

plates. A thick Jurassic to Miocene succession was deposited on the craton and in local extensional depocentres, after which collisional events created mountains along much of southern Asia, with extensional faults reactivated locally as thrusts.

The Kashafrud Formation (Middle Jurassic) of the Kopet-Dagh Basin rests unconformably on Triassic volcanogenic rocks and ultrabasic rocks of the Mashad (Paleotethys) Suture Zone, and comprises nearly 2 km of marine turbidite and fluvio-deltaic facies. The sandstones have considerable reservoir potential, and the shales acted as source rocks for hydrocarbon reservoirs in the overlying Mozduran and Shurijeh formations, including the Khangiran Gas Field. The type of turbidite system and the scale of sandstone bodies make the formation well-suited as an analogue for sand-rich turbidite plays around the world.

The basal fluvial strata are conglomeratic mass flow deposits of boulder grade that occupy valleys cut into the underlying bedrock. The bulk of the formation comprises interbedded sandstone and shale packages with trace fossils and sparse ammonites, and with shallow-marine facies (including red sandstones) and oolitic carbonates at the top. Sandstone packages are mainly 1-10 m thick (maximum 84 m thick) with thinning- and fining-up trends, although some packages thicken-and coarsen-upwards. Most packages have erosional bases, and many contain channel fills with mudstone clasts at their bases. Some lensoid packages tens of metres thick and <200 m wide represent submarine channel fills cut into shales and sandstones. The turbidite facies is interpreted to represent lobes on a basinal slope, and paleoflow data suggest that they were sourced from the south, perhaps funneled through upland river valleys. Abundant plant fragments suggest proximity to terrestrial sources, and hummocky cross-stratification in the upper parts suggests that some turbidites were modified by waves.

The diagenetic history of Kashafrud sandstones was determined from analysis of 270 thin sections, backed up by microprobe analysis. The sandstones underwent porosity reduction through compaction, pressure solution, and precipitation of cements (quartz, carbonates, clay minerals, Fe-oxides, and K-feldspar). Carbonate cements include calcite, dolomite, ankerite, and siderite. Porosity of 24 samples averages 9%, and is largely secondary due to dissolution of feldspar and ultrabasic rock fragments, as well as fracture generation. Diagenesis mainly reflects deep burial in the eo- and mesodiagenetic realms (shallow to deep burial), and the presence of a lava flow and a sill suggests locally enhanced geothermal gradients. Some diagenetic effects probably reflect telodiagenesis (exhumation), linked to Mesozoic hiatuses and/or Miocene to Recent collisional events that created the Kopet-Dagh Mountains.

The Kashafrud Formation of Iran: Jurassic turbidites in the Neotethys Ocean, and their reservoir evaluation

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The Kopet-Dagh Basin of northeast Iran formed in the Neotethys Ocean after the closure of Paleotethys, during which a suite of microcontinents accreted to the Turan and Eurasian