ABSTRACT

The coastline of Orissa is endowed with a number of multi-mineral placer deposits. The present study is focused on textural, mineralogical, geochemical, radiometric and environmental radioactivity studies of beach placer deposits along the coast of Orissa.

The beach sediments of Chhatrapur beach placer deposit are medium grained, well sorted, positively skewed and platykurtic in nature. The Erasama beach placer deposits are fine grained, well sorted, symmetrically skewed and mesokurtic in nature. The grain size differences in both the placer deposits could be due to hydraulic fractionation of heavy minerals by size, shape, density contrast and local wave regimes on the coast. The sediments undergo littoral zone transport and sorting depends on the hydrodynamics conditions along the coast.

Heavy mineral sand provinces occur along the coast of Chhatrapur and Erasama beach placer deposits, along the coast of Orissa. They are rich in heavy mineral sand resources, such as ilmenite, garnet, sillimanite, rutile, zircon and monazites in an economically viable concentration. These beach placer deposits, were characterized by different geological processes such as a high-energy wave regime, relative tectonic stability, long periods of weathering and erosion, supply of heavy minerals from suitable source rocks in the nearby hinterland rocks and reworking of mineral sands during the Quaternary period.

Geochemical analyses of monazite and ilmenite sands were carried out by proton induced X-ray emission (PIXE), energy disperisve X-ray fluorescence (EDXRF) and electron probe microanalysis techniques. Monazites are enriched in Th and light rare earth elements (LREE: La - Sm). Higher concentrations of ThO_2, greater than 8.00 wt%, are found in monazites, which suggests that high grade metamorphics such as granulite facies metamorphic rocks being the principal source rocks. Chondrite-normalized REE distribution pattern of monazite sand grains shows that monazites are uniformly enriched in LREE with prominent negative Eu anomaly, which could be due to the preferential incorporation of lighter lanthanides formed during the partial melting.

Detrital ilmenites shows, TiO_2 concentrations greater than 52 wt%, which suggests that the ilmenites were, formed in high grade metamorphic rocks such as granulite facies rocks. Ti/(Ti+Fe) ratio in ilmenites indicates a lower degree of oxidation. These ilmenites were oxidized by weathering, and underwent a slight en-route or post-accumulation weathering along the coast. Monazites and ilmenites with other heavy mineral sands closely resembles with the mineralogical composition of rocks such as khondalites, charnockites, leptynites, pegmatites and other metasediments, which were possibly derived from the Eastern Ghats Group of rocks.

Radiometric studies were carried out for the quantitative estimation of radioactive elements (^{232}Th, ^{238}U and ^{40}K) in the beach sediments. Contrasting radiometric signatures of bulk sands, light, heavy and individual mineral fractions, can be applied to discriminate between sediments derived from different provenance terrains. Based on contrasting radiometric signatures of monazite and zircon fractions of Chhatrapur and Erasama beach placer deposits, which indicates that they were derived from different provenance terrains. Also contrasting radiometric characteristics of ilmenites from different regions shows difference in activity concentrations of ^{232}Th and ^{238}U. Fine grain sediments shows higher levels of radioactivity. High resolution radiometric techniques can discuss a broad spectrum of applications in sedimentology, mineralogy and geochemical characteristics of beach placers.

Natural high background radiation areas occur along the coast of Orissa. Monazite and zircon sand grains are enriched in higher concentrations of radioactive elements and emit higher levels of radiation. Based on the higher levels of radioactivity, gamma absorbed dose rates and annual external equivalent dose rates, these regions can be considered as natural high background radiation areas (HBRA), and are comparable to other monazite sand bearing HBRAs in southern and southwestern coastal tracts of India, as well as other similar areas in different parts of the world.