Intimacy of Late Ordovician Glacial Valleys Sedimentary Infill Revealed: A Fully Integrated Subsurface Approach Applied on a SE Illizi Basin Dataset

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Abstract

The past 20 years of Exploration and Production efforts within the Illizi basin (SE Algeria) have led to the constitution of a substantial subsurface database; e.g. dozens of seismic 3D volumes and several hundreds of wells penetrating the Paleozoic stratigraphy. Over here, the Lower Paleozoic megasequence (i.e. Cambrian-Ordovician-Early Silurian) appears as the most prolific petroleum system where several reservoirs units are hosted by Cambro-Ordovician sand-prone strata, sealed and sourced by the overlying Lower Silurian “Hot-Shales”. In more detail, Late Ordovician (Hirnantian) glaciogenic deposits (Unit IV) form here the most economically important hydrocarbon reservoirs despite their complexity due to intrinsic spatial heterogeneity (thickness variation, occurrence of subsidiary glacial erosion surfaces, nested sedimentary units) and lithofacies characteristics that have not been fully understood yet. Under the light of detailed sedimentological work (up to 2000 m of core described), tight seismic stratigraphic and seismic geomorphologic investigations, calibrated on the numerous available wells penetrating the succession, the complex nature of the glaciogenic reservoirs is at least partly resolved at a 100 x 100 km scaled area throughout the Eastern edge of Illizi Basin. A comprehensive depositional model may be proposed, defining the facies partitioning for a single glacial cycle. By applying an allostratigraphic method to well-to-well correlations running in parallel of physical tracking of the major stratigraphic surfaces throughout seismic volumes, led to the definition of 2 major glacial cycles. Moreover, by use of seismic attributes, results from petro-elastic seismic inversion, together with systematic horizon slicing throughout seismic volumes, the key features of glaciogenic sedimentary wedges are highlighted, such as:

• The geomorphology of the distinctive successive stacked and/or nested glacial incisions that occur in the glaciogenic record
• The distribution of discontinuous sandy reservoir geobodies, mainly subglacial in origin, plated at the base of and strictly constrained by glacial erosive surface envelops. The organization of the final deglaciation system built by prominent proglacial outwash to subglacial geobodies