Depositional Model for the Ordovician Glaciated Margin of Jordan; Implications for the Reservoir Potential of the Risha Formation

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ABSTRACT

The latest Ordovician to earliest Silurian glacial episode resulted in a significant eustatic, multi-cycle, low-stand event. The glacial advances left their record around the margins of Gondawana in the form of major palaeovalleys and sediments which include tillites, diamictites, and both fluvioglacial and glaciomarine outwash deposits. The south pole and glacial epicenter were located in north Africa and the continental ice sheet extended as far as the Arabian Shield including Jordan. The synglacial Ammar formation in southern Jordan and the equivalent interval in adjacent areas of Saudi Arabia (Sarah/Zarqa Formations) are locally developed within deeply incised palaeovalleys; these have been interpreted as sub-glacial tunnel valleys delivering sediment towards the north to north-east. Some 300km north of these outcrops, in the Risha area of north-eastern Jordan adjacent to borders with Iraq and Saudi Arabia, and located on stable shelf of the Arabian Shield, the late Ordovician Risha Formation (Ashgillian) is encountered in the subsurface. It is a similar age to the synglacial succession elsewhere along the north Gondwana margin although more distal than the subglacial tunnel valleys in south Jordan; is interpreted to be glacial in origin and deposited by sub-aqueous outwash fans. The Risha Formation is generally less than 100 meters thick and comprises stacked sandstone units with thinner mudstone beds; the sandstones are sub-arkoses and quartz arenites which are texturally mature to very mature. Quartz cementation is locally extensive with low porosity and permeability typical but at some levels, porosities are > 10% with permeabilities adequate for gas to flow. Gas has been produced from this formation since 1989 with about forty five wells drilled across the field. It is recognized that the reservoir properties of the producing sandstone intervals are strongly influenced by primary depositional facies and diagenetic alteration.