Red Sediments from Visakhapatnam, Andhra Pradesh

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Abstract

The bad lands or high lands referred earlier from Visakhapatnam are now termed as 'Red Sediments'. The mineralogical approach with reference to statistical studies of zircon from inland and coastal red sediments of Visakhapatnam supports their khondalite parentage. The pebbly and lateritic gravel-silt zones at the bottom of coastal red sediments indicate the different stages of deposition by fluvial processes. The climatic changes from cold to arid along the East Coast of India indicate that the process of formation of red sediments has set in around 11,000 years B.P. The recent archaeological evidence of microliths in the bottom lateritic gravel-silt zones and top red sediments towards Coast reveals the period of transportation and deposition during 7,000 years B.P. and 3,000 years B.P.

Introduction

The red sediments, characterized by badland like topography are closely associated with the khondalite hills along the flanks and mostly in valleys surrounded by hills in Visakhapatnam district. Area west of Dr. V. S. Krishna College in Visakhapatnam proper and areas around Aganampudi, Kantakapalli and Anakapalli in

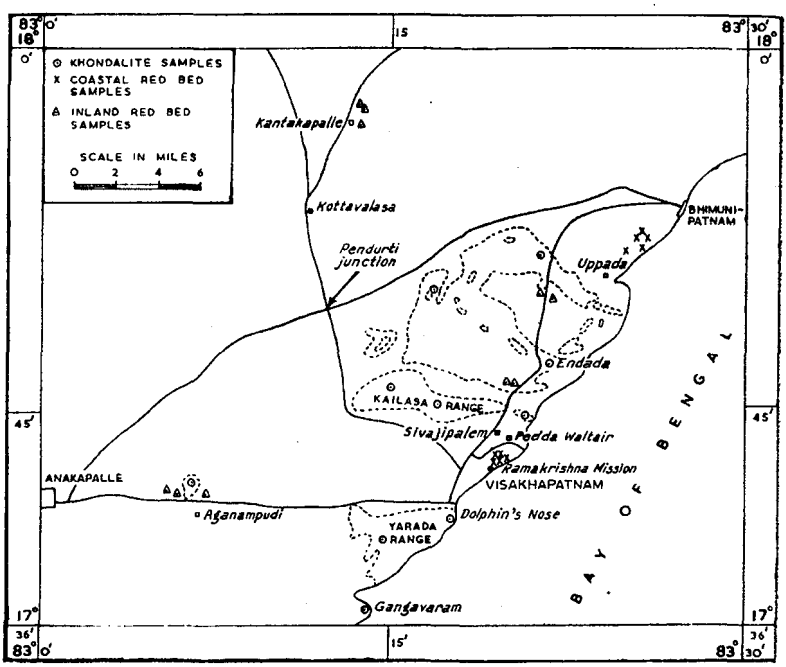

Figure 1. Major places of occurrence of Red Sediments around Visakhapatnam with localities of samples subjected to Zircon studies.

Visakhapatnam district are some of the examples. The red sediments along the Visakhapatnam coast, which attract attention, form a semicircle around the Kailasa and Yarada ranges from south of Sivajipalem on the Visakhapatnam - Bhimunipatnam road through Pedda Waltair to the Ramakrishna Mission in a clockwise direction (Fig. 1). Similar and much more prominent red sediments with a maximum

thickness of 100 feet attaining heights of 200-250 feet above the present sea level are seen southwest of Bhimunipatnam. The red sediments being the loamy deposit with ferruginous clay and silt as matrix, yield easily to rainfall and display the extremely intricate dendritic drainage pattern in the form of projecting land bits and irregularly cut channels (Fig. 2), This distinctly dissected surface of the red sediments was described as bad lands by King (1886) based on topography. Mahadevan and Sathapathi (1949) and Vishnuvardhan Rao and Durga Prasada Rao (1968) have referred to them as highlands.

Figure 2. Topography of Red Sediments.

The terms ' Bad lands ' referring to topography and ' High lands ' often referring to the newly emerged mountain ranges following uplift do not seem to be appropriate. The term ' Red Sediments ' is preferred based on the appearance, composition, origin, considerable extent and thickness.

Mineralogy and Chemistry of Red Sediments

The red sediments in association with the khondalite hills gave average values of mineral assemblage: quartz 55-60%, heavies 10-15%, ferruginous clay 10-11%, and silt 20%. The heavies comprise appreciable amounts of sillimanite, garnet (rich in almandine, 60 to 75%, and pyrope, 20-30%, molecules), magnetite, ilmenite, zircon, monazite and minor amounts of biotite, graphite and hypersthene. The mineral assemblages of the red sediments, taking clay and silt to be the altered potash feldspar and sillimanite, compare well with that of a typical khondalite having average mode: quartz 50-55%, orthoclase 15-20%, sillimanite 15%, garnet 12% and ores 3%. The average chemical analysis of red sediments gave 65-75% SiO_2, 10-15% Al_2O_3 and 9-12% total iron. Apart from the general representation of modes and compositions of inland red sediments and khondalites, the heavy minerals from the coastal red sediments and the beach having identical composition and properties with those of the khondalite minerals point out their definite derivation from khondalite group, representing mainly garnet-sillimanite-orthoclase-biotite-graphite gneisses and intercalations of quartzites, often garnet and sillimanite bearing. Calc-granulites

and limestones which are of restricted occurrence might have been removed in solution as calcium carbonate. Very minor proportions of hypersthene, monazite and slender euhedral zircons, coloured and zoned, in the red sediments indicate that the wastage of charnockites although extensive is meagre because of their occurrence only at depth.

The ferruginous clay has 15-20% iron which is in the Fe_2O_3 state. This oxidised hematite must have formed from magnetite, ilmenite, garnet and biotite. The alteration of magnetite and ilmenite to scales of hematite is pronounced and the uniform coloration of red beds requires a special mechanism that mobilized and distributed hematite throughout the beds. This may be related to the circulation of water and compaction of sediments.

Zircon studies from Red Sediments and Khondalites

The refractory nature of zircons and its consequent utility in petrogenesis are well known. Detailed studies of zircons in the beach sands along East Coast of India have been made (Venkataratnam and Rao, 1968). They have indicated that the zircons along the Visakhapatnam coast were mainly derived from khondalitic rocks. The striking similarity of the rounded nature of zircons observed from the red sediments with those of beach sand and source rocks, khondalites, has necessitated statistical studies to confirm the parentage. The pure zircon crops in all the samples studied from red sediments and khondalites (Fig. 1) are predominantly well rounded (90-95%) and colourless. Overgrowths having rounded nuclei are present and on an average show 6%, grains. Maxima occur in the elongation frequency curves at 1.1–1.2 in all the samples studied. The mean angle $\bar{\theta}$ is 15-20° and the coefficient of variation V ranges from 75-90 in the khondalites and also in the red sediments associated with the khondalites and confined to the Coast. In the samples studied, the mean size in the RMA is $\bar{X}$: 0.04-0.055 mm $\bar{Y}$: 0.03-0.044 mm and slope angle : 36-41°. The zircon shapes and statistical parameters from the khondalites and red sediments of Visakhapatnam district significantly compare with the zircons studied from khondalites from Orissa and Andhra Pradesh by Murthy and Siddiquie (1964). This denotes that the rounded stable zircons from khondalites have remained unchanged in the red sediments representing a single cycle of sedimentation. The minor proportion of euhedral zircons in the red sediments characterises their charnockite derivation and supports the single sedimentary cycle.

Origin and age of Red Sediments

Controversial opinions were expressed about the origin of red sediments around Waltair in Visakhapatnam district. The red sediments having badland topography around Vizag represent the denudational remnants of a great sand bank of Pliocene times or isolated banks formed around the then sunken hills. They have formed by the cumulative work of wind and running water (Mahadevan and Sathapathi, 1949). They were considered to represent the dune environment (Vishnuvardhan Rao and Durga Prasada Rao, 1968) based on different size parameters and the scatter plots. The different size parameters and the scatter plots for the coastal red sediments and the sediments closely associated with the khondalite hills farther inland away from the coast where there is transportation and deposition by water indicate fairly similar results. The mineralogical proportions, compositions and statistical parameters of zircon in both the types of red sediments indicate their original derivation from khondalites.

The occasional presence of a pebbly zone made up of rounded to semi-rounded

khondalite, quartzite and granite, underlain and overlain at places by lateritic gravel and silt found at the base of coastal red sediments supports the fluvial origin. The sequence suggests that the materials were transported and deposited in a number of stages. The delivery of the red sediments into the sea was not considerably effective and were deposited against sea either because of the unfavourable gradient of the land or due to sea level rise at that time. The rise in sea level to heights of 30 feet above the present sea level has left wave cut benches and notch structures in the hills along the Visakhapatnam coast (Bhaskara Rao and Vaidyanadhan, 1975). The red sediments in a near shore environment readily contribute material periodically to the beach through water agency during wet seasons. Losing their colour by the processing of sea waves, considerable parts of the same will be transported away from the sea to give rise to dunes along the beach and as well covering to a great extent the same parent red sediments and khondalites.

The world-wide landforms reveal that a majority of them date back to 20 m.y. The climate has changed from cold to warm conditions along the East Coast around 10,800 years B.P. (Naidu, 1968) and initiated the process of formation of red sediments from khondalites in the Eastern Ghats. The recent findings of microliths in the lateritic gravel and silt zones at the bottom and in the overlying red sediments towards coast have indicated Mesolithic cultural level – 5,000 B.C. and Neolithic culture – 2,000-1,000 B.C respectively (Reddy, 1977). Based on the climatic changes and the archaeological evidence it can be concluded that the process of formation of red sediments has set in around 11,000 years B.P. and transportation and deposition by fluvial process towards Coast began around 7,000 years B.P. and continued till almost 3,000 years B.P.

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