Monday, March 23, 2020

HGS North American Dinner Meeting

Live Oak Room • Norris Conference Center • 816 Town and Country Blvd #210
Social Hour 5:30–6:30 p.m.
Dinner 6:30–7:30 p.m.

Cost: $40 Preregistered members; $45 non-members/walk-ups

To guarantee a seat, pre-register on the HGS website & pre-pay by credit card.
Pre-registration without payment will not be accepted.
Walk-ups may pay at the door if extra seats are available.

If you are an Active or Associate Member who is unemployed and would like to attend this meeting, please call the HGS office for a discounted registration cost. We are also seeking members to volunteer at the registration desk for this and other events.

Andrew Pepper
This is Petroleum Systems LLC
Amalia Doebbert
This is Petroleum Systems LLC, Presently: Total
Jean-Marie Laigle and Laure Laigle
Belmont Technology Inc.

Greater Permian Basin Petroleum Systems – What are We Learning in the Transition from Conventional to Unconventional?

The early "conventional" exploration of the Permian Basin pre-dated many modern concepts in applied geoscience. Its subsequent development coincided with a growing understanding of the basic chemistry of oils, gases and of reservoir fluids in general (AAPG Volumes by Ley, 1935; Galley, 1965 and Beebe, 1968). Pioneering work on carbon isotopes of oils (Kvenvolden, 1967) and gases (Stahl, 1975) followed. However, during the 1980's period when modern organic geochemistry expanded dramatically, accompanied by the advent of basin simulation the basin was already in a mature stage of production and saw relatively little application of these new ideas – integrated into what we now call Petroleum Systems Analysis. It seemed enough to know that the basin had many source rocks ranging in age from Ordovician to Middle Permian, leading to the assumption that every effective trap would be charged with petroleum one way or the other.

During the last decade, the industry's return to the basin for exploration and development of unconventional reservoirs has been accompanied by an illumination of the Petroleum Systems, revealing how the basin fluid system actually works. A range of approaches have been applied: from regional burial and exhumation history and its impact on pressure and maturity/fluid distribution; to analysis at the pore scale of saturation patterns, relative permeability and of mudrock reservoirs. Recent geochemical studies include diamondoid compounds in high maturity samples where oil-to-gas cracking has destroyed many or all classical biomarker compounds.

Returning with this modern toolkit and with the aim of understanding the organic-rich mudrocks not just as source rocks but also as reservoirs, a number of traditional misapprehensions can be redressed:

1. The appreciation of a Cretaceous-Tertiary burial and exhumation history results in an appreciation of the high thermal stress levels attained in the past, before erosion and cooling, leading to a prediction from first principles of GOR and fluid phase properties such as viscosity in the organic-rich source rock reservoirs.

2. The more recent burial and shorter time for dissipation of overpressures explains the extremely high overpressures encountered in the mudstone-rich basinal facies – a key to the prolific production rates obtained from the basin center mudrock reservoirs.

3. When dips are relatively flat, lateral changes in heat flow induced by changing crust composition can generate local maturity "sweet spots" that do not simply follow burial depth.

4. Re-assessment of oil-oil and oil-source correlations shows that the platform carbonate conventional reservoir fluids are not low mature equivalents of the lighter oil in the basins, as traditionally thought, but often belong to a completely different petroleum system driven by a high sulfur (Organofacies A) organic matter apron on the edges of the Midland and Delaware Basins. Low sulfur, more clay-rich source rocks (Organofacies B and intermediate A/B) drive mainly the basinal unconventional petroleum systems.

5. Mudstone reservoirs vary in saturation, not as a function of height, but as a function of the layering of "reservoir" and "seal" lithologies inside the source beds. The source beds are not closed systems, and to differing degrees have charged conventional reservoir systems with early-expelled fluid while retaining latest-expelled fluids within the source bed itself.

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6. New saturation and relative permeability approaches explain how mudstone reservoirs, notably the Wolfcamp, can at high water saturation produce significant petroleum and significant amounts of water.

The talk is based on a major compilation of public data sources and uses standard as well as AI-assisted basin modeling approaches to demonstrate basin burial and thermal history and the resulting fluid distribution. ■

Biographical Sketch

This year **Andy Pepper** will celebrate 39 years' experience as a geologist and petroleum systems analyst: at BP as leader of the Petroleum Systems Network; at Hess as Chief Geologist and then Director of New Ventures; and at BHP as VP Geoscience and VP Unconventional Exploration. He founded This is Petroleum Systems LLC in 2015 as a vehicle to collaborate and innovate in Petroleum Systems concepts, modeling and training.

Nomination for HGS Teacher of the Year Award is Open

The HGS Teacher of the Year has been established to honor individuals whose extraordinary efforts or unique contributions are in earth science education. The selected Teacher will be given a $500 cash award along with a plaque presented at a HGS Event. The HGS Teacher of the Year will be encouraged to apply for the GCAGS and AAPG Teacher of the Year Programs which offer greater cash bonuses ($1500 and $5000 respectfully). If you know of a Teacher who might be interested have them contact the HGS Awards Chairman at mike.deming.HGS@gmail.com for requirements and procedures.