

EGU21-10409, updated on 25 Oct 2021

<https://doi.org/10.5194/egusphere-egu21-10409>

EGU General Assembly 2021

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Sedimentology, stratigraphy and clinoform architectures of a siliciclastic shallow-marine platform: insights from the Late Ordovician of the Anti-Atlas (Morocco)

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The Moroccan Anti-Atlas consists of a several kilometers thick sediment pile accumulated on the northern Gondwana platform since the latest Precambrian (Ediacaran). This study focuses on the Ktaoua Group, early Late Ordovician (Mid-Sandbian to Katian) in age, which records a major and multiphase transgressive/regressive cycle above the shallow marine sandstones of the underlying First Bani Group. In the western Central Anti-Atlas, the Ktaoua Group is formed by offshore shales to coastal sandstones organized in regressive parasequences. Here, high-resolution field-based stratigraphy is used to constrain the shelf architecture and clinoforms geometries within the Ktaoua Group.

Whereas the lower part of the Ktaoua Group records parasequences from silty-shale to fine to coarse sandstones with hummocky-cross-stratification (HCS), its upper part oscillates between HCS beds and very coarse sandstones. Ferruginous, condensed horizons usually drape the parasequences. In this study, we investigate the platform geometry through the correlation of the stacking patterns of seventeen stratigraphic logs along an 85 km long, well-exposed cliff. Drone images support the logging and the correlations of the sections by imaging clinoforms geometries.

Several decameters of fine to coarse sandstones can be observed to grade laterally into condensed level(s) within a few kilometers, hence evidencing clinoforms pinching out. The visible orientation of the clinoforms along the cliff exposures show a proximal to distal trend from the south-west to the north-east, in agreement with the overall basin geometry. Three clinoforms with distinct geometries and lateral evolution of facies associations are highlighted. The distal part of a clinoform, 15 m in thickness, pinches out onto the top of the underlying First Bani Group within 7 km. The overlying regressive parasequence, approximately 50 m thick, remains consistent more than 50 km, and is understood as a prograding clinoform. A third clinoform, capped by a prominent sandstone body constantly thicker than 20 m over ca. 20 km, disappears within its last

3.5 km onto the underlying clinoform. This study offers new details on the progradation and regression geometries along a giant platform within a detailed stratigraphic framework.

We would like to thank the Pacha and the Gendarmerie Royale of Foum-Zguid, the governor of Tata and the different persons who gave their approval and facilitated the use of the drone in the region of Souss-Massa for their precious help.