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A Review of Ordovician Glacial Reservoir Potential Across North Africa

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ABSTRACT

Despite the short duration of only a few 100,000's years (Sutcliffe et al., 2000 & 2001), the Ordovician glaciation event has nevertheless had a profound influence on the regional geology of North Africa. These glacial units form prolific oil and gas reservoirs in Libya and Algeria and offer remaining potential across North Africa. Glacial successions are characterised by a wide range of depositional settings ranging from subglacial, continental glacio-fluvial and lacustrine to glacio-marine. Facies and depositional environments are often cyclic, controlled by phases of ice sheet advance and retreat. It is during retreat (melting of the ice sheet) that most sedimentation occurs. Major retreats are often punctuated by medium and short-term advances of the ice, which produces extensive reworking and development of erosional bounding surfaces. Glacial surfaces are characterized by striated pavements, glacio-tectonism, fractures, and glacial lineations. In general, depositional units are strongly laterally discontinuous and detailed local studies reveal complex depositional histories that produce variable reservoir architecture. Regional scale correlation, and even correlation across fields can be challenging because of rapid lateral facies changes, erosion and syn-sedimentary tectonics. The fluvial systems are dominated by sandy bedload systems and braided complexes. Where ice sheets are in contact with the sea, subaqueous fans may be developed, that contain amalgamated sandstone units with sedimentary structures such as compound climbing dunes, interpreted as having been deposited as a high energy outwash in association with sheet flood deposits. The glacio-fluvial and subaqueous marine clastic reservoirs vary compositionally and in maturity, which affects reservoir quality. Many of these reservoirs are tight and rely on fractures to provide deliverability. Interbedded mudstones with dropstones and muddy diamictites (microconglomerates) record deposition from ice shelves or icebergs into low-energy marine or lacustrine environments. Gravity driven mass flow deposits are also common in zones of high sedimentation rates with unstable slopes. These mudrock facies provide intraformational seals or waste zones. As deglaciation continues, increasing volumes of sediment allow development of large-scale prograding deltas, both as sub glacial or terminal glacial deltas. Understanding the palaeo-topography is a critical factor for exploration as sedimentation was often restricted to large valleys, eroded by ice streams during the glacial advance, and then later filled by sediments during retreat. The final phase associated with ultimate ice sheet collapse and a rise in sea level is commonly recorded as transgressive marine / tidal sandstones that may cap the glacial sequence. These reworked units often have the nest poro-perm characteristics. Ordovician glacial reservoir is complex, with challenges both in terms of reservoir connectivity and quality, but it is a multi-billion-barrel play that is well documented in southwest Libya and southern Algeria. The mapped limit of the ice sheet advance stretch across Algeria into Morocco, with glacial facies recorded at outcrop in the Anti Atlas. Further work is required to chase this play and unlock remaining potential.