

Ecological Distribution of Modern Benthic Foraminifera of Kedah Coastal Waters and their Potential Use as Sea Level Indicator

*FATIN IZZATI MINHAT¹, MOHD LOKMAN HUSAIN², BEHARA SATYANARAYANA^{2,3,4}, VIJAYAN V.V. RAJAN⁵, HASRIZAL SHAARI¹ & SANATUL SALWA HASAN⁶

¹School of Marine Sciences and Environment, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Malaysia

²Institute of Oceanography and Environment, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

³Laboratory of Systems Ecology and Resource Management, Université Libre de Bruxelles - ULB, CPI 264/1, Avenue Franklin Roosevelt 50, B-1050 Brussels, Belgium

⁴Laboratory of Plant Biology and Nature Management, Vrije Universiteit Brussel - VUB, Pleinlaan 2, B-1050 Brussels, Belgium

⁵Mineral and Geosciences Department of Malaysia, Lantai 20, Bangunan Tabung Haji, Jalan Tun Razak, 50658 Kuala Lumpur, Malaysia

⁶Petroleum Resource Exploration Malaysia Petroleum Management, PETRONAS, Level 16, Tower 1, PETRONAS Twin Towers Kuala Lumpur City Centre, 50088 Kuala Lumpur, Malaysia

*Corresponding author: fatinizzatiminhat@gmail.com

Foraminiferal assemblages can provide reliable analogues for understanding changes in the marine environment. Previous studies suggested that the modern foraminiferal assemblages are vertically zoned with respect to tidal level and can be used as analogues to predict the previous sea-level changes during the Holocene. Despite the extensive investigation of foraminifera elsewhere in the world, studies around peninsular Malaysia are limited and focused mainly on documenting the distribution of foraminifera in nearshore environments such as mangrove swamps and lagoon/estuaries. We examined the ecological distribution of subtidal benthic foraminifera on the coast of Langkawi-Kedah. Sixty-six benthic foraminiferal species have been identified from 18 sediment samples in Langkawi-Kedah waters. Of these, 25 species had >2% abundance and 10 species were common (10-20%) in the total (live + dead) dataset. Similar to Penang coastal waters, the predominance of *Ammonia tepida* in all stations can be observed from Langkawi-Kedah.

Other common species include *Ammobaculites exiguus*, *Haplophragmoides* cf. *H. caraviensi*, *Textularia* aff. *T. earlandi*, *Quinqueloculina seminulum*, *Asterorotalia* cf. *A. pulchella*, *Nonion suburgidum* and *Pararotalia ozawai*. Calcareous-hyaline comprised 78% of foraminiferal assemblages in Langkawi- Kedah waters, followed by agglutinated (20%) and calcareous-porcelaneous (2%) groups. The total variance in data produced by CCA was 70% with eigenvalue scores for axes one and two of 0.322 and 0.141 respectively. The CCA analysis showed that dissolved oxygen, weight-percentage of clay and depth have greatest influence on the species distribution in Langkawi-Kedah waters. The assemblages off Langkawi-Kedah are related primarily to depth, dissolved oxygen and sediment characteristics. Therefore, the changes of foraminiferal species with depth, off Langkawi-Kedah coastal waters can potentially serve as indicator for sea-level reconstruction.