Testing partially abiotic origin of pre-salt oils by experimental petrology

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Fischer-Tropsch-type synthesis permits the formation of longer-chained liquid hydrocarbons by catalytic processes on an industrial scale, at pressures >10 bars and temperatures >200ºC. However, in nature, Charlou et al. (2000) reported plumes containing methane to propane over serpentinizing peridotites in the Lucky Strike/Rainbow fields near the Mid-Atlantic ridge. From this and other observation, we are developing experiments on the formation of higher hydrocarbons simulating three tectonic environments at different pressures and temperatures: 1. Over plumes. The presence of thermo-chemical mantle plumes rising from the lowermost mantle was indicated at several locations near the Mid-Atlantic ridge and attributed to heating of crustal fragments, subducted during plate collisions in the late Ediacaran to early Paleozoic times. H- and C-containing fluids rising from such mantle plumes may have metasomatized the lower lithosphere and formed higher hydrocarbons at high pressures and temperatures; 2. Over subduction zones. Subduction of the Farallon Plate started in the early Cretaceous, causing it to release fluids; subsequent westward drift of South America brought the continent's Atlantic margin over the subducted plate. H- and C-bearing fluids rising from the subducted plate may have metasomatized the continent's lower lithosphere resulting in hydrocarbon formation; 3. Over serpentinizing shallow lithosphere. The mantle lithosphere of South America's Atlantic margin was hyperextended and partially exhumed during rifting, with subsequent serpentinization and probable hydrocarbon formation. We will simulate these three environments using a 1000 ton hydraulic press with toroidal chambers, a 1200 ton multi anvil and a hydrothermal reactor. For all experiments, trace element partition coefficient will be determined for mineral/fluid pairs.

Ref.: Charlou, J.L. et al., (2000) Chem Geol 171:49–75.