

Understanding the Hydrocarbon Related Fluid Migration in Norphlet-Smackover Petroleum System of Mobile Bay, Alabama Using Ni-V Ratio of Pyrite

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ABSTRACT

Hydrocarbon in the Smackover-Norphlet petroleum system of Mobile Bay, Alabama have shown a diverse migration direction towards multiple sinks. Geochemical analysis of the gases indicates thermochemical sulphate reduction (TSR) is dominantly responsible for gas destruction generating a low-pressure zone facilitating migration from the high-pressure areas. TSR generated hydrogen sulfide (H₂S) mineralized into pyrite (FeS₂) reacting with the iron coating of the Norphlet reservoir sand. These pyrites act as a sink of trace elements associated with the migrating hydrocarbons. Among the trace elements, nickel (Ni) and vanadium (V) concentration in pyrite will be vital to identify migration. The proposed project will test the existing migration models for Mobile Bays fields by measuring Ni-V ration in the pyrites collected from Mary Ann and North Central Gulf (NCG) fields in Mobile Bay.

During the migration, polar asphaltene with relatively higher V concentration is mostly absorbed by the sand grains due to the polar nature of silicates. However, resin a non-polar aromatic compound with relatively higher concentration of Ni moves along migration until TSR destroy the carrier hydrocarbon and both Ni and V incorporated into pyrite structure. So, it is expected that Ni-V ratio will be higher towards the migration direction. This trend can be used to develop a migration model for individual fields considering both primary (source to reservoir) and secondary (associated with the vertical movement of gas-water contact) migration. Pyrite samples from Mary Ann and NCG fields will be analyzed with LA-ICPMS to measure Ni and V concentrations.