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Jurassic Unconventional Carbonate Source Rocks, Saudi Arabia

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ABSTRACT

Jurassic carbonate source rocks within the Jurassic Tuwaiq Mountain, Hanifa, and basal Jubaila formations supplied vast amounts of oil to Jurassic carbonate reservoirs. Having entered the gas window, these source rocks still contain 1% to 17% total organic carbon (TOC) and abundant organopores. TOC is concentrated in fecal pellets.

Deposition was in an outer ramp to basin depositional environment, beneath fair-weather wave base and within storm wave base. Storms swept organic-rich sediment down-dip into the outer ramp/basin, with traction flow of grains, skeletal detritus and mud along the floor of the basin. Storms appear to have waxed and waned in a cyclic manner. Three general lithofacies have been recognized: 1) anoxic, black, laminated, wackestone to mud-dominated packstone; 2) dysoxic, black, horizontally micro-bioturbated, laminated to very thin bedded, wackestone to mud- dominated packstone; and 3) oxygenated, gray, bioturbated, very thin to thin bedded, wackestone to mud-dominated packstone.

A pycnocline divided the water column into: 1) anoxic water beneath; 2) dysoxic water at the contact; and 3) oxygenated water above. Through time the pycnocline ascended and descended through the water column and may have been controlled by: relative sea level change; variable restriction of circulation; or a combination of both.

Grain types include fecal pellets, which are the most common, and intraclasts. Skeletal constituents include: Bositra buchi bivalves that are whole, shell halves, and fragmented to highly fragmented; abundant non-descript highly fragmented skeletal detritus; micrite-sized skeletal detritus; coccoliths; and calcispheres.

Sedimentary structures include: gently undulating parallel lamination (GUP lamination) or sinuous lamination; micro- hummocky cross lamination; starved ripple lamination; migrating ripple lamination; micro cut and fill lamination; micro- topographic infill lamination and fecal pellet grain flow lamination.
Diagenetic products include: pyrite cubes and finely disseminated pyrite crystals (1% to 3%); pyritized grain flow lamina; dolomite crystals (0% to 5%); anhydrite crystals (0% to 5%); calcite cement; clay (5% to 8% basal Jubaila Formation).
All of this data has been utilized to characterize and explore for unconventional Jurassic carbonate source rocks in Saudi Arabia.