Akkas Oil and Gas Field, Western Iraq Assessment of Hydrocarbon Generation Potential in Silurian Akkas and Ordovician Khabour Formations

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Two hundred and twenty samples of cores and cuttings collected from the Khabour and Akkas Formations in Akkas/ 1- 6, Khleisya/1, KH5/6 and KH 5/1 boreholes. They were subjected to palynological and organic geochemical analysis. Accordingly, abundant acritarch (134 species belonging to 54 genera) assemblage and a few spores (21 species belonging to 16 genera) and Chitinozoa (43 species belonging to 12 genera) with variable types of sedimentary organic matters are recognized in order to develop stratigraphic framework of the studied area, while optical and chemical analysis are for assessing the hydrocarbon generation and accumulation in this basin.

On the basis of acritarchs with tentative selections of Chitinozoa and spores, the studied stratigraphic section subdivided into the Ordovician Khabour, and Silurian Akkas and Upper Devonian Kaista formations in a succession of ten palynozones (PZ1-PZ2) within a stratigraphic framework, each refered to an equivalent stage of the geologic time scale units of Fammenian down to Tremadocian stages , with unconformity boundary between Upper Devonian Kaista Formation and Silurian Akkas Formation including the hiatus of the Caledonian Orogeny in West Iraq.

Formations of this section were deposited in marine environments extending for outer to inner neritic with local upwelling currents and lagoons, especially in boreholes Akkas/1, KH5/1 and KH5/6. Zones of optimum organic matter accumulations are deposited in the zone of maximum flood system track (MFS) and within environmental changes of the high stand system track (HST) in anoxic-dysoxic environment under seasonal pycnocline evidenced by more than 15% chitinozoa and scolecodonts with marine algae of Tasmanites, Deflandrastrum , brasinophyte algae of non reworked organic matter. Those environments underwent upwelling currents evidenced by mixed occurrences of the acritarch N. carminae and Deunffia-Domasia in cold climate of the Arabian Shelf Province along Northern Gondwana Continent, with nill occurrence of reworked organic matters and rate of burial is 4cmka . This rate of burial in such environments is evidencing burial efficiency of more than 5wt.% TOC.

Maturation assessments (figure 1) are on the basis of the Thermal Alteration Indices (TAI) of the acritarchs Diexallophasis denticulata-Orthosphaeridium ternatus and Baltisphaeridium constrictum while hydrocarbon generations potential are assessed by plotting organic matter types on the Bujaks (1970) graphical model. On the other hand, kerogen analysis of the Akkas and Khabour Formations have showed that the Thompson Kerogen types A & B, total organic carbon (TOC) up to 16%, especially for the hot shale of the Lower Silurian Akkas Formation, very low asphaltene and sulphur, saturated and aromatic hydrocarbons of more than 96% and high peaks of C_2-C_2O gas chromatography could indicate predominant gas generation with some light oils. The associated gas are mainly methane and ethane. CH_2, C_2H_6 and C_3H_8. Diagrammatic assimilation of stratigraphic cross sections connecting the studied boreholes collided with total organic carbon(TOC), maturation assessments and the kerogen type and quality as well as PetroMode software excel program for Basin Modeling of the whole succession in western Iraqi Desert based on Transformation Ratios, depth of burial, TOC, maturations and well temperature, have indicated source potential for wet gas and condensates from depth 2750-3000 meters and dry gas from depth of 3570-3650 meters for borehole Akkas-1 only from the Ordovician Khabour Formation of Caradocian and Llanvirnian stages respectively. While higher up from the Silurian, some oil might be generated from the lower Silurian Akkas formation in borehole Akkaz-1 and KH5/6. These potential source rocks are extended towards Jordan, southwest Iraqi Desert and Syria. Recorded oil and gas shows in equivalent strata of Tanf and Swab Formations (equivalent to Akkas and Khabour Formations) in the Akkaz-2 to Akkaz-5 wells drilled later by Syrian Petroleum Company in Qaem District could confirm hydrocarbon generation from the high organic matter black shales and accumulation in the lower Palaeozoic strata of the studied areas within the sandstone pores and fractured shales of the same studied formations along closures of the structured anticline fold, sealed by the non permeable shale interlayer, and fault of this field and along the unconformity boundary of the Upper Silurian Akkas Formation with the Upper Devonian Kaista Formation (figure 2).

The gross gas reservoir column of the Khabour Formation is about 80 meters with average porosity of 10% and permeability of 500mD. On the other hand, the 42? API light oil reservoir of the Lower Silurian hot shale is of 17% porosity and 500 mD and comprise a sandstone unit inter- bedded within the basal hot shale unit of gross thickness approximation of 10 meters and net thickness of 1.5 meters.