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Depositional Environment of KG Basin, East Coast of India

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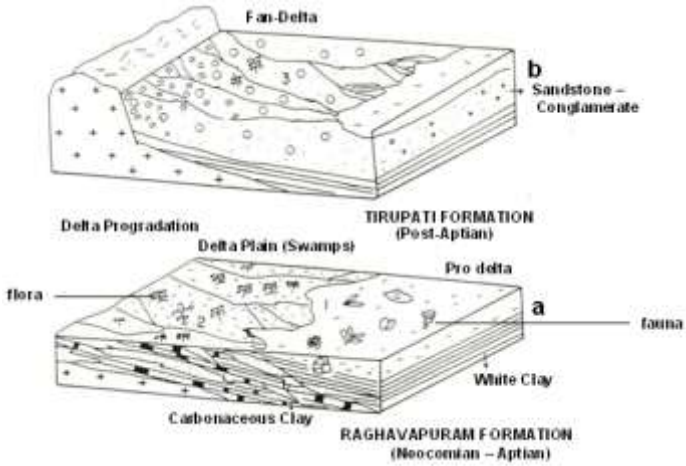
Abstract: By the end of the Upper Jurassic, sedimentation in the Godavari main basin and southern basins were more or less ended. It was, however, followed by the most significant geological event with in the Gondwana Super Continent. India separated from the Gondwana assembly and the eastern margin of the Indian peninsula was positioned at latitude 50^0S and was oriented in an east-west direction (Chatterjee and Ghosh, 1970). The Indian plate has moved north ward, and the eastern continental passive margin rotated 20^0 in counterclockwise direction and tilted to east (Gordon, et al., 1990). Because of this northward Journey of Indian plate, Indian Ocean has opened. Rifting and drifting has followed in the southeastern margin of the Eastern Ghats.At the beginning of Cretaceous, NNE-SSW to NE-SW and E-W faulting that resulted in the further upliftment of basement ridges of the peninsular gneissic complex and the Eastern Ghats Mobile Belt. In between these ridges, a localized basin (Krishna - Godavari basin) existed along the Coastal Gondwana, which was filled with the clay-sandstone sequence of Raghavapuram Formation.

Keywords: Raghavapuram shale, TirupatiSandsstone, Indian Peninsula, Gondwana Super Continent, upliftment.

1. INTRODUCTION

The Krishna-Godavari basin, a pericratonic basin, is located in the central part of the eastern passive continental margin of India. The basin area includes the deltaic plains of the Krishna and Godavari rivers and the interdeltaic regions. Geographically, the basin lies between Kakinada in the northeast and Ongole in the Southwest. Archaean crystalline (Eastern Ghats) rocks acting as the basement on which number of sedimentary rock outcrops ranging from age Triassic to recent are exposed on different parts of the basin. A significant part of the onshore basinal area is covered by Quaternary alluviam. The basin extends southeast into the deep waters of the Bay of Bengal. The Krishna-Godavari basin is located in the southeastern part of the Godavari valley, trending NE-SW and Cretaceous successions comprising Raghavapuram (early Cretaceous) and the Tirupati (middle to late Cretaceous) formations transversely superimpose the Gondwana group of rocks.The study area forms a part of the post Gondwana formations in the Krishna-Godavari basin area. The Raghavapuram formation comprises of clay (shale) dominated with sandstone association, and succeeded by sandstones of Tirupati Formation of Upper Cretaceous age

were taken into consideration for the detailed study of Geology, petrology and geochemistry to understand the paleotectonics, provenance and depositional environments of these rocks of the KG basin area. Clastic sedimentary rocks are indicators of past environments, giving clues even to their geodynamic settings by means of their compositions. The provenance and geodynamic development of shale and sandstone successions can be classified by variety of methods, including petrographic analysis, whole rock chemistry. Above all, clastic sediments can give information on continental and oceanic source regions that have beeneroded or metamorphosed through subsequent tectonic processes (Nesbitt and Young, 1982; McLennan, 1989; MeLennan et al., 1993; Cullers, 1994; Condie et al; 1995). Present study uses the petrographic and geochemical methods on Cretaceous shale and sandstone successions from the parts of Krishna-Godavari basin area to decipher the influence of source rock characteristics, chemical weathering during transport and sedimentation, and post depositional diagenetic reactions, all affecting the chemical record of their compositions and consequently, evidence concerning their parental affinities (Nesbitt, 1979; Cullers et al., 1979, 1987; Banfield and Eggelton, 1989; McLennan, 1989, McLennan et al., 1993; Condie et al., 1995). Here the main question concerning the transgressive and regressive sequences of Cretaceous clastic rocks is that the source area was the same or different. There is a paucity of geochemical data available on the formations of Krishna - Godavari basin in general and Cretaceous formations in particular. In the light of the lack of geochemical data, this is the first time that these clastic rocks were analysed for major, trace and REE's, and their interpretations help to elucidate the paleogeographical conditions of this area. In a more general context, this study offers a chance to understand in detail the effects of the various sedimentary processes on the geochemical signature of sedimentary rocks. Although chemical composition of fine clastic rocks, such as shales, are usually emphasized in geochemical provenance studies, this sample sets also allows direct comparison between sandstones and shales. Comparison of the chemical compositions of the two different lithologies allows an evolution of the control of the hydraulic sorting on elemental distributions.The study area is situated in the West Godavari District, in Andhra Pradesh (Fig.1). The area lies between the Lat. 170101N, Long 810151E, and Lat. 160501N, Long 810401E of Topo sheet numbers 65G/12, 65G/8 and 65G/5. The tract of Raghavapuram shale and Tirupati Formations are cropped out abundantly at Komatigunta.



BLOCK DIAGRAM SHOWING DELTA CYCLE IN THE KG BASIN. (a) AND (b)-DELTA PROGRADATION

2. FIELD OBSERVATIONS : RAGHAVAPURAM SHALE FORMATION

The white-buff, grey/carbonaceous clay assemblage with abundant plant remains indicate a luxuriant plant growth in a swampy/marshy environment. Siltstones and sandstones are stream deposits. The siltstones may indicate deposition in delta front levees whereas the plant debris laden grey sandstone is deposited by delta plain distributaries. The probable depositional setting envisioned for clay and sandstone of Gopalapuram area is delta plain swamps/marshes and delta plain distributaries. Well preserved floral impressions along with foraminifera in white clay envisage a depositional setting that had experienced both the terrestrial and marine influence. Such clay/silt accumulation with a mix of terrestrial floras and marine fanna is prodelta/shallow marine environment (Fig. 46). Further towards east in subsurface sections the Raghavapuram Formation is interpreted to be mainly a marine sequence (Moinuddin et al., 1993). Thus, the litho assemblage of the Raghavapuram Formation deposited in a laterally linked sedimentary regime i.e., Swamps/Marshes with delta plain in the landward i.e West/North West and Prodelta/Shallow marine in East and South East. Active sea ward progradation of delta enables that the prodelta clays are to be overlain by delta front silts/sands and these in turn by distributory mouth bar deposits, mainly sands.The base of Raghavapuram Formation is a prominent unconformity. The prodelta and the delta plain sedimentation in the Raghavapuram Formation is the cause and effect of the advent of sea along the eastern part of the peninsular India where otherwise a landmass that supplied detritus to continental Gondwanas had existed until the end of the Jurassic. This is believed to be due to the separation of landmass in the south east. Therefore, the base of the Raghavapuram Formation can be designated as break-up unconformity.

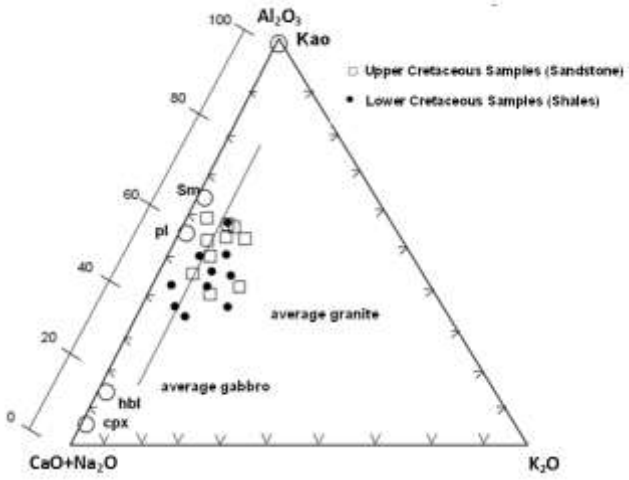
3. TIRUPATI SANDSTONE FORMATION

The sandstone - conglomerate assemblage of the TirupatiFormation records an influx of coarse - detritus in to Krishna-Godavari basin possibly facilitated by the basement upliftment in the Northwest in the Eastern Ghats Group of rocks. There appeared in prominent south-easterly flowing paleodrainage. Petrographic composition of sandstones point to a westerly provenance represented by Peninsular Gneissic Complex, Eastern Ghats Granulite belt. These sandstones shows coarsening up tendency, which is known from tidal, shallow marine, delta and fault controlled alluvial settings. Conglomerates may represent gravel bar in alluvial fan or braided stream whereas very coarse grained sands to granule indicates a rapid deposition from high concentrate suspension in easterly flowing steams It is interpreted that the Cretaceous Formations in the Krishna-Godavari basin was deposited in a prograding delta. Raghavapuram Formation was upward gradation from silty shale to mudstone with interbedded sandstone beds probably represents deposition on the muddy slope of a prodelta. The overlying Tirupati Sandstone beds, which subtly coarsen upward and mostly display grading, are intrapreted as delta front deposits. The abrupt end of

sandstone facies may represent abandonment of the delta lobe before more proximal facies were deposited at this site. At the end of the Cretaceous, the basin gradient became gentle and a marine incursion had taken place and infratrappean (limestone) beds were deposited. The Cretaceous delta cycle was terminated by the onset of the K/T boundary volcanism.

4. RESULTS AND DISCUSSIONS:

Lower Cretaceous successions and the minor occurrence or absence of coarse clastic at the bottom of the successions may be explained by this horst-graben topography. Then, s the basin gradually deepened with its smooth base topography and with possible decrease in tectonic activity, the shales and clay were deposited abundantly. The basin was filled gradually with fine grained detritus. A likely tectonic scenario may have involved a reverse in tectonic style from extension to compression and development of an active margin along the western border of the Krishna-Godavari basin, where Archaean Eastern Ghats Group of rocks and Peninsular Gneissic rocks are present. All the data suggest that tectonically relatively stable period and oxidizing climate conditions in the source areas prevailed during the deposition of the RaghavapuramShales. The deposition of shales to Tirupati sandstones in the Upper Cretaceous age may be interpreted as a transition from a tectonically stable situation to an unstable one, and as initiation of uplift in the source area. Consequently, there was a change in the weathering conditions of the source areas, such as from intensely oxidizing weathering to predominantly physical weathering and transportation of coarse detritus in to the basin.



Al_2O_3-($CaO+Na_2O$)-K_2O (A-CN-K) DIAGRAM FOR LOWER CRETACEOUS SHALES AND UPPER CRETACEOUS SANDSTONES OF KG BASIN AREA. SELECTED ROCK AND MINERAL COMPOSITIONS AND WEATHERING TRENDS (AFTER NESBITT AND YOUNG 1984) ARE GIVEN KaO-KAOLINITE, sm-SMECTITE, pl-PLAGIOCLASE, hbl-HORNBLENDE, cpx-CLINOPYROXENE; AVERAGE GRANITED AND GABBRO FROM NESBITT AND YOUNG (1984).

5. CONCLUSIONS

Raghavapuram shale formations are exposed in a linear NESW trending belt. Raghavapuram shale formation is underlain by the Precambrian igneous and metamorphic complex (Eastern Ghats) in most of the area. Locally at Jangareddigudum area this shale formation is underlain by the Kota formation of Jurassic age. Raghavapuram shale formations show conformable contact and have transversely superimposes the Gondwana formations which occur in the main Godavari sub-basins. The Lower Cretaceous Raghavapuram shale formation is mostly

composed of white, buff and lilac clay with thin lenses of siltstone, mudstone and sandstones. These lenses of coarse grained lithologies are dominates in the upper part of the shale formation. Horizontal stratification and parting are the main structures present in the Raghavapuram shale formation.Tirupati sandstone formation consists of red clasticlithologies mostly sandstone. Minor units in this formation include siltstone, chert and shale. Grain size gradually increases upward with in this formation.

Sandstones of Tiruapati formation are immature and moderately sorted. These sandstones are defined as lithic wacke and lithic arenite type. Majority of Upper Cretaceous Tirupati sandstones plot in the basement uplift to transitional arc field Lithic fragments constitute about 30% in the sandstones. Lithic fragments include charnockite, rhyolite and dacite fragments and basement uplift category of the provenance field.Provenance studies indicate that at least two types of rocks were exposed in the source area and provide detritus to the basin, consisting of a dominant felsic and sub ordinate mafic source.

6. REFERENCES

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