FESAus Monthly Technical Meeting

"Petrophysical Characterisation at the extremes and across three continents: contrasting examples from Utica, Marcellus, Longmaxi and Roseneath-Murteree resource shales

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Abstract:
We investigated geological, petrophysical, rock physics and engineering properties of resource shales using well data and core samples from three continents. The North American Utica-Point Pleasant example, spanning carbonates, marls and shales, came from the base of the oil window in this play. Extremely high resistivity invalidated the Passey method for total organic carbon (TOC) calculation, while elevated uranium marked the original source beds rather than the maximum of organic matter found in underlying carbonates where pyrobitumen is abundant. A 1 GHz dielectric log enabled us to develop a new crossplot where matrix, water and organic matter effects could be differentiated. The North American Marcellus shale example represented the other extreme of thermal maturity, where vitrinite reflectance exceeds 4 % R_o and the organic matter is partly transformed to highly conductive proto-graphite, again complicating petrophysical interpretations. The Chinese Longmaxi shale has classical "hot shale" characteristics where U content from logs or core scanning gives a good estimate of TOC. In both cases, siliceous matrix may be advantageous in terms of rock brittleness but may lock up gas in inaccessible pores. The Roseneath and Murteree Shales of the Australian Cooper Basin represent a hybrid shale/tight gas resource play where Gas in Place (GIP) is dominated by free gas, largely sourced from nearby coals, in inter-mineral pore space. Dielectric responses of lab samples show a linear relationship between water content and permittivity, however no downhole dielectric logs are yet available to evaluate this approach to identify sweet spots. Aside from using advanced petrophysical and microstructural methods we gained insights from standard log correlations. We found that neutron porosity alone could entirely predict the organic-free (background) resistivity log response in the Murteree shale via the non-linear equation: $1/R\_t = C[\![* NPHI]\!]\hat{}d$. We propose that hydrated cation conductivity determines the pre-factor *C*, while pore geometry/topology determine the value of exponent *d*. The application of such nonlinear relationships to modern machine learning methods warrants further investigation.

About the Presenter:
Ben Clennell is a research group leader at CSIRO currently looking after offshore exploration topics, but also having experience in unconventional oil and gas and most recently also with CO2 storage. Ben is a geologist by training who has spent many years investigating many subsurface phenomena involving sediments, rocks and fluids and how they deform and flow, including field, marine and laboratory investigations. A common factor in this research is a multiphysics approach combining expertise of a diverse science team to resolve hard to solve geological problems. He has published and presented around 200 papers on these topics in journals and conferences working with scientists across at least 6 continents but so far not with any Antarcticans.

DATE: **Tuesday 8th August 2017**, 12:00 – 1:30 PM **VENUE:** Hotel IBIS- 334 Murray Street, Perth

COST: Members $30.00; Non Members $40.00; Students/Retirees $10.00

Online registration at www.fesaus.org

Note: limited seats for unregistered attendees may be available: $50.00 cash door charge