出國報告（出國類別：開會）

參加2016年TSOP-AASP-ICCP聯合國際研討會心得

服務機關：台灣中油公司探採研究所

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派赴國家：美國

出國期間：105 年 09 月 16 日至 105 年 09 月 25 日

報告日期：105 年 10 月 1 2 日

摘 要

赴美國參加 2016年TSOP-AASP-ICCP國際研討會議，行程自105年09月16日至105年09月25日為期十日，會議在美國休士頓的Mangolia飯店內舉辦，議程包含129個題目，形式有包括壁報(Poster)論文發表及口頭(Oral)論文發表，本研究所於研討會上發表兩篇關於台灣南部油氣探勘的論文與實驗新技術的論文。

年會的主題包含傳統的生油岩、頁岩油氣資源、顯微鏡相關分析技術、煤的特性、花粉相與油母質等科學議題與實驗新技術的相關研究。大會亦提供1個短期課程，介紹如何結合顯微鏡觀測與地球化學技術來進行生油岩評估。在實驗技術方面，大會有專門議程討論應用顯微鏡與電子顯微鏡觀察岩石孔隙與有機物生成，並討論生烴動力；此方面訊息可作為本所未來地球化學及油氣探勘研究參考之用。

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壹、目的

新技術開發應用為本公司的主要探勘策略之一，本所目前正進行幾項石油探勘應用技術開發，包括應用氣相層析串聯質譜儀（GC-MS-MS）分析原油與生油岩的游離性碳氫化合物成分，使用固相萃取法（Solid Phase Extraction, SPE）分離水中的浮油。使用這些技術，我們得以對台灣南部泥火山與氣苗的伴產浮油進行分析，瞭解這些浮油的地化性質，並與本公司於台灣南部所鑽獲油氣進行比較，如此有助於確定台灣南部的石油系統，油氣來源與移棲路徑。

另外由於早年本公司進行鑽井工作有時會使用油基泥漿，然而油基泥漿會污染岩屑樣本，影響生油岩有機碳含量及熱裂分析的結果。應用熱脫附技術處理處理受油基泥漿影響的樣本，則有助於排除樣本油基泥漿的影響，得以重新檢視早年本公司鑽井樣本的分析結果，對於台灣南部鑽井的地球化學分析重新評價。目前我們應用上述諸方法，分析台灣南部與西南外海鑽井岩屑，以及野外露頭所採集的岩石、凝結油與浮油樣本，已經取得若干初步成果。如我們利用GC-MS-MS分析台灣南部鳳山3號井與甲仙1號井油樣，以及泥火山或氣苗中浮油的生物指標組成，發現鳳山3號井凝結油與甲仙-竹頭崎一帶所產的凝結油，以及泥火山浮油有不同來源。這樣的結果顯示台灣南部可能有不只一套石油系統。而為了增加國家自有能源比率，本公司目前也對於台灣南部陸地，以及台灣西南外海重新展開地質調查，希望能尋找出新的油氣資源並進行開發。上述新技術發展可配合本公司探採事業部的工作項目，投入台灣陸上與海域的探勘工作。

為符合總公司企研處對本所研發單位之要求，我們以這些成果參加本次2016年於美國休士頓所舉辦的TSOP-AASP-ICCP聯合國際會議，預計共發表兩篇論文，第1個題目主要展示台灣西南部地化探勘成果，包括凝結油來源，以及石油系統等。第2個題目重點在技術方面，主要是處理受油基泥漿汙染的樣本，取得正確生油岩評估結果。早期本公司鑽探的岩心與岩屑有部分受油基泥漿汙染，我們可藉由此技術發展對於這類樣本重新進行分析解釋。經由論文發表可彰顯本所在石油探勘上的研發能力，向與會人士介紹台灣南部的探勘成果；同時也希望藉此機會與其他專家互相交流，討論生油岩，與儲集岩評價相關新技術，瞭解國際間石油地球化學探勘技術發展之新趨勢。

藉由和與會人士的交流以吸取並引進相關的探勘新技術與觀念，改善我們的分析技術與進一步瞭解我們公司所擁有的油氣資源，避免在研發與探勘過程中人物力的損耗；最終目的是能在本公司研發出實用之石油探勘技術，協助本公司國內外油氣探勘，降低探勘風險與節省探勘所需巨額委託分析費用，並期望發現具經濟價值之油氣田。

貳、過程

2016年TSOP-AASP-ICCP聯合國際研討會從9月15日開始到9月24日結束，包含會前與會後野外地質考察為期十天，地點在休士頓市區 Mangolia 飯店舉行。本次會議由3個學會聯合辦理，包括有機岩石學會（The Society for Organic Petrology, TSOP），國際煤及有機岩石學協會（The International Committee for Coal and Organic Petrology, ICCP）與美國花粉學會（The Palynological Society, AASP），這是第一次由這三個學會聯合舉辦的研討會，目的在使地質、地球化學與生物科學的科學家齊聚一堂，對於有機岩石學與花粉學能做整合性的討論。會議主題包括生油岩、頁岩油氣資源、顯微鏡相關分析技術、煤的特性、花粉相與油母質等科學議題。

大會共安排兩個野外行程，會前野外為9月15日到9月17日，地點為德州西部的 Eagle Ford 地層，為世界級的生油與儲集岩；會後野外在9月24日，為1天行程，地點在德州東部，主要觀察白堊紀到漸新世地層，此套地層相當於墨西哥灣深水區的主要儲集岩之Wilcox層。由於經費與行程的緣故，筆者並未參加野外活動，只參加位於休士頓的會議，整個研討會會議期間筆者行程如下表。

起迄日期	地點	詳細工作內容
2016.09.16	桃園機場出發，前往美國休士頓	啟程
2016.09.17~ 2016.09.23	美國休士頓	參加 TSOP-AASP-ICCP 聯合會議並發表論文
2016.09.24~ 2016.09.25	從美國休士頓返國	返程

筆者主要行程為參與會議的部分，並於大會進行中發表兩篇壁報論文(poster)，本所發表兩篇論文，題目分別為(1) Geochemical characters of oils in the southwestern Taiwan and their possible source rocks，(2) The study of treatment method in rock samples that had oil base mud contamination。會議進行分為口頭報告與壁報發表兩部份。口頭發表論文共88篇，壁報論文共有41篇；同時也提供一個短期課程，茲將參與過程依時間順序敘述如下。

9月17日為會議第一天，主要行程短期課程。課程主題為Integration of microscopy and geochemistry in petroleum source rock evaluation，這次主講人為Richard Tyson博士。Tyson博士過去曾編一本教科書，書名為 Sedimentary Organic Matter，內容介紹有機物質在地質環境中的變化，特別有許多與生油岩評估相關的內容，如有機碳含量，熱裂分析，還有顯微鏡下油母質觀測等，為學習有機地球化學與生油岩相關知識的入門書籍之一。

課程內容9項主題，包括(1)油母質類型（Kerogen type），介紹如何應用顯微鏡或地球化學分析來對油母質進行分類；(2)沉積環境中的有機相（Organic facies），介紹利用地球化學，以及對於樣本觀測，包括採集的岩石樣本，或觀察顯微鏡薄片，來判斷區別沉積物的有機相。對於生油岩評估而言，可做為產油或產氣的依據。

接者為(3)不定型有機物（Amorphous Organic Matter, AOM）與(4)橘色不定型有機物（Orange AOM, OAOM）之介紹。AOM為利用顯微鏡，於白光下觀察到的有機物質結構，其組成為有機物質集合體，包括浮游生物殘骸、碎屑等。其他AOM尚包含樹脂（Resin），或腐質膠（Humic gels）等來自植物的殘骸。AOM的研究主要在顯微鏡下進行，觀察其外型，結構與顏色，可判斷有機物來源。同時AOM本身為傾向產油的油母質，因此對於生油岩評估是相當重要的一環。另外Tyson博士有介紹到OAOM，顏色接近橘色，比一般AOM有更多類膠狀（gel-like）構造，與更平坦的外型（圖1）；其來源可能與細菌有關。其他特徵如化學分析更接近Type II-S（含較多硫元素），有機碳含量（TOC%）與氫指數（HI），同時有較多鉬（Mo）元素。OAOM存在反映高有機碳通量與硫含量的沉積環境，如現代環境中西南非納米比亞外海的湧升流，也代表有利的生油岩。

接著第5項是課程主要的核心部分之一，如何整合顯微鏡與HI、H/C等地化資料。

在顯微鏡下可以觀測油母質外型，不同油母質比例，顏色等，可以對顯微鏡下所觀測

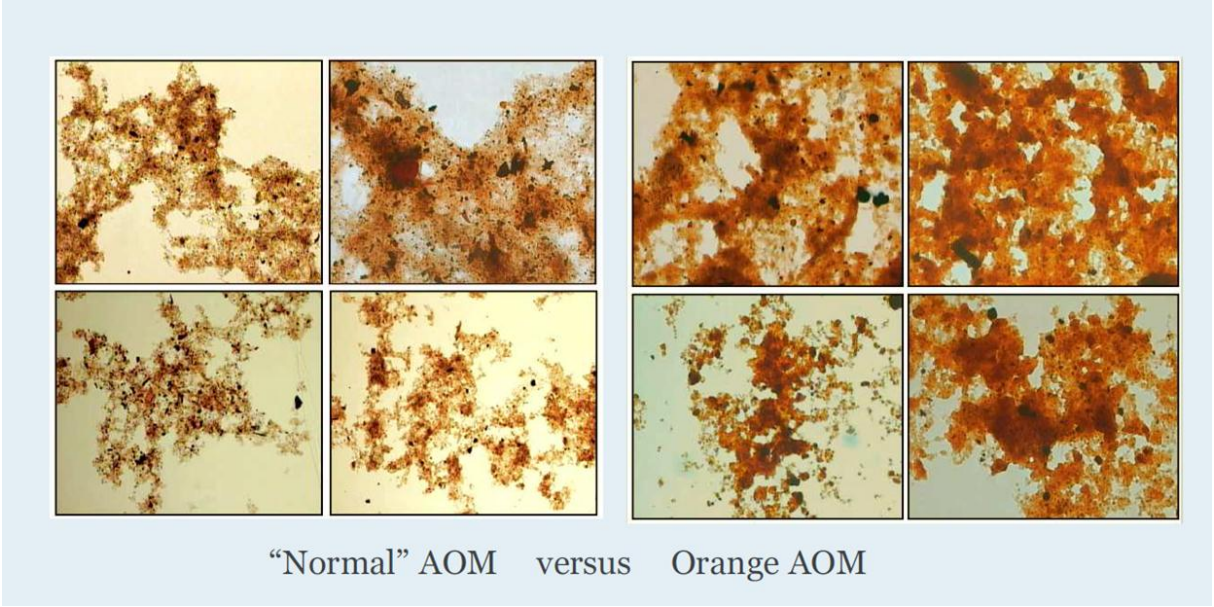

圖1、一般的AOM與OAOM，左邊為AOM，右邊為OAOM。樣本來源為現代西南非納米比亞外海湧升流區。

的不同型態油母質進行定量，如計算特定面積範圍內部AOM比例，或是傾向產油或產氣的煤素質（marcel），與地化分析結果，如TOC含量，或是H/C比，對於生油岩的良窳進行評價，有助於增加只憑地化分析結果進行生油岩評估的準確度。

第6項為螢光（Fluorscene）觀察。這部分為在顯微鏡下使用藍光觀察油母質的螢光反應，可用來判斷成熟度與不同類型AOM。如有螢光反應可能尚有產油潛能，沒有螢光的已經過成熟。螢光觀察也能與地化分析，如 HI或是微量元素分布結合討論。

第7與第8項光學資料權重估計（Weighting of optical data），以及估計初始HI（Estimation of initial HI）。對1個特定樣本進行TOC或熱裂分析，所量測到值為該樣本在測量時的整體狀態。如熱裂分析後HI為一個固定值，一般由 Van Krevelen 圖可以幫助解釋該樣本為何種類型有機物。但若對於同一樣本能進行顯微鏡觀測，計算其中不同的類型油母質的比例，則能依此估計HI值的正確性，進而導出初始的HI。由於有機物在埋藏過程中，受成岩作用（Diagenesis），生物降解（Biodegradation），熱解作用（Catagenesis）等會影響有機物質的保存，造成初始HI或有機碳含量發生變化，導致在估計油氣生成量時發生誤差。對於一個礦區油氣資源的評估，知道初始有機碳或HI的值是相當重要的，除了影響油氣生成量之外，也會影響之後油氣移棲與可採資源量估

算。在課程中，Tyson博士介紹了幾種方法，如從油氣轉化率估計，或是應用與氧化還原環境變化敏感的元素（如鈾、鉬等）來估計受影響程度，或是在顯微鏡下觀察煤素質，計算與氧化還原相關煤素質的比例等。

最後一項為三元圖，這是地球化學常用的方法，藉由分析三種主要的成分來探討地質過程。如對有機岩石學而言，常用顯微鏡下AOM、Phytoclasts 與 Palynomorphs的相對含量來區分沉積時的氧化還原狀態（圖2），或是與HI關係（圖3），以及利用煤素質判別沉積環境等（圖4）。

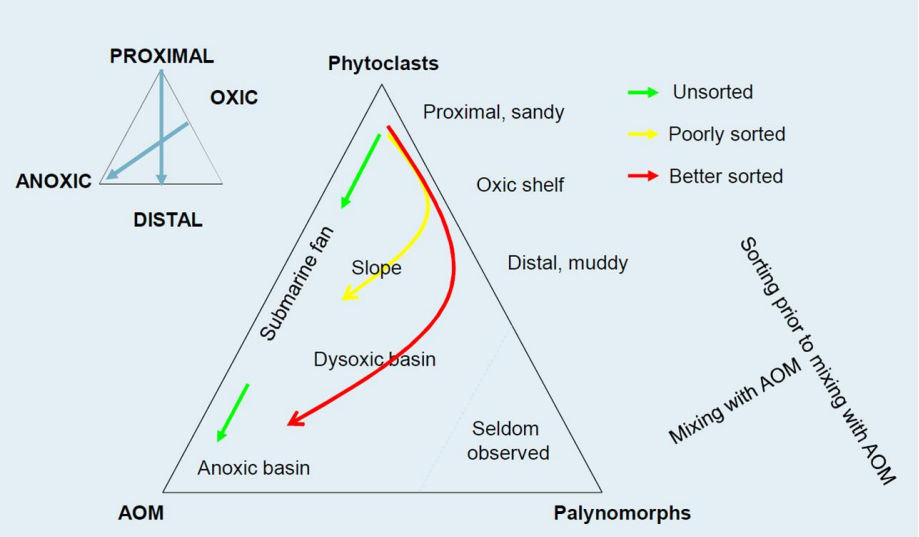

圖2、AOM、Phytoclast 與 Palynomorphs的三元圖，用來判斷沉積時的氧化還原狀態。

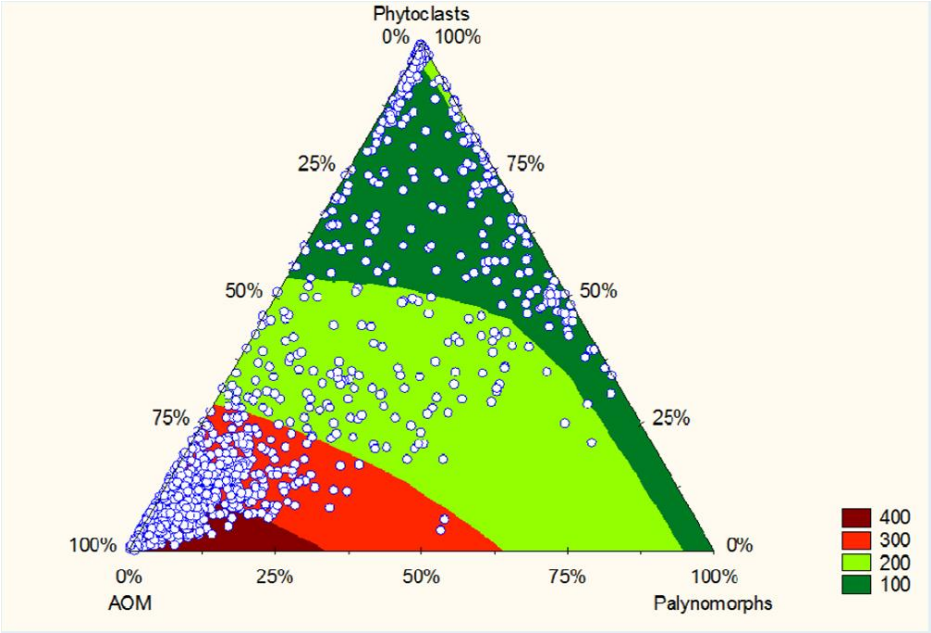

圖3、AOM、Phytoclast 與 Palynomorphs的三元圖與HI的關係，顏色代表HI值。

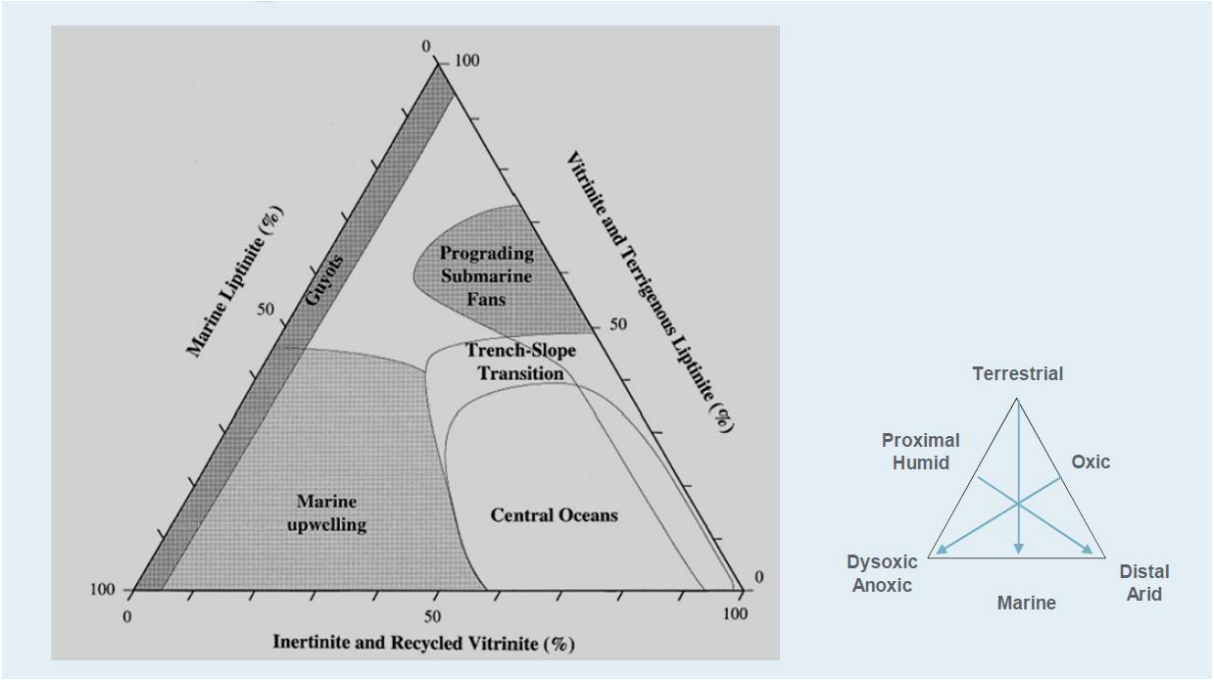

圖4、 應用煤素質（圖中Liptinite、Vitrinitem、Inertinite）區分樣本岩樣的沉積環境示意圖。

Tyson博士的課程主要著重在應用顯微鏡觀測的部分配合地球化學的測量資料，可以防止只依靠化學分析可能造成的失誤。過去筆者在生油岩評估的工作上也曾因為只看化學分析資料，在生油岩評估成熟度時發生一些令人困惑的現象，直到應用顯微鏡觀察油母質色度才有有較合理的判斷。因此顯微鏡觀測技術對於本公司生油岩評估工作仍不可或缺，也須培養這方面人才。而裡面有提到的如何估計初始有機碳含量或HI也是相當重要，對於進行評估礦區能產生多少油氣有相當重要的意義。

9月18日為各學會的會務運作相關事項，主要與各學會的運作及相關事務有關，較不涉及學術與技術的部份，主要科學議題分別在9月19到9月23日。

9月19日議程

本日議程分上下午兩個時段，上午時段著重在有機岩石學相關應用的研究，下午著重在由母質與生油岩研究的方法，特別是使用顯微鏡與電子顯微鏡研究生油岩中的孔隙與煤素質。上午議程開始首先有一個Keynote演講是紀念兩位有機地球化學學者，Jack D. Burgess 博士 及 W. G. Dow 博士。這兩位都已經過世，Burgess 博士過去在有機岩石學有諸多貢獻，特別是在有機物熱成熟有相當卓越的貢獻，熱成熟對於油氣生成至關重要。而 Dow 博士最為人知的貢獻是提出石油系統的概念，這觀念影響之

後石油探勘工作甚鉅，現在探勘基本上遵循石油系統的觀念來進行。上午時間其他議程主要討論有機岩石學中應用顯微鏡觀察薄片中不同煤素質與油母質類型，配合其他的工具，如生物指標、元素與同位素分析、花粉學、礦物學，討論沉積學、環境污染與岩石熱成熟方面的問題。在熱成熟的部分，有一個研究發現白雲石（dolomite）螢光顏色變化與成熟度呈現正相關，在不同溫度下元素分析的結果顯示無甚大變化，顯示白雲石顏色變化可能主要受溫度控制，可也可用來作為成熟度與估計地層受熱過程的指標。另外有個研究利用煤的成熟度，發現在火成岩侵入岩體只能對周邊約岩脈厚度的2倍圍岩成熟度有明顯影響，成熟度主要還是與埋藏過程中加熱速率有關。

下午的議程較偏研究方法，主要內容探討利用顯微鏡或電子顯微鏡，觀察生油岩或油母質中的煤素質，以及其中的瀝青質（Bitumen）。會特別觀察有機岩石中這些物質的原因最主要是油氣在生成過程中，生油岩持續加熱，瀝青質會被排出到岩石中的孔隙並充填之，隨後持續受熱，其中瀝青質或繼續裂解並形成孔隙。這對於非傳統的能源，如頁岩油氣是相當重要，如此方能提供足夠孔隙儲藏油氣。應用電子顯微性技術，配合一般地球化學參數，討論生油岩之沉積環境與成熟度，進一步可探討這類型儲集岩的孔隙率變化原因。

除此之外，尚有些新技巧的應用，其中一項是紅外線奈米顯微鏡（Infrared Nanoscopy, nano-IR）。關於nano-IR為一非破壞性技術，可對於已拋光的生油岩薄片，於奈米尺度下對於特定的煤素質，或其他目標進行以紅外光譜進行的化學成分的測定。對於生油岩中孔隙中的瀝青質成分隨成熟度變化的情形，以及其對孔隙率與滲透率的影響之岩有相當的幫助。另外有一項是在顯微鏡下觀測孢粉反射光，以軟體分解反射光中RGB（Red-Green-Blue）相對成分，並與傳統觀察螢光下孢粉色度定成熟度的TAI指數做比較，建立應用RGB光線分佈進行成熟度分析。這將光線數值化的方法可以免除人為觀察的差異，目前仍在發展中。

9月20日議程

9月20日主要的議程在上午，研討內容重點在花粉相與油母質之間的關係，另外就是與沉積環境的關聯。傳統有機岩石學的研究有一大部分是在顯微鏡下觀察油母質，以及其中所含的煤素質，包括不定型有機物（Amorphous Organic Matter, AOM）、鏡煤素（vitrinite）等。而這些有機物質很多來自於植物，因此在這議程裡，主要都是

結合花粉學與油母質進行沉積環境變動的探討。

這天下午有TSOP的頒獎活動，以及壁報論文討論。

圖5、研討會現場。

9月21日議程

這一天議程上午重點在生油岩，以及本身即為儲集岩的生油岩之地化特性進行討論。第一個keynote演講討論海洋沉積物的成為生油岩潛能，以及初始有機碳含量估計。在這演講之中，作者以現代海洋環境為基礎，結合海洋生地化的模式，從海洋表面初期生產力，有機碳埋藏效率，海洋化學環境改變（如Oxygen Minimum Zone深度變化），陸源有機物質的供應變化，海盆構造改變等參數進行模擬，尋找初始有機碳與HI。應用模式可以預測過去某一時代的有機碳，幫助決定初始的有機碳值，可應用到之後的油氣盆地模擬。

另外有些題目是對於儲集岩的評價，此乃應用熱裂分析（Rock-Eval）的方法，使用與測量HI、OI的升溫速率改變，用來處理儲集岩中的瀝青質。或是使用熱脫附氣相

層析（TD-GC）與熱裂氣相層析（Py-GC）技術來分析之。這樣的方式對於非傳統油氣的研究是相當有幫助。主要如前所述，非傳統油氣中油氣可儲集在生油岩中瀝青質裂解後所形成的孔隙，搭配之前提過的顯微鏡觀測技術，能幫助做出較好的油氣資源評估，同時也能應用在傳統儲集岩的研究。

下午的重點也是相同，但部分報告討論生烴過程，以及結合花粉學與有機岩石學，對於煤層、以及生油岩特性進行討論。其中有一項研究是利用孢粉地球化學作為油母質特性的代用指標。其中使用的技術是傅立葉轉換紅外線光譜（Fluorier Transform Infrared, FTIR ），應用FTIR偵測孢粉質的一些成分辨識其來源。同時偵測不同埋深深度的孢粉之化學成分變化，也有助於判斷在成岩作用或熱解作用過程產生的變化，推測其成熟度。

9月22、23日議程

這兩天議程主要以花粉學相關討論為主，討論花粉學的應用，包括沉積環境的重建，以及地層學的建立。除了以陸地上孢子與花粉作為工具進行第文問題的探討外，水生渦鞭毛藻的殼也作為一種代用指標討論近代問題。如有一篇論文提到利用沉積紀錄中渦鞭毛藻的殼體，配合鉛-210定年，藉由觀察渦鞭毛藻族群的變化，探討Exxon Valdez在1980年代於美國阿拉斯加的漏油事件對於海洋環境的衝擊。

壁報展示

所有的壁報分成兩批展示，第一批展示時間為9月19日中午到9月21日中午，第二批展示時間為9月21日中午到9月23日中午。大會並安排9月20日與9月22日下午為壁報討論時間。壁報論文中有不少討論煤素質與生油岩熱成熟的論文，也有討論煤與微量元素的論文，較少花粉相關的論文。

這個會議與石油探勘的關係主要集中在生油岩相關討論，特別是有較多討論在非傳統油氣的部分，同時應用許多顯微鏡觀測與非破壞性檢測方法進行油母質觀測，以及使用有機岩石學中顯微鏡觀測技巧，結合有機地球化學分析與沉積環境分析。生油岩事關油氣生成種類與量，對於一個礦區石油系統的瞭解，或是對於非傳統油氣資源評估，生油岩評估是不可或缺的一環；故這部分的工作未來應當持續進行，同時也當持續學習並引進相關的新知識。

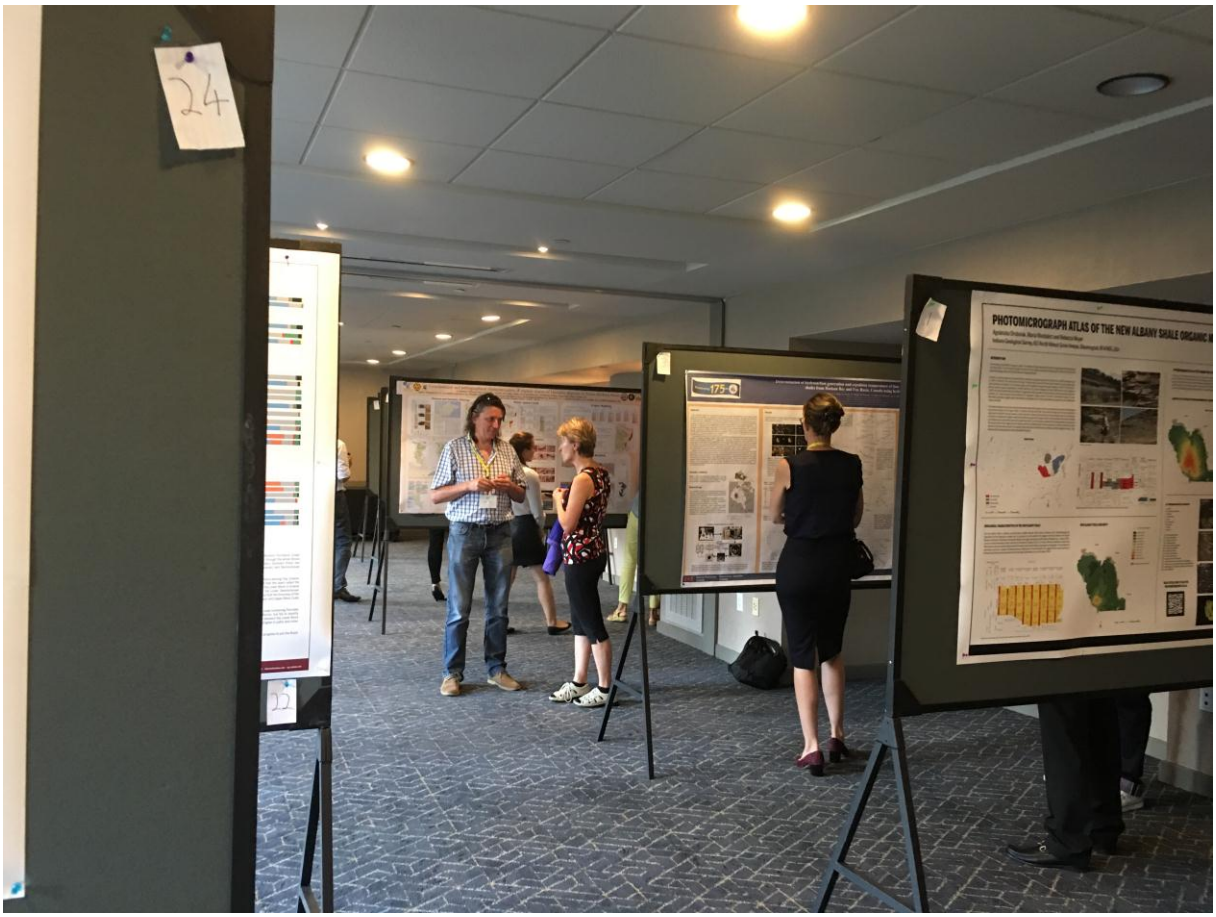

圖6、壁報展示會場。

參、心得與建議

本次出國開會時間共7日(扣除起返程3日)，因事前已做好規劃與準備，因此行程、議程等均順利進行，全程專心參與各項議程，以了解目前世界各國探勘發展之趨勢及可借鏡之處，獲致心得如下：

1. 這次會議中許多發表的論文為運用光學或電子顯微鏡進行觀測油母質、以及非破壞性分析的論文，這些技巧的發展主要是配合非傳統油氣資源探勘而發展。但必要時仍然可借助，或引進這些新工具，對於傳統油氣之生油岩與相關沉積環境進行詳細研究，瞭解其初始狀況，以對油氣生成作更準確的估算。
2. 本公司有些基礎設備，包括光學顯微鏡與元素分析儀、熱裂解儀等進行有機岩石學與油母質的研究。但目前這些資料的應用多半集中在單純的生油岩評估；可多利用現有的資料，特別是台灣地區過去已經累積許多資料，同時配合其它本公司新購入的化學分析設備來進行更深入的地化探勘。

3. 生油岩中油母質與煤素質的觀測對於沉積環境、有機相、或是成熟度的判斷均有助益，可以避免純化學分析可能在生油岩評估工作上造成誤導。但目前公司內相關的專家均已接近退休年齡，因此培養專長油母質觀測人員實為刻不容緩之事。

肆、附錄

一、大會議程

Program Overview

Friday, September 16

10:00 am - 12:30 pm Registration Open / Pre-Meeting Field Trip Check-in	Main Lobby
11:00 am Pre-Meeting Field Trip Departure	Main Lobby

Saturday, September 17

8:00 am - 3:00 pm Registration Open	Exec. Conference Ctr.
9:00 am - 5:00 pm Short Course "Integration of Microscopy and Geochemistry in Petroleum Source Rock Evaluation"	Commerce Room

Sunday, September 18

12:30 pm - 4:00 pm Registration Open	Exec.Conference Ctr.
1:00 pm - 6:00 pm ICCP Council Meeting	Capitol Room
5:30 pm - 9:00 pm TSOP Outgoing Board Meeting	Preston Room

Monday, September 19

7:30 am - 4:00 pm Registration Open	Sterling Ballroom Foyer
8:00 am - 11:50 am TSOP General Session in honor of Burgess and Dow	Sterling Ballroom 2
9:30 am - 12:00 pm ICCP General Assembly	Sterling Ballroom 1
11:00 am -5:00 pm Poster Session I	Commerce Room
1:00 pm - 5:00 pm Microscope Methodologies and Recognizing and Characterizing Organic Microporosity	Sterling Ballroom 2
6:00 pm - 8:00 pm Icebreaker / Exhibitors	Exec. Conference Ctr.

Tuesday, September 20

7:30 am - 12:00 pm (noon) Registration Open	Sterling Ballroom Foyer
8:00 am - 11:50 am Palynofacies and Kerogen	Sterling Ballroom 2
8:00 am - 12:00 pm ICCP Commission III Meeting	Sterling Ballroom 1
9:00 am - 7:00 pm Poster Session I	Commerce Room
12:00 pm (noon) - 12:15 pm TSOP / ICCP Group Photo	TBA
12:15 - 2:00 pm TSOP Business Luncheon	Caroline Room
4:00 - 7:00 pm Happy Hour / Poster Viewing / Exhibitors	Commerce Room and Exec. Conf. Ctr.
7:00 - 9:00 pm Student ONLY Event; meet in Magnolia Lobby	Flying Saucer Restaur.
7:00 - 9:00 pm TSOP Incoming Council Meeting	Preston Room

Wednesday, September 21

7:30 am - 12:00 pm (noon) Registration Open	Sterling Ballroom Foyer
8:00 am - 11:50 am Multi-modal Characterization of Source Rocks, including Source-Rock Reservoirs	Sterling Ballroom
8:00 am - 12:00 pm (noon) ICCP Commission II Meeting	Caroline Room
9:00 am - 12:00 pm Poster Session I	Commerce Room
12:00 pm - 1:00 pm Poster Changeover	Commerce Room
1:00 pm - 1:30 pm Registration Open	Sterling Ballroom Foyer
1:00 pm - 5:20 pm Multi-modal Characterization of Source Rocks, including Source-Rock Reservoirs	Sterling Ballroom
1:00 pm - 4:00 pm ICCP Microscopy Session	Caroline Room
1:00 pm - 6:00 pm Poster Session II	Commerce Room
5:20 pm - 5:40 pm Meeting Group Photo	TBA
7:00 pm - 9:00 pm Conference Dinner	Sambuca Restaurant

Thursday, September 22

7:30 am - 10:00 am Registration Open	Sterling Ballroom Foyer
8:00 am - 10:15 am ICCP Commission II Meeting	Sterling Ballroom 1
8:00 am - 11:50 am Alfred Traverse Symposium	Sterling Ballroom 2
9:00 am - 7:00 pm Poster Session II	Commerce Room
10:45 am - 12:00 pm (noon) ICCP Commission I Meeting	Sterling Ballroom 1
1:00 pm - 6:00 pm ICCP Commission I Meeting	Sterling Ballroom 1
1:00 pm - 5:10 pm Alfred Traverse Symposium	Sterling Ballroom 2
5:00 pm - 7:00 pm Happy Hour / Poster Viewing / Exhibitors	Commerce Room and Exec. Conf. Ctr.
6:00 pm - 9:00 pm ICCP Council Meeting	Capitol Room
6:00 pm - 9:00 pm AASP-TPS Outgoing Board Meeting	Preston Room

Friday, September 23

7:30 - 10:00 am Registration Open	Sterling Ballroom Foyer
8:00 am - 11:50 am AASP-TPS General Session	Sterling Ballroom 1
9:00 am - 12:00 pm Poster Session II	Commerce Room
11:50 am - 12:15 pm AASP-TPS Group Photo	TBA
12:15 - 2:00 pm AASP-TPS Business Luncheon	Library
1:00 pm - 5:00 pm ICCP General Assembly	Sterling Ballroom I
3:00 pm - 5:00 pm AASP-TPS Incoming Board Meeting	Preston

Saturday, September 24

6:30 am Post-Meeting Field Trip Check-in	Main Lobby
7:00 am Post-Meeting Field Trip Departure	Main Lobby

Monday, September 19th

8:00 am - 11:50 am **TSOP General Session in honor of Burgess and Dow** **Sterling Ballroom 2**

Moderators: Thomas Gentzis and Humberto Carvajal-Ortiz

Start Time	Abstract Number	Presenter	Title
8:00 am			Opening Remarks
8:10 am	128 & 129	Jarvie	Keynote: Remembering and Honoring the Life and Times of Two Legends of Organic Petrography: Jack Donald Burgess and Wallace "Wally" Gillmore Dow
8:50 am	37	Borrego	Organic Petrology and Geochemistry of Mississippian Black Shales in the N of Spain: Vegamián Formation, Cantabrian Zone
9:10 am	15	Borrego	Changes in the redox conditions in a Bashkirian carbonate ma rine environment as seen from the organic matter assemblage and the biomarker's fingerpring. Cantabrian Zone, North Spain
9:30 am	102	Singh	Petro-chemical study of coals from Virgin areas of Barakar For mation of Eastern India to assess the utilisation potential in steel industry
9:50 am		**Morning Coffee/Tea Break**	
10:00 am	103	Singh	Petrographic and chemical characterization of low rank coals of Raniganj Formation in India to assess its efficient industrail utilisation
10:20 am	70	Mitrovic	Characteristics of Lignite lithotypes from the Kovin deposit (Ser bia) - implications from petrographical, biomarker, and isotopic studies
10:40 am	53	Jiang/ O'Keefe	Petrology, palynology, and geochemistry of Pliocene lignite in Jinsuo mine, eastern Yunnan, China
11:00 am	6	Ardakani	Dolomite fluorescence color zonation: thermal or chemical effect?
11:20 am	93	Rimmer	Rate matters - the effects of rapid heating on organic matter by dikes and sills
11:40 am			Concluding Remarks
11:50 am		**Lunch Break**	

Monday, September 19th, 11:00 am - Wednesday, September 21, 12:00 pm

Poster Session I **Commerce Room**

Posterboard Number	Abstract Number	Presenter	Title
1	27	Drobniak	Photomicrograph atlas of New Albany Shale organic matter
2	108	Suarez-Ruiz	Influence of solid bitumen on the development of porosity in shale oil reservoirs: The case of the Salada Member of the La Luna Foration (Turonian-Santonian age) in Colombia
3	88	Reyes	Determination of hydrocarbon generation and expulsion tem perature of four organic-rich Upper Ordovician shales from Hud son Bay and Fox Basin, Canada using hydrous pyrolysis
4	119	Wei	Comparative optical properties of vitrinite and other macerals from Upper Devonian to Lower Mississippian New Albany Shale: Implications for thermal maturity
5	106	Stoupakova/ Luzhbina	Geochemical and petrographical characterization of organic mat-ter of Domanic deposits in Timan-Pechora Basin
6	98	Saad	Using isotopic signature sto determine stages of diagenesis within the Montney Formation, Canada
7	22	Damoulianou/ Kalaitzidis	Organic petrographical features and Rock-Eval parameters of the Upper Jurassic Naokelekan Formation, KRG-Iraq
8	60	Lauridsen	The Upper Jurassic Source Rock Potential in the Danish Central Graben
9	10	Beattie	Source rocks and thermal maturity of the Weald Basin, United Kingdom
10	4	Aldred	Metal mobilisation during hydraulic fracturing of the Bowland Shale, United Kingdom
11	42	Haghnazar-Liseroudi	H_2S Generation in the Montney Tight Gas Reservoir: Petrograph-ic Evidence
12	99	Shiau	Geochemical characters of oils in the southwestern Taiwan and their possible source rocks
13	47	Huang	Multiple genetic origins and effects of secondary alteration on the Paleogene natural gasses in the Liaohe Basin, northeast China - insight from the chemical and stable isotopic compositions
14	86	Raji	The effect of demineralization on isolated Kimmeridge Clay kerogens, North Sea
15	19	Clarke	The Evolution of Petrophysical Properties During Pyrolysis: Examples from the Montney and Duvernay Formations, Canada

Monday, September 19th, 11:00 am - Wednesday, September 21, 12:00 pm

Poster Session I **Commerce Room**

Posterboard Number	Abstract Number	Presenter	Title
16	46	Hsu	The study of treatment method in rock sample that had oil base mud contamination
17	57	Kojic	Study of the synergetic effect of co-pyrolysis of lignite lithotypes and high density polyethylene
18	52	Jalonek	Relationship between the content of mercury in coal lithotypes and their ashes of the Upper Silesian Coal Basin (Poland)
19	89	Ribeiro/Flores	Rare earth elements and yttrium in coal, coal waste material and fly ash from Douro Carboniferous Basin, Portugal
20	111	Tian	Mineralogical characteristics and transformation behaviors of silicon bearing minerals during high silicon coal combustion
21	118	Wei	Re-evaluation of the "organic affinity" of trace elements in the high-GE coals from China
22	67	Mastalerz	Application of palynology and petrography in the correlation of the Pennsylvanian Brazil and Staunton Formation coals in the eastern part of the Illinois Basin

Monday, September 19th

1:00 pm - 5:00 pm **Microscope Methodologies and Recognizing and Characterizing Organic Microporosity** **Sterling Ballroom 2**

Moderators: Maria Mastalerz and Stavros Kalaitzidis

Start Time	Abstract Number	Presenter	Title
1:00 pm	16	Cardott	Keynote: Reflections on nanoporosity development in kerogen and bitumen: where and when
1:40 pm	56	Ko	Controls on Pore Types and Pore-Size Distributions in Marine and Lacustrine Mudstones: Examples from Mississippian Barnett, Upper Devonian-Lower Mississippian Woodford, Upper Triassic Yanchang, and Upper Cretaceous Boquillas and Eagle Ford For mations
2:00 pm	104	Smith	Hi-tech characterization of very unconventional sandstone rese-voirs in some deeply buried and folded gas fields, South America
2:20 pm	124	Zhang	Heterogeneity and its porosity and permeability characteristics in the No. 3 CBM reservoir of Gaohe block in Qinshui Basin, China
2:40 pm		**Afternoon Coffee/Tea Break**	
2:50 pm	123	Hackley	New Technique for In Situ Geochemical Characterization of Dis persed Organic Matter: Application of Infrared (IR) Nanoscopy to New Albany Shale
3:10 pm	97	Ruppert	*In situ* neutron scattering measurements of carbon dioxide in Marcellus Shale samples
3:30 pm	105	Smith	Transmission Electron Microscopy (TEM) Analysis of Mineral and Organic-Matter Components in Upper Triassic Yanchang Lacustrine Mudstones, Ordos Basin, China
4:10 pm	110	Gentzis	Classical Thermal Maturity Indices vs. Novel RGB-based Matu rity Index: Calibration Practices and Correlation
4:30 pm		Closing Remarks	

8:00 am - 11:50 am **Palynofacies and Kerogen** **Sterling Ballroom 2**

Moderators: Annette Götz; Kate Greiner

Start Time	Abstract Number	Presenter	Title
8:00 am			Opening Remarks
8:10 am	20	Clayton	Keynote: The age, depositional environments and paleogeograph ic setting of the Upper Devonian Three Lick Bed in northeastern Kentucky, U.S.A.
8:50 am	45	Hennissen	Textural and geochemcial characterization of amorphous organic matter (AOM) in the Carboniferous shales from the Pennine Basin (United Kingdom)
9:10 am	96	Ruckwied	Palynology of the Permain Prince Albert and Whitehill forma tions (Karoo Basin, South Africa): New insights on basin dynam ics and implications for shale gas exploration
9:30 am	120	Wheeler	Palaeoenvironmental and palaeoclimatic signatures of Gond wana's deglaciation recorded inpalynofacies patterns of the Wit bank and Highveld coalfields (South Africa)
9:50 am		**Morning Coffee/Tea Break**	
10:00 am	79	Paterson	An integrated palynological, palynofacies, and chemostratigraph ic study of the upper Ladinian-lower Carnian succession of the Norwegian Arctic; Boreal insights into the Carnian Pluvial Epi sode
10:20 am	34	Fonseca	New paleoenvironmental evidences for the Toarcian
10:40 am	35	Fonseca	Evaluation of thermal maturity in the late Pliensbachian-early Toarcian organic-rich sediments ofdifferent basins of Southern France
11:00 am	68	Mendonça Filho	Keynote: The fossil record of hydrozoans in dispersed organic matter: a palynofacies and organic petrographic approach to kerogen characterization
11:40 am			Concluding Remarks
12:00 pm		**TSOP/ICCP Meeting Photograph**	
12:15 pm		**TSOP Business Luncheon**	

Wednesday September 21st

8:00 am - 11:50 am **Multi-modal Characterization of Source Rocks, including Source-Rock Reservoirs** **Sterling Ballroom**

Moderators: Joe Curiale, Ling Gao

Start Time	Abstract Number	Presenter	Title
8:00 am			Opening Remarks
8:10 am	112	Tyson	Keynote: Predicting the initial source rock potential of marine sediments
8:50 am	17	Carvajal-Ortiz	Geochemical Screening of Source Rocks and Reservoirs
9:10 am	28	Drozd	Vitrinite Reflectance and Programmed Pyrolysis Tmax Measure ments, How can I use both in an Operational Setting?
9:30 am	109	Synnott	The effect of bacterial degradation on bituminite reflecatnce
9:50 am		**Morning Coffee/Tea Break**	
10:00 am	74	Ocubalidet	Controls on Organic Carbon Accumulation in the Late Devonian New Albany Shale, West-Central Kentucky, Illinois Basin
10:20 am	63	Liu	Characterization of geochemical properties and microstructures of the Bakken Shale in North Dakota
10:40 am	40	Gorbanenko	Organic-facies variability and hydrocarbon potential of the Posidonia Shale in response to the Toarcian Oceanic Anoxic Event
11:00 am	126	Sanei	Keynote: Fractionation of organic matter and implications in unconventional petroleum reservoirs quality
11:40 am			Session Break Remarks
11:50 am		**Lunch Break**	

Wednesday, September 21st, 12:30 pm - Friday, September 23, 12:00 pm

Poster Session II **Commerce Room**

Posterboard Number	Abstract Number	Presenter	Title
1	113	Valentine	The importance of correlative microscopy for understanding dispersed organic material: Bridging the gap between optical and electron microscopy
2	43	Hansen	Preliminary study on estimation of relative proportions of or ganic matter types in a Mississippian Barents Sea section
3	51	Jelonek	Petrophysical and statistical analyses and the evaluation of the methane content in the coal seams of the Upper Silesian Coal Basin (Poland)
4	72	Flores	Thermal Maturity study and organic compostion of Early Jurassic Formations (Sinemurian-Lowermost Toarcian) Lusitanian Basin, Portugal
5	9	Bayramova	New data on palynology of Early Pliocene sediments of Azerbai jani oil
6	77	Omodeo-Sale/ Suarez-Ruiz	Definition of the depositional environments where coal and ter restrial organic matter form: The Mannville Group coal bearing strata (Alberta, Canada)
7	30	Suarez-Ruiz	Relationships between Paleocene coals of the Marcelina Forma tion from the Guasare Basin and the crude oils of the Amana oil field (Venezuela)
8	101	Singh	Petrography and Geochemistry in relation to depositional condi tions and hydrocarbon potential of Surkha lignite deposits (Sau rashtra Basin), western India
9	117	Wang/Zhang	Structural characteristics of different barkinite shapes by micro-FTIR
10	116	Wang/Zhang	Petrographic analysis of Middle Jurassic Dameigou Formation from northern Qaidam Basin, China: implications for organic matter soruces and sedimentary environment
11	122	Xu	Theoretical study of stress-induced sorption capacity change of coal and its influence on coal permeability variation
12	31	Misz-Kennan	Geochemical- and petrological Properties of Coal Wastes with high extractable Bitumen Contents from the Lower Silesian Coal Basin (Poland)
13	81	Misz-Kennan	The Welnowiec Coal-Waste Dump (USCB, Poland): Value of a Multidisciplinary Case Study

Wednesday, September 21st, 12:30 pm - Friday, September 23, 12:00 pm

Poster Session II **Commerce Room**

Posterboard Number	Abstract Number	Presenter	Title
14	55	Kedzior	The influence of the second-and third coalification jumps on present-day methane contents in the Depiensko area (The Upper Silesian Coal Basin, Poland)
15	12	Bielowicz	Porosity and Other Petrographic and Technological Parameters of Polish Humic Coals
16	13	Bielowicz	Sulphur and Iron Sulphides in Lignite from the Bogdanka Hard Coal Mine, Lublin Coal Basin
17	125	Zhao	Mineralogy of the Pennsylvanian coal seam in the Datanhao Mine, Daqingshan Coalfield, Inner Mongolia, China: Genetic implications for mineral matter in coal deposited in an intermon tane basin
18	52	Jelonek	Relationship between the content of mercury in coal lithotypes and their ashes of the Upper Silesian Coal Basin (Poland)
19	62	Zeng	FTIR characterization of Zhundong coal under acid treatment and solvent extraction

Wednesday September 21st

1:00 pm - 5:40 pm **Multi-modal Characterization of Source Rocks, including Source-Rock Reservoirs** **Sterling Ballroom**

Moderators: MaryAnn Love Malinconico and Shawn Wright

Start Time	Abstract Number	Presenter	Title
1:00 pm	29	Eble	Keynote: Palynology, Organic Petrography, and Geochemistry of two Coal-to-Shale Sequences in the Eastern Interior (Illinois) Basin, mid-Continent, USA
1:40 pm	87	Reyes	Artificial maturation of chitinozoan and organic-rich Upper Ordovician shale from Boas river Formation, Hudson Bay Basin, Canada using modified hydrous pyrolysis
2:00 pm	48	Jäger	Hydrocarbon potential of Lower Silurian Qusaiba Shales, Saudi Arabia, from optical and geochemical kerogen analysis
2:20 pm	51	Jalonek	Petrografic and palynological analyses as an indicator of environ mental changes during coal seam formation as based on the seam No 209 profile (Upper Silesia, Poland)
2:40 pm	1	Kolo	Petrography, palynology, and geochemistry of organic matter from Upper Jurassic Naokelekan Formation, northern Mesopota mian basin, Kurdistan-Iraq: A study on regional thermal matu rity trends
3:00 pm		**Afternoon Coffee/Tea Break**	
3:10 pm	127	Bogus	Keynote: Palynomorph geochemistry as a kerogen proxy: preliminary work using organic-walled dinoflagellate cysts
3:50 pm	95	Ruble	Assessing thermal maturity in Cambrian Source Rocks, Rome Trough, Appalachian Basin: organic petrology complexities
4:10 pm	39	Gentzis	Hydrocarbon Source Potential in the Jurassic Matruh Basin, North Western Desert, Egypt
4:30 pm	36	Furmann	Organic matter petrography, organic geochemistry, and porosity of Late Cretaceous (Cenomanian-Turonian) organic-rich mud stones from the Belle Fourche and Second White Specks Forma tions, West-Central Alberta, Canada
4:50 pm	54	Suárez-Ruiz	The La Luna Formation (Turonian-Santonian age) in the Middle Magdalena Valley Basin from Colombia: A shale oil reservoir
5:10 pm		Concluding Remarks	
5:20		**Conference Photograph**	

Thursday, September 22nd

8:00 am - 11:50 am **Alfred Traverse Symposium** **Sterling Ballroom 2**

Moderators: Kimberley Bell and Rebecca Hackworth

Start Time	Abstract Number	Presenter	Title
8:00 am			Opening Remarks
8:10 am	91	Rich	Keynote: Alfred Traverse – a brief history of an iconic palynologist
8:50 am	90	Rice	*Retispora lepidophyta* assemblage near the Devonian-Carboniferous boundary: palynology of the Unit 4 shale in the middle Sapington Formation, Montana, USA
9:10 am	66	Mangerud	Towards a revised palynostratigraphy for the Upper Triassic succession of the Norwegian Arctic
9:30 am	64	Lopes	Palynostratigraphic study of the Finnmark Platform, Barents Sea, Norway
9:50 am		**Morning Coffee/Tea Break**	
10:00 am	121	Riding	Resolving the Middle Jurassic dinoflagellate radiation: the palynology of the Bajocian of Europe
10:20 am	92	Riding	The Upper Jurassic (Oxfordian) palynology of northwest Colorado and Utah, USA
10:40 am	21	Cooling	Palynology of the Jurassic-Cretaceous transition in the Surat Basin, Queensland, Australia
11:00 am	33	Fisk	Palynology of a Franciscan Mélange - A Case of Marginal Palynology Redux
11:20 am	82	Pocknall	Palynology of non-marine and marine strata of the Straight Cliffs Formation (Coniacian-Campanian), Kaiparowits Plateau, Utah
12:00 pm		**Lunch Break**	

Thursday, September 22nd

1:00 pm - 5:40 pm **Alfred Traverse Symposium** **Sterling Ballroom 2**

Moderators: Kimberley Bell and Jen O'Keefe

Start Time	Abstract Number	Presenter	Title
1:00 pm	26	Dickey	Floral Response to the Paleocene Eocene Thermal Maximum in the Western U.S. Gulf Coast
1:20 pm	44	Harrington	High-resolution palynofloral record through a middle-latitude PETM section: The Red Hot Truck Stop, MS
1:40 pm	25	Denison	Paleocene and Eocene stratigraphy, Central Texas: pitfalls, new insights and lessons learned
2:00 pm	24	Demchuk	A Proposal for an AASP-TPS Working Group on U.S. Gulf Coast Pollen/Spore Nomenclature and Synonomy
2:20 pm	58	Korasidis	Cyclic Floral Succession and Fire in a Cenozoic Wetland/Peatland System
2:40 pm	94	Romero	Biogeography and taxonomical affinity of *Striatopollis catatum-bus*, using Airyscan confocal superresolution microscopy
3:00 pm	**Afternoon Coffee/Tea Break**		
3:10 pm	41	Greiner	Changes in pollen grain size as a proxy for long-term climate change: evidence from modern and fossil pollen
3:30 pm	8	Baudoin	Cenozoic paleoenvironments evicenced from organic microfos sils recovered from subglacial lakes and ice streams in Western Antarctica
3:50 pm	69	Miao	Neogene Fungal Record from IODP Site U1433, South China Sea: implications for paleoenvironmental change
4:10 pm	100	Silwadi	Dinoflagellate cyst stratigraphy and paleoecology of the Rees Borehold, Northern Belgium
4:30 pm	2	Abomriga	Central North Atlantic (IODP Site U1313) Paleoceanography Based on a High-Resolution Dinoflagellate Cyst Record across the Early-Middle Pleistocene Boundary (Marine Isotope Stages 20-18, ~773 ka).
4:50 pm	32	Farley	Pollen as sedimentary Particles - Alfred Traverse's contributions and the future
5:10 pm			Concluding Remarks

Friday September 23rd

8:00 am - 11:50 am **AASP-TPS General Session** **Sterling Ballroom 2**

Moderators: Sophie Warny & Katrin Ruckwied

Start Time	Abstract Number	Presenter	Title
8:00 am			Opening Remarks
8:10 am	61	Laurence	Keynote: Forensic Palynology in the United States: The Search for Geolocation
8:50 am	38	Genest	The Impacts of the Exxon Valdez oil spill on phytoplankton in Prince William Sound (Alaska, USA): Evidence from dinoflagel late cyst sedimentary records
9:10 am	11	Beck	Comparing pollen in packrat coprolites to assocaited sediment from Paisley Caves, OR
9:30 am	78	Pardes	Pollen analysis of the early Initial Period of Gramalote in north ern Peru
9:50 am		**Morning Coffee/Tea Break**	
10:00 am	14	Black	Plant Ecosystem Change from the 1380's through 1930's in East ern Kentucky: Results from the BEPSUR Project
10:20 am	80	Perrotti	The effects of sonication-assisted screening on Quaternary pollen samples
10:40 am	59	Lau	Determining the number of pollen counts needed for honey bee pollen pellet analysis
11:00 am	76	O'Keefe	Comparison of feral and managed honeybee diet among three hives in Northeastern Kentucky: preliminary implications for improving bee health
11:20 am	107	Stukins	The John Williams Index of Palaeopalynology, digitizing a Big Data archive: A case study into the spatio-temporal richness of Aquilapollenites
11:40 am		**AASP-TPS Group Photograph**	
12:00 pm		**AASP-TPS Business Luncheon**	

附錄二、參加研討會壁報

Geochemical characters of oils in the southwestern Taiwan and their possible source rocks

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Introduction

Kaohsiung-Pingtung area in southern Taiwan has considerable seeps exposed shown to have oil and gas exploration potential. In 2013, the condensate was discovered in the FS well in this area. In addition, the wide distribution of mud volcanos and seeps in this area that provides not only nature gas but also accompanying oil slicks. Here we collected these oil slicks from the mud volcanos and seeps, and separated the hydrocarbon part by the solid phase extraction (SPE), then applied gas chromatography/tandem mass spectrometry (GC-MS-MS) to analyze these oil slick, condensate, and outcrop rocks in southern Taiwan. Samples are listed in the table 1, the site locations and regional stratigraphic chart are illustrated on Fig.1, Fig.2 and Fig3 respectively.

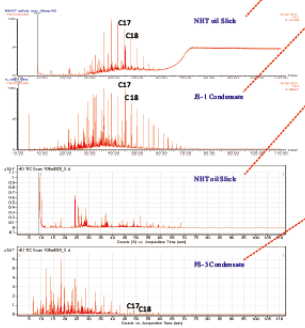


Fig.5 The TIC chromatograph of condensates and oil slicks. The condensates were taken from FS-3 well and JS-1 well, respectively. The oil slicks were taken from Yancho mud volcano area (including KNU, NYNH, TNH, WSD) and Nanhuatan (NHT) pond, respectively.

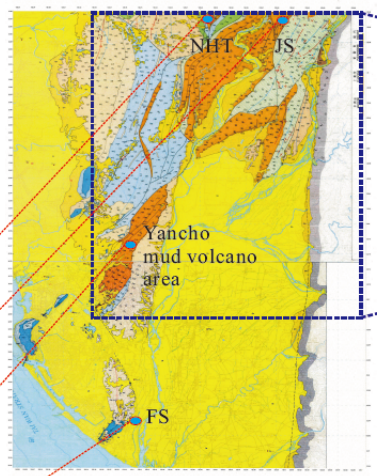


Fig.1 The locations of oil samples.

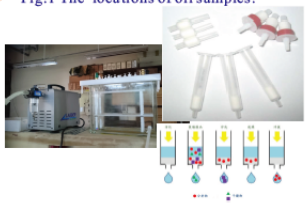


Fig.4 The solid phase extraction (SPE) procedure. The SPE could separate the organic and water phases efficiently, we use this method to separate oil slick from the water.

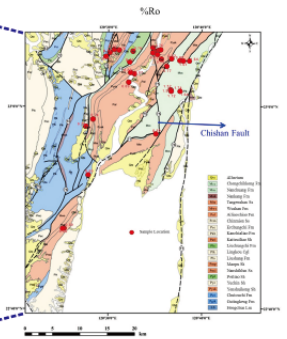


Fig.2 The outcrop samples location and their vitrinite reflectance (%Ro%) distribution in the study area. The samples with higher %Ro are distributed in the East of the Chishan Fault.

NO.	Longitude	Latitude	Stratum	Ro%
1	120°35'42.48"	23°09'06.51"	Alihsuchiao Fm	0.67
2	120°31'07.68"	23°08'07.08"	Yanshuikeng Sh	0.72
3	120°31'25.56"	23°08'25.13"	Alihsuchiao Fm	0.69
4	120°32'06.36"	23°08'21.09"	Maopu Sh	070
5	120°31'56.40"	23°08'14.88"	Peiliao Sh	0.70
6	120°33'14.76"	23°08'10.31"	Changchihkeng Fm	0.71
7	120°35'04.16"	23°08'05.71"	Yanshuikeng Sh	0.77
8	120°33'04.16"	23°08'05.17"	Alihsuchiao Fm	0.74
9	120°34'10.08"	23°08'14.02"	Yanshuikeng Sh	0.77
10	120°35'11.64"	23°08'18.56"	Yanshuikeng Sh	0.76
11	120°35'21.00"	23°08'20.09"	Yanshuikeng Sh	0.77
12	120°34'22.56"	23°07'53.28"	Yanshuikeng Sh	0.78
13	120°34'37.44"	23°04'58.32"	Alihsuchiao Fm	0.83
14	120°36'12.60"	23°04'58.92"	Alihsuchiao Fm	0.79
15	120°37'45.00"	23°04'59.76"	Changchihkeng Fm	0.82
16	120°37'13.08"	23°03'48.36"	Changchihkeng Fm	0.77
17	120°36'37.32"	23°04'35.52"	Tangenshan Sh	0.86
18	120°38'39.24"	23°04'01.08"	Changchihkeng Fm	1.01
19	120°39'38.52"	23°04'37.80"	Changchihkeng Fm	1.61
20	120°38'28.56"	23°03'38.88"	Tangenshan Sh	1.64
21	120°37'39.00"	23°03'38.88"	Changchihkeng Fm	1.31
22	120°37'37.20"	23°03'36.60"	Changchihkeng Fm	1.72
23	120°37'38.16"	23°03'28.56"	Changchihkeng Fm	1.78
24	120°37'43.32"	23°03'17.88"	Changchihkeng Fm	1.52
25	120°45'03.60"	23°37'38.16"	Tangenshan Sh	0.89
26	120°37'46.92"	23°47'37.56"	Nanhuatan Sh	-
27	120°49'39.60"	23°47'46.32"	Kaitzuliao Sh	0.86
28	120°39'37.80"	23°03'36.96"	Outinglong Fm	0.89
29	120°37'15.84"	23°03'38.28"	Yanshuikeng Sh	0.89
30	120°32'39.84"	23°03'31.56"	Alihsuchiao Fm	0.89
*30-1	120°32'39.84"	23°03'31.56"	Alihsuchiao Fm	0.74
31	120°33'51.36"	23°03'13.56"	Yanshuikeng Sh	0.87
32	120°39'05.52"	23°39'58.32"	Yanshuikeng Sh	0.74
33	120°38'03.12"	23°39'04.19"	Liukuo Gil	0.76

Table 1 The outcrop samples list and %Ro results.

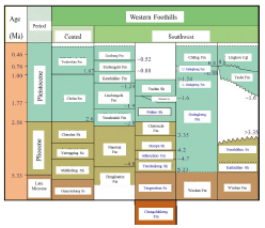


Fig. 3 Regional stratigraphic chart

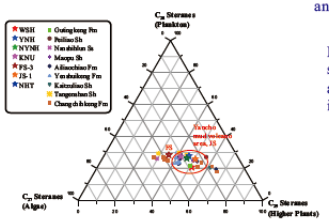


Fig.7 Ternary diagram of C_{27}-C_{29} regular steranes.

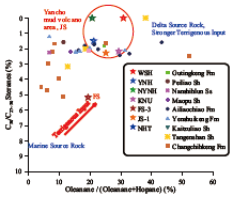


Fig.8 Cross-plot of C_{30}/C_{27-30} steranes and oleanane/(oleanane $+C_{30}$hopane).

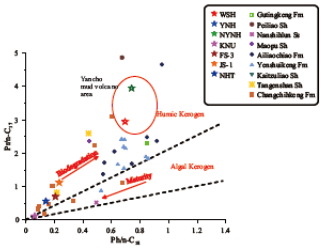
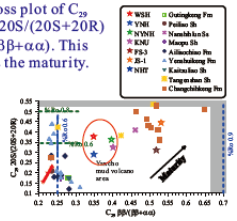


Fig.6 Cross-plot of Pristane/C_{17} n-alkane (Pr/n-C_{17}) and Phytane/C_{18} n-alkane (Ph/n-C_{18})

Fig.9 Cross plot of C_{29} steranes 20S/(20S+20R) and ββ/(ββ+αα). This indicates the maturity.



Results and Discussion

1. Based on the biomarkers analysis, the oil slicks and condensates might have different sources. The oil slicks from Yancho mud volcano area and condensate from JS-1 well contain more terrigenous input than the FS-3 well condensates.

2. Two condensates show different compositions. The condensate from FS-3 well contains more light components, and less long chain hydrocarbons than another one taken from the JS-1 well.

3. The biomarkers results indicate the sources of oil in the southern Taiwan mainly come from the neritic shale of Changchihkeng Fm deposited in the late Miocene or other earlier strata. The source is still needed to the further research.

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The study of treatment method in rock sample that had oil base mud contamination.

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Abstract

According to the different geology condition, adding different type of mud is a normal way in drilling process. Especially, Oil base mud is one of the common types, however, it often causes some problem for example, the adsorption contamination on the core and cutting surface so that these kind of interference will affect the source rock evaluation and other geochemistry experiments. Soxhlet extraction is a traditional method to collect organic matter from matrix. This extraction method has some disadvantages such as consumes large amount of solvent, sample (50~150 g, depend on TOC content) and reflux for a long time. Considering the limit of sample quantity, by mixing samples to extract might make unpredictable error in experiment results.

The thermal desorption / pyrolysis is one of the necessary items in traditional geochemistry analysis, the generation organic matter divide into two portions, one is free hydrocarbon (S1), the other is pyrolysis hydrocarbon (S2). In the analysis process, Oil base mud almost covers the free hydrocarbon portion, so that the solvent extraction just could collect S1part and had lower efficiency for pyrolysis product. The study combines rock pyrolysis technique with gas chromatography by using suitable temperature to desorb part of mud covered; just keep S2 part for Rock-Eval. Through this method could not only find the oil generation depth quickly but also distinguish pyrolysis product successfully by gas chromatography. Otherwise, this method still could just use small amount of sample and short pretreatment time to get correctly data for oil exploration.

Methodology

The oil base mud cutting sample were crushed and cleaned before pretreatment. We will use 50g sample for Soxhlet extraction and 1mg sample for thermo-desorption gas chromatography.

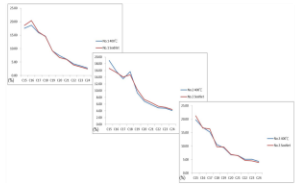
The OPTIC 4 LVI injector and GL science GC 4000 gas chromagraph was use to analyze the rock samples. OPTIC 4 LVI injector is different from traditional GC injector, it has maximum temperature 600℃ and programming design like GC oven. The GC was operated using the following conditions: DB-1 column (60 m × 250 μm I.D. × 0.25 μm film thickness), injector temperature programming is 50ºC to 300℃, 325℃, 350℃, 375℃and 400℃, flow rate 1ml/min, split ratio set to 10:1, and FID temperature of 320ºC. The GC oven was programmed from 50 ºC with a 5 min initial isotherm, then the heating rate program of 5ºC /min to 300ºC with a 35 min hold time. Helium carrier gas was used with a minimum purity of 99.999 %, and additional filters were used to remove any residual water, oxygen, and hydrocarbons. The injected sample size was 1mg.

We will use stepwise thermo-desorption process to find the suitable temperature for treating the oil base mud. The pyrolysis product(S2) will generate at 500 ºC. And then we can compare the raw sample S2 with the sample after Soxhlet extraction by using repeatability limit method, if the RPD%<14%, it represents two methods can achieve the same efficiency.

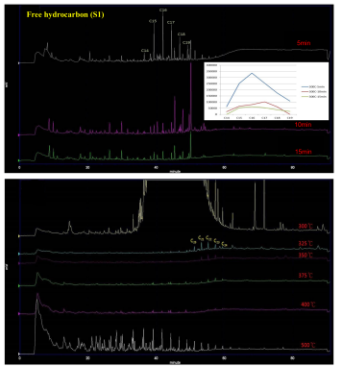
Results

Oil base mud contamination treatment flow chart

Comparison of two treatment methods of 3 sets cutting mixed sample, the plot show normal alkanes of pyrolysis product distribution.



Stepwise thermo-desorption process can help us find the correct treating time and temperature (15min and 400℃)



Repeatability Limit method

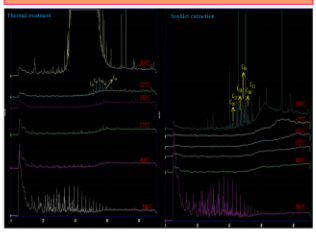
Two sample in the same batch, if the analysis data over the repeatability limit, two samples are different. We use this statistics method to confirm two treatment methods can achieve the same efficiency.

Formula:

RPD%=(Absolute difference/Avg.)*100

When RPD%<14%, two methods can achieve the same efficiency

Comparing the raw sample stepwise thermo-desorption chromatogram with Soxhlet extraction sample, we can use 400℃ to deal with other samples.



Repeatability Limit Result : we can use repeatability Limit method to calculate the normal alkane of C_{15}~C_{29} RPD%, all of the results<14%, it conforms the two method that have the same efficiency

$C_{Rip=15-29}/\sum C_{15-29}$	No.1 400℃	No.1 Soxhlet	No.2 400℃	No.2 Soxhlet	No.3 400℃	No.3 Soxhlet
C_{15}	17.56	18.57	18.99	16.67	19.83	21.26
C_{16}	18.70	20.43	15.86	15.46	16.92	16.73
C_{17}	15.92	16.20	13.54	14.09	15.28	16.42
C_{18}	14.61	14.46	15.69	14.72	10.59	9.79
C_{19}	9.10	9.14	9.38	10.33	9.41	9.64
C_{20}	7.40	6.68	8.85	7.41	6.81	6.93
C_{21}	6.05	6.02	5.88	6.47	6.55	6.46
C_{22}	4.33	3.89	4.90	5.38	5.15	4.70
C_{23}	3.59	3.21	4.80	5.08	5.14	4.54
C_{24}	2.76	2.45	4.12	4.39	4.32	3.91

Carbon No./AD.RPD%	No.1 AD-	No.1 RPD%-	No.2 AD-	No.2 RPD%-	No.3 AD-	No.3 RPD%-
C_{15}	1.01	5.60	2.32	13.01	1.43	6.94
C_{16}	1.73	8.85	0.46	2.53	0.19	1.11
C_{17}	0.29	1.88	0.56	4.03	1.14	7.17
C_{18}	0.15	1.06	0.97	6.41	0.80	7.88
C_{19}	0.04	0.44	0.95	9.67	0.23	2.39
C_{20}	0.72	10.25	0.56	7.79	0.12	1.78
C_{21}	0.03	0.43	0.60	9.65	0.08	1.28
C_{22}	0.43	10.50	0.48	9.27	0.46	9.26
C_{23}	0.38	11.08	0.28	5.64	0.59	12.22
C_{24}	0.33	12.69	0.27	6.40	0.41	9.92

Conclusions

A number of preliminary conclusions about the application of dealing with oil base mud contamination samples be drawn from this study.

1. **Stepwise thermal desorption/pyrolysis method can help us choose correct thermal treatment temperature.**
2. **According to the repeatability limit method, thermal treatment method has the same efficiency as soxhlet extraction.**
3. **Thermal treatment method also can provide new way to extract rock sample, it did not use any organic solvent, just need short treatment time and small amount sample.**

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