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**The Petroleum Systems of the Berkine and Illizi Basins, Their Potential based on  
Geochemistry and Basin Modelling**

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Through the integration of geochemistry, basin modelling and basin reconstructions through time, the Berkine and Illizi basins were evaluated for their respective hydrocarbon potential.

These two basins, located in eastern Algeria, are similar in most aspects of their petroleum system, but some major differences exist in the basin evolution. Most notable is, and a major controlling factor, is the amount of uplift and erosion that occurred during 3 events at Hercynian, Aptian and Miocene time. Paleostucture maps at these times, when fully restored to depth, can indicate hydrocarbon migration pathways through time.

Petroleum system analysis assesses source, maturity, migration, reservoir, trap and seal. For this paper, only the source, maturity and migration to potential traps will be discussed. Primary reservoir, which will not be discussed except in broad terms, includes the Ordovician Unit III and IV sands, the Devonian F6 sands and the Triassic Tag-I sands.

The Berkine and Illizi basins contain 2 primary source sequences, the lower Silurian or basal gamma-ray hot shales and the gamma-ray hot shales of the Devonian Frasnian. The Silurian source matures at different times and is mature over almost all of these two basins. The main kitchen area for the Devonian Frasnian (oil to gas mature) is across the central Berkine basin. What is favorable for hydrocarbon prospectivity is the timing of oil and gas expulsion from these two source rocks. For the Devonian Frasnian, expulsion occurs from the Late Cretaceous to almost present-day, whereas the Silurian expels part of its hydrocarbon charge during the Carboniferous in response to the Paleozoic burial in the deep Berkine and Illizi basins. The final, and most important phase of maturation and expulsion from the Silurian source occurred during Mesozoic and Tertiary burial. Because of the overlapping timing of expulsion from the 2 source units, and the potential for using the same migration pathways in some parts of the basin (e.g., Ordovician and Devonian sand subcrops at the Hercynian/Tag-I levels), the oils throughout some of the Berkine represent a mixed product. However, the Illizi basin has F6 and Ordovician primary reservoirs, and these are more easily charged by Silurian expelled products, either oil or gas depending on location in the basin.

To assess primary migration routes and fluid flow, 2D TemisPack and pathways EXODUS mapping were used to determine the how migration occurred through time. The TemisPack models (Figure 1) illustrate how the oils and gases expelled from the two source units within the Berkine basin migrate and charge the Triassic Tag-I reservoir sands creating a mixed hydrocarbon system which is also verified by oil-oil correlations. For the Illizi basin, the TemisPack modeling (Figure 2) shows that the only significant source for the Ordovician and Devonian F6 sands is the Silurian source.

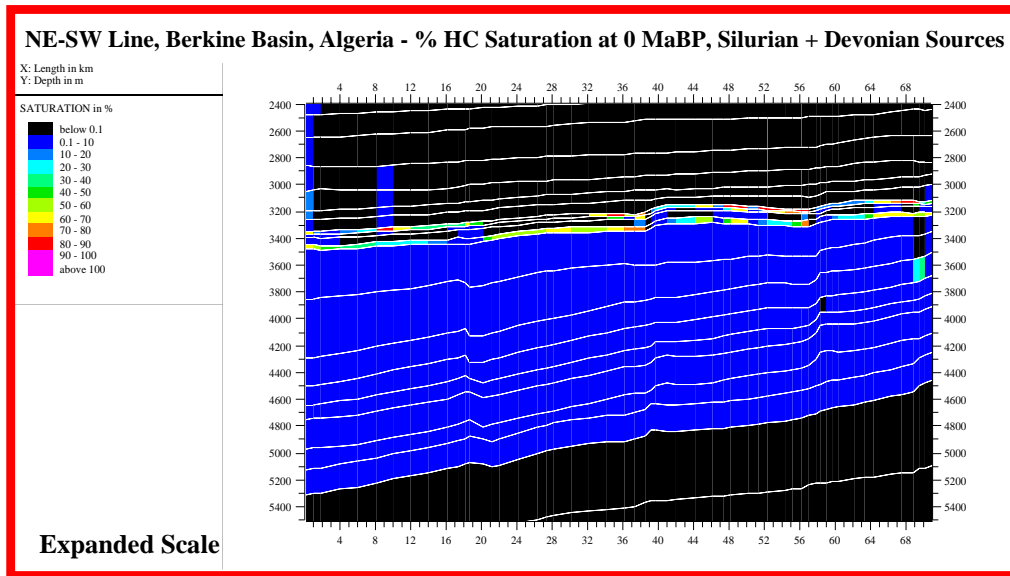


Figure 1: Present-day petroleum saturation along the Berkine basin line assuming mature and active Silurian hot shale and Devonian Frasnian hot shale sources. When both sources are active, the maximum saturation occurs, but is dominated by the Silurian sourced hydrocarbons, and this particular field has light API, high GOR oils consistent with the modeling results. Therefore, this is a mixed dual-sourced hydrocarbon system within the Tag-I sands in the Berkine basin. Moldeing sensitivities using only a Devonian Frasnian source shows less charge into the Tag-I sands than a similar sensitivity using only a mature Silurian source. The Devonian Frasnian source has limited kitchen extent, but a larger kitchen exists for the Silurian source. However, best charge of the Tag-I is when both sources contribute to the filling of and migration along the Tag-I sands.

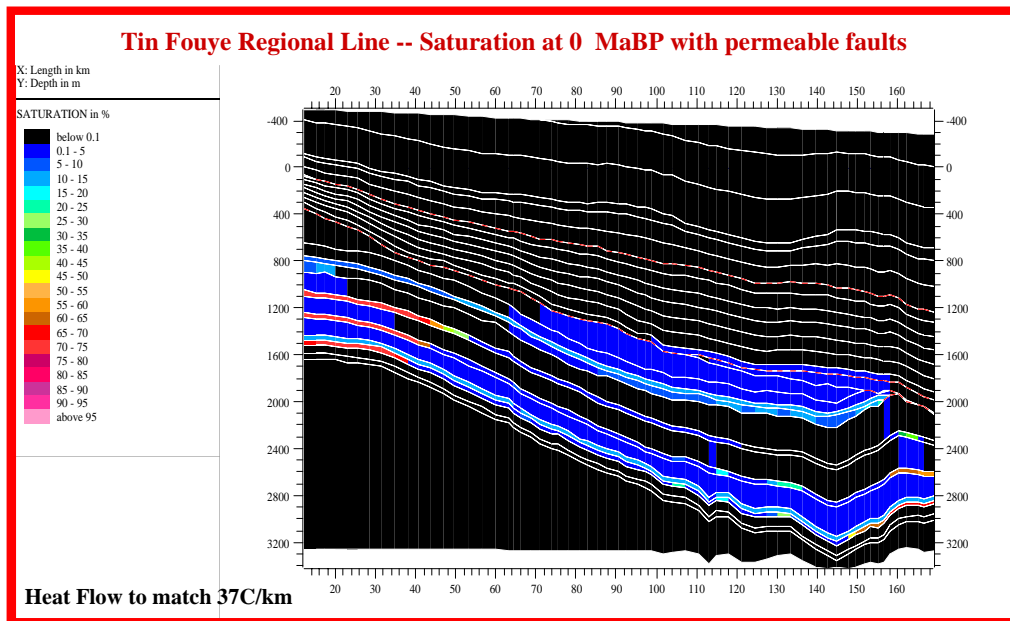


Figure 2: Oil saturation patterns at 0 Ma for the Tin Fouye model showing charge into the Ordovician and Devonian sands from the mature basal Silurian shales. The Devonian Frasnian, though mature in the deep basin, does not contribute any hydrocarbons into the Devonian F6 or Ordovician sands.