

Paper Number: 2609

Sequence Stratigraphic Interpretation of Terminal Cenozoic Succession of Kutch (Sandhan Formation), Western India

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The siliciclastic succession of Sandhan Formation deposited in passive margin sag-basin of western Kutch (India) represents youngest Neogene sediment, witnessed final withdrawal of marine condition from the basin. The succession is exposed along cliffs and banks of Kankawati River (type section) as discontinuous outcrops. Their sedimentation primarily controlled by relative interaction between sea-level fluctuations vis-à-vis siliciclastic supply. The Sandhan Formation has an unconformable contact with underlying Chhasra Formation and gradational contact with overlying Quaternary sediment. The formation shows a typical transition from lower marine to upper fluvial environment. However, it is not yet attended for sedimentology, depositional environments and sequence stratigraphic analysis.

The field based stratigraphic and facies analysis suggests that the lower part (135m) of the formation is deposited in tide to wave dominated shallow marine environment and upper part (157m) in fluvial environment. The process based sedimentological analysis of Sandhan Formation led to identify the following facies in stratigraphic order:1.Conglomerate (regional unconformity),2.Cross-bedded sandstone (backshore),3.Cross-stratified and planer laminated sandstone (upper shoreface), 4.Interbedded sandstone and siltstone (lower shoreface),5.Compound cross-stratified sandstone (intertidal),6.Interbedded siltstone and mudstone (tidal flat),7.Fossiliferous muddy limestone (shallow inner shelf), 8.Inclined graded beds-horizontally laminated sandstone (beach complex), 9.Thinly laminated shale (lagoon),10.Medium to coarse grained sheet sandstone (migrating channels), 11.Medium grained planar laminated tabular sandstone (planar bed flow),12.Tabular cross-stratified coarse to medium grained sandstone (transverse bars),13.Trough cross-stratified coarse grained sandstone, often pebbly (channel floor dunes),14.Thick compound trough cross-stratified sandstone (compound bar),15.Massive pebbly sandstone (channel-lag/flash flood),16.Trough cross-stratified gravel (migrating transverse bars),17.Coarse grained poorly sorted massive matrix supported gravel (gravel bars), 18.Mudstone interbedded with fine silt (overbank fines),19.Calcretised shale and silt with abundant root penetrations (floodplain, paleosol).

The unconformity bounded 292m thick siliciclastic succession is regarded here as a sequence. The facies from conglomerate to fossiliferous muddy limestone (~95m) represents tide affected fining upward succession, is regarded as transgressive systems tract (TST). The shoreline transgression of Sandhan Formation over Chhasra Formation can be observed at many places as coastal onlap. The base of the TST is characterized by basin-wide unconformity between Chhasra and Sandhan Formation indicates a large shift of depositional environment from Burdigalian limestone to post Burdigalian siliciclastics across the unconformity. The muddy limestone rich in oyster, pecten and shallow benthic foraminifera is identified as maximum flooding surface (MFS). The prominent coarsening-upward succession above MFS is characterized by laminated shale (lagoon) and beach barrier complex (95 to 135m) is interpreted as

normal regression of highstand systems tract (HST). The coarsening and thickening upward, horizontal laminations, sharp and erosional base of individual units and abundant trough and tabular cross-stratification indicate wave dominated setting during HST. The HST is bounded at the top by basal surface of forced regression, characterized by abundant fluvial channel lags occurring at top of the beach barrier complex. Thick poorly sorted fluvial sediments of braided nature deposited afterward due to sudden and rapid fall in relative sea-level (?) is regarded as falling stage systems tract (FSST). The fluvial sediments are characterized by variety of architectural elements culminated towards top by thick occurrence of regional paleosol indicates upper sequence boundary. Eventually depositional milieu shifted westward (i.e. present continental shelf of Arabian Sea) and sedimentation/basin closed at onland.

