Composition, Origin, and Maturation of the Paleozoic Source Rocks Outcrop Analogue, Saudi Arabia

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Abstract

Early Silurian shales are the source of 9 % of the world's hydrocarbons and accounts for 80–90 % of the Palaeozoic hydrocarbons in North Africa and Saudi Arabia. One of these units is the Qusaiba shale that is widely distributed in northwest, central, and southwestern Saudi Arabia. Most of the previous studies focused on the geology and stratigraphy of this shale using core samples. Origin and maturation of this shale were not studied well.

Samples from the Qusaiba shale outcrops have been analyzed for their mineralogy, clay mineralogy, and whole- rock geochemistry (major oxides and trace and rare earth elements) to examine its provenance, paleoclimate, tectonic setting, and maturation.

Mineralogical and geochemical proxies suggested an intermediate igneous source, a shallow marine depositional environment, humid and warm conditions, and a passive margin tectonic setting of the Qusaiba shale. It represents a transgressive phase in the Early Silurian followed the Late Ordovician regressive event marked by the glacial non-marine sandstone of the Sarah Formation. Illite contents and illite crystallinity values suggest a late diagenesis stage for the Qusaiba shale.

The outcrops of the Early Silurian Qusaiba shale in Saudi Arabia represent a good analogue for the Paleozoic source rocks as well as the unconventional shale gas. These outcrops have been used to determine the composition, origin, and maturation of this geologically and economically important shale.