the problem of local minima in the solution space. Second, for events occurring outside the seismic network NONLINLOC can provide a much better constraint on the hypocentral depth and its corresponding vertical error estimate (Lomax et al., 2000). Third, the horizontal/vertical error estimates derived by linear algorithms have been found unrealistically small when compared to those obtained by NONLINLOC (Lippitsch et al., 2005).

The NONLINLOC package can utilise either a 1D or 3D velocity model but no detailed velocity information from a tomographic or a refraction seismic experiment exists for the TVG area. In order to obtain initial locations for the events in our dataset we used the 1D velocity model listed in Table 2 assuming a V_P/V_S ratio of 1.723 suggested for the Taiwan region by Kim et al. (2005a). This model has been empirically compiled previously by one of the authors of this paper in an effort to accurately locate events recorded by local seismic networks in northern Taiwan (C. H. Lin unpublished work). Nevertheless, it is necessary to assess the applicability and accuracy of the velocity model used before we embark on further analysis and refinement of earthquake locations.

3.2. Estimation of the minimum 1D velocity model

The concept of the minimum 1D velocity model has been introduced by Kissling et al. (1994) and refers to a 1D model that yields the smallest possible uniform error for a set of well-locatable events. Furthermore, the authors developed a methodology of how to obtain such a velocity model from the P- and S-wave traveltimes of local earthquake data by simultaneously inverting for 1D velocities, hypocentre locations and station delays. The forward problem is solved by ray-tracing from source to receiver and computing direct, refracted and reflected rays passing through the 1D model while the inverse problem is solved by using a standard damped least-squares method. The freely available code VELEST (Kissling, 1995) calculates a minimum 1D model by implementing the computational scheme described above.

Prior to inverting for the minimum 1D model we screened our dataset in order to filter out any outliers and to select only well-constrained events as input to VELEST. This selection process was based on two criteria: (a) an azimuthal gap less than 180°, and (b) a root-mean-squared (rms) residual value smaller than 0.1 s. The final dataset used for the calculation of the minimum 1D model consisted of 135 events with 900 P-phase and 657 S-phase observations. Following the procedure described by Kissling et al. (1995), we used several initial models with different layers of thicknesses and velocities in order to avoid being trapped in a local minimum of the solution space. We initially chose to invert only the P-phase observations since they provide better spatial sampling and have smaller picking errors than the corresponding S-phases. After obtaining a stable solution for the P-wave velocities, we included the S-phase observations in the inversion in order to obtain also the minimum 1D S-wave velocity structure.

Fig. 8 shows the final minimum 1D model for P- and S-waves along with the variation of V_P/V_S ratio with depth. Because the hypocentral depth for the majority of selected events is shallower than 5 km, the number of rays sampling deeper crustal horizons is limited and therefore the velocity value below that depth is almost arbitrary. A comparison between this model and averaged 1D models resulting from seismic tomography studies shows greater similarity with the results published by Rau and Wu (1995) for northern Taiwan rather than the model suggested by Chen (1995) for the whole of the island (used by CWB for routine earthquake locations). It is also interesting to note the similarity between the resulting minimum 1D model and the model used for obtaining the initial event locations.

We tested the quality and stability of the minimum 1D model by randomly shifting the initial hypocentral coordinate values by 3 to 4 km before introducing them to VELEST. It is expected that if the proposed minimum 1D model represents a robust minimum in the solution space, no significant changes in velocity and event locations should occur. The average difference in latitude and longitude between the original locations and the recalculated ones are 80 and 122 m respectively, while in focal depth it is 230 m. Another way to test the quality of the velocity model is to check whether the values of the resulting station delays (relative to a reference station in the central part of the area) reflect the near-surface geology. The delays observed across our network, using station YM05 as the reference station, are listed in Table 3 for both P- and S-waves. Stations that exhibit either small positive or zero values (indicating true velocities lower than those of the 1D model), are located on volcanoclastic material and sediments. On the other hand, only two stations (YM04 and YM08) located on andesitic lavas exhibit negative values.

3.3. Error analysis and location results

We calculated probabilistic earthquake locations for our dataset using NONLINLOC and the minimum 1D model with its corresponding station corrections derived earlier. By default, NONLINLOC provides two kinds of hypocentre coordinates for each event: (a) one corresponding to the maximum likelihood (or minimum misfit) point of the complete nonlinear location PDF, and (b) one corresponding to a Gaussian estimate based on the covariance matrix that is obtained from samples drawn from the PDF. The Gaussian location estimate as well as the resulting confidence ellipsoid will be good indicators of the location uncertainty only if the complete, nonlinear PDF has a single maximum and an ellipsoidal form (Lomax et al., 2000).

In order to make an accurate assessment of the errors involved in our location results, we first examined the difference between the resulting maximum likelihood and Gaussian hypocentres for each event. In this way we aim at identifying events that have a distorted PDF and therefore their confidence ellipsoid estimates are biased. We found that the majority of our events exhibit

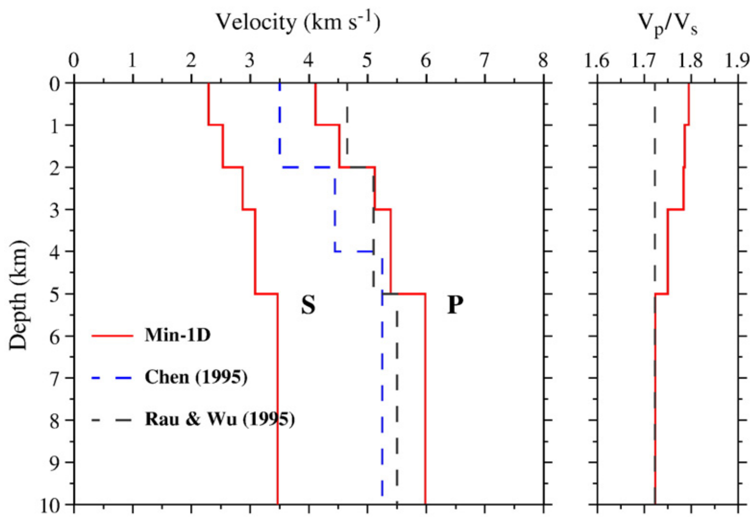


Fig. 8. Left panel: diagram showing the minimum 1D P- and S-wave velocity model for the TVG area compared with other regional velocity models. The model is well-constrained only for the upper 5 km. Right panel: the variation of the V_P/V_S ratio with depth stemming from the minimum 1D model.

Table 3
P- and S-wave station corrections for the minimum 1D model relative to the reference station YM05

Station	P-delay (s)	S-delay (s)
YM01	0.02	0.05
YM02	0.02	0.09
YM03	0.00	0.00
YM04	−0.03	−0.15
YM05	0.00	0.00
YM06	0.01	−0.04
YM07	0.01	0.00
YM08	−0.02	−0.11

horizontal differences in the range 0–200 m, vertical differences smaller than 0.5 km and quasi-ellipsoidal PDFs (Fig. 9). Larger differences coincide with events that originate at depths shallower than 1 km (mostly spasmodic burst events) where the closest station used for the location is at a distance larger than 1.5 times the focal depth (Fig. 10). This is consistent with the results of Gomberg et al. (1990) that suggest that at least one P- and one S-wave arrival time at a station within a distance of 1.5 focal depths from the source is needed for a constrained location. Based on the confidence ellipsoid dimensions of the well-constrained events, we estimate the mean absolute error in the epicentre location as 700 m and in focal depth as 1.5 km.

Fig. 11 shows a map of the distribution of probabilistic locations including two depth cross-sections. Isolated high frequency events form tight clusters at the places where most of the hydrothermal activity is observed (western part of the Chihsinshan edifice and Tayiokeng). Their hypocentres seem to form two layers beneath Chihsinshan at depths 0–2 km and 2.5–4 km, while the foci become progressively deeper in the NE direction down to a depth of approximately 6 km. On the other hand, spasmodic bursts events form one small cluster beneath Chihsinshan at depths ranging from 0 to 2 km and a second larger cluster near Tayiokeng at depths shallower than 2 km. Mixed frequency events occur very close to high frequency events and at similar depths (~2 km) with only one exception. It is also interesting to note that all seismogenesis ceases at a

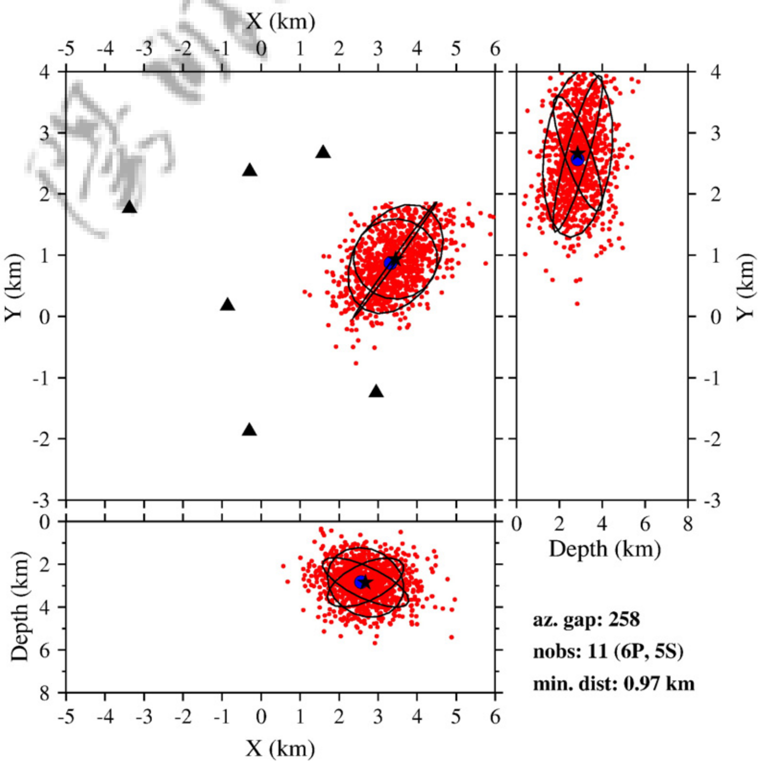


Fig. 9. Density scatter plot for a high frequency event (M_L 1.5) that occurred at (GMT) 10:29:23 February 19, 2005. Black triangles represent the stations that were used for the location. The blue circle indicates the maximum likelihood location estimate, while the black star the Gaussian one. Solid black curves indicate the projection of the 68% of the confidence ellipsoid. Additional information like azimuthal gap (az. gap), number of observations used for the location (nobs) and distance to the closest station (min. dist) can be seen at the lower right corner of the plot. The closest station here lies at a distance (0.97 km) smaller than 1.5 times the focal depth of the event (2.85 × 1.5 = 4.27 km).

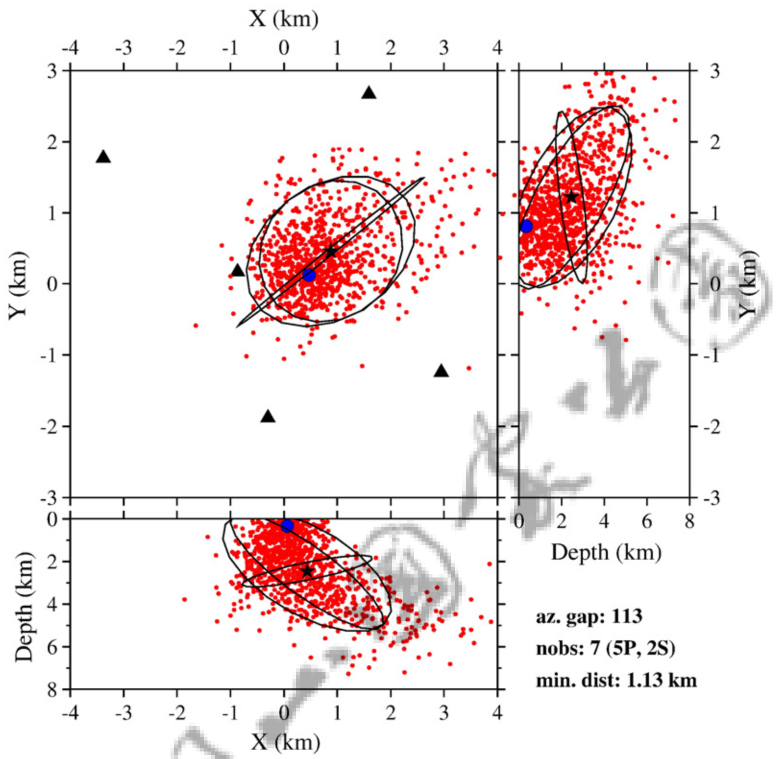


Fig. 10. Same as in Fig. 10 for a high frequency event (M_L 1.0) that occurred at (GMT) 09:24:03 October 29, 2003. The closest station lies at a distance (1.13 km) larger than 1.5 times the focal depth of the event (0.33 × 1.5 = 0.49 km). This results in a non-ellipsoidal form of the sampled PDF as compared to the one in the previous figure.

depth near 4 km, with the exception of four events that occur between 5.5–7 km.

4. Relative earthquake locations

We further applied the double-difference method developed by Waldhauser and Ellsworth (2000) in order to obtain precise relative locations for the events of our dataset. The method tries to minimise the residuals between observed and calculated traveltime differences for pairs of events at common stations by iteratively adjusting the vector difference between the hypocentres. The algorithm makes use of any combination of ordinary picks from earthquake catalogues and/or differential traveltimes from cross-correlation of P- and/or S-phases. We calculate catalogue traveltime differences for P- and S-wave arrivals from pairs of earthquakes that are separated by less than 1 km distance. Except from the catalogue traveltime differences, we obtain differential traveltimes from correlated P-phase waveforms using the technique of VanDecar and Crosson (1990). Two waveforms were considered similar within a tapered 1 s window (100 samples) if they had a cross-correlation coefficient above 70%. Differential traveltimes were calculated when the criteria described above were satisfied at three or more stations per event pair. The distribution of cross-correlation values shows a small variation and a peak around 0.85–0.90 coherency (Fig. 12). Following Waldhauser (2001), we applied a two-stage weighting scheme: during the first stage the catalogue data are given a higher weight in order to constrain the relative position of events, while in the second stage they are down-weighted in favour of the highly accurate cross-correlation data that constrain the locations of close-by events.

From our initial dataset, 151 events were finally relocated using the double difference-method (Fig. 13). This reduction in the number of events after the relocation process is probably due to the loss of linkage for some spasmodic bursts events with quite shallow focal depths. As mentioned earlier, these events lack phases from stations close to the source and are located by the algorithm above ground ('airquakes') causing the vertical offset between events to be poor. Relative errors for all relocated events were estimated using the singular value decomposition method and their average values are 4 m in latitude/longitude and 7 m in depth. The average shift

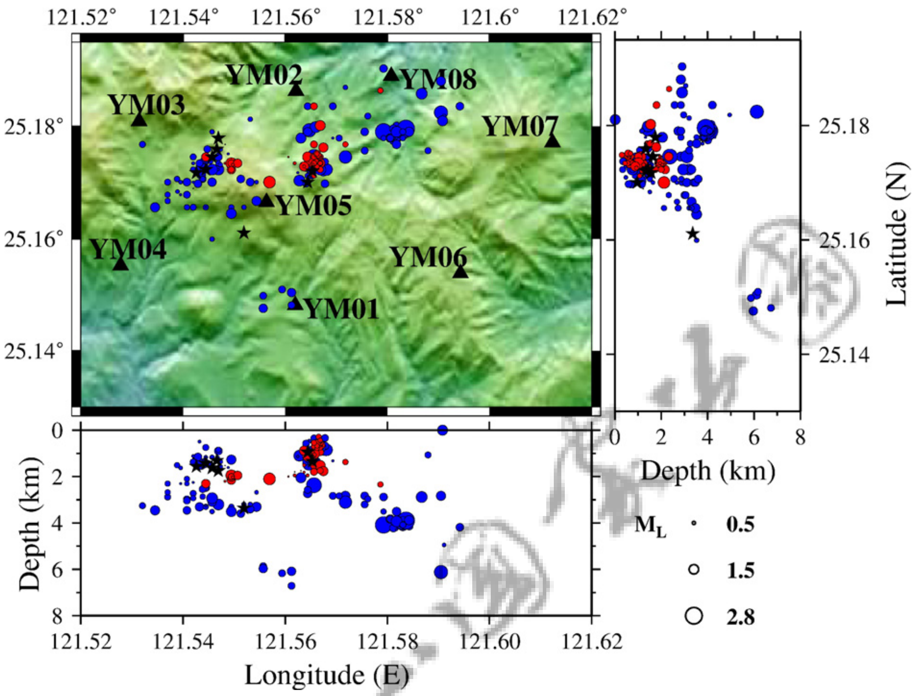


Fig. 11. Map of the TVG area showing the locations obtained using NONLINLOC and the minimum 1D model with station corrections. The blue circles indicate the isolated high frequency events, the red ones the spasmodic bursts events and the black stars the mixed frequency events. A scale relating the circle size to magnitude values is given at the lower right corner of the plot.

between locations obtained with NONLINLOC and those obtained from the relocation was ±11 m in latitude/longitude and ±18 m in focal depth, hence no significant change in the pattern of seismicity was observed. This result shows that NONLINLOC locations are already precise and well-constrained, a conclusion also reported by Lippitsch et al. (2005) in a similar seismicity study of Torfajökull volcano in Iceland.

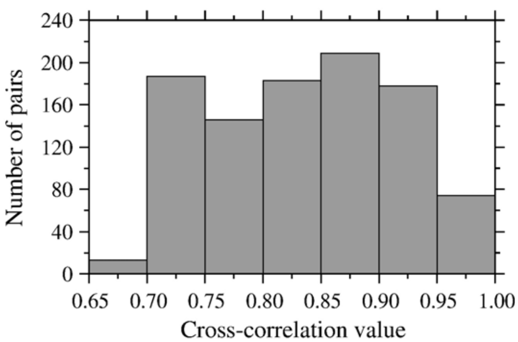


Fig. 12. Histogram showing the distribution of cross-correlation coefficients of P-phase waveforms used for determining differential traveltimes between events and common stations.

5. Discussion

5.1. Possible mechanisms of observed seismicity

High frequency events, similar to tectonic earthquakes, are caused by brittle failure of rock and constitute the main form of seismicity in the TVG area. Their occurrence is the result of the combined effect of the extensional regional stress field in northern Taiwan and the local stress field induced by the movement of hydrothermal fluids and/or magma. The relative contribution of these two stress fields can be determined by using two important parameters (Hill et al., 2003): (a) the ratio of the cumulative seismic moment to the geodetic moment derived from the observed deformation, (b) the frequency–magnitude distribution for an earthquake sample as represented by its *b*-value. The first parameter simply indicates which type of deformation (seismic versus aseismic) dominates, considering that mass transport is driven primarily by aseismic processes. The second parameter gives the relative proportion between small and large events in the sample under study. High *b*-values are thought to indicate high material heterogeneity and/or high thermal stress gradients in the vicinity of a magma chamber or conduit

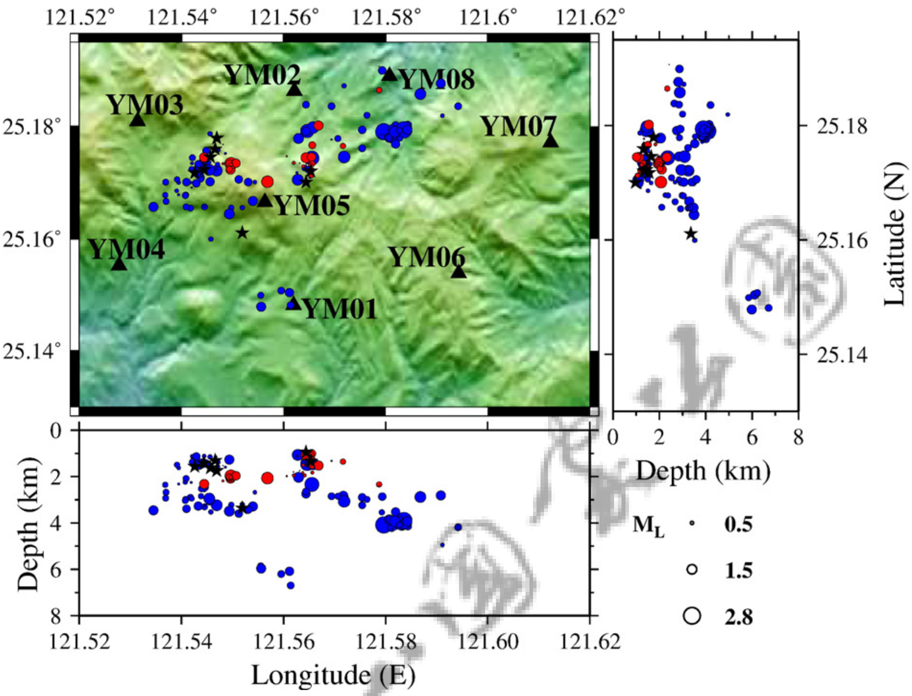


Fig. 13. Same as in Fig. 11 for the locations obtained using the double-difference method.

(Wyss et al., 1997; Wiemer and McNutt, 1997). For the TVG area, the first parameter cannot be estimated since there are no geodetic measurements for the period under study that could be used for the calculation of geodetic moment. However, the *b*-values reported for TVG in this and previous studies are much higher than those for the rest of Taiwan (Wang, 1988; Kim et al., 2005b) and imply the strong influence of hydrothermal fluid circulation on the local seismicity.

An observation that supports this conclusion is the frequent occurrence of another kind of high frequency seismicity, namely spasmodic bursts. These sequences of high frequency earthquakes are thought to be associated with a rupture cascade through a fracture mesh, driven by a transient increase in pore pressure (Hill, 1977; Hill et al., 1990; Hill and Prejean, 2005). Most of the hypocentres of spasmodic burst events in the TVG area are located at a depth interval of 0–2.5 km that coincides with large values of the V_P/V_S ratio (~1.79), as indicated by the minimum 1D velocity model. Laboratory experiments have shown that this ratio is significantly higher in fluid-saturated rocks (Carcione and Cavallini, 2002), that supplies additional evidence for highly fractured, fluid-saturated rocks surrounding the focal area of spasmodic bursts.

Mixed frequency earthquakes represent only a small fraction of the observed seismicity, even though they can be considered as further evidence for the dominance of fluid-related processes in TVG. The commonest source model that has been used in order to explain the occurrence of mixed frequency events invokes two processes (Lahr et al., 1994; Gordeev and Senyukov, 2003; Ibáñez et al., 2003): first, the initial brittle failure of rock under high fluid pressure, that is responsible for the high frequency part of the observed signal; second, the flow of fluid into the void space resulting in the resonance of the newly formed crack and is responsible for the low frequency harmonic coda. Other proposed models include (a) the interference of two high frequency events that occur with a time delay dt, generating a harmonic waveform with regularly spaced spectral peaks every 1/dt Hz (Hough et al., 2000; Stroujkova and Malin, 2001); (b) brittle failure of rising melt under a sufficiently high strain rate (Goto, 1999; Tuffen et al., 2003).

The explanation given in (b) seems to be less likely for events occurring in TVG, since we have no evidence to suggest that a magma injection could have taken place during the period covered by this study. In order to try to distinguish which of the other two interpretations fits our observations better, we took a more detailed look of the characteristics of these signals in the time and frequency domains. For each mixed frequency event the Fourier spectrum of the vertical velocity component at each station was calculated, using a standard FFT and a Hanning window that bracketed the main part of each waveform. Following that, the amplitude spectra were stacked so as to enhance the spectral peaks that were common and suppress those produced by path or site effects (Fig. 14). Two events (first two traces in Fig. 14) exhibited very regularly spaced peaks in their stacked spectra, every about 2 and 5 Hz respectively. However, no such pattern was apparent in the stacked spectra of the other events. An inspection of their waveforms recorded at the nearest stations, shows the existence of a large-amplitude secondary arrival that is delayed by 0.5 and 0.2 s for each event (Fig. 15). If one assumes that they represent the first arrival of a second seismic event, then it is expected that their spectrum will peak every 1/0.5 = 2 Hz and 1/0.2 = 5 Hz, as it is actually observed. Therefore, even though there is enough evidence to suggest that two of the mixed frequency events were caused by the interference of two high frequency earthquakes, the rest of them probably is better explained by the interaction of hydrothermal fluids with the bedrock.

5.2. A model for the volcano–hydrothermal system

A volcano–hydrothermal system can be defined as a system where heat and mass transfer from an igneous body (usually a magma chamber) to the Earth's surface, involving the convection and mixing of both magmatic and meteoric fluids (Hochstein and Browne, 2000). The magmatic fluids (gas exsolved from magma and/or water vapor) move from several kilometers depth through a network of cracks and ascend into the upper crust where they mix with infiltrated meteoric water and condense before they discharge on the surface. The manifestations of such a discharge can take the form of hot springs, hot lakes or fumaroles/solfataras. At the TVG area numerous hot springs and fumaroles with temperatures in the range of 90–200 °C attest to a vigorous hydrothermal activity. Most of these surface manifestations can be observed around the Tayiokeng area and at the NW part of the Chihsinshan edifice (Hsiaoyiokeng fumarole).

Based on the generic model described above, knowledge of local geology and the results of this

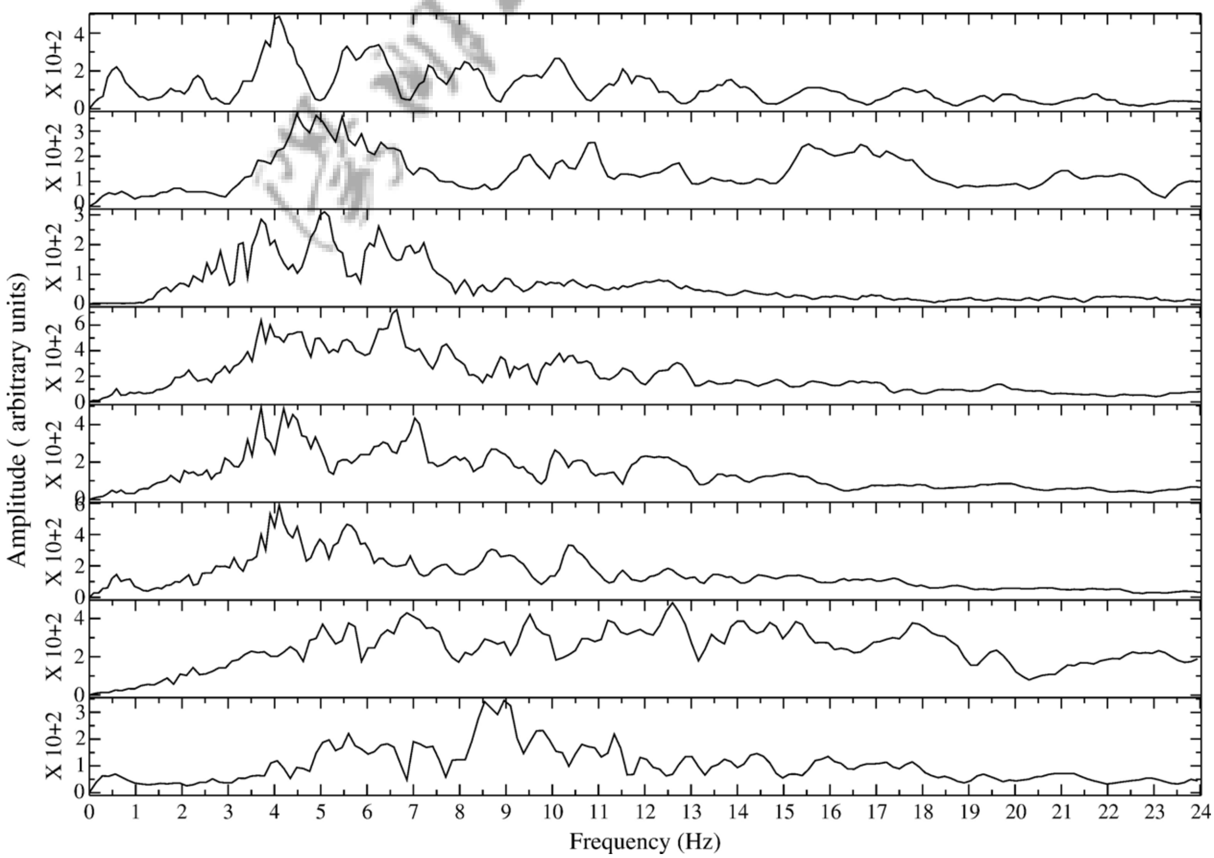


Fig. 14. Stacked amplitude spectra of the eight mixed frequency events that were recorded during the observation period. Note the spectral peaks every 2 and 5 Hz for the first and second trace respectively.

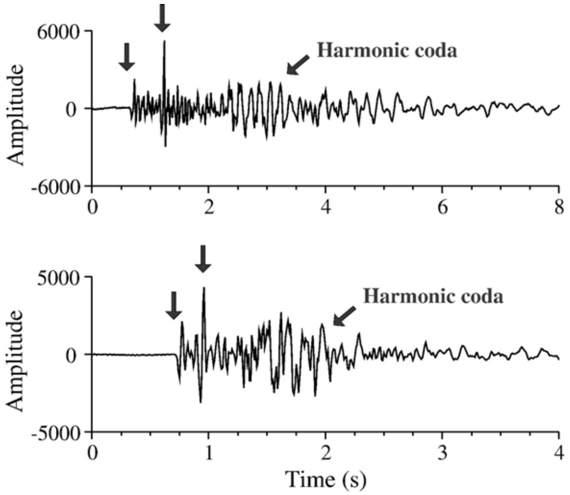


Fig. 15. Vertical velocity waveforms of two mixed frequency events recorded at station YM05 by a short-period sensor. The vertical arrows highlight the two large amplitude arrivals in the high frequency part of the signal.

study, we can construct a possible configuration of the volcano–hydrothermal system beneath the Chihsin-shan–Tayiokeng area (Fig. 16). Surface geology indicates the existence of a system of extensional fractures around Chihsin-shan and near the Hsiaoyiokeng fumarole that probably function as a fluid feeding conduit (Chu et al., 1998). A zone of highly fractured and fluid-saturated rock may lie beneath Chihsinshan, extending to Tayiokeng, as evidenced by the occurrence of spasmodic bursts and elevated values of the V_P/V_S ratio in the upper 3 km of the crust. This zone is fed with exsolved magmatic fluids through a system of conduits that connects it with a deeper magma source beneath TVG.

A crude estimate of the depth of the magma chamber can be obtained by considering the geothermal gradient of the area and the depth where the seismogenesis ceases. The maximum depth of seismogenesis at TVG does not exceed (with very few exceptions) 4 km, signifying a strong temperature or structural boundary at that depth. The former explanation may be more plausible than the latter one, if we take into account that the depth distribution of shallow earthquakes in Taiwan seems to be more correlated to the heat flow distribution rather than other factors (such as faulting mode, strain, geological composition and pore fluid pressure) (Wang et al., 1994). Assuming that the bottom of the seismogenic layer defines an isotherm, then for continental crust the temperature at 4 km should be in the range 350–400 °C (Ranalli and Rybach, 2005). This assumption is also supported by sub-surface temperature measurements taken from drilled holes at TVG that indicate a geothermal gradient of 100 °C km^{-1} (Song et al., 2000b). Based on this information for the thermal structure, we can infer that the postulated magma chamber beneath TVG should be deeper than 7 km, since the temperature of rocks adjacent to a magma chamber seldom exceeds 700 °C (Gudmundsson, 1988).

5.3. A comparison with other Quaternary volcanoes

An interesting question that arises from this study is whether the characteristics observed at TVG can be considered as similar to those found in long-dormant

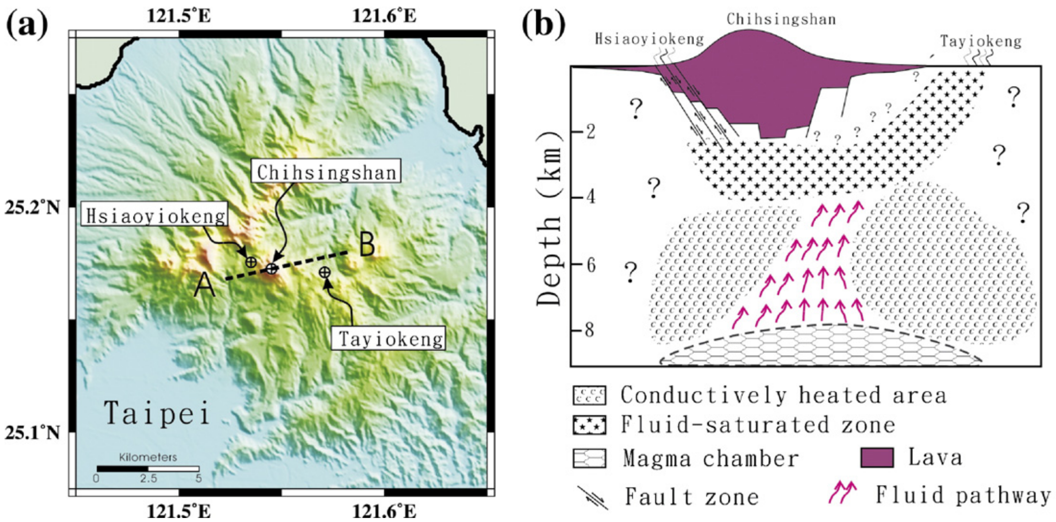


Fig. 16. Left panel: map of the TVG area showing the approximate orientation of the cross-section AB. Right panel: possible configuration of the volcano–hydrothermal system beneath the study area (see text for more details).

volcanoes that are expected to resume their eruptive activity in the future. Two such volcanoes that have been studied in some detail, are the Alban Hills volcano in central Italy (Amato et al., 1994; Chiarabba et al., 1997) and Mammoth Mountain in California (Hill et al., 1990; Hill and Prejean, 2005). Both of them exhibited a decreasing eruptive activity within the Quaternary period and their latest eruptions occurred 19 ka and 57 ka ago at Alban Hills and Mammoth Mountain respectively. In particular, chronostratigraphic studies at Alban Hills have shown that the volcano experienced a long dormancy period (~80 ka) interrupted by small scale eruptions (Marra et al., 2003). This pattern seems consistent with the observations cited earlier about the existence of similar eruptions at TVG during the last 20 ka.

Based on the results obtained after years of seismic and also geodetic monitoring of these two volcanic systems, their characteristics can be summarised as follows:

(1) Swarms of high frequency earthquakes form the majority of the observed seismicity and their duration can vary from several days to several years. Their local magnitudes are usually small (<3) but a few stronger events (M_L ~ 4) have taken place from time to time and were felt by the people living near these volcanoes. The maximum hypocentral depth for most of these high frequency events does not exceed 6–10 km for both volcanic areas, indicating a shallowing of the brittle–ductile transition presumably due to a high geothermal gradient.

(2) A small number of anomalous (low frequency) events has been observed at Alban Hills volcano after a seismic swarm that occurred during 1989–1990. The situation was similar at Mammoth Mountain with very few or no anomalous events before the onset of the 1989 seismic swarm and was followed by the progressive occurrence of spasmodic bursts, Deep (>10 km) Low Frequency (DLF) events and three very long period tremor episodes. One interpretation for this temporal pattern of anomalous events occurrence is that the swarms, through the brittle failure of rock, created the network of cracks necessary for the magmatic fluids to flow and to cause seismic disturbances like those observed.

(3) Frequent geodetic leveling surveys during the period 1927–1994 around Alban Hills volcano have revealed a maximum uplift of the order of 40 cm that was interpreted as evidence for the replenishment of its magma chamber from a deeper source. Similar measurements at Mammoth Mountain during the 1989 swarm have showed far smaller deformation (1–2 cm) and strain changes that can be modeled as a crack dislocation centered beneath Mammoth Mountain.

Our observations during 18 months of seismic monitoring of TVG can be viewed as qualitatively similar to what was observed at Alban Hills and Mammoth Mountain. However, there are a number of differences that have to be noted: (a) the maximum local magnitude at TVG was equal to 2.78 and therefore local residents living near this area never felt any of the ongoing seismic activity; (b) unlike TVG, Alban Hills and Mammoth Mountain each experienced a period of unrest that was followed by thousands of earthquakes occurring over a short time period; (c) even though four GPS stations have recently been deployed in the TVG area, there are no previous geodetic measurements that could reveal any aseismic deformation linked to the movement of hydrothermal fluids or even magma. As mentioned earlier, this latter point may be quite important since it was found that most of the deformation associated with the 1989 swarm at Mammoth Mountain developed aseismically (Langbein et al., 1993). Therefore, a longer observation period that would result in the accumulation of both seismic and deformation data is needed for a more accurate comparison with other Quaternary volcanoes in this respect.

5.4. A dormant or extinct volcano?

The traditional definition of an active volcano is the one with historical eruptions, or alternatively with historically documented eruptions (e.g. Smithsonian Institution, 1989). Szakáks (1994) argued that such a definition is inappropriate, on the grounds that the recorded history of volcanic eruptions represents a very different time span in different places around the world and that it ignores the diversity of volcano typology which in turn controls the eruption periodicities. The author proposes instead a phenomenological definition that states that a volcano can be considered active if its magmatic plumbing system is still working. In a similar way the IAEA guidelines for assessing volcanic hazards near nuclear facilities also takes into account the current status of the magmatic system of a volcano in order to classify it as capable/not capable for a future eruption (McBirney and Godoy, 2003).

This phenomenological definition relies on the detection of a number of symptoms that would imply the existence of a functional magma chamber beneath the volcano under study. Tilling (1989) recognised four such symptoms: (a) the occurrence of volcanoseismic signals, (b) high heat flow, (c) geochemical anomalies in the gas composition of the volcano–hydrothermal system, and (d) deformation of the volcanic edifice. More recently, several authors have also suggested the occurrence of DLF events (Hasegawa and Yamamoto, 1994; Nakamichi et al., 2003; Power et al., 2004 among others) and the triggering of seismicity due to large distant earthquakes (Moran et al., 2004; Johnston et al., 2004; Husen et al., 2004 among others), as further diagnostics for detecting the reawakening of magmatic processes at a given volcano.

At TVG the first three symptoms mentioned above have been observed in the form of spasmodic bursts and low frequency signals, a high geothermal gradient and anomalous He isotope signatures of fumarole gas. During the period covered by this study our network did not record any DLF events. One possible reason for this may be the relatively short observation window, considering that such events are infrequent and their occurrence period may span several years (see for example Power et al., 2004). We also did not observe any seismicity increase after large distant events, including the December 26, 2004 (Mw ~ 9) Andaman–Sumatra earthquake. However, the results of the studies cited above have shown that several conditions have to be met (e.g. directivity of the large event, physicochemical properties of the magmatic system) for the occurrence of a triggering effect. In conclusion, even though there are some clear signs that TVG is not extinct as previously thought, the lack of more concrete evidence about the existence of magma beneath the area maintains the uncertainty regarding its status. Therefore, we prefer to use the term 'potentially active' for TVG, utilised by Szakáks (1994) to describe all such uneroded Quaternary volcanic systems.

In terms of volcanic hazards implications, it is likely that a future eruption at TVG may be a small one based on the evidence of previous small eruptions during the last 20 ka (Section 1.1). Such an eruption would be mostly composed of basaltic lava effusion and of a minor part of pyroclastic products. The hazards associated with such a scenario would be the direct threat posed to the visitors of the national park and to the nearby buildings due to possible forest fires or the lava flow itself. However, a danger more plausible than that of a future eruption is the occurrence of a prolonged seismic activity that would be accompanied by a number of locally felt events. This may inspire fear to the local society about a possible reawakening of the volcano and result in the mass movement of the population away from that area. Taking into account the proximity of TVG to the capital Taipei, such a development would have severe consequences for both the economic and social life, in a manner similar to the volcanoseismic crises at Long Valley caldera, California or Campi Flegrei in Italy. These cases have shown that a real-time seismic/deformation monitoring system would be able to give scientists enough hints so as to be able either to alert the authorities for an approaching eruption, or to reassure the population that there is no imminent danger.

6. Conclusions

The main conclusions of this study can be summarised as follows:

1. The seismicity in the TVG area consists mainly of high frequency earthquakes and a small number of mixed and low frequency events located near places of intense hydrothermal activity. A high *b*-value and an elevated V_P/V_S ratio throughout the upper 3 km of the crust, demonstrate the influence of the hydrothermal fluid circulation on the local seismicity.
2. A crude estimate of the depth of the postulated magma chamber, derived from prior knowledge of the thermal structure of the area and the depth where seismogenesis ceases, points to a location deeper than 7 km.
3. A comparison of seismicity characteristics between TVG and two other well-studied dormant Quaternary volcanoes (Alban Hills in Italy; Mammoth Mountain in California) shows similar features. However, the lack of deformation data in TVG and the relatively short observation window covered by this study, do not allow a more accurate common pattern of behaviour to be identified.
4. Previous geochemical and geophysical studies, coupled with the results presented here, suggest that TVG may be a potentially active rather than an extinct volcano. This result may have severe implications for the safety of the nearby Taipei Metropolitan area and perhaps for the whole of northern Taiwan. Even in the best-case scenario where no eruption occurs, a prolonged seismic unrest near TVG may be enough to cause serious problems to both the economic and social life in the area.

Acknowledgements

We would like to thank the National Research Council of Taiwan and the Yang-mingshan National Park for the financial support of the project and for a visiting scholar fellowship awarded to the first author. We are grateful to Frederik Tilmann and John VanDecar for allowing us to use their cross-correlation code. This manuscript benefited from constructive reviews by Philippe Lesage, Greg Waite and Haruhisa Nakamichi.

References

Amato, A., Chiarabba, C., Cocco, M., di Bona, M., Selvaggi, G., 1994. The 1989–1990 seismic swarm in the Alban Hills volcanic area, central Italy. J. Volcanol. Geotherm. Res. 61, 225–237.

Carcione, J.M., Cavallini, F., 2002. Poisson's ratio at high pore pressure. Geophys. Prospect. 50, 97–106.

Chen, Y.L., 1995. Three-dimensional velocity structure and kinematic analysis in the Taiwan area, PhD thesis, National Central University, Jungli, Taiwan.

Chen, C.H., Lin, S.B., 2000. Distribution and significance of volcanic materials in sediments of the Taipei basin. J. Geol. Soc. China 43, 287–310.

Chen, C.H., Lin, S.B., 2002. Eruptions younger than 20 ka of the Tatun volcano group as viewed from the sediments of the Sungshan formation in the Taipei basin. West. Pac. Earth Sci. 2, 191–204.

Chen, K.J., Yeh, Y.H., 1991. Gravity and microearthquake studies in the Chinshan–Tamshui area, northern Taiwan. Terr. Atm. Ocean. Sci. 2, 35–50.

Chen, K.J., Yeh, Y.H., Yen, H.Y., Lin, C.H., 1995a. Seismological studies in the Chinshan fault area. Terr. Atm. Ocean. Sci. 4, 335–353.

Chen, C.H., Lee, C.Y., Lin, S.B., 1995b. The eruption age of volcanic ashes in the Wugu well, Taipei basin: constraints on mineral chemistry and $^{40}Ar/^{39}Ar$ dating. J. Geol. Soc. China 38, 371–381.

Chen, K.J., Lin, C.H., Hsieh, C.J., 2002. Mapping seismic attenuation structures of the volcanic area in northern Taiwan. West. Pac. Earth Sci. 2, 273–290.

Chiarabba, C., Amato, A., Delaney, P.T., 1997. Crustal structure, evolution and volcanic unrest of Alban Hills, central Italy. Bull. Volcanol. 59, 161–170.

Chu, C.J., Lee, C.T., Teng, L.S., 1998. Structural features and Quarternary tectonics of the Chinshan fault, northern Taiwan. J. Geol. Soc. China 41, 25–42.

Gordeev, E.I., Senyukov, S.L., 2003. Seismic activity at Koryakski volcano in 1994: hybrid seismic events and their implications for forecasting volcanic activity. J. Volcanol. Geotherm. Res. 128. doi:10.1016/S0377-0273(03)00256-7.

Goto, A., 1999. A new model for volcanic earthquake at Unzen volcano: melt rupture model. Geophys. Res. Lett. 26, 2541–2544.

Goldstein, P., Minner, L., 1996. SAC2000: seismic signal processing and analysis tools for the 21st century. Seismol. Res. Lett. 67, 39.

Gomberg, J.S., Shedlock, K.M., Roecker, S.W., 1990. The effect of S-wave arrival times on the accuracy of hypocentre estimation. Bull. Seismol. Soc. Am. 80, 1605–1628.

Gudmundsson, A., 1988. Effect of tensile stress concentration around magma chambers on intrusion and extrusion frequencies. J. Volcanol. Geotherm. Res. 35, 179–194.

Hasegawa, A., Yamamoto, A., 1994. Deep, low-frequency micro-earthquakes in or around seismic velocity zones beneath active volcanoes in northeastern Japan. Tectonophysics 233, 233–252.

Hill, D.P., 1977. A model for earthquakes swarms. J. Geophys. Res. 82, 1347–1352.

Hill, D.P., Prejean, S., 2005. Magmatic unrest beneath Mammoth Mountain, California. J. Volcanol. Geotherm. Res. 146. doi:10.1016/j.jvolgeores.2005.03.002.

Hill, D.P., Ellsworth, W.L., Johnston, J.S., Langbein, J.O., Oppenheimer, D.H., Pitt, A.M., Reasenberg, P.A., Sorey, M.L., McNutt, S.R., 1990. The 1989 earthquake swarm beneath Mammoth mountain, California: an initial look at the 4 May through 30 September activity. Bull. Seismol. Soc. Am. 80, 325–339.

Hill, D.P., Langbein, J.O., Prejean, S., 2003. Relations between seismicity and deformation during unrest in Long Valley Caldera, California, from 1995 through 1999. J. Volcanol. Geotherm. Res. 127. doi:10.1016/S0377-0273(03)00169-0.

Hochstein, M., Browne, P.R.L., 2000. Surface manifestations of geothermal systems with volcanic heat sources. Encyclopedia of Volcanoes, pp. 835–855.

Hough, S.E., Dollar, R.S., Johnson, P., 2000. The 1998 earthquake sequence south of Long valley caldera, California: hints of magmatic involvement. Bull. Seismol. Soc. Am. 90, 752–763.

Husen, S., Wiemer, S., Smith, R.B., 2004. Remotely triggered seismicity in the Yellowstone National Park region by the 2002 Mw 7.9 Denali Fault earthquake, Alaska. Bull. Seismol. Soc. Am. 94, S317–S331.

Ibáñez, J.M., Carmona, E., Almendros, J., Saccorotti, G., Del Pezzo, E., Abril, M., Ortiz, R., 2003. The 1998–1999 seismic crises at Deception island volcano, Antarctica. J. Volcanol. Geotherm. Res. 128. doi:10.1016/S0377-0273(03)00247-6.

Johnston, M.J.S., Prejean, S.G., Hill, D.P., 2004. Triggered deformation and seismic activity under Mammoth mountain in Long Valley Caldera by the 3 November 2002 Mw 7.9 Denali Fault earthquake. Bull. Seismol. Soc. Am. 94, S360–S369.

Kao, H., Jian, P.R., 2001. Seismogenic patterns in the Taiwan region: insights from source parameter inversion of BATS data. Tectonophysics 333, 179–198.

Kim, K.H., Chiu, J.M., Pujol, H., Chen, K.C., Huang, B.S., Yeh, Y.H., Peng, S., 2005a. Three dimensional V_P and V_S structural models associated with the active subduction and collision tectonics in the Taiwan region. Geophys. J. Int. 162. doi:10.1111/j.1365-246X.2005.02657.x.

Kim, K.H., Chang, C.H., Ma, K.F., Chiu, J.M., Chen, K.C., 2005b. Modern seismic observations in the Tatun volcano region of northern Taiwan: seismic/volcanic hazard adjacent to the Taipei metropolitan area. Terr. Atm. Ocean. Sci. 16, 579–594.

Kissling, E., 1995. Program VELEST User's Guide — Short Introduction, Institute of Geophysics, ETH Zurich.

Kissling, E., Ellsworth, W.L., Eberhart-Phillips, D., Kradolfer, U., 1994. Initial reference models in local earthquake tomography. J. Geophys. Res. 99, 19635–19646.

Kumagai, H., Chouet, B., 2000. Acoustic properties of a crack containing magmatic or hydrothermal fluids. J. Geophys. Res. 105, 25493–25512.

Lahr, J.C., Chouet, B.A., Stephens, C.D., Powers, J.A., Page, R.A., 1994. Earthquake classification, location, and error analysis in a volcanic environment: implications for the magmatic system of the 1989–1990 eruptions at Redoubt volcano, Alaska. J. Volcanol. Geotherm. Res. 62, 137–151.

Langbein, J.O., Hill, D.P., Parker, T.N., Wilkinson, S.K., 1993. An episode of reinflation of the Long Valley caldera, eastern California: 1989–1991. J. Geophys. Res. 98, 15851–15870.

Lin, C.H., Konstantinou, K.I., Liang, W.T., Pu, H.C., Lin, Y.M., You, S.H., Huang, Y.P., 2005a. Preliminary analysis of volcanoseismic signals recorded at the Tatun volcano group, northern Taiwan. Geophys. Res. Lett. 32, L10313. doi:10.1029/2005GL022861.

Lin, C.H., Konstantinou, K.I., Pu, H.C., Hsiu, C.C., Lin, Y.M., You, S.H., Huang, Y.P., 2005b. Preliminary results from seismic monitoring at the Tatun volcanic area of northern Taiwan. Terr. Atm. Ocean. Sci. 16, 563–577.

Lippitsch, R., White, R.S., Soosalu, H., 2005. Precise hypocentre relocation of microearthquakes in a high-temperature geothermal field: the Torfajökull central volcano, Iceland. Geophys. J. 160. doi:10.1111/j.1365-246X.2005.02467.x.

Lomax, A., Curtis, A., 2001. Fast, probabilistic earthquake location in 3D models using Oct-Tree importance sampling. Geophys. Res. Abstr. 3.

Lomax, A., Virieux, J., Volant, P., Berge-Thierry, C., 2000. Probabilistic earthquake location in 3D and layered models. In: Thurber, Rabinowitz (Ed.), Advances in Seismic Event Location, pp. 101–134.

Ma, K.F., Wang, J.H., Zhao, D., 1996. Three-dimensional seismic velocity structure of the crust and uppermost mantle beneath Taiwan. J. Phys. Earth 44, 85–105.

Marra, F., Freda, C., Scarlato, P., Taddeucci, J., Karner, D.B., Renne, P.R., Gaeta, M., Palladino, D.M., Triglia, R., Cavarretta, G., 2003. Post-caldera activity in the Alban Hills volcanic district (Italy): $^{40}Ar/^{39}Ar$ geochronology and insights into magma evolution. Bull. Volcanol. 65. doi:10.1007/s0044-002-0255-9.

Molina, I., Kumagai, H., Yepes, H., 2004. Resonances of a volcanic conduit triggered by repetitive injections of an ash-laden gas. Geophys. Res. Lett. 31. doi:10.1029/2003GL018934.

Moran, S.C., Power, J.A., Stihler, S.D., Sánchez, J.J., Caplan-Auerbach, J., 2004. Earthquake triggering at Alaskan volcanoes following the 3 November 2002 Denali Fault earthquake. Bull. Seismol. Soc. Am. 94, S300–S309.

McBirney, A., Godoy, A., 2003. Notes on the IAEA guidelines for assessing volcanic hazards at nuclear facilities. J. Volcanol. Geotherm. Res 126. doi:10.1016/S0377-0273(03)00113-6.

McNutt, S.R., 1996. Seismic monitoring and eruption forecasting of volcanoes: a review of the state-of-the-art and case histories. In: Scarpa, Tilling (Ed.), Monitoring and Mitigation of Volcanic Hazards, pp. 100–146.

Nakamichi, H., Hamaguchi, H., Tanaka, S., Ueki, S., Nishimura, T., Hasegawa, A., 2003. Source mechanism of deep and intermediate-depth low-frequency earthquakes beneath Iwate volcano, north-eastern Japan. Geophys. J. Int. 154, 811–828.

Power, J.A., Stihler, S.D., White, R.A., Moran, S.C., 2004. Observations of deep long-period (DLP) seismic events beneath Aleutian arc volcanoes; 1989–2002. J. Volcanol. Geotherm. Res. 138. doi:10.1016/j.jvolgeores.2004.07.005.

Ranalli, G., Rybach, L., 2005. Heat flow, heat transfer and lithosphere rheology in geothermal areas: features and examples. J. Volcanol. Geotherm. Res. 148. doi:10.1016/j.volgeores.2005.04.010.

Rau, R.J., Wu, F.T., 1995. Tomographic imaging of lithospheric structures under Taiwan. Earth Planet. Sci. Lett. 133, 517–532.

Roecker, S.W., Yeh, Y.H., Tsai, Y.B., 1987. Three-dimensional P and S wave velocity structures beneath Taiwan: deep structure beneath an arc-continent collision. J. Geophys. Res. 92, 10547–10570.

Shin, T.C., 1993. The calculation of local magnitude from the simulated Wood–Anderson seismograms of the short-period seismograms in the Taiwan area. Terr. Atm. Ocean. Sci. 4, 155–170.

Smithsonian Institution, 1989. Global Volcanism 1975–1985. Prentice Hall, New Jersey.

Song, S.R., Lo, H.J., 1995. The source and origin of the volcanoclastics in Linkou formation of northern Taiwan. J. Geol. Soc. China 38, 287–314.

Song, S.R., Tsao, S., Lo, H.J., 2000a. Characteristics of the Tatun volcanic eruptions, north Taiwan: implications for a cauldron formation and volcanic evolution. J. Geol. Soc. China 43, 361–378.

Song, S.R., Yang, T.F., Yeh, Y.H., Tsao, S.J., Lo, H.J., 2000b. The Tatun volcano group is active or extinct? J. Geol. Soc. China 43, 521–534.

Stroujkova, A., Malin, P., 2001. Multiple ruptures for Long valley microearthquakes: a link to volcanic tremor? J. Volcanol. Geotherm. Res. 106, 123–143.

Szakáks, A., 1994. Redefining active volcanoes: a discussion. Bull. Volcanol. 56, 321–325.

Tarantola, A., Valette, B., 1982. Inverse problems = quest for information. J. Geophys. 50, 159–170.

Teng, L.S., 1996. Extensional collapse of the northern Taiwan mountain belt. Geology 24, 949–952.

Tilling, R.I., 1989. Volcanic hazards and their mitigation: progress and problems. Rev. Geophys. 27, 237–269.

Tsao, S.J., Song, S.R., Lee, C.Y., 2001. Geological implications of Lahar deposits in the Taipei basin. West. Pac. Earth Sci. 1, 199–212.

Tuffen, H., Dingwell, D.B., Pinkerton, H., 2003. Repeated fracture and healing of silicic magma generate flow banding and earthquakes? Bull. Geol. Soc. Am. 31, 1089–1092.

VanDecar, J.C., Crosson, R.S., 1990. Determination of teleseismic relative phase arrival times using multi-channel cross-correlation and least squares. Bull. Seismol. Soc. Am. 80, 150–169.

Waldhauser, F., Ellsworth, W.L., 2000. A double-difference earthquake location algorithm: method and application to the northern Hayward fault, California. Bull. Seismol. Soc. Am. 90, 1353–1368.

Waldhauser, F., 2001. HypoDD: a Program to Compute Double-Difference Hypocentre Locations. U.S. Geological Survey, Open File Report, vol. 01-113.

Wang, J.H., 1988. *b*-values of shallow earthquakes in Taiwan. Bull. Seismol. Soc. Am. 78, 1243–1254.

Wang, J.H., Chen, K.C., Lee, T.Q., 1994. Depth distribution of shallow earthquakes in Taiwan. J. Geol. Soc. China 37, 125–142.

Wang, K.L., Chung, S.L., Chen, C.H., Shinjo, R., Yang, T.F., Chen, C.H., 1999. Post-collisional magmatism around northern Taiwan and its relation with opening of the Okinawa trough. Tectonophysics 308, 363–376.

Wiemer, S., McNutt, S.R., 1997. Variations in the frequency–magnitude distribution with depth in two volcanic areas: Mt. St Helens, Washington and Mt. Spurr, Alaska. Geophys. Res. Lett. 24, 189–192.

Wyss, M., Shimazaki, K., Wiemer, S., 1997. Mapping active magma chambers by b values beneath the off-Ito volcano, Japan. J. Geophys. Res. 102, 20413–20422.

Wu, F.T., Rau, R.J., Salzberg, D., 1997. Taiwan orogeny: thin-skinned or lithospheric collision? Tectonophysics 274, 191–220.

Yang, C.H., Shei, T.C., Lue, C.C., 1994. Gravity and magnetic studies in the Tatun volcanic region. Terr. Atm. Ocean. Sci. 5, 499–514.

Yang, T.F., Sano, Y., Song, R.S., 1999. $^3He/^4He$ ratios of fumaroles and bubbling gases of hot springs in Tatun volcano group, north Taiwan. Nuovo Cim. 22, 281–285.

Yeh, Y.H., Liu, C.C., Lin, C.H., Liu, C.C., Yen, H.Y., 1998. Geophysical monitoring of volcano activities at Mt. Tatun. Eos Trans. AGU 79 (24), W124 (Westrn Pac. Geophys. Meet. Suppl.).

Yu, S.B., Chen, H.Y., Kuo, L.C., Lallemand, S.E., Tsien, H.H., 1997. Velocity field of GPS stations in the Taiwan area. Tectonophysics 274, 41–59.

TAO, Vol. 16, No. 3, 563-577, August 2005

Preliminary Results from Seismic Monitoring at the Tatun Volcanic Area of Northern Taiwan

Cheng-Horng Lin[1,*], Konstantinos I. Konstantinou[1], Hsin-Chieh Pu[2], Chia-Chi Hsu[3], Yu-Mei Lin[4], Shuei-Huei You[4] and Yuan-Ping Huang[4]

(Manuscript received 6 April 2004, in final form 11 June 2005)

ABSTRACT

To enhance our understanding of the seismic characteristics of the Tatun volcanic area, a small aperture seismic array consisting of 5 seismic stations has been deployed in the area since May 2003. Each of the seismic stations was installed with both short-period and broadband sensors to record micro-earthquakes as well as long-period volcanic tremors. The preliminary results of the seismic monitoring of the Tatun volcanic area show a large number of shallow micro-earthquakes clustered beneath the Chihsingshan volcano and Tayoikeng areas. Among these, some swarms were also detected. Intensifying the issue further, some complex seismograms with harmonic codas and seismic tremors have been identified. Considerable crustal heterogeneity in the Tatun volcanic area is indicated by the presence of strong coda waves. Combining our findings with other geological and geochemical observations, we postulate that volcanic activities might not be totally extinct in the Tatun volcanic area. Thus, further investigations of Tatun volcanic area ought be conducted to examine the possibility of such potential volcanic activity.

(Key words: Tatun volcano, Seismicity, Swarm, Volcanic tremor)

1. INTRODUCTION

The Tatun volcanic group, which includes more than 20 volcanoes (Chen and Wu 1971;

[1] Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan, ROC
[2] Institute of Geophysics, National Central University, Chung-Li, Taiwan, ROC
[3] Dept. of Earth Sciences, National Cheng-Kung University, Tainan, Taiwan, ROC
[4] Dept. of Earth Sciences, National Taiwan Normal University, Taipei, Taiwan, ROC
[*] *Corresponding author address:* Dr. Cheng Horng Lin, Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan, ROC; E-mail: lin@earth.sinica.edu.tw

Wang and Chen 1990), is located on the northernmost tip of Taiwan (Fig. 1). It is just north of the Taipei basin, the capital of Taiwan with a total population of more than seven million inhabitants. One of the major geological structures in the Tatun volcanic group is the Chinshan fault, which is a reverse fault and strikes in the NE-SW direction. The southwestern extension of this fault might be connected to the Hsinchun fault beneath the western Taipei basin. Based on the K-Ar dating (Juang and Chen 1989; Tsao 1994) and fission track analyses (Wang and Chen 1990), the eruption history of the Tatun area can be divided into two major periods. As for the first, the major eruption was around 2.5 - 2.8 Ma, whereas the second started in 1.5 Ma and continued until the last eruption around 0.1 - 0.2 Ma (Song et al. 2000a).

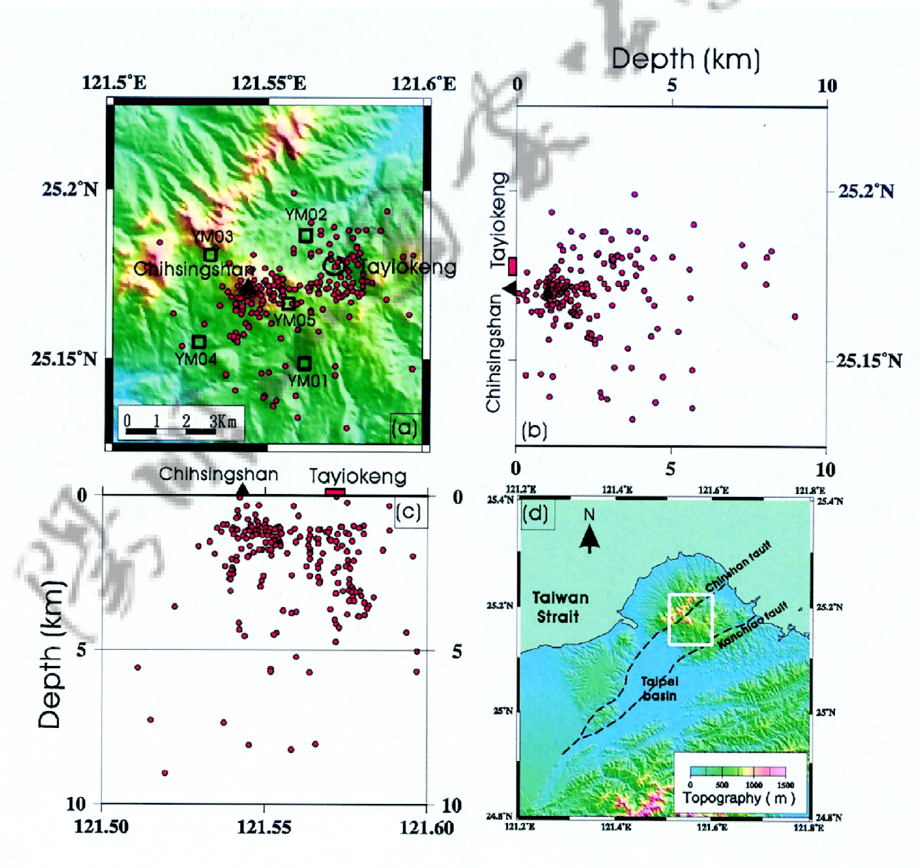


Fig. 1. (a) Seismicity (circles) and the five seismic stations (squares) are indicated on the topographic map of the Tatun volcanic area. Projections of seismicity along (b) the E-W and (c) the N-S cross-sections are shown. (d) Topographic map of northern Taiwan with the two major faults, the Chinshan and Kanchiao faults, through the Tatun volcanic area are marked by dashed lines. The box shows the Tatun volcanic area given in Fig. (a).

True that the Tatun volcanoes have been extinct for a very long time, but by virtue of new research findings, the possibility of periodic re-eruptions can be no longer ruled out. First of all, such geothermal activities as hot springs and gas fumaroles are certainly still very widespread on the surface (Chen and Wu 1971). Added to this, the volcanic evolutionary history of Taiwan shows the Tatun volcanoes could be reactivated simply on the grounds that two major eruptions have occurred in the past few million years. Finally, recent geochemical analyses of fumarole gas further show that the Helium isotopic ratios are very high (Yang 2000), indicating some magma chambers might still exist beneath the Tatun volcanoes. Such geological and geochemical observations as these suggest that active magma chambers probably lie beneath the volcano group (Song et al. 2000b).

In addition to the findings from both geological and geochemical analyses, seismic monitoring has been providing substantive evidence in support of the likelihood of volcanic magma beneath the Tatun volcanic area. In the past decade, several seismic surveys have been undertaken in the Tatun volcanic area (Yu et al. 1980; Chen and Yeh 1991; Yeh et al. 1998), with the results having shown a large number of micro-earthquakes clustered beneath some volcanoes, such as the Chihsingshan and Huandrashan (Yeh et al. 1998; Yang 2002). Strong volcanic seismicity in the Tatun area also indicates that volcanic activity might not have yet become totally extinct; however, additional positive seismic activity that characterizes active volcanoes, such as swarms and tremors, had not been detected. This is largely because not until recently has seismic activity been continuously recorded by broadband sensors.

To improve our understanding of the seismic features of the Tatun volcanic area, in this study we started with the deployment of a small-aperture seismic array in the Chihsingshan area where seismicity is often clustered in the uppermost crust. Each of the five seismic stations was installed with both short-period and broadband sensors to detect micro-earthquakes as well as any other seismic activity, like seismic tremors and harmonic oscillations. Some of our preliminary results obtained from this small seismic array are presented in this study for the purposes of shedding light on the possible seismic characteristics of active volcanoes.

2. SEISMIC ARRAY

In this study, we utilized a small aperture seismic array comprised of five seismic stations in the Tatun volcanic area since May 2003 (Table 1). The seismic array in this study was first designed for focusing on a small area (5 km × 5 km) around the Chihsingshan volcano where micro-earthquakes were clustered between the Chinshan and Kanchiao faults, as determined by a previous seismic survey (Yeh et al. 1998). Each of the seismic stations was constructed on a concrete-platform and was completely covered with Fiber Reinforce Plastic (FRP) to protect it from possible sulfide damage, and supplied with stable AC power (110 Volts) for continuous recording. At the same time, a 90-Am battery was connected to stabilize the power system and serve as an alternative source in case of an emergency power outage. Each seismic station was installed with both a short-period sensor (Lennartz LE3D, with a dominant frequency of 1 Hz) and a broadband sensor (Glap-30, period of up to 30 seconds) to record seismic signals generated by micro-earthquakes as well as any other possible long-period seismic tremors in the Tatun volcanic area. All seismograms have been continuously sampled at a rate of 100 points per second and these data stored in two hard disks at each station with a full memory of 20 G-byte. The timing system at each station is automatically synchronized by satellite signals from the Global Position System (GPS). These seismic data are frequently retrieved about once a month while regular system maintenance is going on.

Table 1. Location of the five seismic stations in the Tatun volcanic area.

Stations	Longitude (E)	Latitude (N)	Altitude (m)
YM01 (Chukaoling)	25° 08' 48.0"	121° 34' 12.8"	488
YM02 (Chihku)	25° 11' 04.4"	121° 34' 13.2"	521
YM03 (Machao)	25° 10' 44.8"	121° 32' 22.5"	702
YM04 (Lioku)	25° 09' 12.2"	121° 32' 09.8"	401
YM5 (Renhsuiken)	25° 09' 52.9"	121° 33' 52.8"	740

3. DATA PROCESSING

To examine all possible seismic activities in the Tatun volcanic area, continuous seismograms recorded in the vertical component at each station are plotted on a daily basis. Daily seismic activities, from 0 to 24 hours in UTC time, are shown from the uppermost trace to the lowest one (Fig. 2). In total, there are 96 traces for each day, with each one showing seismograms continuously recorded every 15 minutes. Although all seismic events generated by local, regional and teleseismic earthquakes might have been recorded by this seismic network, at first, we were only focusing on micro-earthquakes in and around the Tatun volcanic area. With the aim of identifying micro-earthquakes within the Tatun volcanic area, seismic events were selected only if they complied with the following two criteria: events where (1) the arrivals of both the P- and S-waves were clearly recorded at more than three stations, and (2) the travel-time difference between the P- and S-waves at each station was less than 5 seconds.

Based on these two criteria, seismic data for possible micro-earthquakes were extracted from the raw data and transferred to the Seismic Analysis Code (SAC) format by using the available software (PPK) provided by SAC for the later picking process. The arrivals of both the P- and S-waves were picked with different levels of (Q) ranging from 0 to 4 based on the uncertainty of arrivals (Lee and Stewart 1980). The impulsive arrivals of better quality were given by smaller levels. More specifically, the best arrivals with an uncertainty of less than

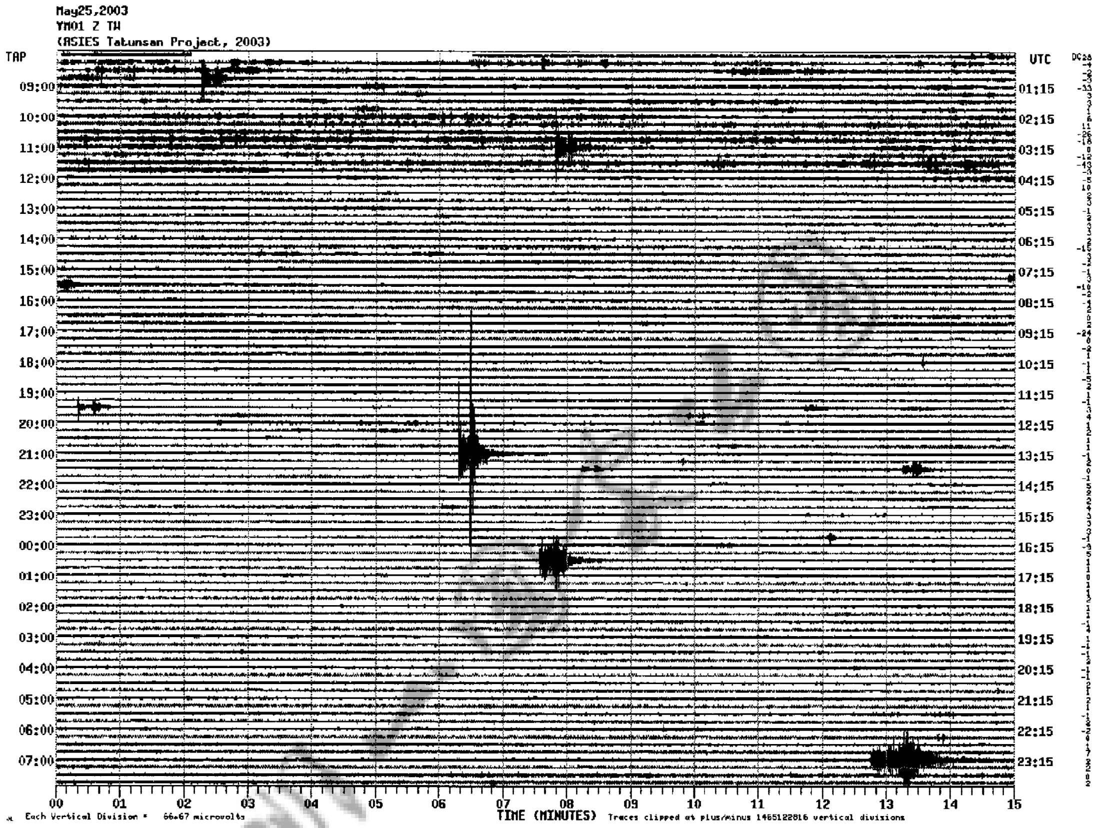


Fig. 2. Example of 24-hour seismograms recorded in vertical component at one station (YM01). Each trace shows seismic records for a 15-minute period. Local (Taipei) and UTC times are respectively marked on left and right hand sides.

0.02 seconds were given the highest level of 0. Against this, the poorest ambiguous arrivals with an uncertainty of greater than 0.1 seconds were given the lowest level of 4. The relative weights W used to further locate earthquakes as related to quality (Q) were designated by the following relationship: W = 1 - Q/4. In other words, a full weight of 100% corresponds to Q = 0, and 75%, 50%, 25% and 0% weights correspond to Q = 1, 2, 3 and 4, respectively.

In addition to the arrivals of the P- and S-waves, the durations of the micro-earthquakes recorded at each station were determined so as to estimate earthquake magnitude (Md) based on an empirical formula (Lee et al. 1972; Crosson 1972). The duration of a seismic signal generated by an earthquake is defined as the time interval between the onset of the first P-wave and the cut-off point when the signal amplitude was approximately twice that of the noise (Lee et al. 1972). For a given earthquake, signal duration had to be measured at as many stations as possible to ensure the reliability of the calculated local magnitudes.

Finally, the hypocenters of the micro-earthquakes were routinely determined by using the HYPO71 computer program (Lee and Lahr 1975). Apart from the arrivals of both the P- and S-waves as well as the durations of the signals recorded at each station, a one-dimensional velocity model (Table 2) was employed to locate the hypocenters of the micro-earthquakes within the Tatun volcanic area.

Table 2. One-dimensional P- and S-wave velocity model in the Tatun volcanoc area.

Depth (km)	P-wave (km/sec)	S-wave (km/sec)	Vp/Vs
-1.0~1.0	3.79	2.13	1.78
1.0 ~ 2.0	4.07	2.29	1.78
2.0 ~ 3.0	4.55	2.56	1.78
3.0 ~ 5.0	5.12	2.88	1.78
5.0 ~ 7.0	5.39	3.03	1.78
7.0 ~ 9.0	5.98	3.36	1.78
9.0 ~ 17.0	6.10	3.43	1.78
17.0 ~ 36.0	6.70	3.76	1.78
36.0 ~ 80.0	7.80	4.38	1.78

4. PRELIMINARY RESULTS

The preliminary results of our seismic monitoring of the Tatun volcanic area show numerous shallow micro-earthquakes, with local magnitudes (Md) smaller than 1 clustered within the study area in the May to September 2003 period (Fig. 1). Most of the micro-earthquakes are located in the uppermost crust at focal depths of less than 5 km. Location errors for most of the micro-earthquakes are less than 100 m at the epicentral distance and less than 500 m at the focal depth (Fig. 3). Noteworthy is that one group of micro-earthquakes is highly clustered just beneath the Chihsingshan volcano, which has the highest peak (1,120 m) in the Tatun volcanic area and which has a typical volcano shape of topographic relief. These events are clustered at depths of only around 2 km, which is just beneath the bottom of the quaternary volcanic rocks, the deepest thickness of which is ~1500 m (Song et al. 2000a). East of this group of micro-earthquakes are some other micro-earthquakes with depths of 2 - 4 km which are roughly scattered around Tayiokeng, where both geothermal activity and the Helium isotopic ratios are the highest in the Tatun volcanic area (Yang 2000). For the most part, therefore, these micro-earthquakes are indicative of a seismic zone with an east-west trend and with focal depths in the east deeper than those in the west.

The detailed examination of the micro-earthquakes in spatial and temporal variations shows some micro-earthquakes often took place as swarms, or groups of earthquakes which closely

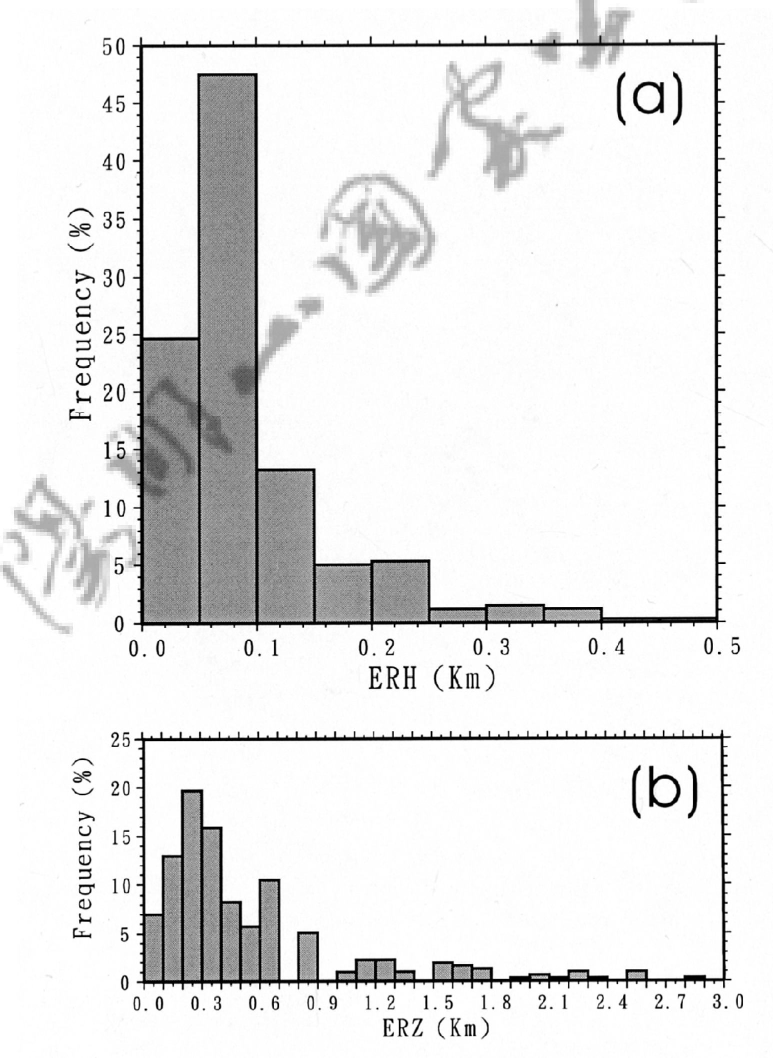


Fig. 3. Histograms of the location errors for the (a) epicenter and (b) focal depth.

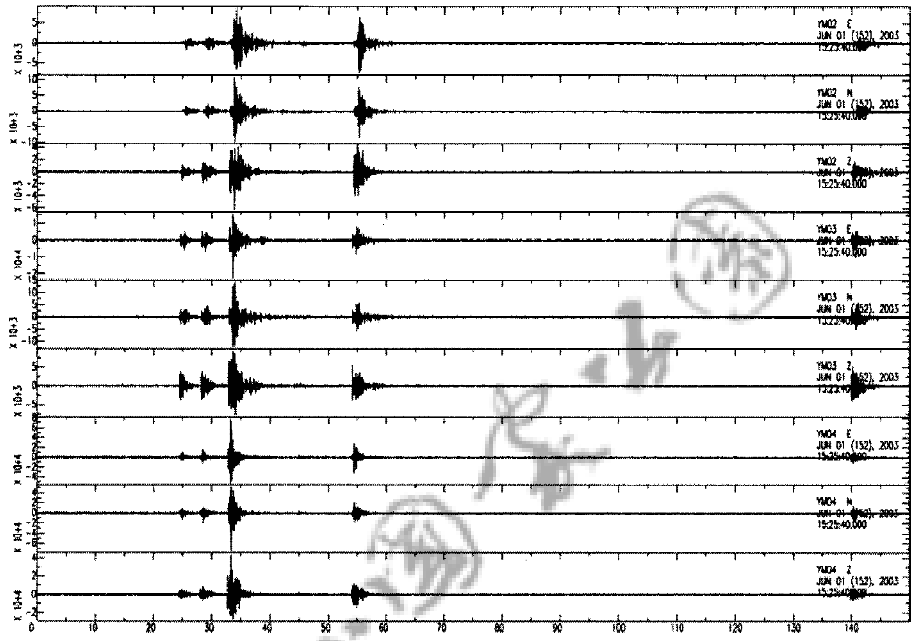
occur in time and space without a single outstanding mainshock, a phenomenon often observed in active geothermal areas such as in volcanic areas and mid-ocean ridges. For example, a series of micro-earthquakes occurred within a short period of time (only a few minutes) on June 1, 3 and 8, 2004 (Fig. 4). Consistent with the general pattern of all of the micro-earthquakes recorded here (Fig. 1), the hypocenters of these swarms are clearly clustered in two small areas (Fig. 5), one situated just beneath the Chihsingshan volcano at depths of around 2 km, and the other at depths of 3 - 4 km beneath Tayiokeng. The locations of the micro-earthquakes beneath the Chihsingshan are more reliable than those of the other group because the former are located inside the seismic network.

What is particularly interesting to note is that our seismic survey in the Tatun volcanic area recorded some complex seismograms with decaying harmonic oscillations. Two groups of harmonic coda, for example, are clearly detected in the vertical component after S-waves were generated by a local earthquake (Fig. 6). Further spectral analysis shows that the frequency content in the harmonic coda is dominant at around 20 Hz. While the detailed mechanism for generating such complicated seismograms is still unknown, the harmonic codas are substantially different from seismograms generated by typical tectonic earthquakes along tectonic faults in plate boundaries.

On top of this, strong seismic scattering is observed in the Tatun volcanic area. Seismograms generated by a regional earthquake and recorded both in the Tatun volcanic area of northern Taiwan and in the Chiayi area of southwestern Taiwan are significantly different (Fig. 7). In the Chiayi area, typical regional seismograms with clear P- and S-waves were recorded by a small aperture linear array that consisted of 18 stations (Huang 2004). Seismic energy in most of the later phases is smaller than that of the direct P- and S-waves. Contrast this with many of the later phases with large amplitudes that were recorded after both the direct P- and S-waves were recorded by the seismic array in the Tatun volcanic area. It is, at best, very difficult to identify the arrival of direct S-waves. Seismic energy decays very slowly for coda waves, which indicates that these coda waves did not belong to regular plane waves but rather were scattered from the strong heterogeneities in the crust medium (Aki 1969; Aki and Chouet 1975).

In addition to seismicity clustered beneath the two volcanoes as well as the unusual harmonic and scattered seismograms, a detailed examination of the seismic data in the Tatun volcanic area further shows that some seismic tremors are occasionally found at the seismic stations. For example, an unusual seismic tremor was concurrently observed in at least two stations (YM01 and YM03) on April 2, 2003 when the seismic network was first installed to examine background noises (Fig. 8). The seismic tremors with amplitudes significantly greater than background noise were continuously recorded for more than 5 hours, but these seismic tremors obviously could not have been generated by artificial noises, such as that from traffic or any other man-made source, because they were recorded in the middle of the night (10pm - 3am). Also, they could not have been caused by any other unknown sources near the station site since similar tremors were simultaneously detected by at least two stations (YM01 and YM03) that were at least 5 kilometers apart. Tremors similar to these were also simultaneously recorded at all five of the stations when the seismic network was normally operated after May 15, 2003.

(a)



(b)

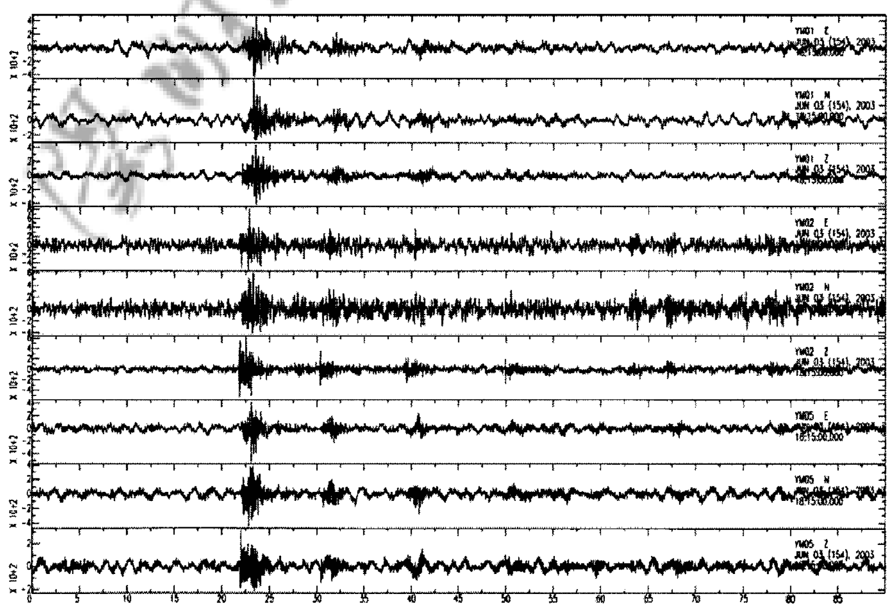


Fig. 4. Examples of swarm seismograms recorded at 3 seismic stations on (a) June 1 and (b) June 3, 2003.

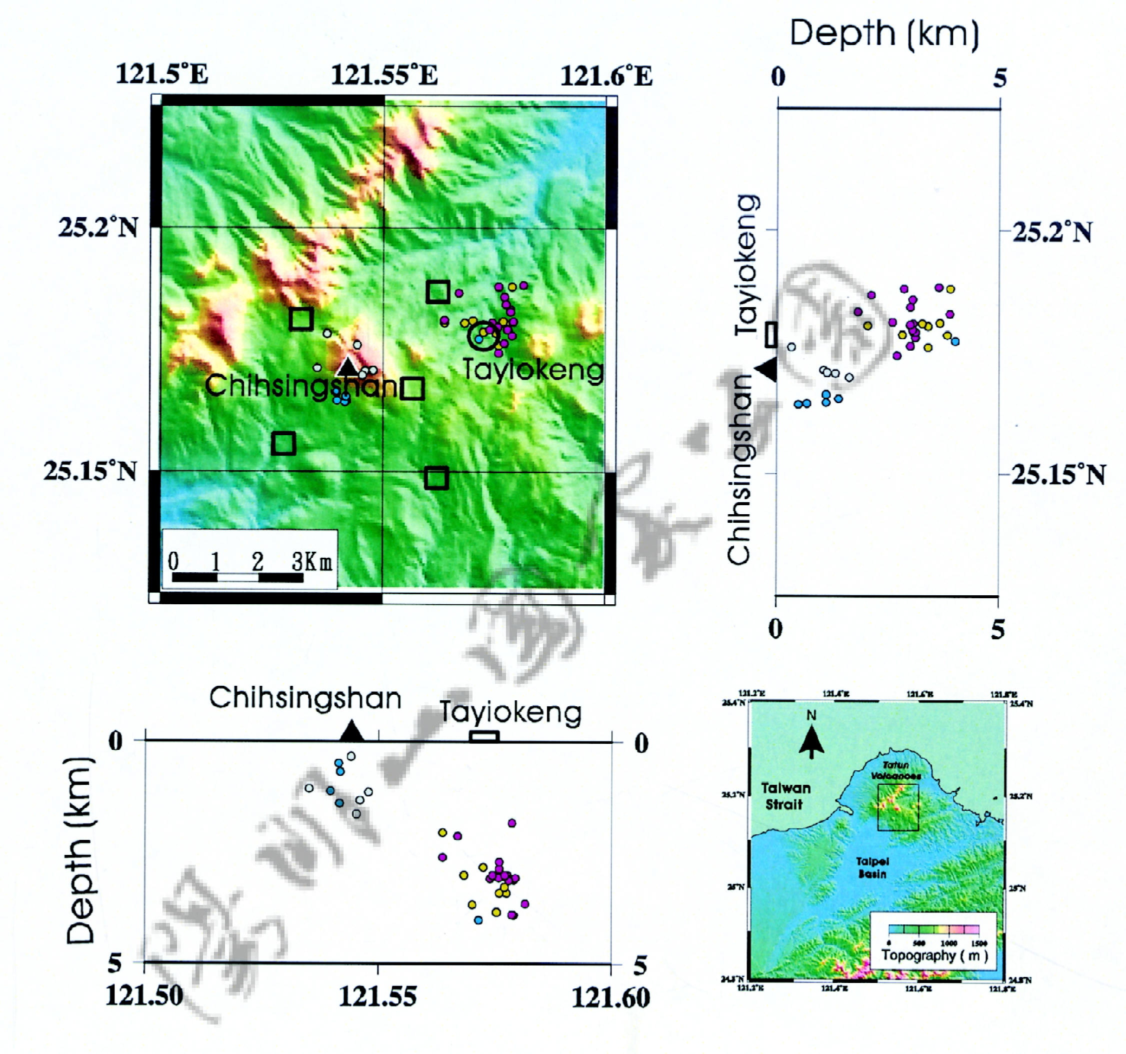


Fig. 5. Locations of the seismic stations (squares) and swarms (circles) beneath the Tatun volcanic area.

5. DISCUSSIONS AND CONCLUSIONS

The preliminary results from the seismic monitoring in this study convincingly show that some seismic characteristics in the Tatun volcanic area are basically similar to those in active volcanic areas in other parts of the world. First of all, the clustering of micro-earthquakes with local magnitudes of less than 1 indicates that seismic activity is still strong in the Tatun volcanic area. Since it cannot be denied that both the P- and S-waves are observed for these earthquakes, they might be classified as A-type volcanic earthquakes (Minakami 1960, 1974), which are volcanic-tectonic type, differentiating them from purely tectonic earthquakes which

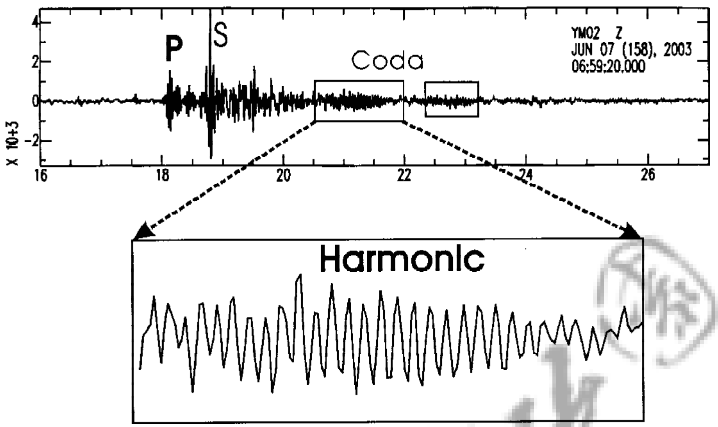


Fig. 6. Complex coda seismogram recorded at a seismic station (YM02) in the Tatun volcanic area. A harmonic section located within the small box in the seismogram is enlarged in the box below.

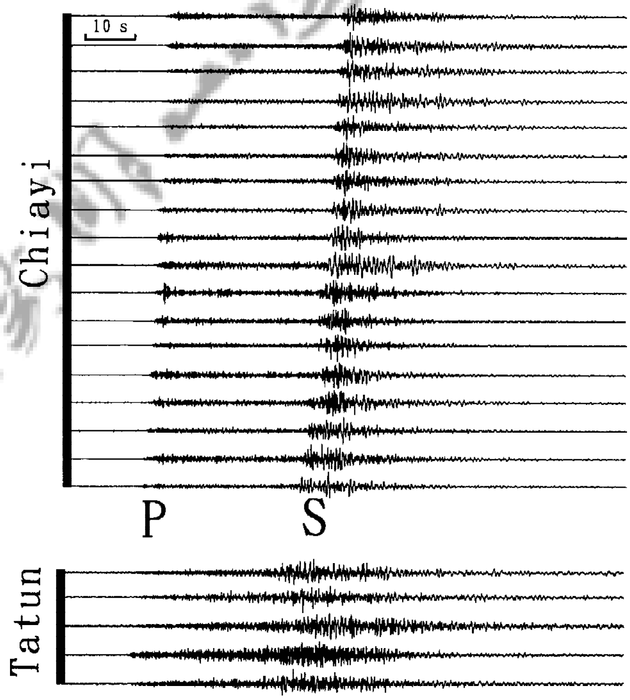


Fig. 7. Comparison of the seismograms generated by a regional earthquake and recorded in the Chiayi seismic array (the upper 18 traces) and the Tatun volcanic area (the lower 5 traces). Strong seismic scattering was recorded in the Tatun volcanic area.

occur at plate boundaries. A-type volcanic earthquakes are commonly associated with magma movements or other thermal effects on overlying rocks, and they are often the first indicators of renewed volcanic activity (Ida 1991; Tilling and Dvorak 1993). Secondly, some seismic swarms are clustered just beneath the two most typical volcanic zones in the Tatun volcanic area. One is just beneath the Chihsingshan volcano, where the highest peak in the Tatun area is located. The clustered shallow earthquakes at 2 km in depth are just beneath the bottom of the quaternary volcanic rocks, the deepest thickness of which is ~1500 m (Song et al. 2000a). The

(a)

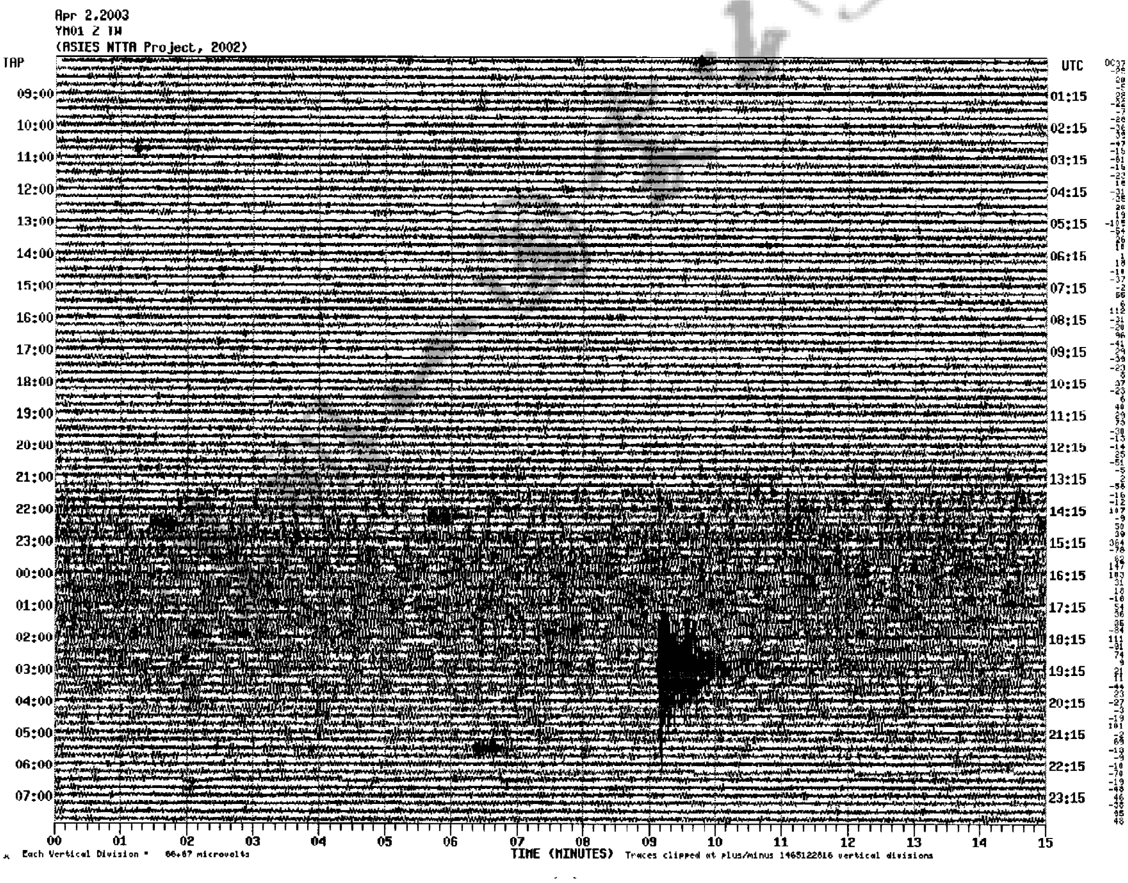


Fig. 8. Continuous seismograms recorded 24 hours at two stations, (a) YM01 and (b) YM03, on April 2, 2003. Seismic tremors continuously persisting for several hours at mid-night from around 22:00 PM to 04:00 AM at Taipei local time as recorded at two seismic stations. A distant earthquake was also recorded at two stations around the end of the seismic tremors.

(b)

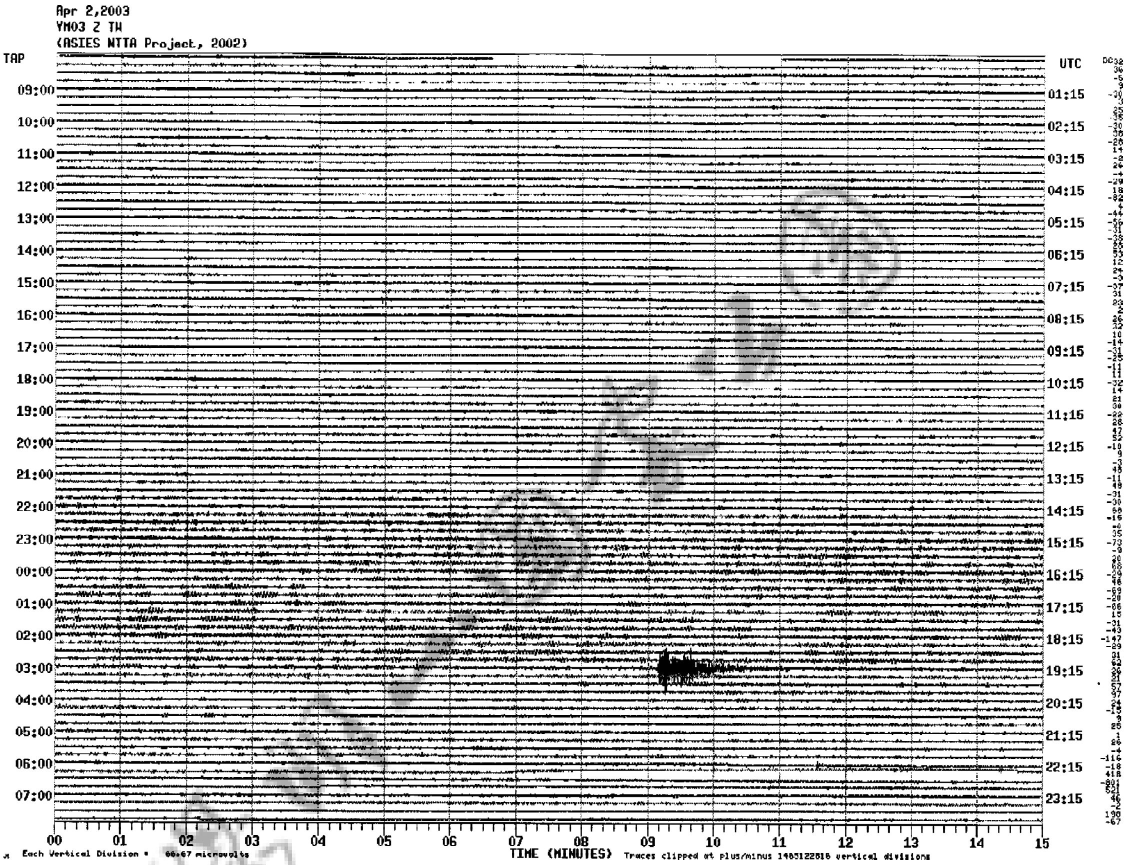


Fig. 8. Continued.

other group of earthquakes is beneath Tayiokeng, which not only has the strongest geothermal activity but also the highest isotope ratio of Helium in the Tatun volcanic area (Yang 2000). These correlative features might very well indicate the possibility of hydrothermal or magma activities in the Tatun volcanic area. Thirdly, the seismic events recorded in the Tatun volcanic area have anomalous seismograms decaying a harmonic coda, which is commonly interpreted as oscillations of a fluid-filled resonator in response to a time-localized excitation (Chouet 1986, 1996). Fourthly, the strong scattered waves generated by regional earthquakes reveal that crustal heterogeneity in the Tatun volcanic area is high. One of the best factors involved in the generation of such strong seismic scattering is the possibility of open cracks or the fluid medium beneath active volcanoes (Nishigami 1997). Finally, the existence of continuous seismic tremors recorded in the Tatun volcanic area is a feature resembling volcanic tremors that have been regarded as oscillations of some resonator in response to a sustained excitation (Chouet 2003). Whilst the possible sources of the generation of the seismic tremors and harmonic coda have not yet been clarified, all of the seismic characteristics reported in this study closely resemble the fundamental phenomena resulting from dynamic flow processes involving gas and liquid phases.

In light of the seismic features uncovered in this study and previous geochemical analyses, such as the Helium isotope ratios in the Tatun volcanic area (Yang 2000), we strongly suggest that further investigations be undertaken to examine the possibility of a volcanic re-eruption in the future. In this regard, one of the key questions to directly answer is, “Are there still any residual or new magma chambers beneath the Tatun volcanic area?” To examine the possibility of magma chambers beneath the volcanoes, many more detailed studies have to be performed in the future. Examples of these abound: high-resolution seismic tomography will help to image anomalous low velocities or the high Poison ratios in magma chambers; a small-aperture seismic antenna can be used to map such volcanic seismicity as tremors and swarms; moment tensor inversion can be employed to derive the source geometry and mass-transport budget of magmatic fluids; and last but not least, spectral analyses of long-period tremors have the capability of providing adequate information to determine the acoustic properties of magmatic and associated hydrothermal fluids.

Acknowledgments The first author would like to express his gratitude for the financial support from both of the Yangminshan National Park and the National Science Council, R.O.C..

REFERENCES

Aki, K., 1969: Analysis of the seismic coda of local earthquakes as scattered waves. *J. Geophys. Res.*, **74**, 615-631.

Aki, K., and B. Chouet, 1975: Origin of coda waves: source, attenuation and scattering effects. *J. Geophys. Res.*, **80**, 3322-3342.

Chen, K. J., and Y. H. Yeh, 1991: Gravity and Micro-earthquakes Studies in the Chinshan-Tanshui Area, Northern Taiwan. *Terr. Atmos. Ocean. Sci.*, **2**, 35-50.

Chen, C. H., and Y. J. Wu, 1971: Volcanic geology of the Tatun geothermal area, northern Taiwan. *Proc. Geol. Soc. China*, **14**, 5-20.

Chouet, B. A., 1986: Dynamics of a fluid-driven crack in three dimensions by the finite difference method. *J. Geophys. Res.*, **91**, 967-992.

Chouet, B. A., 1996: Long-period volcano seismicity: its source and use in eruption forecasting. *Nature*, **380**, 309-316.

Chouet, B. A., 2003: Volcano seismology. *Pure Appl. Geophys.*, **160**, 739-788.

Crosson, R. S., 1972: Small earthquakes, structure, and tectonics of the Puget Sound region. *Bull. Seism. Soc. Am.*, **62**, 1133-1171.

Huang, S. M., 2004: Crustal structures imaged from a dense linear seismic array in the Chiayi area, southwestern Taiwan, MSc Thesis, Nat. Central Univ., Taiwan.

Ida, Y., 1991: Anatomy of an eruption. *Nature*, **352**, 571-572.

Juang, W. S., and Chen, J. C., 1989. Geochronology and geochemistry of volcanic rocks in northern Taiwan. *Bull. Geol. Surv.*, **5**, 31-66.

Lee, W. H. K., R. E., Bennett, and K. I. Meagher, 1972: A method of estimating magnitude of local earthquakes from signal duration, USGS Open-file Rept., 28 pp.

Lee, W. H. K., and J. C. Lahr, 1975: HYPO71 (revised): A computer program for determining hypocenter, magnitude, and first motion pattern of local earthquakes, USGS Open-file Rept. 75-311, 116 pp.

Lee, W. H. K., and S.W. Stewart, 1980: Principles and applications of micro-earthquake networks. *Adv. Geophys.*, **23**, 415 pp.

Minakami, T., 1960: Fundamental research for predicting volcanic eruptions, Part I. *Bull. Earthq. Res. Inst., Tokyo Univ.*, **38**, 4497-4544.

Minakami, T., 1974: Seismology of volcanoes in Japan, In: Civetta L., P. Gaspasini, G. Luongo and A. Rapolla (Eds.), Physical Volcanology, Elservier, Amsterdam, 1-27.

Nishigami, K., 1997: Spatial distribution of coda scatterers in the crust around two active volcanoes and one active fault system in central Japan: Inversion analysis of a coda envelope. *Phys. Earth Planet. Inter.*, **104**, 75-89.

Song, S. R., Tsao, S. J., and Lo, H. J., 2000a: Characteristics of the Tatun volcanic eruptions, north Taiwan: implications for a cauldron formation and volcanic evolution. *Proc. Geol. Soc. China*, **43**, 361-378.

Song, S. R., T. F. Yang, Y. H. Yeh, S. J. Tsao, and H. J. Lo, 2000b: The Tatun volcanogroup is active or extinct? *Proc. Geol. Soc. China*, **43**, 521-534.

Taso, S. J., 1994. Potassium-argon age determination of volcanic rocks from the Tatun Volcano Group. *Bull. Geol. Surv.*, **9**, 137-154.

Tilling, R. I., and J. J. Dvorak, 1993: Anatomy of a basaltic volcano. *Nature*, **363**, 125-133.

Wang, W. H., and C. H. Chen, 1990: The Volcanology and fission track age dating of pyroclastic deposits in Tatun Volcano Group. *Acta Geol. Taiwanica*, **28**, 1-30.

Yu, S. B., and Y. B. Tsai, 1980: Micro-earthquakes and seismic tremors in the Tatun volcanic area, Open-File Rept., Inst. Earth Sci., Academia Sinica, 68 pp.

Yang, Y. H., 2002: Three-dimensional velocity structures in the Tatun volcanic area, M.Sc. Thesis, Nat. Central Univ., Taiwan, 127 pp.

Yang, T. F., 2000: The Helium isotopic ratios of fumaroles from the Tatun Volcano Group of Yangmingshan National Park, N. Taiwan. *J. Nat. Park*, **10**, 73-94.

Yeh, Y. H., C. C. Liu, C. H. Lin, C. C. Liu, and H. Y. Yen, 1998: Geophysical monitoring of volcano actvities at Mt. Tatun, Western Pacific Geophys. Meeting, Taipei, Taiwan.

GEOPHYSICAL RESEARCH LETTERS, VOL. 32, L10313, doi:10.1029/2005GL022861, 2005

Preliminary analysis of volcanoseismic signals recorded at the Tatun Volcano Group, northern Taiwan

C. H. Lin,[1] K. I. Konstantinou,[1] W. T. Liang,[1] H. C. Pu,[2] Y. M. Lin,[3] S. H. You,[3] and Y. P. Huang[3]

Received 28 February 2005; revised 21 April 2005; accepted 28 April 2005; published 27 May 2005.

[1] The Tatun Volcano Group lies at the northern tip of Taiwan only 15 km north of the capital Taipei. A seismic array consisting of 5 stations equipped with both broadband and short-period sensors was installed in 2003 in order to monitor the seismic activity of the area. It recorded a variety of events including common volcano-tectonic earthquakes and volcanoseismic signals like tornillos, short duration monochromatic events (10–15 s) and long duration spasmodic bursts (~15 min). An analysis of the complex frequencies of the tornillo/monochromatic signals shows that Q-values are of the order of several hundreds. Based on the model of a fluid-filled crack, such Q-values can result from the oscillations of a crack containing a misty or dusty gas. These observations put into doubt the long-standing suggestion that the Tatun volcanoes are extinct and prompt for a thorough assessment of the volcanic hazard for this area. **Citation:** Lin, C. H., K. I. Konstantinou, W. T. Liang, H. C. Pu, Y. M. Lin, S. H. You, and Y. P. Huang (2005), Preliminary analysis of volcanoseismic signals recorded at the Tatun Volcano Group, northern Taiwan, *Geophys. Res. Lett.*, *32*, L10313, doi:10.1029/2005GL022861.

1. Introduction

[2] The Tatun volcano group (hereafter called TVG) includes more than 20 volcanoes [*Wang and Chen*, 1990] and is located at the northern tip of Taiwan (Figure 1). TVG is about 15 km north of Taipei, the capital of Taiwan that has more than seven million inhabitants. Besides that two nuclear power plants that were built 30 years ago along the northern coast of Taiwan, are located only a few kilometers northeast of the TVG. Thus, the assessment for any potential volcanic activity in the Tatun area is not only a scientifically interesting topic, but will also have a great impact on the safety of the whole of the northern Taiwan area.

[3] Based on the K-Ar dating [*Juang and Chen*, 1989; *Tsao*, 1994] and fission track analysis [*Wang and Chen*, 1990], the eruption history of TVG can be divided into two major periods: the first eruptive period occurred around 2.5–2.8 Ma, while the second one started 1.5 Ma and continued until around 0.1–0.2 Ma [*Song et al.*, 2000a]. Although the Tatun volcanoes are considered to be extinct because of no previous historical eruptions, some recent studies suggest that the possibility of future volcanic activity may not be completely excluded [*Song et al.*, 2000b]. In particular, geochemical analysis from fumarole gas shows that the Helium isotope ratios are very high and strongly indicate that some magma chambers might still exist beneath the TVG area [*Yang*, 2000]. Thus, it becomes a topic of great importance to assess the volcanic hazard posed by the TVG volcanoes.

[4] The installation of local seismic networks is the commonest way to monitor activity in a volcanic area, since any episode of unrest is usually accompanied by increased levels of seismicity. Typically, seismic activity in an active volcano often includes temporal and spatial variations of earthquakes and unusual seismic signals such as various kinds of low-frequency events and volcanic tremor. Although some previously seismic observations such as *Yeh et al.* [1998] were reported in the Tatun volcanic area, they were only focusing on the location of the earthquake activity and not on the analysis of the characteristics of the recorded events. As a result, typical volcanoseismic signals have not been reported in the TVG area yet.

[5] To improve the understanding of potential volcanic activities in the TVG area, in this study we have continuously monitored the seismic activity by using a small-aperture array in the Chishinshan area from May to October 2003. In addition to clusters of common volcano-tectonic earthquakes, we have detected and located some volcanoseismic events such as tornillos, monochromatic signals and spasmodic bursts in and around the Chihsingshan area. The Q-value for a fluid filled resonator has been also estimated from the tornillos and monochromatic events by using the Sompi method [*Kumazawa et al.*, 1990].

2. Data Collection

[6] A small-aperture seismic array consisting of five seismic stations has been installed in the TVG area since May 2003 (Figure 1a). The seismic array was designed to monitor a small area around the Chishinshan volcano where the earthquakes were found to be clustered during a previous seismic experiment [*Yeh et al.*, 1998]. Each seismic station was installed with both a short-period sensor (Lennartz LE3D, with a natural frequency of 1 Hz) and a broadband one (Guralp 30T, with a period up to 30 s).

[7] To protect instruments from possible damage due to the high acidity of sulfides in the volcanic area, seismic stations were put on a concrete-platform and covered by FRP. The seismic instruments were supplied by stable AC power for continuous recording, while a battery was connected for stabilizing power and as an emergency power source. To improve the signal-to-noise ratio, the concrete-

[1] Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan.
[2] Institute of Geophysics, National Central University, Chungli, Taiwan.
[3] Department of Earth Sciences, National Taiwan Normal University, Taipei, Taiwan.

0094-8276/05/2005GL022861$05.00

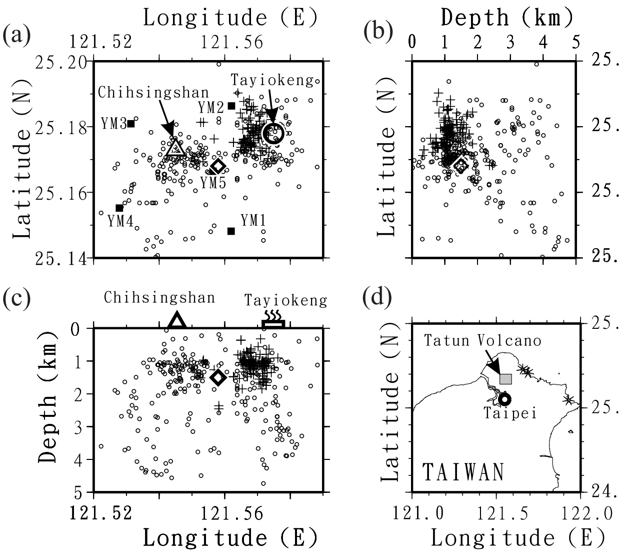


Figure 1. (a) Locations of volcano-tectonic earthquakes (small circles), burst events (pluses), a tornillo (diamond) and seismic stations (squares) in the Tatun volcanic area, northern Taiwan. The triangle and large circle respectively signify the peak of the Chihsingshan volcanic cone and actively geothermal area (Tayiokeng). (b) and (c) Projections of focal depth distribution at the W-E and N-S cross-sections, respectively. (d) The locations of Tatun volcano (a box), power plants (stars) and Taipei city in northern Taiwan.

platform was constructed with a number of steel-piers plugged into the ground down to at least 50 cm.

[8] In each station, seismic data recorded by the two sensors were stored into recorders at six channels. All seismograms were continuously sampled at a rate of 100 samples per second. The timing system in each station has been automatically synchronized by the GPS satellite signals. The seismic data were usually retrieved once per month during the regular network maintenance.

3. Seismic Signals Recorded at TVG

[9] The first processing step for the TVG dataset was to create daily drum-plots of the vertical component for all the stations of the network and identify events with good signal-to-noise ratio for further analysis. We used a simple classification scheme based on waveform appearance and frequency content for events recorded at different stations, to group them into two main categories: namely volcano-tectonic earthquakes resulting from brittle failure of rock and signals related to fluid-rock interaction like low-frequency harmonic signals and spasmodic bursts. A description of the characteristics of these two groups is given below.

3.1. Volcano-Tectonic Events

[10] This type of earthquakes exhibited impulsive first P-wave arrivals, clear S-wave phases and substantial energy at higher frequencies (Figure 2a). These phases were picked and the arrival times were inverted using HYPO71 to obtain their absolute locations. The velocity model used for the location purposes is an average 1D model based on the results of a previous experiment [*Yeh et al.*, 1998]. Formal locations errors for events inside the network did not exceed 0.2 km horizontally and 0.6 km vertically (typical values of ERH and ERZ respectively). Most events with local magnitudes smaller than 1 were located in the uppermost crust at depths less than 5 km. One group of shallow earthquakes was primarily clustered just beneath the Chihsingshan volcano, which is the highest peak (1,120 meters) in the TVG area and its topographic relief has a typical volcanic-cone shape. East to this group, some other earthquakes with depths of 2–4 km were roughly scattered around Tayiokeng, where most of the superficial fumaroles showing high Helium isotope ratios are observed.

3.2. Harmonic Signals and Spasmodic Bursts

[11] In addition to volcano-tectonic earthquakes, some signals of purely volcanic origin have also been recorded by our network. During the period covered by our observations three different kinds of volcanoseismic signals were also observed: (a) multichromatic, low-frequency events known also as ‘‘tornillos’’ (Spanish word for screw) because of the appearance of their waveform (Figure 2b), (b) short-duration monochromatic, low-frequency events (Figure 2c), (c) long-duration, high-frequency spasmodic bursts (Figure 3).

[12] The tornillo signals are characterized by a low-frequency multichromatic waveform and slowly decaying codas that increase the duration of the signal up to 40 seconds. The first arrivals of two tornillo signals that were clear enough, were picked at five stations and their source was located (using HYPO71) between Chihsingshan and Tayiokeng at a depth of 1.5 km, but with a vertical error estimate of 4 km (Figure 1). We further analyzed the tornillos waveforms by using the Sompi method [*Kumazawa et al.*, 1990] that performs a spectral analysis based on an autoregressive (AR) model and determines the complex frequencies (frequency and quality factor Q) of decaying oscillations. The results of such an analysis are described in a diagram of the frequency (*f*), versus the

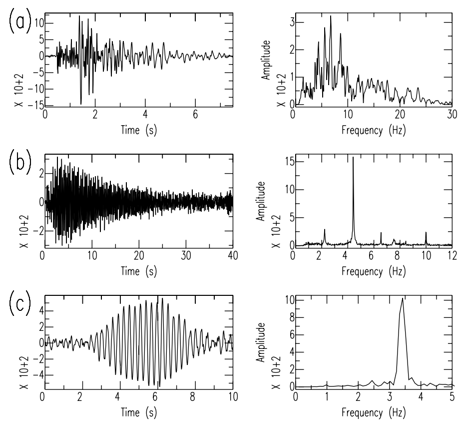


Figure 2. Vertical component velocity waveforms recorded at one seismic station and corresponding spectra of (a) a volcano-tectonic earthquake, (b) a tornillo event, and (c) a short duration monochromatic event. Waveforms have been high-pass filtered at 1 Hz so as to eliminate ocean microseismic and local noise. Note the different time scales of the recorded signals.

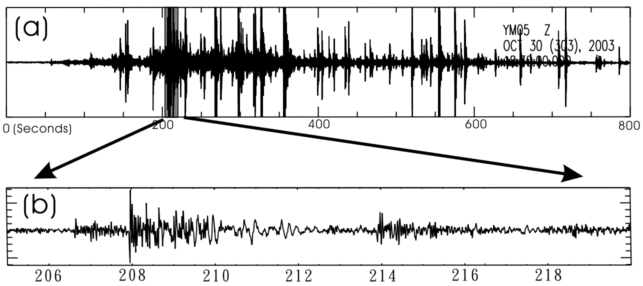


Figure 3. (a) Vertical component velocity waveforms of a high-frequency spasmodic burst recorded at one seismic station, (b) an enhanced section of the highlighted part of the waveform shown in Figure 3a.

growth rate (g), defined as $g = -2Q/f$, where the complex frequencies for different trial AR orders between 20–60 are plotted [see *Kumagai and Chouet*, 2000]. Areas of the diagram that are densely populated represent stably determined complex frequencies, while scattered points indicate incoherent noise. Figure 4a shows such a diagram for one of the tornillo events we analyzed indicating a Q-value ranging for different frequencies from 400 to more than 1000.

[13] Monochromatic low-frequency signals have usually only a short duration of about 10–15 s. In the frequency domain there is only one broad peak visible, ranging from 3.2 to 3.7 Hz having its largest amplitude at 3.4 Hz. These events appear to have a striking similarity with the "Gota" or drop-shape signals recorded at Galeras volcano, Colombia described by *Narváez et al.* [1997]. We also applied the Sompi method to the decaying part of the waveforms of these events and the corresponding frequency-growth diagram is shown in Figure 4b. These results indicate somewhat lower values of Q between 250–500, but still significantly higher than 100.

[14] Finally, spasmodic bursts are quite occasionally observed in the TVG area and have durations that can range from several tens of seconds to more than 15 minutes. A detailed examination of these signals showed that they are composed of tens of small earthquakes that have clear P and S phases (Figure 3b). We manually picked and located these events in the same way as the volcano-tectonic earthquakes mentioned in the previous section. In total, 119 of such events were located around the hydrothermally active area of Tayiokeng at depths that extended from 0 to 2 km (Figure 1).

4. Discussion

[15] Similar to the results from previous seismic experiments in the TVG area [*Yeh et al.*, 1998], most of the seismic activity manifests itself as clusters of common volcano-tectonic earthquakes. It is interesting to point out that the cluster of small, shallow earthquakes beneath the Chihsingshan volcanic cone is roughly located at depths between 1 and 2 km, which is about the deepest boundary between the Tertiary sedimentary and Quaternary volcanic rocks [*Song et al.*, 2000a]. We may conclude therefore that this kind of activity is the response of the brittle upper part of the crust to the combined effect of the local hydrothermal fluid pressure and the regional stress field.

[16] In addition to the usually reported volcano-tectonic events, it is the first time in the TVG area to observe volcanoseismic signals such as multichromatic tornillos, monochromatic events and high-frequency spasmodic bursts. Tornillos and monochromatic events have long been considered to be the linear or nonlinear response of a fluid-filled cavity to fluid pressure variations, while their different frequency content probably reflects compositional differences of the fluid phase [*Seidl and Hellweg*, 2003]. If the harmonic signatures observed in TVG are interpreted as oscillations of a fluid-filled resonator, then ash-gas or water droplet-gas mixtures are required in order to explain their long-lasting oscillations with Q significantly larger than 100 [*Kumagai and Chouet*, 2000]. On the other hand, the difference in the Q values between the tornillos and the monochromatic events can be attributed to two reasons: (a) a variation of the fluid composition that is filling the crack, where the fluid with the lower gas-weight fraction causes oscillations with a higher Q as shown by *Kumagai and Chouet* [2000]; or (b) a different crack geometry for each kind of event, with the crack having smaller aspect ratio generating oscillations with higher Q values [*Kumagai and Chouet*, 2001]. The latter explanation has also the effect of increasing the frequency of the generated signal, which seems consistent with the higher dominant frequency of the tornillos (4.2 Hz) in comparison to the monochromatic events (3.4 Hz).

[17] Spasmodic bursts of the type described in this study, have also been observed at Long Valley caldera [*Hill et al.*, 1990] and White island, New Zealand [*Nishi et al.*, 1996]. Even though they seem to consist of ordinary volcano-tectonic earthquakes, the studies mentioned above suggest that they represent the response of an extended network of cracks to the pressure variations generated by fluid injected from a deeper source. Our results seem consistent with this interpretation, since most of the spasmodic bursts events are located in the area of Tayiokeng where there is an abun-

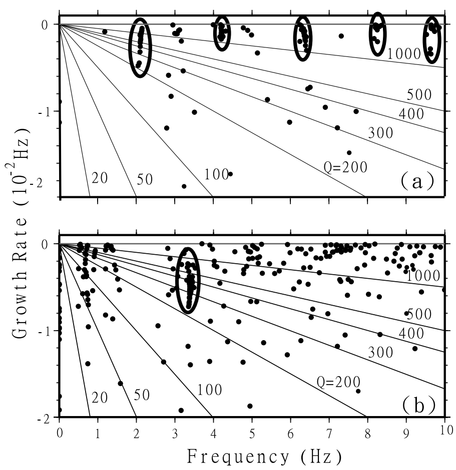


Figure 4. Plots of the complex frequencies of individual wave elements for all the trial AR orders (20–60) estimated for (a) tornillo and (b) monochromatic signals shown in Figures 2b and 2c. The clusters of points within ellipses indicate consistent signals, and the solid lines mark constant Q values.

dance of hydrothermal activity in the form of fumaroles and hot springs.

[18] The manifold seismic activity described in this study puts forward the question whether a magmatic plumbing system may still be working beneath the TVG area. This further leads to the consideration of whether such a vigorous hydrothermal activity can be sustained by a residual magma body 0.1 Ma after its last eruption without any replenishment from a deeper source, if we accept that the Tatun volcanoes are indeed extinct. The answers to these questions are of considerable importance, since according to a phenomenological definition of active volcanoes proposed by *Szakacs* [1994], TVG may be considered active if its magmatic plumbing system is still working.

[19] The seismic features described in this preliminary study and the geochemical analysis cited previously, suggest that further research should be done in order to be able to assess the volcanic hazard posed by TVG. As a step towards fulfilling this need, we increased the number of the temporary stations of our local network so that they can also cover the seismically active area of Tayiokeng providing additional high-quality digital data. Future work, therefore, will focus on the following aspects: (a) acquiring high precision absolute and relative locations of the best recorded events, so as to be able to accurately delineate the seismic structures inside the study area, (b) spectral analysis of the whole dataset in order to determine the existence of low-amplitude tremor or Very Long-Period (VLP) signals and provide information about the acoustic properties of magmatic/hydrothermal fluids, and (c) determination of focal mechanisms of volcano-tectonic earthquakes for the purpose of inferring faulting-type and stress distribution patterns.

5. Conclusion

[20] A small aperture seismic array has been deployed for monitoring seismicity at the Tatun volcanic area in northern Taiwan. In addition to volcano-tectonic earthquakes, we recorded several volcanoseismic signals such as tornillos, monochromatic events and spasmodic bursts, that have often been reported in active volcanoes worldwide. Although the detailed source mechanism of these signals is still unknown, it is most probable that they are associated with the direct or indirect interaction between hydrothermal or magmatic fluids and solid rock in the upper crust. Combining the earthquake activity and the volcanic signals observed in this study along with the previous analysis of Helium isotope ratios, we suggest that it should be further investigated whether the magmatic plumbing system beneath the TVG is still working. It is thus necessary to evaluate the volcanic hazard posed by TVG, through detailed geophysical and geochemical monitoring of this area.

[21] **Acknowledgments.** We would like to thank two anonymous reviewers for constructive comments. Gratitude is also extended to the Yangminshan National Park and the National Science Council of Taiwan for financial support through the form of research grants and fellowships.

References

Hill, D. P., et al. (1990), The 1989 earthquake swarm beneath Mammoth mountain, California: An initial look at the 4 May through 30 September activity, *Bull. Seismol. Soc. Am.*, *80*, 325–339.

Juang, W. S., and J. C. Chen (1989), Geochronology and geochemistry of volcanic rocks in northern Taiwan, *Bull. Geol. Surv.*, *5*, 31–66.

Kumagai, H., and B. A. Chouet (2000), Acoustic properties of a crack containing magmatic or hydrothermal fluids, *J. Geophys. Res.*, *105*, 25,493–25,512.

Kumagai, H., and B. A. Chouet (2001), The dependence of acoustic properties of a crack on the resonance mode and geometry, *Geophys. Res. Lett.*, *28*, 3325–3328.

Kumazawa, M., Y. Imanishi, Y. Fukao, M. Furumoto, and A. Yamamoto (1990), A theory of spectral analysis based on the characteristic property of a linear dynamic system, *Geophys. J. Int.*, *101*, 613–630.

Narváez, M., R. A. C. Torres, D. M. M. Gomez, G. P. J. Cortes, H. V. Cepeda, and J. Stix (1997), "Tornillo"-type seismic signals at Galeras volcano, Colombia, *J. Volcanol. Geotherm. Res.*, *77*, 159–171.

Nishi, Y., S. Sherburn, B. J. Scott, and M. Sugihara (1996), High-frequency earthquakes at White Island volcano, New Zealand: Insights into the shallow structure of a volcano-hydrothermal system, *J. Volcanol. Geotherm. Res.*, *72*, 183–197.

Seidl, D., and M. Hellweg (2003), Parameterization of multichromatic tornillo signals observed at Galeras Volcano (Colombia), *J. Volcanol. Geotherm. Res.*, *125*, doi:10.1016/S0377-0273(03)00095-7.

Song, S. R., S. J. Tsao, and H. J. Lo (2000a), Characteristics of the Tatun volcanic eruptions, north Taiwan: Implications for a cauldron formation and volcanic evolution, *Proc. Geol. Soc. China*, *43*, 361–378.

Song, S. R., T. F. Yang, Y. H. Yeh, S. J. Tsao, and H. J. Lo (2000b), The Tatun volcano group is active or extinct?, *Proc. Geol. Soc. China*, *43*, 521–534.

Szakacs, A. (1994), Redefining active volcanoes: A discussion, *Bull. Volcanol.*, *56*, 321–325.

Tsao, S. J. (1994), Potassium-argon age determination of volcanic rocks from the Tatun Volcano Group, *Bull. Geol. Surv.*, *9*, 137–154.

Wang, W. H., and C. H. Chen (1990), The volcanology and fission track age dating of pyroclastic deposits in Tatun Volcano Group, *Acta Geol. Taiwan.*, *28*, 1–30.

Yang, T. F. (2000), The helium isotopic ratios of fumaroles from Tatun Volcano Group of Yangmingshan National Park, n. Taiwan, *J. Nat. Park*, *10*, 73–94.

Yeh, Y. H., C. C. Liu, C. H. Lin, C. C. Liu, and H. Y. Yen (1998), Geophysical monitoring of volcano activities at Mt. Tatun, *Eos Trans. AGU*, *79*(24), West. Pac. Geophys. Meet. Suppl., W124.

Y. P. Huang, Y. M. Lin, and S. H. You, Department of Earth Sciences, National Taiwan Normal University, Taipei, 106 Taiwan.

K. I. Konstantinou, W. T. Liang, and C. H. Lin, Institute of Earth Sciences, Academia Sinica, P O Box 1-55, Nankang, Taipei, 115 Taiwan. (lin@earth.sinica.edu.tw)

H. C. Pu, Institute of Geophysics, National Central University, Chungli, 320 Taiwan.

參考書目

中文部分

余水倍，蔡義本，胡錦城，林國安，1980. 大屯火山區微震及地動雜波之研究，探採研究彙報，中國石油公司，3，101~130 頁。

楊燦堯，1999. 陽明山國家公園大屯火山群之氦氣及其同位素地球化學之研究，內政部營建署陽明山國家公園管理處委託計畫。

陳朝輝，1985. 利用地震時間項和重力波譜分析法研究大屯火山區之地殼構造，國立台灣大學海洋研究所碩士論文，93 頁。

葉義雄，林正洪，顏宏元，劉啓清，劉忠智，1999. 大屯火山區地球物理監測研究，台灣電力公司委託計畫。

英文部分

Chen, C. H., 1983, The geochemical evolution of Pleistocene absarokite, shoshonite and high-alumina basalt in northern Taiwan. Mem. Geol. Soc. China, 5, 85-96.

Chen, C. H., 1990, Igneous rocks in Taiwan. Cetral Geol. Surv., MOEA, 137pp.

Chen, C. H. and Nakada S., 1994, Comparison of late Cenozoic basaltic magma generation in Ryukyu arc, Okinawa Trough and adjoining area (NW kyushu, Japan and N. Taiwan). 1994 8th International Conference on Geochronology, 54.

Chen, C. H, Nakada S., Chen, C. H., Mertzman, S. A., 1996, An unusal volcanic zone behind the southern Okinawa trough (back arc basin)- the western extension of the Ryukyu volcanic arc front?

Chen, K. J., and Yeh, Y. H., 1991. Gravity and Microearthquakes Studies in the Chinshan-Tanshui Area, Northern Taiwan, TAO, 2, 1, 35~50.

Ho, C. S., 1982, Tectonic evolution of Taiwan explanatory text of the tectonic map of Taiwan. Ministry Econ. affairs, ROC. 126pp.

Juang, W. S. and Bellon H., 1984, The Potassium-argon dating of andesites from Taiwan. Proc. Geol. Soc. China, 27, 86-100.

Kawakatsu, H., Kaneshima, S., Matsubayashi, H., Ohminato, T., Sudo, Y., Tsutsui, T., Uhira, K., Yamasato, H., Ito, H., and Legrand, D., 2000. Aso94: Aso seismic observation with broadband instruments, JVGR, 101, 129-154.

Lee, W. H. K., and Lahr, J. C., 1972, HYPO71: A computer program for determining hypocenter, magnitude, and fist motion pattern of local earthquakes , USGS Open file Rep., 100pp.

Suppe, J., 1984, Kinematics of arc-continent collision, flipping of subduction, and back-arc spreading near Taiwan. Mem. Geol. Soc. china, 6, 21-33.

Song, S. R., Lo H. J., Chen, C. H., Tsao, S. and Yang, J. J., 1992, cauldron fromation and volcanic eruption of the Tatun volcanic group. 4th Symposium Quaternary of Taiwan, 45.

Teng, L. S., Chen, C. H., Wang, W. S., Liu, T. K., Juang, W. S. and Chen, J. C., 1992, Plate kinematic model for late Cenozoic arc magmatism in northern Taiwan. J. Geol. Soc. China, 35, 1-18.

Tsao, S. J., 1994, Patassium-argon age determination of volcanic rocks from the Tatun Volcano Group. Bull. Central Geol. Surv., 9.

Wang, W. H. and Chen, C. H., 1990, The volcanology and fission track age dating of pyroclastic deposits in Tatun volcnao froup, northern Taiwan. ACta Geol. Taiwanica, 28, 1-30.

Yang, T. F., Sano, Y., Ho, H. H., Shieh, P. S., Liu, N. T. and Chen, C. H., 1999, Variations of Helium isotopic ratios of gases from Tatun Volcano Group, N. Taiwan, Handbook of Annual Meeting of Geolo. Soc. China, 35-36.

Yang, T. F., 1999, The helium isotopic study of fumaroles from Tatun Volcano Group of Yangmingshan National Park, Journal of National Park.

Yen, T. P., Tzou, Y. H. and Lin, W. H., 1984, Subsurface geology of the region of the Tatun Volcano Group. Petrol. Geol. Taiwan. 20, 143-154.