Lower Cretaceous microbialite and encrusters; implication for lagoon-sea level oscillations under Milankovitch effects in NE-Iran

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During the Early Cretaceous time, carbonate-siliciclastic sequences (Zard and Tirgan Formations) were widely deposited on shallow platforms of the west Kopet-Dagh basin in NE-Iran. Facies variations within the Lower Cretaceous deposits are interpreted as a transgressive succession that formed during the drowning of many Tethyan carbonate platforms. In addition, changes in fossil components associated with less terrigenous input during the transition from the deposition of Zard Formation (Hauterivian- Barremian in age) to Tirgan Formation (Barremian-Aptian in age) indicates that the initial microbialite community was replaced by the encrusters community. Periodical input of terrigenous sediments, interrupting the carbonate deposition of the Zard Formation, indicates that microbialite beds formed as a response to the decrease of terrigenous influx. Lagoonal environments during the deposition of the Zard Formation become more restricted with high nutrient concentration causing high primary productivity, which in turn reduced oxygen in the environment through bacterial decomposition of organic matter. Therefore, lagoons were changed to suitable environments for the formation of thrombolite-dominated microbialites. These periodical changes in the Tirgan Formation are associated with environmental fluctuations that are shown by changes in the taxonomic composition. The Existence of encrusters and micro-encrusted associations in some beds indicate open lagoonal conditions. Sea-level fluctuations played an important role in opening and closing the environments on the shallow platform. This is influenced by climatic changes affecting the rate of siliciclastics and nutrients influx, as well as the alkalinity of the water. Strong sea level fall led to restricted lagoonal conditions with high nutrient concentration inducing high primary productivity, which in turn leads to oxygen consumption through bacterial decomposition of organic matter. The resulting dysoxic to anoxic environment is suitable for the formation of pure thrombolite-dominated microbialites. The low-amplitude sea-level variations which are related to the precession (20-ky orbital cycles) could probably be influenced by opening and closing lagoons. Therefore, sea-level oscillation and climatic changes and consequently, the crises in growth of encrusters, are linked to orbital cycles in the Milankovitch frequency band.