Geophysical Research Abstracts
Vol. 18, EGU2016-1434, 2016
EGU General Assembly 2016

Storm deposits as graves in Early Life: the Fezouata Lagerstätte case (Lower Ordovician, Morocco)

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The Fezouata Shale (Early Ordovician, Morocco) is renowned in the palaeontological community for its Konservat-Lagerstätte (Tremadocian in age) that yielded thousands of exceptionally well-preserved fossils (EPF) from the Great Ordovician Biodiversification Event. Lower Ordovician deposits in the central Anti-Atlas Mountain (Zagora area) are expressed by the Fezouata Shale and the Zini Formation. They consist in ca. 900m of siltstones and sandstones deposited in an epicontinental sea at the periphery of the Gondwanaland.

Sedimentologic field analysis and sequence analysis were achieved on ten stratigraphic sections in order to constrain the palaeoenvironmental context of the Fezouata Biota and to predict the location (geographically and stratigraphically) of new Lagerstätten. Sedimentary structures (cm- to m-scale symmetrical ripples) and geometries (lobe, lobe-channel) point to storm dominance on the sedimentation but peculiar sedimentary features suggest a tide modulation. Thus, a wave-dominated tide-modulated model of deposition recording proximal offshore to shoreface environments for the Fezouata Shale and shoreface to foreshore environments for the overlying Zini Fm is proposed.

Layers yielding EPF are argillaceous siltstones (with wave ripples of cm-scale wavelength) always overlain by fine-grained sandstones (distal storm deposits, few cm-thick, several m-long, with cm- to dm-scale hummocky cross-stratifications). Fast burying by storm deposits appear to be of prime importance to initiate the exceptional preservation of the soft tissues of animals in the fossil record. According to the model of deposition it correspond to environments close to the storm weather wave base.

Lower Ordovician succession was deposited during a 2nd order cycle, although 3rd and 4th order cycles were also identified. Encoding these different orders of sea level fluctuations giving a value of “1” for the deepest part of sequences (for each order) and a value of “0” for the shallowest, a reconstruction of the sea level fluctuation is then proposed. This reconstruction clearly highlights the stratigraphic position of the today discovered Lagerstätte. It also suggests that a second, younger (Floian in age) stratigraphic interval has very comparable sedimentary conditions in terms of facies and sea level, and has the potential for being a new Lagerstätte in the Fezouata Shale.