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The Deepwater GoM Petroleum System: Seepage *Versus A*nomalies *Versus* Background using Piston Coring and Fluid Flow Models

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In the early days of GoM piston coring, locations were chosen on a grid basis, or selected from loose 2D seismic surveys. Such locations resulted in some seepage "hits", but the majority had either a background signature or an "anomalous" value that was between a true visible seep and background (using fluorescence intensity and UCM content). A scale based on these early data identified anything <5000-10,000 fluorescence units as background, 10000-100000 as anomalies associated with seepage, and >100000 as seepage.

Using new 3D surveys, it is easier to locate seepage-related seabed features. With better defined seepage sites and an extensive geochemical database, the old scale for background *versus* anomaly *versus* seepage has changed. By correlating true seepage to reservoired oil, most "anomalies" are not related to seepage or to the reservoired oils, therefore, NOT related to the subsurface petroleum system. The biomarker signatures can be used to define source origins, and when merged with regional understanding of source rocks in the greater GoM basin, a deepwater source model can be derived. 2D Temispack modeling confirms the seepage results based on a deepwater source rock model placing the primary source centered on the Tithonian with possible secondary source rocks at the MCU and Oxfordian levels.

Based on oil-to-seep correlations, we can demonstrate:

1. that most piston cores <30000-50000 fluorescence (on the old scale) represent background, 30000-100000 are anomalies, and >100000 are "clean" seepage. Only the "cleaqn seepage pistoncore extracts type to reservoired oils.
2. biomarker signatures of most cores with <100000 fluorescence do not correlate to the reservoired oils.
3. geographical differences exist.
4. a pervasive background biomarker signature is present across the GoM, related to either river discharge sediments containing extractable oil and/or organic matter, or possible sediment de-watering carrying an oil-like signature, unrelated to the subsurface petroleum system.

5. there is a distinct pattern related to the Mississippi fan. The "background signatures" appear to contain real oil, but do not correlate to the active true seepage.

Using a rigorous approach when interpreting the detailed geochemical data from the piston cores, the "clean" seepage shows a regional trend that can be used to infer source rock type across the deepwater GoM.

Migration of petroleum from source to reservoir to seep contains both lateral and vertical elements based on 2D TemisPack fluid flow models. Vertical flow dominates from the source to the first primary carrier bed. This is followed by lateral flow along the carrier to the structure (though can be modified by GoM overpressures), and then vertical migration dominates again which is controlled by shale capillary pressures and possible faulting issues. Because of the migration controls, true seepage should be predictable, whereas anomalies can be caused by different mechanism not related to hydrocarbon seepage. This is easily observed on present day sea floor bathymetry where shelf slope failures or drainage systems deliver sediments containing extractable oil-like signatures. These signatures, however, are unrelated to the oils from the subsurface petroleum system.