

Role of Foraminifera in Establishing the Biostratigraphy and Paleoecology of Paleogene Sediments in Kosamba - Valecha – Olpad and Navsari Area in Narmada-Tapti Block of South Cambay Basin, Gujarat, India*

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Expanded Abstract

The southern part of Cambay Basin in Narmada–Tapti block has a number of hydrocarbon occurrences confined to Paleogene sediments belonging to Ankleshvar and Olpad Formations. The area witnessed its first marine transgression during Early Eocene over the epiclastic sediments of Olpad Formation. Detailed biostratigraphic studies have been carried out on the sub-surface Paleogene succession of South Kosamba-Valecha-Olpad-Navsari area of Narmada-Tapti Block. The oldest sedimentary succession of Olpad Formation has given a poor yield of dinoflagellate cysts and mostly devoid of foraminifera/microfauna except for a few ostracods, bivalves, and gastropods. The Olpad sediments were deposited in fresh to brackish water or lacustrine and intertidal paleoenvironments.

The first open marine condition prevailed during Early Eocene corresponding to Cambay Shale Formation as evident from the development of shallow inner shelf conditions inferred on the basis of occurrence of *N. burdigalensis*, *Operculina sp.*, *Assilina spinosa* biofacies in the Valecha-PariyaOlpad-Dumas-Navsari area. The major part of the Early Eocene sections is poorly fossiliferous consisting of gastropods and bivalves, indicating that sediments of these sections were deposited under fresh to brackish water conditions. The Middle Eocene sections corresponding to Hazad Member were laid down in shallow inner neritic condition in south Kosamba area (arenaceous foraminifers) while comparatively deeper bathymetry existed in Pariya and Valecha area as indicated by the presence of *C. martini*, *Halkyardia minima*, and *Hantkenia dumbeli*. Further to the south at Navsari this section (1265- 1220m) was deposited under more than 100m of paleobathymetry as indicated by the presence of rich assemblage of planktic foraminifera such as *Acrinina brodermanni*, *Bulimina sp.*, *Turborotalia cerrozulensis*, *T. C. frontosa*, *T. boweri*, *Uverigerina schwageri*, *Globigerina inequispira*, *G. maxicana*, *G. eoacena*, *G. cryptomorpha*, and *G. senni*. High planktic benthic ratio and

pyritised microgastropods are suggestive of anoxic conditions at this location. Biostratigraphically well established Middle Eocene marker species viz. *Hantkenina dumbeli* and *Halkyardia minima* are encountered which are indicative of deeper paleobathymetry and supports linkage between Cambay Basin and Bombay offshore having similar reported assemblage. The Hazad Member is overlain by the Kanwa Shale which has been dated as late Middle Eocene on the basis of *Chiloguembelina* biofacies.

Late Eocene succession is uniformly developed in the entire area which represents Ardol and Telwa Members of Ankleshver Formation. This succession is represented by mainly *Discocyclus dispansa*, *Pellatispira madraszi*, *Nummulites chavannesi*, and *N. fabianii* and is identified in wells Valecha #1 (540-760m), Kosamba #25 (670-720m), Kosamba #34 (535-780m), Olpad #21 (1250-1400m), Olpad # 20 (1020-1270m), Pariya #1 (1070-119m), Dumas # 1 (1430-1660m) and Navsari #1 (1150- 1220m). The lower part of Ardol Member was deposited under shallower sea while the upper part was laid down under inner to middle shelf conditions. During deposition of the upper part of Ardol and Telwa Members, deep shelf conditions prevailed as indicated by the presence of *Uvigerina sp.*, *Globorotalia sp.*, and *Lenticulina sp.* in the Olpad-Dumas-Navsari area while inner shelf conditions prevailed in Pariya, Valecha, and South Kosamba area as shown by the presence of *Nummulites sp* and *Discocyclus sp.* The Late Eocene transgression continued probably without break into the Early Oligocene with gradual fall in bathymetry.

The Early Oligocene succession in this area could be identified based on *N. fichteli*, *N. vascus*, *Globigerina opima nana*, and *Cassigerinella chipolensis*. During Early Oligocene inner shelf conditions of 20 to 30m existed as inferred from occurrence of *Rotalia 1840/3 – Cassigerinella chipolensis* in Surat, Puna, and Pariya area while shallower bathymetry is inferred in Valecha, South Kosamba and Navsari area as indicated by the presence of *N. fichteli-N. vascus* biofacies. Pandey et al., 1993, correlated wells of Narmada block with Bombay offshore wells and opined that *N. fabianii retiatius* terminates along with *N. pengaronensis* assemblage within the zones P-15 to P-18 whereas *C. chiploensis* terminates at P18-P19/20.

The present study indicates that Early Eocene transgression uniformly engulfed the study area for a short span. The subsequent transgression during Late Eocene was most pronounced with minor interruptions which resulted in deposition of upper part of Ankleshvar Formation. This transgression continued upwards without any break in Early Oligocene time and there after marine conditions were completely withdrawn.

Six biostratigraphic levels have been identified in the subsurface which are persistent all along the studied section with minor exception. They include : (i) *Nummulites burdigalensis* of Early Eocene in Older Cambay Shale Formation, (ii) Acme of arenaceous foraminifers of Middle Eocene (iii) *Chiloguembelina martini - C. mauriciana* of Middle Eocene, Kanwa Member of Ankleshvar Formation (iv) *Pellatispira madraszi* of Late Eocene (v) LAD of *Nummulites fabianii* towards the top of Late Eocene (vi) *N. fichteli - Cassigerinella chipolensis* in Early Oligocene.

Total of three hiatuses have been marked, of which two hiatuses of 2ma between Early-Middle Eocene and Middle–Late Eocene (2ma each) and between Early Oligocene– Early Miocene (6ma) on the basis of absence of diagnostic foraminifera and flora (Aswal et al., 2010, ONGC Bull., Vol.45, No.1, p. 24-29). This work brings out the dating and envisages the paleodepositional model for Paleogene sedimentary sequence in Kosamba - Valecha – Olpad and Navsari area. In addition to this, biostratigraphic correlation of these fields is also attempted. The overall age boundaries, hiatuses, and paleoecology bears significance in both establishing the seismic markers and anticipate the distribution of reservoir facies in the southern part of Cambay Basin.

Reference

Pandey, A.N., H. Upadhyay, and P.K. Minz, 1993, Lithofacies, depositional environments and reservoir characteristics of middle Eocene sands in Nada area, Cambay Basin, *in* Proceedings of the Second Seminar on Petroliferous Basins of India; West Coast Basins, India Petroleum Publishers, Dehra Dun, India, v. 2, p. 121-126.