

Microfacies analysis of Early Miocene carbonates of Kutch

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The Khari Nadi Formation and the overlying Chhasra Formation represent a mixed carbonate siliciclastic deposit of Early Miocene age in western Kutch. Microfacies studies are carried out on the carbonate samples from the two formations along the Khari Nadi section in sequence stratigraphic framework.

The Early Miocene sedimentary succession of Kutch is bounded by regional unconformities at the base and on the top. Clastic dominated Khari Nadi Formation unconformably overlies foraminiferal limestone of the Bermoti Member of Maniyara Fort Formation (Upper Oligocene). Khari Nadi Formation gradationally passes over to Chhasra Formation which is overlain unconformably by the clastic-dominated Sandhan Formation. The succession was developed in marginal marine to middle shelf setting.

The basal part of Khari Nadi Formation is represented by thick clastic sequence that is almost barren of fossils intervened by laterally extensive carbonate bed. Limestone is more dominant in the upper part of the Khari Nadi Formation to the middle part of the Chhasra Formation. The sequence stratigraphic architecture of the sedimentary succession was proposed by Kumar et al. (2009). The entire Khari Nadi Formation and the overlying lower part of the Chhasra Formation is overall deepening upward and represent a transgressive systems tract. Maximum flooding surface occurs at the middle of Chhasra Formation. The upper part of the Chhasra Formation represents a highstand systems tract.

Nine microfacies types have been identified from the carbonates of the Khari Nadi Formation and the Chhasra Formation. Silty bioclastic packstone with oyster, echinoderm and benthic foraminifera and a lithoclast-bioclastic wackestone with transported micritic lithoclast and fragmented fossils are found in lower part of Khari Nadi Formation. Both the facies represent high energy depositional conditions corresponding to backshore to lower shore face

environments. These microfacies characterize the lower part of transgressive systems tract (Table 1).

Limestone beds occurring at the upper part of Khari Nadi Formation are silty bioclastic wackestone and bioclastic packstone. Lower part of the Chhasra Formation is represented by silty-bioclastic wackestone and bioclastic wackestone-packstone (with diverse larger foraminifera and algae). The microfacies types correspond to deposition in inner shelf environment with intermittent high energy conditions and belong to the middle part of the transgressive systems tract.




The lower part of the Chhasra Formation comprises of bioclastic packstone-grainstone with diverse larger foraminifera, bioclastic wackestone-packstone dominated by small benthic foraminifera and bioclastic packstone with larger miliolid foraminifera. The microfacies types correspond to inner shelf to middle shelf depositional conditions. High abundance of miliolid foraminifera suggests low energy conditions, below the wave base, and possibly represents the maximum bathymetry of depositional basin. Abundance of planktic foraminifera further supports this inference.

Bioclastic packstone and bioclastic wackestone with larger miliolid foraminifera characterize the upper part of the Chhasra Formation. The microfacies types correspond to inner shelf to shore face depositional conditions. Surpulid colonization is observed on bioclastic packstone. Vertical stacking of microfacies type characterizes the overall shallowing highstand systems tract.

The microfacies study reflects shallow marine origin of the Early Miocene succession of Kutch and the recognized microfacies are comparable to ramp microfacies RMF13, RMF14 and RMF 16 of Flugel (2004). Microfacies study proves useful to infer depositional conditions and complements the sequence stratigraphic interpretation of Kutch.

Table: 1

Microfacies, depositional environments and sequence stratigraphy of the Early Miocene carbonate succession of Kutch

DEPOSITIONAL ENVIRONMENTS	MICROFACIES	
Inner shelf to shore face	Bioclastic Wackestone with larger miliolid foraminifera. Bioclastic packstone. Serpulid Grainstone.	 H S T MFS
Open marine (deeper inner shelf to middle shelf)	Bioclastic Packstone with larger miliolid foraminifera. Bioclastic Wackestone- Packstone dominated by small benthic foraminifera. Bioclastic Packstone-Grainstone with diverse larger foraminifera.	 T S T
Inner shelf (with intermittent high energy condition)	Bioclastic Wackestone-Packstone with diverse larger foraminifera + algae. Silty Bioclastic Wackestone.	T S T
Backshore to lower shore face (in high energy condition)	Lithoclast-Bioclastic Wackestone. Silty Bioclastic Packstone.	

References:

Kumar, P., Saraswati, P.K. and Banerjee, S., 2009. Early Miocene shell concentration in the mixed carbonate-siliciclastic system of Kutch and their distribution in sequence stratigraphic framework. *Journal of the Geological Society of India* 74: 432-444.

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