

Application of Markov Chain Method in depositional sequences interpretation to provide ichnological model of carbonate sediments of the Mobarak Formation (central and eastern Alborz Zone, North Iran)

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Abstract

The carbonate succession of the Mobarak Formation (Mississippian) located in Central and Eastern Alborz, have a diverse trace fossils in Toyeh Rodbar and Siaheh mountain sections. In this research, different lithofacies cycles of the Mobarak Formation are examined by Markov method as well as field observations, and depositional environment has interpreted by proposed ideal sequence. To do this, the deposits of this Formation have divided into five lithofacies associations including argilaceous limestones intercalated with dark shales bearing Zoophycos ichnofacies, thin- to medium-bedded limestones bearing Cruziana ichnofacies, limestones bearing Skolithos ichnofacies, medium- to thick-bedded limestones bearing mixed Skolithos and Cruziana ichnofacies, and limestones intercalated shales without any trace fossils. Markov chain analysis shows that Mobarak Formation deposits are composed of coarsening upward cycles. A complete cycle from base to top consists of limestones intercalated shales without any trace fossils, argilaceous limestones intercalated with dark shales bearing Zoophycos ichnofacies, thin- to medium-bedded limestones bearing Cruziana ichnofacies, limestones bearing Skolithos ichnofacies, and medium- to thick-bedded limestones bearing mixed Skolithos and Cruziana ichnofacies. The development of sedimentary cycles bearing Ichnofacies is primarily controlled by environmental factors, e.g. sediment type, food accessibility, oxygenation and energy level. In this Formation, four ichnofacies have been recognized including Cruziana, Skolithos, Zoophycos and mixed Skolithos–Cruziana ichnofacies. The inner ramp sediments are characterized by low-diversity Skolithos elements. In the distal inner ramp and proximal middle ramp sediments of Mobarak Formation, the presence of suspension to deposit-feeding trace-makers (mixed Skolithos–Cruziana) indicate the presence of adequate food resources in both the substrate and in the water column. The Middle ramp deposits of Mobarak Formation are characterized by different trace-fossils association consistent with fully marine environment which presence of deposit-feeding structures, with associated grazing structures (Cruziana ichnofacies), supports a middle ramp setting.

Keywords: Mobarak Formation, Alborz Zone, Ichnofacies, Markov chain