

Precambrian Geology of the Hiyam Dolomite, Hatat Window: An Outcrop Analog to Birba-Buah Reservoirs in North Oman

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Abstract

The Hiyam Formation is a thick Precambrian dolomite exposed in north Oman under the Early Paleozoic clastic sediments of the Amdeh Formation, and above the metamorphosed basement sediments of the Hatat Schist. In the past the Hiyam Formation was correlated to different carbonate units of the Ediacaran Nafun Group based on lithology or colour. New techniques applied to the study of the Precambrian succession of Oman (including carbon stable isotopes, elemental chemostratigraphy, and detrital zircon geochronology), integrated with sedimentology and sequence stratigraphy, have allowed for a new correlation to be proposed. Our data support that a complete equivalent to the Ediacaran Nafun-base Ara Group is present in the Hatat area in the Hiyam and underlying Sirin Formations. They lie directly on metamorphic basement, in absence of the Cryogenian Abu Mahara Group, and under the Amdeh (Am1) clastics, equivalent to the Nimr Group, in absence of the Ara salt. The Sirin Formation (formerly part of the Hatat Formation) includes shales, a 5-10m thick dolomite (Tawny dolomite), and a 80m thick succession of thinly bedded shales and silty calciturbidites. The Hiyam Formation above is over 400m thick and consists of dolomites with 4 major depositional sequences, namely HS1 to HS4.

These units have been characterized in terms of facies, cyclicity, elemental chemostratigraphy, and isotopes stratigraphy. Detrital zircon geochronology was undertaken on interbedded sandstone units. These data have allowed for regional correlation between the Hiyam Formation and the Buah and Birba carbonates elsewhere in Oman. The shales and carbonates of the Sirin Formation below have equivalents in the Masirah Bay, Khufai (Tawny Dolomite) and Shuram Formations. The succession is very different in facies and thickness to age- equivalent Precambrian sediments elsewhere in Oman, but the new datasets support this correlation. Potential reservoir analogues are found in Hiyam HS2 dolomites and in HS1 dolomites and sandstones.

The Hiyam Formation presents a shallowing to deepening upwards sequence from marine subtidal to intertidal carbonates below (H1, H2), to carbonate slope deposits above (HS3, HS4). We interpret the deepening sequence as the result of rapid subsidence related to incipient loading in the Western Deformation Front fold and thrust belt, to the W-NW, from the latest Ediacaran. Like in the western Hajar Mountains, the section would have been subsequently involved in the deformation and uplifted in the Early Cambrian, to form a regional high. This high shed sediment (debrites, megabreccias, conglomerates) into a proximal slope to marginal marine setting in the lower Amdeh Formation (Am1 and lower Am2). These deposits, as well as the Ara salt and the complete Paleozoic clastic succession, pinch out against the deformation front exposed to the west in the western Hajar Mountains, where the Precambrian successions lies directly under Permian carbonates.