

## ***ABSTRACT***

The Upper Ordovician (Hirnantian) Glaciogenic deposits, located within Murzuq Basin - SW Libya, are known as important hydrocarbon reservoirs. Extensive studies have been done in outcrops, such as Gargaf Arch in order to understand the origin and architecture of Ordovician tunnel valleys. However, little is known about the subsurface of these Ordovician glacial deposits.

The Melaz Shuqran and Mamuniyat Formations represent the Late Ordovician sediments within Murzuq Basin. The former represents the glaciomarine sediments, and it is overlain by glaciofluvial and proglacial marine sediments of Mamuniyat Formation. A deep glacial erosion surface is set at the base of Melaz Shuqran and a second glacial erosion surface in the middle of Mamuniyat, both surfaces are related to the two first-order glacial cycles, respectively.

In this study, high resolution of 3D seismic reflection dataset, four wells with borehole logging data and two cores provided by Repsol ® S.A. from NC-186 concession zone in southwest Murzuq Basin were analyzed.

Three tunnel valleys were observed in 3D seismic data. Two of them (Tunnel Valley I and II) were the main focus of this study based on the high quality of seismic coverage. The Tunnel Valley I has the proximal, medial and distal segment captured by the 3D seismic volume. The Tunnel Valley I and II shows steep margins ( $12 - 27^\circ$ ), widths  $< 5$  km, length  $> 10$  km and depths between 175 and 230 m for the medial and distal segments. Both tunnel valleys show U-shape and are oriented toward northwest directions, parallel to the ice-sheet flow. Variance and spectral decomposition attribute analysis enabled to recognising two potential glacial erosional surfaces related to the two first-order cycles of glaciation during the Hirnantian. Four main seismic sequences

were identified and named as follows: Basement, Pre-Glacial, Glacial and Post-Glacial units and their respective subunits. The Glacial Unit was divided into four subunits.

The Glacial sequence 1 and 2 are related to sedimentary deposits of the first Glacial cycles, posteriorly eroded by the second glacial cycle. The Glacial sequence 3 represent the prograding clinoform reflections related to continental sediments input by glaciofluvial deposits above the second glacial erosion surface. The clinoforms are dipping oriented toward northwest directions (basinward). The Glacial sequence 4 onlaps the clinoforms reflections towards the continent in an initial transgressive system. Coring descriptions indicate that these onlapping reflections, represented by Mamuniyat sandstones, were deposited in proglacial marine environment.

The finds of the works should integrate the knowledge in Late Ordovician glacial deposits, as well as the tunnel valley genesis.

**Keyword:** Murzuq Basin, Upper Ordovician, Hirnantian glaciation, Tunnel valleys, 3D seismic reflection, Seismic geomorphology.