

會議室	Room 603
日期	11月17日(星期二)
時段	08:30-08:45
議程代碼	S4-O-01
議題	- Seismology 觀測地震學
作者	管卓康(Zhuo-Kang Guan) [國立中央大學地球科學系] (通訊作者) 鄭璟郁(Ching-Yu Cheng) [國立中央大學地球科學系] 郭陳濤(Hao Kuo-Chen) [國立中央大學地球科學系]
中文題目	以短周期密集地震網觀測台灣西南部的地震特性及其地體構造初探
英文題目	
投稿類型	口頭報告 Oral
摘要	本研究使用 100 台短周期地震儀 Smart Solo，針對台灣西南部平原及麓山帶建立了密集觀測網，觀測範圍自雲林至屏東，於 2020 年 3 月至 2020 年 7 月間觀測，Smart Solo 是今年引進的新型短周期地震儀，內建三分量 geophone、GPS 校時系統，內置鋰電池的續航力可達 30 日，在同樣觀測時間的條件下，比起以往使用 Texan 搭配單分量 geophone 的組合，建置 Smart Solo 站的體積僅剩下 Texan 測站的四分之一，使佈站效率、測站安全性與資料完整性大幅的進步。觀測期間內共紀錄約 90 天連續資料，資料處理包含挑選到時、FPfit 震源機制解與計算規模等工作透過 Seisan 軟體執行以分析地震分佈特性。此外，連續資料所建立的交相關函數，可觀測地震站之間表面波的頻散曲線，並利用地震到時資料與表面波頻散曲線進行聯合反演，此方法可以結合體波與表面波的優點，深層構造的解析依賴豐富的地震資料，而表面波資料能加強控制近地表速度構造，最後求得西南部測區的細緻的 P、S 波的層析成像。
中文關鍵字	台灣西南部，密集地震網，聯合反演，地震層析成像
英文關鍵字	South-west Taiwan, Dense Seismic Array, Joint Inversion, Seismic Tomography.

會議室	Room 603
日期	11月17日(星期二)
時段	08:45-09:00
議程代碼	S3-O-01
議題	- Seismology 環境與噪聲地震學
作者	蘇建旻(Chien-Min Su) [國立中正大學] (通訊作者) 吳瑋哲(Wei-Jhe Wu) [國立中正大學] 溫士忠(Strong Wen) [國立中正大學] 陳朝輝(Chau-Huei Chen) [國立中正大學]
中文題目	利用密集陣列資料配合噪聲成像方法探討梅山斷層帶之淺層構造
英文題目	The investigation of shallow structures at Meishan Fault zone with Ambient Noise tomography using a dense array data
投稿類型	口頭報告 Oral
摘要	<p>地震監測往往倚重野外地震儀器的架設，但由於過去地震儀器造價昂貴使得地震網架設成本過高，以致測站間距過大，進而導致許多細節的遺失或是研究成果受測站分佈狀況的限制。由於近年來科技進步，讓地震儀器造價成本降低，使得佈設密集陣列的監測方式變得可行，因此本研究於嘉義梅山斷層帶利用線性陣列的形式來解析斷層構造，希望透過便攜式地震感測器密集陣列的方式來提高我們對斷層幾何構造上的解析度。由於發生在 1906 年的梅山地震(M=7.1)為臺灣第一個有完整文獻與儀器記錄之致災性地震，近年來學者們對梅山斷層的幾何型態有諸多研究，如地表的地質勘查、震測研究及古地震的情境模擬等，但仍對此區域的淺層斷層帶與鄰近斷層構造未作詳盡的分析，因此本研究使用密集陣列資料搭配噪聲 double-beamforming 的成像方法，以全新方式詮釋梅山斷層帶的淺層構造。由本研究結果顯示，於鄰近於地調所繪製斷層線的位置，呈現一個寬度約 200 公尺寬並向南傾斜的剪力波低速帶，波速約為 0.2~0.4 km/s；另外 Wang(2019)則提出另一個為梅山斷層可能通過之位置，也觀察到一個寬度約 300 公尺寬並向北傾斜的剪力波低速帶，波速約為 0.4~0.6 km/s；而此兩處的低速帶位置與震測結果提及淺層一公里內的壓縮型開花構造兩側邊界相符。本研究透過使用密集陣列資料並配合噪聲成像方法，結果不僅顯示了梅山斷層開花構造位置與前人研究一致，本研究更提供了構造內精細剪力波速度的測向分佈，以利未來對梅山斷層帶構造細節與活動特性有更進一步的瞭解。</p>
中文關鍵字	梅山斷層、線性密集陣列、淺層構造、噪聲成像
英文關鍵字	Meishan Fault, Linear Dense array, Shallow structure, Ambient noise tomography

會議室	Room 603
日期	11 月 17 日(星期二)
時段	09:00-09:15
議程代碼	S4-O-02
議題	- Seismology 觀測地震學
作者	孫維芳(Wei-Fang Sun) [國立東華大學環境學院自然資源與環境學系] (通訊作者) 管卓康(Zhuo-Kang Guan) [國立中央大學地球科學系] 郭陳濤(Hao Kuo-Chen) [國立中央大學地球科學系] 徐乙君(Yi-Chun Hsu) [國立中央大學地球科學系] 張建興(Chien-Hsin Chang) [國立中央大學地球科學系] 張文彥(Wen-Yen Chang) [國立東華大學自然資源與環境學系] []
中文題目	利用 1986 年 M6.2、2018 年 M6.4 及 2019 年 M6.2 花蓮地震序列探討臺灣東部板塊邊界複雜孕震變形構造
英文題目	The complex seismogenic deformation near the plate boundary in eastern Taiwan: The aftershock sequences of the 1986 M6.2, 2018 M6.4, and 2019 M6.2 Hualien earthquakes
投稿類型	口頭報告 Oral
摘要	臺灣東北部為歐亞板塊與菲律賓海板塊，由碰撞作用過渡到以隱沒作用為主的轉換帶，常有具破壞性中大型地震發生。位處該區的花蓮，在 1986 年五月、2018 年二月及 2019 年四月發生三個規模大於 6.0 的地震，三個主震彼此相距不到 20 公里，卻有截然不同的發震機制及餘震分布，顯見花蓮地區的孕震構造複雜。使用密集地震網資料，能有效提昇地震事件偵測能力及地震定位精準度。為了了解花蓮地區孕震構造的樣貌，我們在 2018 及 2019 年花蓮主震後兩天內，分別在餘震分布區裝設 70 台單分量及 47 台三分量短週期地震儀(測站距 1-5 公里) 監測餘震活動。結果顯示，密集地震網監測資料所紀錄的地震數量比中央氣象局利用區域地震網獲取的數量增加至少兩倍以上，且地震定位各項殘差值皆小於中央氣象局定位，顯示密集地震網數據的重要性。經由重新定位 1986 年花蓮地震序列，我們發現 1986 及 2019 年花蓮兩個主震震央雖僅相距 7.5 公里，其引發的餘震分布呈現共軛斷層。結合三個花蓮地震(1986、2018 與 2019)餘震分布與震源機制結果，在僅 25 公里見方地理區域內(立霧溪至壽豐溪間，中央山脈東部淺山至沿海地區)，2018 年花蓮地震序列顯現板塊邊界斷層機制(高角度向西傾)，1986 及 2019 年花蓮地震序列則位處緊接板塊邊界西邊的中央山脈內，推測由於發震時不同的應力分布狀態，而觸發向東及向西傾的共軛斷層。另外，這三個花蓮主餘震分布皆與地表活動斷層相關性低(例如美崙斷層、嶺頂斷層)，主要發生在盲斷層構造內，顯示板塊邊界轉換帶上複雜的地震地體構造形貌，以及盲斷層調查的重要性。
中文關鍵字	花蓮地震、餘震序列、孕震區域、密集地震網
英文關鍵字	Hualien earthquake; aftershock sequence; seismogenic zone; dense seismic array

會議室	Room 603
日期	11月17日(星期二)
時段	09:15-09:30
議程代碼	S4-O-03
議題	- Seismology 觀測地震學
作者	李恩瑞(En-Jui Lee) [成功大學地球科學系暨研究所] (通訊作者)
中文題目	利用 GPU 加速自動微震監控 (GAMMA)
英文題目	GPU-Accelerated Automatic Microseismic Monitoring Algorithm (GAMMA)
投稿類型	口頭報告 Oral
摘要	<p>Foreshocks and/or aftershocks play critical roles in improving our understanding of the processes of faulting, such as nucleation of earthquakes, earthquake triggering, and postseismic deformation. A rapid and accurate earthquake detection and location algorithm can provide timely information of seismic activities, thereby benefitting our understanding of physical mechanisms of faulting and seismic hazard assessment. We have developed a graphic processing unit (GPU)-accelerated automatic microseismic monitoring algorithm (GAMMA) for accurate and near real-time detection and location of earthquakes. GAMMA utilizes methods based on backprojection to automatically detect potential earthquakes, and then the waveforms of qualified earthquakes are selected as templates when searching for small earthquakes in continuous recordings using the template-matching algorithm. The use of GPUs has substantially accelerated the calculations and has made GAMMA capable of (near-)real-time earthquake monitoring. We have successfully applied GAMMA to the 2019 Ridgecrest earthquake sequence in southern California. The number of earthquakes detected by GAMMA is more than 21 times that documented in the regional catalog. The more complete catalog determined by GAMMA may provide crucial information for improving our understanding of the physical mechanisms of faulting and also supply useful constraints for a variety of types of studies, including dynamic rupture simulations and crustal deformation modeling.</p>
中文關鍵字	圖形處理器, 微震
英文關鍵字	Graphics Processing Unit, Microseismic

會議室	Room 603
日期	11月17日(星期二)
時段	09:30-09:45
議程代碼	S1-O-01
議題	- Seismology 一般地震學研究
作者	劉庭佑(Liu, Ting-Yu) [中央研究院地球科學所] (通訊作者) 李憲忠(Lee, Shiann-Jong) [中央研究院地球科學所]
中文題目	即時震源監測系統年度報告
英文題目	Annual report of the real-time moment tensor monitoring system
投稿類型	口頭報告 Oral
摘要	Real-time moment tensor monitoring system (RMT) is an automatic monitoring system for earthquake activities in Taiwan. The system integrates real-time broadband seismic recordings, grid search scheme and centroid moment tensor (CMT) inversion technique. The inversion procedure is based on a 3-D Green's function database calculated by the spectral-element method. The monitoring area covers 119.2°E to 123.0°E and 21.0°N to 26.0°N, with depth from 2 to 180 km. And the grid interval is less than 0.05° in horizontal and 2 km in vertical direction. The RMT system worked for three years in 1-D Green's function version from 2012 to 2015. And has worked in 3-D version since 2015. It provides origin time, hypocentral location, moment magnitude and focal mechanism of events. These source parameters can be determined simultaneously within 2 minutes after the occurrence of an earthquake. The monitoring results for events occurred between 2012 and 2019 are compared with earthquake catalogue of Central Weather Bureau (CWB) and CMT solutions of the Broadband Array in Taiwan for Seismology (BATS). The average differences of event origin time and hypocentral location are less than 1.5 s and 6.5 km, respectively. The results of focal mechanisms are also compatible to BATS CMT solutions. Therefore, RMT system is a reliable and efficient monitoring for local seismic activities. The long-term goal of RMT system is to provide real-time source information of moderate-to-large earthquakes for rapid seismic hazard assessment.
中文關鍵字	即時監測、地震矩逆推、震源參數、三維格林函數、地震數值模擬
英文關鍵字	Real-time monitoring, moment tensor inversion, source parameters, 3-D Green's function, Computational seismology

會議室	Room 603
日期	11月17日(星期二)
時段	09:45-10:00
議程代碼	S3-O-02
議題	- Seismology 環境與噪聲地震學
作者	馮冠芙(Kuan-Fu Feng) [Department of Geosciences, National Taiwan University] (通訊作者) 黃信樺(Hsin-Hua Huang) [Institute of Earth Sciences, Academia Sinica] 許雅儒(Ya-Ju Hsu) [Institute of Earth Sciences, Academia Sinica] 吳逸民(Yih-Min Wu) [Department of Geosciences, National Taiwan University]
中文題目	
英文題目	Single-station cross-component analysis of ambient noise reveals seasonal crustal seismic velocity variations in Taiwan
投稿類型	口頭報告 Oral
摘要	Ambient noise interferometry is a promising technique to gain an insight into the crustal structures and crustal behaviors. In this study, benefit from the long-term continuous data of Broadband Array in Taiwan for Seismology (BATS) that has been operated from 1994, we analyze continuous seismic data from 1998 to 2019 by applying single-station cross-component (SC) techniques to investigate the temporal variations of crustal behavior on seismic velocity. We process the data of all BATS stations, construct the empirical Green's functions, and compute daily seismic velocity changes by the stretching technique in four different frequency bands. Our preliminary results show a strong seasonality, with a period of near one-year, at most stations. These annual variations are mainly observed in the lower frequency bands, which are sensitive to the crust at depths of around 2-10 km for most of stations. At some stations, these annual variations are also found in the higher frequency bands, which are sensitive to the crust at near-surface depths. The modeling of seismic velocity changes from rainfall-induced pore-pressure change shows good fits with the estimated results and suggests a dominant role of rainfall than other environmental factors such as temperature and pressure in causing the seasonal variations of crustal seismic velocity. The frequency dependent variations may then represent different aquifer systems at various depths region by region.
中文關鍵字	
英文關鍵字	seismic velocity change, single-station cross-correlation, stretching technique, annual variation

會議室	Room 604
日期	11月17日(星期二)
時段	08:30-08:45
議程代碼	GP-O-01
議題	- Geophysics 地球物理、地球物理探勘與環境地球物理
作者	姜智文(Chih-Wen Chiang) [國立臺灣海洋大學] (通訊作者) 楊志賢(Zhi-Xian Yang) [國立中央大學] 陳建志(Chien-Chih Chen) [國立中央大學] 葉恩肇(En-Chao Yeh) [國立臺灣師範大學] 陳洲生(Chow-Son Chen) [國立中央大學] 王乾盈(Chien-Ying Wang) [國立中央大學]
中文題目	再論紅柴林地區電性模型與地熱潛能之關聯
英文題目	
投稿類型	口頭報告 Oral
摘要	科技部第二期能源國家型科技計畫，將宜蘭縣三星鄉紅柴林地區，選定作為探勘地熱資源潛能開發之重要研究場址之一。經過多年期的研究成果累積，業已完成高密度反射震測、大地電磁等地球物理資料收集與分析工作，以及兩口地熱深井鑽探工作，用以探討地熱潛能研究之目的。其中，大地電磁資料依據不同資料收集階段、分析方法，先後提出二種版本的電性模型，分別探討、解釋其特徵與火山型地熱模型之關聯性。然而，兩電性模型呈現之特徵與解釋並不完全一致，造成該區相關研究學者莫大的困擾與疑問。究竟地熱潛能區在哪裡？仍是未解之謎。因此，本研究利用相同之大地電磁資料，重新進行細究資料分析及比對工作，並結合震測模型、電井測資料，綜合探討電性模型與地質、地熱構造之關聯性。本研究所提出的新電性模型與震測模型特徵一致程度頗高。除此之外，新電性模型特徵更發現一明顯導體異常，坐落於兩口地熱探勘深井南方約 500 公尺，深度介於 500 至 1,100 公尺處，其成因可能與變質型地熱系統、地熱流體有關。根據新電性模型結果，進一步推論該導體異常的熱源可能來自於深處，並受控於濁水斷層、粗坑斷層活動及板岩變質帶交互作用機制有關。鑑於先前電性模型解釋，皆認為該區之導體異常分布成因屬火山型地熱系統，但未能提供充分之相關佐證資料。故本團隊依據現有資料，首次提出斷層活動與變質作用交互機制，補充說明及解釋紅柴林地區之地熱、地質構造特徵。
中文關鍵字	地熱潛能、電性模型、導體異常、大地電磁、流體
英文關鍵字	

會議室	Room 604
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議程代碼	GP-O-02
議題	- Geophysics 地球物理、地球物理探勘與環境地球物理
作者	董倫道(Lun-Tao Tong) [工業技術研究院] (通訊作者) 郭泰融(Tai-Rong Guo) [工業技術研究院] 林蔚(Wayne Lin) [工業技術研究院] 林朝彥(Chao-Yan Lin) [工業技術研究院] 陳棋炫(Chi-Hsuan Chen) [經濟部中央地質調查所] 張育仁(Yu-Zen Chang) [經濟部中央地質調查所]
中文題目	大屯山地熱區之三維地電阻模型初探
英文題目	Preliminary 3D Resistivity Model and its Implication in the Tatun Geothermal Area
投稿類型	口頭報告 Oral
摘要	<p>大屯山是受矚目的地熱區，民國 60 年代便是在大屯山開展了全省地熱探勘，之後停頓了將近 30 餘年，民國 95 年能源局重啟地熱發電計畫以來，政府長期投注於此區之地熱探勘工作，並已完成重點區域的大地電磁探勘及探勘井鑽鑿等工作，國內外地熱工作者，曾分別於 2014 年及 2015 年產出二個三維地電阻模型。唯因各界意見不一，對於大屯山地熱區之地電阻構造仍莫衷一是。本研究採用與產出 2014 年模型相同的數據，測點主要分布在陽明山國家公園中間地帶，篩選後採用其中 42 個測點，探勘區域內三維網格的水平間距為 175 公尺，垂直間距為 25 公尺，採用 DEM 模擬地形及海水水體。經三維逆推後獲得三維地電阻模型，與地質圖及既有井錄等資料比對具一致性。初步分析顯示，深部熱水通道可能受 NNE 及 SSE 破裂帶控制，熱水上湧至火山岩體後，沿不整合面側向流動，在火山體底部及內部形成廣泛具低電阻特徵的熱水換質帶。此外，在沉積岩基盤內發現具有高磁的帶狀低電阻異常區，是否意味為深部火成岩侵入體，由於測點分布未能完整涵蓋，故仍有待後續補充探測加以求證。</p>
中文關鍵字	大屯山、地熱、大地電磁、三維地電阻模型
英文關鍵字	Tatun volcano group, geothermal, magnetotellurics, 3D resistivity model

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議題	- Geophysics 地球物理、地球物理探勘與環境地球物理
作者	陳建志(Chien-Chih Chen) [中央大學] (通訊作者)
中文題目	台灣地區地電阻監測之應用案例
英文題目	Case studies on ERT monitoring in Taiwan
投稿類型	口頭報告 Oral
摘要	Electrical resistivity tomography (ERT) has been widely used for the investigation to various kinds of urban and mountain hydrogeological problems. Groundwater, together with its physical and chemical conditions, is sensitive to electrical resistivity of soil-rock mixtures. To address these hydrogeological problems dynamic factors such as variation in water content and preferential path are even more important than static distribution in space of groundwater. Developing real-time ERT monitoring technique thus becomes crucial in hydrogeology. Yet another attractive benefit from a series of consecutive ERT images is to reduce ambiguity in interpreting resistivity structures. While electrical resistive or conductive structures could have multiple explanations in a single ERT image, short-term resistivity/conductivity changes in a series of consecutive ERT monitoring images are very likely attributed to some specific dynamics relevant to, say, water content and pollutant concentration. Given in this presentation are some case studies on ERT monitoring about applications to landslides, water resources management and environmental pollution in Taiwan.
中文關鍵字	地電阻影像剖面法、監測、台灣
英文關鍵字	Electrical resistivity tomography, Monitoring, Taiwan

會議室	Room 604
日期	11月17日(星期二)
時段	09:15-09:30
議程代碼	GP-O-04
議題	- Geophysics 地球物理、地球物理探勘與環境地球物理
作者	張竝瑜(Ping-Yu Chang) [中央大學地球科學系] (通訊作者) Yonatan Garkebo Doyoro [中央大學地球科學系] Jordi Mahardika Puntu [中央大學地球科學系] 謝孟勳() [中央大學地球科學系] Tran Van Hu [中央大學地球科學系] Diah Ayu Rahmalia [中央大學地球科學系]
中文題目	基於 python 開源函式庫的地電阻反演算軟體之檢視與比較
英文題目	A review of the open-source python softwares for the electrical resistivity modeling and inversion
投稿類型	口頭報告 Oral
摘要	近年來由於 python 語言的開源地球物理正演及反演算程式逐漸普及，由於 python 的直譯式結構及越來越多的開源函式庫支援，使得過去需要購買或訂閱模擬程式才可以完成之相關演算，現在均可以在開源的函式庫中透過簡單的直譯語言程式碼，呼叫出相關的函式庫加以完成。本研究中檢視目前支援地電阻模擬演算的開源程式，包括一些開源核心獨立程式的 python 介面，例如 pyres 及 ResIPy，以及基於開源 python 函式庫(例如 pyGIMLi 及 SimPEG)發展的地電阻正反演算程式(例如 BERT 以及 COMET 程式)，這些開源地球物理函式庫主要提供了包括像是物件導向的二維或三維、結構化和非結構化網格建立、有限元素和有限體積求解器，以及各種地球物理正演算、反演算與聯合反演算框架。我們比較這些程式以及它們的架構，並利用相同的模型來測試各不同程式的反演算與正演算解析度、敏感度與演算誤差與收斂速度，提供未來研究者，利用相關程式進行研究時的參考。
中文關鍵字	開源軟體、地電阻、反演算
英文關鍵字	open source, python, electrical resistivity inversion

會議室	Room 604
日期	11 月 17 日(星期二)
時段	09:30-09:45
議程代碼	GP-O-05
議題	- Geophysics 地球物理、地球物理探勘與環境地球物理
作者	羅祐宗(LO, YU-TSUNG) [國立中央大學地球科學系] (通訊作者) 顏宏元(YEN, HORNG-YUAN) [國立中央大學地球科學系]
中文題目	平均三維密度模型探討上部與下部地殼構造
英文題目	Exploring the upper and lower crustal structures using an three-dimensional average density model average density model
投稿類型	口頭報告 Oral
摘要	我們分析三種可信度高的速度模型的速度格點，找尋彼此之間的一致性，並重新組合成一個平均的速度模型。透過速度與密度的轉換關係式，可計算平均的速度模型的理論重力值。透過分析速度轉密度的模型格點可以發現在深度 26 公里以下，台灣北部及西南部的速度模型結果較不一致；深於 40 公里，速度模型的不一致出現在中央山脈下方。平均速度模型的理論值計算結果與重力觀測很接近，可透過濾波將兩者之間的殘差重力值區分為淺層與深層效應，加入速度轉密度模型的理論重力值中，達到修正模型的目的。最後分別探討淺層與深層地殼所產生的重力效應及其地體構造含意。
中文關鍵字	重力、密度模型、速度密度關係式、速度模型、地體構造
英文關鍵字	Gravity, Density model, v-d relationship, velocity model, tectonic structure

會議室	Room 605
日期	11 月 17 日(星期二)
時段	08:30-08:45
議程代碼	V2-O-01
議題	- Volcanology and Geochemistry 火山學
作者	洪瑋澤(Wei-Tze,Hung) [中國文化大學] (通訊作者)
中文題目	以岩象學及地球化學探討基隆山及牡丹山火山熔岩特徵之研究
英文題目	Application petrography and geochemistry on the characteristics of lava in Keelung and Mudan Mountains
投稿類型	口頭報告 Oral
摘要	本研究利用岩象學及地球化學方法分析基隆山及牡丹山火山熔岩之特徵，以了解在風化作用的影響下火山熔岩中礦物相的轉變。本研究初步成果顯示，於基隆山的礦物組成有石基佔 31%、斜長石佔 40%、角閃石類佔 22%、輝石類 2%、石英 3%及黑雲母 2%。且基隆山的普通角閃石以已不具任何光學特徵，僅存解理特徵為主。牡丹山的礦物組成有石基佔 28%、斜長石佔 37%、角閃石類佔 26%、輝石類 2%、石英 2%及黑雲母 5%。其普通角閃石以礦物外圍呈現黑色特徵為主，內部仍呈現光學特徵。最後，將整合岩象學及地球化學說明基隆火山群火山熔岩在風化作用下的礦物相轉變過程。
中文關鍵字	岩象學、地球化學、火山熔岩、基隆山、牡丹山
英文關鍵字	petrography, geochemistry, lava, Keelung Mountain, Mudan Mountain

會議室	Room 605
日期	11月17日(星期二)
時段	08:45-09:00
議程代碼	V2-O-02
議題	- Volcanology and Geochemistry 火山學
作者	陳治宇(Chih-Yu Chen) [中興工程顧問股份有限公司] (通訊作者)
中文題目	由野外地質調查探討竹子山火山亞群之火山堆積物特徵
英文題目	
投稿類型	口頭報告 Oral
摘要	<p>由野外地質調查探討竹子山火山亞群之火山堆積物特徵 陳治宇 1、施國偉 1、賴憶菁 1、蕭丁槐 1、羅正彥 1、張皓雲 1、蔡裕偉 2、劉佳玫 2 中興工程顧問股份有限公司 中國文化大學地質學系 摘要 台灣北部大屯火山群由 50 餘座火錐體所構成，可分為 5 個火山亞群：竹子山亞群、大屯山亞群、磺嘴山亞群、七星山亞群及丁火朽山亞群。本研究以竹子山亞群為例，以野外地質調查為基礎，彙整前人與本研究成果，並整理地質鑽孔資料，建立竹子山亞群火山堆積物分布及火山層序。竹子山亞群之火山堆積物包括更新世安山岩及火山碎屑岩，前者可分為 8 個層序(Z1~Z8)；後者可分為上部火山碎屑岩(ZUPY)及下部火山碎屑岩(ZLPY)。其形成可分為兩個主要階段，第一階段為下部火山碎屑岩(ZLPY)形成時期，以火山泥流作用為主，厚度約 100~150 公尺，廣泛分布於現今竹子山稜線至三芝、石門沿岸一帶，岩性以凝灰角礫岩為主，礫質凝灰岩次之，岩塊包含多種不同安山岩種類及少量沉積岩，呈圓狀至次圓狀，局部具層理構造或礫石具順向排列特徵。第二階段為安山岩(Z1~Z8)及上部火山碎屑岩(ZUPY)形成時期，前者由火山熔岩流作用形成，厚度數十公尺至 500 公尺不等，分布於竹子山至小觀音山稜線沿線、二坪頂至富貴角一帶及 556 高地。顯晶比例介於 3~15%不等，長石顯晶比例介於 1~10%，礦物大小約 1 公厘；鐵鎂礦物顯晶比例介於 1~5%，礦物大小約 1~3 公厘；後者以火山泥流作用為主，分布於八連溪頭、六和山莊、土地公嶺、西勢湖山等山稜地區，厚度於六和山莊約 60 公尺，岩性以礫質凝灰岩為主，岩塊包含多種不同安山岩種類，呈角狀至次圓狀，膠結度差，局部具層理構造。</p>
中文關鍵字	竹子山火山亞群、火山堆積物、火山泥流、火山熔岩流
英文關鍵字	

會議室	Room 605
日期	11月17日(星期二)
時段	09:00-09:15
議程代碼	V2-O-03
議題	- Volcanology and Geochemistry 火山學
作者	畢如蓮(Ju-lien Pi) [中正大學] (通訊作者)
中文題目	大屯火山區溫泉水—以鋇、硼同位素以及揮發性元素探討水文地質分布以及岩漿庫排氣活動
英文題目	Sr, B isotopes and volatiles of hot springs in Tatun Volcanic Group—constraint in hydrogeology and implication for magmatic degassing
投稿類型	口頭報告 Oral
摘要	<p>當位於淺部地殼的岩漿庫進行結晶分異等演化時，會同時分離出氣態物質，這些氣態物質可經由管道逸出地表形成噴氣孔、或由地下水溶解吸收成為溫泉水中的成分、或是沉澱為礦物等。所以一些稍具揮發性的元素，例如 S, Cl, B, As 等在高溫的岩漿排氣作用下易被傳送到噴氣孔或溫泉水中。由於這些元素在溫壓條件不同時各具特定之氣-液相的分布係數，在過去的研究中顯示其分布與岩漿活動的溫度有關，因而可作為觀測岩漿活動的指標。然而有效的觀測，首先必須瞭解本區的水文地質條件，釐清這些物質的來源。本研究即透過溫泉水的地化測量，包含同位素等資訊，為大屯火山區提出更清晰的水文地質條件，釐清元素的可能來源—來自沉積岩層、火山岩、或是岩漿氣體；並初步提出本區岩漿來源氣體的 B/Cl, As/Cl 比值，作為日後觀測岩漿庫排氣活動的參考。依據溫泉水的主要元素成分，本區溫泉水可分為四類，各具水文地質及形成過程上的意義；由 Cl 的豐度以及 Sr 同位素可分辨出兩類的熱水系統：1. 原生熱水系統(primary hydrothermal system, PHS)接收較直接的岩漿來源氣體，分布於沉積層或火山岩層中；2. 次生熱水系統(secondary hydrothermal system)接收來自 PHS 的氣體。Sr 同位素作為來源的示蹤，有助於分辨出如 Na, K, Rb, Li, Mn, As, Zn 等，其在部分溫泉水中含量特別高，主要是來自於沉積岩層。基於這些地化上的觀察，我們提出了一個水文地質的概念模式來解釋這些水文化學上的分布。而對揮發性元素如 B/Cl, As/Cl 的探討結果，顯示 B/Cl~0.0045 (ppm/ppm)可能代表著目前 PHS 所接收的岩漿源氣體中的 B/Cl 比值，值得後續做長期的觀測研究。</p>
中文關鍵字	岩漿排氣、溫泉水、鋇同位素、硼同位素、揮發性元素、大屯火山群
英文關鍵字	Magmatic degassing; Hydrothermal; Strontium isotopes; Boron isotopes; hot springs; Tatun Volcanic Group

會議室	Room 605
日期	11月17日(星期二)
時段	09:15-09:30
議程代碼	V2-O-04
議題	- Volcanology and Geochemistry 火山學
作者	李東翰(Dung-Han Lee) [國立臺灣師範大學地球科學系] (通訊作者) 賴昱銘(Yu-Ming Lai) [國立臺灣師範大學地球科學系] 李皓揚(Hao-Yang Lee) [中央研究院地球科學所] 飯塚義之(Yoshiyuki Iizuka) [中央研究院地球科學所]
中文題目	台灣東部海岸山脈熔積岩產狀與年代學之研究
英文題目	Occurrence and geochronology of peperites in the Coastal Range, eastern Taiwan
投稿類型	口頭報告 Oral
摘要	<p>台灣東部海岸山脈熔積岩產狀與年代學之研究 Occurrence and geochronology of peperites in the Coastal Range, eastern Taiwan 摘要 熔積岩為熱的岩漿物質與未固結的沉積物交互作用所形成的產狀，為一個良好的定年材料。前人文獻指出在海岸山脈中有多處熔積岩出露，只存在屬於陸上噴發環境的石梯坪灰岩層中，但經由重新檢視熔積岩之定義，只要火山產物能保存其熱能，在水下環境也能產生熔積岩，且大部分的國外文獻所判視的熔積岩是於含水環境形成。本研究利用沉積物流體化與岩象學等證據，在海岸山脈中發現七處熔積岩，分別為：嶺頂、砂脈橋、月洞遊憩區、膽曼海岸、泰源隧道、馬武窟溪及七里溪區域，對各區域熔積岩的組合與種類進行記錄，並針對馬武窟溪與七里溪區域熔積岩中的火山碎屑進行鋯石鈾鉛定年，藉此找尋海岸山脈南段火山頂層的噴發年代。 研究結果顯示熔積岩由白色或黑色火山碎屑與凝灰質或鈣質的沉積岩所組成，這些組合中具有凝灰質砂岩的熔積岩可以視為火山島弧已成長至水面上的指標。熔積岩的種類除了砂脈橋與泰源隧道區域為流體狀熔積岩，其餘皆為塊狀與流體狀熔積岩同時出現，流體狀熔積岩的出現表示熔積岩的生成環境為含水環境，由此可知海岸山脈熔積岩形成於任意含水環境。 馬武窟溪與七里溪的熔積岩分別屬於成廣澳火山與都蘭山火山的範圍內，位在石梯坪凝灰岩層與八里灣層的交界處，熔積岩鋯石鈾鉛定年結果為：成廣澳火山頂層噴發年代為 6.3 ± 0.4 Ma、都蘭山火山頂層噴發年代為 6.3 ± 0.3 Ma 及 6.8 ± 0.3 Ma，表示說這兩座火山島約在 6 Ma 時就已經成長超出水面了。都蘭山火山頂層噴發年代相較於前人的年代結果年輕了約 2 Ma，透過分別計算鋯石核心與邊緣年代，發現有數顆鋯石有顯著的年代變化，鋯石邊緣的年代落在 5-7 Ma，其中年代 5 Ma 的鋯石不在少數，可能表示有更年輕的噴發年代。</p>
中文關鍵字	海岸山脈、火山島弧、火山岩相、熔積岩、鋯石鈾鉛定年
英文關鍵字	Coastal Range, Volcanic arc, Volcanic lithofacies, Peperite, Zircon U-Pb dating

會議室	Room 605
日期	11月17日(星期二)
時段	08:45-09:00
議程代碼	V3-O-01
議題	- Volcanology and Geochemistry 環境地球化學
作者	黃升一(Shengyi Huang) [中央研究院] (通訊作者) 梁茂昌(Mao-Chang Liang) [中央研究院]
中文題目	以電腦模擬計算流體動力學(CFD)模擬城市污染物擴散
英文題目	Computational fluid dynamics (CFD) simulation for pollution dispersion in urban areas
投稿類型	口頭報告 Oral
摘要	<p>Depending on dispersion, anthropogenic emission can be categorized mainly in two types: point source (PS) and non-point source (NPS). PS and NPS emissions from cities are, respectively, caused by industries (e.g., thermal power plant, etc.) and traffic transportation (e.g., vehicle emissions). The large range of meteorological settings and urbanization levels between cities causes actual emission received per capita that differs widely. A computational system consisting of an urban mobility simulation model, validated fluid dynamics, and an integral exposure model, is utilized to assess outdoor air pollution (such as PM_{2.5}) exposure in an urban anthroposphere. The computational experiments were set in a simple three-dimensional model city (with simple buildings, roads and trees), subject to emissions from gasoline vehicles (NPS pollution) and coal fire power plant (PS pollution), in several scenarios under various meteorological conditions. For PS simulation, emission (from, for example, coal-fired power plant) located at distances (e.g., <5, 10, 20, 30, 50 km) away from people crowded areas is assessed. For NPS, two traffic scenarios (hump, 500 pcu, and non-hump, 250 pcu) are implemented. The utilized computational fluid dynamics matrix provides information on how meteorological conditions (e.g., temperature, wind velocity, and relative humidity) influence the inhomogeneous pollutant distribution in the street-canyon, providing a basis for assessing the affections of residents by PS/NPS pollution. Preliminary results show that people crowded (in 20 km distance from PS pollution under non-hump, 250 pcu, traffic condition) areas under meteorological conditions of 30 oC temperature, 2 m/s wind speed and 70% relative humidity PS and NPS pollutions contribute, respectively, 10~20% and 80~90% of total PM_{2.5}. The synthetic system provides a computational platform to study urban atmospheric fluid dynamics and pollution dispersion for human exposure and health assessment.</p>
中文關鍵字	點源污染(PSP), 非點源污染(NPSP), 電腦模擬計算流體動力學(CFD), 污染擴散, 人體暴露
英文關鍵字	

會議室	Room 605
日期	11 月 17 日(星期二)
時段	09:45-10:00
議程代碼	V3-O-02
議題	- Volcanology and Geochemistry 環境地球化學
作者	黃蔚人(Wei-Jen Huang) [國立中山大學海洋科學系] (通訊作者) 陳鎮東(Chen-Tung Arthur Chen) [國立中山大學海洋科學系] 李明達(Ming-Ta Lee) [行政院原子能委員會輻射偵測中心] 李明安(Ming-An Lee) [國立台灣海洋大學環境生物與漁業科學學系] 楊穎堅(Yiing Jang Yang) [國立台灣大學海洋研究所] 詹森(Sen Jan) [國立台灣大學海洋研究所]
中文題目	2018-2019 年銫-134 及銫-137 於台灣鄰近海域中之分布
英文題目	Distributions of Cs-134 and Cs-137 at the Taiwan Strait and the Kuroshio east of Taiwan during 2018 to 2019
投稿類型	口頭報告 Oral
摘要	發生於 2011 年的福島事件釋出大量的人工放射性核種至太平洋中，前人研究指出該事件能夠影響北太平洋以及日本海，我們仍不清楚長半衰期的銫-137(30.2 年)及短半衰期的銫-134(2.06 年)在台灣鄰近的西北太平洋以及黑潮海域中如何分布及變化。因此本研究於 2018 至 2019 年間在上述區域(116-123°E, 20-27°N)蒐集了 288 個水樣，由原子能委員會輻射偵測中心計測，結果顯示所有的銫-134 活度都在偵測極限以下(0.5 Bq·m ⁻³)。表層水的銫-137 的極大值介於 2.1 至 2.2 Bq·m ⁻³ ，其所在之水團密度與 Subtropical Mode Water (STMW) 一致，而 STMW 之極大值源自於福島外釋事件。以季節性而言，台灣海峽表層水的銫-137 活度則與溫度呈現季節性變化，我們推測與季節性的水團變化有關。
中文關鍵字	銫-137、銫-134、台灣海峽、人工放射性核種
英文關鍵字	Cs-137, Cs-134, Taiwan Strait, radiocesium

會議室	Room 606
日期	11月17日(星期二)
時段	08:30-08:45
議程代碼	H1-O-01
議題	- Hydrology 水文與水文地質
作者	馬嵩哲(Sung-Che Ma) [國立台灣海洋大學地球科學研究所] (通訊作者) 劉慶怡(Ching-Yi Liu) [國立台灣海洋大學地球科學研究所] 邱永嘉(Yung-Chia Chiu) [國立台灣海洋大學地球科學研究所]
中文題目	利用跨井熱示蹤劑試驗特徵化裂隙岩體之優勢水流路徑
英文題目	Using Cross-borehole Heat Tracer Test to Characterize the Preferential Flow in Fractured Rocks
投稿類型	口頭報告 Oral
摘要	<p>在公共建設中，如交通隧道工程、污染場址處理及高放射性廢棄物最終處置場設置，裂隙岩體中節理與岩層破裂面所形成之透水裂隙為主要控制地下水流路徑之因素，量化地下水流方向與速度及其與裂隙岩體水力特性之相關性將成為至關重要的角色。為判釋裂隙岩體中導水裂隙的位置與連通性，本研究選擇以熱為示蹤劑搭配水力試驗進行導水裂隙的特徵化，研究區域選定南投和社水文地質實驗場址進行現地試驗。試驗採用跨孔熱示蹤劑試驗，選定兩對四口裸井作為試驗井(W6-W4、W3-W8)，並設置一系列之溫度計陣列於井下監測溫度，以注入熱水及井內加熱等方式改變地下水溫，並經由溫度陣列所紀錄之溫度變化判釋導水裂隙的深度位置。描繪溫度破透曲線與熱峰值抵達時間，進一步量化裂隙中之地下水流速，並推估導水裂隙之水力特性。試驗過程中，透過製造不同的水力梯度與自然梯度條件下，研析流場改變對於導水裂隙流通特性之影響。此外，本研究選用數值模式 SEAWAT 建置單一裂隙之水文地質模型，透過現地溫度量測數據與二維數值模擬，計算導水裂隙中水流速度與方向、推估裂隙岩體的熱傳導係數及量化導水裂隙之水文地質參數。試驗與模擬結果顯示，觀測井 W4 在沒有抽水的情形下，井內具垂直向下的水流，W6-W4 與 W3-W8 主要透水裂隙之水力傳導係數分別約為 5×10^{-4} m/s 及 1×10^{-5} m/s。本研究之成果顯示，熱示蹤劑試驗運用於特徵化裂隙岩層中優勢水流路徑極具潛力，藉由裂隙岩體的水力特性量化與優勢地下水流路徑分析，未來可為裂隙岩體地下水流研究之相關議題提供參考依據。</p>
中文關鍵字	熱示蹤劑試驗、裂隙岩體、優勢水流、SEAWAT、南投和社
英文關鍵字	Heat tracer test, Fractured rock, Preferential flow, SEAWAT, Nantou Heshu

會議室	Room 606
日期	11月17日(星期二)
時段	08:45-09:00
議程代碼	H1-O-02
議題	- Hydrology 水文與水文地質
作者	張瑀宸(Yu-Cheng Chang) [國立臺灣海洋大學 地球科學研究所] (通訊作者) 邱永嘉(Yung-Chia Chiu) [國立臺灣海洋大學 地球科學研究所]
中文題目	以鹽水示蹤劑試驗結合數值模擬探討高山一級河川之地表水與地下水交互作用
英文題目	
投稿類型	口頭報告 Oral
摘要	<p>以鹽水示蹤劑試驗結合數值模擬探討高山一級河川之地表水與地下水交互作用 張瑀宸 1、邱永嘉 2 1 國立臺灣海洋大學地球科學研究所碩士班研究生 2 國立台灣海洋大學地球科學研究所副教授 摘要 台灣國寶魚『櫻花鉤吻鮭』棲息於七家灣溪流域，然而此流域之一級河川-有勝溪在近年來頻繁出現河川斷流的現象，造成育外流放的櫻花鉤吻鮭被圍困於斷流河段中，無法擴張其棲地，致使復育成效不彰。本研究利用鹽水示蹤劑試驗配合數值模擬探討伏流水的流動行為模式，藉以了解河道斷流之發生機制及地表水與地下水交互作用下與斷流間潛在的關聯性。本研究於七家灣溪的支流有勝溪河道上，由上游至下游共設置七口深 3.95 公尺之觀測井，進行長期地表水與地下水之水位、溫度及導電度監測。監測期間，在 2017 年 4 月至 2018 年 3 月，針對研究區內之不同河道區段，於不同基流、不同流速及有無斷流發生情形下，共進行了五次的現地鹽水示蹤劑試驗，透過破透曲線的描繪，以判釋不同環境狀態下地下水出滲與入滲之位置，並分析水平與垂向伏流水流動狀態。此外，依據鹽水示蹤劑試驗結果，本研究選用一維河道溶質傳輸模式 OTIS 及耦合地下水流與溶質傳輸模式 MODFLOW 與 MT3D-USGS，分別針對地表水與地下水溶質傳輸行為進行模擬，藉以估算伏流水路徑、滯留時間、河川入滲量及地下水出滲量。研究結果顯示，在高山一級河川的高孔隙礫石河床中，地表水及地下水之間交互作用極為頻繁，然而在基流量上升的狀態下與支流匯入主河道之位置，交換的頻率會呈現減少的趨勢。除此之外，河川的地形地貌亦會影響伏流水水流路徑與停滯時間長短。當上游河水經過河階地形時，會避開階梯處，於側邊河岸入滲至河床中，並於下游處再出滲回到河川中。河床中強烈的入滲現象與強烈的垂直向下水流，使得河水可入滲至深部的地下含水層。藉由本研究之研究成果，進一步釐清高山一級河川發生斷流現象以及伏流水流動特性的理論基礎，以提供日後河道復育的參考資訊。 關鍵詞：伏流水、斷流、鹽水示蹤劑、數值模擬、七家灣溪</p>
中文關鍵字	伏流水、斷流、鹽水示蹤劑、數值模擬、七家灣溪
英文關鍵字	

會議室	Room 606
日期	11 月 17 日(星期二)
時段	09:00-09:15
議程代碼	H1-O-03
議題	- Hydrology 水文與水文地質
作者	劉慶怡(Ching-Yi Liu) [國立臺灣海洋大學地球科學所] (通訊作者) 黃柏勳(Po-Syun Huang) [國立臺灣海洋大學地球科學所] 邱永嘉(Yung-Chia Chiu) [國立臺灣海洋大學地球科學所] 林立虹(Li-Hung Lin) [國立台灣大學地質科學系暨研究所] 柯建仲(Chien-Chung Ke) [財團法人中興工程顧問社] 王珮玲(Pei-Ling Wang) [國立臺灣大學海洋研究所]
中文題目	應用分散式光纖溫度感測器於大崙水文地質試驗井場量測地層溫度分布之先期試驗成果
英文題目	Preliminary Test Results of Borehole Temperature Distribution at Dalun Hydrogeological Experimental Site Using Fiber Optic Distributed Temperature Sensor
投稿類型	口頭報告 Oral
摘要	山區地下水資源之蘊含、分布、流通，為近年 10 年來台灣水資源發展之重要議題。台灣位於板塊交界處，造山活動持續進行，山區的岩層多經板塊擠壓而破裂，地下水可存在於這些破裂或透過這些破裂所形成的水流路徑而流動，因此需仰賴水文地質調查技術以獲得相關資訊。隨著對調查解析度的需求，可提升解析力的新式感測器為近年來各方發展之趨勢。本研究使用新發展之分散式光纖溫度感測器 (fiber optic distributed temperature sensor, FO-DTS) 量測技術，以熱能為示蹤劑，在選定之水文地質試驗井場進行裂隙岩體地下水現地試驗，期能有效進行連通裂隙之偵測。試驗之井場位於台東縣海端鄉，大崙溪流入新武呂溪前之左岸，此處之地表高程約為 400 公尺，井場設置了四口試驗井，深度範圍介於 45 公尺至 150 公尺不等，其中二口為裸孔而另外二口設置了特定區段開篩之套管。依據鑽井過程所取得之岩芯判斷，各井之地表下崩積層深度範圍約由 6 公尺至 10 公尺不等，岩盤部分之岩性則以片岩為主，膠結度佳、具高角度片理，部分深度有明顯的裂隙構造存在，推測是地下水流動的主要通道。試驗井完工後，進行了地球物理井測、井孔流速量測等試驗。本研究使用之 FO-DTS，在試驗設計上分為埋在套管外隨套管理設於井內，以及放置於地下水中之布設方式，在布設光纖的井內可對各井同時進行溫度變化的觀測。初步資料分析結果顯示，各井在垂直方向具有明顯的地溫梯度變化趨勢，而各別試驗井之熱能示蹤劑試驗結果則顯示，經由升溫幅度的變化，可以區分出透水區段之所在範圍。後續試驗若是配合跨孔抽水試驗，透過 FO-DTS 在空間及時間上對溫度量測解析度的優勢，可進一步探查各井之間的水力連通性。
中文關鍵字	分散式光纖溫度感測器、溫度、裂隙岩體、地下水
英文關鍵字	FO-DTS, temperature, fractured rock, groundwater

會議室	Room 606
日期	11月17日(星期二)
時段	09:15-09:30
議程代碼	H1-O-04
議題	- Hydrology 水文與水文地質
作者	許少瑜(Shao-Yiu Hsu) [國立台灣大學] (通訊作者) 羅瑞祥(Jui-Hsiang Lo) [國立台灣大學] 黃群展(Qun-Zhan Huang) [國立台灣大學] 蔡義誌(Yi-Zhih Tsai) [國立台灣大學]
中文題目	應用水壓與邊界條件資料觀測阻塞層發展
英文題目	Detecting Time and Location of Clogging Development in a Meso-scale Lysimeter with Tensiometers
投稿類型	口頭報告 Oral
摘要	Based on Darcy's law layered soil, we developed a simple one-dimension equation to describe the location and evolution of the clogging layer with soil water pressure head and the effective hydraulic conductivity. Furthermore, we examined the influence of the clogging layer on the surface water-groundwater interaction and the groundwater flow patterns. The appearance of the clogging layer significantly reduces infiltration and induces the unsaturated zone. We analyzed a series of measured soil water pressure head from a tensiometer in a meso-scale lysimeter. The measurement revealed the development of the clogging at the bottom of the lysimeter. Moreover, through the numerical simulation, the upper clogging, which may be caused by the entrapped air or the low permeability soil layer, decreased the effective hydraulic conductivity and induced an unsaturated zone. With the development of upper clogging, the state of the surface water-groundwater (SW-GW) interaction transfers from connection to disconnection.
中文關鍵字	張力計、地表地下水互動、入滲儀
英文關鍵字	Darcy's law, layered soil,

會議室	Room 606
日期	11月17日(星期二)
時段	09:30-09:45
議程代碼	H2-O-01
議題	- Hydrology 地下水與傳輸
作者	廖中翊(Zhong-Yi Liao) [國立中央大學] (通訊作者) 陳瑞昇(Jui-Sheng Chen) [國立中央大學]
中文題目	二維具複雜反應途徑的多物種污染團遷移解析解模式
英文題目	Analytical solutions for simulating two-dimensional multispecies plume migration with complex reaction networks
投稿類型	口頭報告 Oral
摘要	<p>This study presents exact analytical solutions for two-dimensional multispecies reactive transport with complex dechlorination reaction network. Among the chlorinated solvents, such as tetrachloroethylene (PCE) and trichloroethylene (TCE), are the common organic compounds in the subsurface. During the process of degradation, TCE reacts to produce three different isomers of dichloroethylene (DCE) simultaneously, and three DCEs react to produce vinyl chloride (VC). Analytical solutions to a set of simultaneous multispecies advective-dispersive transport equations have been widely used to describe the movements of decaying or degradable contaminants in the subsurface. Most previous studies were often simplified as a sequential first-order reaction chain and failed to consider the divergent or convergent reactions. This study of analytical solutions are derived for simulating degradable contaminants with complex reaction networks subject to different inlet boundary conditions. A method of consecutive applications of integral transformation techniques in combination with sequential substitutions is adopted to derive the analytical solutions to the governing equation system. The developed analytical model is robustly verified with different complex reaction cases. The results of verification between this study and the previous research or numerical solutions indicate the derived analytical solutions are accurate and robust. Then, this study will be used to simulate a chlorinated solvent transport problem and to investigate the simulation by using this model and the past model which consider for a straight decay chain. Hope the developed model can become a more realistic and efficient tool that to simulate the degradable contaminants on contaminated sites.</p>
中文關鍵字	解析解，多物種，污染團遷移，複雜反應途徑
英文關鍵字	analytical solutions, multispecies, plume migration, complex reaction network

會議室	Room 606
日期	11月17日(星期二)
時段	09:45-10:00
議程代碼	H2-O-02
議題	- Hydrology 地下水與傳輸
作者	樂宣(Maria Nollita Dizon) [國立台灣海洋大學 地球科學所] (通訊作者) 邱永嘉(Yung-Chia Chiu) []
中文題目	
英文題目	Combination of Surrogate Model and Data Assimilation for Seawater Intrusions Simulations – Case Study of Cavite, Philippines
投稿類型	口頭報告 Oral
摘要	<p>Seawater Intrusion (SWI) is a major environmental problem commonly found in the coastal aquifers around the world. It is mostly caused by the decreasing groundwater levels of excessive groundwater extraction. The utilization of numerical simulation models has been widely used in the line of studying SWI; however, complex numerical simulation models in the simulation-optimization approach could increase the computational time significantly. The goal of this study is to reduce the computational time through replacing the numerical simulation models with a surrogate model. At the same time, an application of data assimilation technique is implemented to autonomously update and gradually improve the numerical model that are typically affected by uncertainties on hydrological parameters, as well as the boundary conditions. The Artificial Neural Network (ANN) was used as a surrogate model while the Ensemble Kalman Filter (EnKF) was used for the data assimilation in this study. The province of Cavite, Philippines was selected to demonstrate the proposed methodology. First, a numerical model of SEAWAT, was selected to solve the coupled groundwater flow and solute-transport equations with variable-density water. Second, the SEAWAT model will be replaced by a surrogate model ANN through the training, validation, and testing processes using the inputs and outputs obtained from SEAWAT. Finally, the EnKF was used for the on-line data assimilation technique to update the model in real time once the new data become available. The results show that ANN model could significantly reduce the computational time by replacing the numerical model of SEAWAT; an indication of effectiveness of ANN as a surrogate model. On the other hand, the results of EnKF on data assimilation shows a good performance in improving the sources of uncertainties and avoid the computational burden needed for updating numerical and surrogate models.</p>
中文關鍵字	
英文關鍵字	seawater intrusion, numerical model, artificial neural network, Ensemble Kalman Filter, Philippines

會議室	Room 607
日期	11月17日(星期二)
時段	08:30-08:45
議程代碼	ER2-O-07
議題	- Energy and Resource 溫泉與地熱能源
作者	周士婷(Shih-Ting Chou) [中國文化大學地質學系暨研究所] (通訊作者) 郭欽慧(Ching-Huei Kuo) [中國文化大學地質學系] 劉佳玫(Chia-Mei Liu) [中國文化大學地質學系] 林君怡(Jun-Yi Lin) [中國文化大學地質學系暨研究所]
中文題目	以地球化學模擬探討清水地熱區水-岩反應之研究
英文題目	Application geochemical simulation on the water-rock interaction in Chingshui Geothermal Field area
投稿類型	口頭報告 Oral
摘要	本研究於2018年8月至2020年7月採集清水地熱區河水、天然溫泉及井下溫泉共6個標本，以感應耦合電漿原子發射光譜儀、離子層析儀及自動滴定儀分析水中離子成份，再以 PHREEQC 地球化學模擬軟體探討水-岩反應。本研究初步成果顯示，當清水地熱河水或是雨水在溫度(0-250)、pH值(4-9)及 pe 值(-9-14)的條件下，水-岩反應過程中石英、方解石、菱錒礦、伊萊石、綠泥石及高嶺石之飽和指數變化情形。其中綠泥石飽和指數變化，主要受控於溫度及 pH 值，當溫度或 pH 值越高，向飽和沉澱之趨勢移動。伊萊石及高嶺石飽和指數變化，主要受控於溫度，當溫度越高，向不飽和之趨勢移動。石英、方解石及菱錒礦之飽和指數變化，幾乎不受溫度、pH 值、pe 值之影響。
中文關鍵字	清水地熱區、地球化學模擬、水-岩反應
英文關鍵字	Chingshui Geothermal Field area, geochemical simulation, water-rock interaction

會議室	Room 607
日期	11月17日(星期二)
時段	08:45-09:00
議程代碼	ER2-O-08
議題	- Energy and Resource 溫泉與地熱能源
作者	陳彥瑾(Yen-Chin Chen) [中國文化大學] (通訊作者)
中文題目	以岩象學及地球化學探討中性溫泉區火山熔岩的礦物相特徵之研究
英文題目	Application petrography and geochemistry on the characteristics of mineral assemblages of lava in the neutral hot spring
投稿類型	口頭報告 Oral
摘要	本研究利用岩象學及地球化學方法分析中性溫泉區火山熔岩的礦物相特徵，以了解在蝕變作用的影響下火山熔岩中礦物相的轉變。本研究初步成果顯示，於5公尺深的火山熔岩岩芯標本中，2公尺處岩芯顏色以灰色為主，斜長石呈現聚片雙晶為主，鐵鎂礦物以普通輝石數量最多，次之為紫蘇輝石和普通角閃石，而普通角閃石周圍有黑色的邊緣；3公尺處岩芯顏色以紅色為主，斜長石呈現聚片雙晶而主，而鐵鎂礦物以普通角閃石數量最多，次之為普通輝石，紫蘇輝石數量最少，普通角閃石礦物呈現全黑，而普通輝石周圍出現黑色邊緣；4公尺處岩芯顏色為灰色且帶有黃色斑點和紅色兩種，斜長石以聚片雙晶為主，且外形較為破碎，紅色岩芯鐵鎂礦物以普通角閃石數量最多，而灰色岩芯則以普通輝石數量最多；5公尺處岩芯顏色以灰色為主，斜長石具有聚片雙晶和環狀消光比例各半，鐵鎂礦物以普通輝石數量最多，次之為紫蘇輝石，普通角閃石數量較少，普通角閃石周圍呈現黑色邊緣。最後，將整合岩象學及地球化學說明中性溫泉區火山熔岩在蝕變作用下的礦物相轉變過程。
中文關鍵字	岩象學、地球化學、火山熔岩、中性溫泉、蝕變作用
英文關鍵字	petrography, geochemistry, lava, neutral hot spring, alteration

會議室	Room 607
日期	11月17日(星期二)
時段	09:00-09:15
議程代碼	ER2-O-09
議題	- Energy and Resource 溫泉與地熱能源
作者	陳亭佑(Ting-Yu Chen) [中國文化大學] (通訊作者)
中文題目	宜蘭地區黏土礦物特徵之研究
英文題目	The characteristics of clay minerals in Ilan area
投稿類型	口頭報告 Oral
摘要	<p>本研究以持續加溫序列方法及慢速 X 光繞射掃瞄分析宜蘭地區黏土礦物特徵，以了解硬頁岩區及板岩區在風化作用及蝕變作用下的黏土礦物轉變。本研究初步成果顯示，清水溪硬頁岩區域中，黏土礦物組合以伊萊石、高嶺石與綠泥石為主，但高嶺石與綠泥石含量較板岩區域低，含量不超過 25%，且無膨脹性礦物與混層礦物出現，伊萊石結晶度值為 $0.409-0.75 \Delta^{\circ}2\theta$。伊萊石結晶度值多分布於 $0.505-0.608 \Delta^{\circ}2\theta$ 之間。清水溪板岩區域中，黏土礦物組合以伊萊石、高嶺石與綠泥石為主，且混層礦物與膨潤石較多於伊萊石、高嶺石與綠泥石之組合中出現，板岩的伊萊石結晶度值則為 $0.324-0.491 \Delta^{\circ}2\theta$，變質砂岩的伊萊石結晶度值則為 $0.307-0.536 \Delta^{\circ}2\theta$。整體而言，清水溪板岩區由北至南，板岩與變質砂岩之結晶度值皆有愈往南其結晶度值愈低趨勢。且硬頁岩區標本之伊萊石結晶度值明顯較板岩區高。最後，將整合慢速 X 光繞射掃瞄分析結果了解硬頁岩及板岩區在風化作用及蝕變作用下的黏土礦物轉變。</p>
中文關鍵字	黏土礦物、X 光繞射、風化作用、蝕變作用
英文關鍵字	clay mineral, X-ray diffraction, weathering, alteration

會議室	Room 607
日期	11月17日(星期二)
時段	09:15-09:30
議程代碼	ER1-O-01
議題	- Energy and Resource 天然資源與能源研究
作者	陳彥宇(chen yen yu) [學生] (通訊作者)
中文題目	利用傅立葉紅外光衰減全反射光譜分析各種有機物官能基團差異建立快速分析方式
英文題目	Use Fourier Infrared Attenuated Total Reflectance Spectroscopy to analyze various organic functional groups to establish an efficient analysis method
投稿類型	口頭報告 Oral
摘要	<p>石油為當代最重要的能源之一，人類的生活所需都與石油及其衍生品息息相關。在極高的油田開採成本之下，為了減低開採時的乾井率及失敗風險，需要進行石油探勘，透過分析油母質的性質，分辨其傾向產油或產氣，藉此評估開採成本及效益。而油母質有機物沉積來源有許多，其中 Type III 油母質沉積物來源之一的樹脂，也可形成琥珀，是一種有機寶石，其產地是影響品質與價格的重要因素。本研究旨在提升分析油母質、琥珀、原油等有機物的效率及準確度，以上述有機物為樣品，進行傅立葉紅外光衰減全反射光譜(FTIR-ATR)分析，利用紅外線激發分子使其振動，探討不同有機物因化學組成結構差異，在吸收光譜時所產生的不同吸收率，進而達到鑑別、分辨及分析產地之目的。研究結果顯示，傅立葉紅外光衰減全反射光譜(FTIR-ATR)可利用於各種高度經濟價值之有機物鑑定及來源判斷，亦可節省時間成本。為提升可信度，本研究使用不同類型的原油、油母質、琥珀樣品，皆來自不同地區，而在 FTIR-ATR 分析中，不同產地的樣品在結果顯示上也有所差異。研究結果顯示，原油樣品在紅外光譜分析中，吸收波數特徵在甲基(CH₃)，亞甲基(CH₂)，芳香烴(C=C)碳碳雙鍵，硫氧鍵(S-O)有較強的吸收反應，而透過硫氧鍵(S-O)的吸收率，可知其含硫與否，避免在原油煉製過程中，因有較高的含硫量導致處理成本上升。而琥珀及油母質樣品則是主要反應在甲基(CH₃)，亞甲基(CH₂)、碳氧雙鍵(C=O)。觀察油母質的紅外光譜吸收反應可知，在油母質不同的化學鍵結上，會依來源有機物的不同而有不同的吸收反應，例如在碳氧雙鍵(C=O)的吸收反應中，Type I 油母質吸收率最高、Type II 次之、Type III 較低；而碳氫鍵(C-H)的吸收比率則是 Type III 大於 Type II，大於 Type I，依上述特性可分辨出油母質的類型差異，藉此判斷其產油潛能及預估經濟價值。在琥珀中也有相似的現象，其碳氧雙鍵(C=O)與碳氫鍵(C-H)的吸收強度因不同產地而有所差距，例如地處東南亞之琥珀，其碳氧雙鍵(C=O)的紅外吸收現象較為強烈，拉脫維亞之碳氫鍵(C-H)吸收比例較為強烈，馬達加斯加樣本則是碳氧雙鍵(C=O)與碳氫鍵(C-H)吸收皆不強烈，可用這些特性判斷其產地。由於油母質為組成複雜之有機物聚合物，光譜特徵歧異度較大，琥珀同樣在各種產地的光譜上，皆有不同特徵，其多樣性不利於肉眼判斷，因此本研究將碳氫鍵(C-H)、碳碳雙鍵(C=C)與碳氧雙鍵(C=O)的吸收峰加以積分，製成比值 Factor(H)、Factor(O)以及 Factor(C)輔助判斷，達成更精確的研究依據。本研究利用比值 Factor(H)、Factor(O)以及 Factor(C)建立數據資料庫，將目前所使用的樣本：原油、油母質、琥珀列入其中，相同性質的有機物在數值呈現上十分相近，因此當未知有機物樣本進入分析時，可透過數據資料庫對照，快速判斷其類型及特性。衰減全反射式紅外光譜為一種快速的分析方式，僅需少量樣品卻能有高解析度的分析結果，且研究結果具高度再現性。透過觀察其原始光譜和計算不同化學鍵結的吸收比值，快速辨別油母質之沉積相以及琥珀之產地，以期達到對於未知樣本進行快速鑑定之效果，建立更高效率、高準確度的分析。雖然目前的樣本範圍以有機物為主，本研究期待未來可將此研究方法及其比值方法應用於其他樣本，如塑膠種類、植物樹種、矽膠晶圓良率分析等，除了更多方面的驗證本實驗方式之正確性外，亦可將此快速、節省成本的分析方式應用於更多面向。關鍵字：油母質、琥珀、原油、傅立葉紅外光衰減全反射光譜、化學官能基</p>
中文關鍵字	油母質、琥珀、原油、傅立葉紅外光衰減全反射光譜、化學官能基
英文關鍵字	Kerogen, Amber, Oil, FTIR-ATR, Functional groups

會議室	Room 607
日期	11 月 17 日(星期二)
時段	09:30-09:45
議程代碼	ER3-O-01
議題	- Energy and Resource 地球科學在深層地質處置上的應用
作者	蔡維倫(Wei-Lun Tsai) [國立臺灣師範大學地球科學系暨研究所地質組] (通訊作者)
中文題目	非彈性應變回復法之誤差分析
英文題目	Error analysis and improvement of anelastic strain recovery method
投稿類型	口頭報告 Oral
摘要	<p>岩石現地應力為地熱井開發、大地工程、石油鑽探、隧道開挖設計或國家基礎建設的重要相關資訊之一。現地應力的量測與評估皆為工程開挖和設計不可或缺的工作，對於開挖穩定性分析具有相當重要性。現地應力測量有多種不同方法，從早期國外引進的套鑽法和水力破裂，到近年使用較新的音射法和非彈性應變回復法等，其中以非彈性應變回復法(Anelastic Strain Recovery, ASR)是目前的耗費成本較低、效率高的三維現地應力測量方法。非彈性應變回復法是利用地下深處岩石回到地表後，由應力解壓後所產生的回復應變，推算三維現地應力方向和規模的分析方法。為了提高非彈性應變回復法之精度，首先需要分析此方法之誤差，以瞭解誤差來源，進而移除誤差且提高精度。因此，本研究將以往 9 個方向 18 個應變計調整為 24 個應變計的量測方式，使用 6 個方向之應變計為一組計算其應變張量與主應變數據，並以抽樣方式計算各組應變結果，加以統計分析，以評估誤差與可能來源。位於臺東南橫大崙溪，深度 140 米之片岩樣本的 ASR 初步結果顯示，樣本結果不屬於典型的安德森斷層應力場形式。最大、次大和最小主應變之位態分別為 141.14°/45.79°、036.22°/14.05°和 293.74°/40.81°，水平最大應力的擠壓方向為西北-東南向，葉理走向和傾角分別為 296.18°和 65.31°W，葉理面的法向量沒有與三軸主應變重合，且兩點於赤平投影網上相距較遠，推測本實驗結果可能較無受到葉理面岩石力學參數異相性的問題，解算主應力由大到小分別為 3.66、2.22 和 2.06 MPa。未來工作將會進行抽樣與統計分析，將這些新資料運用新的改良方式進行演算，得到較高可信度的應力場大小。冀望未來此新技術可以廣泛運用於各項工程開發與地質科學學術研究。</p>
中文關鍵字	非彈性應變回復法、現地應力場
英文關鍵字	Anelastic strain recovery method, in-situ stress field

會議室	Room 607
日期	11 月 17 日(星期二)
時段	09:45-10:00
議程代碼	ER3-O-02
議題	- Energy and Resource 地球科學在深層地質處置上的應用
作者	莊松稜(Sung-Leng Chuang) [中興工程顧問股份有限公司] (通訊作者) 李佳慧(Chia-Hui Lee) [中興工程顧問股份有限公司] 李宇陞(Yu-Sheng Lee) [中興工程顧問股份有限公司] 柯文韜(Wun-Tao Ke) [中興工程顧問股份有限公司] 林英傑(Ying-Chieh Lin) [中興工程顧問股份有限公司] 林伯聰(Po-Tsung, Lin) [中興工程顧問股份有限公司]
中文題目	以近地表地質特徵建立區域裂隙特徵模型
英文題目	Constructing characterization models of regional fracture on the basis of near-surface geological features
投稿類型	口頭報告 Oral
摘要	<p>台灣過往對於隧道進行許多裂隙特徵研究，較少對於大區域(數平方公里至數十平方公里範圍)與深層地質(深度超過 100 公尺)進行區域裂隙特徵研究，在這個尺度範圍內，並不容易去描述裂隙特性，特別在台灣構造活動頻繁區域，裂隙特性更顯複雜且不易建立一套完整的離散裂隙網路模型(Discrete Fracture Network, DFN)。本研究結合文獻、地表露頭與地質鑽探資料之分析，將目標區域進行裂隙特徵分區。以台東縣達仁鄉以及金門縣烏坵鄉為例，達仁鄉區域以深海環境的泥岩為主，經歷 4 期構造活動與造山運動所產生的輕度變質作用後，在地表形成以潮州層硬頁岩所組成的各式褶皺作用，如今在研究區域的尺度上僅可見第 3 期構造活動產生西北-東南走向的構造線，與最後一期南北走向的構造線，根據這些構造線，將此區域的裂隙特徵分為 4 個均勻區(DOMAIN)(D1~D4)，D1 為草埔背斜的一翼，D2 為南北走向的連續褶皺，D3 為偃臥褶皺(Recumbent Fold)及其他，D4 為背斜的一翼，4 個均勻區的地表露頭資料均可反應出不同的優勢位態存在，另外透過地質鑽探資料研究裂隙密度(P10)與深度之關係，可發現 P10 隨深度增加而遞減的趨勢，據此趨勢的斜率變化可將深度分為 3 層；在烏坵鄉區域，基盤是燕山期的火成岩侵入岩體，大地應力歷經過 4 期活動，配合地質鑽探資料顯示，研究區域內不同地點的裂隙特徵相當相近，故於水平方向歸納為同一個均勻區，僅在深度上依據裂隙密度(P10)隨深度增加而遞減之趨勢分為 2 層。透過上述分析可以得知，近地表地質特徵所建立的構造線，可作為區域裂隙特徵分類的基礎，深度則依靠 P10 所建立的趨勢線來分層，所分出各均勻區的裂隙特徵，將可在未來回饋給離散裂隙網路模型使用。</p>
中文關鍵字	區域裂隙、深層地質、裂隙密度
英文關鍵字	

會議室	Room 608
日期	11月17日(星期二)
時段	08:30-08:45
議程代碼	G1-O-01
議題	- Geodesy 測地學與活動地殼變形
作者	吳善薇(Sin-Mei Ng) [中國文化大學理學院地質學系] (通訊作者)
中文題目	
英文題目	Applications of Radar Interferometry in 2018 Hualien Earthquake and 2020 Taal Volcano Eruption using Sentinel-1 Data and GMTSAR Algorithm
投稿類型	口頭報告 Oral
摘要	<p>In this presentation, the satellite geodetic technique, synthetic aperture radar interferometry or interferometric synthetic aperture radar, InSAR, is performed using Sentinel-1 data and GMTSAR algorithm for processing in order to temporally and spatially understand the surface deformation caused by 2018 Hualien Earthquake in eastern Taiwan and 2020 Taal Volcano Eruption in the Philippines. Synthetic aperture radar (SAR) interferometry was first introduced for topographic mapping in 1974. Essentially it combined two technologies: synthetic aperture and interferometry techniques. When the first interferogram (post-processing interferometric fringes) showing the Landers earthquake was published, a quarter-century had elapsed. SAR interferometry and its subsequent developments in the past two decades have successfully proved their capabilities in monitoring crustal deformation and various geophysical applications. This satellite geodetic technique calculates the interference pattern generated by the difference in phase between two images acquired by spaceborne synthetic aperture radar mounted on satellite at distinct times. The resulting interferogram is a contour map of the change in slant range distance. A new family of satellites, known as Sentinels, specifically for the operational needs of the Copernicus programme is developed by the European Space Agency (ESA). In this study, particularly, Sentinel-1's SLC Level 1 data are used. Besides, an InSAR processing system based on the Generic Mapping Tools (GMT), or GMTSAR, for short, is used for Sentinel-1 data processing. It is an open source (GNU General Public License) InSAR processing system for users familiar with GMT. It was installed upon Ubuntu 16.04 LTS, another open source software operating system.</p>
中文關鍵字	
英文關鍵字	Sentinel-1, GMTSAR, InSAR, Hualien earthquake, Taal Volcano Eruption

會議室	Room 608
日期	11月17日(星期二)
時段	08:45-09:00
議程代碼	G1-O-02
議題	- Geodesy 測地學與活動地殼變形
作者	洪雋凱(Hung Chun-Kai) [國立交通大學] (通訊作者) 林玉儂(Lin, Yunung Nina) [中央研究院地球科學所] 史天元(Peter T.Y. Shih) [國立交通大學] 童忻(Hsin Tung) [中央研究院地球科學所]
中文題目	大台北地區地表形變模型建置探討
英文題目	On the Deformation Model of Greater Taipei Area with InSAR
投稿類型	口頭報告 Oral
摘要	本研究透過多時序差分合成孔徑雷達分析技術(Multi-Temporal InSAR, MT-InSAR)中的短基線集方法(Small Baseline Subset, SBAS)建立2016年至2019年的Sentinel-1合成孔徑雷達之升軌與降軌視方向位移時間序列。本研究同時利用ERA5大氣模型進行對流層改正，採用訊號雜訊比(Signal-to-noise ratio, SNR)來判斷大氣改正的品質，比較大氣改正前後以及經過品質篩選後的大氣改正資料對時間序列以及速度場分析的影響，並結合GPS與合成孔徑雷達時間序列來建立大台北地區的地表形變模型，以探討大台北地區盆地中心沉降速度的演變。關鍵詞：短基線集干涉、對流層校正
中文關鍵字	短基線集干涉、對流層校正
英文關鍵字	SBAS interferometry, Tropospheric correction

會議室	Room 608
日期	11月17日(星期二)
時段	09:00-09:15
議程代碼	G1-O-03
議題	- Geodesy 測地學與活動地殼變形
作者	庫馬(Utpal Kumar) [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan] (通訊作者) 賽德利克(Cédric. P. Legendre) [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan] 李建成(Jian-Cheng Lee) [Research Fellow, Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan] 趙丰(Benjamin Fong Chao) [Distinguished Research Fellow, Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan]
中文題目	
英文題目	Crustal Motion of Active Plate Convergence in Eastern Taiwan: Agglomerative Clustering based on Dynamic Time Warping
投稿類型	口頭報告 Oral
摘要	Rapid anomalous elevation changes have been detected in the Longitudinal Valley along the Eastern coast of Taiwan using tide-gauge/altimetry and GPS observations. We applied the agglomerative clustering method based on the Dynamic Time Warping (DTW) to investigate the tectonic motions in that region for potential incoherency in the GPS spatiotemporal waveform patterns. The conventional clustering approach uses the Euclidean distance metric, which inherently ignores the full-waveform information and may not be a true representation of the long-term crustal motion. The DTW based clustering algorithm uses the waveform similarity metric applied on the 27 3-D continuous GPS network data for 13 years (2005-2018) in the area. The data fall into three quantitatively determined optimum clusters with most distinct waveform patterns. Those clusters align geographically to the locations on the Chengkung Fault, inside, and outside Longitudinal Valley, respectively. Further dimensionality reduction analysis found that the stations inside the Longitudinal Valley are moving north-west downwards relative to the tectonically stable station of Penghu in the Taiwan Strait.
中文關鍵字	
英文關鍵字	GPS data, Dynamic Time Warping, Agglomerative Clustering

會議室	Room 608
日期	11月17日(星期二)
時段	09:15-09:30
議程代碼	G1-O-04
議題	- Geodesy 測地學與活動地殼變形
作者	王崇佑(Chongyou Wang) [交通大學土木工程學系] (通訊作者) 黃金維(Cheinway Hwang) [交通大學土木工程學系] 林玉儂(Yu-Nung Lin) [中央研究院地球科學研究所]
中文題目	以永久散射體雷達干涉法監測哈德遜灣附近冰後回彈
英文題目	Detecting post-glacial rebound around the Hudson Bay using Persistent Scatterer SAR Interferometry
投稿類型	口頭報告 Oral
摘要	To provide additional geodetic constraints for glacial isostatic adjustment (GIA) models, we adopt the Persistent Scatterer Interferometric Synthetic Aperture Radar approach (PSInSAR, Hooper et al., 2007) to detect surface deformation around the Hudson Bay by using Sentinel-1B SAR images from June 2017 to October 2019. To mitigate the strong tropospheric noises and resolve the underlying long-wavelength signals, we apply a spatially varying scaling strategy (Shen et al., 2019) to improve the tropospheric correction values obtained from ERA5. We stack the PSInSAR velocity map into profiles to further improve the signal-to-noise ratio. The stacked PSInSAR-derived velocities in the LOS direction and vertical direction match those from GPS to 2.57 mm/year and 5.05 mm/year (RMS differences), respectively. The RMS differences between the stacked PSInSAR-derived and the ICE-6G_D-derived velocities are 3.36 mm/year in the LOS direction and 6.14 mm/year in the vertical direction. The accuracy and consistency among the velocities from PSInSAR, GPS and ICE-6G_D GIA model suggest that for regions with sparse ground-based observations, the proposed processing flow may augment future GIA modeling with SAR-based geodetic constraints.
中文關鍵字	冰後回彈、永久散射體雷達干涉法、空間長波長變形量、估計空間變化尺度因子、Stacking
英文關鍵字	post-glacial rebound, PSInSAR, long wavelength deformation, spatially varying scaling method, stacking

會議室	Room 608
日期	11月17日(星期二)
時段	09:30-09:45
議程代碼	G1-O-05
議題	- Geodesy 測地學與活動地殼變形
作者	陳冠翔(Sean Kuanhsiang Chen) [台灣大學地質科學系] (通訊作者) 吳逸民(Yih-Min Wu) [台灣大學地質科學系] 詹瑜璋(Yu-Chang Chan) [中研院地球所]
中文題目	琉球隱沒帶在慢滑移與近期主震發生之後的大地震機率
英文題目	Probability of megathrust earthquake following slow slip and earthquakes: Southernmost Ryukyu subduction zone
投稿類型	口頭報告 Oral
摘要	<p>Slow slip events (SSEs) are one of the slow earthquakes with slowest rupture velocities and longest durations from days to months or years, which relieve tectonic stresses in subduction zones and are widely observed geodetically. Recent studies have observed that the timing of SSEs propagation is prior to the rupture of nearby large earthquake in several subduction zones. This mechanism is regarded as a triggering by transient static stress loading. However, most of approaches of probabilistic seismic hazard analysis for subduction earthquakes did not consider such effect caused by SSEs. We apply a simple SSE-based earthquake probability model in the Southernmost Ryukyu subduction zone, where a shallowest locked zone, Ryukyu Fault, could rupture as a size over Mw 8.0 and is surrounded by episodic SSEs. To know the time-dependent probability of Ryukyu Fault rupture caused by the SSEs and the other local mainshocks, we established a synthetic time-dependent shear stress catalog for the study area considering the earthquake stress drop, earthquake recurrence intervals, and background stressing rate, and then estimated those transient static stress loads on the Ryukyu Fault. Our results show that the annual probabilities of Mw 8.0 earthquake are less than 3% on the Ryukyu Fault. The probabilities do not strongly depend on the variations of earthquake stress drop and slip-deficit rate when the assumed earthquake size increases. Nevertheless, we notice that the rupture probabilities increase by at least 1.3 times relative to the background annual probabilities when the SSEs or mainshocks occurred. The scenarios illuminate a potential interaction between SSEs and large earthquakes in Southernmost Ryukyu subduction zone and imply the importance of SSEs monitoring in where the earthquake rupture zone is adjacent.</p>
中文關鍵字	慢滑移; 地震機率; 應力降; 地震週期; 琉球斷層
英文關鍵字	slow slip; earthquake probability; stress drop; earthquake recurrence interval; Ryukyu Fault

會議室	Room 608
日期	11月17日(星期二)
時段	09:45-10:00
議程代碼	G1-O-06
議題	- Geodesy 測地學與活動地殼變形
作者	陳國華(Kwo-Hwa Chen) [國立臺北大學 不動產與城鄉環境學系] (通訊作者) 莊昶叡(Ray Y. Chuang) [國立臺灣大學 地理環境資源學系] 楊名(Ming Yang) [國立成功大學 測量及空間資訊學系]
中文題目	考量地表板塊變形效應於臺灣半動態參考框架之建立
英文題目	Establishment of Taiwan semi-kinematic reference frame by considering surface deformation effect
投稿類型	口頭報告 Oral
摘要	<p>地震活動週期包含各種形式的板塊變形效應，其產生的各類型地表位移，對於國家或區域的坐標參考框架精度均造成顯著影響，特別是位處具高度擠壓及高度變形板塊的臺灣地區，地震活動效應之影響更是明顯。臺灣目前使用的國家坐標參考框架仍為靜態的形式，尚未考量地震活動造成的影響，在傳統上，僅能於每使用一段時間之後，採取區域性的坐標轉換方式以修正地表的變形量，然而，其修正的成效仍有許多待改善的空間。地震活動週期的板塊變形主要有震間變形、同震變形以及震後變形等，本研究以2018年2月6日的花蓮地震為例，使用研究區域內2010~2019年共28個GNSS連續站的監測資料，分別探討此3種形式的板塊變形效應，分析各自對於區域性坐標參考框架精度的影響。由結果得知，相較於採用傳統坐標轉換或局部更新區域坐標框架的作法，考量完整地震週期的地表板塊變形效應，可獲得更精確的地表變形修正結果，並更能藉以維護區域坐標參考框架的精度與使用年限；而在實務的修正作法上，採用完整的非線性震後變形修正模式，可有效改善以片段式(piecewise)線性方式修正地表板塊變形的做法，提升修正結果的精度，並且亦可增進震後地表變形樣態預測的準確性，提供半動態參考框架之建立與有效維護的依據。</p>
中文關鍵字	半動態參考框架、震間速度、同震位移、震後變形
英文關鍵字	Semi-reference frame, Interseismic velocity, Coseismic displacement, Postseismic deformation

會議室	Room 609A
日期	11月17日(星期二)
時段	08:45-09:00
議程代碼	M3-O-02
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	許樹坤(Shu-Kun Hsu) [中央大學地球科學學院] (通訊作者) Leo Armada [National Institute of Geological Sciences, University of the Philippines, Diliman, Quezon City, Philippines] Yi-Ching Yeh [Department of Earth Sciences, National Central University, Taiwan] Carla Dimalanta [National Institute of Geological Sciences, University of the Philippines, Diliman, Quezon City, Philippines] Teresito Bacolcol [Philippine Institute of Volcanology and Seismology, Quezon City, Philippines] Ching-Hui Tsai [Center for Environmental Studies, National Central University, Taiwan]
中文題目	從南海海洋地殼擴張看板塊構造運動：“VOTE”新南向菲律賓地科合作
英文題目	Research on South China Sea Seafloor Spreading under “VOTE” project
投稿類型	口頭報告 Oral
摘要	The South China Sea (SCS) basin and the Manila subduction zone predominate the geodynamics of the South-East Asia. The SCS is divided into several sub-basins. Among all, the eastern basin of the SCS is the largest one. The eastern sub-basin holds the critical role of understanding the change of the seafloor spreading from almost N-S direction to NW-SE direction. The last phase of the SCS seafloor spreading ceased around 15 Ma. To better understand the tectonics the SCS basin, we have cooperated with Philippine scientists under the VOTE project and conducted two marine geophysical surveys in 2014 and 2019. Our results show that the extinct mid-ocean-ridges of the basin was segmented. Especially, a fossil propagated rift system is found. Several linear volcanic chains exist in the eastern SCS basin. The volcanic chains indicate that the SCS asthenosphere magma, probably linking to the Hainan plume, had involved in the SCS spreading. The Hainan plume can be traced down to 1900 km deep in the NW-SE direction. Part of the Hainan plume possibly escaped from the main plume and emerged in the eastern SCS around 23 Ma. The new NW-SE spreading direction of the SCS follows the Hainan plume orientation. The ascending partial melt caused the upwelling of the asthenosphere and triggered the northeastward propagation of the ridge. The SCS spreading and propagated rift stopped around 15 Ma. Overall, the tectonic evolution of the eastern South China Sea basin may be described in three stages. Before magnetic lineation C6b (~23Ma), the oceanic crust has spread in a N-S direction. After C6b, the seafloor spreading gradually changed from N-S direction to NW-SE direction. The cessation of the SCS spreading implies the supply ending of the ascending magma from the partial Hainan plume into the eastern SCS. The seafloor spreading of the SCS basin indicates that spreading and formation of oceanic crusts depend not only on mantle convections, but also on events of mantle plumes.
中文關鍵字	南海、馬尼拉隱沒帶、海洋地殼、構造
英文關鍵字	South China Sea, Manila subduction zone, Ocean crust, Tectonics

會議室	Room 609A
日期	11 月 17 日(星期二)
時段	09:00-09:15
議程代碼	M3-O-03
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	黃柏壽(Bor-Shouh Huang) [中央研究院地球科學研究所] (通訊作者) 黃文紀(Win-Gee Huang) [中央研究院地球科學研究所]
中文題目	由台灣地震網觀測驗證規模 7.8 之 1990 年呂宋地震之高震源破裂速度
英文題目	High rupture speed of the 1990 Ms=7.8 Luzon Earthquake evidenced from the seismic network in Taiwan
投稿類型	口頭報告 Oral
摘要	<p>The Luzon earthquake with a 7.8 Ms magnitude occurred on July 16, 1990 in the Philippines. The earthquake produced a 125 km-long ground rupture along the Philippine Fault System. This event is one of largest strike-slip earthquakes ever recorded in the world and its aftershock area extended more than 100 km along the fault zone from the north to its southern end. The source rupture process and its aftershocks distribution have been detailed studied using the global seismic network observations and its crustal deformation from a regional GPS network. However, limited regional and local observations and analysis were reported. Six hundred kilometers away of this earthquake northern end, there was a dense short-period seismic network named the Taiwan Telemetered Seismographic Network (TTSN) installed and continuous operation to monitor earthquakes occurring in Taiwan and its surrounding area. During this earthquake, 24 short-period digital seismic stations of this network were well operated to record the main shock and its aftershock. After 30 years of this earthquake occurrence, we have relocated aftershocks of this earthquake. We analyzed its source rupture in detail using modern vision and analyzed seismological techniques developed in recent years. Based on the deconvolution analysis of mainshock waveform using a similar mechanism aftershock, two asperities were determined. To fit the mainshock waveform envelopes of P and S waves, high rupture speed (near source area S-wave velocity) of this event is required. Similar behavior of source rupture has been reported from the 2018 Palu, Indonesia earthquake.</p>
中文關鍵字	1990 年呂宋地震, 破裂速度, 台灣地震觀測網
英文關鍵字	1990 Luzon Earthquake, Rupture speed, Taiwan seismic network

會議室	Room 609A
日期	11月17日(星期二)
時段	09:15-09:30
議程代碼	M3-O-04
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	吳逸民(Yih-Min Wu) [台灣大學地質科學系暨研究所] (通訊作者)
中文題目	P-Alert 地震預警系統之最新發展與南向國家推廣進展
英文題目	Progress on the P-Alert earthquake early warning system and its promotion to southbound countries
投稿類型	口頭報告 Oral
摘要	<p>P-Alert 是由微機電感應器所開發的 P 波警報器，單一的機器可以提供現地預警，價位低可以大量佈設，形成即時強震網可以進行區域預警及繪製即時地動分布圖。經過 10 年的研發目前 P-Alert 在台灣建立了 732 個即時觀測站，除了提供現地預警外，近三年的研發目前可以於地震後一分鐘內提供 PGA (peak ground acceleration)、PGV(peak ground velocity)及不同週期 Sa (spectral acceleration)分布圖供救災參考。P-Alert 因為價位低十年來也推廣到韓國、中國、越南、菲律賓、紐西蘭、印度、印尼、索羅門群島、希臘、不丹、墨西哥及尼泊爾等國。菲律賓、不丹及尼泊爾為新南向計畫中推動，近年來印尼也主動與我們聯繫，目前正在進行峇厘島地區地震預警及震度圖系統之建立。在新南向計畫之推動下，我們也進行了台印雙方的地震預警研究，目前已完成兩篇論文。此外，以色列也主動與我們聯繫，將利用 P-Alert 增強該國地震預警系統。整體而言，低價位的 P-Alert 系統讓我們可以建立高密度的強震網，完成許多過去不易達成的科學項目，例如：製即時震度圖及震後快速分析斷層破裂方向。也因低價位可以將 P-Alert 順利推動到地震高風險的開發中國家，為國際社會盡一分心力。</p>
中文關鍵字	地震、地震預警、地震減災、震度圖
英文關鍵字	earthquake, earthquake early warning, seismic hazard mitigation, shakemap

會議室	Room 609A
日期	11月17日(星期二)
時段	09:30-09:45
議程代碼	M3-O-05
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	詹忠翰(Chung-Han Chan) [國立中央大學地震災害鏈風險評估及管理研究中心] (通訊作者)
中文題目	東南亞地震危害分析：創新、應用與展望
英文題目	Seismic hazard assessments for Southeast Asia: Innovation, application, and prospection
投稿類型	口頭報告 Oral
摘要	<p>Although most countries in Southeast Asia have seismic hazard maps, these national products reveal a wide range of methodologies and quality. Thus, this study has conducted a uniform assessment across the region through standardized approach and databases to propose regional seismic hazard maps and evaluate detailed hazard levels for some cities in Southeast Asia. To apply this assessment to Southeast Asia requires a uniform set of databases that incorporates both earthquake catalogues and fault parameters. The earthquake database contains seismic parameters obtained from global and national seismic networks, harmonized by removal of duplicate events and the use of moment magnitude. The fault database includes fault parameters from previous studies and the databases implemented for national hazard maps. Utilizing the databases, this study has constructed regional probabilistic seismic hazard maps. The assessment shows highest seismic hazard levels near those faults with high slip rates. This assessment demonstrates the important fact that regions with low earthquake probability may have a higher aggregate probability of future earthquakes. The significant irony then is that in areas of low to moderate probability, where building codes usually provide less seismic resilience, seismic risk is likely to be greater. An innovative approach of seismic hazard assessment is being developed by incorporating a dynamic seismic model using the discrete element method that simulates plates-tectonic movements. The anticipated outcome of this approach will provide not only better constraints on probabilistic seismic hazard assessment but also better understanding on tectonic evolution.</p>
中文關鍵字	地震危害分析、東南亞、離散元素法
英文關鍵字	Seismic hazard assessment, Southeast Asia, discrete element method

會議室	Room 609A
日期	11月17日(星期二)
時段	09:45-10:00
議程代碼	M3-O-06
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	陳韋仁(Wei-Jen Chen) [國立臺灣大學 海洋研究所] (通訊作者) 魏志潏(Chih-Lin Wei) [國立臺灣大學 海洋研究所] 柯佳吟(Chia-Ying Jessie Ko) [國立臺灣大學 漁業科學研究所]
中文題目	南海海洋生物多樣性之現況、衝擊和保育
英文題目	Marine biodiversity of the South China Sea: Status, impacts and conservation
投稿類型	口頭報告 Oral
摘要	<p>南海是世界最大的邊緣海，周邊國家包括我國、菲律賓、越南、馬來西亞、印尼、汶萊以及中國等，富含豐富的海洋資源，也是國際間重要的航運管道。此外，南海的自然環境變化相當多樣，是自然科學研究的寶庫。此區域有超過 1.5 億的人口在此居住並依賴此海洋生態系及其衍生的產品和服務；造就了周邊國家的生產總值（GDP）總貢獻達 1.2 兆美元，以及價值約一百億美元的漁業產值，佔全球市場的 10.5%。然而，我們利用南海資源的同時也對其生態系統造成嚴重的衝擊，包括：過漁、海洋污染、棲地破壞、海洋酸化和氣候變遷等，都威脅著南海生態系統的健全發展及生物多樣性的正常呈現；如何促進南海海洋資源的永續利用是非常重要且迫切的議題。而此議題的關鍵在於全盤了解此區域的海洋生物多樣性和生態系現況、自然環境變動與人為活動的衝擊，以及妥適的保育策略規劃。有基於此，我們透過一整合型的研究策略，以進行南海及與其臨接的印度-西太平洋水域海洋生物多樣性、物種演化、生物地理學及保育生物學之研究，研究成果除了增加我們對此區域海洋生物資源及生態環境的全盤了解外，我們亦進行了與南海周邊國家之科學研究交流、推廣科學研究成果共享，與國際海洋科學研究接軌。</p>
中文關鍵字	生物多樣性, 人為衝擊, 演化, 保育
英文關鍵字	Biodiversity, human impact, evolution, biogeography, conservation

會議室	Room 609B
日期	11月17日(星期二)
時段	08:30-08:45
議程代碼	M2-O-01
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	詹瑜璋(Yu-Chang Chan) [中央研究院地球科學研究所] (通訊作者)
中文題目	以多學科視角研究山崩偵測、坡體破壞和沈積物輸送
英文題目	Multidisciplinary Research on Landslide Detection, Slope Failure, and Sediment Transport
投稿類型	口頭報告 Oral
摘要	<p>The landslide and erosion processes have been considered very critical in shaping the landscapes and environments, particularly in mountainous areas like Taiwan and many parts of the world. Studying the landslide and erosion processes not only helps us understand how surface processes work, but also assists in predictions of land changes for practical engineering projects in the modern world. However, effective research tools evolve rapidly and improve through time, particularly in recent several years, and it is high time for integrating all the emerging tools from different perspectives to advance the studies of the landslide and erosion processes. This project integrates most advanced geophysical, seismological, geological, remote sensing, and geochemical tools for studying the landslide and erosion processes, particularly the three research components: landslide detection, slope failure, and sediment transport. The project also serves as a research platform that brings together multidisciplinary research personnel for better analyzing the landslide and erosion processes based on excellent natural laboratories in Taiwan. For the proposed project, we expect to offer improved and new answers to the following four questions for understanding the landslide and erosion processes that affect the lives and sustainable development of human beings. These fundamental yet critical questions are: (1) How do we detect precisely where and when a landslide from afar has happened? (2) How do we monitor a potential landslide site and evaluate the triggers for its failure? (3) How do we measure the rates of sediment transport and subsequently model them? (4) How do we determine the rates of chemical erosion and compare/relate them with physical erosion? The expected research results will be supportive for redesigning and upgrading future routine risk mapping and mitigation of landslide or erosion hazards that have caused serious loss of lives and damages to properties.</p>
中文關鍵字	山崩、侵蝕、山崩偵測、坡體破壞、沈積物輸送
英文關鍵字	

會議室	Room 609B
日期	11月17日(星期二)
時段	08:45-09:00
議程代碼	M2-O-02
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	黃信樺(Hsin-Hua Huang) [中央研究院地球科學研究所] (通訊作者) 陳俊德(Chun-Te Chen) [中央研究院地球科學研究所] 陳柔妃(Rou-Fei Chen) [中國文化大學地質系] 許雅儒(Ya-Ju Hsu) [中央研究院地球科學研究所] 林慶偉(Ching-Weei Lin) [成功大學地球科學系] 劉承楠(Cheng-Nan Liu) [中央研究院地球科學研究所] 陳璽安(Hsi-An Chen) [中央研究院地球科學研究所]
中文題目	以地震噪訊干涉法監測南台灣竹林地區的複雜大型深層山崩
英文題目	Monitoring a complex large-scale deep-seated landslide at Chunlin, southern Taiwan using seismic noise interferometry
投稿類型	口頭報告 Oral
摘要	Large-scale deep-seated landslides are one of most catastrophic natural hazards that cause huge damage and economic loss in the world. The Chunlin landslide located at Kaohsiung city in the southern Taiwan is one of such composed of complex morphology and sub-regions that exhibit different deformation behaviors. Monitoring the sliding characteristics of different sub-regions is crucial to understand when and where the next failure may come. To this end, a seismic network of 16 stations was installed since July 2019. Using the one-year seismic data to date, we apply seismic noise interferometry method to estimate subsurface seismic velocity changes and investigate the medium changes in association with external forcing such as rainfall and earthquakes. For the three storms and numerous nearby earthquakes present during the time period, the rainfall seems to play a dominant role in decreasing seismic velocities in some sub-regions. Analysis of multiple frequency bands also suggests a deep depth of the velocity decreases, consistent with the deep-seated character of the Chunlin landslide bottoming at ~100 meters. Longer monitoring time period is needed for a systematic investigation to gain insight into distinct responses of different sub-regions and in turn help the hazard assessment and mitigation of the complex Chunlin landslide as a whole.
中文關鍵字	大型深層山崩、地震噪訊干涉法、地震速度時序變化、竹林山崩
英文關鍵字	large-scale deep-seated landslides, seismic noise interferometry, temporal seismic velocity variations, Chunlin landslide

會議室	Room 609B
日期	11月17日(星期二)
時段	09:00-09:15
議程代碼	M2-O-03
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	趙韋安(Vvn Weian Chao) [國立交通大學土木工程學系] (通訊作者) 楊哲銘(Che-Ming Yang) [Department of Civil and Disaster Prevention Engineering, National United University] 洪啟耀(Chi-Yao Hung) [Department of Soil and Water Conservation, National Chung Hsing University]
中文題目	
英文題目	Seismic monitoring-and-quantifying of river sediment transport
投稿類型	口頭報告 Oral
摘要	The river sediment transport is a key process governing the fluvial geomorphology. However, sediment flux in rivers is very difficult to measure, especially for typhoon period, causing large unknowns in predictions of fluvial bedrock erosion and mountain landscape evolution. Recently, seismic technique as merged as a promising new tool to measure the bedload flux from the seismic noise generated by river processes. To better understanding the surface erosion processes in rivers, the streamside monitoring and high-frequency sampling of sediment load is needed. In 2019, a temporary seismic network composed of six broadband seismometers and one geophone sensor has been deployed along the Laonong River (named LaoNet). Four seismic stations are located around the Putanpunas River, which is steep tributary (relief: 1500 m; mean gradient: 0.3) and constitutes a major sediment source supply to the Laonong River. Four high-resolution time-lapse cameras were installed to capture the temporal changes in river stage. Based on the continuous seismic signals during the storms, we conduct a series of time-frequency analysis. Results show a strong correlation between seismic spectral power and water stage. In addition, the tributary Weichin River was selected to be our surface erosion observatory (SEO), where is equipped with a real-time monitoring system, including weather station (rainfall, atmosphere pressure, wind direction and speed), water level gauge, Seismic stations, and time-lapse camera in 2020. Aforementioned sites would be very helpful to test the capability of fluvial seismology in constraining the bedload flux when the model parameters are well known.
中文關鍵字	
英文關鍵字	river sediment transport, seismic signals, bedload flux, fluvial seismology

會議室	Room 609B
日期	11月17日(星期二)
時段	09:15-09:30
議程代碼	M2-O-04
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	陳奕靖(Yi-Ching Chen) [中央研究院地球科學研究所] (通訊作者) 林玉儂(Yunung Nina Lin) [中央研究院地球科學研究所] 郭昱廷(Yu-Ting Kuo) [中央研究院地球科學研究所, 國立中正大學地球與環境科學系] 趙韋安(Vvn Weian Chao) [國立交通大學土木工程學系]
中文題目	
英文題目	Automatic Landslide Detection using SAR Change Detection and Landquakes
投稿類型	口頭報告 Oral
摘要	<p>Synthetic Aperture Radar (SAR) plays a crucial role in the domain of natural disaster monitoring with its unique day-and-night observing and, especially, weather-independent ability. In this framework, we utilize amplitude-based change detection method to detect landslides captured by the Real-time LAndquake Monitoring System (RLAMS: http://collab.cv.nctu.edu.tw/rlms_central.html). Sentinel-1 Level-1 Ground Range Detected (GRD) SAR image stack are first calibrated and geocoded to backscattering coefficient (σ^0). The z-score image thus computed from the multi-temporal backscattering stack highlights the location of the landslides. A newly-developed tile-growing algorithm further facilitates automatic detection of the exact landslide area. The whole flow is implemented into a high performance computing (HPC) environment. We adopt the flexible Graph Processing Framework (GPF) under ESA's Sentinel Application Platform (SNAP), which invokes command line-based SNAP-Graph Processing Tool (gpt). We test the following three flows: 1) calling the SNAP-Python (snappy) interface, 2) calling gpt with an operator at a time, and 3) calling gpt with an xml-encoded graph. The last flow design allows the best automation efficiency and guarantees a fully-automatic landslide detection jointly with landquakes and SAR observations.</p>
中文關鍵字	
英文關鍵字	landslide, change detection, SNAP, landquake

會議室	Room 609B
日期	11月17日(星期二)
時段	09:30-09:45
議程代碼	M2-O-05
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	陳俊德(CHUN-TE CHEN) [中研院地球所] (通訊作者) 李憲忠() [中研院地球所] 詹瑜璋() [中研院地球所]
中文題目	地形效應對地震動的影響與誘發山崩的關係
英文題目	
投稿類型	口頭報告 Oral
摘要	<p>地形效應影響自由地表的震動行為，通常會放大山頂或山脊處的振動幅度，而會降低山谷處的振動幅度。然而，地震誘發滑坡的現象與地形放大效應之間的相關性還沒有被充分研究。為了研究九九峰地區地表地震響應的放大行為以及在集集地震誘發滑坡作用的相關性，我們基於譜元素法在台灣九九峰地區進行了三維地動模擬。我們以光達衍生的 20 公尺分辨率數值高程模型構建具有接近真實地形起伏的網格模型。為此，建模中應用了設計的緩衝層以減輕網格扭曲程度。靠近地表的網格層擁有更細緻的網格模型。我們的模擬結果顯示，九九峰頂和山脊上的 PGA 放大程度要比周圍的山脈高，而壓抑放大現象則主要發生在山谷和山坡附近。地表的起伏形貌對於 P 波的 PGA 放大可以有±50%的變化，對於剪力波的 PGA 放大可以具有更大的變化，其範圍約在-50%到+ 100%之間。透過模擬我們還證明，在集集地震發生後，高比例的滑坡分佈位於地形放大區。震源頻率內容與地形特徵會相互作用，通常，小尺度的地形變化會放大較高頻率的地震波。此外，值得進一步研究地形效應與速度模型之間的相互作用，以及研究地形效應如何影響不同頻段的地震波。我們建議在地震危險性評估和滑坡評估中考慮地形震波放大的影響。</p>
中文關鍵字	山崩，地形效應，譜元素法
英文關鍵字	landslide, surface topography, spectral element method

會議室	Room 609B
日期	11月17日(星期二)
時段	09:45-10:00
議程代碼	M2-O-06
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	曾佳漢(Chia-Han Tseng) [國立中央大學地震災害鏈風險評估及管理研究中心] (通訊作者) 詹瑜璋(Yu-Chang Chan) [中央研究院地球科學研究所] 鄭清江(Ching-Jiang Jeng) [華梵大學景觀與環境設計學系] 饒瑞鈞(Ruei-Juin Rau) [國立成功大學地球科學系] 張中興(Chung-Hsing Chang) [國立成功大學地球科學系] 謝有忠(Yu-Chung Hsieh) [中央地質調查所]
中文題目	
英文題目	Long-term monitoring of surficial deformation of a landslide: a dip slope case in northern Taiwan
投稿類型	口頭報告 Oral
摘要	In order to understand the spatial-temporal movement behavior of landslides, long-term and continuous monitoring of surficial deformation is a direct and economic method. In this study, observations from a nail network and continuous Global Position System (CGPS) are analyzed. According to our results, we observed seasonal slow motion and short-term fast displacement from CGPS sites on the slope in the Central Range of Taiwan. To better understand the slope movement, the targeted slope is a dip slope about 20° toward southwest, being composed of early Miocene alternations of sandstone and shale in northern Taiwan. In addition to a nail network established since 2001, we also set 13 single-frequency and 2 dual-frequency CGPS stations on the dip slope in April 2016. During the observation period, the slope creeps slowly with a velocity of about 13 mm/year toward southwest and south, and the angle of the movement vector is steeper than the angle of the sliding surface, suggesting that the movement is not associated with sliding surface but plastic deformation of the slope mass. Noticeable displacement events with the maximum 68.1 mm displacement occurred in September 2016, June 2017, October 2017 and October 2018, respectively. These fast displacements concurred with the four apparent rainfall events which had accumulated rainfall amount of 661, 365, 435 and 384 mm. The surface displacements are synchronous with slip on the sliding surface resulting from the rainfall events, and rainfall infiltration to sliding surface is a main factor to trigger the slope failure. The movement pattern of fast displacement is changed by different rainfall patterns: short-term extreme rainfall causes larger displacement in a short time, and long-period rainfall with low intensity causes a longer displacement duration.
中文關鍵字	
英文關鍵字	Long-term monitoring, GPS, movement pattern of slope failure, dip slope

會議室	Room 609C
日期	11月17日(星期二)
時段	08:30-08:45
議程代碼	SE3-O-01
議題	- Stratigraphy 地質定年學與地層學
作者	杲紹伊(Kao, Shao-I) [臺灣大學地質科學系研究所] (通訊作者)
中文題目	從晚中新世里龍山層磷灰石核飛跡定年研究探討恆春半島抬升歷史
英文題目	Apatite fission-track dating of the Late Miocene strata (Lilungshan Formation) in the Hengchun Peninsula, southern Taiwan: Implications for the uplift history
投稿類型	口頭報告 Oral
摘要	<p>This study aims to investigate the thermal history regarding the Late Miocene strata in the Hengchun Peninsula with low-temperature thermochronometry. Those samples collected were from the Lilungshan Formation, including quartzite (pebbles) and sandstones (matrix). Apatite fission-track thermochronology is a radiometric dating method that refers to thermal histories of the sedimentary basin within the closure temperature range of $135\pm 20^{\circ}\text{C}$. Our study shows that fission-track ages of quartzite pebbles and the sandstones obtain pooled ages between 2.6 ± 0.5 Ma and 3.5 ± 0.6 Ma, and the age distributions indicate total reset. Nevertheless, the formation age of the Lilungshan Formation based on nannofossil data of NN11 zone (5.6-8.3 Ma). If the fission-track age record is less than the depositional age, which represents a post-deposition annealing age, the strata should be buried deeply to over the closure temperature of apatite fission-track. Therefore, we confirm that the Lilungshan Formation has encountered a thermal event caused by tectonic burial in the foreland basin. In conclusion, the apatite fission-track ages of the Lilungshan Formation have been totally reset due to paleo-burial. Besides, the onset of uplift in the Hengchun Peninsula was between 2.6 ± 0.5 Ma and 3.5 ± 0.6 Ma. Furthermore, if we assume the geothermal gradient is $45\pm 13^{\circ}\text{C}/\text{km}$, the thickness of overlying strata must at least 2.1-3.8 km to reach the closure temperature of apatite fission-track ($\sim 135^{\circ}\text{C}$). It shows that the cooling rate of the basin is $34.3\text{-}46.2^{\circ}\text{C}/\text{Myr}$, and the exhumation rate of the basin is 0.6-1.4 mm/yr.</p>
中文關鍵字	恆春半島，晚中新世，里龍山層，磷灰石核飛跡定年，熱歷史，低溫熱年代學，初始碰撞，剝蝕速率，抬升
英文關鍵字	Hengchun Peninsula, Late Miocene, Lilungshan Formation, apatite fission-track dating, thermal history, low-temperature thermochronometry, initial collision, denudation rate, uplift

會議室	Room 609C
日期	11月17日(星期二)
時段	08:45-09:00
議程代碼	SE3-O-02
議題	- Stratigraphy 地質定年學與地層學
作者	洪崇勝(Chorng-Shern Horng) [中央研究院地球科學研究所] (通訊作者) 謝凱旋() [經濟部中央地質調查所] 陳國航() [中央研究院地球科學研究所] 林俊宏() [中央研究院地球科學研究所]
中文題目	從烏山層、古亭坑層、崎頂層的年代及磁性礦物看台灣南部前陸沉積盆地的演變
英文題目	
投稿類型	口頭報告 Oral
摘要	<p>出露在台南左鎮斷層以南、高雄旗山斷層以西麓山帶的岩層，由老至幼依序為烏山層、古亭坑層、崎頂層。對於烏山層與古亭坑層以及古亭坑層與崎頂層界面的年代，目前推斷大約是在中新世/上新世的界面附近以及在更新世早期，惟尚缺乏確切的定年證據。從沉積環境的觀點，烏山層是以厚砂岩與薄頁岩互層為主，屬淺海陸棚相；古亭坑層則是以泥岩為主、偶夾薄砂層，屬半深海陸坡相；上到崎頂層，岩性改以厚砂岩與砂泥互層為主，部分地區含石灰岩礁，又恢復至淺海陸棚相。上述地層之岩性與沉積環境的改變反映了台灣南部前陸沉積盆地的演變。本研究針對高雄田寮區古亭村的二仁溪剖面從事磁生物地層及磁性礦物的研究，試圖訂定上述地層界面的年代並展示岩層所含磁性礦物的特徵藉以闡述前陸沉積盆地的演變。由於此一剖面被古亭坑逆斷層所截切，因此在斷層東側出露有老的地層，其年代可追溯至約 8.5-8.2 Ma，而在斷層西側則有最年輕的地層，年代小於 0.77 Ma，已進入布倫正向世代的範圍內。此一剖面共建立了 17 個年代序列，包括中新世/上新世的界面 (5.32 Ma)，因此可以作為地層層序的時間控制點。磁性礦物及相關岩石磁學的資料顯示，在 8.5-5.32 Ma 期間的泥岩夾厚砂岩的地層中(認定為烏山層，僅 90 公尺厚)其磁性礦物是氧化態的磁鐵礦(magnetite, Fe₃O₄)，而自 5.32 Ma 起，岩性是以幾乎不含砂層的泥岩為主(認定為古亭坑層)，在此一單調的泥岩中其磁性礦物改以還原態的硫複鐵礦(greigite, Fe₃S₄)出現，並在爾後巨厚泥岩中(近乎 2000 公尺)皆有存在，一直持續至松山反向世代的晚期，年代落在 0.99 Ma 至 0.77 Ma 之間。爾後，沉積物的砂質含量顯著增加(認定為崎頂層)，其磁性礦物又改以碎屑源磁黃鐵礦(pyrrhotite, Fe₇S₈)並持續出現在更年輕的地層中。在 5.32 Ma 時，磁性礦物所以轉變是因當時的前陸盆地起了重大變化，盆地開始下陷，使得沈積環境從沈積速率極為緩慢的淺海陸棚進入半深海的陸坡，且因海底的構造活動，包括斷層與褶皺的形成，使得海床底下的甲烷氣得以擴散方式進入其上方的沈積物中形成還原環境，遂有硫複鐵礦的生成，此一甲烷氣所形成的還原環境一直持續至松山反向世代的晚期，年代介於 0.99 Ma 至 0.77 Ma 之間。爾後，台灣造山帶的快速隆起，使得含有磁黃鐵礦的變質岩經由侵蝕搬運開始大量堆積在古前陸沈積盆地中，盆地也因淺化使得沈積物砂質的成分明顯增加，形成崎頂層。因此古亭坑層的上、下界代表著台灣南部前陸盆地重大的環境變化。</p>
中文關鍵字	烏山層、古亭坑層、崎頂層、磁性礦物、前陸盆地
英文關鍵字	

會議室	Room 609C
日期	11月17日(星期二)
時段	09:00-09:15
議程代碼	SE3-O-03
議題	- Stratigraphy 地質定年學與地層學
作者	紀子勤(Tzu-Chin Chi) [中央研究院臨海研究站] (通訊作者) 甘怡(Yi Gan) [] 楊子睿(Tzu-Ruei Yang) [國立自然科學博物館地質學組；國立成功大學地球科學系] 張鈞翔(Chun-Hsiang Chang) [國立自然科學博物館地質學組]
中文題目	藉由傳統形態學以及幾何形態學分析揭示台灣的花豹化石紀錄
英文題目	An integration of morphological and geomorphometric analyses reveals prehistoric leopards from Taiwan
投稿類型	口頭報告 Oral
摘要	臺灣南部恆春半島之墾丁地區，擁有分佈廣闊的生物礁石灰岩，有許多石灰岩洞之地形。位於墾丁國家森林遊樂區內的石灰岩洞—龍蝦洞，其洞穴內之沉積物中保存大量更新世陸生脊椎動物化石。其中包含許多從未在台灣地層紀錄以及歷史文獻紀錄中從未發現過的物種。於近期的發掘中，發現三顆貓科動物下顎白齒化石 P3、P4、M1，在大小比較以及發現位置等因素可以推斷來自同一隻個體，在型態特徵大至分類可知道為豹屬之物種。本研究以傳統牙齒尺寸的線性測量和牙齒咬合面的二維幾何形態測量，以亞洲常見的豹屬物種例如：老虎、雲豹、花豹等牙齒標本做為參考來比對。結果顯示在兩種方法中本研究之化石牙齒和花豹之結果最為相近，因此推測為花豹 (<i>Panthera pardus</i>) 之化石。本研究為首次在台灣發現之更新世花豹存在之紀錄。此外，與中國之花豹化石相比較後，台灣的花豹體型較小，未來需要更多研究幫助了解是否為島嶼侏儒化的結果。
中文關鍵字	墾丁、貓科、化石、形態學、花豹
英文關鍵字	Felidae, Morphology, <i>Panthera pardus</i> , Late Pleistocene, Geomorphometric analysis

會議室	Room 609C
日期	11月17日(星期二)
時段	09:15-09:30
議程代碼	SE3-O-04
議題	- Stratigraphy 地質定年學與地層學
作者	楊子睿(Tzu-Ruei Yang) [國立自然科學博物館/國立成功大學] (通訊作者) Thomas Engler [Rheinische Friedrich-Wilhelms-Universität Bonn, Germany] Jen N. Lallensack [University of Liverpool, UK] Adun Samathi [Mahasarakham University, Thailand] Makowska Malgorzata [Paul Scherrer Institute, Switzerland] Burkhard Schillinger [Heinz Maier-Leibnitz Zentrum (MLZ), Germany]
中文題目	竊蛋龍類不同步孵化與其生殖生物學演化的啟示
英文題目	Hatching asynchrony in oviraptorid dinosaurs and its implications for their unique reproductive biology
投稿類型	口頭報告 Oral
摘要	竊蛋龍類是一群生活於白堊紀的小型獸腳類恐龍。自 1924 被命名以來，有賴許多珍稀的標本，古生物學家認為它們已具有孵蛋、共巢、以及群居等現生鳥類特有的行為，也因此認為竊蛋龍在生殖生物學上代表一個介於恐龍與鳥的之間的過渡型。本研究利用中子斷層掃描、蛋殼組織學、骨骼發育特徵、以及地層層位判釋等方法，研究一件產自中國江西的部分竊蛋龍蛋窩，該蛋窩有三顆蛋（包含一對蛋與一顆蛋），每顆蛋內皆含有胚胎。地層層位判釋顯示對蛋產下的時間早於單顆蛋。中子斷層掃描與骨骼發育特徵說明對蛋內的胚胎發育程度高於單顆蛋的胚胎，呼應了地層層位判釋的結果。胚胎發育過程因需鈣質以建構骨骼，因此會由蛋殼獲取鈣質而造成蛋殼減薄的現象。而蛋殼組織學分析結果也支持前述的推論。結合數研究的結果，我們推論，竊蛋龍類已經開始嘗試孵育行為，但尚不能完全類比至現生鳥類，也因此竊蛋龍類所展現的獨特生殖生物學並非單純為恐龍與鳥之間的過渡型態。
中文關鍵字	竊蛋龍類、恐龍、生殖生物學、不同步孵化
英文關鍵字	Oviraptoridae, dinosaurs, reproductive biology, hatching asynchrony

會議室	Room 609C
日期	11月17日(星期二)
時段	09:30-09:45
議程代碼	SE3-O-05
議題	- Stratigraphy 地質定年學與地層學
作者	汪良奇(Liang-Chi Wang) [國立中正大學地球與環境科學系] (通訊作者)
中文題目	台灣東部晚全新世古湖沼變遷與古颱風紀錄
英文題目	Paleolimnological changes and paleo-typhoon records during the late Holocene in eastern Taiwan
投稿類型	口頭報告 Oral
摘要	<p>宜蘭平地、山區與沖繩海槽沉積物紀錄皆顯示台灣東北部區域在小冰期晚期有較多颱風通過所引起的強降雨事件，然而台灣其他地區古颱風紀錄依然缺乏。本研究分析台灣東部低海拔湖泊鯉魚潭與高山湖泊屯鹿妹池沉積物內矽藻、磁感率、TOC、C/N與穩定碳同位素，來重建晚全新世台灣東部古湖沼演替與古颱風紀錄。花蓮鯉魚潭沉積物岩性與多指標參數在 2850 cal BP 以來有顯著變化，顯示當時鯉魚潭為穩定的湖泊狀態。鯉魚潭湖泊水位指標矽藻逐漸增加顯示在 1600 cal BP 以來降雨逐漸增加，反應東亞夏季季風增強。優養化指標矽藻在近兩百年的大量增加，可能與較多人類活動與土地利用改變有關。屯鹿妹池沉積物在 760 cal BP 以來才有矽藻保存，顯示穩定的湖沼狀態與較多的降雨。在小冰期初期矽藻所指示 pH 的降低事件，可能反應颱風的強降雨。花蓮鯉魚潭與屯鹿妹池的紀錄皆顯示在小冰期初期有較多颱風，這樣結果與台灣東北部在小冰期晚期颱風增加時間並不一致。這種颱風強度在時間與空間上的不一致，顯示在最近一千年以來全球氣溫異常與 ENSO 強度變化可能在百年尺度上調控東亞沿岸地區颱風路徑並造成區域降雨模式改變。</p>
中文關鍵字	小冰期、矽藻、穩定同位素、颱風
英文關鍵字	Little Ice Age, diatom, stable isotope, typhoons

會議室	Room 609C
日期	11月17日(星期二)
時段	09:45-10:00
議程代碼	SE3-O-06
議題	- Stratigraphy 地層與古生物研究
作者	張鈞翔(Chun-Hsiang Chang) [國立自然科學博物館] (通訊作者)
中文題目	從澎湖原人談臺灣第四紀哺乳動物的演化
英文題目	The Penghu hominin and the evolution of Quaternary mammals in Taiwan
投稿類型	口頭報告 Oral
摘要	<p>「澎湖動物群」堪稱是來自澎湖黑水溝的化石瑰寶！這些化石來自澎湖水道(Penghu Channel)，這是位於臺灣本島和澎湖列島之間，臺灣海峽中一段地形比較特殊的水域。水深一般為70~80米、最深處可達200米。在過去的二、三十年間，從澎湖水道打撈的動物化石數以萬計。分佈在博物館、民間私人蒐藏家、古董商，甚至在漁民家或漁船上。這些經過長年的採集與蒐集，累積成千上萬的臺灣第四紀哺乳動物化石，這些化石證明了冰河時期海平面下降，也是陸橋形成，動物群遷徙的證據。其中包括了臺灣最早的人類化石，具有直立人特徵的澎湖原人！以及許多哺乳動物化石，像是德氏水牛、淮河古菱齒象、最後鬣狗、四不像鹿、斑鹿、熊、馬等。在型態特徵上，多數物種保留了相對較原始的特徵。很有可能在冰河時期，亞洲大陸北方的動物群，朝向臺灣遷徙，臺灣成為早期動物遷徙避寒的避難所。澎湖原人更呈現原始的特徵，顯示在冰河時期，包括直立人在內的動物從歐亞大陸遷徙到臺灣時，因為臺灣的環境適切，反而讓澎湖原人保留了原始直立人的特徵。這些材料是提供臺灣地區動物的起源、發展，古氣候環境的變遷、動物的適應、型態變異與演化之絕佳的線索與證據。</p>
中文關鍵字	第四紀、直立人、澎湖水道、澎湖動物群、演化
英文關鍵字	Quaternary, Homo erectus, Penghu Channel, Penghu Fauna, Evolution

會議室	Room 603
日期	11月17日(星期二)
時段	14:00-14:15
議程代碼	S3-O-03
議題	- Seismology 環境與噪聲地震學
作者	劉承楠(Cheng-Nan Liu) [Institute of Earth Sciences, Academia Sinica, Taipei 115, Taiwan] (通訊作者) 林凡奇(Fan-Chi Lin) [Department of Geology and Geophysics, University of Utah] 黃信樺(Hsin-Hua Huang) [Institute of Earth Sciences, Academia Sinica, Taipei 115, Taiwan] 王昱(Yu Wang) [Department of Geosciences, National Taiwan University, Taipei 10617, Taiwan] Elizabeth M. Berg [Department of Geology and Geophysics, University of Utah] 林正洪(Cheng-Horng Lin) [Institute of Earth Sciences, Academia Sinica, Taipei 115, Taiwan]
中文題目	
英文題目	High Resolution 3-D Shear Wave Velocity Model of Northern Taiwan via Bayesian Joint Inversion of Rayleigh Wave Ellipticity and Phase Velocity with Dense Array
投稿類型	口頭報告 Oral
摘要	Resulting from rapid convergence between the Eurasian Plate (EP) and Philippine Sea Plate (PSP), Taiwan has been one of the most active orogenic belts worldwide. Through oblique collision to post-collisional extension, the northern Taiwan experienced intense tectonic and magmatic activity that leads to complex geological structures including numerous faults, basins, and volcanic groups. Better illuminations for structural complexity can further the understanding to the orogenic processes and potential earthquake hazard assessment. While attempts have been made by numerous studies which used tomographic imaging and seismic reflection/refraction profiling, the former lacks of resolution at shallow depths in general and the latter is mainly restricted to localized 2-D lines in basin and plain areas. With the technique of Ambient Noise Tomography (ANT), we measure Rayleigh wave phase velocity and ellipticity via 113 Formosa Array (FM) stations and 24 Broadband Array in Taiwan for Seismology (BATS) stations, and employ Bayesian joint inversion framework to obtain a high-resolution 3-D shear wave velocity model at near surface depths in the northern Taiwan. The new model shows consistent results with drilling data in Taipei Basin, and so do the other well-known regions like Ilan Plain and Linkou Tableland. Furthermore, the model also resolves local fault geometry of Lishan fault, dike intrusion beneath Ilan Plain, volcanic cap of Tatun volcano group, and coastal Jinshan Basin, allowing a comprehensive investigation on shallow geologic structures in the northern Taiwan.
中文關鍵字	
英文關鍵字	Ambient noise tomography, Bayesian joint inversion, dense array, 3-D shear wave velocity model

會議室	Room 603
日期	11月17日(星期二)
時段	14:15-14:30
議程代碼	S4-O-04
議題	- Seismology 觀測地震學
作者	林志銘(Chih-Ming Lin) [國立臺灣大學師範大學地球科學系] (通訊作者) 林佩瑩(Pei-Ying Patty Lin) [國立臺灣大學師範大學地球科學系] 賴雅娟(Ya-Chuan Lai) [大屯火山觀測站、國家實驗研究院國家地震工程研究中心] 史旻弘(Min-Hung Shih) [大屯火山觀測站、中央研究院地球科學研究所] 林正洪(Cheng-Horng Lin) [中央研究院地球科學研究所、大屯火山觀測站、國立臺灣大學地質科學系、國家實驗研究院國家地震工程研究中心] 賴昱銘(Yu-Ming Lai) [國立臺灣大學師範大學地球科學系]
中文題目	密集臺灣陣列遠震轉換波資料分析北臺灣火山群底下的 ^[1] 地殼低速帶分佈與莫荷面起伏
英文題目	Receiver Function Mapping of Moho and Crustal Low-velocity Zones beneath the Volcano Groups in Northern Taiwan
投稿類型	口頭報告 Oral
摘要	The tectonic in northern Taiwan have gone through from oblique arc-continent collision to post-collisional extension with complex volcanisms. Among the volcanisms, Tatun volcano group is proven active and the magma reservoir exists in the crust in recent years. The detailed image of the magma reservoir is still poorly constrained due to spatial sampling. In this study, we analyzed the converted phases after the P-waves of teleseismic earthquakes recorded in Formosa array (FM) to estimate the crustal discontinuities (e.g. Moho and low-velocity zone) using receiver function (RF) analysis. FM array consists of more than 100 broadband seismic stations deployed in northern Taiwan with spacing ~5km and has been operating since April 2018. Such a new and dense array provides great opportunities to present the Moho variations and crustal velocity anomaly area in northern Taiwan. The variations of Moho are also first-time systematically mapped based on clear converted phases in the RFs binned with the back-azimuths. In addition, two distinct low-velocity zones are found beneath the east side of Tatun volcano group (TVG) and near Keelung volcano group (KVG), respectively. Both estimated velocity drop and thickness of the low-velocity zones beneath TVG are significantly larger than KVG from our inversion and synthetic forward modeling. The compressional and shear wave velocity depressed by ~12% and ~25% under the east side of TVG might reveal that partial melt is ~15-20%.
中文關鍵字	臺灣陣列、接收函數、莫荷面、低速帶、大屯火山群、基隆火山群
英文關鍵字	Formosa array, receiver function, Moho, low-velocity zone, Tatun volcano group, Keelung volcano group

會議室	Room 603
日期	11月17日(星期二)
時段	14:30-14:45
議程代碼	S4-O-05
議題	- Seismology 觀測地震學
作者	林侑頻(Yu-Pin Lin) [中央研究院地球科學所] (通訊作者)
中文題目	
英文題目	Three-dimensional Frequency-dependent attenuation models for P and S waves in Northern Taiwan
投稿類型	口頭報告 Oral
摘要	<p>Taiwan is located around the convergence boundary between the Philippine Sea Plate and the Eurasian Plate. The series of complex faulting system result in moderate earthquakes (M~6) every year which lead to property damages. Therefore, it is critically important to provide realistic and reliable assessment of seismic hazards. To improve the accuracy in wave propagation modeling for seismic hazard assessments, we not only need the strong ground motion simulations at low frequencies by elastic models, but also the simulations at the high frequencies which will depend strongly on the attenuation structure. We plan to solve a 3-D attenuation tomography model in Northern Taiwan, and also to probe the frequency-dependent attenuation structures which is often described by a power-law rate equation $Q(f)=Q_0(f/f_0)^\alpha$. The α parameter can be related to the different materials, which enables us to understand the structures that might not be revealed in elastic models. The observed amplitude at different frequency bands are measured through the spectra by wavelet transform. The geometrical spreading and the source parameters which also affect the amplitude spectra were accounted for by referencing the spectral amplitudes to values computed from synthetic seismograms. The frequency-dependent attenuation model can be inferred by inverting Q models in different frequency bands. The ratio of QP and QS models with the frequency dependence may suggest that the attenuation at high frequencies is dominated by strong scattering effects which reflect the strong horizontal heterogeneous in the crust (Lin & Jordan, JGR, 2018).</p>
中文關鍵字	
英文關鍵字	Frequency-dependent Q, 3-D attenuation tomography, Northern Taiwan

會議室	Room 603
日期	11月17日(星期二)
時段	14:45-15:00
議程代碼	S4-O-06
議題	- Seismology 觀測地震學
作者	王維豪(Wang, Wei-Hau) [中正大學地球與環境科學系] (通訊作者) 葉玉蓮(Yeh, Yu-lien) [中正大學地球與環境科學系] 溫士忠(Strong Wen) [中正大學地球與環境科學系]
中文題目	台北大都會區之下真的存在一個大規模的岩漿庫嗎?
英文題目	Is a mappable magma chamber beneath Taipei metropolis, Taiwan?
投稿類型	口頭報告 Oral
摘要	<p>We report new seismic evidence from dense seismic arrays in northern Taiwan to refute the presence of a mappable magma chamber. We investigated two near Taipei earthquakes with focal depths of ca. 140 km. We found that all the waveforms exhibited distinct S waves even when they traversed across the previously postulated magma chamber. Instead, the S-wave shadows found in the previous study may result from seismic waves traveled through a magma diapir above the subducting Philippine Sea Plate offshore northern Taiwan. Moreover, we found the P-wave delay increased with hypocentral distance once the seismic waves propagated through the footwall (west side) of the Shanchiao fault, regardless of whether they traversed across the postulated magma chamber. Our study results also indicate that there was no abnormal attenuation when seismic rays traversed across the postulated magma chamber. Furthermore, the average QP/QS ratio around the TVG is less than 1, which implies that scattering attenuation is dominant. We conclude that a highly fractured rock body is beneath the TVG with a tiny fraction of magma instead of a mappable magma chamber. Without sufficient magma supply, the TVG may stay dormant (except small phreatic eruptions) if not goes extinct.</p>
中文關鍵字	岩漿庫、台北、大屯火山群
英文關鍵字	Magma chamber, Taipei, Tatun Volcano Group

會議室	Room 603
日期	11月17日(星期二)
時段	15:00-15:15
議程代碼	S4-O-07
議題	- Seismology 觀測地震學
作者	洪宇陞(Maxwell Yu-Sheng) [台灣大學海洋研究所] (通訊作者) 柯彥廷() [台灣大學海洋研究所]
中文題目	
英文題目	Determination of the age and morphology of the Ryukyu subducting slab beneath northern Taiwan
投稿類型	口頭報告 Oral
摘要	Determination of the age and morphology of the Ryukyu subducting slab beneath northern Taiwan Maxwell Yu-Sheng,Hung1 and Justin Yen-Ting,Ko1 1 Institute of Oceanography, National Taiwan University The Huatung basin (HB) is situated between Taiwan and the Gagua ridge, which marks the spot at the front edge of Philippine Sea Plate (PSP) subduction zone. The age of HB is a heated debate throughout the past decade. Although there is a general consensus that the birth of HB should be roughly in the Eocene, inferences vary from 30Ma to 125Ma. In this study, we collected the tele-seismic waveforms with epicenter distance between 30 – 90 degree and depth over 100 km recorded by the Broadband Array in Taiwan (BATS). We measure traveltimes and amplitude fluctuations comparing to the PREM based on P-wave data. A noticeable focusing and defocusing of amplitude are shown while we took a closer look at North-East seismic events which mostly occurred in Aleutian Island and Kamchatka peninsula. In order to investigate the detailed morphology of the PSP subducting plate, we use GPU-accelerated Finite-difference method to compute large numbers of the Green's functions to create a library of the idealized 2D models. We grid search for the six parameters, including the thickness, the length, the dipping angle, the velocity perturbation, sharpness and the top boundary of the slab, by minimizing the differences in traveltimes, amplitudes and waveform shapes between data and synthetics. With a preliminary glance of the simulation results, we suggest that the optimal model would have a better conclusion to the slab dynamics and a precise constraint on the age of HB.
中文關鍵字	
英文關鍵字	seismology, geodynamics, Huatung Basin, subducting slab, age, morphology

會議室	Room 603
日期	11月17日(星期二)
時段	15:15-15:30
議程代碼	S4-O-08
議題	- Seismology 觀測地震學
作者	柯彥廷(Justin Ko) [國立台灣大學海洋研究所] (通訊作者) Donald V. Helmberger [Seismological laboratory, California Institute of Technology, CA, USA] Zhongwen Zhan [Seismological laboratory, California Institute of Technology, CA, USA] Michael Gurnis [Seismological laboratory, California Institute of Technology, CA, USA] Jennifer Jackson [Seismological laboratory, California Institute of Technology, CA, USA]
中文題目	
英文題目	Hidden ultralow velocity zone beneath the paleoslab near the core-mantle boundary
投稿類型	口頭報告 Oral
摘要	Understanding the origin of structures in the lower mantle and D" in particular is key to understanding how the Earth works as a global interconnected system. The role of subducted slabs involving the Circum-Pacific lower mantle high velocity belt proves particularly complicated with a mixture of phase-changes and up-welling zones. Here, we address such a complicated structure beneath South America by exploiting diffracted S-waveforms from a deep event beneath the South Sandwich Islands recorded by USArray. The upper mantle effects are removed by using a calibrated procedure provided by closer events. Our modeling results display a NS trending ultra-low-velocity strip, about 250 km wide, and over 1,000 km long. The pile-like structure in cross-section is 30 km high with a 10% decrease in shear wave velocity. This is overlaid by a normal perovskite to post-perovskite (PV-PPV) transition structure or a cold subducting slab debris. Such features are quite compatible with an iron-oxide mixture bulldozed by a sinking slab as suggested in some recent seismic and dynamic models.
中文關鍵字	
英文關鍵字	Diffracted waves; ULVZ; core mantle boundary; D"; Slab debris

會議室	Room 604
日期	11月17日(星期二)
時段	14:00-14:15
議程代碼	GP-O-06
議題	- Geophysics 地球物理、地球物理探勘與環境地球物理
作者	李健平(Chien-Ping Lee) [台灣中油公司探採研究所] (通訊作者)
中文題目	利用 AVO 異常分析天然氣水合物的空間分布
英文題目	
投稿類型	口頭報告 Oral
摘要	<p>天然氣水合物為地下賦存天然氣的一種形式，其以固體的狀態存在，並伴隨游離氣體。天然氣水合物為新型態的能源，過去發現於高緯度的永凍層與被動大陸邊緣深水海域的海底地層，日本與台灣周遭海域亦有發現。因天然氣為潔淨能源，如能確認天然氣水合物的分布，將有助於未來開發此潛在能源。從震測剖面的海底仿擬反射 (bottom simulating reflector, BSR) 信號可得知天然氣水合物的存在，因此 BSR 是天然氣水合物存在的一個指標。在震測剖面可看到與海床平行的 BSR 信號，但是此信號與地層層位並不一致，因此需由人工費時摘取 BSR 信號，尤其是三維震測資料。本研究嘗試利用油氣探勘的振幅隨支距變化 (amplitude versus offset, AVO) 技術分析 BSR 信號，以某一小區域三維震測的聚排 (gather) 資料分析 BSR 的 AVO 特性，確認是否有 AVO 異常與其異常類型，透過 AVO 的特性快速找出 BSR 信號的空間分布，進而瞭解天然氣水合物的空間分布。首先確認 BSR 在某一位置的同反射點聚排剖面的深度，以此深度觀察振幅隨支距的變化，用 Shuey 二項式擬合 AVO 資料點，得到截距與斜率，再由截距與斜率關係圖區分 AVO 異常類型，最後找出 AVO 異常在空間上的分布。研究結果顯示 BSR 為第三類 AVO 異常，反映出含氣地層的特性，並找出 BSR 在空間上的分布，視為天然氣水合物的分布。本技術不僅可釐清天然氣水合物的分布，更可節省人工摘取範圍的時間，未來可套用於大範圍的震測資料，提供快速且可靠的結果。</p>
中文關鍵字	天然氣水合物、BSR、AVO 異常
英文關鍵字	

會議室	Room 604
日期	11 月 17 日(星期二)
時段	14:15-14:30
議程代碼	GP-O-07
議題	- Geophysics 地球物理、地球物理探勘與環境地球物理
作者	伍允豪(Henry Y. H. Wu) [台灣中油公司探採研究所] (通訊作者) 賴光胤(K. Y. Lai) [台灣中油公司探採研究所] 黃桂奕(K. Y. Huang) [國立海洋大學地球科學研究所] 姜智文(C. W. Chiang) [國立海洋大學地球科學研究所]
中文題目	整合井、震和非震測勘資料應用於高屏地區
英文題目	Integration of Well, Seismic Reflection, and Non-seismic data in Kao-Ping Region, Taiwan
投稿類型	口頭報告 Oral
摘要	<p>本研究整合重力測勘數據，利用 Schlumberger 公司 Petrel® 構造解釋平台下之 WinGLinkIEM 重磁模組 (Gravity and Magnetic, 2018.1) 插件 (Plug-in) 進行資料處理與分析。針對布蓋重力異常數值進行頻率域濾波，於台灣西南沿海地區之剩餘重力正異常與前人研究之海域泥貫入體位置相符；而在屏東平原內以屏東九如一屏東市為界具有南北兩區塊之現象，推測屬於較淺之構造訊號為主；利用布蓋重力異常數值的一次導數進行構造邊界描繪則顯示潮州斷層邊界有向西修正之可能。在二維震測剖面構造模擬方面，於屏東平原北段 1 條東西向長構造剖面進行模擬，以及 2 條二維震測線進行井、震及非震資料整合，於民國 105 年施作之高密度重力測勘範圍內具有 3 條震測線，2 條南北向沿高屏溪兩岸進行施測，1 條東西向具有鑽井井下資料。在整合井下、二維震測以及非震 (聲頻大地電磁法, AMT 與重力) 資料進行構造解釋與分析時，是使用深度域之資料進行處理，而震測資料與非震資料 (尤指 AMT) 是在時間域或頻率域之數值資料，需要與震測資料建立時深關係。因此，利用井下聲波走時與密度測錄曲線進行合成震波比對與速度校正。此外，利用地表實測之布蓋重力異常值以順推方式驗證地下密度模型也需深度域構造形貌，因此也利用井下分層的深度與時間域解釋之層面進行校正，針對高密度重力測勘區域進行三維速度模型建立工作，最後將二維震測線以及其對應的層面解釋轉換至深度域。初步結果顯示於經過已鑽井之東西向震測線下方具有低密度異常體，其位置與泥貫入體之位置相符，此結果與民國 105 年之研究相異；而在北段利用構造地質順推結果顯示西側之旗山斷層下方之高密度異常體則與前人研究相同。本研究共完成 22 站 AMT 資料收集工作，包含一站位於高雄市茂林區之遠端參考點。在經過井下電阻率校正、一維、二維與三維逆推處理後，其結果均顯示淺層 500 至 1,000 公尺具有低電阻效應，並將三維逆推結果與震測資料疊置相互參照，初步結果顯示，淺部富含泥質地層 (包含流體效應) 可能主導低電阻率之結果，亦或淺層生物氣之富集度不佳，針對淺層生物氣之潛能評估，仍待後續其他相關研究工作之輔助，方能給予較佳之成效。</p>
中文關鍵字	井測、重力異常、聲頻大地電磁
英文關鍵字	Wireline logs、Gravity anomaly、Audio Magnetotellurics (AMT)

會議室	Room 604
日期	11月17日(星期二)
時段	14:30-14:45
議程代碼	GP-O-08
議題	- Geophysics 地球物理、地球物理探勘與環境地球物理
作者	張翠玉(Emmy T.Y. CHANG) [台灣大學海洋研究所] (通訊作者) Laetitia Mozziconacci [Institute of Applied Geosciences, National Taiwan Ocean University]
中文題目	
英文題目	Earthquake Driven Hydration and Dehydration Processes: A Case Study from the Northern Manila Subduction Zone
投稿類型	口頭報告 Oral
摘要	Fractures in subducting plates are considered important carriers for the transport of fluid into mantle wedges. However, the evolution of petrology processes associated with the faulting of plates is not well understood. In this paper, the seismic characteristics of two intraplate earthquake sequences located in the northern Manila subduction system provided information for a hydration mechanism within the subducting South China Sea plate. The seismic sequences in this study were small-to-moderate events. The sequences were acquired by two ocean-bottom seismometer networks individually deployed on the frontal accretionary wedge in 2005 and the outer trench slope in 2006. The seismicity retrieved in 2005 varied with time and space and is considered to be an over-pressured burst sequence. Because the V_p/V_s ratios were high for the lower crust of the subducting plate, it is suggested that dehydration occurred as the temperature and pressure increased during subduction. The seismicity retrieved in 2006 from earthquakes detected on the outer slope were the aftershock events of an extensional-faulting sequence. They formed two distinct fault planes with different dip angles and high seismic activity during the experimental period. Using focal mechanism determination, these aftershock events exhibited the important components of strike-slip and reverse mechanisms, which demonstrated that the stress regime in a subduction system is strongly subject to relative plate motion and regional accommodation. The varying lithology with depth in the subducting plate was discussed, and verification of the Moho boundaries in association with water transport processes within the subducting plate were proposed. By providing near-field observations of two earthquake sequences occurring before and after subduction, we were able to contrast their seismic characteristics and take a close look at the hydration and dehydration processes that occur at different stages within a subducting plate.
中文關鍵字	
英文關鍵字	Ocean-bottom seismometer, velocity model, seismic focal mechanisms, northern Manila Trench, over-pressured burst sequence, subducting plate hydration

會議室	Room 604
日期	11月17日(星期二)
時段	14:45-15:00
議程代碼	GP-O-09
議題	- Geophysics 地球物理、地球物理探勘與環境地球物理
作者	陳浩維(How-Wei Chen) [中央大學地球科學系暨地球物理研究所] (通訊作者) 法東尼(Fandy Adji Fachtony) [中央大學地球科學系暨地球物理研究所]
中文題目	波場延拓反演-快速穩定有效的震測資料反算研發
英文題目	Extended Wavefield Inversion – An Efficient and Stable Optimization Development for Seismic Data Collected in Taiwan
投稿類型	口頭報告 Oral
摘要	<p>The fundamental restrictions utilize current available seismic data posed several challenging issues: different types of instruments and dataset, inconsistent clock time and spatiotemporal sampling rate, sparse or overly concentrated source and receivers spacing, severe near-surface effects affected by large (topography) elevation changes and strong laterally varying velocity distribution and unclear local or regional reference model including source and receiver site conditions. The goal of my talk emphasis the proposed approach through constrained wave field inversion; cross validation through forward simulation with high and broad frequency contents; pre-stack depth migration to extract addition information on the possible existing reflectors beyond the depth not sampled by the transmitted rays. Feasibility studies of wavefield inversion were tested through three crustal scale synthetic models: (1) flat layer model, (2) model with elevation statics effect, (3) model with near-surface effects that containing both topography changes and laterally varying velocity variations. Wavefield inversion of input dataset with separate effects were inverted to test its feasibility. Furthermore, correction of near-surface effects by wave equation based upward or downward datuming through wavefield continuation process are further investigated. The estimated velocity profile together with uncertainty can be derived promptly (less than ten minutes) from input data containing different frequency range. Inversion is robust and stable for all test models. Near-surface effects can be compensated through wave-equation datuming processes follow by wavefield inversion. For quality check, the inverted velocity is further verified through travel-time calculations and fits to the input data. Cross-validation between the record data and multi-frequency forward simulation responses provide additional quantitative evaluation.</p>
中文關鍵字	波場逆推,淺地層效應,基準面修正,理論,印證,模擬驗證,穩定,快速,有效
英文關鍵字	Wavefield inversion, Datum, Near-surface effect, Theory, Verification, Synthetic, Stable, Efficiency

會議室	Room 604
日期	11月17日(星期二)
時段	15:00-15:15
議程代碼	GP-O-10
議題	- Geophysics 地球物理、地球物理探勘與環境地球物理
作者	法東尼(Fandy Adji) [National Central University] (通訊作者) How-Wei Chen [National Central University]
中文題目	
英文題目	Wavefield Inversion for Deep Structure Imaging Along TAIGER T6 Line, Northern Taiwan
投稿類型	口頭報告 Oral
摘要	TAIGER T6 transects is one of the four crustal-scale Wide Angle Refraction/Reflection (WARR) survey lines under TAIwan Integrated GEodynamics Research (TAIGER) project conducted in 2008 in Taiwan. The north main array consist of five shot points (N1, N2, N3, N3P and N4) across northern Taiwan from west to east cover ~100km of distance. A total of 456 TEXAN geophone sensors deployed with receiver interval of ~200m on average. Constrained wavefield inversion were performed on four shot gather dataset collected along TAIGER T6 transects line. Constrained wavefield inversion strategies include inversion of several subsets of seismic data, upward or downward datuming of recorded data follow by inversion, travel-time verification, extend the 1D to quasi-2D velocity profile sampled by the ray bottoming points, multi-frequency waveform syntheses and similarity evaluation between recorded and synthetic data. From inverted velocity model, fairly distinct basin structure in the coastal plain, laterally varying near surface velocity distribution, Li Shan Fault and elevated high velocity distribution below the Hsuehshan Range and Central Range are well-depicted. For data along T6 line, the maximum inverted frequencies is 8 Hz. Quality check on the final velocity model through multi-frequency waveform simulations and travel time residual distributions show good fit with minimum error compared to the real data. Comparison and validation of proposed model with several published models along T6 line show obvious improvement with sufficient accuracy and resolution through limited datasets. The large scale velocity structure feature in the proposed velocity model has consistent results compare to the published model by Avendonk et al (2016).
中文關鍵字	
英文關鍵字	Wavefield Inversion, Wave-Equation Datuming, Travel Time Inversion, TAIGER Project

會議室	Room 606
日期	11月17日(星期二)
時段	14:00-14:15
議程代碼	T2-O-01
議題	- Tectonophysics 大地構造及造山作用
作者	譚諤(Eh Tan) [中研院地球所] (通訊作者)
中文題目	呂宋弧前地塊消失到那去？
英文題目	The fate of Luzon forearc and its tectonic implications
投稿類型	口頭報告 Oral
摘要	The Eurasia plate is subducted under the Luzon Arc at the Manila trench. South of 21N, the Luzon forearc (defined as the region between the arc and the offshore Hengchun Ridge) is about 80 km long. The forearc length gradually decreases north of 21N and eventually disappears at 23N. Several hypotheses try to explain whereabouts the disappeared forearc is: 1) the forearc is underthrust underneath the arc, 2) the forearc overthrust above the Central Range and is later eroded away, 3) the forearc is underthrust beneath the Central Range, and 4) the forearc is subducted with the Eurasian plate. We tested each hypothesis with numerical thermo-mechanical models. The tectonic consequences in the numerical models of each hypothesis indicate that hypothesis 4 is the preferred scenario.
中文關鍵字	地體動力 花東海盆 呂宋島弧 碰撞
英文關鍵字	geodynamics, Huatung basin, Luzon arc, collision

會議室	Room 606
日期	11月17日(星期二)
時段	14:15-14:30
議程代碼	T2-O-02
議題	- Tectonophysics 大地構造及造山作用
作者	蘇柏立(Po-Li Su) [國立中央大學地球科學學系] (通訊作者) 陳伯飛(Po-Fei Chen) [國立中央大學地球科學學系] 王乾盈(Chien-Ying Wang) [國立中央大學地球科學學系]
中文題目	台灣東北部地下三維高解析度 P 波速度構造與其地體構造意涵
英文題目	High-resolution 3-D P wave velocity structures under NE Taiwan and their tectonic implications
投稿類型	口頭報告 Oral
摘要	<p>First P wave arrival-time data from local earthquakes recorded by a dense geophone array deployed on the Ilan Plain and by existing permanent stations were combined to invert for high-resolution P wave velocity structures under northeast Taiwan. With relatively high resolution, we were able to examine the structures in more detail and to investigate their significance and tectonic implications. We introduce two distinct groups of proposals for mechanisms of subduction polarity flipping in Taiwan, referred to as the “tear model” and “breakoff model.” While the predicted boundaries of the Philippine Sea Plate – the junction with the Eurasian Plate in eastern Taiwan and the west edge beneath northern Taiwan – differ between the two models, those of the breakoff model are geodynamically similar to those predicted by the subducting indenter model (Wu et al., 2009). The surface junction as extrapolated and the west edge as determined by the imaged high Vp anomalous Philippine Sea Plate in this study comply with those predicted by the subducting indenter model and thus favor the breakoff model over the tear model. While the observed high Vp anomalous region in the mantle wedge can be explained as eclogitization of previously subducted crust, eclogitization of the overriding continental crustal roots cannot be ruled out. The low Vp anomalies beneath the Taipei Basin and the Tatun Volcano Group exhibit a pattern potentially connected to the low Vp anomalies in the mantle wedge, suggesting the involvement of the Philippine Sea slab, either by asthenospheric upwelling due to extensional collapse or by fluid migration due to slab dehydration. The low Vp anomalies beneath the Ilan Plain exhibit a pattern extending to deeper origins in the eastern offshore region, suggesting a connection with the opening of the Okinawa Trough.</p>
中文關鍵字	地震層析成像, 菲律賓隱沒板塊, 隱沒方向反轉
英文關鍵字	High-resolution P-wave tomography, Philippine Sea Plate subduction in Taiwan, Subduction polarity flipping

會議室	Room 606
日期	11月17日(星期二)
時段	14:30-14:45
議程代碼	T2-O-03
議題	- Tectonophysics 大地構造及造山作用
作者	宋聖榮(Song, Sheng-Rong) [台灣大學地質科學系暨研究所] (通訊作者)
中文題目	
英文題目	Debris Avalanche Deposits in the Wushihpi Area of Coastal Range, Eastern Taiwan: Implications for Sedimentation and Tectonics of Arc-Continent Collision
投稿類型	口頭報告 Oral
摘要	<p>Wushihpi is located at the south Coastal Range, eastern Taiwan and is predominantly composed of the volcanic rocks, which are interbedded in the Paliwan Formation. Based on the field surveys, different occurrences of volcanic lithofacies have been recognized in outcrops. They are pillow breccias with and without white vesicle fillings, hyaloclastites, peperites rich and poor in zeolite fillings, lahars, lava flows with columnar structures, weathered brownish and reddish blocks in tuffaceous conglomerates and limestones. Those lithofacies can be grouped into three volcanic facies, the shallow marine, transitional from submarine to subaerial facies and subaerial facies. Those facies occur together chaotically and contact sharply. It infers that the volcanic rocks occurred in Wushihpi is debris avalanche deposits and the source may come from different stratigraphic sequences of the Tulunshan volcanics, the major eruption products of Luzon Arc. Meanwhile, similar occurrences of debris avalanche deposits as huge blocks are also widely distributed in whole Coastal Range from the north to the south and Lutao. Those observations suggest that the sedimentation of debris avalanche and tectonics of slope failures may play major roles for denudation of volcanic arc during Taiwan arc-continent collision.</p>
中文關鍵字	
英文關鍵字	Debris avalanche deposits, Coastal Range, Paliwan Formation, Tulunshan volcanics

會議室	Room 606
日期	11月17日(星期二)
時段	14:45-15:00
議程代碼	T2-O-04
議題	- Tectonophysics 大地構造及造山作用
作者	張秋蓮(Chiu-Lien Chang) [國立臺灣大學地質科學系暨研究所] (通訊作者) 陳文山(Wen-Shan Chen) [國立臺灣大學地質科學系暨研究所]
中文題目	臺灣北部和平溪上游變質花崗岩與變質礫岩層的地質意義
英文題目	The geologic significance of the meta-granitoid and the meta-conglomerate in the Hoping River, Northern Taiwan
投稿類型	口頭報告 Oral
摘要	<p>大南澳片岩上覆的板岩層一般認為是由來自西側華南提供的碎屑沉積物推積而成，然而年代的缺乏，使得兩者之間的不整合年代有所爭議。野外調查發現，臺灣北部和平溪上游（包含奇瑤谷和南湖區域）出露的變質礫岩（E 礫岩）為大南澳片岩與上覆板岩層的不整合面。兩區域變質礫岩（E 礫岩）的礫石組成，奇瑤谷地區為片岩、變質燧石、石英岩與變質花崗岩礫石，南湖區域為變質燧石和石英岩礫石，雖有明顯差異，但礫石組成顯示來自下伏大南澳片岩（含碧綠層）與變質花崗岩（奇瑤谷變質花崗岩），顯示當時東側可能為高區，提供沉積物來源。為了驗證此假說，本研究藉由碎屑鋯石鈾鉛定年法，探討不整合面（E 礫岩）以及奇瑤谷變質花崗岩的年代，利用地球化學分析，討論變質花崗岩原岩的成因，並藉由碎屑鋯石頻譜討論沉積物侵蝕來源，進而探討當時臺灣地體架構演變。根據碎屑鋯石鈾鉛定年分析結果，顯示奇瑤谷變質花崗岩最年輕碎屑鋯石族群為 $74.8 \pm 1.7\text{Ma}$ (MSWD=0.38, n=6)。地球化學分析資料，呈現奇瑤谷變質花崗岩的原岩，為弧陸碰撞環境下所形成的火山弧 I-type 花崗岩。此外，對比 E 礫岩及其下伏地層（大南澳片岩）的碎屑鋯石頻譜，顯示 E 礫岩的礫石主要侵蝕來自東側的大南澳片岩與變質花崗岩，而非由西側華南所提供，代表當時東側基盤受南澳運動影響，被抬升露出水面，形成古中央山脈，受到侵蝕而沉積礫岩層。E 礫岩的碎屑鋯石頻譜結果，呈現落在鋯石年齡族群三角圖（ternary diagram）的白堊紀，與以礫岩為基底生長的珊瑚化石（\leq Eocene）有明顯年代落差，此結果表示鋯石年齡族群三角圖，對於接收來自西側華南沉積物的地層（如西部麓山帶、雪山山脈與脊梁山脈西翼等），具良好的沉積年代指示意義，但對侵蝕來自東側大南澳片岩的脊梁山脈東翼部分地層而言，三角圖所得出的年代，無法代表其沉積年代，因此碎屑鋯石年齡族群三角圖的應用，需注意再積性問題。根據兩區域的野外調查、變質礫岩的礫石組成與碎屑鋯石頻譜結果，推斷奇瑤谷地區的碧綠層已被侵蝕殆盡，南湖地區則仍保留部分碧綠層。</p>
中文關鍵字	大南澳片岩, 變質礫岩, 變質花崗岩類, 碎屑鋯石鈾鉛定年
英文關鍵字	Tananao schist, Meta-conglomerate, Meta-granitoid, Detrital zircon U-Pb dating

會議室	Room 606
日期	11月17日(星期二)
時段	15:00-15:15
議程代碼	T2-O-05
議題	- Tectonophysics 大地構造及造山作用
作者	李芳儀(Fang-Yi Lee) [臺灣大學海洋研究所] (通訊作者) 張翠玉(Emmy T.-Y. Chang) [臺灣大學海洋研究所] 譚諤(Eh Tan) [中央研究院地球科學研究所]
中文題目	滑脫面深度對地表斷層發育之影響
英文題目	Surface Faults under Varied Décollement Depths
投稿類型	口頭報告 Oral
摘要	<p>The surface fault systems develop in-between the free surface and a décollement under thin-skinned deformation. "Décollement" is the boundary separating the surface deformed layer from the little deformed one laying below. In this research, we perform numerical modeling to investigate how the characteristics of the décollement and surface processes influence the surface thrust developments. First, the depth of the décollement controls the confining pressure at the base of the deforming layer. The interior normal stress is proportional to the confining pressure, and the shear yield stress is a function of normal stress. The thickness of the deformed layer above the décollement is hence primary in discussing the formation of faults. The frictional strength of the décollement is also important due to its effect on scaling shear stress. Furthermore, the surface geological processes can dynamically change the confining pressure by modifying the topography. In this study, we adopt DynEarthSol to simulate the thrust belts evolving in time and space. A 2D flat-layer geometry is taken with a lateral expansion of 200 km. The mechanically weak layers are designed at 3, 6, and 9 km to mimic the varied décollement depths in the field. Lateral convergence set by a leftward motion in a velocity of 5 cm/yr from the right side. Our simulations run in 80,000 years for each experiment, which makes a lateral shortening of 40 km. Our result demonstrates that the first order deformation for all experiments is the thrust belts developing in-sequence. A high-friction décollement creates a steep critical wedge. Active surface processes erode the uplift materials during thrusting and retard the propagation of failure at the décollement. High-friction décollement and large surface erosion cause large displacements along thrusts. Most of the thrusts develop with their conjugate backthrust and form pop-up structures. The length of pop-up structures is a function of the décollement depth.</p>
中文關鍵字	數值模擬、滑脫面深度、薄皮變形、突起構造
英文關鍵字	numerical simulation, décollement depths, thin-skin deformation, pop-up thrust system

會議室	Room 606
日期	11月17日(星期二)
時段	15:15-15:30
議程代碼	T2-O-06
議題	- Tectonophysics 大地構造及造山作用
作者	張頌平(Sung-Ping CHANG) [國立台灣大學海洋中心; CNRS UMR 8538, Laboratoire de Géologie, Ecole Normale Supérieure, PSL Research University, France] (通訊作者) Manuel Pubellier [CNRS UMR 8538, Laboratoire de Géologie, Ecole Normale Supérieure, PSL Research University, France] SN Fathiyah Jamaludin [Petroleum Geosciences, Universiti Teknologi PETRONAS, Perak, Malaysia] Chee Ming Choong [Petroleum Geosciences, Universiti Teknologi PETRONAS, Perak, Malaysia]
中文題目	後造山時期泥灌入體之大地構造演化：以婆羅洲北部為例
英文題目	The Tectonic Evolution of Mud Diapirism during the Post-Orogeny Period in the Kudat Area, North Borneo
投稿類型	口頭報告 Oral
摘要	Paleogene convergence resulted in a fold-and-thrust belt in the Borneo and Palawan area, caused by the subduction of Proto-South China Sea slab. The front of the wedge was continuously active during the post-orogeny period, and a coeval of slab detachment generated granitic intrusion, which is currently expressed as a 4000-meter mountain in the northern Borneo. During the same period, the shallow accretionary wedge concerned with deformation as a result of diapirs as well as anticlinal/synclinal features in the offshore and the onshore. However, the mechanism of remobilization and the occurrences of diapirs are rarely understood. This study integrates the seismic profiles, field observation, and topographic interpretation to discover the genetic link in tectono-stratigraphy from the late orogeny to post-orogeny periods. A layer with chaotic seismic facies shows various thickness along with the seismic profiles, connecting to mushroom-shaped diapirs that pierce the overlying strata. Seismic images illustrate this layer mobilized in two phases, and their boundary is present by an angular unconformity, dated circa 14 Ma from bio-stratigraphy. The lower diapirism involved on the top of the wedge and was sealed by the unconformity delineating the termination of orogeny. The upper strata were deformed mainly around diapirism in consequence of the synclines and anticlines. The core of the mobile layer exposed to the surface characterizes a matrix-supported unit containing ophiolitic blocks, suggesting the origin of mélangé. We, therefore, propose that diapiric process was initiated with accretionary wedge and remobilized during post orogeny in a coeval of magmatic intrusions. This magma-related uplift resulted in the slope instability and triggered the mélangé to remobilize as diapirism in the offshore Borneo.
中文關鍵字	泥灌入體; 後造山時期; 婆羅洲
英文關鍵字	Mud Diapir; Post-orogeny; Borneo

會議室	Room 607
日期	11 月 17 日(星期二)
時段	14:00-14:15
議程代碼	M1-O-01
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	景國恩(Kuo-En Ching) [國立成功大學] (通訊作者) 謝尊堯(Tsun-Yao Hsieh) [國立成功大學] 楊名(Ming Yang) [國立成功大學]
中文題目	泥貫入體促成車瓜林斷層之潛移行為
英文題目	Creep on the Chegualin Fault Caused by Mud Diapir
投稿類型	口頭報告 Oral
摘要	<p>位於臺灣西南部長約 25 公里之車瓜林斷層呈東北走向，在地質上被判釋為逆衝斷層。然而，根據 2016 年美濃地震前之測地資料指出，該斷層在國道三號田寮三號高架橋下通過，為具有左移分量傾角約 30°-40°之逆衝斷層。根據斷層模擬結果指出，該區域跨越車瓜林斷層之地表速度梯度無法被斷層模型所擬合，且鎖定深度僅約 110-140 公尺左右，據潛移特性。此外，車瓜林斷層西南端往西延伸之構造線形會通過高鐵路線，根據 2016 年中至 2019 年底由台灣高鐵公司提供之測地資料分析結果指出，相對於澎湖白沙 S01R 站，構造線形南側之水平速度較北側快約 10 mm/yr 朝 N269°方向運動；線形南側之垂直速度場也較北側抬升約 2-3 mm/yr。透過速度剖面與斷層模型分析，同樣指出跨斷層之地表速度梯度無法完全由斷層模型擬合，且斷層面近乎垂直，以右移為主，同樣呈潛移行為。從構造力學的角度來看，同一條斷層之運動行為應該要相當接近，然而車瓜林斷層在現今的運動行為卻截然不同，皆顯示為潛移的行為，也皆無法完全用斷層活動來解釋全部的地表運動行為。由於這兩個地區皆有現生泥火山的發育，且泥火山往往指示泥貫入體的存在，因此本研究推測車瓜林斷層現今之運動行為和泥貫入體之活動有關。</p>
中文關鍵字	車瓜林斷層、泥貫入體、測地資料、斷層模型
英文關鍵字	Chegualin fault, Mud diapir, Geodetic data, Fault model

會議室	Room 607
日期	11 月 17 日(星期二)
時段	14:15-14:30
議程代碼	M1-O-02
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	陳松春(Song-Chuen Chen) [經濟部中央地質調查所資源地質組] (通訊作者) 景國恩(Kuo-En Ching) [成功大學測量及空間資訊學系] 羅祐宗(Yu-Tsung Lo) [中央大學地球科學學系] 陸挽中(Wan-Chung Lu) [經濟部中央地質調查所資源地質組]
中文題目	台南及中洲背斜之泥貫入體特徵及地質安全
英文題目	Mud diapiric characters and geohazards of the Tainan and Chungchou anticlines
投稿類型	口頭報告 Oral
摘要	<p>在 1970 年代，中國石油公司先進根據鑽井、震測及重力等資料，指出臺灣西南部之陸上背斜構造(台南背斜、中洲背斜、鳳山背斜及屏東背斜)是泥貫入體構造，後續許多研究也指出海陸泥貫入體的關聯性，但都以海陸線性關係來推論，缺乏直接證據，因此，陸域泥貫入體的存在一直都在被論證著。直到 2013 年中油公司根據新的鑽井及震測資料，證實鳳山背斜是泥貫入體構造，並且可和海域泥貫入體相連接，才再度吸引學研界關注海陸域泥貫入體構造關聯的議題。 本研究調查區位在台南背斜及中洲背斜，經由蒐集與調查分析各種地質、地球物理及大地觀測資料，嘗試解析泥貫入體在台南地區構造發育中扮演的角色。根據鑽井地質剖面資料指出，台南及中洲背斜是在高壓力環境下發育的泥基背斜。台南及中洲背斜有多處正重力異常高區呈局部分布在軸部及側翼，這和典型背斜在軸部呈現連續的正重力異常高區不同。另此二背斜向外海延伸處，分別各有 1 處海域泥貫入體相對應，其形貌和台南及中洲背斜相似。故本研究認為台南及中洲背斜是泥貫入體構造，並且可和海域泥貫入體相連結。 沿著這兩個背斜構造，已發現超過 10 處的建築物受到抬升損壞，結合大地測量之觀測結果，顯示泥貫入體現今正持續活躍抬升中。長期而言，位於中洲背斜的二重溪層/下部古亭坑層老於台南背斜的六雙層/上部古亭坑層；且同一全新世沉積層在台南及中洲背斜分別呈水平及傾斜狀，顯示中洲背斜的長期抬升速率高於台南背斜。 本研究透過跨越台南背斜東緣(跨越三爺宮溪)之地電阻探測資料，發現位於後甲里斷層東側且平行於它的三爺宮溪具有正斷層特徵，本研究命名為「三爺宮斷層」，這正斷層可能是部分研究認為後甲里斷層正斷層的位置。本研究認為，受到上新世以來蓬萊造山運動的大地構造擠壓力，台南背斜因泥貫入體抬升，在東翼造成三爺宮正斷層，並在後來之泥貫入體背斜上方發育後甲里背衝斷層。</p>
中文關鍵字	台南背斜、中洲背斜、泥貫入體、後甲里斷層
英文關鍵字	Tainan anticline, Chungchou anticline, mud diapir, Houchiali fault,

會議室	Room 607
日期	11 月 17 日(星期二)
時段	14:30-14:45
議程代碼	M1-O-03
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	溫怡瑛(Yi-Ying Wen) [中正大學 地球與環境科學系] (通訊作者) 景國恩(Kuo-En Ching) [成功大學 測量及空間資訊學系] 饒瑞鈞(Ruey-Juin Rau) [成功大學 地球科學系]
中文題目	Coseismic inelastic deformation during the 2016 Mw 6.4 Meinong Earthquake, Taiwan
英文題目	
投稿類型	口頭報告 Oral
摘要	The coseismic deformation caused by seismogenic source has been well studied and simulated. Therefore, it is a puzzle why an unexpectedly aseismic large-scaled uplift was detected by geodetic observations during the 2016 Mw 6.4 Meinong earthquake, Taiwan, which occurred in the thick mudstone region. Using both high-rate GPS and free-field strong motion data, the aseismic surface displacements during the earthquake were differentiated and were first verified as the earthquake-induced inland mud diapirism. Before this event, the geological hazard caused by mud diapir was usually ignored or underestimated. However, the mud diapirs broadly occupy the metropolitan area in southern Taiwan, it is important and necessary to consider the threat and uncertainty of mud diapir in the earthquake hazard assessment.
中文關鍵字	同震非彈性變形、泥貫入體、2016 美濃地震、高頻 GPS
英文關鍵字	coseismic inelastic deformation, mud diapirism, 2016 Meinong earthquake, high-rate GPS

會議室	Room 607
日期	11月17日(星期二)
時段	14:45-15:00
議程代碼	M1-O-04
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	盧志恒(Chih-Heng Lu) [國立臺灣大學地理環境資源學系] (通訊作者) 莊昀叡(Ray Y. Chuang) [國立臺灣大學地理環境資源學系] 江秉宸(Ping-Chen Chiang) [國立臺灣大學地理環境資源學系]
中文題目	美濃地震的震後地表變形對台灣西南部大眾運輸設施的潛在危害
英文題目	The potential damages of infrastructure caused by the surface deformation after Meinong earthquake in southwest Taiwan
投稿類型	口頭報告 Oral
摘要	<p>活動斷層的活動特性一直以來是許多科學家關心的議題，藉由許多大地測量技術，如 GNSS、InSAR 和水準測量等，所量測到的空間位移資訊，已能有效獲得同震和間震時期的地表變形量，進而圈繪可能的自然災害分佈範圍，以及評估對公眾建設影響的程度，所以鄰近或是跨越活動斷層的工程建設，在規劃時期都會考量場址的地質條件，對其結構物的潛在損害進行評估。然而，每次強震之後在到達間震時期之前的這段震後時期，整個區域的應力需要調整以達到平衡階段，因此可能誘發某些次構造活動而造成地表變形，這些震後的地表變形是不容易被監測到，同時對於公眾設施影響的相關研究也相對稀少。因此，本研究將利用 Sentinel-1 雷達衛星影像分析美濃地震震前後台灣西南部的地表變形差異，並探討震後位移對於大眾運輸設施的潛在影響。本研究使用永久散射體差分干涉技術分析 166 幅 Sentinel-1 雷達衛星影像（升軌 89 幅、降軌 77 幅），時間自 2014 年 10 月至 2018 年 12 月，並且搭配 GNSS 修正空間上的誤差，進而解算出地震前後地表於東西和垂直方向的變動量。結果顯示，地震前後新化斷層一路延續至後甲里斷層有 10mm/yr 的垂直差異量；左鎮斷層、小崗山斷層和旗山斷層所包圍的區域有 20-40mm/yr 的垂直差異量，其中小崗山和旗山斷層之間還有 10mm/yr 的東西方向差異量。進一步分析鄰近快速道路的永久散射點，除了跨越斷層兩側的位置之外，在震後的西部麓山帶構造線上，也有高達 40mm/yr 的垂直和±20mm/yr 的東西方向位移速率；靠近鐵路和高速鐵路的永久散射點，除了在新化斷層和後甲里斷層連線上具有明顯的變形梯度外，在部分構造線延伸的線段上也有震後 20mm/yr 的位移速率，部分高鐵路段的震後地表變形量已能提供設施容許變形值每年 1-3% 的貢獻量。本研究建議未來的工程建設除了需考慮同震和間震的地表位移量之外，也需要考量震後地表變形所造成的影響，打造更安全、更耐久的公共建設。</p>
中文關鍵字	震後地表變形、自然災害、雷達差分干涉、公共建設
英文關鍵字	post-seismic surface deformation, nature hazard, InSAR, infrastructure

會議室	Room 607
日期	11月17日(星期二)
時段	15:00-15:15
議程代碼	M1-O-05
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	彭國瑛(Kuo-Ying, Peng) [中央研究院地球科學研究所] (通訊作者) 李建成(Jian-Cheng, Lee) [中央研究院地球科學研究所] 劉家瑄(Char-Shine, Liu) [國立台灣大學海洋中心]
中文題目	台灣西南褶衝帶增積岩體泥貫入體變形構造分析
英文題目	Structural Characteristics of Diapiric ridge in an Accretionary Wedge Under Mountain Building: Connection Between Offshore and Onshore in Southwestern Taiwan
投稿類型	口頭報告 Oral
摘要	<p>本研究以台灣西南部為例，來探討增積岩體泥貫入體，包括變形構造特徵、形成機制、變形速率、泥貫入體上拱與板塊聚合擠壓褶皺的交互關係等。台灣西南部為歐亞大陸板塊及菲律賓海板塊弧陸碰撞的構造過渡帶，近海及遠洋沉積物因隱沒及造山運動而形成增積岩體，富含流氣體的沉積物受到水平方向的擠壓，於增積岩體上形成一系列平行排列的泥貫入體。我們利用陸海結合不同的資料，包括野外調查、反射震測資料等，並綜合文獻研究的井測及重力資料，建構新的陸上及海域的地質剖面。基於台灣西南部泥貫入體多伴隨著背斜褶皺構造及逆衝斷層，本研究嘗試分析探討這些背斜褶皺的形成機制，有多少是由泥貫入體上拱所形成？有多少是上部地殼的擠壓？我們結合陸域及海域的分析，可以發現陸上的台南背斜與外海泥貫入體 MD14 是相連接的。我們建立了兩套抬升機制運動學模型，來模擬沈積及變形的演化過程：1) 泥貫入體上拱褶皺模型及 2) 斷層及擠壓褶皺模型。「泥貫入體上拱褶皺模型」是先排除水平構造擠壓所導致的變形，而計算泥貫入體作用造成的抬升量及水平縮短量（地層面長度改變）；「斷層及擠壓褶皺模型」則是考慮後甲里斷層地下幾何（參考既有文獻資料），並以台南台地水準測量近二十年來平均的抬升量分佈為資料。我們陸海比對的運動學分析得出以下結果。綜合兩個模型結果顯示，台南背斜及外海 MD14 由泥貫入體上拱褶皺的貢獻比較大，斷層及擠壓褶皺的比例比較小。在探討泥貫入體與同沉積作用的關係上，我們發現台南背斜及外海 MD14 的泥貫入體上拱為間歇性的。由震測剖面的仔細分析，我們可以在深度兩公里範圍內，區分出五個不同時期：3-5 個貫入活躍期與休止期。我們進一步利用文獻陸海的沉積速率，陸上為第四紀沈積速率（0.15 mm/yr），海域為海床沈積物同位素定年（0.0625mm/yr），計算出各個貫入活躍期的年代，由老而新分別為 82-55 萬年、55-39 萬年、39-15 萬年、15-0 萬年。泥貫入體活躍度推測可能與流體的豐度有關，我們的結果也暗示泥貫入體的運動或許與冰河期的循環有一些關連。</p>
中文關鍵字	泥貫入體、台灣西南部構造
英文關鍵字	Mud diapir, Diapir, Southwestern Taiwan

會議室	Room 607
日期	11月17日(星期二)
時段	15:15-15:30
議程代碼	M1-O-06
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	溫士忠(Strong Wen) [國立中正大學地球與環境科學系] (通訊作者) 溫怡瑛(Yi-Ying Wen) [Department of Earth and Environmental Sciences, National Chung Cheng University] 陳映年(Ying-Nien Chen) [Department of Earth and Environmental Sciences, National Chung Cheng University] 黃有志(Yu-Chih Huang) [National Center for Research on Earthquake Engineering] 張議仁(Yi-Zen Chang) [National Center for Research on Earthquake Engineering]
中文題目	台灣西南部活動構造微震觀測及其應用
英文題目	The Observation of Micro-earthquakes and Application in Active fault Zones in SW Taiwan
投稿類型	口頭報告 Oral
摘要	<p>在台灣西南部，大多數斷層活動發生在上部地殼深度約在 10~15 公里範圍內。根據早期的研究，本研究區位於被稱為旗山轉型斷裂帶的區域其走向呈現西北-東南方向具左旋走滑機制。從過去三次中強地震的餘震空間分佈來看，總體趨勢與旗山轉型斷裂帶或多或少平行，但與先前已知的斷層系統無關。是故，西北-東南走向的左鎮斷層很可能是旗山轉型斷裂帶的地面特徵，且這一斷層在台灣西南麓山帶的地質構造南北兩側的地質意義非常重要。另外，從地球物理證據顯示，研究區內龍船地區亦存在流體壓力異常高的區域和深度深於 4 公里的逆衝雙重斷層結構，其異常壓力帶的起源是由於古亭坑層的高流體壓力覆蓋在低滲透頁岩主導的蓋層岩上，同時也意味著高壓、高流體及高微震發生率的來源。從以往研究顯示小地震現象是岩體破壞失穩發生前給出的重要資訊，研究岩體變形破壞過程的微地震特徵對於預報岩體破壞、或大地震前之地殼活動具有重要意義。先前研究結果亦指出，地震矩張量中的非雙力偶震源分量所佔比重控制著微震的破裂行為，這可能導因於地下流體遷徙產生新形成的裂隙，造成岩體體積因應力調整產生部分補償所致。因此，從反演獲得的震源參數可作為了解地下破裂細部的物理狀態，並可用於調查斷層帶的孕震結構。故本研究針對台灣西南部重要活動斷層及其附近地區，分區施行精密微震測量，並分析微震之震源分佈、震源機制與構造成像來探討台灣西南部若干活動構造及其鄰近地區之局部應力場、地震活動模式與斷層的相關性，歸納彙整斷層區孕震構造完整的輪廓與脈絡並探討西南部造山帶前緣地殼變形及其地震構造特性，作為地震危害評估的基本資料。</p>
中文關鍵字	微震監測、造山帶變形前緣、大地應力、孕震構造
英文關鍵字	microseismicity、the deformation front of orogenic belt、tectonic stress、seismogenic structure

會議室	Room 608
日期	11月17日(星期二)
時段	14:00-14:15
議程代碼	G3-O-01
議題	- Geodesy 遙感探測技術
作者	林玉儂(Yunung Nina Lin) [中央研究院地球科學所] (通訊作者) 陳奕靖(Yiching Chen) [中央研究院地球科學所] Cheryl Tay Wen Jing [Earth Observatory of Singapore, Nanyang Technological University] Sang-ho Yun [Jet Propulsion Laboratory] Emma Hill [Earth Observatory of Singapore, Nanyang Technological University]
中文題目	
英文題目	A Tile-growing Flood Detection Approach for Urban and Rural Flood from SAR Intensity Images
投稿類型	口頭報告 Oral
摘要	<p>Synthetic aperture radar (SAR)-based flood mapping has the capability to identify both open-water floods and urban floods. As these two flood types demonstrate different backscattering mechanisms (forward vs. double-bounce) and patch geometry (large and intact vs. small and fractal), the statistical properties of their SAR intensities should be separately considered for more accurate flood mapping. Here we introduce a bottom-up tile-growing procedure to extract the flood statistics from the z-score image normalized from the multi-temporal SAR intensity stack. The z-score image is first split into small and equal-sized tiles, each fitted with a three-Gaussian curve to its histogram. For those tiles that pass our pre-assigned fitting thresholds, the following rounds of curve fitting work on the neighboring tiles sequentially until each individual tile is either merged into one large patch or discarded. Finally we interpolate the mean and standard deviation from the large patches, and compute the Bayesian flood probability for the whole image. This bottom-up linear processing approach, as compared to the top-down hierarchical splitting procedure proposed by Chini et al. 2017, allows efficient parallelization and hence significantly shortens the runtime. We test this procedure on the 2016 Hurricane Matthew flood in Lumberton, North Carolina, USA and the 2019 Typhoon Hagibis flood in Kawagoe, Japan. We also test different tile sizes for the detection of rural floods and urban floods. With manually-created validation datasets, we obtain overall/urban accuracy of 0.84/0.68 for Lumberton area (more urban flood) and 0.85/0.82 for Kawagoe area (more rural flood). The validation results also confirm that smaller tiles are needed in order to extract the statistics of the urban floods.</p>
中文關鍵字	
英文關鍵字	Bayesian probability, Change detection, synthetic aperture radar, urban flood

會議室	Room 608
日期	11月17日(星期二)
時段	14:15-14:30
議程代碼	G1-O-07
議題	- Geodesy 測地學與活動地殼變形
作者	陳冠宏(KUAN-HUNG CHEN) [國立交通大學] (通訊作者)
中文題目	臺灣沖積平原重力變化調查
英文題目	Investigation of Gravity Fluctuations in Alluvial Plains in Taiwan
投稿類型	口頭報告 Oral
摘要	<p>造成短期(數日至數月)重力變化的原因，排除潮汐與大氣壓力作用，大致可分為三種，第一為地殼運動造成的地表變形，例如斷層活動或是地層下陷。第二為事件形的地表質量遷移，如山崩與土石流。第三為地下流體移動造成的質量重新分佈，亦可能伴隨地表變形，例如地下水、泥流或是岩漿的流動。除了鄰近斷層線，臺灣沖積平原的地表變形(尤其是垂直變形)並不劇烈，因此沖積平原的重力變化，大多為地下水的流動所引起，部份地區則因地下水過度取用而造成地層下陷，進而造成重力變化。本研究使用絕對重力儀，於臺灣各大沖積平原進行重力變化調查，重力變化的量測時間介於數月至一年之間，地層則涵蓋沖積扇頂的砂礫岩地區與扇央至扇尾的泥岩地區。調查結果顯示，沖積平原的扇頂地區，短期重力變化可達 5 至 30 μgal，以泥質為主的扇央至扇尾地區，短期重力變化則僅 1 至 5 μgal，另外地層下陷區的重力變化，雖然重力變化的趨勢為正增加，但具有明顯的季節波動。本研究使用高精度的重力量測儀器，研究成果可供大地測量與地球物理學家，了解臺灣沖積平原的重力變化型態。</p>
中文關鍵字	沖積扇、重力、地下水
英文關鍵字	Alluvial Plain, Gravity, Groundwater

會議室	Room 608
日期	11 月 17 日(星期二)
時段	14:30-14:45
議程代碼	G1-O-08
議題	- Geodesy 測地學與活動地殼變形
作者	黃楷元(Huang Kai Yuan) [台灣大學地理與環境資源學系] (通訊作者)
中文題目	超低頻電磁波遙測技術應用於地層下陷潛勢區之研究 —以濁水溪沖積扇為例
英文題目	Application of Ultra Low Frequency Electromagnetic Wave Remote Sensing Technology to Subsurface Depression Potential Area--A Case Study of Zhuoshui River Alluvial Fan Area
投稿類型	口頭報告 Oral
摘要	雲林彰化地區地層下陷問題長年為民眾及政府所關切，經濟部水利署自 2001 年開始監測，近年地層下陷問題已有明顯減少。目前地層下陷監測方法，精密水準測量以地表變化為量測依據，但較耗時，磁環分層式地層下陷監測井和深層水準樁為地下監測，可觀察地底下地層壓縮特性及各深度土層之壓縮情形，需設置監測井才能探勘；雙頻 GPS 固定追蹤站和雷達干涉測量則以觀測地表變化量進行計算，但無法得知地下情形。上述幾種方法各有其限制，需相互搭配使用才能得知地表變遷以及地下的情況，且無法得知監測井深度 300 公尺以下之地層壓縮資訊。超低頻電磁波的探勘方法具有非破壞性，速度快、範圍廣、可探測地下深度較深處和不受結構與地形影響之優點，適合用於地層下陷區之深層壓縮機制的探測。本研究將採用超低頻電磁波進行探勘，於研究區域設置超低頻電磁波監測站，蒐集研究區域近 20 年來以現有方法所獲得之下陷資料，並與現有 300 公尺以上已知資料進行比對分析，找出兩者之間的迴歸判釋模式，驗證其正確性。成果將利用監測之地應力變化與歷年累積下陷資料進行比對，找出兩者間對應關係；針對測站及周圍區域探測地下地質並與水文地質剖面之比對；並利用低頻電磁波監測站資料和監測井地下水位進行相互比對，以及透過低頻電磁波監測站調查與評估 300 公尺以下的土層壓縮機制。
中文關鍵字	地應力、地下水、地質災害、天然電磁場
英文關鍵字	Ground stress, groundwater, geological disasters, natural electromagnetic field

會議室	Room 608
日期	11月17日(星期二)
時段	14:45-15:00
議程代碼	GT1-O-01
議題	- Geoscience Technology 地質資訊技術研發與應用
作者	王炫詠(Hsuan Yung Wang) [晏晟科技股份有限公司] (通訊作者) 賴品妙(Pin-Miao Lai) [晏晟科技股份有限公司] 謝亞璇(YaHsuan Hsieh) [晏晟科技股份有限公司] 張閔翔(Min-Hsiang Chang) [經濟部中央地質調查所] 陳致言(Zhi-Yan Chen) [經濟部中央地質調查所] 魏正岳(Cheng-Yueh Wei) [經濟部中央地質調查所] 鄭文昕(Wen-Hsin Cheng) [經濟部中央地質調查所] 侯進雄(Chin-Shyong Hou) [經濟部中央地質調查所]
中文題目	應用 GEO2020 系統分層功能建構三維地質剖面模型
英文題目	Constructing a 3D Geological Section Model using the Layered Function of GEO2020 System
投稿類型	口頭報告 Oral
摘要	地質鑽探報告是最直接的地質調查方法，是作為後續解析地質環境及評估工程規劃設計之重要參考。「工程地質探勘資料庫」係政府長期推動整合國內鑽探資料之建置計畫，新版工程地質探勘資料庫系統（GEO2020 雲端版）藉由雲端技術之導入，加速地質鑽探資料的蒐集與建置流程、檢核流程與強化圖台查詢功能，開放給國內產官學研加值應用，亦增加民眾使用的意願。本文主要說明新版工程地探勘資料庫系統之衍生加值服務，運用雲端服務提供使用者建置、管理並提交鑽探資料，有效簡化並整合資料蒐集流程，即時更新及擴充服務外，並提供 3D 視覺化方式查詢鑽孔資料，包含 3D 鑽孔柱狀圖、繪製 3D 地質剖面圖服務及分層對比建構自訂地質剖面三維模型等更多元化應用服務，提供更即時且三維視覺化地質資訊以輔助工程建設、土地利用及地質災害防治規劃、分析及應用，提升國內工程建設品質，達成全民督工之目標。
中文關鍵字	工程地質探勘資料庫、GEO2020、雲端服務、三維模型、地質分層、地質剖面圖繪製
英文關鍵字	Engineering Geological Investigation Databank, GEO2020, Cloud services, 3D model, Geological section, Geological profile drawing.

會議室	Room 608
日期	11月17日(星期二)
時段	15:00-15:15
議程代碼	GT1-O-02
議題	- Geoscience Technology 地質資訊技術研發與應用
作者	陳家生(Chen Chia-Sheng) [捷連科技有限公司] (通訊作者) 潘怡光(Pan Yi-Kuang) [捷連科技有限公司] 陳致言(CHEN ZHI-YAN) [經濟部中央地質調查所] 陳玉鴛(Chen Yu-Yuan) [捷連科技有限公司] 鄭文昕(Cheng Wen-Hsin) [經濟部中央地質調查所] 魏正岳(WEI ZHENG-YUE) [經濟部中央地質調查所] 侯進雄(Hou Chin-Shyong) [經濟部中央地質調查所]
中文題目	運用人工智慧結合有限資料自動化推估地質剖面之技術初探—以馬可夫鏈演算法為例
英文題目	Automatically estimating geological profile with artificial intelligence and limited data -- taking Markov chain algorithm as an example
投稿類型	口頭報告 Oral
摘要	<p>在工程建設之初，工址調查提供規劃所需的資料，其中必會進行工程鑽探以了解工址之地下地層特性；然而工程鑽探僅能提供離散的實際地層樣本，因此過去許多專家學者致力於發展使用離散之樣本推估地層分層之方法。本研究主要參考 Elfeki and Dekking (2001) 所提出之馬可夫鏈分層推估方法，以及 Xiao-Hui Qi 等人(2016) 所提出之耦合馬可夫鏈應用於實際鑽探資料之分層推估方法，並結合中央地質調查所於全台收集的各工程鑽探資料，建立地層推估展繪平台。本研究所開發之地層推估展繪平台，使用者由瀏覽器進入此平台網頁，可由平台頁面上選擇欲進行推估的資料範圍，設定部分參數並提交計算後，系統於頁面上即時展繪出由耦合馬可夫鏈方法計算而得的推估地層概況。平台左側地圖可瀏覽全台的工程地質鑽孔資料分布，平台右側為計算後的 3D 展繪結果，3D 繪圖的結果輸出方式，可同時瀏覽多條馬可夫鏈的推估結果，如地層柵狀圖的效果，同時將使用的資料鑽井繪於其上，方便手動排除不合理的資料內容，使用者可直觀的觀察所選資料區域大致的地層分層概況，並隨時修改資料範圍及參數重新計算繪製。本平台使用上仍需注意幾項限制，因演算方法皆有其初始假設，若使用者輸入資料偏離假設過多，可能導致演算失敗或結果不合理；在繪製剖面線時應盡量沿鑽孔資料連線，所選鑽孔距離也不應過遠，設定網格間距時亦應考慮實際資料距離，若過大可能致使薄層資料被忽略，過小則計算時迭代步數過多，計算失敗；此外，為縮短計算時間，推估結果僅考慮機率最大者，因此機率次大者的可能性將被忽略。所有計算結果僅供參考，並非實際地層狀態。本平台之目的在於提供使用者根據台灣實際的工程地質鑽孔資料可以快速、概略且直觀地觀察小地區的地下地層情況，雖並非完正確，仍可做為參考使用。</p>
中文關鍵字	馬可夫鏈,地質,工程鑽井,地質雲,開放資料
英文關鍵字	Markov Chain,Geology,Drill, GeologyCloud,OpenData

會議室	Room 608
日期	11 月 17 日(星期二)
時段	15:15-15:30
議程代碼	GT1-O-03
議題	- Geoscience Technology 地質資訊技術研發與應用
作者	賴俊璋(Chun-Wei Lai) [中興工程顧問股份有限公司] (通訊作者) 丁哲庸(Che-Yung Ting) [中興工程顧問股份有限公司] 黃能偉(Neng-Wei Huang) [中興工程顧問股份有限公司] 徐濤德(J. Bruce H. Shyu) [國立台灣大學地質系] 鄭世楠(Shih-Nan Cheng) [私立健行科技大學通識中心] 游能悌(Neng-Ti Yu) [國立清華大學院務中心應用科學系] 蘇志杰(Chih-Chieh Su) [國立台灣大學海洋研究所] 顏一勤(I-Chin Yen) [顏一勤應用地質技師事務所]
中文題目	空中無人載具技術於九棚區域異常孤石之應用
英文題目	The application of UAVs Technique for topography analysis of Abnormal Boulders on Jiupeng Coast
投稿類型	口頭報告 Oral
摘要	在 1771 年 4 月 24 日早上 8 時，琉球國的八重山發生地震，導致了琉球歷史上最具有破壞力的海嘯之一，除了無數人員傷亡，也在陸地上堆積出許多異常的孤石，成為現今著名的海嘯石。之後，在 2004 年以及 2011 年兩次大規模海嘯事件，重新燃起台灣學界對於海嘯沉積物與海嘯石研究的熱情。由於異常的巨礫經常在地形陡坡之岩岸或珊瑚礁平台上被發現並保存，且具有年代或地層上的控制，進而考量其可能來之事件成因。然位於台灣東部、東部離島與南部海岸為岩岸或珊瑚礁海岸，則具備岩岸與定年材料這樣的條件，也因此恆春半島東側之九棚地區以及蘭嶼島北側，皆有疑似數顆海嘯石的報導，然其搬運的模式有待釐清。因此，本文將利用空中無人載具，針對九棚地區之海嘯石以及海岸區域，進行地表面影像掃描，透過尺度不變特徵轉換法(Scale-Invariant Feature Transform, SIFT)、運動回復結構(Structure from Motion, SFM)及視覺外型技術(Visual-Hull)等影像處理技術，結合即時動態定位技術(Real Time Kinematic, RTK)進行地面控制點定位重建現今海岸地形以及海嘯石形貌，反衍海嘯石與地形關係，並推估其搬運模式。
中文關鍵字	海嘯石、九棚、無人載具
英文關鍵字	Tsunami Boulders、Jiupeng、UAV

會議室	Room 609A
日期	11月17日(星期二)
時段	14:00-14:15
議程代碼	M3-O-07
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	王昱(WANG YU) [國立台灣大學地質科學系] (通訊作者) Shi Xuhua [School of Earth Sciences, Zhejiang University] Lin Thu Aung [Earth Observatory of Singapore, Nanyang Technological University] Weerachat Wiwegwin [Department of Mineral Resources, Thailand] Suwith Kosuwan [Department of Mineral Resources, Thailand]
中文題目	
英文題目	The new active fault database of the mainland Southeast Asia
投稿類型	口頭報告 Oral
摘要	The mainland of Southeast Asia, extending from Myanmar on the west, to Vietnam on the east, suffers different degrees of seismic hazard potentials resulting from the on-going Indian-Asian collision and associated lithospheric escaping process. In order to provide a systematic understanding of the regional seismic hazard, we develop a new version of active fault database for the mainland Southeast Asia based on the compilation of geological, geodetic and geomorphological studies. Based on information mentioned above, we are able to update both the active fault map and corresponding fault slip rates, especially for those active faults in the central and western part of mainland Southeast Asia. Our new map suggests that, while only a few plate-boundary faults (e.g., Sunda megathrust, Sagaing fault) exhibit 1 to 2 cm/yr high slip rate, most of active faults within the continent accommodate mm-level or sub-mm-level annual slip rate. Such slip rates indicate those active faults, mainly strike-slip faults, have rupture recurrence intervals of about one thousand to more than ten thousand years if these faults tend to rupture the entire fault in once. The long rupture interval and low slip rate thus make many of them difficult to be measured by modern geodetic analysis, and require careful paleoseismological investigations to evaluate their seismic hazard potentials.
中文關鍵字	
英文關鍵字	Active Fault; Active tectonics; Southeast Asia;

會議室	Room 609A
日期	11 月 17 日(星期二)
時段	14:15-14:30
議程代碼	M3-O-08
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	劉司捷(Sze-Chieh Liu) [國立臺灣大學地質科學系暨研究所] (通訊作者) 徐浩德(J. Bruce H. Shyu) [國立臺灣大學地質科學系暨研究所] 王昱(Yu Wang) [國立臺灣大學地質科學系暨研究所] 姜宏偉(Hong-Wei Chiang) [國立臺灣大學地質科學系暨研究所] 沈川洲(Chuan-Chou Shen) [國立臺灣大學地質科學系暨研究所] 王珮玲(Pei-Ling Wang) [國立臺灣大學海洋研究所]
中文題目	珊瑚微型環礁所記錄的緬甸巽它大型逆衝帶變形特性
英文題目	Deformation patterns of the Sunda megathrust recorded by coral microatolls
投稿類型	口頭報告 Oral
摘要	巽它大型逆衝帶是南亞最主要的板塊邊界之一，在印澳板塊與歐亞板塊間的聚合作用下，使該逆衝帶上不乏地震矩規模 8 以上的歷史地震事件。緬甸西海岸緊鄰著巽它大型逆衝帶，儘管前人對此逆衝帶在本區域的古地震事件特性已有一定的認識，但因為缺乏當代儀器的觀測，目前我們對巽它大型逆衝帶在緬甸西海岸的震間行為仍並不清楚，而珊瑚微型環礁可能是一種了解此議題的合適途徑。珊瑚微型環礁為某些特定種屬的珊瑚在向上生長時，受到海水面低潮線的限制所形成的一種外觀。珊瑚頂部高度與海水面之間的關係建立後，珊瑚微型環礁的年生長紋能夠逐年地紀錄下相對海水面的變化過程。本研究透過採集並重建珊瑚微型環礁所記錄的年解析度古海水面歷史，探討沿著緬甸西海岸巽它大型逆衝帶上盤在垂直方向上的變形性質。研究結果顯示，巽他大型逆衝帶在南北方向上有著不同的震間特徵，可能反應著不同程度的地震風險。
中文關鍵字	緬甸、震間變形、珊瑚微型環礁、地震災害
英文關鍵字	Myanmar, inter-seismic deformation, coral microatolls, earthquake hazard

會議室	Room 609A
日期	11月17日(星期二)
時段	14:30-14:45
議程代碼	M3-O-09
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	蔡仲霖(Chung-Lin Tsai) [銓日儀公司] (通訊作者)
中文題目	小琉球周邊底流與泥貫入體交互作用之強烈海床侵蝕及海底山崩作用
英文題目	Bottom Current and Mud Diapirism interaction caused Severe Seafloor Erosion and Submarine Landslides near coast of Xiaoliuchiu islet
投稿類型	口頭報告 Oral
摘要	<p>The Gaoping River (GR)-Gaoping Submarine Canyon (GPC) is one of largest river dispersal systems in the world. Ten tons of terrestrial sediments per year discharges at river mouth where forms gravity driven flow could damage telecommunication cable along 260 kilometers long GPC. However, to the east of the GPC the continental shelf has been eroded obviously. In order to understand this geological phenomenon, we collected high resolution sparker seismic data around the continental shelf and parallel or across the GPC. We also collected deep-towed sub-bottom profiler and ship board ADCP data. We have identified three major para-sequences off SW Taiwan that are Low-stand system tract (LST), Transgressive system tract (TST) and Highstand system tract (HST). Based on the stratigraphic sequences, the coastline at last glacial maximum is identified at about 138 meters deep below present-day sea surface. Analysis of the deep-towed sub-bottom profiler sections suggest sandy sediment overflows through GPC breakage in the east bank of GPC. Nevertheless, a convergence of bottom currents with a speed up to 1.5 m/s flowing southeastward has eroded the continental shelf intensively and has formed the Xiaoliuchiu channel. Although an active mud diapir is undergoing just to the east of the GPC and formed the Xiaoliuchiu islet, the mud diapir has been eroded at the Xiaoliuchiu channel. The average erosion rate in the east bank of the GPC is estimated to be about 609 cm/ka in the past 8.2 ka. On the other hand, between the GPC and the Xiaoliuchiu islet, the continental shelf is wasting due to serious seabed slumping.</p>
中文關鍵字	泥貫入體、海底山崩、海床侵蝕、小琉球、火花反射震測
英文關鍵字	

會議室	Room 609A
日期	11月17日(星期二)
時段	14:45-15:00
議程代碼	M3-O-10
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	林郁伶(Yu-Ling Lin) [國立臺灣師範大學地球科學系] (通訊作者) 李通藝(Tung-Yi Lee) [國立臺灣師範大學地球科學系] 羅清華(Ching-Hua Lo) [國立臺灣大學地質科學系] 李皓揚(Hao-Yang Lee) [中央研究院地球科學研究所] 郭龍翔(Long Xiang Quek) [國立臺灣師範大學地球科學系] 飯塚義之(Yoshiyuki Iizuka) [中央研究院地球科學研究所] 白杵直(Tadashi Usuki) [國立臺灣大學地質科學系] Punya Charusiri(Punya Charusiri) [Department of Geology, Chulalongkorn University, Bangkok, Thailand]
中文題目	泰國西北部湄平剪切帶熱定年學之年代差異：橫移壓縮剪切作用或火成事件入侵造成的快速冷卻？
英文題目	Thermochronologic variation inside the Mae Ping shear zone, NW Thailand: rapid cooling from transpressive shearing or igneous intrusion?
投稿類型	口頭報告 Oral
摘要	The Lan Sang gneisses crop out on the highway across the 5 km wide Mae Ping shear zone (MPSZ) in NW Thailand. Previous studies suggested the MPSZ should have been initiated during the Cenozoic collisional tectonics of Asia but lacked a convincing onset/syn-shearing radiometric date. Moreover, the overall cooling pattern of NW Thailand indicates that the sinistral shear of the MPSZ has not dominated the cooling history. Therefore, this study applied thermochronology on a series of samples from the Lan Sang gneisses to reconstruct the local cooling history. Results show that the SW and NW Lan Sang gneisses, which are divided by a zone of mylonitic calc-silicate rocks and marbles, possess different cooling paths. Zircon U-Pb dating on the SW Lan Sang gneisses yields detrital zircon age spectra with 500 Ma peaks confirming their sedimentary protoliths from the Sibumasu terrane. The youngest zircon ages ~199 Ma come from metamorphic zircon overgrowths (Th/U <0.1). In-situ ⁴⁰ Ar/ ³⁹ Ar dating on muscovite fishes in a sheared leucogranite indicates a syn-shearing duration of 42-38 Ma. On the other side, zircon U-Pb dating on the NE Lan Sang gneisses yields two major peaks at 220-200 and 35-32 Ma (Th/U > 0.1), implying their protoliths consist of Indosinian and Eocene granodioritic intrusions. The cooling path of NE Lan Sang gneisses reveal a rapid cooling at ≥ 123 °C/myr from 35 to 30 Ma, while the SW Lan Sang gneisses cooled more slowly at 10 °C/myr. However, meso-scale structures and microstructures indicate that both sides recorded similar structures of two different dipping sinistral transpressive shears. The thermochronologic variation among the Lan Sang gneisses should result from the Late Eocene granodioritic intrusion. Therefore, simply regarding the rapid cooling of sheared granodiorites as the consequence of sinistral shear would be problematic, and the tectonic evolution of the MPSZ should be more complicated than previously thought.
中文關鍵字	藍山片麻岩、湄平剪切帶、熱定年學、冷卻歷史
英文關鍵字	Lan Sang gneisses, Mae Ping shear zone (MPSZ), thermochronology, and cooling history

會議室	Room 609A
日期	11月17日(星期二)
時段	15:00-15:15
議程代碼	M3-O-11
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	林俞青(YU-CHIN LIN) [中央研究院地質科學研究所] (通訊作者) 鍾孫霖(Sun-Lin Chung) [中央研究院地質科學研究所] Shigenori Maruyama [Earth-Life Science Institute, Tokyo Institute of Technology, Tokyo, Japan] Ade Kadarusman [Geology and Geophysical Department, University of Indonesia, Jakarta, Indonesia] 李皓揚(Hao-Yang Lee) [中央研究院地質科學研究所]
中文題目	碰撞驅動形成之帝汶蛇綠岩對 SSZ 蛇綠岩成因的啟示
英文題目	Collision-driven formation of world's youngest ophiolite in Timor: Implication for generation of supra-subduction zone ophiolites
投稿類型	口頭報告 Oral
摘要	The Timor ophiolite exposed in the active collision zone between the Banda Arc and the Australian continent is generally considered as a modern analogue for supra-subduction zone (SSZ) ophiolites. The Timor ophiolite consists of dismembered blocks of the mantle and crustal rocks. Here we report a zircon U-Pb dating analysis from a variety of the crustal rocks from Timor and Moa islands, including gabbro, granite, and rhyolite. A total of 11 dates yield a short magmatic span from 10 to 8 Ma, suggesting both the occurrence of the youngest ophiolite on Earth and a rapid emplacement after its generation. The major and trace element data indicate that the Timor mafic rocks (gabbro and basalt) are similar to typical island-arc tholeiites, with flat-REE or mildly LREE depleted patterns. By contrast, the Moa gabbros exhibit lower REE abundances with U-shaped patterns, resembling the boninitic lavas. A boninitic gabbro has positive zircon $\epsilon_{\text{Hf}}(t)$ values of +12 to +15. We, therefore, propose that the Timor ophiolite may have originated from a nascent intra-oceanic arc complex such as the initial Banda Arc. This arc complex was generated in a slab rollback system driven by the oblique, multi-stage continental collision between Eurasia/Sundaland and Australia. The earlier collision of the northern arm of Australia (Bird's Head) with Sundaland gave rise to the southward slab rollback, leading to the stepwise opening of the Banda Sea since ~12 Ma with the associated generation of the Banda Arc. The southernmost part of this nascent arc complex was later emplaced onto the Australian continent as a consequence of the arc-continent collision since ~4 Ma around Timor. Generation of the Timor ophiolite was essentially collision-driven rather than subduction initiated. Analogous to the Timor scenario, we suggest that many SSZ ophiolites in older collision zones may have formed in short-lived, small-scale oceanic basins, as the present case in SE Asia, by collision-driven processes.
中文關鍵字	碰撞驅動、SSZ 蛇綠岩、帝汶、弧陸碰撞、回捲盆地
英文關鍵字	collision-driven, SSZ ophiolite, Timor, arc-continent collision, rollback basin

會議室	Room 609B
日期	11月17日(星期二)
時段	14:00-14:15
議程代碼	M2-O-07
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	黃國芳(Kuo-Fang Huang) [中央研究院地球科學研究所] (通訊作者) 王若梅(Ruo-Mei Wang) [中央研究院地球科學研究所] 劉永欣(Yung-Hsin Liu) [中央研究院地球科學研究所]
中文題目	
英文題目	Main controls on riverine lithium isotope fractionation in landslide-dominant river catchments of Taiwan
投稿類型	口頭報告 Oral
摘要	<p>Bedrock landslides can generate fresh, highly reactive mineral surfaces, and the conditions favorable for weathering via intense fragmentation and/or water-rock interaction of unweathered rock. The relationship among landsliding, physical erosion and chemical weathering, however, remains unclear due to complexities in weathering regime, water travel time, and hydrological cycle in different geological settings. A study in the rapidly eroding mountains of Taiwan on the landslide and catchment scales provides important constraints on the role of bedrock landslides in localizing and accelerating chemical weathering in tropical high-stand island. Here we investigate the Li isotopic compositions ($\delta^7\text{Li}$), a probe for silicate weathering intensity, in riverine materials collected from Kao-Ping River (KPR) and Beinan River (BNR) in southern Taiwan. Our results show that the $\delta^7\text{Li}$ in the dissolved load (+11.7‰ to +20.6‰ for KPR vs. +4.3‰ to +11.3‰ for BNR) is fractionated toward heavy values compared to the suspended load (+0.80‰ to +1.13‰ for KPR vs. -0.33‰ to +0.65‰ for BNR) as a result of the preferential uptake of ^6Li by secondary minerals during weathering. The Li isotope fractionations between dissolved and suspended loads ($\Delta^7\text{Li} = \delta^7\text{Li}_{\text{diss}} - \delta^7\text{Li}_{\text{susp}}$) in the upstream of the KPR are greater than those in the BNR, indicating stronger silicate weathering intensity in the KPR catchment compared to the BNR, consistent with geochemical constraints based on other river water chemistry. The extent of Li isotope fractionation in the BNR catchment is mainly controlled by formation of secondary minerals, however, other processes are required in order to explain the observed behavior in the KPR catchment. Potential mechanisms, such as the effects of landsliding and uplift, as well as source mixing, will be discussed in the presentation.</p>
中文關鍵字	
英文關鍵字	Lithium isotope fractionation, bedrock landslides, Taiwan river

會議室	Room 609B
日期	11月17日(星期二)
時段	14:15-14:30
議程代碼	M2-O-08
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	王若梅(Ruo-Mei Wang) [中央研究院地球科學研究所] (通訊作者) 黃國芳(Kuo-Fang Huang) [中央研究院地球科學研究所] 施郁庭(Yuting Shih) [台灣大學地理環境資源學系]
中文題目	
英文題目	Influence of landslide on weathering processes in the mountainous river catchment of Taiwan by isotopic approach
投稿類型	口頭報告 Oral
摘要	<p>Bedrock landslides can elevate dissolved solutes by the interaction between water and fresh mineral surface resulted from mechanical erosion processes. The positive correlation between physical erosion and chemical weathering in active orogenic regions conflicts with models anticipating the kinetic limitation on chemical weathering at high erosion rates. The relationship of physical erosion and chemical weathering can, therefore, be applied to understand the main controls on weathering processes. Landsliding is the dominant erosion process in active orogenic settings. The study area, Taiwan, is characterized by heavy rainfall and frequent earthquakes, which both easily generate landslides. In order to examine the influence of landslides on the weathering processes, a series of water samples from landslide sites and surrounding rivers were collected in the Kaoping River catchment, and the measurements of elemental concentrations and non-traditional isotopes were performed on the specimens. The concentration of total dissolved solids (ranging from 5554 to 18530 $\mu\text{mol/L}$) shows the correlation not with the volume of the landslide, but with the concentration of sulfate, which may imply the dissolved solute concentration is mainly controlled by sulfuric acid weathering than the landslides. The variations of strontium isotopic ratios seem to reflect different chemical weathering intensity relative to congruent- and incongruent- weathering. Dissolved uranium and lithium isotopic data reflect the degree of physical erosion and silicate chemical weathering, respectively, and show a negative correlation with each other. The variations of uranium and lithium isotopes correspond to the characteristics in the weathering limited area. Furthermore, the potential application of isotopic ratios in the landslide weathering may also be assessed in this study.</p>
中文關鍵字	
英文關鍵字	landslide; weathering; uranium isotope; lithium isotope

會議室	Room 609B
日期	11月17日(星期二)
時段	14:30-14:45
議程代碼	M2-O-09
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	陳嘉俞(Chia-Yu Chen) [Department of Geosciences, National Taiwan University, Taiwan] (通訊作者) 徐濤德(J. Bruce H. Shyu) [Department of Geosciences, National Taiwan University, Taiwan] Sean D. Willett [Geological Institute, ETH Zurich, Switzerland] Marcus Christl [Laboratory of Ion Beam Physics, ETH Zurich, Switzerland]
中文題目	荖濃河流域內沈積物的搬運與侵蝕速率在時間與空間上的變化
英文題目	Spatial and temporal variations in erosion rate and sediment transport in a landslide dominated basin, SW Taiwan
投稿類型	口頭報告 Oral
摘要	As an island that has high tectonic uplift and humid climate with frequent typhoons, landsliding is one of the major processes that shape the landscape in Taiwan. Landslides provide pulses of sediment into the channel system, which may alter the evolution of the landscape. To explore the impact of landslides on the long-term erosion rate, we analyzed spatial and temporal variations in erosion rate in a landslide-dominated basin, the Lao-Nung basin, in southwestern Taiwan. In this basin, many well-surveyed and dated fluvial and landslide fan terraces are distributed along the main trunk, permitting a detailed paleo-erosion rate study through concentrations of in-situ ^{10}Be cosmogenic nuclides. We collected ^{10}Be samples from terraces with ages of 450, 1k, 6k, 12k, and 17k years along the main trunk and from the modern channel close to those sampled terraces to derive paleo- and modern erosion rates, respectively. The results show an average long-term erosion rate of ~ 0.7 mm/yr with both temporal and spatial variations, indicating changes in climate and tectonic forcings through time and space. A lower erosion rate at 12 ka is likely resulted from a cold and dry climate as indicated by pollen records. A higher erosion rate at 6 ka might reflect more frequent landslide activity at that time as many landslide fan terraces were formed around 6 ka. However, the higher rate could also reveal a higher uplift rate in the upstream area as channel steepness shows an increasing trend towards upstream and no contemporaneous landslide fan terraces were discovered in the upstream area of the sample site. Despite the widespread recent landslides, the modern erosion rates show little variations along the main trunk except in the most upstream sample, indicating most of the landslide materials are likely still trapped in the upstream area.
中文關鍵字	侵蝕速率、山崩、沈積物、鉍 10
英文關鍵字	erosion rate, landslide, sediment, ^{10}Be

會議室	Room 609B
日期	11月17日(星期二)
時段	14:45-15:00
議程代碼	M2-O-10
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	陳承鴻(Cheng-Hung Chen) [台灣大學地質科學系暨研究所] (通訊作者) 徐浩德(J. Bruce H. Shyu) [台灣大學地質科學系暨研究所] Sean D. Willett [Geological Institute, Swiss Federal Institute of Technology, Zurich, Switzerland] 陳嘉俞(Chia-Yu Chen) [國立台灣大學地質科學系]
中文題目	台灣造山帶西部河流地形動態演育
英文題目	Drainage pattern development of western Taiwan orogenic belt
投稿類型	口頭報告 Oral
摘要	<p>河流地形的形貌可以紀錄其所在位置的構造發育歷史。台灣西部山區的河川主要流向顯示，在濁水溪以北的水系主流皆大致垂直造山帶而向西流，但南側卻主要平行造山帶而向南流。若台灣島的造山過程符合前人模型逐漸由北往南推進，則伴隨的河流地形特徵也應該隨時間由南往北演育，也代表著台灣南北兩段不同的流向特徵可能指示河流的不同演育階段。本研究利用分水嶺兩側崩塌地統計、河道地形參數χ、數值地形分析、區域構造與野外調查等資料，發現台灣西部各流域有由南往北演化且漸趨穩定之現象。西部麓山帶南段各河川主分水嶺多未達平衡，且有偏西側水系襲奪東側河，進而使流向改而向西流的趨勢；麓山帶中段流域本身已達穩定，但與周圍流域分水嶺多未達平衡；北段流域本身與流域間則皆已達到穩定狀態。此河川演化趨勢可能與褶皺逆衝帶的構造發育與活動有關，逆衝斷層的發育造成南流河的形成與後續的襲奪事件。若加入麓山帶造山作用向南傳遞的速率估算，河川於台灣南端形成到轉而發育垂直造山帶向西流約需要歷經1.3百萬年，並可造成分水嶺的穩定性、河川形態與流域面積的快速變化，進而造成水流能量與下游沉積物特性改變。本研究建議未來對於台灣西部河川以及其沉積盆地之研究，都應該納入整體流域變化的概念進行討論，才能使解釋更為完備。</p>
中文關鍵字	崩塌地統計、河道參數 χ 、河川襲奪、分水嶺移動、褶皺逆衝帶
英文關鍵字	landslide analysis, geomorphic index χ , river capture, divide moving, fold-and-thrust belt

會議室	Room 609B
日期	11月17日(星期二)
時段	15:00-15:15
議程代碼	M2-O-11
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	呂喬茵(Chiao-Yin Lu) [台灣大學] (通訊作者) 胡植慶(Jyr-Ching Hu) [台灣大學] 詹瑜璋(Yu-Chang Chan) [中央研究院] 蘇元風(Yuan-Fong Su) [國家災害防救科技中心] 張志新(Chih-Hsin Chang) [國家災害防救科技中心]
中文題目	應用多時域雷達干涉技術監測潛在性山崩：以華梵大學為例
英文題目	Monitoring of Creeping Landslides by Multi-Temporal Interferometry (MTI): A case study of the Hua-Fan University
投稿類型	口頭報告 Oral
摘要	Slow-moving or creeping slopes may further evolve to rapid and destructive landslides. Therefore, detecting and monitoring slope deformation can provide better clues for landslide forecasting and identify sites of possible landslides. That is a crucial topic for hazard risk management and assessment in mountainous areas. This study applies 337 SAR images derived from Sentinel-1A and 1B satellites during 2014/10/22-2019/10/28 for analyzing the creeping slope of the Hua-Fan University in New Taipei City, Taiwan. By processing those SAR images with Multi-Temporal Interferometry (MTI) technique, the deformation condition of the creeping slope can be obtained. The creeping phenomenon of this slope is significant, and the maximum deformation velocity along the line of sight (LOS) direction is about 7 mm/yr during 2014-2019. The vertical and eastern-western velocity field can be calculated and presented based on the MTI results derived both from the ascending and descending SAR images. According to the results of our ongoing research, the capability of Multi-Temporal Interferometry (MTI) technique for landslide detection, mapping and monitoring can be revealed. For further discussions, comparing the surface deformation derived from the MTI technique with other in situ monitoring data is needed in the future.
中文關鍵字	潛在性山崩, 多時域雷達干涉技術, 合成孔徑雷達
英文關鍵字	creeping landslide, Multi-Temporal Interferometry (MTI), SAR

會議室	Room 609B
日期	11 月 17 日(星期二)
時段	15:15-15:30
議程代碼	M2-O-12
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	翁瑋辰(Wei-Chen Weng) [台北科技大學土木與防災所] (通訊作者) 張國楨(Kuo-Jen Chang) [國立臺北科技大學土木工程系] 謝有忠(Yu-Chung Hsieh) [經濟部中央地質調查所] 黃美甄(Mei-Jen Huang) [國立臺北科技大學土木工程系]
中文題目	草嶺山崩之活動性－兼論無人機空間測繪及監測之可行性
英文題目	Evaluation of Tsaoling Landslide Activity and Feasibility of Drone Surveying and Hazard Mapping
投稿類型	口頭報告 Oral
摘要	<p>草嶺山崩為九二一集集地震以來，於台灣島上所見之最大型山崩。集集地震時，觸發了大規模山崩，崩積物堵塞了清水溪河道，並形成一堰塞湖－新草嶺潭。此潭並於 2004 年七月由敏督利颱風之所淤滿。爾後淤滿之河道及兩側崩塌堆積區，亦再開始快速下切，形成新的河階及下切的深谷。2009 年的莫拉克風災再次重創本區，造成山崩區東側翼的變形。之後草嶺山崩區相關的山崩現象較不受到關注。無人飛行載具因其具有機動力強、時效性快、經費較廉、及較寬鬆天氣條件即可操作的優點等特性，成為近年來流行的工具。於自然災害的調查中，可方便取得災區即時、清晰、全面之中低空照片，透過航拍亦可清楚鳥瞰災害區全貌，明確辨識災害範圍，以彌補地面勘災「見樹不見林」之不足，並方便作為後續分析災害原因與災後整治之用。自本團隊導入無人機於測繪工作以來，一直持續關注草嶺山崩區，定期記錄草嶺山崩之地形變動。尤其於 2017 年六月梅雨季期間，主滑動面上之小崖(春秋斷崖)有重要的崖線後退現象，最大後退距離超過 150 公尺，原滑動面上的崩塌量體亦超過 150 萬方。後續各年份，我們持續以無人機進行航拍來置空間資訊資料庫，其結果指示了本區地形地貌持續地變動。本研究，一方面積極發掘新的演算法，使各時期地形的相對誤差最小化，以精確計算各時期間之地形變異量，另一方面由草嶺山崩區之地形變異量指出本區山崩之活動性，以及物質運移堆積之特性。</p>
中文關鍵字	無人飛行載具、攝影測量、山崩、量體、草嶺
英文關鍵字	unmanned aerial vehicle、Photogrammetry、Landslide、Volume、Tsaoling

會議室	Room 609C
日期	11月17日(星期二)
時段	14:15-14:30
議程代碼	SE5-O-01
議題	- Global Change 千年至軌道尺度氣候變化
作者	施路易(Ludvig Löwemark)(Ludvig Löwemark) [台灣大學地質科學系暨研究所] (通訊作者)
中文題目	
英文題目	What does d18O in speleothems record? Clues from a daily resolved precipitation record from peninsular Thailand
投稿類型	口頭報告 Oral
摘要	Stable oxygen isotopes in terrestrial archives such as e.g. speleothems or tree rings are commonly used to reconstruct past variations in precipitation. However, although rainfall on historical time scales appears to show a reasonable correlation to yearly averaged stable oxygen isotope values, the actual mechanisms behind this correlation are complex. To improve our understanding of the climatic and meteorological processes controlling d18O in the precipitation over peninsular Thailand, daily rain water samples were collected at the Krabi Airport Meteorological Station. For daily d18O values, no significant correlation with rain amount was detected, indicating that the amount effect (sensu stricto) does not play a major role on the isotopic composition of the rain water. Comparison to outgoing long wave radiation, a proxy for local convection, shows that short term variability in d18O is best explained by variations in local convection. In contrast, monthly amount weighted isotope values show a weak, but significant, correlation to monthly precipitation amount, indicating that moisture source, mixing processes, and rainout history play a more important role in controlling long term variations in d18O. In a short pilot study, two months of daily drip water were collected from a cave in the Krabi province and compared to the rain water data. Even though short, the time series suggests that cave waters were close to yearly average and that extreme rain events may be recorded, although strongly muted, with a lag of a couple of weeks.
中文關鍵字	
英文關鍵字	oxygen isotopes, monsoon rain, Thailand, speleothem, paleoclimate

會議室	Room 609C
日期	11月17日(星期二)
時段	14:30-14:45
議程代碼	SE5-O-02
議題	- Global Change 千年至軌道尺度氣候變化
作者	鍾伯均(Bor-jiun Jong) [國立臺灣大學地質科學系] (通訊作者)
中文題目	
英文題目	Ba/Ca Ratios in Planktic Foraminifera as an Indicator of River Freshwater Input in the Arctic Ocean
投稿類型	口頭報告 Oral
摘要	<p>The freshwater input in the Arctic Ocean has profound effect on the global ocean system. Change in freshwater input can alter both regional ocean circulation and North Atlantic Deep Water (NADW) driven by seawater salinity. In the Arctic Ocean, river runoff contributes one-third of the total freshwater input, significantly affecting the freshwater budget. The common proxy for freshwater input, oxygen isotopes of planktic foraminifera, however, is susceptible to other environment factors, so a new paleoceanographic proxy, Ba/Ca ratio in planktic foraminifera, is introduced in this study. This new proxy has been shown to be a useful indicator of Ba/Ca in seawater, which derives its Ba mainly from river input. Hence, we studied the feasibility of Ba/Ca in planktic foraminifera as a proxy for river freshwater input in the Arctic Ocean. We selected 8 cores and 11 sites of surface sediment covering eastern Arctic Ocean. The planktic foraminifera, <i>Neogloboquadrina pachyderma</i> (sinistral), was tested using an Inductively Coupled Plasma Mass Spectrometry (ICP-MS) in the National Taiwan University. The Ba/Ca values from the surface sediment increase as the sites get closer to Laptev Sea and Kara Sea in which Eurasian rivers empty. This spatial increase in Ba/Ca shares a similarity with modern observation of seawater Ba concentrations, suggesting the Ba/Ca in <i>N. pachyderma</i> reflects the distribution of seawater Ba in the Arctic Ocean. In addition, the downcore results show increase during the last deglaciation and decrease in the early Holocene. The consistent variations, spatially and temporarily, in Ba/Ca ratios suggest that this new proxy could be a promising tool to indicate the river freshwater input in the Arctic Ocean.</p>
中文關鍵字	
英文關鍵字	paleoceanography, Arctic Ocean, Ba/Ca ratio, planktic foraminifera, river freshwater input

會議室	Room 609C
日期	11月17日(星期二)
時段	14:45-15:00
議程代碼	SE5-O-03
議題	- Global Change 千年至軌道尺度氣候變化
作者	Shital Godad(Shital Godad) [National Taiwan University] (通訊作者) Ludvig Löwemark(Ludvig Löwemark) [National Taiwan University] Haojiya Abby Ren(Haojiya Abby Ren) [National Taiwan University]
中文題目	
英文題目	Changes in Foraminifera Bound Nitrogen Isotopes: Implications for Quaternary Interglacial variations and Climate change.
投稿類型	口頭報告 Oral
摘要	<p>Abstract The Arctic Ocean plays fundamental role in the global climate system. Arctic snow and ice cover play an important function by reflecting solar radiation back to the space. Also, the melting and formation of sea ice can impact the surface sea water density which influence production of Arctic Intermediate and Bottom water masses, critical for sustaining a strong Atlantic Deep water circulation which forms a part of the Atlantic Meridional Ocean Circulation (AMOC). Our understanding of past environmental and climatic changes in the Arctic, and how these changes are related to other components of the climate system, are still restricted due to lower abundance of calcareous micro and nano fossils and low sedimentation rates. In addition, the conventional isotope $\delta^{18}\text{O}$ is biased by fresh water influx which makes paleoreconstructions difficult. Arctic Ocean forms a crucial part of the global conveyor belt. Despite of such great importance of the Arctic climate system, we have very little information about earlier millennial climate changes in this region. In this study we are using a, $\delta^{15}\text{N}$ as a proxy which gives us information about variations in surface water structure. Foraminiferal-bound $\delta^{15}\text{N}$ preserved in the calcite tests have been shown to represent ambient sea-water nitrate values at the time of calcification. Because the $\delta^{15}\text{N}$ values of the sea water are controlled by the degree of nutrient utilization in the surface waters, the $\delta^{15}\text{N}$ values measured in the foraminifers allows us to reconstruct variations in the surface water structure. Preliminary investigation suggests that foraminifer-bound $\delta^{15}\text{N}$ is a good tracer for variations in surface water structure in the Arctic Ocean during times of large changes due to melting ice sheets and changes in the amount of fresh water influx from the rivers.</p>
中文關鍵字	Arctic Ocean, Foraminifera, Nitrogen isotope
英文關鍵字	Arctic Ocean, Foraminifera, Nitrogen isotope

會議室	Room 609C
日期	11月17日(星期二)
時段	15:00-15:15
議程代碼	ST1-O-07
議題	- Stratigraphy 地層與古生物研究
作者	Kuo-Yen(Wei) [台灣大學地質科學系暨研究所] (通訊作者) 羅立(Lo, Li) [台灣大學地質科學系暨研究所]
中文題目	
英文題目	A high resolution Ba-based orbital tuning age model for MD01-2414 and paleo-productivity during the past 1.5 million years in the Okhotsk Sea
投稿類型	口頭報告 Oral
摘要	<p>Session SE5 A high resolution Ba-based orbital tuning age model for MD01-2414 and paleo-productivity record for the past 1.5 million years in the Okhotsk Sea Kuo-Yen Weia and Li Loa a. Dept. of Geosciences, National Taiwan University Abstract</p> <p>It has been difficult to establish adequate age models for high-latitude Quaternary marine sedimentary records due to the lack of continuous occurrence of calcareous microfossils to generate marine oxygen isotope stratigraphy. In this study, we examined high-resolution elemental records obtained from XRF scanning of Core MD01-2414 in the central Okhotsk Sea of the past 1.5 million years and found that the time-series of the centered log-ratio transformation of Ba intensity shows a perfect correlation with the benthic foraminiferal isotope stack of LR04 (Lisiecki and Raymo, 2005). The Ba time-series was then finely tuned with the LR04 stack and obliquity curve to result in a high resolution age model. The resultant Ba time-series shows strong periodicity at 306, 218, 100, 76 and 41-kyrs above the 95% significance level. The variation of Ba matches mainly with opal concentration, and otherwise, in some time intervals, is in concert with the variation of calcite, implying that Ba was deposited in association with settling particles of silicious and calcareous micro-organisms. The Ba intensity record is then considered a proxy of paleo-bio-productivity. High productivity occurred at terminations (from glacial to interglacial), or, at a finer time-scale, from stadial to interstadial transitions, and therefore, coinciding with rapid sea-level rising intervals during the past 1.5 million years. Keywords: stratigraphy, barium, astro-chronological tuning, periodicity, XRF</p>
中文關鍵字	地層學、鋇、天文調頻、週期、X 螢光掃描儀
英文關鍵字	stratigraphy, barium, astro-chronological tuning, periodicity, XRF

會議室	Room 603
日期	11月17日(星期二)
時段	16:00-16:15
議程代碼	NH1-O-01
議題	- Natural Hazards 山崩與土石流災害
作者	張睿明(Jui-Ming Chang) [國立臺灣大學] (通訊作者) 趙韋安(Wei-An Chao) [國立交通大學] 陳宏宇(Hongey Chen) [國立臺灣大學]
中文題目	從現地實驗探討區域型邊坡之地動訊號監測之可行性
英文題目	Examining the feasibility of seismic monitoring based on slope-scale rockfall experiments
投稿類型	口頭報告 Oral
摘要	<p>Understanding the dynamics of the falling/rolling rock mass processes in near-real-time function is a crucial issue. The unknown size of the rock and unpredictable trajectory are hidden threats to the road user. Traditionally, modeling is used to reconstruct the source process, providing the possible dynamics and trajectory of mass particles. In recent years, seismic analysis is widely applied to slope-scale monitoring. However, previous studies only focused on the typology of signal and spectrogram features of rockfall, and only a few of them addressed the issue of its' size estimate and trajectory. In this research, we deployed a micro-seismic network on the slope next to 112k of provincial highway 9 and used cameras to record the experiment's process. The result, first, indicates the non-fragmentation of impact inherit the pure pulses in the seismic signal. The break segments of rock produce the micro quakes between the substance pulses. Further, the impact of a more massive boulder exhibits the lower frequency band in spectrograms. By those phenomena, we can easily distinguish the non-fragmentation and fragmentation during the falling/rolling processes and identify the size of rock mass roughly. Second, the seismic ground vibration caused by impact has different characteristics of seismic wave propagation. When the distance between the impact point and seismic station is beyond 60 m, the seismic wave's arrival time through the underground is substantial earlier than the wave propagates along the topographic surface. Under the restriction, the impact point can be located on the surface wave domain area, and the location error is less than 15 m. From the experiments, both results are essential to real-time monitoring, which can provide the size of rock boulder mass, distinguish the non-fragmentation and fragmentation process, and the rock mass trajectory. We final involved the modeling tool to examine the feasibility of monitoring the future's high-risk slope.</p>
中文關鍵字	落石，地動訊號監測，邊坡尺度
英文關鍵字	rock fall, seismic monitoring, slope scale

會議室	Room 603
日期	11月17日(星期二)
時段	16:15-16:30
議程代碼	NH1-O-02
議題	- Natural Hazards 山崩與土石流災害
作者	楊哲銘(Che-Ming Yang) [國立聯合大學土木與防災工程學系] (通訊作者) 翁孟嘉(Meng-Chia Weng) [國立交通大學土木工程學系] 魏殷哲(Jason Ngui) [國立交通大學土木工程學系] 李國維(Kuo-Wei Li) [國立交通大學土木工程學系] 傅鈺堯(Yu-Yao Fu) [國立交通大學土木工程學系] 林志平(Chih-Ping Lin) [國立交通大學土木工程學系] 張智安(T. A. Teo) [國立交通大學土木工程學系] 羅佳明(Chia-Ming Lo) [國立交通大學土木工程學系]
中文題目	深層片岩坡體滑動之活動性調查、監測、破壞機制與地質模型探討
英文題目	Failure mechanism and slope geologic model of deep-seated schist landslide
投稿類型	口頭報告 Oral
摘要	2017年1011豪雨事件於花蓮縣瑞穗鄉舞鶴台地西側之舞鶴山，一朝向南方坡地受累積降雨誘發大規模坡體運動，其崩崖明顯出露落差可達30m，且趾部存在兩處陡峭崩塌，並造成下游自來水取水口掩埋。然而，此坡體雖已累積大量位移(>28m)且持續以每日約10mm速度滑移，並未轉變為高速滑動，此種坡體破壞之機制缺乏文獻報導釐清，值得深入研究探討。本研究藉由資料蒐集、遙測分析、現地調查、岩心判釋、監測等方法分別獲得調查與分析結果，並整合各方法成果提出可能之破壞機制與坡體地質模型。以多期正射影像、雨量與地震資料分析長期坡面變化之可能原因與過程；由地表地質調查與鑽探岩心判釋坡體之地表堆積物、滑動體與岩盤之材料組成；再利用孔內安裝同軸電纜與地中傾斜管監測坡體運移行為；此外，以無人機空拍產製正射影像與數位地表模型藉由質點影像測速技術(Particle Image Velocimetry, PIV)分析坡體地表位移量與方向。根據上述成果了解此坡體之滑動體深度最大可達37.5m，面積約10.5公頃，由破碎片岩岩塊構成，其與片岩岩盤之間存在一泥層弱帶，然而，滑動帶可能受葉理與節理產狀而呈現非平面之幾何形貌；此外，PIV分析運移方向往東南方，配合光達地形與現場調查推估，此崩塌地左翼一蝕溝有閉合變窄之現象，可能造成滑動體左側壁之地形阻抗，皆為滑動體持續滑移而未轉為高速滑動之原因。為更清楚瞭解此坡體之運移行為，仍有弱帶之力學與坡體之水文特性等需進一步研究。
中文關鍵字	深層崩塌、片岩、坡體地質模型、破壞機制、山崩調查與監測
英文關鍵字	Deep-seated landslide, schist, slope geologic model, failure mechanism, investigation and monitoring of landslide

會議室	Room 603
日期	11 月 17 日(星期二)
時段	16:30-16:45
議程代碼	NH1-O-03
議題	- Natural Hazards 山崩與土石流災害
作者	戴東霖(Tai Tung-Lin) [經濟部中央地質調查所] (通訊作者) 謝有忠() [經濟部中央地質調查所] 林樞衡() [經濟部中央地質調查所] 鍾明劍() [財團法人中興工程顧問社] 趙韋安() [國立交通大學]
中文題目	潛在大規模崩塌之場址地質調查及未來展望
英文題目	The Geological Site Investigation and Future prospect of Potential Large-scale Landslide
投稿類型	口頭報告 Oral
摘要	<p>莫拉克風災後十週年，大規模崩塌已成為近年坡地防災之核心議題，其定義為崩塌面積大於 10 公頃、土方量超過 10 萬立方公尺或滑動深度 10 公尺以上，為找出可能發生大規模崩塌的潛勢地區且防範未然，本所於 99-104 年藉由空載光達技術測製全島高精度數值地形資料，DEM(數值高程模型)呈現去除地表植被及人工建物後的地表地形高程起伏面，可清楚顯現崩塌微地形特徵，如崩崖、側邊裂縫、蝕溝、坡址隆起等地形破壞特徵而圈繪出潛在大規模崩塌範圍，此類屬性資料亦納入第 1 階段(103~105 年)全島公告之山崩與地滑地質敏感區。 因應潛在大規模崩塌已納入山崩與地滑地質敏感區，考量土地開發行為及各級單位進行潛在大規模崩塌相關調查工作，本所於 106~109 年選定 4 處潛在大規模崩塌場址(D160 茶山、D008 車心崙、D007 梵梵及霧鹿)進行調查觀測與地質安全評估，逐年滾動修正調查工項並引進新興觀測技術，期許建立潛在大規模崩塌的完整調查流程，並提供各地球物理技術重點以及探討不同環境地質的適用性。 本所於 106~110 年持續完成潛在大規模崩塌之精進判釋與補充調查，其判釋數量勢必增加，下階段應有通盤的活動性評估，以分級或分類的方式篩選出重點調查區位，判釋底圖如坡度圖或陰影圖，在視覺化處理後納入平台供各界參考。另場址調查重點為重力變形現象，結合地表地形特徵、現地地質調查及岩芯紀錄，以建立潛在大規模崩塌地質模型；然潛在大規模崩塌的水文控制條件最為複雜，單點觀測井之水位難以代表區域崩塌場址的地下水變化，水文條件涉及降雨入滲、土壤含水量及地下水位，其機制在未來中長程規劃中可列為重點釐清議題。</p>
中文關鍵字	潛在大規模崩塌、場址、地質調查、觀測
英文關鍵字	Potential Large-scale Landslide, Site, Geological investigation, Monitoring system

會議室	Room 603
日期	11月17日(星期二)
時段	16:45-17:00
議程代碼	NH1-O-04
議題	- Natural Hazards 山崩與土石流災害
作者	朱崇銳(Chung-Ray Chu) [國家災害防救科技中心] (通訊作者) 林冠瑋(Guan-Wei Lin) [國立成功大學地球科學系] 張簡意逢(Yi-Feng Chang-Chien) [國立成功大學地球科學系] 劉哲欣(Che-Hsin Liu) [國家災害防救科技中心] 張志新(Chih-Hsin Chang) [國家災害防救科技中心]
中文題目	機械學習架構之落石地動訊號辨識模型
英文題目	Machine Learning Based Model for Rockslide Seismic Signal Identification
投稿類型	口頭報告 Oral
摘要	<p>詳實的坡地災害記錄對防災工作極為重要，取得災時、災點與災害型態除了幫助防災單位了解災中情資外，更可提供研究單位探討相關致災因子並提升預警能力。然而，坡地災害具有高度不確定性，大多數案例的災時和災點常由人為通報得知，時間誤差可能達小時以上，因此必須借重現地監測技術。傳統監測方法以安裝設備於可能崩塌的坡面上為主，如位移計和傾斜儀等，但此類設備屬於一次性設備，災後必須重新安裝；此外，考量成本效率，無法將所有坡地災害潛勢區均事先佈署監測設備，因此大多數災時或災點資訊仍無法準確得知。近年來地球物理相關研究發現，當坡地災害發生時，邊坡塊體移動過程中會與地表產生複雜的撞擊與摩擦行為，因而產生地動。藉由監測設備捕捉坡地災害所引發的地動訊號，具備遠距離連續監測優勢，成為突破監測極限的可能應用方法。分析全時地動記錄，找出屬於坡地事件的訊號，便有機會建立更完整的坡地災害資料庫。然而，全時地動監測數據量龐大，以人工方式判識曠日廢時，而且目標訊號經常混雜於背景噪訊中，導致人為判識容易誤判或遺漏，因此引進自動化訊號辨識技術，開發後端演算法，才能有效率地將長期地動數據應用於災防作業流程中。相關文獻指出，不同的坡地災害類型所造成的地動特性並不相同，發生機率也有所不同。為了有效取得足夠的案例，本研究設定以道路邊坡落石為監測目標，選定苗栗縣南庄鄉鹿湖崩塌區作為研究場域，以地聲計監測落石所產生的地動訊號。鹿湖崩塌區近年來常在颱風及梅雨季傳出崩塌災情，2018年因坡址支撐力不足使大量土砂崩落，形成現今的大型崩塌面。地表裸露加上日曬與降雨導致坡面上不穩定的土石材料頻繁崩落，因此適合作為本研究監測場址。本研究參考該區常見之落石路徑，以橫跨坡面方式裝設4組地聲計。藉由長期監測數據，蒐集地動樣本資料庫，用來建立機械學習辨識模型。本研究以隨機森林作為模型主架構，挑選落石、地震、噪訊及車輛4種訊號類型，各類型分別挑出226筆樣本訊號，經由5-fold交互驗證方式測試辨識效果，整體辨識正確率達86%；以單一類型而言，落石、地震、噪訊及車輛的辨識正確率分別為78%、85%、94%及85%，由此可知本研究測試的辨識模型可有效認知不同來源的地動訊號。</p>
中文關鍵字	坡地災害、落石、地動監測、機械學習、隨機森林
英文關鍵字	Slope Disaster, Rockslide, Seismic Monitoring, Machine Learning, Random Forest

會議室	Room 603
日期	11月17日(星期二)
時段	17:00-17:15
議程代碼	NH2-O-01
議題	- Natural Hazards 地震災害
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中文題目	機率式斷層位移危害度分析:以花蓮地區為例
英文題目	Probabilistic Fault Displacement Hazard Analysis : An Example of the Hualien area
投稿類型	口頭報告 Oral
摘要	Seismic impact on infrastructures may include strong ground-motion impact, fault displacement and ground deformation. Coseismic surface displacements associated with large earthquakes have caused significant damage to structures located on or near a fault and may impact existing structures. A method has been proposed (Youngs et al., 2003) to estimate fault displacement in a similarly probabilistic manner as a probabilistic seismic hazard analysis (PSHA). A probabilistic fault displacement hazard analysis (PFDHA) is one such procedure that provides an estimate of expected levels of slip on a fault due to surface rupture. An earthquake of Mw 6.4 occurred in the Hualien area of eastern Taiwan on 6 February 2018. It caused surface ruptures in several areas mostly near the Milun Fault in Hualien City. The offset reached its maximum of 30 cm. Thus, we try to select empirical distributions for surface rupture, maximum and average displacement, spatial variability of slip, and other random variables that are the key to implementing PFDHA. We calculated fault displacement hazard and compared the results with the distribution of co-seismic surface ruptures through field surveys.
中文關鍵字	機率式斷層位移危害度分析
英文關鍵字	Probabilistic Fault Displacement Hazard Analysis

會議室	Room 603
日期	11 月 17 日(星期二)
時段	17:15-17:30
議程代碼	NH2-O-02
議題	- Natural Hazards 地震災害
作者	黃能偉() [中興工程顧問股份有限公司、中央大學地球物理研究所] (通訊作者) 鄭世楠() [私立健行科技大學通識中心] 游能悌() [國立清華大學院務中心應用科學系] 蘇志杰() [國立台灣大學海洋研究所] 施國偉() [中興工程顧問股份有限公司] 丁哲庸() [中興工程顧問股份有限公司] 陳昱彤() [中興工程顧問股份有限公司] 彭子軒() [中興工程顧問股份有限公司]
中文題目	淺談 1867 年台灣北部古海嘯歷史紀錄
英文題目	Discussion 1867 paleotsunami historic records in Northern Taiwan
投稿類型	口頭報告 Oral
摘要	2011 年日本東北地方太平洋近海地震誘發海嘯事件，造成福島第一核能電廠及其鄰近區域莫大災害，而台灣臨海區域具有三座營運中之核能電廠，也掀起台灣古海嘯調查與歷史紀錄之研究。從歷史文獻來看，位於台灣北部區域，在 1867 年 12 月 18 日(同治 6 年 11 月)曾有多篇文獻紀載，北部各地曾發生有感地震事件與地震造成之傷亡，其中，基隆港與金山平原甚有海水入侵或退去之報導，也因此，推測其可能為地震引起之海嘯事件。近年來，位於金山平原與基隆和平島等地皆有發現古海嘯沉積物之跡象。本文整理 1867 年以來之相關歷史文獻紀錄顯示，地震、災損以及傷亡現象分布於台灣北部，而海水退去與侵入則報導於具港灣地形之金山平原與基隆港區，惟下沉現象則沿金山平原與山麓區域交界處，相當於現今山腳斷層延伸位置，故推估該事件可能為山腳斷層活動後，金山平原產生盆地瞬間沉降效應，造成海水入侵，形成似水庫潰壩現象。因此，推估本事件可能為地震斷層活動造成海水漲退結果，提供後續 1867 年海嘯事件研究之另一種想像。
中文關鍵字	1867 年、基隆海嘯、山腳斷層
英文關鍵字	1867、Keelung Tsunami、Shanchiao Fault

會議室	Room 604
日期	11月17日(星期二)
時段	16:00-16:15
議程代碼	ST3-O-01
議題	- Stratigraphy 沉積學
作者	李通藝(Tung-Yi Lee) [台灣師範大學地球科學系暨研究所] (通訊作者) 楊智宇(Chi-Yu Yang) [台灣師範大學地球科學系暨研究所] 林郁伶(Yu-Ling Lin) [台灣師範大學地球科學系暨研究所] 葉孟宛(Meng-Wan Yeh) [台灣師範大學地球科學系暨研究所] 吳榮章(Jong-Chang Wu) [台灣中油公司探採事業部] 張渝龍(Yu-Long Chang) [台灣中油公司探採事業部] 魏聲焜(Sheng-Kuen Wey) [台灣中油公司探採事業部]
中文題目	苗栗地區新近系碎屑鋯石紀錄研究：台灣前陸隆起發育的關聯
英文題目	Neogene Detrital Zircon Records from Miaoli: Implications for Forebulge Development in Taiwan
投稿類型	口頭報告 Oral
摘要	The timing of arc-continent collision initiation in Taiwan has long been a subject of debate. U-Pb dating of detrital zircons within the Neogene sedimentary formations near Chuhuangkeng Anticline in Miaoli, Central Taiwan are analyzed by single collector Laser Ablation-Inductively Coupled Plasma-Mass Spectrometer (LA-ICP-MS) to investigate the evolution of possible sedimentary source regions. Continual strata samples were collected from the Miocene Peiliao Sandstone up to the Pliocene Chinshui Shale. The U-Pb zircon ages obtained from the Lower Miocene Peiliao Sandstone to the Upper Miocene Tungkung Formation display major peaks at 165-95 Ma, 250-200 Ma, and 850-750 Ma from the overall age spectra. Yet only 190-90 Ma and 250-200 Ma peaks are identified from the age spectra of detrital U-Pb zircon ages obtained from the Upper Miocene Shangfuchi Sandstone and Kuantaoshan Sandstone. The lack of 850-750 Ma peak for the Upper Miocene sandstone units suggests that sediment supply source could have changed since the Late Miocene time. Proterozoic zircon ages are dominant signature of Cathaysia basement, which may imply the sediment supply of Miocene formations (the Peiliao Sandstone to the Tungkung Formation) should have come from the Cathaysia area. The fact the terminal Miocene formations showed a higher Mesozoic age peak and the lack of Proterozoic age peaks strongly indicated the Yanshanian and granitic plutons in East Cathaysia should be the dominant sedimentary source for the Shangfuchi and Kuantaoshan Sandstone units. These sandstones were interpreted to have deposited in the initial arc-continent collision setting between Luzon Arc and Eurasian passive continental margin. The arc-continent collision might have induced a buildup of the lithospheric forebulge which led to the noticeable change of sediment source region during the terminal Miocene as our age spectra indicated.
中文關鍵字	碎屑鋯石鈾-鉛定年、前陸隆起、弧-陸碰撞
英文關鍵字	detrital zircon U-Pb dating, forebulge, and arc-continent collision

會議室	Room 604
日期	11月17日(星期二)
時段	16:15-16:30
議程代碼	ST3-O-02
議題	- Stratigraphy 沉積學
作者	朱孝承(Xiao-Cheng Zhu) [國立臺灣大學地質科學研究所] (通訊作者) 陳文山(Wen-Shan Chen) [國立臺灣大學地質科學研究所]
中文題目	探討大漢溪剖面更新世卓蘭層至楊梅層之沉積層序及前陸盆地演化
英文題目	Sequence stratigraphy and evolution of foreland basin from Cholan Formation to Yengmei Formation in Dahan River section
投稿類型	口頭報告 Oral
摘要	<p>晚中新世以來，弧陸碰撞使得臺灣形成一系列南北向造山帶，在其西側前緣發育一系列前陸盆地。前陸盆地具有高沉降速率及高沉積速率的特性，使得其沉積層序可反映小尺度的海水面變動。更新世的海水面升降受米蘭科維奇行星軌道影響，具有週期性變化。其中，臺灣西北部大漢溪剖面的卓蘭層與楊梅層，為更新世前陸盆地地層，沉積環境呈現海相轉為陸相，也導致卓蘭層上部至楊梅層，缺乏超微化石的資料而無法得知年代。因此，本研究透過岩相分析、岩相組合分析及層序地層分析，調查卓蘭層至楊梅層第五級的沉積層序，並對比至米蘭科維奇週期，建立卓蘭層至楊梅層的年代模式，再透過構造沉降速率及沉積速率的計算，探討沉積層序及北部前陸盆地的演化歷史。卓蘭層至楊梅層共可分出45個沉積層序，具4種型態的沉積層序，分別為遠濱型、河口型、分流河道型及陸相河道型。整個沉積層序及沉積環境呈現向上變淺，海相轉變為陸相。其中，沉積層序演化有兩種看法，關鍵在於層序編號42之後的沉積層序有明顯增厚的現象，第一種看法是認為受到構造沉降速率及沉積速率加速的影響，第二種看法除了構造沉降速率及沉積速率加速外，也受到十萬年週期的影響。兩種看法皆透過沉積速率及沉積速率的計算，顯示北部前陸盆地分別1.86 Ma及0.98-0.87 Ma有增加的趨勢。1.86 Ma，前陸盆地沉降速率及沉積速率增加，是受到雪山山脈及內麓山帶的抬升造成前陸盆地的沉降速率增加，同時造成雪山山脈及外麓山帶的沉積物大量剝蝕至盆地堆積，沉積速率因此而增加及沉積環境快速變淺。0.98-0.87 Ma，沉降速率及沉積速率增幅大於1.86 Ma，顯示前陸盆地已經相當靠近斷層前緣，造成沉積速率及沉降速率大幅增加。</p>
中文關鍵字	層序地層、前陸盆地、更新世、米蘭科維奇週期
英文關鍵字	Sequence stratigraphy, foreland basin, Pleistocene, Milankovitch cycle

會議室	Room 604
日期	11月17日(星期二)
時段	16:30-16:45
議程代碼	ST3-O-03
議題	- Stratigraphy 沉積學
作者	劉俊旻(Jyun-Min Liou) [國立臺灣師範大學] (通訊作者) 林宗儀(Tsung-Yi Lin) [國立臺灣師範大學]
中文題目	桃園海岸草漂沙丘之沉積學初探
英文題目	Preliminary study of the sedimentology of the Caota sand dune at the Taoyuan coast
投稿類型	口頭報告 Oral
摘要	位於桃園市大園、觀音二區的草漂沙丘，長度約8公里，包含老街溪、富林溪、大堀溪三條溪流的出海口，在穩定的沉積物供應下，形成高大的海岸沙丘。本研究主要從草漂沙丘的沉積物粒徑、礦物組成分析和剖面的沉積構造來探究海岸沙丘的相關沉積學特徵，以為海岸地區沙丘風成堆積環境建立初步的研究基礎資料。本研究透過沙丘現場的沙樣採取和室內的雷射粒徑分析與立體顯微鏡觀察及計量，分析沙丘沉積物的顆粒大小與分布及沉積物顆粒的礦物成分，另外也在野外進行剖面挖掘，對沙丘的沉積構造進行描述及觀測。初步研究成果發現，沙丘沉積物樣本的中值粒徑值約在 250 μ m-300 μ m，屬於細沙-中沙、峰度>20、淘選度良好，粒徑分布呈正偏態之特性，顯示顆粒高度集中於中間偏粗。顆粒的礦物成分以石英與不透光礦物(如磁鐵礦)為主，夾雜少許生物與人造物碎屑。草漂沙丘剖面的沉積構造大多以平行層為主，並夾雜部分交錯層，傾斜的交錯層交角可達28度。
中文關鍵字	海岸沙丘、風成堆積、沉積構造、粒徑分析、礦物組成
英文關鍵字	coastal dune, aeolian deposition, sedimentary structure, grain size analysis, mineral composition

會議室	Room 604
日期	11月17日(星期二)
時段	16:45-17:00
議程代碼	ST3-O-04
議題	- Stratigraphy 沉積學
作者	潘惠娟(Hui-Juan Pan) [國立臺灣海洋大學地球科學研究所] (通訊作者)
中文題目	
英文題目	Spatial accuracy assessment of biogenic sediment contents determined from derivative color reflectance spectra by a novel varimax-rotated principal component analysis (VPCA) in western Pacific marginal seas
投稿類型	口頭報告 Oral
摘要	<p>Biogenic contents of marine sediments such as carbonate (CaCO₃), total organic carbon (TOC), and opal provide critical information for understanding past climatic and environmental changes. The laboratory consumptive analysis of biogenic sediment contents requires enormous time and effort especially for the long sediment cores with high sedimentation rates. Non-destructive methods such as those based on diffuse color reflectance spectra data measuring from the surface of marine sediment samples for empirically estimating downcore biogenic contents have been developed in previous marine drilling and coring programs. However, those methods have been demonstrated only useful in on-site estimations for downcore samples, not fully feasible in testing samples from regional or more spatial scales. In this study, a novel protocol of spectral decomposition method which used varimax-rotated principal component analysis (VPCA) was developed and demonstrated more successful in estimating biogenic contents of sediment samples from basin scale. We tested the new protocol by using color reflectance and biogenic content data from two sediment cores MD972148 and MD012396 which were located in the South China Sea (SCS) with a distance of 200 km. A set of empirical equations for estimating CaCO₃, TOC, and opal contents have been carefully established via the stepwise regression based on six VPCA components of color reflectance data and laboratory analyzed biogenic contents of core MD972148. We tested the equations by data from core MD012396 and demonstrated that our new regression equations provide useful estimations. With the improvement of the regression model with reduced number of independents, possibly more physically meaningful variables, our studies demonstrated that better estimations could be achieved by our new methods. This study implies that our new method will provide a basis of more regional or longer biogenic content estimations in future researches.</p>
中文關鍵字	
英文關鍵字	Biogenic, Diffuse color reflectance spectra, VPCA, South China Sea

會議室	Room 604
日期	11月17日(星期二)
時段	17:00-17:15
議程代碼	ST3-O-05
議題	- Stratigraphy 沉積學
作者	游能悌(Neng-Ti Yu) [國立清華大學通識中心] (通訊作者) 呂政豪(Cheng-Hao Lu) [國立澎湖科技大學] 顏一勤(I-Chin Yen) [國立中央大學] 顏君毅(Jiun-Yee Yen) [國立東華大學]
中文題目	千年以來南海的巨波浪事件：澎湖海岸的地層記錄之二
英文題目	South China Sea mega-wave events from the last millennium: coastal stratigraphic records on Penghu Islands (II)
投稿類型	口頭報告 Oral
摘要	澎湖群島位於南海北坡大陸棚的東北角，以往研究已經發現，各島海岸經常有巨波浪與暴潮事件堆積層，因為南海不僅是颱風的溫床，周邊的地震帶與火山島弧也能引發海嘯。過去六年來，本團隊在馬公、望安與七美的海岸持續進行露頭調查，最近在馬公與虎井嶼又發現9個含有海相事件堆積層的新剖面，並完成初步的地層學與沈積學分析。在虎井嶼北面海岸有三個剖面，各發現一到二層海相事件礫石層，具有侵蝕底面、基質支持、海相化石碎屑、圓形岩礫等特徵，反映高懸浮濃度混濁水流的堆積作用。事件層的高程在4–7.8公尺之間，遠高於颱風暴潮水位，可能與海嘯作用比較相關。碳十四定年結果指向二個年代區間：晚十七–晚十八世紀、與近代，由於澎湖並沒有近代海嘯的觀測紀錄，最上部事件層的年代有待進一步確認。本團隊以往在蛇頭山與鎖港等剖面中，也有發現晚十七–晚十八世紀的事件礫石層。馬公東北側有三個海岸剖面，有一產狀類似的海相事件層，高程在2.0–3.4公尺之間，高於颱風暴潮水位，也可能反映海嘯的堆積作用。本層形成年代不老於十六世紀，可以對比蛇頭山剖面另一層年代較老的事件堆積礫石層（晚十五–早十七世紀）。在馬公西北側有三個海岸剖面，有三個產狀類似的事件層。上部二層的高程位於1.0–1.5公尺之間，近乎於颱風暴潮水位，下層年代不老於十九世紀，上層年代屬於現代，這期間澎湖有至少三次1.06–1.5公尺高的颱風暴潮（1813、1832、1969）。最老一層的年代不老於十二世紀，高程在6.0–6.8公尺，也可能反映海嘯的堆積作用，並且是本團隊新發現、年代較老的事件層之一，層位在其他剖面之下。
中文關鍵字	南海、澎湖群島、海嘯、颱風暴潮、事件堆積、過去千年
英文關鍵字	South China Sea, Penghu Islands, tsunami, typhoon surge, event deposit, last millennium

會議室	Room 604
日期	11 月 17 日(星期二)
時段	17:15-17:30
議程代碼	ST3-O-06
議題	- Stratigraphy 沉積學
作者	游能悌(Neng-Ti Yu) [國立清華大學通識中心] (通訊作者) 顏君毅(Jiun-Yee Yen) [國立東華大學] 顏一勤(I-Chin Yen) [國立中央大學] 朱美妃(Mei-Fei Chu) [國立臺灣大學]
中文題目	基隆—金山海嘯六探：二千年來的溢淹再現間隔、浮石來源與漂移路徑
英文題目	A senary study on Keelung-Jinshan Tsunami: inundation recurrence, pumice sources, and drifting routes from the last two millennia
投稿類型	口頭報告 Oral
摘要	<p>從 1860 到 1920 年代以來，基隆海岸就時有浮石筏 (pumice raft) 擱淺上岸的報導，另外在野柳海岸的上部全新統國姓埔層中，也至少有兩個層位出露古代的擱淺浮石。這充分反映了台灣周遭旺盛的島弧火山活動，並且指示可能有經常性的傳輸路徑與堆積機制。在 2018 年年會，本團隊初步報導了基隆與金山相當地層的土壤化崩積層剖面中，有七層海相事件層，其中六層含大量黑色與白色浮石圓礫，並且顯示了不同的浮石來源、火山活動與岩漿成分。此次，我們重新整理歷史與地質記錄，包括颱風、海嘯、火山噴發、洋流、沿岸流、與盛行風，並擴大檢視範圍，涵蓋整個菲律賓海，嘗試釐清過去二千多年來，北台灣的海嘯週期、浮石來源、與傳輸路徑。在北台灣，這些浮石圓礫是指標性的海相沈積物，沒有伴隨緻密的火成岩碎屑，顯示在傳輸過程中，顆粒間撞擊磨蝕造成圓形的顆粒，可觀的傳輸距離與差異沈降只留下密度小、能懸浮的浮石。另外，各事件層的海拔高度在 2.4–11.5 公尺之間，遠超過全球暖化 (西元 1960 年) 以來的颱風暴潮高度，代表這些浮石擱淺在濱前沙灘 (foreshore) 之後，應是被海嘯的溢淹作用再度搬運、堆積在濱後 (backshore)，並被崩積層掩埋而保存至今。各事件層的黑色浮石屬於粗面岩—粗面安山岩組成，白色浮石屬於流紋岩—石英安山岩組成。在過去二個世紀中，環菲律賓海的島弧火山都有產出這二種典型的浮石筏，前者集中在伊豆—小笠原島弧南段 (Izu-Bonin)，後者則廣泛出產於琉球、九州—西本州、與伊豆—小笠原等火山弧。在 1924 年，南琉球的白色浮石筏就曾隨著黑潮東北台灣支流 (Kuroshio Branch Current northeast of Taiwan) 漂流到北台灣外海，再受到東北季風與沿岸流的共同推送，擱淺於 200 公里外的基隆海岸。在 1986 年，南伊豆—小笠原島弧的黑色浮石筏更隨著黑潮回流 (Kuroshio Counter Current)，向西漂流到 1500–1900 公里外的南琉球諸島。依據碳十四定年與模式年代計算結果，這些海嘯溢淹事件分布於西元前 362 年到西元 1867 年之間，再現間隔是 83–725 年。黑色與白色浮石可能來自伊豆—小笠原島弧南段，漂流路徑長達 2000 公里以上，沿黑潮回流、黑潮、與黑潮東北台灣支流來到北台灣外海，再由東北季風、沿岸流、與向岸流共同作用而擱淺堆積。部分白色浮石則來自相對近程 (short-distance) 的南琉球島弧，堆積受到黑潮東北台灣支流、東北季風、沿岸流、與向岸流的共同作用。</p>
中文關鍵字	基隆海嘯、浮石筏、再現間隔、伊豆—小笠原島弧、琉球島弧、長程漂移、近程漂移
英文關鍵字	Keelung Tsunami, pumice raft, recurrence, Izu–Bonin Arc, Ryukyu Arc, long-distance drifting, short-distance drifting

會議室	Room 605
日期	11月17日(星期二)
時段	16:00-16:15
議程代碼	V4-O-01
議題	- Volcanology and Geochemistry 岩石地球化學
作者	馬努(Manu Prasanth M.P) [National Taiwan Normal University] (通訊作者) 謝奈特(J. Gregory Shellnutt) [] 哈里(K.R. Hari) [School of Studies in Geology and Water Resource Management, Pt. Ravishankar Shukla University, Raipur 492010, Chhattisgarh, India.]
中文題目	
英文題目	Platinum-group element (PGE) geochemistry of Sonakhan greenstone belt of Bastar craton and its relations to the greenstone belts of eastern Dharwar craton
投稿類型	口頭報告 Oral
摘要	The volcanic-intrusive units in the Archean greenstone belts are potential hosts for the PGE mineralization. Here we evaluated the Platinum group element (PGE) geochemistry of an ultramafic intrusion from the Sonakhan Greenstone belt (SGB) in the northern Bastar craton, and its tectono-magmatic relations with the greenstone belts of eastern Dharwar craton (EDC). The SGB comprises mafic-ultramafic, volcanic-intrusive sequences in the lower stratigraphic regime; meta-sedimentary sequences and Banded Iron Formations (BIF) overlie these units. The chondrite normalized PGE patterns of ultramafic units of SGB exhibit higher abundance of Platinum group PGEs ($\Sigma\text{PPGE} = 292\text{-}496$ ppb) relative to the Iridium group PGEs ($\Sigma\text{IPGE} = 32\text{-}52$ ppb). The PPGE and IPGE relations attributed to a boninitic parental melt, where the IPGEs in the source partitioned into a monosulfide solid solution (mss). The Cu (22-80 ppm), elevated Pt (22-238 ppb) and Pd (31-377 ppb) relations indicate Pt and Pd partitioned into semi-metal rich melt during late stage of crystallization. The geochemical characters of SGB are consistent with an oceanic environment and the tectonic regime is similar to supra subduction zones. The SGB ($\text{V}/\text{Yb} = 146 \pm 25$; 1σ ; $n=8$) and greenstone belts of EDC ($\text{V}/\text{Yb} = 134 \pm 52$; 1σ ; $n=92$) record oxidized mantle conditions similar to modern arc settings ($\text{V}/\text{Yb} = 158 \pm 60$). The volcanic associations in the greenstone belts of both cratons exhibit hydrated mantle regimes, possibly derived through subduction-related events. The western Dharwar craton, however, dominated by plume derived komatiite-tholeiite associations. Based on the litho tectonic relations of greenstone sequences and dyke swarm associations, we propose magmatic as well as tectonic correlations possible for the Archean-Paleoproterozoic Bastar and eastern Dharwar cratons.
中文關鍵字	鉑系元素, 綠色岩帶, 晚太古代-早元古代
英文關鍵字	Greenstone belts, Archean, Platinum Group Elements

會議室	Room 605
日期	11月17日(星期二)
時段	16:15-16:30
議程代碼	V4-O-02
議題	- Volcanology and Geochemistry 岩石地球化學
作者	陳威宇() [國立台灣師範大學] (通訊作者) 謝奈特(J. Gregory Shellnutt) [國立台灣師範大學] Ghulam M. Bhat [Department of Geology, University of Jammu] 鈴木勝彥(Katsuhiko Suzuki) [Research Institute for Marine Resources Utilization (MRU), Japan Agency for Marine-Earth Science and Technology (JAMSTEC)] 瑪麗亞 露易莎(Maria Luisa G. Tejada) [Research Institute for Marine Geodynamics (IMG), Japan Agency for Marine-Earth Science and Technology (JAMSTEC)] 史蒂芬(Steven W. Denyszyn) [University of Western Australia, School of Earth and Environment]
中文題目	印度北部喀什米爾地區潘加爾火成岩區東西部的關係
英文題目	Correlation across the Panjal Traps, Kashmir, India
投稿類型	口頭報告 Oral
摘要	The Early Permian volcanic sequences in the Himalaya are contemporaneous with the opening of Neotethys Ocean. The Panjal Traps are the largest exposure of the Neotethyan rift-related basalt in Western Himalaya. Few, if any, investigations are focused on the Pir Panjal Range. This study presents a CA-ID-TIMS zircon U-Pb age from a basalt, new whole-rock geochemistry and whole-rock Sr and Os isotope of rocks. The CA-ID-TIMS zircon U-Pb age was obtained from a basalt yielded a weighted-mean $^{206}\text{Pb}/^{238}\text{U}$ age of 288.2 ± 0.3 Ma ($N = 4$, $\text{MSWD} = 1.5$). This age is within the error of Zircon LA-ICP-MS age from Panjal rhyolite (289 ± 3 Ma). Major elements indicate that the samples from Jawahar Tunnel can be roughly divided into three groups (basaltic, basaltic andesite, silicic) and may correlate with the eastern region of the Panjal Traps. The normalized trace element plots show that both mafic and silicic samples have patterns similar to the rocks collected from Guryal Ravine. The Eu/Eu^* values and the depletion of Sr and Ba in the primitive mantle normalized incompatible element plot imply the magma experienced fractional crystallization of plagioclase. Low Mg# indicates the magma also experienced fractional crystallization of olivine or pyroxene. The $^{87}\text{Os}/^{188}\text{Os}$ ratios in different parts of Panjal Traps range from 0.1230 to 0.1746. Two samples from northern Pir Panjal have the ratio 0.1230 and 0.1256 which are similar to primitive upper mantle whereas samples from other sections show enriched values (0.1343-0.2832). The new data from Jawahar Tunnel imply the southern portion of the Pir Panjal range might be correlative to the Guryal Ravine section instead of northern Pir Panjal. The Os and Nd isotopes suggest the original source of the Panjal Traps is initially chondritic. The mantle transition from enriched at Jawahar Tunnel and Guryal Ravine to relatively depleted in the northern Pir Panjal is consistent with a transition from continental rifting to ocean opening.
中文關鍵字	印度、喀什米爾、大陸洪流火成岩、二疊紀、新特提斯洋
英文關鍵字	India, Kashmir, continental flood basalt, Permian, Neo-Tethys

會議室	Room 605
日期	11月17日(星期二)
時段	16:30-16:45
議程代碼	V4-O-03
議題	- Volcanology and Geochemistry 岩石地球化學
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中文題目	
英文題目	Behaviour of first-row transition elements during early differentiation of arc magmas, Solomon Islands, SW Pacific: Implications for the redox state of sub-arc mantle
投稿類型	口頭報告 Oral
摘要	Many first-row transition elements (FRTE) are redox-sensitive, making them ideal candidates in exploring the redox states in magmatic systems. Because arc lavas in general are differentiated, it is challenging to apply proxies involving these elements to investigate the oxygen fugacity of sub-arc mantle. A cogenetic suite of arc magmas, wherein the most primitive members are in direct equilibrium with the mantle, is thus valuable because it gives an opportunity to examine source geochemistry and how elemental systematics changes with differentiation. Here, we document new geochemical analyses for picritic and basaltic lavas from the Solomon arc, SW Pacific with a specific focus placed on FRTE. The lavas have variable MgO with the relatively primitive ones mostly in Fe/Mg exchange equilibrium with Fo ₈₉₋₉₁ olivine. With MgO as a proxy for differentiation, Cr, Co and Ni behave compatibly, and V, Cu and Ga behave incompatibly. Iron and Zn might have partitioning behaviour intermediate between compatible and incompatible. Scandium gently increases with decreasing MgO before it plummets at ~8 wt.% MgO, consistent with the onset of clinopyroxene fractionation. The above trends indicate that the oxybarometric proxies V/Sc, V/Ga and Zn/FeT can be applied to the picritic and relatively primitive basaltic lavas for oxygen fugacity estimation. The oxygen fugacity of the mantle source from which these lavas derived can be tightly constrained at FMQ to FMQ - 1. Covariation of MgO and Cu further indicates that the oxygen fugacity during differentiation did not exceed FMQ + 1.3. Our results concur with the view that the redox state of sub-arc mantle asthenosphere is similar to that of MORB-source mantle, and that high Fe ³⁺ /FeT generally seen in arc lavas and basaltic glasses therein is a result of transcrustal magmatic processes.
中文關鍵字	
英文關鍵字	first-row transition elements, Solomon Islands, oxygen fugacity, differentiation

會議室	Room 605
日期	11月17日(星期二)
時段	16:45-17:00
議程代碼	V4-O-04
議題	- Volcanology and Geochemistry 岩石地球化學
作者	謝奈特(Greg Shellnutt) [台灣師範大學地球科學系暨研究所] (通訊作者) Matthew W. Vaughan [Siletzia Resources] Hao-Yang Lee [Academia Sinica, Institute of Earth Sciences] Yoshiyuki Iizuka [Academia Sinica, Institute of Earth Sciences]
中文題目	澳門晚侏羅紀花崗岩燕山期造山運動期間地殼循環的記錄
英文題目	Late Jurassic leucogranites of Macau (SE China): a record of crustal recycling during the Early Yanshanian Orogeny
投稿類型	口頭報告 Oral
摘要	<p>The Yanshanian Orogeny consists of Jurassic to Cretaceous compressional-extensional cycles related to the subduction of the Paleo-Pacific Ocean beneath East Asia. Numerous granitic plutons were emplaced across southeast China at distinct intervals over a period of ~100 million years that migrate from the interior to the coast. A key region to help constrain the secular evolution of granitic magmatism related to the Yanshanian Orogeny is the Pearl River estuary as three distinct Mesozoic magmatic belts congregate. The islands of Taipa and Coloane, Macau Special Administrative Region, are located along the western bank of the Pearl River estuary and are composed of spessartine-bearing biotite leucogranite. In situ zircon geochronology yielded Late Jurassic weighted-mean $^{206}\text{Pb}/^{238}\text{U}$ ages of 160.0 ± 2.0 Ma and 161.5 ± 2.0 Ma that correlate to the late Early Yanshanian Orogeny. Inherited zircons of Middle Triassic to Middle Jurassic age were also identified. The rocks are peraluminous, ferroan, calc-alkalic to calcic and classify as post-collisional granite. Geochemical modeling indicates that the chemical variability of the rocks is related to hydrous fractional crystallization under reducing conditions (DFMQ -1) at ~7 km depth. The Sr-Nd isotopes ($^{87}\text{Sr}/^{86}\text{Sr} = 0.71156$ to 0.72477; $\epsilon\text{Nd}(t) = -7.9$ to -8.6), zircon Hf isotopes ($\epsilon\text{Hf}(t) = -3.8$ to -8.8), incompatible trace element ratios, and whole rock composition indicate that the parental magma was derived primarily from a sedimentary source. It is likely that the islands of Taipa and Coloane form a coherent plutonic complex that may be a member of larger batholith that extends across the Pearl River estuary to Hong Kong. The emplacement of the leucogranites is attributed to decompressional melting associated with a period of crustal relaxation or tensional plate stress that occurred during the transition from low angle subduction to high angle subduction of the Paleo-Pacific plate.</p>
中文關鍵字	燕山期造山運動、中國東南、碰撞前花崗岩、S花崗岩
英文關鍵字	Early Yanshanian Orogeny, SE China, post-collisional granite, S-type granite, Cathaysia Block

會議室	Room 605
日期	11月17日(星期二)
時段	17:00-17:15
議程代碼	V4-O-05
議題	- Volcanology and Geochemistry 岩石地球化學
作者	林建偉(Lin, Jian-Wei) [台灣大學地質科學系] (通訊作者)
中文題目	
英文題目	Exotic origin of Pingtan Island in the Pingtan-Dongshan Metamorphic Belt (SE China): Zircon U-Pb age and Hf isotope evidences
投稿類型	口頭報告 Oral
摘要	<p>Cathaysia Block in South China had accreted tremendous amounts of Mesozoic magmatic rocks. Recent zircon U-Pb age results revealed existence of some Early Jurassic gneissic granites (200-190 Ma) in the Pingtan-Dongshan Metamorphic Belt (PDMB), coastal SE China which corresponds one stage of magmatic quiescence in the rest part of East Cathaysia. To better understand Mesozoic thermal evolution of the PDMB, U-Pb geochronology and Hf isotope composition of zircon separates (LA-ICPMS) and inclusions (NanoSIMS, age only) are examined for two granitic rocks and one meta-sandstone in Pingtan area (northern PDMB) and three granites in Matsu Islands further north. For Pingtan rocks, ages of discrete zircons are close to the Early Jurassic time in two stages (196 Ma and 173 Ma) yet all with predominantly positive $\epsilon_{\text{Hf}}(t)$ values (-0.2 to 7.5), whereas zircon inclusions within rock-forming minerals yield a wide age span from Permo-Triassic to Early Cretaceous in six clusters that basically coincide the major Mesozoic thermal episodes in Cathaysia except the second cluster. Noting that there are similarities of zircon ages and $\epsilon_{\text{Hf}}(t)$ values between the granite-schist associations in Tananao Metamorphic Belt (TMB) of eastern Taiwan and Pingtan island of northern PDMB, these Early Jurassic granites were probably originated from a same source. Three consistent Early Cretaceous age clusters of zircon inclusions over the studied samples match two well-known magma prevailing episodes in the coastal SE China, with one tectonic episode (128-119 Ma) in the PDMB that is often invisible from the zircon separates remains unexplainable. In response to a plausible tectonic evolution, we support the earlier proposition for a now-concealed microcontinent that had impinged on Cathaysia around 125 Ma, but further suggest that it left Pingtan Island behind as a remnant fragment when drifted away at later time.</p>
中文關鍵字	
英文關鍵字	Zircon U-Pb age, Hf isotope composition, LA-ICPMS, NanoSIMS, Pingtan-Dongshan Metamorphic Belt, Cathaysia Block

會議室	Room 605
日期	11月17日(星期二)
時段	17:15-17:30
議程代碼	V4-O-06
議題	- Volcanology and Geochemistry 岩石地球化學
作者	林秋婷(Chiou-Ting Lin) [中國科學院海洋研究所] (通訊作者) 馮奎智(Kuei-Chih Feng) [明志科技大學機械工程學系] 龔慧貞(Jennifer Kung) [國立成功大學] Ron Harris(Ron Harris) [Department of Geology, Brigham Young University] 朱繼浩(Ji-Hao Zhu) [中國自然資源部第二海洋研究所] 孫衛東(Wei-Dong Sun) [中國科學院海洋研究所]
中文題目	新型安山岩: 隱沒起始的超高溫熔融事件
英文題目	Unconventional Andesite/Dacite: Ultrahigh Temperature Slab Melting during Subduction Initiation
投稿類型	口頭報告 Oral
摘要	<p>隱沒起始的直接證據與誘發機制至今仍未完全解決。尤其是邊緣海盆等小型板塊是如何被隱沒的仍存在爭議。然而，目前公認可代表隱沒起始岩漿作用事實上仍無法代表早期隱沒起始的指紋。本研究首次發現一種新型鈣鹼性安山岩／英安岩 (Unconventional Andesite/Dacite)，並認為是目前已知可代表邊緣海盆地隱沒起始的岩石學證據。新型安山岩/英安岩缺乏含水礦物，且基質中含有奈米級方石英，低壓且超高溫的熔融環境。全岩微量元素具有埃達克質地球化學特徵，但卻表現為 Nb-Ta 相對富集，有別於傳統安山岩／英安岩 Nb-Ta 虧損的特徵，進一步證明超高溫之下金紅石不穩定的情況之下發生板片部分熔融並噴出快速冷卻。此外，該樣品中不存在鉛正異常，與一般的島弧安山岩相比並具有高 Nb/U 和 Ce/Pb 比值，暗示著受到沉積物的影響很少。值得注意的是，低鋁頑火輝石表明形成於 1200-1300°C 的溫度條件之下且無水的環境。研究結果顯示，新型安山岩／英安岩的岩石學與地球化學特徵表明隱沒板片在幾乎無水且缺乏沉積物的環境之下歷經超高溫部分熔融。該樣品的鋯石鈾鉛定年結果為 17-16 Ma 進一步證實，該岩類可能是形成於擴張中的南海洋中脊從其與轉換斷層連接處破裂並發生初始隱沒的時期。我們認為新型安山岩／英安岩可能是代表板塊隱沒起始最早的岩漿特徵。</p>
中文關鍵字	隱沒起始、板片熔融、方石英、安山岩、英安岩、馬尼拉海溝
英文關鍵字	Subduction initiation, Slab melting, Cristobalite, Andesite, Dacite, Manila Trench

會議室	Room 606
日期	11月17日(星期二)
時段	16:00-16:15
議程代碼	T4-O-01
議題	- Tectonophysics 大地構造及造山作用
作者	葉恩肇() [國立臺灣師範大學地球科學系] (通訊作者) 陳炳權() [國立臺灣大學地質科學系] 曾雅筑() [國立臺灣師範大學地球科學系] 張郁敬() [國立臺灣師範大學地球科學系] 何恭睿() [中央研究院地球科學所] 李建成() [中央研究院地球科學所] 李元希() [國立中正大學地球與環境科學系] 羅偉() [國立台北科技大學材料及資源工程系] 蔡金河() [國立東華大學環境學院自然資源與環境學系] 玉里剝蝕研究團隊() []
中文題目	台灣中央山脈東翼脆塑性轉換帶的運動學變化
英文題目	
投稿類型	口頭報告 Oral
摘要	Kinematic evolution of exhumation process is always a fascinating mystery for solid earth sciences. Analyses of structures and strain distribution associated with exhumation of the eastern Central Range in Taiwan provide a unique opportunity to understanding the structural history and kinematic evolution of orogenic belts. It is well known that sub-horizontally along-strike stretching lineation is noticeable on the foliation and slaty cleavage with moderate dip at the eastern Central Range, contrast to the down-dip stretching lineation at the western Central Range. The observation of sub-horizontal stretching lineation is compatible with results of orogeny-parallel anisotropy of shear wave splitting in Taiwan. Small shear band and kink band is overprinted on the penetrative foliation. With shear-sense indicators, it illustrated that along-strike shearing associated with almost N-S compression took place during ductile and semi-ductile deformation under the strike-slip faulting stress regime. Conversely, sub-horizontal crenulation cleavages and listric normal faults and also sub-vertical quartz veins and sub-vertical joints subparallel to the motion of the Philippine Sea Plate and quite often locally cut the foliation and slaty cleavage throughout the eastern Central Range, displaying that sub-vertical ductile thinning associated with N 20-30E extension was active during semi-brittle and brittle deformation under normal faulting stress regime. Variation of kinematics at the brittle-ductile transition might indicate that dynamics changes dramatically in the orogenic exhumation system and might further suggest that the existence of a lid separated brittle from ductile deformation to facilitate the exhumation in the eastern Central Range, Taiwan.
中文關鍵字	
英文關鍵字	kinematics, brittle-ductile transition, Taiwan

會議室	Room 606
日期	11月17日(星期二)
時段	16:15-16:30
議程代碼	T4-O-02
議題	- Tectonophysics 大地構造及造山作用
作者	許哲瑋(Che-Wei HSU) [國立中正大學 地球與環境科學系] (通訊作者) 李元希(Yuan-Hsi LEE) [國立中正大學 地球與環境科學系] 盧金山(Lucas Mesalles) [國立中正大學 地球與環境科學系]
中文題目	中橫公路與蘇花公路沿線大南澳變質雜岩中最大變質溫度與構造之間的關係
英文題目	Relationship between peak metamorphic temperatures and structure in the Tananao metamorphic complex along the Central Cross Island Highway and Suao-Hualian Highway transects
投稿類型	口頭報告 Oral
摘要	<p>We combine peak metamorphic temperature estimates from Raman Spectroscopy of Carbonaceous Material (RSCM) with detailed structural observations to establish a chronology of tectonic development in the Tananao metamorphic complex. Two detailed structural transects in Tungao and Nanao area indicate that the rocks experienced two main ductile deformation phases. The development of S1, which appears to be subparallel to bedding, is associated with layer-parallel stretching (i.e. boudinage structure) and recrystallized mica growth. D2 phase is a regional anticline/syncline structure, associated with a local development of crenulation cleavage in the Tananao metamorphic complex and slaty cleavages in Eocene to Miocene strata. D3 phase was mainly observed in the Central Cross Island Highway and locally manifested as recumbent folding of S2 in the eastern end of the Tananao metamorphic complex. RSCM was carried out across two main transects, the Central Cross Island Highway and Suao-Hualian Highway, sampling mainly sediments of Cretaceous to Cenozoic depositional age. Obtained peak metamorphic temperatures extending from 300°C to over 500°C in both transects. Existing muscovite and biotite 40Ar-39Ar ages, however, indicate that the maximum metamorphic temperature did not exceed ca. 400°C during the Penglai orogeny, suggesting the highest metamorphism event is likely coeval to D1. In the northern Tananao metamorphic complex, the youngest detrital zircon U-Pb ages are 75-78 Ma old, muscovite and biotite 40Ar-39Ar cooling ages of 30-40 Ma, and the existence of the E-conglomerate unconformity (ca. 40Ma) indicating subaerial conditions. Taken together, these evidences suggest the timing of D1 is between 75 Ma to 30 Ma. D2 is the main deformation phase during the Penglai orogeny controlling the regional lithological distribution. D3 shows a paleo-stress in the vertical direction, which is related to the recent high exhumation rate stage in the eastern Central Range.</p>
中文關鍵字	碳質物拉曼光譜、大南澳變質雜岩、蓬萊造山運動
英文關鍵字	Raman Spectroscopy of Carbonaceous Material, Tananao Metamorphic Complex, Penglai Orogeny

會議室	Room 606
日期	11月17日(星期二)
時段	16:30-16:45
議程代碼	T4-O-03
議題	- Tectonophysics 大地構造及造山作用
作者	林翰君(HAN CHUN, LIN) [國立中正大學地球與環境科學系] (通訊作者) 李元希(YUAN HSI, LEE) [國立中正大學地球與環境科學系] 盧金山(Lucas Mesalles) [國立中正大學地球與環境科學系] 李建成(JIANG CHENG, LEE) [中央研究院地球科學研究所]
中文題目	台灣東部玉里帶的變質溫度與構造特性
英文題目	The metamorphic temperature and structural characteristic of Yuli belt, eastern Taiwan
投稿類型	口頭報告 Oral
摘要	<p>臺灣造山帶導因於 6.5 Ma 的弧陸碰撞，並伴隨高壓相岩體的剝露，先前研究顯示高壓相岩層(玉里帶)的構造深埋深度約為 50 km，而太魯閣帶則僅深埋至 12-20 km。過去在構造上認為此兩者以壽豐斷層為界，但此斷層對於兩側岩層間的變質溫度與構造差異的影響仍不甚清楚。而東側的玉里帶與初來層邊界亦需釐清是否為斷層接觸或是整合接觸。除此之外，高壓岩體僅零星分布，故其與周圍基質的相互關係仍有待確認。為解決上述問題，本研究自中央山脈東翼採集變質程度低至高之樣本，使用碳質物拉曼光譜分析變質溫度，並結合構造分析以了解不同岩層間構造的關係，並最後討論可能的剝蝕抬升過程。根據碳質物拉曼光譜結果，數個中央山脈東翼樣本具有溫度分布範圍寬廣的特性，推測可能為混合碎屑或不同反應程度碳質物。大體上中央山脈東翼東西向剖面的變質溫度呈現類似背斜分布特徵，由東至西約 14 km 的水平距離內從 340°C 增至 500°C，其水平溫度梯度約為 12-15°C/km，於太魯閣帶達到最高溫，並且溫度以西逐步下降；此外，由於高壓岩體出露於部分玉里帶區域，使其梯度增加至 21°C/km。中央山脈東側共可觀察到三期葉理面：S1 葉理面與 S0 近乎平行並且葉理面上具有發育良好的雲母礦物，此階段應與最大變質溫度有關；S2 為高角度夾皺劈理，葉理面間有細顆粒雲母生長並形成緊密或等斜褶皺，為控制區域性岩層分布最主要構造階段；S3 為低角度夾皺劈理，與小到中規模偃臥褶皺有關，近期的剝蝕抬升作用產生鉛直方向的作用力，S3 的形成即與此有關。根據碳質物拉曼光譜、構造分析與前人定年資料，本研究認為中央山脈岩層共經歷三個主要構造階段，D1 為隱沒時所產生之變質作用階段(10-11 到 7 Ma 之間)，也是與碳質物拉曼光譜所記錄到的最大變質溫度有所關聯；D2 為弧陸碰撞導致的水平壓縮，並使岩層緩慢抬升剝蝕(7-2 Ma)時；D3 則為快速剝蝕抬升(< 2 Ma)時所造成垂直變形階段。</p>
中文關鍵字	玉里帶、碳質物拉曼光譜、變質溫度
英文關鍵字	Yuli belt, Raman Spectroscopy of Carbonaceous Material, Metamorphic temperature

會議室	Room 606
日期	11月17日(星期二)
時段	16:45-17:00
議程代碼	T4-O-04
議題	- Tectonophysics 大地構造及造山作用
作者	李建成(Jian-Cheng Lee) [中央研究院地球科學研究所] (通訊作者) Gong-Ruei Ho [Institute of Earth Sciences, Academia Sinica] Kai-Hsiang Yang [Institute of Earth Sciences, Academia Sinica] Yuan-Hsi Lee [Department of Earth and Environmental Sciences National Chung Cheng University] En-Chao Yeh [Department of Earth Sciences, National Taiwan Normal University] Wei Lo [National Taipei University of Technology] Chin-Ho Tsai [National Dong Hwa University]
中文題目	中央山脈東翼玉里帶海洋地殼岩塊(蛇紋岩)快速掘升造成之穹丘構造
英文題目	Doming induced by rapid exhumed serpentinite bodies in the subduction mélange and the associated structures: a case study of the Yuli Belt in eastern Taiwan
投稿類型	口頭報告 Oral
摘要	Based on field, microscopic, petrological, and geochronological investigations, this study intends to characterize the doming structures induced by the relatively higher strength serpentinite bodies surrounded by pelitic rocks in the subduction mélange of the Yuli belt (Taiwan). During subduction then exhumation of the Eurasian continental margin, the Philippine Sea plate has been approaching in the vicinity of Taiwan since the Miocene time. The Yuli belt is composed of continental margin turbiditic sediments with exotic blocks that contain high-pressure minerals (omphacite, glaucophane, garnet) with Miocene ages (15-10 Ma) suggesting rapid exhumation from depths of 40-50 km probably since 5-6 Ma. Field surveys within the Yuli belt in the Chingshui River area indicate that the km-scale-wide serpentinite served as stronger competent rock bodies. The surrounding pelitic schist, behaved as weaker incompetent rocks, shows bending of the main penetrative cleavage set S2, which also is associated with folding and crenulation of the earlier cleavage set S0/S1. The edge of the serpentinite bodies has often formed a series of layers of hydrothermal metasomatism products, such as chlorite schist and talc schist, which developed a sub-vertical cleavage, with orientations generally parallel to the edge shape of the serpentinite. Commonly observed breccia deformation bands implies strongly mechanical shearing occurred around the edge of serpentinite in contact with the surrounding pelitic schist. The deforming S2 cleavage surrounding the km-wide serpentinite indicates that the pelitic rocks encountered the serpentinite after they have already formed the S2-related structures, probably during exhumation. In the regional scale, the shallow dipping S2 and S3 outside the serpentinite reveal a dome shape, suggesting upward serpentinite and unroofing process during the rapid exhumation of the eastern Central Range of Taiwan.
中文關鍵字	穹丘構造、玉里帶、掘升
英文關鍵字	doming, serpentinite body, exhumation, Yuli belt

會議室	Room 606
日期	11月17日(星期二)
時段	17:00-17:15
議程代碼	T4-O-05
議題	- Tectonophysics 大地構造及造山作用
作者	盧金山(Lucas Mesalles) [國立中正大學] (通訊作者) 李元希(Yuan-Hsi Lee) [國立中正大學]
中文題目	台灣雪山山脈北段繼承熱事件的變質與年代證據
英文題目	Metamorphic and chronological evidence for an inherited thermal imprint in the northern Hsuehshan Range.
投稿類型	口頭報告 Oral
摘要	<p>Metamorphic conditions estimates found in active and ancient mountain belts are typically attributed to be the result of crustal thickening processes such as thrust sheet and nappe stacking or underplating. Earlier thermal events, notably during the preceding rifting phase, are usually either ignored or considered of negligible relevance. Here we report a compilation of previously published and new metamorphic temperatures estimates from syn-rift sediments of SCS affinity and syn-collisional sediments now incorporated in the deformed northern Hsuehshan Range mountain belt. We find that for the syn-rift sediments metamorphic grade is highly correlated to the local stratigraphy, with higher temperatures in the stratigraphically-older anticlinal cores. We interpret this pattern as an indication that metamorphism predates deformation. At a regional scale, our compilation indicates that laterally equivalent stratigraphic formations have undergone variable maximum metamorphic temperatures which we demonstrate to reflect both, increasing sediment thickness and geothermal gradients in different domains of the proximal to distal passive margin. We further attempt to constrain the timing of metamorphism through a reprocessed and new dataset of existing partially-reset and totally reset fission-track ages which in some cases unexpectedly preserve both the pre-orogenic thermal events as well as the orogenic events. Preliminary results indicate that the timing of the thermal event appears to be somewhere between 8 to 16 Ma. Interestingly, our timing appears to correspond with known volcanic events taking place in the outer margin (Chiaopanshan volcanic event; ~13-7.1Ma), particularly represented in the geological record of northern Taiwan and likely related to South China Sea post-breakup renewed extension.</p>
中文關鍵字	變質作用, 繼承熱事件, 雪山山脈
英文關鍵字	metamorphism, inheritance, Hsuehshan range

會議室	Room 606
日期	11 月 17 日(星期二)
時段	17:15-17:30
議程代碼	T4-O-06
議題	- Tectonophysics 大地構造及造山作用
作者	李元希() [中正大學地球與環境科學系] (通訊作者) 羅偉(Wei Lo) [台北科技大學]
中文題目	新釋”南澳運動”及台灣中央山脈北段的區域變質作用
英文題目	New Insight of the “Nanao Orogeny” and Regional Metamorphism in Northern Central Range
投稿類型	口頭報告 Oral
摘要	<p>造山帶中常出露受區域變質作用的變質岩，因此造山作用常與區域變質作用密不可分，台灣的南澳運動過去亦認為肇因於古太平洋板塊(or Izanagi plate)隱沒有關，但在古太平洋板塊隱沒過程由於板塊隱沒向東退卻，以至於在中生代時歐亞大陸邊緣產生了多期的伸張構造，也發育了典型的變質核心雜岩構造(metamorphic core complex)。新生代以來張裂盆地亦普遍發育於歐亞板塊邊緣，並至少歷經兩次主要伸張作用分別發生於古新世-始新世及 30-40Ma 的南中國海開裂時期。台灣大南澳變質雜岩過去認為位處於板塊隱沒邊界，因此認為南澳運動為此壓縮性的造山事件。但由岩相及地體構造位置，大南澳變質雜岩在中生代時位於島弧或弧後位置，在新生代時則處於大陸地殼與海洋地殼的過度帶。伸張作用下伴隨區域性變質作用已有許多報導，以比里牛斯山為例，伸張作用造成深部地函的剝露，並伴隨區域變質作用，上覆的石灰岩變質成大理岩並伴隨水平葉理面的發育，變質溫度可達 400 度。台灣處於歐亞大陸邊緣，雖長期位於伸張構造環境下，但由於近期劇烈的蓬萊造山運動掩蓋了早期伸張性構造與變質作用，因而不易分辨，這種現象在其他造山帶亦極為常見，也導致許多爭議。大南澳變質雜岩中，最高變質度的葉理面 S1 約平行於層面，新生的雲母沿此 S1 生長，並常伴隨串腸構造發育，此 S1 的葉理通常在層位較老的大南澳變質雜岩中發育較佳。之後的蓬萊運動在中新世至始新世的板岩層發育區域性的向斜、背斜構造及軸面劈理。此蓬萊作用在大南澳變質雜岩亦產生區域性向斜與背斜構造，但伴隨夾皺劈理(S2)的發育，此階段劈理的變形機制大多以壓溶作用為主，部分地區有細顆粒的雲母發育。將蓬萊運動的構造作用去除後，此 S1 近於水平且幾乎平行層面，為典型在伸張作用下的構造型態。對南澳運動發育時間，可用在中橫以北地區許多 Ar-Ar 定年資料加以限制，由於白雲母的 Ar-Ar 定年在蓬萊運動中未癒合，因此限制了蓬萊運動在中橫以北的變質溫度低於 400 度，但 RSCM 的變質溫度顯示最高變質溫度顯示近於 500 度，此暗示最高變質溫度發生的時間應於蓬萊運動之前，考量在始新世晚期(30-40Ma)發生區域性抬升與冷卻事件，及大南澳變質雜岩最年輕的地層年代，南澳變質作用發生時間應在 75Ma 到 30Ma 之間，並為區域性伸張作用下的產物。此外過去將礫岩視為壓縮性造山運動的產物，但在伸張性環境中亦會發育如盆嶺(Basin and Range)的構造，過去在中央山脈所提出的 E 礫岩與 N 礫岩，應也是盆嶺構造之伸張作用下的產物，而非在壓縮性構造環境下形成的。</p>
中文關鍵字	南澳運動、區域變質作用、中央山脈
英文關鍵字	Nanao Orogeny, regional metamorphism, Central Range

會議室	Room 607
日期	11月17日(星期二)
時段	16:00-16:15
議程代碼	M1-O-07
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	羅祐宗(YU-TSUNG LO) [國立中央大學地球科學系] (通訊作者) 顏宏元(Horng-Yuan YEN) [國立中央大學地球科學系] 陳松春(Song-Chuen Chen) [中央地質調查所] 景國恩(Kuo-En Ching) [國立成功大學測量系]
中文題目	西南部厚層泥岩區剩餘重力異常空間分布特性
英文題目	Spatial distribution characteristics of residual gravity anomalies in thick mudstone areas in southwestern Taiwan
投稿類型	口頭報告 Oral
摘要	台灣西南部位於西部麓山帶的最南端，有許多褶皺逆衝斷層等區域性構造，而絕大部分區域被沖積層所覆蓋，所以重力測勘成為研究這個區域的地下構造的重要方法之一。本研究蒐集了陸上及海域之重力資料，繪製台灣西南部之布蓋異常圖。透過分析重力異常的波長得到淺層與深層的剩餘重力效應，並依據不同深度討論其重力效應與構造的關係。剩餘重力異常的分布與斷層線及背斜軸部的位置有很好的對應，可幫助我們辨識在厚層沉積層下的構造改變，同時透過異常效應隨深度上的變化我們可以推估異常體隨深度上的傾斜及延伸的深度。 本研究的結果顯示，旗山斷層可透過剩餘重力異常去推估其延續之趨勢向西南至壽山出海，其餘在深度2至6公里的重力效仍能觀察區域性的正異常，將剩餘異常圖比對前人研究之海域泥貫入體及泥火山的位置，其與陸地的異常高區位置也有關聯性存在。
中文關鍵字	重力，泥貫入體，布蓋異常
英文關鍵字	Gravity, mud diapirs, Bouguer anomaly

會議室	Room 607
日期	11月17日(星期二)
時段	16:15-16:30
議程代碼	M1-O-08
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	石瑞銓(Ruey-Chyuan Shih) [國立中正大學] (通訊作者) 施泉賢(Chyuan-Hsan Shih) [國立中正大學]
中文題目	垂直應力主導之褶皺發育？臺灣西南部厚層泥岩區之淺層震測成果分析
英文題目	Development of folds dominated by vertical stress? Analysis of shallow seismic reflection results in thick mudstone areas in southwestern Taiwan
投稿類型	口頭報告 Oral
摘要	<p>近年來，對於台灣西南部造山前緣的活動構造發育機制，已發展出兩個最主要的觀點：泥貫入體的發育與逆衝斷層或其與背衝斷層所共同形成之上拱構造。斷層之發育機制更加符合板塊擠壓環境所可能造成之構造型態，後續研究已多採用斷層構造發育的角度進行解釋。然而，利用斷層錯位模型反演台灣西南部水平速度場與垂直速度場的結果指出，斷層運動並無法擬合台灣西南部之地表變形型態，還需要另一個機制才能一起產生足夠的地表抬升量。泥貫入體是已知最有可能造成地表快速抬升的重要機制，是否真的在造山前緣活動構造之發育中扮演重要角色？又如何影響造山前緣之活動構造發育？泥貫入體之研究仍非常重要。反射震測可以幫助釐清地下構造，解析泥貫入體和活動斷層或活動褶皺間的相對關係。本文利用反射震測於臺灣西南部陸地泥貫入體與活動構造交互作用區域，研究台灣西南部之造山前緣構造是否能引入或排除泥貫入體之影響。4條測線分別2條位於高雄燕巢滾水坪泥火山，以及2條位於屏東萬丹鯉魚山泥火山。測線長度分別約1-2公里長，各測線皆為144波道，受波器為10Hz垂直受波器，間距4公尺，震源間距為16公尺，各測線之最大遠支距約660公尺。施測時迷你震盪震源器之震盪頻率範圍為15-120Hz，震盪時間8秒。野外震測紀錄除了位於燕巢工廠區之測線Y2因人為雜訊大而品質較差外，其餘3條測線之資料品質良好。震測結果顯示滾水坪泥火山和萬丹泥火山一帶皆是以垂直向上的力量為主造成，而非由橫向力量活動而成。震測影像也顯示泥火山活動的證據，顯示這兩處的泥貫入體仍持續活動成長中。</p>
中文關鍵字	反射震測、泥火山、活動構造
英文關鍵字	Seismic reflection surveys, mud volcanoes, active structures

會議室	Room 607
日期	11月17日(星期二)
時段	16:30-16:45
議程代碼	M1-O-09
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	饒瑞鈞(Ruey-Juin Rau) [成功大學地球科學系暨研究所] (通訊作者) 景國恩(Kuo-En Ching) [成功大學測量及空間資訊學系] 賴力嘉(Li-Chia Lai) [成功大學地球科學系] 何立新(Li-Hsin Ho) [成功大學地球科學系]
中文題目	
英文題目	Deformation at the tip of the Hsinhua fault during and after the 2016 Meinong earthquake
投稿類型	口頭報告 Oral
摘要	<p>We present the mode of deformation at the tip-damage zone of the Hsinhua fault during and after the 2016 Meinong earthquake using both the continuous and campaign GPS observations. The extensional fracture patterns at the tip-damage zone are subsequently related to the frequently-occurred liquefactions at the Hsinhua area. The localized Hsinhua, Tainan area in SW Taiwan, had repeatedly experienced liquefaction-induced damages after the nearby moderate (M 6.1-6.6) earthquakes occurred in 1946, 2010 and 2016, respectively. We established 70 campaigned-mode with 400-700 m station-spacing and 9 continuous GPS stations in the Hsinhua area about three months before the 2016 Meinong earthquake, and we made the first campaigned-mode GPS measurements 3-13 days before the event. The campaigned-mode GPS measurements were repeated 2-weeks, six months and one year, respectively after the Meinong earthquake. Each campaign GPS site was occupied 4-8 hours, and the data were calculated by Bernese 5.2 following the standard GPS processing procedures. While the coseismic displacement of the overall Hsinhua area directing mainly northwest-ward, the coseismic displacement within the dense 2x8 km² Hsinhua GPS network shows NW-striking on stations located at two sides of the network and on the contrary, sites intervened in the middle section of the network directing SE. Both the NW- and SE-directing displacements have amplitudes of 20-100 mm. The sites with SE motions form a band with a dimension of 2x5 km² striking NE, normal to the regional coseismic displacement direction. The localized SE-directing area coincides with the InSAR results and roughly consistent with the published liquefaction prone area. In addition to the liquefaction-induced deformation pattern, we will present the initiation and evolution of liquefaction caused by the shaking of the 2016 Meinong earthquake.</p>
中文關鍵字	
英文關鍵字	tip-damage zone, strike-slip fault, 2016 Meinong earthquake, liquefaction

會議室	Room 607
日期	11月17日(星期二)
時段	16:45-17:00
議程代碼	M1-O-10
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	吳泓昱(Hung-Yu WU) [Department of Resources Engineering, National Cheng-Kung University] (通訊作者) 林辰叡(Chen-Ray Lin) [Department of Earth Science, National Central University] 廖怡雯(Yi-Wun Liao) [Earthquake Disaster & Risk Evaluation and Management Center (E-DREaM), NCU]
中文題目	利用時率地震模擬討論梅山斷層的複雜破裂機制
英文題目	Complex Fault Rupture Behavior in Rate and State Earthquake Simulation ~ Exemplified by Meishan fault system
投稿類型	口頭報告 Oral
摘要	In twenty centuries, the 1906 Meishan earthquake was the one of significant seismic event in the south-west Taiwan. The previous studies show that the focal mechanism indicated the fault system is the strike-slip fault with an oblique thrust fault. Even the significant aftershocks are constant with the intensity maps. To explorer this earthquake occurrences in complex fault geometry and its nucleation, we exam the efficient fault system earthquake simulator, RSQSim. Based on the rate and state-dependent friction, the detailed fault plane setting. Simulated fault rupturing and stress change with the temporal and spatial seismic event clustering can be identified with each the significant event circle. The fault geometry in the simulation play the main role for the event intensity distribution and the earthquake recurrence. We propose these fault system models and apply the RSQ simulation to understand the rupture behavior in the complex fault system and the stress evolution.
中文關鍵字	時率模擬, 應力, 破裂狀態
英文關鍵字	Rate and state simulation, stress evolution, nucleation

會議室	Room 607
日期	11月17日(星期二)
時段	17:00-17:15
議程代碼	M1-O-11
議題	- Multidisciplinary Theme 臺灣西南部造山帶之活動構造及其地震、地質災害特性
作者	林辰叡(Chen-Ray Lin) [國立中央大學地球科學學系/ 國立中央大學地震災害鏈風險評估及管理研究中心] (通訊作者) 卓穆蓼(Sebastian von Specht) [國立中央大學地震災害鏈風險評估及管理研究中心/ 中央研究院地球科學研究所/ GFZ 德國地球科學研究中心] 馬國鳳(Kuo-Fong Ma) [中央研究院地球科學研究所/ 國立中央大學地球科學學系/ 國立中央大學地震災害鏈風險評估及管理研究中心] 廖怡雯(Yi-Wun Liao) [國立中央大學地震災害鏈風險評估及管理研究中心]
中文題目	1906年台灣梅山地震之動態破裂模擬斷層摩擦行為與應力條件參數
英文題目	The Dynamic Modeling of the 1906 Mw 7.1 Meishan, Taiwan, Earthquake: Constraints on Frictional behavior and Stress condition
投稿類型	口頭報告 Oral
摘要	The March 17th, 1906 (UTC) Mw 7.1 Meishan earthquake marks one of the most devastating events in Taiwan's history. Past studies regarded the Meishan earthquake as a right-lateral strike-slip event, related to the coseismic surface rupture along the Meishan fault. A recent study by Liao et al. (2018) discusses a possible scenario that rupture on a predominantly blind thrust fault triggered the preexisting weak zone on the Meishan fault. They validated their model by comparing waveforms recorded on three Omori seismographs in Taiwan with synthetic waveforms from kinematic modeling. We investigated this multiple segment rupture scenario from a dynamical modeling perspective. Despite the numerous assumptions in parameters setup controlling the rupture behavior in earthquake dynamic modeling, in this study, we adopted the dynamic parameters, namely the stress, friction and slip-weakening distance from mechanical model and previous kinematic modeling. Model parameters are constrained within physically reasonable ranges by incorporating stress mechanics related to frictional limit and the Wallace-Bott hypothesis; horizontal stress orientations are taken from the World Stress Map and investigated ranges of stress drop follow globally observed values. We set the static friction coefficient to $\mu_s=0.4$, following the findings of Kidder et al. (2012), implying that Byerlee's law does not hold for the region. The dynamic friction coefficient $\mu_d=0.2$, resulting from our stress constraints, is in agreement with other studies for the region (Wang, 2009). The linear slip-weakening model is run on a 3D finite element mesh in a homogeneous half-space. Resulting average slip is about 4 to 8 meters on the Meishan fault and the blind thrust, respectively. The observed Omori seismograph records are comparable to the synthetic waveforms from the dynamic rupture model, indicating that the 1906 Meishan earthquake can be reasonably explained as a multiple segment rupture system.
中文關鍵字	1906梅山地震、多段破裂、斷層摩擦之行為、物理應力參數
英文關鍵字	1906 Meishan Earthquake, Multiple segment rupture, Frictional behavior, Physical stress constraints

會議室	Room 608
日期	11月17日(星期二)
時段	16:00-16:15
議程代碼	EM2-O-01
議題	- Earth Materials 礦物及岩石物理
作者	龔慧貞(Jennifer Kung) [成功大學地球科學系] (通訊作者) 花天享(Florian Tian-Siang Hua) [成功大學地球科學系]
中文題目	造成軟流圈低速的成因一定要有熔體嗎?
英文題目	
投稿類型	口頭報告 Oral
摘要	<p>軟流層是位於岩石圈下的一個機械弱層，其特徵是地震波速度相對得低(所謂的低速帶，Low-Velocity Zone, LVZ)及高衰減，這深度其導電率也是相對得高。對此「低速帶」的可能成因被建議;1)有少量的熔體，2)在此深度的地函礦物相(橄欖石，輝石及石榴子石)其結晶結構有[OH⁻]存在，及 3)地溫梯度的改變。為探討軟流圈的「低速帶」可能成因，我們以高壓實驗合成一系列含水頑火輝石(hydrous orthoenstatite)，其含水量相當於來自上部地函所發現的天然直輝石。這系列輝石單晶在鑽石高壓砧以X光繞射技術，得到這些含水輝石的高壓下的壓縮性質。在此報告我們將以此系列含水輝石高壓性質及現存含水橄欖石的彈性性質來展示於大陸地區的低速帶的成因不一定要有熔體的存在，而是與地溫從表面極導熱梯度(conductive mantle)漸變成所謂的絕熱(或半絕熱)地函梯度(adiabatic mantle)有極大的關聯。</p>
中文關鍵字	軟流圈，低速帶，含水頑火輝石，高壓實驗，X光繞射
英文關鍵字	Asthenosphere, low-velocity zone, hydrous enstatite, high pressure experiment, X ray diffraction

會議室	Room 608
日期	11月17日(星期二)
時段	16:15-16:30
議程代碼	EM2-O-02
議題	- Earth Materials 礦物及岩石物理
作者	簡祐祥(Yu-Hsiang Chien) [Earth System Science Program, Taiwan International Graduate Program (TIGP), Academia Sinica and National Central University, Taipei, Taiwan] (通訊作者) 謝文斌(Wen-Pin Hsieh) [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan] 孫偉(Wei Sun) [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan]
中文題目	含水及含鐵量對尖晶橄欖石熱導率在地函過度帶之影響
英文題目	Effects of water and iron on the thermal conductivity of wadsleyite in Earth's mantle transition zone
投稿類型	口頭報告 Oral
摘要	Wadsleyite, a high-pressure polymorph of olivine, is a major mineral in the upper part of the mantle transition zone and could contain up to 3 wt% of water. Prior studies have shown that the incorporation of water in mantle minerals could significantly affect the physical properties of the mantle. Lattice thermal conductivity is a key parameter controlling the temperature profile and dynamics of the mantle. However, the effects of hydration and iron on the lattice thermal conductivity of wadsleyite remain poorly understood. In this study, using an ultrafast optical pump-probe method combined with diamond anvil cells, we investigated the thermal conductivity of wadsleyite with different water and iron contents under high pressure and ambient temperature. Our preliminary data show that 10 wt% iron content reduces the thermal conductivity of hydrous wadsleyite, but higher hydration (1 wt% of water) only causes few variations in the thermal conductivity at ambient conditions. We will further compare the high-pressure thermal conductivity data with previous studies and then discuss how the water and iron contents within wadsleyite influence the geodynamics in the transition zone.
中文關鍵字	尖晶橄欖石, 熱導率, 水合作用, 地函過度帶
英文關鍵字	Wadsleyite, Thermal conductivity, Hydration, Mantle transition zone

會議室	Room 608
日期	11月17日(星期二)
時段	16:30-16:45
議程代碼	EM2-O-03
議題	- Earth Materials 礦物及岩石物理
作者	麥迪倫(Dylan Meyer) [Institute of Earth Sciences, Academia Sinica] (通訊作者) 謝文斌(Wen-Pin Hsieh) [Institute of Earth Sciences, Academia Sinica] 林俊孚(Jung-Fu Lin) [The University of Texas at Austin, Jackson School of Geosciences]
中文題目	
英文題目	Thermal and Acoustic Properties of Solid Methane at Extreme Pressures
投稿類型	口頭報告 Oral
摘要	<p>Methane is the simplest saturated hydrocarbon and is an abundant component of the solar system. On gas-ice giants, such as Uranus and Neptune, methane exists at high pressures and low temperatures as a molecular solid. Solid methane exhibits a rich set of crystalline phases, with as many as seven phases and sub-phases at room temperature occurring with increasing pressure. As methane is a significant component in these types of systems, defining its physical properties at high pressure will improve our understanding of the thermo-chemical evolution in planetary interiors. We gradually compress methane up to 24 GPa at room temperature in a symmetric diamond anvil cell (DAC). We use Raman spectroscopy to confirm the presence of solid methane, to estimate its phase, and to determine the internal DAC pressure. At each pressure point, we measure the thermal conductivity using time-domain thermoreflectance and calculate the Brillouin frequency from picosecond interferometry to estimate the compressional velocity. The thermal conductivity increased gradually (0.6-2.9 W m⁻¹ K⁻¹) across the pressure range, though this trend was punctuated by a sharp spike in the thermal conductivity at ~6 GPa (max. 3.3 W m⁻¹ K⁻¹). In contrast, the compressional velocity exhibited a linearly increase from 6.5 to 11.7 km s⁻¹. Heat transfer in molecular crystals is affected by both the transrotational motion of molecules and their orientation degrees of freedom. Previous studies have shown that methane experiences dramatic changes in these parameters when undergoing phase transitions. As such, the observed spike in thermal conductivity may result from changes in the molecular ordering of crystalline methane associated with the phase transition from fcc methane-I to rhombohedral methane-A. Our novel discovery of highly pressure- and phase-sensitive thermal conductivity has dramatic implication for thermal transport in planetary bodies.</p>
中文關鍵字	
英文關鍵字	crystalline methane, extreme pressure, thermal conductivity, diamond anvil cell

會議室	Room 608
日期	11月17日(星期二)
時段	16:45-17:00
議程代碼	EM2-O-04
議題	- Earth Materials 礦物及岩石物理
作者	阮氏貞(Nguyen Thi Trinh) [National Central University] (通訊作者) 郭力維(Li-Wei Kuo) [National Central University]
中文題目	
英文題目	Fluid drainage of slipping zone during earthquake propagation
投稿類型	口頭報告 Oral
摘要	<p>At shallow depths (<5 km), fault slip zones are expected to contain clay gouges in water-saturated conditions. To understand what the weakening mechanisms operate during earthquake propagation, numerous high-velocity friction experiments have been performed on fault gouge, mostly under room humidity and low normal stress (<5 MPa). In addition, the effect of fluid drainage from saturated slipping zones on frictional strength during seismic faulting remains unclear. Thanks to the newly purpose-built sample holder, we could perform rock friction on saturated gouges under both drained and undrained conditions. Here, we conducted rotary shear test on simulated fault gouges of kaolinite samples under water-saturated condition with various fluid drainage conditions to understand how fluid drainage influences the weakening mechanisms within fault zone. The water-saturated kaolinite gouges were deformed at a slip rate of 1m/s, a normal stress of 10 MPa, and total displacements of ~ 5m, under undrained and drained conditions. The mechanical data show (1) under undrained condition, the value of the peak friction coefficient ~ 0.3, fast slip weaken and very low value of steady-state friction coefficient ~ 0.1. (2) Under drained condition, the frictional behaviors were the same with undrained condition, but the steady-state friction coefficient is higher. We suggest that because water vaporization can endothermic the frictional heat that limits temperature rise in undrained condition. Therefore, frictional energy in drained conditions is higher than in undrain condition. To date, we have no sufficient results for the investigation of fluid drainage during seismic faulting. It is expected to have fruitful outcomes for unraveling earthquake physics in the very near future.</p>
中文關鍵字	
英文關鍵字	Rock friction, fluid drainage, kaolinite gouge, water-saturated condition.

會議室	Room 608
日期	11 月 17 日(星期二)
時段	17:00-17:15
議程代碼	EM2-O-05
議題	- Earth Materials 礦物及岩石物理
作者	吳文傑(Wen-Jie Wu) [中央大學地球科學系] (通訊作者) 郭力維(Li-Wei Kuo) [中央大學地球科學系] 吳惟馨(Wei-Hsin Wu) [中央大學地球科學系]
中文題目	車籠埔斷層泥之摩擦強度及其隱示集集地震之熱增壓作用
英文題目	Frictional strength of Chelungpu fault gouge and its implications for thermal pressurization during Chi-Chi earthquake
投稿類型	口頭報告 Oral
摘要	Inefficient fluid drainage of slip zone materials during seismic faulting drives the onset of thermal pressurization prior to other slip weakening mechanisms such as frictional melting. In the case of an active fault in Taiwan, the rupture of Chelungpu Fault was triggered by the 1999 Mw7.6 Chi-Chi earthquake. One of the proposed slip weakening mechanism leading to unstable fault motion is thermal pressurization (i.e., thermal expansion of pore fluid), based on the microstructural observations from the principal slip zone of the Chelungpu Fault. To reproduce the deformation conditions during the 1999 Chi-Chi earthquake, we conducted high-velocity friction experiments on the saturated fault gouge retrieved from the Taiwan Chelungpu-fault Drilling Project (TCDP) at a normal stress of 18 MPa and a slip rate of 1 m/s under undrained condition. The apparent friction coefficient μ of saturated gouge (defined as the ratio of the applied shear and normal stresses) shows an increase to peak $\mu \sim 0.2$ and then dropped to steady-state $\mu \sim 0.01$. The microstructural and mineralogical analyses on experimentally deformed materials show a relative isotropic texture and identical mineralogical phases to the starting materials. Taken together, the slip weakening can be likely attributed to the fluidization of gouge and thermal pressurization. Our results are in agreements with the reported observations from TCDP and imply that the near-fault ground motion dominated by large low frequency displacements with relatively small high-frequency accelerations.
中文關鍵字	車籠埔斷層、集集地震、摩擦強度、熱增壓效應、滑移弱化
英文關鍵字	Chelungpu Fault, Chi-Chi earthquake, frictional strength, thermal pressurization, slip weakening

會議室	Room 608
日期	11月17日(星期二)
時段	17:15-17:30
議程代碼	EM2-O-06
議題	- Earth Materials 礦物及岩石物理
作者	謝文斌(Wen-Pin Hsieh) [中央研究院地球科學研究所] (通訊作者)
中文題目	地球深部含水礦物所引起之熱異常
英文題目	Thermal anomalies induced by hydrous minerals in Earth's deep interior
投稿類型	口頭報告 Oral
摘要	<p>Knowledge to the thermal conductivity of deep Earth materials play critical roles in understanding many geophysical and geochemical phenomena, such as the temperature profile and dynamics of the mantle and subduction zones, as well as the heat flux across the core-mantle boundary. Recently we have successfully combined an ultrafast optical pump-probe method with high-pressure diamond cells to precisely measure lattice thermal conductivity of deep Earth materials under extreme conditions. We will present our recent results on the thermal conductivity of hydrous olivine and δ-(Al,Fe)OOH phases under relevant mantle pressure-temperature conditions. Modeling of our new data show potentially significant influences of hydration and iron (and its spin state) on the thermo-chemical structures and dynamics of the deep mantle and subduction zones. For instance, both hydration and iron substantially reduce the thermal conductivity of minerals; the spin transition could even induce drastic, several-fold variations in the thermal conductivity. Some future directions that are important to further understand the thermal state and dynamics of the deep Earth will also be discussed.</p>
中文關鍵字	熱傳導率, 熱異常, 含水礦物
英文關鍵字	thermal conductivity, thermal anomaly, hydrous minerals

會議室	Room 609A
日期	11月17日(星期二)
時段	16:00-16:15
議程代碼	V4-O-07
議題	- Volcanology and Geochemistry 岩石地球化學
作者	Truong-Tai Nguyen [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan; Hanoi University of Mining and Geology, Hanoi, Vietnam] (通訊作者) Kwan-Nang Pang [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan] Yoshiyuki Iizuka [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan] Hao-Yang Lee [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan] Tsuyoshi Komiya [Department of Earth Science and Astronomy, The University of Tokyo, Tokyo, Japan] Shigenori Maruyama [Earth-Life Science Institute, Tokyo Institute of Technology, Tokyo, Japan] Sun-Lin Chung [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan]
中文題目	
英文題目	Origin of low-Ca olivine from basalts and picrites in New Georgia Group, Solomon Islands
投稿類型	口頭報告 Oral
摘要	The New Georgia Group, Solomon Islands consists of Quaternary basalts and minor picrites. Previous studies identified two populations of olivine in these rocks with variable Ca contents (400-3300 ppm), yet their origin is poorly understood. Here, we attempt to place constraints on their formation by examining the distribution of major and minor elements in olivine from 22 basalts and picrites from the New Georgia Group. Compositional variability among the cores of relatively evolved olivine (Fo 83-87) reflects down-temperature crystallization and partial equilibration with the crystallizing matrix. Among the cores of relatively primitive olivine (³ Fo 88), the Ca content is variable and two populations could be identified. Low-Ca olivine, which has Ca contents of ~ 1400 ppm or less, displays Fo 83 - 94. Compositions and Ni contents from 1500 to 3300 ppm high-Ca olivine, which has Ca contents of 1400-3300 ppm, spans a similar content range in forsterite (Fo 83 - 92).. and Ni contents (800-2000 ppm) to reconcile such variations are with down-apologetic crystallization temperature-alone. We suggest that both low-Ca and high-Ca olivines have igneous origin. In the presence of H ₂ O in the parent magma in the order of several weight percent, low-Ca olivine might crystallize due to lowering of $\mu_{\text{H}_2\text{O}}$, which has been demonstrated experimentally. High-Ca olivine might have crystallized from the similar magma after degassing at a relatively shallow level (≈ 0.6 GPa). Both types of olivine were entrained by the magma(s) that eventually solidified as the basalts and picrites, reflecting a heterogeneous crystal cargo. Applying the Ca-in-olivine geothermometer to the low-Ca olivine, we find that the primary magma might have contained ~4-6 wt.% H ₂ O from the outset. Such amount of water probably obviates the need for high mantle potential temperatures indicated by the picrites that is otherwise incompatible in an arc setting.
中文關鍵字	
英文關鍵字	low-Ca olivine, picrites

會議室	Room 609A
日期	11月17日(星期二)
時段	16:15-16:30
議程代碼	M3-O-12
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	Long Xiang Quek [National Taiwan Normal University] (通訊作者) Tung-Yi Lee [National Taiwan Normal University] Azman A. Ghani [University of Malaya] Yu-Ming Lai [National Taiwan Normal University] Muhammad Hatta Roselee [University of Malaya] Hao-Yang Lee [Academia Sinica] Yoshiyuki Iizuka [Academia Sinica] Yu-Ling Lin [National Taiwan Normal University] Meng-Wan Yeh [National Taiwan Normal University] Muhammad Amirrudin Amran [University of Malaya] Rezal Rahmat [Academia Sinica]
中文題目	
英文題目	Tracing zircon detrital signatures in Malayan granitoid source area from Peninsular Malaysia: A potential sediment passage to West Borneo
投稿類型	口頭報告 Oral
摘要	Permo-Triassic (300-200 Ma) Malayan granitoid makes up about 50% of Peninsular Malaysia terrain. Erosion of the source would generate an enormous volume of detrital zircon that masks other potential detrital sources. Previous studies suggest that Peninsular Malaysia may recycle “Indochina signature” detrital zircons to other parts of Sundaland, but there is a lack of data to prove this. To investigate this, we compiled our new 602 zircon U-Pb isotopic data from modern river sands in Peninsular Malaysia with all available data to create a dataset which revealed five detrital zircon patterns with different age populations: (1) North Central zone (~72 Ma and ~220 Ma); (2) Northeastern zone (~233 Ma and ~280 Ma); (3) Southeastern zone (~164 Ma, ~245 Ma, ~287 Ma, 401-430 Ma and 1.6-1.9 Ga); (4) Main Range east foothills (~218 Ma); and (5) Southwestern zone (~223 Ma and 1.1-1.2 Ga). Southeastern zone appears to receive its source from Mesozoic strata at the northwest, e.g. Bertangga and Gerek formations, instead of the nearby Malayan granitoid. Although in proximity with the Malayan granitoid, the Southeastern zone's detrital pattern is distinct from other zones and is comparable with sources from Indochina terrane and Late Mesozoic strata in Singapore. However, drainages from Indochina terrane ceased to supply sediments to Peninsular Malaysia after Late Mesozoic. We suggest distribution and samples detrital pattern in Southeastern zone show a defunct sedimentation passage during the Cenozoic could have transported eroded sediments from the Mesozoic strata at the northwest to the sink at the southeast. If the sink connects with North Sunda Paleo River during glacial regression period, it might contribute to the “Indochina signature” detrital provenance in West Borneo. This would support that Indochina was unlikely a direct source of sediment to West Borneo, and rather, West Borneo received sources other than the Malayan granitoid from Peninsular Malaysia.
中文關鍵字	
英文關鍵字	Detrital Zircon, Sundaland, Peninsular Malaysia, West Borneo

會議室	Room 609A
日期	11月17日(星期二)
時段	16:30-16:45
議程代碼	M3-O-13
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	迪馬斯(Dimas Sianipar) [TIGP Earth System Sciences, Academia Sinica & National Central University] (通訊作者) 黃柏壽(Bor-Shouh Huang) [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan] 馬國鳳(Kuo-Fong Ma) [Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan; Earthquake-Disaster and Risk Evaluation and Management Center (E-DREaM), National Central University, Taoyuan, Taiwan] 謝銘哲(Ming-Che Hsieh) [Sinotech Engineering Consultant Inc, Taipei, Taiwan] Tio A. P. Setiadi [Agency for Meteorology, Climatology, and Geophysics of the Republic of Indonesia (BMKG), Jakarta, Indonesia] Haekal A. Haridhi [Department of Marine Sciences, Faculty of Marine and Fisheries, Syiah Kuala University, Banda Aceh, Indonesia] D. Daryono [Agency for Meteorology, Climatology, and Geophysics of the Republic of Indonesia (BMKG), Jakarta, Indonesia]
中文題目	
英文題目	Rupture extent controlled by structural heterogeneity in the eastern Sunda-Banda back-arc system: Insights from finite fault modeling and recent seismicity
投稿類型	口頭報告 Oral
摘要	One of the prominent earthquake sources in the eastern Sunda-Banda back-arc (Indonesia) is the Flores Back-Arc Thrust (FBT). However, the western extension, segmentation, and deformation of FBT are poorly investigated. We perform finite fault inversion and seismicity analysis and present kinematic rupture process and coseismic slip models for seven Mw 6.4+ earthquakes that struck between 2000 and 2020. Three of these earthquakes ruptured the middle part: the 2007 Mw 6.5 Sumbawa doublet, and the 2009 Mw 6.6 Sumbawa event. Later, in 2018, a sequence of large earthquakes (three M6.4+) took place in the north of Lombok that marked the previously westernmost termination of the continuous back-arc thrusting. The Mw 6.4 (28 July), Mw 6.9 (5 August), and Mw 6.9 (19 August) and its massive subsequent aftershocks mostly occurred at south-dipping low angle thrust while it also activated aftershocks on surrounding complex faulting with distinguishing distributions. Our results suggest that: (1) the estimated rupture extents of the 2007-2009 Sumbawa events, and 2018 Lombok sequence were limited by structures that define segment boundaries; (2) the variation of rupture along FBT suggests heterogeneously distributed multiple-size asperities, combined with triggering process; (3) down-dip extension of the unilateral rupture initiated from mid-crust with a single patch of asperity as a common feature of low dip angle faults along FBT; (4) the 5 August 2018 event was an exception that it had the most complex record and possible repeating rupture, and may indicate unique process from the interplay between seismic and aseismic slip; (5) the back-arc thrusting might be extended further to the west; (6) possible structure revealed from subsequence aftershocks; (7) an unmapped threat is showed by a normal-faulting mechanism of the 2003 Mw 6.4 Flores earthquake. This study provides a unified treatment of faulting mechanics in the region and would be important for further hazard analysis.
中文關鍵字	
英文關鍵字	finite fault, rupture process, Flores back-arc thrust

會議室	Room 609A
日期	11月17日(星期二)
時段	16:45-17:00
議程代碼	M3-O-14
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	丁氏惠(Thi-Hue Dinh) [中央研究院地球科學研究所] (通訊作者) 詹瑜璋(Yu-Chang Chan) [中央研究院地球科學研究所] 張中白(Chung-Pai Chang) [中央大學太空遙測研究所] 陳致同(Chih-Tung Chen) [中央大學地球科學系] 徐乙君(Yi-Chun Hsu) [中央大學地球科學系]
中文題目	越南北部范西潘山脈的變形模式和潛在的地體活動
英文題目	Deformation patterns and potential active movements of the Fansipan mountain range, northern Vietnam
投稿類型	口頭報告 Oral
摘要	<p>Located in northern Vietnam, the Fansipan mountain range is the highest topography in the Indochina area. Until recently, there has been limited research regarding the tectonic deformation of the Fansipan mountain range and whether there are notable surface ruptures or active faults in the area. This study provides the first insight into the deformation patterns and potential active movements of the Fansipan mountain range, and may improve our understanding of the overall tectonic activities in northern Vietnam. Our observations from ASTER 30-m DEM show a symmetrical mountain form in the north and an asymmetrical form in the south. The analysis of river profiles indicates similar patterns on both sides in the north and different patterns in the south with short and steep rivers on the SW side and long and gentle rivers on the NE side. The results of the normalized steepness index (ksn) also show higher values on the SW side of the south part than the values from the other sides. These results suggest a spatial variation in rock uplift patterns of the Fansipan mountain range. Notably, the mountain front of the SW side of the southern Fansipan mountain range is associated with the Phong Tho-Nam Pia normal fault, suggesting that the normal faulting activity likely played an important role in tectonic uplift of this high mountain range. Our investigation of the stress field using fault kinematics indicates that the Fansipan mountain range and its surrounding areas are undergoing an inhomogeneous mixture of strike-slip and normal faulting. It is proposed that the strike-slip and normal motions alternated because of a permutation of σ_1/σ_2 under the same extensional stress regime of approximately NE-SW σ_3. This kinematic pattern may effectively control the recent tectonic movements in northern Vietnam.</p>
中文關鍵字	范西潘山脈、變形模式、活動構造
英文關鍵字	Fansipan mountain range, deformation pattern, active structures

會議室	Room 609A
日期	11月17日(星期二)
時段	17:00-17:15
議程代碼	M3-O-15
議題	- Multidisciplinary Theme 智慧災防新南向：東南亞地球科學合作研究計畫
作者	阮銘(Minh Nguyen) [Institute of Earth Sciences, Academia Sinica] (通訊作者)
中文題目	
英文題目	Long-term sinking of the Hanoi metropolitan induced by groundwater extraction
投稿類型	口頭報告 Oral
摘要	We utilize multiple synthetic aperture radar (SAR) satellites including ALOS-1, COSMOS SkyMed and Sentinel-1 to derive the ground deformation of the Hanoi metropolitan in the period of 2007-2018. We also analyze thirty years (1990-2018) of groundwater levels and compute the pumping rates thereby in conjunction with Global Precipitation Measurement (GPM) data. In central Hanoi, the decreasing rate of the main Pleistocene hydraulic level changes from 0.5 m/yr in year 1997-2006 to nearly zero in year 2007-2018. The ground displacement time-series, however, still reveals ongoing subsidence at 1-2 cm/yr during the latter period. This remnant subsidence may be the result of hydrodynamic lag due to delayed compression in fine-grained layers. In suburban Hanoi, the decrease of Pleistocene hydraulic level exacerbates during the last 3.5 years (2015-2018), leading to significant land subsidence at 3-4 cm/yr in the same period. Pumping rate estimates also reveal transition of pumping center from central Hanoi to the suburban area after 2014. The main suburban subsidence patches in Ha Dong (3 cm/yr) and Hoai Duc (>4 cm/yr) may require further attention for future urban planning.
中文關鍵字	
英文關鍵字	groundwater, subsidence, InSAR, ALOS-1, COSMOS SkyMed, Sentinel-1, Hanoi.

會議室	Room 609B
日期	11月17日(星期二)
時段	16:00-16:15
議程代碼	M2-O-13
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	謝有忠(Yu-Chung Hsieh) [經濟部中央地質調查所環工組] (通訊作者) 戴東霖(Dong-Lin Dai) [經濟部中央地質調查所環工組] 朱偉嘉(Wei-Chia Chu) [經濟部中央地質調查所環工組] 林錫宏(Hsi-Hung Lin) [經濟部中央地質調查所環工組] 紀宗吉(Chung-Chi Chi) [經濟部中央地質調查所環工組]
中文題目	台灣脊梁山脈正斷層作用與坡面重力變形現象之探討
英文題目	Normal Faulting and Gravitational Slope Deformation In Backbone Ridge, Taiwan
投稿類型	口頭報告 Oral
摘要	<p>台灣為一個造山運動活躍的區域，過去多認為正斷層為聚合板塊造山帶所常見的地質構造，Crespi et al.(1996)提出了臺灣活躍弧陸碰撞帶的野外量測證據，後續也開始有 GPS、地震、物理模型、數值模擬等研究表示在臺灣這個活躍的造山帶確實有正斷層之地質構造存在，唯中央山脈地勢陡峭、交通不易，且受限地形圖資精度及解析度有限，並未有地表地形證據。坡面重力變形作用為坡面上大規模岩體因重力作用造成岩體產生變形作用，多會出現張裂地形特徵以及壓縮地形特徵、高度破裂岩體等，岩體破碎進而易發生大規模山崩現象，這些重力變形區域也極可能為潛在大規模崩塌之位置。隨著測量技術的發展，數值地形資料解析度也隨之提高，當解析度越高時，更多的細微地貌特徵可以被顯示出來，空載光達數值地形資料之解析度就適合應用於地質之分析研究。本研究將利用空載光達數值地形資料，以地形計測分析方法、水體範圍判釋、地形剖面分析技術、野外調查與無人載具空拍等研究方法，來探討在中央山脈所出現的正斷層地形抑或坡面重力變形現象。本研究初步結果發現在數值地形資料判釋時，中央山脈坡頂處可以發現多組走向之線型，常呈陷落地形，主要有南北走向、北西北走向及北東北走向等，經野外調查後，南北走向和北東北走向之線型多與坡向及主要劈理位態方向接近，研判此線型為坡面重力變形作用所產生，而北西北走向之線型有較佳延續性，常穿越脊線或山谷，野外露頭中常可量測到有一組截切劈理之節理面，方向與此線型平行，部分露頭並可見滑動方向為正斷層之擦痕，此線型也與 Crespi et al.(1996)所發現的野外證據方向一致，故研判此組線型應為中央山脈造山運動中所產生之正斷層相關。研究範圍中也可見部分池塘或積水窪地，多呈現橢圓或長條狀，反映正斷層滑落後或坡面岩體重力變形影響下，陷落地形所形成之積水窪地。而以條帶式地形剖面方法，也說明中央山脈緩地形範圍多分布在脊線附近，此部分與正斷層抑或坡面重力變形作用仍待後續研究持續討論。本研究除增進對於中央山脈地形之研究外，也可增進目前國內對坡面重力變形作用的了解，未來則可對坡地災害治理與防災工作上可有所貢獻。</p>
中文關鍵字	空載光達; 數值地形模型; 坡面重力變形; 正斷層作用
英文關鍵字	Airborne LiDAR, DEM, Gravitational Slope Deformation, Normal Faulting

會議室	Room 609B
日期	11 月 17 日(星期二)
時段	16:15-16:30
議程代碼	M2-O-14
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	陳奕霖(Chen-Yi-Lin) [台北科技大學土木與防災所] (通訊作者) 蔡杰凱(TSAI, JAI-KAI) [台北科技大學土木與防災所]
中文題目	多時期光達資料精度分析及應用-以寶來地區為例
英文題目	Assessment and application of Multi-temporal LiDAR datasets
投稿類型	口頭報告 Oral
摘要	<p>近年來隨著電子測距儀與遙測技術的演進，從過往以單點測量為主的全測站，慢慢演變成光達技術。以往由於掃描儀重量較大，一般都是使用航空飛機搭載。由於科技的進步，掃描儀的發展，其重量越來越輕巧，且掃描速率也越來越快，並發展出由無人飛行載具(Unmanned Aerial Vehicle, UAV)來搭載光達雷射掃描器。結合無人機及地基光達，可使量測距離更遠，於精度上也有顯著的提升。台灣位於歐亞與菲律賓板塊邊界上，地質構造發育快速，使得地形陡峭加，加之頻繁的地震，造成先天不良的地質條件。另一方面，台灣位於西北太平洋的颱風路徑上，颱風伴隨而來瞬間的豪大雨，更易弱化岩體。地質及氣候兩者因素相結合，使得台灣成為山崩地滑最為好發頻繁的國家。本論文因以莫拉克颱風所造成的大型山崩的高雄市寶來村之研究目標，本團隊長期以來持續不斷的監測此山崩區。本研究使用無人單旋翼直升機 VAPOR55 搭載 Riegl VUX-1 UAV 光達系統，以及 Riegl VZ2000i 地面光達雷射掃描儀，兩儀器相結合，同時進行地形資料之掃描工作。針對本研究區，我們一共蒐集了五個時期的點雲資料(五個時期無人機光達與三個時期的地面光達)。首先進行資料之整體精度評估，並進而進行資料處理及製作數值地形模型。針對多期之數值地形模型，計算地形差異，分析崩塌區之量體之虧損與加積，以及其量體變化，探討其在不同時間的高程變化量、滑落方向並評估其崩塌之地形特徵。台灣高雄寶來地區經過莫拉克颱風與甲仙地震後，本團隊從 2015 年使用無人機攝影測量，更在 2017 年開始運用光達系統對於此崩塌區進行監測，從無人單旋翼直升機 VAPOR55 搭載光達 VUX-1 UAV，在監測上精度一直提升，本研究更再 2018 年時加入了 VZ2000i 地面光達系統，精度也從公分提升到了毫米等級，並使用實地測量之點位，給予系統絕對座標，以掃描儀紀錄資訊進行各時期整合與平差。透過測量、航帶解算、絕對座標與掃描器平差改正後，各時期點雲之整體精度約為 4cm。地面光達掃描範圍以 100m 內且角度 0°~60°較佳，才能更精準的點選絕對座標位置。分類點雲後，首先比較不同時期數值地形模型之高程變化，並利用多時期優勢來獲取期間內樹木滑移之平均速度，並將各時期數值地形模型進行地形判釋，如蝕溝、崩崖與滑動體，以探討崩塌區特徵地形。</p>
中文關鍵字	光達系統、點雲、精度評估、山崩監測
英文關鍵字	LiDAR system、point cloud、data quality assessment、landslide monitoring

會議室	Room 609B
日期	11月17日(星期二)
時段	16:30-16:45
議程代碼	M2-O-15
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	吳庭瑜(Ting-Yu Wu) [經濟部中央地質調查所] (通訊作者) 謝有忠(Yu-Chung Hsieh) [經濟部中央地質調查所] 李祖鈺(Tsu-Yu Lee) [經濟部中央地質調查所] 孫武群(Wu-Cyun Sun) [經濟部中央地質調查所]
中文題目	無人飛行載具影像成果在地形變遷應用之評估
英文題目	Feasibility Analysis on Applications in Topographic Changes by Using UAV Aerial Photogrammetry
投稿類型	口頭報告 Oral
摘要	近年來無人飛行載具 (Unmanned Aerial Vehicles, UAV) 的技術日新月異，入門門檻逐漸降低，應用層面也越來越廣泛，針對不同領域應用的需求可選擇的 UAV 也越來越多樣。本所過去也引進數台無人飛行載具，可在野外地質調查、山崩調查等進行遠距露頭或地形觀察，此外也可利用以 SfM 攝影測量範圍成像技術進行三維地形建模，獲取正射影像與數值地表模型資料，有助於地表地形分析。本研究為了解 DJI PHANTOM 4 PRO (P4P) 及搭配地面基站 D-RTK 2 的 PHANTOM 4 RTK (P4RTK) 兩款搭載不同衛星定位模組之無人飛行載具，於同一地區且未加入地面控制點拍攝的影像所產製之正射影像成果差異，故選定宜蘭力霸產業道路旁崩塌地進行四期空拍作業，並利用質點影像測速法 (Particle Image Velocimetry, PIV) 進行分析並探討兩者所產製的正射影像成果之穩定性；此外，為探討本研究產製的正射影像之空間資訊與現地 RTK 測量資料之差異，也針對其成果與現地測量資料進行平面誤差計算。綜合質點影像測速法比較及平面誤差計算的結果可得知，利用 P4RTK 執飛 (無論是否開啟地面基站) 所產製的正射影像，其穩定性及誤差皆較 P4P 佳；此外，由 P4RTK 產製出的不同時期正射影像經比對下皆呈現系統性偏差的情形，不同於透過 P4P 產製出的成果呈現隨機偏差的情況。藉由本研究可瞭解透過 P4RTK 所產製出的正射影像之成果誤差約在數公分，在此誤差規模下，未來透過 P4RTK 進行空拍建模的資料，將可直接應用於山崩體積量體估算、土砂堆積量體估算、地表侵蝕差異分析及地表變動觀測等變動規模在公吋至公尺以上的項目上。
中文關鍵字	無人飛行載具 (UAV)、質點影像測速法 (PIV)、地形變遷
英文關鍵字	Unmanned aerial vehicles(UAV), Particle image velocimetry(PIV), Topographic changes

會議室	Room 609B
日期	11月17日(星期二)
時段	16:45-17:00
議程代碼	M2-O-16
議題	- Multidisciplinary Theme 山崩與地表侵蝕作用
作者	溫子億(WEN, ZI-YI) [國立台北科技大學] (通訊作者) 陳冠榕(CHEN, KUAN-JUNG) [國立台北科技大學]
中文題目	無人機影像點雲與地面光達點雲之融合及精度評估
英文題目	Point Cloud Matching and Quality Assessment from TLS and Photogrammetry
投稿類型	口頭報告 Oral
摘要	<p>災害的調查傳統上常直接於現地進行測繪，但隨著科技的發展，現在已可運用無人機科技進行影像拍攝及分析。另一方面若能進行地面光達現地掃瞄，此方式除了能快速且精準的獲取現地資訊。若能將無人機影像與地面光達相結合，將能發揮無人機影像(天空視角)與地面光達(地面視角)之效益，補足各方面視角的點雲，使點雲建置之空間資料更完善、且精度更高更可靠。針對高雄寶來山崩區，本研究使用四軸無人機 DJI Phantom 4 PRO 進行航拍任務，另一方面，同時運用地面光達掃瞄儀 RIEGL VZ-2000i 進行地面掃瞄，一共進行了兩次、不同時期之資料收集。針對現地控制點及檢核點，並使用 e-GNSS 及 RTK-GNSS 兩種方法直接於現地進行量測。現地測量成果指出使用 RTK GNSS 可獲取較高精度之測量成果，並將此現地測量成果做為無人機影像及地面光達兩套系統的控制測量之基準及控制點之選點。無人機影像所產製之點雲及地面光達，兩者光達點雲首先進行點雲的融合，並產製出同一時期之數值地形模型，藉此比較兩套系統的精度，以及點雲融合的成效。基於現地量測之地面檢核點，比較兩來源之點雲及數值地形模型，成果指出無人機影像點雲平面誤差約為 5 公分，地面光達點雲之平面精度在 5 公分以下，兩者融合後之點雲平面精度約略為 5 公分。高程部份無人機影像點雲高程誤差約為 4 公分，地面光達點雲高程精度約為 2 公分，兩方法融合後之點雲，其高程精度約略為 5 公分。本研究使用點雲融合技術來產製 2019、2020 兩不同時期的資料空間資料庫，並用以進行寶來崩塌地的崩塌區域範圍分析、崩塌量體估算，以及評估山崩體之活動性。</p>
中文關鍵字	無人機影像、地面光達、數值地形模型、精度評估、點雲
英文關鍵字	Photogrammetry、Terrestrial Laser Scanner (TLS)、Digital Terrain Model (DTM)、precision、point cloud

會議室	Room 609C
日期	11月17日(星期二)
時段	16:00-16:15
議程代碼	SE5-O-04
議題	- Global Change 千年至軌道尺度氣候變化
作者	莊智凱(CHIH-KAI CHUANG) [國立臺灣大學地質科學系暨研究所] (通訊作者) 羅立(Li Lo) [國立臺灣大學地質科學系暨研究所]
中文題目	三百廿萬年來西太平洋暖池南緣高解析古海洋紀錄
英文題目	High resolution record of hydrological changes in surface waters of southern Western Pacific Warm Pool during 3.2 Ma
投稿類型	口頭報告 Oral
摘要	Here we present a high-resolution record of sea surface and upper thermocline hydrological changes in the southern Western Pacific Warm Pool (WPWP) of Plio-Pleistocene using geochemical proxy data (Mg/Ca- $\delta^{18}O$) of planktonic foraminifera <i>Trilobatus sacculifer</i> and <i>Neogloboquadrina dutertrei</i> in ODP Hole 1115B (9°11'S, 151°34'E, water depth 1149 m). Results show an early onset (~2.0 million years ago, Ma) of thermocline deepening and surface warming (SST increased by ~3 °C during 2.0-1.5 Ma) in the southern WPWP region which was preceding the tilting of east-west thermal gradient in the equatorial Pacific Ocean (~1.7 Ma). Combining with previous regional data from Indo-Pacific realm, our results suggest a meridional expansion of the WPWP could be associated with an intensified zonal Walker Circulation during the studied period.
中文關鍵字	西太平洋暖池, ODP Hole 1115B, 氧同位素, 鎂鈣比
英文關鍵字	WPWP, ODP Hole 1115B, Oxygen isotope, Mg/Ca ratios

會議室	Room 609C
日期	11月17日(星期二)
時段	16:15-16:30
議程代碼	SE5-O-05
議題	- Global Change 千年至軌道尺度氣候變化
作者	鍾昫娟(Chung Yun-Chuan) [國立台灣大學地質科學系] (通訊作者) 胡訓銘(Hsun-Ming Hu) [國立台灣大學地質科學系] 米泓生(Horng-Sheng Mii) [國立師範大學地球科學系] Véronique Michel [Université Côte d'Azur] Patricia Valensi [Département de Préhistoire] 姜修洋(Xiuyang Jiang) [福建师范大学地理科学学院] 沈川洲(Chuan-Chou Shen) [國立台灣大學地質科學系]
中文題目	
英文題目	Hydroclimate variability in the northern Mediterranean region at Marine Isotope Stage 5a
投稿類型	口頭報告 Oral
摘要	Marine isotope stage (MIS) 5a, 85.8-76.0 thousand years ago (ka, before AD 1950) could be analogue for the current global warming, as MIS 5a was a relative warm period after an abrupt global temperature rise from MIS 5b, 95.0-85.8 ka. However, lack of paleoclimate records with good age-control from MIS 5a hampers our understanding of regional response from climatic change and corresponding global links on centennial-to-millennial scales. Here, we present a 230Th-dated stalagmite $\delta^{18}O$ -inferred precipitation time series during 83.6-80.3 ka from Observatoire Cave (43°44'N, 7°25'E), Monaco, southern Europe. The record shows a millennial-scale decreasing trend in precipitation from 83.6 to 82.5 ka punctured by an abrupt 200-year wet event at 82.7 ka and a rapid shift from aridity to wetness during 82.5-82.4 ka, followed by relatively small-scaled fluctuation with a general arid trend until 80.3 ka in southern Europe. This hydroclimatic variability is consistent with changes in seawater circulation in the Mediterranean during sapropel 3 and an ice rafted debris event in the Nordic Sea on multi-centennial-to-millennial scales. Consistent with published proxy records and model stimulations, the results reveal a strong connection between mid-latitude and high-latitude climate systems and indicate that the decreased precipitation in the southern Europe resulted from the weakening AMOC during the early period of MIS 5a.
中文關鍵字	
英文關鍵字	MIS 5a, Mediterranean, AMOC, hydroclimatic oscillations

會議室	Room 609C
日期	11月17日(星期二)
時段	16:30-16:45
議程代碼	SE5-O-06
議題	- Global Change 千年至軌道尺度氣候變化
作者	高甘(Gagan Mandal) [National Central University] (通訊作者)
中文題目	
英文題目	THE ROLES OF WIND AND SEA ICE IN DRIVING THE DEGLACIAL CHANGE IN THE SOUTHERN OCEAN UPWELLING: A MODELING STUDY
投稿類型	口頭報告 Oral
摘要	<p>The Southern Ocean (SO) played a fundamental role in the deglacial climate system by providing a gateway for the communication of carbon-rich deep ocean water with the surface. The dynamic theory of the SO circulation and the physical mechanisms that determine the variability of SO upwelling temporally and spatially within Ocean basins are still being developed. Therefore, here we track this change by investigating the simulated transient SO atmosphere, ocean, and sea ice evolution during the last deglaciation in a fully coupled Earth system model. Our results show that decreases in SO upwelling follow the weakening of Southern Hemisphere surface Westerlies, wind stress forcing, and sea ice coverage from Last Glacial Maximum to Heinrich Stadial 1 and Younger Dryas. Therefore, SO upwelling is primarily driven by wind stress forcing. However, during the onset of Holocene, Southern Ocean upwelling increases while the surface wind stress forcing decreases. The deglacial sea ice controls the surface ocean density and determines the transition between the positive and negative buoyancy flux. At the onset of Holocene, an increase in freshwater flux at the sea ice boundary explains the anomalous increase in SO upwelling. Our study suggests that varying zonal wind stress forcing, and buoyancy forcing control by sea ice together regulates SO upwelling. This transient experiment illustrates the importance of sea ice in modulating buoyancy forcing, salt, and freshwater fluxes, ocean stratification, and altering surface and deep ocean density structure. Our results support the hypothesis that in the high latitudes of Southern Ocean, the Southern Hemisphere Westerlies, ocean, and sea ice are dynamically intertwined, and together regulated the deglacial change in the SO upwelling.</p>
中文關鍵字	
英文關鍵字	Southern Ocean, upwelling, sea ice, Buoyancy forcing, wind stress

會議室	Room 609C
日期	11月17日(星期二)
時段	16:45-17:00
議程代碼	SE5-O-07
議題	- Global Change 千年至軌道尺度氣候變化
作者	黃國芳(Kuo-Fang Huang) [中央研究院地球科學研究所] (通訊作者) 孫韻如(Yun-Ju Sun) [中央研究院地球科學研究所] 林詩耘(Shih-Yun Lin) [台灣大學海洋研究所]
中文題目	
英文題目	Deglacial variability in surface-water pH in the South China Sea: The role of East Asian Monsoon
投稿類型	口頭報告 Oral
摘要	<p>Unraveling mechanisms that control marine carbonate system in the past provides important constraints on the prediction of future climate change. During the last deglaciation, oceanic CO₂ outgassed from the Southern Ocean has been considered as a major contributor to atmospheric CO₂ rise. Despite the disproportionately important role, comprising 21% of the global net air-sea CO₂ flux while accounting for only 7% of its surface area, marginal seas, however, received less attention due to its dynamic feature. Here we present reconstructed variation in surface-water pH of the South China Sea (SCS) since the Last Glacial Maximum using boron isotope ($\delta^{11}\text{B}$) and B/Ca in planktic foraminifera (<i>T. sacculifer</i>) from the sediment core MD97-2142 (water depth 1557m). Our new record suggest that the SCS was a CO₂ source throughout the last deglaciation, with pronounced CO₂ outgassing during Heinrich Stadial 1 and Younger Dryas. We propose that deglacial variability in surface ocean carbonate chemistry was controlled by the upper ocean condition, which is mainly driven by the East Asian Monsoon (EAM). This indicates that during the last deglaciation, the EAM was capable of influencing the surface water pH (and pCO₂), and that the oceanic CO₂ outgassed from marginal seas possibly make a substantial contribution to the deglacial atmospheric CO₂ rise. More paleo-pCO₂ reconstructions in the marginal seas are clearly required to better understand their roles in regulating glacial-interglacial pCO₂ changes.</p>
中文關鍵字	
英文關鍵字	Surface-water pH, deglacial variability, boron isotopes, South China Sea, East Asian Monsoon

會議室	Room 609C
日期	11月17日(星期二)
時段	17:00-17:15
議程代碼	SE5-O-08
議題	- Global Change 千年至軌道尺度氣候變化
作者	林采玟(Tsai-wen Lin) [國立臺灣大學地質科學系] (通訊作者)
中文題目	
英文題目	East Asian winter monsoon variation during the last 3,000 years as recorded in a subtropical mountain lake, northeastern Taiwan
投稿類型	口頭報告 Oral
摘要	<p>East Asia takes one-quarter of the world's population, the precipitation in this area is heavily controlled by the East Asian monsoon system and typhoons. When reconstructing paleoclimate using geological material, these different climate sources need to be disentangled in order to understand how different mechanisms influence paleoclimate archives. Here we observe modern lake sediment deposited under different precipitation sources to understand how environmental factors change the geochemical and physical characteristics in lake sediments. A set of sediment trap was placed in Cueifong Lake, a mountain lake in northeastern Taiwan. The observation lasted from September 2017 to December 2019. Grain-size changes in monthly collected samples indicate that a decrease in sediment grain size reflects the strengthening of the East Asian winter monsoon (EAWM). We further reconstructed the EAWM change in the Late Holocene by analyzing grain-size change from a sediment core (CFL-3) in Cueifong Lake. Three grain-size subpopulations were extracted using end-member modeling analysis in both monthly collected sediments and the core CFL-3. A gradual decrease in the coarse-grain subpopulation (EM 2) indicates a gradual strengthening of the EAWM over the past 3,000 years in northeastern Taiwan. This long-term increased EAWM trend was also supported by a decrease in aquatic plant abundance from n-alkane results. This enhanced Late Holocene EAWM can be tentatively linked to the expansion of sea-ice cover in the western Arctic Ocean triggered by decreased summer insolation. Our result could serve to assess possible EAWM variation under the in the future affected by climate change scenario.</p>
中文關鍵字	
英文關鍵字	East Asian winter monsoon (EAWM), Late Holocene, grain size, n-alkane, sediment trap

會議室	Room 609C
日期	11月17日(星期二)
時段	17:15-17:30
議程代碼	GC2-O-01
議題	- Global Change 古環境與全球氣候變遷
作者	曾琬鈴(Wan-Ling Tseng) [中央研究院] (通訊作者) 林冠慧(Kuan-Hui Elaine Lin) [臺灣師範大學] 王寶貫(Pao K. Wang) [中央研究院] 許晃雄(Huang-Hsuan Hsu) [中央研究院]
中文題目	
英文題目	Reconstructed tropical cyclone climates in the 14-20th centuries reflecting natural variability of general circulation
投稿類型	口頭報告 Oral
摘要	This study used Reconstructed East Asian Climate Historical Encoded Series (REACHES) database (Wang et al. 2018) to reconstruct historical typhoon series in the East and South Coasts of China during the Ming and Qing dynasties (1368-1911). The document with 'typhoon' (Chinese character 颶) or 'hurricane' (颶) were retrieved, with descriptions of other compounding effects such as strong wind, torrential rain and storm surge to consist of the data set. To avoid repetition and multiple counting of the same typhoon event, records that have temporal (± 1 days) and spatial ($\pm 2^\circ$ degree latitude/longitude) proximity were combined accounting for one single typhoon event. The method was based on the systematic database approach and data quality was checked and validated through comparison with other independent reconstructed series and IBTrACS (Tropical Cyclone Best Track Data) 1884-2013. The reconstructed series demonstrate clear multi-decadal to centennial variabilities in the East and South Coasts. The 17th century was the period with active typhoon activities; fluctuation in the earlier half of the 18th century was relatively small and was followed by dynamic variations throughout the later 18th and 19th centuries. The analysis suggesting the period associated with lower global temperature and warmer North West Pacific SST both could enhance typhoon activity. The intercomparison with the nature climate variability shows stronger correlation with ENSO during 1870-1911. It indicates that the changing temporal-spatial pattern of the typhoon activity can be associated with general atmospheric-oceanic circulations over certain periods.
中文關鍵字	
英文關鍵字	typhoon