



## **Integrated analysis (stratigraphy and microfacies) of the mid-Cretaceous (Upper Albian–Turonian) Debarsu Formation (Yazd Block of Central Iran)**

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Cretaceous strata are excellently exposed in the Khur area, Yazd Block, western Central Iran. However, apart from basic lithostratigraphic mapping surveys, little has been known about the depositional setting and precise chronostratigraphy of the Cretaceous formations of that area. Starting in 2009, the area was repeatedly re-visited within the framework of the International Darius Programme, aiming at the understanding of the geodynamic significance of the Cretaceous succession of the Yazd Block, western Central Iran. Here we focus on the Debarsu Formation, an up to 600-m-thick unit of marls and shallow-water limestones.

Detailed ammonite biostratigraphy provides for the first time reliable data for the chronostratigraphy of the Debarsu Formation and the hiatus at the base of the unconformably following Coniacian–Campanian Haftoman Formation. The Upper Albian *Mortoniceras (M.) inflatum*, *M. (Subschloenbachia) rostratum* and *M. (S.) perinflatum* zones are proved by their index taxa in the lower part of the formation while there is no evidence for the terminal Albian *Praeschloenbachia briacensis* Zone (possible hiatus). In the middle part of the Debarsu Formation, the *Mantelliceras saxbii* Subzone in the upper part of the lower Lower Cenomanian *M. mantelli* Zone is proved by *M. saxbii* and *M. cf. mantelli*. The upper Lower Cenomanian is documented by the occurrence of typically *M. dixoni* zonal ammonites. Unequivocal Middle Cenomanian as well as Upper Cenomanian and Turonian ammonites have not yet been found in the upper part of the Debarsu Formation, but micro-biostratigraphic evidence (planktonic foraminifers) from the uppermost part indicate that the formation ranges into the Middle Turonian.

The Debarsu Formation in the type area south of Khur is a unit of skeletal shallow-water limestone interfingering with marly basinal deposits. Decametre-scale shallowing-upward cycles capped by karst unconformities are evidence of significant relative sea-level changes. The sedimentary cycles are asymmetrically shallowing-upward, starting with deeper marine marls, often sharply overlying a karst surface capping the underlying cycle. Up-section, nodular limestones (often with ammonites) were deposited, overlain by shallow-water bio- and intraclastic grain- and rudstones with clinofolds, resulting in the development of thickening- and coarsening-upward cycles with thicknesses of up to 100 m. These cycles can be traced in the type area for several kilometres. Tongues of prograding shallow-water limestones pinch out towards the north and northeast where marly (i.e. basinal) deposition prevailed. Thus, a deeper marine area is expected in this direction while in the south to southwest, a swell area was situated. The depositional setting of the Debarsu Formation was a homoclinal carbonate ramp (absence of gravitationally redeposited sediments, smooth facies transitions).

In the mid-Upper Albian to lower Middle Turonian of the Debarsu Formation, eight sedimentary unconformities are recognized that define a corresponding number of 3rd-order depositional sequences. The unconformities are characterized as palaeo-karst surfaces capping the shallowing-upward cycles described above. The chronostratigraphic positions of the sequence-bounding unconformities correspond to time-equivalent surfaces known from other Cretaceous basins elsewhere (e.g., in central Europe). Thus, eustatic sea-level changes are held responsible for their formation. The novel stratigraphic data for the Debarsu Formation have considerable geodynamic significance for the greater area: the development of the major tectonic unconformity at the base of the overlying Lower Coniacian–Campanian Haftoman Formation was obviously a geologically instantaneous event during the Late Turonian (less than 2 myr according to the GTS 2012). These observations highlight the significant synsedimentary tectonic activity of Central Iran during the mid-Cretaceous.