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Sedimentology of the Khabour Formation (Ordovician) of Iraq

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The Khabour Formation is the oldest known formation of the Paleozoic of Iraq. The formation is of variable bed thicknesses and lithologies; dark gray and black shale, gray and white sandstones and siltstones. The Khabour Formation is found in the wells Khleisia-1 and Akkas-1 of western Iraq and it outcropped in the extreme northern Iraq. In the Khleisia well a total of 1250 m of the formation was penetrated, without reaching the bottom of the formation, whereas, 1913 m of the formation was recorded in the Akkas well. Lithofacies analysis of the succession in the well Akkas-1 revealed that five lithofacies can be recognized. The Khabour facies have been shown to be inconsistent with a shallow- marine depositional environment. The shallower near shore environment (coarser, assemblage 1) exhibits features of tidal marine conditions and the sandstone-shale alternations (assemblages 2&3) show diagnostic tidal storm sedimentation facies. The transition zone between the shelf and shore- face areas (assemblage 4) can be interpreted as storm sediments intimately connected with the finer (assemblage 5) basinal shale. The thick pile of Khabour Formation, coupled with the nature of its sediments, indicates a subsiding- shelf environment.

Petrographic investigation of the khabour sandstones revealed that they are mainly of quartz arenite as well as subarkose and sublitharenites. The framework composition of khabour sandstones is 87% quartz; 6.5% feldspars; 3.4% lithic fragments (includes metamorphic, igneous and chert); and 3% mica and other grains (including pyrite and heavy minerals dominated by zircon, tourmaline and rutile). Mono-crystalline quartz is the most abundant framework grains. Quartz grains may be with or without inclusions, the most common inclusions recognized are vacuoles, acicular rutile, spherulitic zircon, muscovite, apatite and iron oxides. Straight to slightly undulatory extinction is frequent type in the quartz studied. Plagioclase dominates over microcline and orthoclase. Much of plagioclase and orthoclase appear to be altered to clay

minerals. Quartz types, inclusions and undulosity indicate a derivation from a dominantly granitic source with subordinate input from low rank metamorphic rocks. The most likely source of the sediments are the basement rocks of Iraq. The crystalline basement rocks of Iraq is interpreted from seismic and geophysical data to range in depth from about 6–10 km in west Iraq and is composed mostly of basic and ultra basic igneous and metamorphic rocks. The sandstones are generally cemented by carbonates, secondary silica and clayey materials.

Homogeneous black Khabour shales (assemblage 5, at bottom of the formation) commonly are fissile with dominant mica content and irregular pyrite bloches. Higher thickness (600 m) of this black shale, along with its pyrite content and less bioturbation, may reflect deposition under reducing euxinic conditions in a basinal transgressive cycle. These black shales near the base of the Khabour Formation were also recognized as a maximum flooding surface within the middle part of the Hiswah Formation in Jordan, near the base of the Swab Formation in Syria, and near the base of Saih Nihayda Formation in Oman.