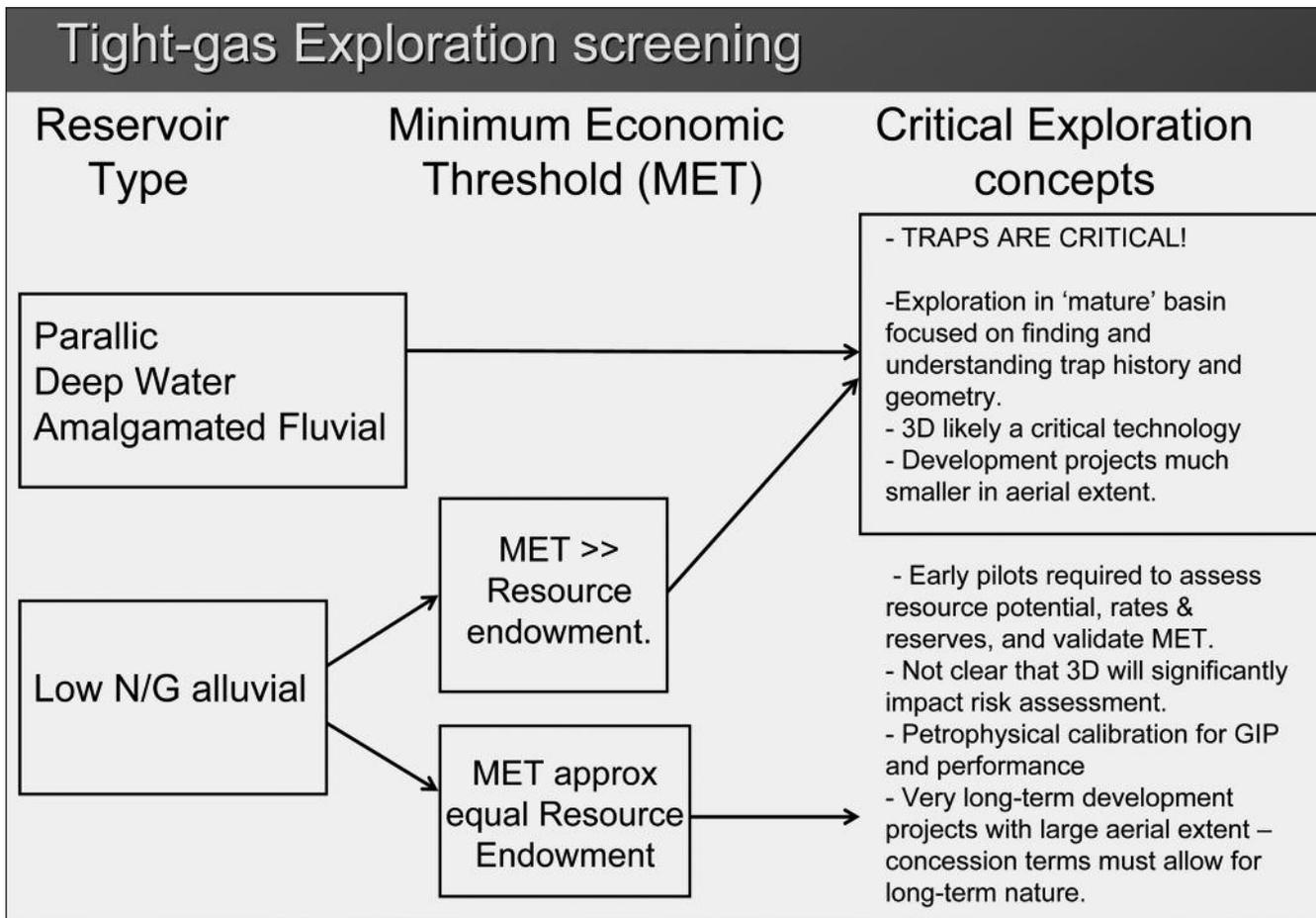


Appropriate Exploration Strategies in Tight-gas Sandstone Plays.

The role of unconventional resources in the nation's energy portfolio has been steadily increasing since the early 1900's! Once the ugly duckling desperately seeking recognition, unconventional resources now make up more than 45% of total domestic production and that proportion is expected to grow. Within the suite of unconventional plays, tight-gas sandstones now account for between 35% and 40% of total unconventional production, and exploration firms both large and small seek unconventional targets as part of their portfolio. For years, discussion of unconventional gas plays was restricted to sedimentary basins in North America, but as worldwide demand

for natural gas increases, petroleum provinces throughout the world are being reexamined for their tight-gas potential. These international ventures reference North American analogs where subsurface and performance datasets are voluminous. To many, a discussion of tight-gas sandstone plays conjures an image of limited exploration risk and widespread drilling programs, where field boundaries are diffuse and where the predominant risk-element is assigned to the cost or efficacy of extraction technologies (drilling, completion, and transportation). To be sure, there are tight-gas plays that approach these characteristics, however, there

HGS General Luncheon continued on page 24



are equally large and profitable tight-gas plays that carry all the subsurface risks commonly associated with more conventional petroleum systems in which fields are more aerially restricted and where exploration must be more surgical. Both types of tight-gas opportunities are capable of delivering large numbers of very long-lived producing wells providing an almost annuity-like financial profile. Clearly, appropriate exploration strategies must distinguish between these two very different types of investment categories if sound decisions are to be consistently made.

Examination of tight-gas plays in the Rocky Mtn. region of the United States suggests that two broad play types can be identified. In basins with favorable petroleum-system elements, those plays involving more laterally persistent deep-water, paralic, or high net/gross alluvial reservoirs must have a strong focus on trap identification, trap timing and evolution. In these settings, exploration for tight-gas opportunities is similar to more traditional exploration with the added complications induced by fluid flow in very low permeability reservoirs. In low net/gross alluvial reservoirs, however, where traps can also occur at the scale of individual sandbodies, the initial analysis must first compare 'minimum economic thresholds' (MET) and resource endowments associated with the play opportunity. In cases where the MET is much greater than the resource endowment, the need (and hence search) for traps at a much larger scale than the individual sandbody is of paramount importance. In other low net/gross alluvial reservoir systems where the MET and resource endowment are more similar, traps at a scale larger than individual sandbodies may enable optimization, however, identification of these traps may not be required for economic success. In these cases early exploration efforts should be on pilot projects designed to validate that the MET and resource endowment are indeed similar. In low net/gross alluvial plays where there is considerable disparity between the MET and resource endowment, early exploration efforts must be more traditional and have a strong focus on trap identification at a scale much larger than individual sandbodies.

New venture exploration for tight-gas plays is only likely to occur in mature petroleum provinces where the efficacy of the petroleum system has already been established: It is highly unlikely that new venture exploration for tight-gas resources will initially occur in a frontier basin setting (CBM may be an exception).

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The petrophysical challenges that accompany many of these plays often makes the evaluation of tight-gas plays fundamentally different from more traditional plays. The time and tasks required to adequately appraise a tight-gas play may be substantially longer than in more traditional plays. Because reservoirs are low-permeability, these plays often require drilling 100's to 1000's of wells over a time period that may span decades, requiring an organizational competency (not to mention persistence) generally not needed in more traditional plays. The operational demands associated with such plays and the high degree of subsurface complexity at the reservoir scale often makes manpower and capital requirements on a BOE basis in these types of plays much higher than more traditional plays. ■

Biographical Sketch

KEITH W. SHANLEY is a consulting geologist aligned with the Discovery Group in Denver, Colorado with more than 25 years of experience in petroleum exploration, development, and research. He has worked in a variety of basins around the world for both major and independent oil and gas companies in positions ranging from upstream geosciences research and technology development to exploration, production, and appraisal. Keith has published numerous papers, edited volumes, and organized conferences and seminars dealing with sequence stratigraphy, its application to reservoir characterization and prediction, non-marine sedimentology and stratigraphy, and tight-gas resources. Keith's work on tight-gas resources has been well recognized by the American Association of Petroleum Geologists which awarded him and his co-authors the 2006 Pratt Award for best paper, and by the Canadian Society of Petroleum Geologists which awarded them the 2005 Medal of Merit for the most significant paper pertaining to the petroleum geology of Canada. In 2005 Keith was a co-convenor of the Vail Tight Gas Hedberg Conference. The resulting volume – AAPG Hedberg Series #3 was recently awarded the 2010 Robert H. Dott Award by the AAPG for the best special publication. Keith Shanley was born in The Hague, The Netherlands and moved to the United States

