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New Geochemical Insights on Palaeozoic Source Rocks, Berkine Basin, North Africa

Anadarko and joint ventures partners' drilling campaign in Algeria and Tunisia has enabled a Berkine Basin-wide evaluation of the Palaeozoic source rock intervals and their generated hydrocarbons.

High-resolution gas chromatography originally undertaken for reservoir continuity studies has been found to be equally as useful in source identification. Conventional biological marker analysis is of limited use because of the high maturity of the hydrocarbons and source rocks, and similar biological marker distributions in the Silurian and Devonian source facies. Both C7 isomers, and resolved C8 to C13 isoprenoids, branched alkanes and aromatic hydrocarbons give source-specific distributions. Three distinct families are identified: Silurian Tannezuft, Devonian Frasnian-Lower Famennian and a third, originally untyped group, represented by lighter gas-condensate products, from the Famennian to Strunian interval. Screening of the Palaeozoic section for other potential source intervals revealed significant potential in the whole shale interval between Frasnian and Carboniferous Visean age, amounting to up to 1900m of stacked source section. These newly identified source rocks typically contain Type II / Type III kerogen, and are of mixed hydrocarbon potential. Their effectiveness in the basin is, unlike the other main source rock units, limited by maturity constraints.

Study of the stable carbon isotopes of whole oils and source rock extracts provide one of the clearest definitions of oil to source rock correlation: a 'heavier with younging' relationship which clearly identifies the Tannezuft and Strunian oils as end members. The Frasnian values lie between these end points, thus making their clear identification from stable carbon isotopes in isolation somewhat problematic. However, in conjunction with the C7+ ratios and bulk compositions it is possible to distinguish between pure end-members and mixtures of oils from the various sources.

Spatial analysis of oil type defined by these methods can aid interpreters' understanding of migration pathways from the various source rock intervals within the basin. By considering maturity trends and the primary migration directions from this thick shale sequence it has been possible to suggest that the upper part of the shale stack (Famennian to Strunian) expels into local Strunian and Carboniferous reservoirs. The bottom of the source rock sequence may expel downwards, then migrate dominantly laterally to the Hercynian Unconformity then laterally in TAGI reservoirs. Local vertical fault migration related to the structural style of the basin has also been identified as a result of the analysis of hydrocarbon type distribution.