

出國報告（出國類別：研究）

美國頁岩油氣的開發與評估

服務機關：台灣中油公司探採事業部國資處

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派赴國家：美國

出國期間：101年12月31日至102年2月9日

報告日期：102年5月9日

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摘要

在傳統易於開採的油氣資源日趨耗竭時，許多非傳統油氣在開採技術突破後，已能在目前油價下具有經濟價值；其中尤以水平鑽井配合液裂完井方式生產的頁岩油氣最為重要，且已改變全球能源供給情勢，是本公司未來發展重點。

此次研習為執行 101 年國外專題研究計畫「非傳統油氣產業分析與開採研究」，即以美國頁岩氣及頁岩油為主，除與相關顧問公司研討其相關之產業分析、購併等資料，同時藉由參與儲集層評估、液裂生產技術、經濟分析與法務等短期課程與業界人士交流，以瞭解頁岩油氣發源地美國之產業發展，將有助於本公司未來投資國外非傳統能源礦區的經濟評估、合約洽商及礦區經營等工作能力提升，降低投資及開發風險。

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壹、目的

非傳統油氣資源係指有別於傳統生產開發方式之油氣能源，在天然氣部分主要有緻密氣、頁岩氣、煤層氣與天然氣水合物；在原油的部分則包括頁岩油、油砂、油頁岩與重油等。這些油氣資源或是因為低滲透率岩層、或是因為油質黏度高，在過去的生產開發技術下不具經濟開採可行性，但隨著液裂等生產方式的進步，僅天然氣水合物及油頁岩尚未商業化開採。

在非傳統油氣資源之中，以生產量及生產成本而言，當以頁岩氣及頁岩油(緻密油)最突出，已在液裂發源地美國之天然氣及原油供給造成振撼，進而帶動製造業復興，甚至影響未來全球能源市場及國際戰略均勢。

本次研習因此以頁岩氣及頁岩油為主，參與美國休士頓地區國際探油法務、非傳統油氣經濟分析，並與顧問公司研討其相關之產業分析、購併等資料以瞭解美國之產業發展，同時亦參與儲集層分析、液裂等基礎技術課程以瞭解技術團隊如何運作以及基礎的液裂操作等。

本次研習雖因時間及經費限制(第 4 季始遞補為執行 101 年國外專題研究人選，適逢耶誕新年及寒假，一般大學及訓練機構課程較少)，但仍參與了各類相關課程以瞭解頁岩油氣發源地美國之產業發展，同時可以作為未來相關訓練的參考。研習攜回之課程資料，受限於著作權規定，將以繳存內部圖書室方式，提供未來投資國外非傳統能源礦區的經濟評估、合約洽商及礦區經營等工作之參考，俾降低投資及開發風險。

貳、過程

本次出國主要研習項目如下：

1. 研習Wood MacKenzie資料庫

Wood Mackenzie 公司是世界知名的顧問公司，以油氣產業為主力，在上游探採、天然氣及煉製等方面提供市場資訊、軟體與資料庫等；本公司過去已向 Wood Mackenzie 顧問公司購買多項產品，包括 Upstream Service, 經濟分析軟體 GEM 等，對新礦區的及時掌握及評估，有相當正面的助益。

此次除研習 Wood Mackenzie 過去發佈有關頁岩油氣的資訊外，亦與 Unconventional Play Service 人員討論美國頁岩油氣產業現況；對於本公司以藉由購買液化天然氣參與頁岩油氣開採，Wood Mackenzie 人員認為加拿大雖有政府支持頁岩氣液化出口，但就生產成本而言，因為較晚開始，仍處於學習曲線早期，其整體發展可能要較美國晚十年。

對於加拿大油砂及澳洲天然氣的未來，Wood Mackenzie 曾發佈頁岩油氣平均損益平衡價格(Breakeven Price)較低，會擠壓加拿大油砂及澳洲天然氣市場空間，但 Wood Mackenzie 人員認為長期原油及液化天然氣價格下滑有限，加拿大油砂及澳洲天然氣只是減緩成長空間。

該公司 Unconventional Play Service 提供世界各非傳統油氣盆地技術及經濟資訊，比較生產成本及主要公司績效，目前已有超過 50 個客戶；Wood Mackenzie 所提供的樣本報告已轉寄公司內部頁岩氣小組參考。

2. 研習IHS資料庫

IHS 公司號稱是世界最大的顧問公司集團，在各產業均可提供服務，在上游探採除提供市場資訊、軟體與資料庫等外，亦可針對客戶個案需求，提供資源及

經濟評估、估價與細部查核、策略與市場分析等顧問服務；本公司過去已向該公司購買多項產品，包括能源公司購併交易與估價的 Herold、國家風險評估的 PEPS 以及經濟分析 Questor 等，對新礦區的及時掌握及評估，有相當正面的助益。

此次除研習 IHS 過去發佈有關頁岩油氣的資訊外，亦與 IHS CERA(Cambridge Energy Research Associates)人員討論美國頁岩油氣產業現況。IHS 認為頁岩油氣是 Resource Play，以開發大面積資源取代尋找蘊藏點，其特色是：

1. 統計(statistical)由生產經驗統計典型曲線(Type Curve)，
2. 取決於基礎建設(infrastructure)來降低材料、設備和能源投入運送成本，以及產品輸出成本，
3. 同時也是個像製造業一樣的製造流程(Manufacturing Process)，不斷的需要投入大量資金以維持產能，但其資本回收也較傳統油氣探勘來的快。

IHS 認為成功的公司有兩類，一是先尋找未開發盆地，租下許多土地並出售部份股權成為大公司，另一類是快速追隨，甚至購併其他公司，雖必須付出代價，但卻降低風險。

3. 參加國際上游能源交易(International Upstream Energy Transactions)課程(德州大學法學院)

德州大學法學院長期開辦各項課程，有關油氣方面則與美國石油協商協會(AIPN)合作，今年的國際上游能源交易課程有知名油公司 Anadarko 及律師事務所贊助(議程詳見附錄，第 10-12 頁)。

今年課程先以半天時間介紹國際能源(傳統及非傳統油氣)計畫從探勘、開發到生產的生命週期、傳統及非傳統油氣地質探勘概念的不同、地主國合約及利潤計算、合資合約架構等基本概念；第一天正式課程則有最近國際仲裁案例、非傳統油氣生產分享合約(PSC)、保險、領海疆界糾紛、外包服務合約風險轉嫁、美國反賄賂及資訊公開法等主題，第二天有管理政治風險、國際探油公司安全(如

海盜或綁架)、制定反賄賂規章、國際環境永續發展的 Equator Principle、非傳統油氣的聯合經營合約(JOA)等。

上課期間發生阿爾及利亞人質危機,也更加體會到文字化的合約可以對這些風險提供一定的保障,雖然目前本公司因為自任經營人的礦區不多,較少面臨海盜、綁架等危機,但隨著業務發展,對於這些經營上的管理制度也必須逐步建立。

由於非傳統油氣的蘊藏量、生產量、鑽井數目、探勘階段、完井方式皆與傳統油氣不同,除了地主國合約必須開始調整外,傳統聯合經營合約(JOA)也必須修改以賦予經營人更大的彈性,如 Sole Risk 的觀念在非傳統油氣就必須修改,另外 Unitization 方式也必須修正。

4. 參加石油工程師協會(SPE)免費課程

本次研習亦利用時間參與 SPE 傑出講座(Distinguished Lecturers)線上同步演講” Tight Oil Approaches and Technology Gaps-What Works, What Hasn't”。另外此一講座亦有許多相關演講檔案如” Estimating Frac Risk and Improving Frac Performance in Unconventional Gas and Oil Wells” 等,值得同仁上網研習。

5. 參加非傳統油氣儲集層特性分析 (Reservoir Characterization Unconventional)課程(Hanson Wade 公司)

Hanson Wade 是一家英國公司,專門辦理各產業之研討會,在非傳統油氣方面,除了非傳統油氣儲集層特性分析,還有蘊藏量評估課程。此次在休士頓舉辦的非傳統油氣儲集層特性分析,主題在強調評估團隊內不同領域如地化、地質、地物和開發、油層的成員如何溝通、整合資料、配合現場鑽井完井流程,加速提出儲集層特性分析,以降低開發成本及風險(議程詳見附錄,第 13-17 頁)。

在會前工作坊(Workshop)的基礎課程，從基本的岩心採集、實驗室試驗程序開始，介紹孔隙率等資料之取得，進而以俄亥俄州 Utica 為例從區域地質開始，再分析 TOC、成熟度、孔隙率及生產潛能指數。

研討會第一天先從說明非傳統油氣儲集層特性分析目前仍處於青少年期為開場，進而說明不同的非傳統 Play 在岩性、電測有那些共同特性，再介紹地化、岩力的評估及 Sparse Layer Inversion 的應用。

在第一天的的小組討論以降低地質風險為題，與會學員認為不同領域資料庫整合、知識管理及技術整合是評估時的挑戰。另外目前在非傳統油氣的做法就是不斷鑽井，雖然累積不少資料卻未好好分析，而地化、地質、地物評估人員卻也未能即時整合提出完整分析給鑽井完井人員。

研討會第二天先從如何整合岩石物理、岩石力學、震測、地化、區域板塊構造、地質統計及工程評估，進而介紹地球物理應用在非傳統油氣儲集層特性分析、增加採收率的油層模擬等。

在第二天的小組討論首先為地質師、地物師及工程師如何開始評估，結果地質師關心區域盆地地質及鑽井資料，工程師需要現場鑽井生產數據，以及類似油田資料對比，地物師在意斷層及甜蜜點(sweet spot)，會嘗試建立整合的模型。由於非傳統油氣需要更多溝通、整合與資訊分享，大家也討論如何在組織中促進溝通。會前工作坊則由現場實作簡單的震測剖面，但也可看出甜蜜點為開場，並以加拿大 Pouce Coupe Field 探討如何整合各種技術評估。

與會學員來自服務公司如 Halliburton,油公司如 TOTAL、Statoil、YPF、PTTEP 等，背景有地質師、地物師、工程師及業務代表。其中來自 PTTEP 的油層工程師表示 PTTEP 目前策略是先探勘國內陸上頁岩氣潛能，目前並沒有像前幾年耗費巨資向 Statoil 購買油砂資產的打算。

6. 拜訪本公司美國分公司及參加美國華人石油協會(CAPA)年會

此次拜訪美國分公司主要在瞭解其組織與工作內容，同仁當時說明有許多職缺尚待補足，且不足以未來擔任礦區經營人所需；另外其電腦等辦公室設備之採購也受到政府採購法約束。

還有國外油氣合作探探之鑽井工作從決定井位、租地以及鑽機鑽探均十分快速，如美國約 1 個月，加上頁岩氣等非傳統油氣鑽井數量龐大，本公司如擔任經營人(權益超過 50%)，則須依照中華民國採購法公開招標，不但違反行業慣例，引起合作夥伴不滿，更可能無法及時取得鑽機；目前正向工程會爭取免依採購法辦理中。對於人力不足及利用休士頓成爲油氣訓練中心等課題，目前正研擬以半年爲一期，採駐外工作同時在職訓練方式辦理。

另外美國華人石油協會(CAPA)舉行年會時，因美國分公司爲團體會員而一同前往，亦見到這幾年許多來台演講的 CAPA 會員；年會期間還舉辦有獎徵答，其中一題爲油頁岩(Oil Shale)的主要蘊藏區，一開始也有人誤以爲是頁岩油(Shale Oil, Tight Oil)。

7. 參加液裂學校(Frac School)課程 (PeroleumETC 公司)

Peroleum ETC (Emerging Technology Corporation) 總部設在德克薩斯州 College Station，鄰近德州農工(A&M)大學，專門辦理有關液裂之完井及蘊藏量評估課程。

此次於休士頓舉辦的液裂學校(Frac School)爲其液裂基礎課程，由教導基本岩石力學、電測及下降曲線分析 (Decline Curve Analysis)，以及液裂流體調配、支撐劑(Propant)及添加劑、液裂設計、裂隙預測及效果分析等實務，同時亦介紹相關法規等，十分紮實。講師除了有休士頓大學及加拿大卡爾加利(Calgary)大學教授外，其他則來自業界、顧問公司及律師事務所等 (課程項目

詳見附錄，第 18-19 頁) 。

學員分別來自服務公司、油氣公司等，許多有實地現場經驗，因此當講師播放環保團體(GasLand)拍攝影片，以家中自來水龍頭可以點火燃燒說明頁岩氣危險性時，引起哄堂大笑，大家都覺得與實際有所出入；另外對於引發地震及污染地下水等說法，課堂上亦播放馬拉松(Marathon)石油公司於 Youtube 網站說明水平井均位於數千公尺以下，且裂隙微小不致於引發地震及污染地下水。

整體來說，學員及講師都對美國頁岩油氣的現況及未來十分樂觀，但大家都認為從實際經驗中學習修正比建立完美的預測及事後估計理論重要，也就是先做了再說，以實際液裂加快學習曲線；例如液裂流體調配方式，有一種是不加入膠(gel)的作法，其實當初只是因應業主省錢的要求而開始，但試驗結果在某些地層效果反而不錯。

8. 參加非傳統天然氣經濟評估(Economics of Unconventional Gas)課程 (NEXT 公司)

NEXT 公司是 Schlumberger 專責訓練的子公司，在休士頓、卡爾加利(Calgary)等石油業發達的城市均設有訓練中心；此次課程即在休士頓 Schlumberger 大樓，緊鄰馬拉松(Marathon)石油公司，同時間有亦多項其他軟體課程開班。

本課程先由介紹非傳統天然氣的類型、緻密氣，煤層氣和頁岩氣之間的相似之處、進而介紹儲集層評估以及規劃，鑽井，完井等技術，以利學員就非傳統天然氣的生命週期和關鍵參數，建立決策模型進行經濟可行性分析。(課程項目詳見附錄，第 20 頁)

課程以小組討論和實例以 Schlumberger Merak Peep 練習，與 Wood Mackenzie 的 GEM 軟體相較，特點是在強調其決策樹及風險(機率)分析，其計算之投資報酬率已考量風險因素。同時講師亦提供不少美國能源資訊局 EIA

(Energy Information Administration) 及石油工程師協會(SPE)之報告及論文，有助於經濟評估時決定風險機率及氣價等因素。

本次課程講師亦以親身體驗，認為這次頁岩氣的蓬勃發展帶來能源危機以來，油氣探採最繁榮的景象，不但德州到處可見車隊，即便 North Dakota 等原本人煙較少的州亦受惠。

參、心得與建議

以目前頁岩油氣的蘊藏、開採成本及規模，加上未來經驗的累積又將降低成本及提高可採蘊藏量，未來仍將在北美非傳統能源的開發生產居於主流領導地位，此已成為此次研習接觸的業界人士的共識。而北美頁岩油氣的開發不但影響了油氣產業，其他替代能源成長也受到壓縮，甚至可能會讓中東在國際政治重要性下滑。

對全世界其他國家而言，如何成功學習並複製美國的產業是大家最亟於探討的；雖然有地表基礎建設、地質條件等不同，但重點應該在頁岩油氣的與傳統油氣的開發流程、獲利模式及鑽井完井數量完全不同，如何能快速又便宜的鑽井、完井才是挑戰。這次美國頁岩油氣革命是自由經濟體制造就的許多中小油氣公司在探勘觀念及液裂技術突破後結合鑽井完井公司所造就的，也是其他國家想複製模式的困難。

對中油公司而言，雖然對這項資源的發展一直密切關心，也具備了亞洲液化天然氣進口大國的優勢，但似乎尚未形成主動前往北美租地並自行擔任礦區經營人的策略。但如果在台灣未能及時自行開始小型試驗，在國外又因預算及採購法限制僅能參加非主導性的少數投資，為免流於只進行評估等紙上作業，錯失藉此次頁岩油氣革命成長的機會，建議應在投資參與後，加派人手前往美國合作公司參與合作礦區之實際工作，或前往鑽井完井公司實習，以加快本公司學習曲線。

肆、附錄

PRIMER: THE LAW, SCIENCE AND FINANCE OF INTERNATIONAL ENERGY PROJECTS

January 16, 2013 ▪ Four Seasons Hotel ▪ Houston, Texas

Earn up to 4.50 Hours of Credit

New in 2013: This unique half-day multidisciplinary Primer—designed for the legal practitioner who is new to or is thinking of entering the field, or for the experienced practitioner who desires a refresher—offers a high-level introduction to legal structures and agreements and the science and finance that underlie and drive upstream international energy projects.

WEDNESDAY AFTERNOON, JAN. 16, 2013

Optional Box Lunch \$30

See Registration form to pre-order box lunch. Pick up at registration to enjoy during the Primer.

12:30 p.m. Registration Opens

1:00 p.m.

Introduction and Overview of an International Energy Project Lifecycle

An introduction to program objectives and faculty with an overview of a typical international energy project lifecycle from development through decommissioning.

D. Marie Wagner, Anadarko Petroleum Corporation, The Woodlands, TX

1:15 p.m. .75 hr

Energy, Geology and Geophysics

An introduction for the lawyer to the science underlying the agreements we draft and negotiate in the course of developing and operating an international energy project. Petroleum, crude, natural gas, liquids and shale—what are they? Where are they located? How do we find them? When do we think they might run out? Also, a brief introduction to geophysical data acquisition and processing techniques and the leading role geophysical data plays in modern oil and gas exploration and operations.

Speaker TBA

PRIMER MCLE

This course has been approved for Minimum Continuing Legal Education credit by the State Bar of Texas Committee on MCLE in the amount of 4.50 hours. The University of Texas School of Law is a State Bar of California approved MCLE provider (#1944), and an Oklahoma Bar Association MCLE presumptively-approved provider (#169).

2:00 p.m. .50 hr

Petroleum Engineering

How do we physically explore for, develop and produce hydrocarbons? As a lawyer, we must have an understanding of the fundamentals of petroleum activities to accurately draft agreements and effectively provide counsel to energy industry clients. An introduction to different types of offshore and onshore drilling and production systems including FPSOs (floating, production, storage and off-loading vessels) and TLPs (tension-leg platforms). Typical liquefied natural gas (LNG) production facilities (liquefaction, regasification and pipelines) are discussed, with coverage of “high-level” drilling and production facilities and operation cost estimates.

Keith Troutman, Anadarko Petroleum Corporation, The Woodlands, TX

2:30 p.m. 1.00 hr

Host Country Instruments (HCIs)

A look at the legal regimes used globally for buying, selling, exploring, developing and producing hydrocarbons, including Concession or Royalty/Tax, Production Sharing, Risk Service Agreements and so-called “hybrids;” with a discussion of basic natural resource ownership/ title concepts and provisions of various HCIs, including key fiscal and non-fiscal terms.

D. Marie Wagner, Anadarko Petroleum Corporation, The Woodlands, TX

3:30 p.m. Break

3:45 p.m. .75 hr

International Energy Project Economics

Designed to provide a lawyer the basics of energy project economics “101” so that they can better work with their energy industry clients to develop legal options in various deal scenarios that are also “economic.” An examination of how we develop project economic models to calculate investor rates of return and other key economic indicators by using facility and operation cost estimates, revenue estimates and Host Country Instrument provisions. Also considered are the role of “risk analysis” in developing project models and the concept of leverage and how it can impact project economics.

Keith Troutman, Anadarko Petroleum Corporation, The Woodlands, TX

4:30 p.m. 1.25 hrs

Co-Venture Formation and Agreements

Leverage and risk allocation are two factors that frequently lead most international energy projects to be undertaken by more than one co-venture party. This session covers the most common arrangements by which parties acquire interests in energy projects including farmins, farmouts, participation agreements and swaps, with coverage of the fundamental provisions of typical co-venture Joint/Unit Operating Agreements (JOAs) using the AIPN model form as a basis.

D. Marie Wagner, Anadarko Petroleum Corporation, The Woodlands, TX

5:45 p.m. .25 hr

Summary and Q&A

Your questions get answered by the program faculty in this moderated Q&A session.

Moderator:
D. Marie Wagner, Anadarko Petroleum Corporation, The Woodlands, TX
Keith Troutman, Anadarko Petroleum Corporation, The Woodlands, TX
Speaker TBA

6:00 p.m. Adjourn

2013

INTERNATIONAL UPSTREAM ENERGY TRANSACTIONS

January 17–18, 2013 • Four Seasons Hotel • Houston, Texas

Earn up to 13.75 Hours of Credit Including 1.50 Hours of Ethics Credit
Specialization Credit Approved for Oil, Gas and Mineral Law

THURSDAY MORNING, JAN. 17, 2013

Presiding Officer:

Timothy R. Brown, Anadarko Petroleum Corporation, The Woodlands, TX

8:00 a.m. Registration Opens
Includes continental breakfast.

8:50 a.m. Welcoming Remarks

9:00 a.m. .50 hr

Frontier Energy Plays and Trends

Examine ongoing and future exploration areas of interest in the oil and gas industry, with a focus on the role of large and small independent exploration companies in frontier exploration.

Gerald Kepes, PFC Energy, Washington, DC

9:30 a.m. .75 hr

Recent Developments in International Energy Disputes

A review of recent arbitration awards concerning expropriation of upstream oil and gas investments, plus several significant arbitral decisions concerning emergency interim measures to protect petroleum contracts, investments and personnel.

R. Doak Bishop, King & Spalding, Houston, TX

10:15 a.m. Break

10:30 a.m. 1.00 hr

Host Country Instruments Developments

Discussion on recent developments in the evolution of host government petroleum exploration and development instruments throughout the world.

Owen L. Anderson, The University of Oklahoma College of Law, Norman, OK

11:30 a.m. .75 hr

Unconventional PSCs: Special Issues

Conventional Host Country Instruments (HCIs) do not necessarily fit well with unconventional resource plays. The most problematic areas in typical HCIs are highlighted and suggested solutions and negotiating techniques to deal with them are provided.

Steven P. Otilar, Akin Gump Strauss Hauer & Feld LLP, Houston, TX

12:15 p.m. Pick Up Lunch
Included in conference registration fee.

THURSDAY AFTERNOON

Presiding Officer:

Donald W. Wendland Jr., Noble Energy Inc., Houston, TX

LUNCHEON PRESENTATION

12:30 p.m. .75 hr

Dodd-Frank's New Disclosure Requirements for U.S. Energy Companies

An overview of the new extractive-industry disclosure requirements passed by Congress as part of the Dodd-Frank Act, including practical guidance on what the law will require of U.S. companies that have oil, natural gas or mineral leases with foreign governments, and why the law and the SEC's rules implementing it are being challenges by four trade associations in a lawsuit.

Thomas M. Johnson Jr., Gibson, Dunn & Crutcher LLP, Washington, DC

1:15 p.m. Break

1:30 p.m. .75 hr

International Boundary Disputes: Issues and Considerations

Legal and practical approaches to handling issues that arise relating to oil and gas transactions affected by boundary disputes or the absence of a legally certain boundary.

Derek C. Smith, Foley Hoag LLP, Washington, DC

2:15 p.m. 1.00 hr

Risk Allocation Service Agreements

Risk allocation issues arise frequently in drilling contracts and other service agreements and the pitfalls can be very significant. A look at common risk allocation problems and how to maximize indemnity and insurance protection.

William W. Pugh III, Liskow & Lewis, Houston, TX

3:15 p.m. .75 hr

Considerations When Entering a Country

The main issues an E&P company should consider when entering a country after capture of a new international exploration project, including a checklist of issues and dos and don'ts to consider when entering a country.

Timothy R. Brown, Anadarko Petroleum Corporation, The Woodlands, TX

4:00 p.m. Break

4:15 p.m. .75 hr including .25 hr ethics

Anti-Corruption Overview

Hear the latest developments and emerging trends in global anti-corruption enforcement. A special emphasis on the Foreign Corrupt Practices Act (FCPA), including such critical subjects as the increase in individual prosecutions, taking more FCPA cases to trial and potential amendment of the FCPA.

Jay G. Martin, Baker Hughes Incorporated, Houston, TX

5:00 p.m. .75 hr

Insurance Issues in International Upstream Transactions

Wortham Insurance and Risk Management, Houston, TX

5:45 p.m. Adjourn

NETWORKING RECEPTION

Sponsored by

The Oil, Gas and Energy Resources Law Section of the State Bar of Texas

5:45 p.m.

Networking opportunity to meet program faculty, clients and colleagues.

CONFERENCE MCLE

This course has been approved for Minimum Continuing Legal Education credit by the State Bar of Texas Committee on MCLE in the amount of 13.75 hours, of which 1.50 credit hours will apply to legal ethics/professional responsibility credit. The University of Texas School of Law is a State Bar of California approved MCLE provider (#1944), and an Oklahoma Bar Association MCLE presumptively-approved provider (#169).

FRIDAY MORNING, JAN. 18, 2013

Presiding Officer:

**John Bowman, King & Spalding,
Houston, TX**

7:45 a.m. Conference Room Opens
Includes continental breakfast.

8:30 a.m. 1.00 hr ethics

Ethics of Negotiation: Are There Any?

What are the boundaries, borders and gray areas for lawyers involved in negotiations? A fast-paced presentation with points to ponder, hypotheticals to consider and something to smile about.

Michael J. Golden, Boulette & Golden L.L.P.,
Austin, TX

9:30 a.m. 1.00 hr

Managing Political Risk

A brief commentary on the challenges of managing political risk in international upstream energy transactions followed by a panel discussion of risk mitigation methods and strategies to manage political risk in international upstream energy transactions.

Moderator:

Michael P. Irvin, Fulbright & Jaworski L.L.P.,
Houston, TX

Panelists:

David Asmus, Morgan, Lewis & Bockius LLP,
Houston, TX

John Bowman, King & Spalding, Houston, TX

10:30 a.m. Break

10:45 a.m. .75 hr

Equator Principles: Project Finance and Emerging Sustainability Requirements

The Equator Principles is a risk management framework for determining, assessing and managing environmental and social risk in project finance transactions—adopted so far by 77 financial institutions worldwide. These principles are increasingly setting a mandatory standard for sustainability issues in project finance around the globe. January 2013 is the anticipated launch of "EP III"—the first update of the Principles in several years. Learn the requirements of EP III, as well as emerging best practices for implementation by both financial institutions and the energy industry.

Gwendolyn Wilber Jaramillo, Foley Hoag LLP,
Boston, MA

11:30 a.m. Pick Up Lunch
Included in conference registration fee.

FRIDAY AFTERNOON

Presiding Officer:

**Michael P. Darden, Latham & Watkins LLP,
Houston, TX**

LUNCHEON PRESENTATION

11:45 a.m. .75 hr

Legal Issues Arising in Corporate Security

Selected issues an E&P company may encounter in the area of security when operating internationally, including piracy and OFAC regulations, U.K. Corporate Manslaughter Act and issues related to kidnap and ransom of employees.

James C. Arnold, Bell, Ryniker & Letourneau, P.C.,
Houston, TX
Daniel Johnson, ASI Global, LLC, Houston, TX

12:30 p.m. Break

12:45 p.m. .75 hr including .25 hr ethics

Elements of Drafting a Good Anti-Corruption Program

Any compliance program needs to be both legally sufficient and practical. A good compliance program is supported by both the business and the legal or compliance organization.

Martin J. Weinstein, Willkie Farr & Gallagher LLP,
Washington, DC

1:30 p.m. .75 hr

**Areas of Mutual Interest (AMIs):
What, When and How**

AMIs show up as clauses in a variety of international upstream agreements and as stand-alone agreements. Notwithstanding their frequent use, AMIs are often misunderstood. Clear guidance on the key differences between AMIs and buy-back rights and when we might choose to use a reciprocal versus one-way or an up-front versus after-the-fact AMI. In addition, learn best practices for the implementation and drafting of clauses.

D. Marie Wagner, Anadarko Petroleum Corporation,
The Woodlands, TX

2:15 p.m. 1.00 hr

Joint Operating Agreements (JOAs) for International Unconventional Projects: (How) Have Horizontal Drilling and Fracturing Changed the Game?

Is unconventional resource exploration and production a joint operations "game changer?" If so, how should joint interest parties handle this in an operation agreement? There are few institutionalized form agreements that offer unconventional-specific provisions. Explore whether and how commonly-used JOAs are conceptually deficient and discover points for consideration when negotiating a JOA governing an international unconventional project.

David H. Sweeney, Van Dyke Energy Company,
Houston, TX

3:15 p.m. Adjourn

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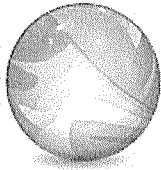
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RESERVOIR CHARACTERIZATION UNCONVENTIONALS

Tackle heterogeneous lithology & acquire better data
to accelerate assessment

21-24 January 2013
Houston, Texas

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Accelerating the characterization process in unconventional reservoirs

There is a lack of clarity around which new approaches are needed to find commonalities which can be applied across plays; how to accelerate the assessment of unconventional reservoirs and how to make strong play evaluations based on small data sets.

But you know this.

What you need are applicable and practical case studies detailing how to avoid the risk of incorrect geo-chemical analysis and inaccurate data correlation throughout the characterization process. You need the techniques and methodologies to ensure you avoid the critical financial implications of poor reservoir characterization.

Reservoir Characterization for Unconventionals will provide you with the opportunity to tackle these challenges alongside your industry peers. Our speakers are at the forefront of data analysis, lithology characterization and reservoir navigation. Through 4 days of technical panels and networking they will share their expertise with you.

This year's agenda delves into the granular technicalities of reservoir characterization as well as the strategic challenge of multi-disciplinary collaboration. **Cut through the hype of unconventionals and you will:**

- Uncover the commonalities that exist between plays: Shell show you how to capitalize on this knowledge
- Build a business case for investment in unconventional reservoir characterization to reduce development risk later on
- Remove the guesswork: Translate geochemical analysis into real impact characterization
- Examine geological uncertainties to build a petro-physical model that is applicable in multiple plays
- Accurately predicting reservoir performance: Correlating data correctly with production to avoid current discrepancies
- Improve communication between geoscience, reservoir engineering and completions: Working across the disciplines to understand and mitigate the frustrations of each department

Who should attend?

Geoscientists
Geologists
Geophysicists
Geochemists
Petro-physicists
Reservoir Engineers
Heads of Completions
Heads of Drilling

Pre-Conference Workshops

21st January 2013

9.00am – 4.00pm

Workshop A: The Fundamentals of Unconventional Reservoir Characterization

Better reservoir knowledge and increasingly sophisticated technologies make the production of unconventional resources economically viable and more efficient. This efficiency is bringing shale reservoirs, tight gas and oil, and coalbed methane into the reach of more companies around the world. However, a poor characterization process at the start could lead to huge financial implications later on. It is imperative that the fundamentals of reservoir characterization are understood throughout the value chain.

Workshop Breakdown:

9am – 10am: Introduction and brainstorming

10am: Morning Refreshment Break

10.30am – 12pm: Presentation by John Castagna (Professor of Geophysics, University of Houston in conjunction with Lumina)

12pm – 1pm: Lunch

1pm – 4pm: Presentation and working group facilitated by Don Westacott, Principle Advisor, Global Unconventional Reservoirs, Halliburton

Workshop Leaders:

John Castagna, Professor of Geophysics, University of Houston
Don Westacott, Principle Advisor, Global Unconventional Reservoirs, Halliburton

Conference Day 1

8.00 Registration

8.50 Chair's Opening Remarks

9.00 Accelerating Your Unconventional Characterization Process By Overcoming Technical Challenges

Wafik Beydoun, President & Chief Executive Officer, TOTAL E&P Research & Technology USA

9.40 Increasing Your Awareness Of What Commonalities Do Exist Between Plays And How To Capitalize On This Knowledge

Roger Slatt, Gungoll Family Chair, Professor of Petroleum Geology and Geophysics Director, Institute of Reservoir Characterization, University of Oklahoma

10.20 Morning Refreshment Break And Speed Networking

Tackling Heterogeneous Lithology

11.20 Geochemical Evaluation Of Reservoir Fluids And Reservoir Properties

Dan Jarvie, President, Worldwide Geochemistry

12.00 Analyzing The Importance Of Rock Physics In Reservoir Characterization For Unconventionals

Dr Franklin Ruiz, Reservoir Characterization Specialist, Repsol

12.40 Lunch

1.40 Overcoming Geological Uncertainties: Working Group

2.40 Afternoon Refreshment Break

3.10 Application Of Sparse Layer Inversion In Unconventional Reservoirs

Miguel Silva, VP, Business Development, Lumina Geophysical

3.50 Accurately Predicting Reservoir Performance: Correlating Data Correctly With Production To Avoid Current Discrepancies

Dr Franklin Ruiz, Reservoir Characterization Specialist, Repsol
Miguel Silva, VP, Business Development, Lumina Geophysical
Dan Jarvie, President, Worldwide Geochemistry

4.30 End of Day One

Conference Day 2

Conference Day 2

8.30 Registration

9.15 Chairman's Opening Remarks

9.20 Focus On The Application Of Elastic Parameters To Reservoir Characterization
Peter Bartok, Petroleum Exploration Consultant, Bartok Incorporated

10.00 Utilizing Geophysical Concepts In Unconventionals Resource Characterization
And Evaluation
Eric von Lunen, Senior Geophysical Advisor and Team Lead, Canadian Shale Gas
Optimization Group, Nexen

11.00 Morning Refreshment Break

11.30 Multi-disciplinary Round-Tables Integrating Geoscience, Petrology And
Reservoir Engineering: Is This Working In Practice And How Could
Communication Be Improved?

12.30 Lunch

1.30 The Value of Unconventional Reservoir Characterization
Thomas L. Davis, Professor of Geophysics, Director of the Reservoir
Characterization Project, Colorado School of Mines

2.10 Subsurface Characterization: Analyze What Is Happening Under The
Subsurface In Order To Optimize Recovery
Mark McClure, Assistant Professor, University of Texas at Austin

3.00 Chairman's Closing Remarks And Close of Conference

Post-Conference Workshops

24th January 2013

9.00am – 4.00pm

Workshop B: Seismic Reservoir Characterization Unconventionals

There are huge challenges associated with the real and perceived lack of commonalities between unconventional plays across North America. However, there are commonalities to be found. Finding these will ensure more efficient and quicker characterization as well as the opportunity to avoid repetition of work from one play to another.

Attend this workshop benefit from:

- Comparative analysis of opportunities, data and technologies being used across today's largest plays
- An insight into the well log and core data collected at each play • An increased knowledge of North American shale plays including production mechanisms and knowledge of local reservoir characteristics
- Working together to keep development costs under control and optimize production over the life of the reservoir
- Refining techniques to achieve best practice and that can evolve to meet specific, local challenges

Who should attend this workshop?

Attend this workshop if you are involved in any of the North American shale plays including The Bakken, Woodford, Eagleford, Marcellus, Barnett or Hainsville and responsible for the geology or reservoir engineering for these plays.

Workshop Leaders:

Thomas L. Davis, Professor of Geophysics, Director of the Reservoir Characterization Project, **Colorado School of Mines**



Thomas L. Davis is currently a professor of geophysics at the Colorado School of Mines, where he teaches courses in seismic interpretation and integrated exploration and development. He is founder and codirector of the Reservoir Characterization Project, an industry-funded consortium, applying multicomponent seismic to improve hydrocarbon recovery. In addition to his teaching and research activities, he consults worldwide in the field of seismic interpretation. He holds a PhD in geophysical engineering from the Colorado School of Mines, an MS in geophysics from the University of Calgary, and a BE in geological engineering, geophysics option, from the University of Saskatchewan. Memberships include SEG, AAPG and a host of other geoscience and engineering societies.

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Frac School

You are invited you to attend our state-of-the-art, week-long course on hydraulic fracturing. Best known for a balanced presentation of the theoretical and the practical, Frac School provides a unique learning experience. Come and learn from the finest the industry has to offer!

The class is an introduction to hydraulic fracturing. You should have an engineering or scientific background . This course is ideal for reservoir, production and operations engineers serving on multidisciplinary asset teams. Frac School is the course of choice for both the engineer with less than 5 years experience in fracturing or those who just need a refresher.

Theory provided by Distinguished University Faculty: Dr. Peter Valko (Texas A&M University), Dr. Shari Dunn-Norman (University of Missouri-Rolla) and Dr. Jerry Jensen (University of Calgary). Practical provided by Quality Control and Design Experts: John Ely (Ely & Associates of Texas) and Steve Wolhart (Pinnacle). Special guest speaker, Nick Deutsch (Shook, Hardy and Bacon) will cover Regulatory Issues and Litigation Trends. We offer a Unique Bring-Your-Own-Well Session.

Frac School by Petroleum(etc) is the leading course in hydraulic fracturing. Our week-long course offers attendees 40 PDH's / 4 CEU's.

Cost: \$3,200 for Early Registration, \$3,500 after Early Registration deadline.

If you have any questions please contact Petroleum(etc).

Upcoming Courses:

Houston, TX - January 28 - February 1, 2013

Dallas, TX - April 8-12, 2013

Topics Covered:

- Latest in water fracturing techniques
Fracturing methods
Fundamentals in rock mechanics and fracture design

Registration

Sign up for Email Updates

Sponsors



Houston November 2012



Houston September 2012

FRAC SCHOOL

Hilton Garden Inn
Houston, Texas
January 28 - February 1, 2013

Instructors:



Jerry Jensen



John Ely



Mark Mulkern



Steve Wolhart



John Lee



Nick Deutsch

Monday - January 28, 2013

- 8:00 Welcome and Introduction (*PetroleumETC*)
- 8:10 Intro to Fracing (*Mulkern*)
- 10:00 Overview of Hydraulic Fracturing (*Mulkern*)
- 12:00 Lunch
- 1:00 Well Design/Completion (*Mulkern*)
- 2:30 Fracturing Procedure (*Mulkern*)
- 4:00 Regulatory issues & Litigation Trends (*Deutsch*)
- 5:00 Adjourn to Reception

Sponsored By:



Tuesday - January 29, 2013

- 8:00 Rock Mechanics for Hydraulic Fracturing (*Jensen*)
- 9:00 Log Analysis for Hydraulic Fracturing (*Jensen*)
- 10:30 Class Problem No. 2: Rock Properties (*Jensen*)
- 12:00 Lunch
- 1:00 Advanced Fracturing Diagnostics (*Wolhart*)
- 5:00 Adjourn

Thursday - January 31, 2013

- 8:00 Propping Agents (*Ely*)
- 10:00 Fracturing Fluids (*Ely*)
- 12:00 Lunch
- 1:00 Rigup on Location (*Ely*)
- 3:00 Quality Control (*Ely*)
- 5:00 Adjourn

Wednesday - January 30, 2013

- 8:00 Fractured Well Productivity (*Lee*)
- 9:00 Shale Well Recovery (*Lee*)
- 10:30 Tight Gas Reserves (*Lee*)
- 12:00 Lunch
- 1:00 Arps Decline Model (*Lee*)
- 2:30 Advanced Decline Curve Analysis (*Lee*)
- 4:00 Class Problems 1 & 2
- 5:00 Adjourn

Friday - February 1, 2013

- 8:00 Frac School Evaluation
- 8:10 Forced Closure (*Ely*)
- 9:00 Mini-Frac Interpretation and Design (*Ely*)
- 10:30 Water Fracturing/Tortuosity (*Ely*)
- 12:00 Lunch
- 1:00 Safety Issues (*Ely*)
- 2:00 Discussion: "Bring Your Own Well" (*Ely*)
- 4:30 Summary of Course Objectives (*Ely*)
- 5:00 Adjourn

All times subject to change.



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Economics of Unconventional Gas



Houston, Texas
February 04 - 07, 2013

Discipline: Management and Economics , Unconventional Resources & Geomechanics

Level: Skill

Duration: 4

Price: USD 3,200.00



What to Do in Houston

Accommodations

Course participants will learn about the types of unconventional resources and the similarities between tight gas, coalbed methane and shale gas. The lifecycle and key parameters of unconventional plays will be discussed in order for participants to understand how to model the economic viability of potential development. This modelling process utilizes the latest industry knowledge on unconventional resource development including sweet spot identification, well planning, drilling, and completions to maximize potential for profitability.

Print Email

The course uses a combination of instruction, group discussions and practical examples and exercises to ensure participants absorb both the theory and the practical application of the topics.

The course will provide:

- An overview of worldwide unconventional activity
- Discussion of best practices and key uncertainties
- A proven process for modelling the economics of unconventional resource development including decision mapping and decision trees

Related Courses

Shale Plays Evaluation - F
Production Sweet Spots

Geomechanics Application
Shale Gas

Risk, Uncertainty and Dec
E&P Projects

Upcoming 3 Course

United States, Houston,
February 04 - 07, 2013

Colombia, Bogota
March 04 - 07, 2013

Canada, Calgary
March 11 - 14, 2013

- Audience
- Prerequisites
- Instructors
- Agenda

- Welcome and Registration
- Lifecycle of unconventional resources
- Overview of worldwide unconventional resources
- Case studies on North America development
- Current practices, in evaluation and development
- Key technical and business parameters
- Best practices for successful development
- Modelling unconventional development
- Build decision map and decision model
- Build project schedule and economic cases
- Understand major impacts on project viability
- Perform decision analyses
- Understand breakeven price, hurdle rate and other metrics
- Consider options for development and project modelling
- Revise model based on new project schedules and other parameters
- Course Review and Wrap Up