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Application of large benthic foraminifera as a tool for interpretation of paleoclimate and water depth, in the Ziyarat Formation, Alborz, Iran

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The Ziyarat Formation, with a total thickness of 213 m, is a shallow warm water limestone, overlies the Fajan conglomerate and is overlain by tufaceous siltstone of the Karj Formation. The age of late Paleocene- Middle Eocene was considered for the Ziyarat Formation at the type section.

From late Paleocene towards Middle Eocene, temperature has increased (Scheibner et al., 2005). This rising temperature has intensified and giving way to an unprecedented expansion of Large Benthic Foraminifera (LBF) dominating Tethyan platform during Middle Eocene (Scheibner et al., 2005). 18O paleotemperature calculation based on heaviest oxygen isotope value of micrite and 18Ow of Eocene seawater of 0.85 SMOW shows that temperature was around 39˚C in the study area. In response to continued global warming during Paleocene-Eocene Termal Maximum (PETM), some organisms (such as corals) has been declined, while at the same time, L.B.F. were increasingly favored as dominant carbonate producing organisms in oligotrophic environment (Scheibner et al., 2008). For the even warmer period of PTEM a transient rise in sea-surface temperature of 4-5˚C in low latitudes and 8 to 10˚ C in high latitudes has been proposed based on Mg/Ca ratios of planktic foraminifera (Zachos et al., 2003; Tripati and Elderfield, 2004). Thus, L.B.F was able to exploit their niche as evidenced by their increase in size, species diversity and their overwhelming abundance.

In the Ziyarat Formation, 11 microfacies were recognized from the shallower to deeper part of the platform. The lack of evidence of resedimentation, e.g. turbidite, related to steep slop, and absence of reefal facies and widespread tidal flat deposits indicate that the Ziyarat Formation was deposited in a homocline carbonate ramp environment. The evaporite facies, dolomicrite, intraclast ooid packstone to grainstone, Miliolid wackestone, and Alveolina nummulite packstone belong to inner ramp sub-environment; middle ramp microfacies composed of Nummulite packstone, red algae nummulite packstone, Discocyclina nummulite wackestone, and Nummulite discocyclina wackestone to packstone; and outer ramp microfacies consist of benthic foraminifera packstone and radiolar sponge spicule wackestone. The ramp model proposed here for the Ziyarat Formation represent an example of a foraminifera dominated ramp system.

The Paleogene was a time of particular abundance and radiation of miliolid and larger hyaline foraminifera and, especially during the Eocene they occurred in rock-forming quantities. Among L.B.F typical of Early Cenozoic carbonate platforms, Nummulites occupied a broad range of open marine environments on both ramps and shelves, and was generally absent from more restricted waters. Assilina and discocyclina in relatively deep water environments, while smaller lenticular Nummulites occur in shallower, inner ramp/shelf settings, often co-existing with Alveolina.

Nummulites in the Ziyarat Formation showing variation in test shape, along the paleoenvironmental gradient. Nummulites from inner ramp have robust ovate shape with thick walls, while by increasing water depth, lower temperature, decreasing light levels and water energy, the test shape becomes flatter and elongate.