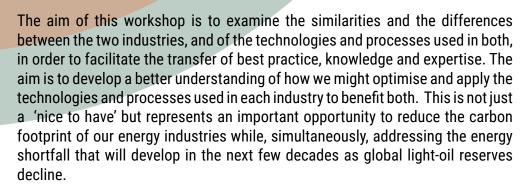GEOTHERMAL
CROSS OVER
TECHNOLOGY
WORKSHOP

COLLINWOOD COLLEGE
DURHAM UNIVERSITY
DURHAM, UK
25-26 APRIL 2017

AAPG
Europe Region

WELCOME

The petroleum and geothermal industries both produce 'high-energy' fluids from the subsurface. These fluids provide chemical and kinetic energy in the case of the petroleum industry and thermal and kinetic energy in the case of the geothermal industry. There is huge overlap between the geology of petroleum and geothermal systems and between the technologies and practices applied by the two industries. There is, however, little collaboration or exchange of information, technology and expertise between them. Even the fundamental measures of fluid production rate used by the two industries are different: barrels/day or standard cubic feet/day for the petroleum industry and litres/second for the geothermal industry. Such simple things often form unnecessary barriers to the transfer of knowledge and expertise.

The aim of this workshop is to examine the similarities and the differences between the two industries, and of the technologies and processes used in both, in order to facilitate the transfer of best practice, knowledge and expertise. The aim is to develop a better understanding of how we might optimise and apply the technologies and processes used in each industry to benefit both. This is not just a 'nice to have' but represents an important opportunity to reduce the carbon footprint of our energy industries while, simultaneously, addressing the energy shortfall that will develop in the next few decades as global light-oil reserves decline.

Jon Gluyas and Jonathan Craig
Co-Chairs of the Geothermal Cross Over Technologies Workshop

J. Craig
ENI

J. Gluyas
Durham University
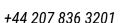
Jeremy Richardson
Director - AAPG Europe
Email: jrichardson@aapg.org

Marta Diaz
Event Organiser- AAPG Europe
Email: mdiaz@aapg.org

Where to find us:
21-22 New Row, WC2N 4LE, London, UK   *+44 207 836 3201*   *aapg.org/global/europe*

25 APRIL 2017

9:00 Workshop introduction
Jonathan Craig, ENI

Session 1 **Petroleum-Geothermal Combined Systems**

9:20 **Hydrocarbon-Geothermal Exploration 'Cross-over' Technologies**
Raymond Levey, EGI

10:00 Using geothermal gradient anomalies of hydrocarbon entrapment in rejuvenating mature basins and identifying missed and bypassed traps
Ibrahim Muhammad, Target Exploration Consultants

10:30 From Hydrocarbons to Heat: Mutual benefits of co-production for hydrocarbon and geothermal industries
Charlotte Adams, Durham University

11:00 Coffee

11:15 Feasibility Study for mini power and heat production from abandoned oil and geothermal wells
Luca Guglielmetti, University of Geneva

11:45 Deep Karst and Geothermal: Redefining the Oil Industry
Nadia Narayan, Durham University

12:15 Lunch

Session 2
Evaluating the prospectivity of fluid systems: lessons from the petroleum and geothermal industries

13:30 **The role of Tertiary strike-slip faulting in sub-surface fluid flow in Ireland: potential implications for UK and Irish geothermal and petroleum systems.**
John Walsh, University College Dublin

14:10 The influence of basement structure and drainage networks on prospectivity in the East African Rift System
Rowan Edwards, NPA Satellite Mapping

14:40 Importance of Outcrop Analogues for Predicting Fluid Flow in Fractured Rock: Lessons from Hydrocarbon Exploration & Production
Richard Jones, Geospatial Research

15:10 Coffee

15:25 Quartz and Fe-dolomite cements record shifts in formation-water chemistry and hydrocarbon migration in Devonian shoreface sandstones, Ghadamis basin, Libya
Howri Mansuberg, Soran University

15:55 Regional exploration for geothermal resources production and heat storage in Western Switzerland.
Andrea Moscariello, Dept. of Earth Sciences, University of Geneva

16:25 A Playfairway Analysis of the Geothermal Potential of Ireland
Nick O'Neill, SLR Consulting

16:55 The DGSW concept for deep geothermal heat extraction: critical appraisal under UK conditions
Rob Westaway, Glasgow University

17:25 Day 1 summary and wrap up
Jon Gluyas, Durham University

17:30 End day 1

PROGRAMME

26 APRIL 2017
Session 3 **Play Systems & Modelling and measuring fluid flow in geothermal and petroleum systems**

9:00 **Novel play approach for ultra deep geothermal**
Thijs Boxem, TNO

9:40 Oil exploration and the Geothermal Dual Play in the West Netherlands
Eveline De Vaal, NAM

10:10 Optimization of Geothermal Well Placement under Geological Uncertainty – a tech transfer example from oil and gas
Daniel Arnold, Heriot Watt University - Institute of Petroleum engineering

10:40	Coffee

10:55 Numerical Simulation and Modelling Studies of CO2 Storage in a Depleted Oil Reservoir using Eclipse CO2SOL Option. (A Case Study of reservoir X, Prinos Field Greece).
Fait Oko-Jaja, Coventry University

11:25 New method for monitoring steam injection for EOR & finding sources of geothermal heat
Gordon Stove, Adrok

11:55 Geothermal potential of aging oilfields, UK East Midlands
Cat Hirst, COWI Ltd

12:25	Lunch

Session 4 **Enhanced geothermal systems and petroleum reservoir fracking**

13:30 **Microseismic monitoring of geothermal systems**
Gillian Foulger, Durham Univesity

14:10 Near-Well Fracturing Stimulations by Thermal Methods
Gary Couples, Heriot Watt

14:40 Effects of anisotropy in layered shale and limestone sequences on fracture propagation
Nathanial Forbes Inskip, Royal Holloway

15:20	Coffee

15:35 Adding Value to Deep Enhanced Geothermal Projects
Susan Petty, Hotrockenergy Research Organization

16:05 Geomechanical characterization of the Buntsandstein for a quantification of the geothermal energy potential in the West Netherlands Basin
Thomas Hinkofer, Delft University

16:20 Hydraulic fracturing methods and gas shales in the UK
Fivos Spathopoulos, Imperial College

16:50 Facilitated discussion and workshop wrap up
Dr Susie Daniels, Geospatial Research Limited

17:15 End of the workshop

Abstract

Title:

New method for monitoring steam injection for EOR & findings sources of geothermal heat

Authors: Paul Harness, David Barnes, (CNAEP,AAPG,SEG) Colin Stove, Gordon Stove* (Adrok Ltd.)

A database of over 10,000 wells with open hole logs, of which over 600 wells are dedicated surveillance wells with whole core, time lapse Carbon/Oxygen, Neutron, and Temperature data is being used for evaluating a deep penetrating radar system. The database is from the thermally operated Kern River Super Giant oilfield in Kern County California, USA. The technology being tested is ADROK, LTD's deep penetrating radar system. The Kern River field and dataset thru-out its history has provided a robust environment for training and blind testing of various technologies (time lapse Carbon Oxygen, EM, cross well tomography to name a few).

Kern River is on its way to recovering 90% of its OOIP and surveillance is playing a significant role in achieving such a world class milestone. Future growth for develop of the field and surveillance technologies still exist as well. To that end, we are looking at the possibly of surface only acquisition for our surveillance needs.

Significant time and effort was spent on di-electric logging in the 70's – 80's by operators and service companies alike. ADROK's Dielectric Resonance (ADR) claims to interact with the subsurface in the same region of the electro-magnetic spectrum as di-electric logging, but from surface measurement. First Principles predicts a rise in dielectric constant as temperature rises. An experiment was conducted in 2014 were a group of surveys were conducted around Kern Rivers surveillance wells. The surveys were divided up into two groups, one for training (full access to database) and one for blind testing (no access to database). Surprisingly, the blind tests could detect the presence or absence of a single zone steamchest by a rise in dielectric constant at the correct spacetime.

Building on the positive outcome of the first test, current efforts are focused on laboratory studies of EM wave interacts with the varying sedimentary lithology and pore saturation states. In addition theoretical work is being conducted to understand wave transmission thru a classically defined conductive/lossy media. The body of the presentation will describe in greater detail the technology, field experiment and results to date.

In addition, results from onshore geothermal heat exploration projects will be discussed whereby Adrok's ADR technology found sources of geothermal heat at a number of sites in New Zealand, Cornwall and Northeast England.

AAPG Europe Office
21-22 New Row
London WC2N 4LE