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**Paleogene Planktonic Foraminiferal  
Biostratigraphy of the Sulaiman Range, Southern  
Indus Basin, Pakistan**

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## ABSTRACT

The Paleogene marine sequences are well exposed in several sections throughout the Sulaiman Range, Southern Indus Basin, Pakistan. In order to study lithostratigraphic and biostratigraphic framework of these Paleogene successions, three representative land sections that exhibit excellent exposures and have undisturbed sequences, were selected. These sections include the Rakhi Nala, Zinda Pir eastern, and Zinda Pir western sections. All these sections are situated in the northeastern margin of the Sulaiman Range in Central Pakistan. These sequences consist of four lithostratigraphic units, the Dunghan, Shaheed Ghat, Baska, and the Kirthar Formations in ascending order. The exposures of the Dunghan Formation are restricted to the central part of anticline. This formation consists mainly of black-colored siltstone with some intercalation of sandstone in the base, and many interbeds of limestone in the upper part. The main lithology of the Shaheed Ghat, Baska and Kirthar Formations is mudstone that is green gray, pale-green gray; brown to chocolate color and is intercalated with thin-bedded limestone in parts.

After detailed route geological mapping and section measurements along all three sections, lithostratigraphic units are revised and new subdivision is given. The Pab Sandstone is renamed as the Pab Formation as it was an informal term for lithostratigraphic unit (Formation). The Shaheed Ghat Formation is revised which includes now the Drug Formation. Moreover, based on field and lab observations, two unconformities are introduced that are between the Dunghan

Formation and the overlying Shaheed Ghat Formation and between the Baska Formation and the Kirthar Formation.

Late Paleocene to early late Eocene Tethyan planktonic foraminifera is studied from these three measured surface sections for taxonomy, biostratigraphy, faunal changes, Paleocene/Eocene boundary transition and for depositional environment.

This sequence has yielded abundant and well-preserved Paleocene-Eocene planktonic foraminifers. A total of 96 species and subspecies that belong to 17 genera were identified and recorded. A new species *Globanomalina rakhiensis* is described from the Rakhi Nala section. Zones P3 to P15 of the tropical zonal schemes were recognized based on identified planktonic fauna recovered from the Paleogene sequences of the Sulaiman Range. Moreover, Zones P3, P4 and P6 are each subdivided into two subzones (Subzones A and B), respectively.

Late Paleocene through early Eocene age is assigned to the Dunghan Formation based on Zones P3 to P8 recognized from it. Zones P6A to P10 are recognized from the Shaheed Ghat Formation and based on them an early Eocene to early-middle Eocene age is assigned to it. The Baska Formation does not yield any determinable planktonic foraminifera, therefore the age assignment remains in question, however, as it lies between the Shaheed Ghat and the Kirthar Formations, therefore from its stratigraphic position, it may have the age of early middle Eocene. Lower part of the Kirthar Formation (Pir Koh Limestone and Sirki

Members) does not produce any determinable planktonic foraminifera. However, the upper part (Pir Koh Limestone and Marl Member, and Drazinda Member) has produced well preserved planktonic foraminifera based on which P12 to P15 zones are established and therefore middle-middle Eocene to early-late Eocene age is assigned it.

The species relative abundance data indicates some faunal turnovers have occurred at the Zones P3A/B and P4B/P5 boundary or within Zone P5, close to the Paleocene/Eocene boundary.

Paleocene/ Eocene transition boundary is placed within the Zone P5 based on the last appearance datums (LAD) of *Globanomalina pseudomenardii*, *Morozovella velascoensis* and first appearance datums (FAD) of the *M. subbotina*, *Pseudohastigerina wilcoxensis*, *M. formosa gracilis*, *M. formosa formosa*, and *M. lensiformis*. This interpretation is further confirmed by the identification of Benthic Foraminiferal Extinction Event (BFEE) with the Zone P5.

The gray-black colored siltstone sequence of the Dunghan Formation with limestone intercalations were mainly deposited in relatively deep waters since it produced highly diversified planktonic foraminiferal assemblage with higher P-ratios. The Shaheed Ghat Formation is interpreted as deposited in deep to shallow Sea as it contains rich planktonic fauna, planktonic foraminiferal mudstone-wakestone, and platy limestone/mudstone-micrit-dismicrite microfacies in the basal part and contain restricted fauna microfacies in the upper part. The Baska Formation is devoid of pelagic fauna and mainly consists of restricted fauna microfacies with anhydrite facies in the upper part clearly indicate signatures of

regression related very shallow waters environment. Deep to open marine environment of deposition is interpreted for the Kirthar Formation as it has micrite-dismicrite microfacies and pelagic wackestone microfacies in the base followed by restricted fauna to again pelagic wackestone microfacies in the upper part.

**Key words:** *Lithostratigraphy, taxonomy, biostratigraphy, Paleocene/Eocene, planktonic foraminifera, faunal turnover, paleoenvironment, Sulaiman Range, Indus Basin, Pakistan*

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