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Estimation of Heavy Mineral Resources in Bendi Coast, Srikakulam District, their Techniques Involved in Separating the Individual Minerals from Raw Sand

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Abstract :

The State of Andhra Pradesh lying along the east coast of India within latitudes 12°14' – 19°54' North and longitude 76°50' – 84°50' East, has an area of about 1, 55,842 Sq.km and 700 km of coastline against Bay of Bengal to the east. Bulk of the rocks exposed in Andhra Pradesh belongs to the Precambrian Eon represented by both Archean and Proterozoic Eras.

Eastern Ghats Mobile Belt (EGMB). It extends for over 1000 km from Odisha to southeastern parts of Andhra Pradesh along the east coast of the Indian Peninsula, representing one of the most highly deformed and metamorphosed crustal segment of the Indian Shield. The Gohira – Sukinda shear/thrust belt separates it from the Eastern Indian Craton lying to the north. The eastern margin of the belt is truncated by Bay of Bengal.

The western margin of the belt has a trusted contact with the Bastar Craton. It is characterized by a distinctive association of garnetiferous graphite bearing sillimanite schist and gneiss (khondalite) and large masses of charnockite within garnetiferous granite gneiss - migmatite country. The rock types in the EGMB are thus represented by the following major rock associations, viz.

1. Khondalite Group of rocks

2. Charnockite Group of rocks

3. Mafic granulites

4. Meta-ultramafic rocks

5. Migmatitic granitic gneisses/leptynites/granitoids

6. Plutonic alkaline complexes

7. Massif-type anorthosite complexes

Introduction:

Exfoliation weathering is very much common in the migmatised gneisses. Low level laterites occur at places as mound mostly derived from khondalites consists of considerable amounts of iron, magnesium. Coastal sedimentary province consists of beach sand, dune sand and swampy/marshy lands containing considerable amounts of silt and clay admixed with sand. The important geomorphic landforms along the coast are Bendi creek, estuary, tidal swamps, spit, foreshore, high tidal line, back shore, berm, embryo dunes, beach ridge, sand dunes, residual hills and promontories. Bendi creek drains through hinterland areas and joins with the sea at Vajrapukotturu village and forms an estuary with it's mouth located at 2.00km NE of Nuvvalarevu village.

The location of estuarine mouth is not a static one and dynamic. Formation of the spit restricts the direct entry of creek waters into the sea and thus creek waters flows NE direction due to long shore drift.The area has well developed beach zone upto 100m width with a foreshore area (inter tidal zone) of up to 20m. Well to moderately developed beach ridge is one of the important geomorphic feature just parallel to the coast line with an elevation of more than 15m.

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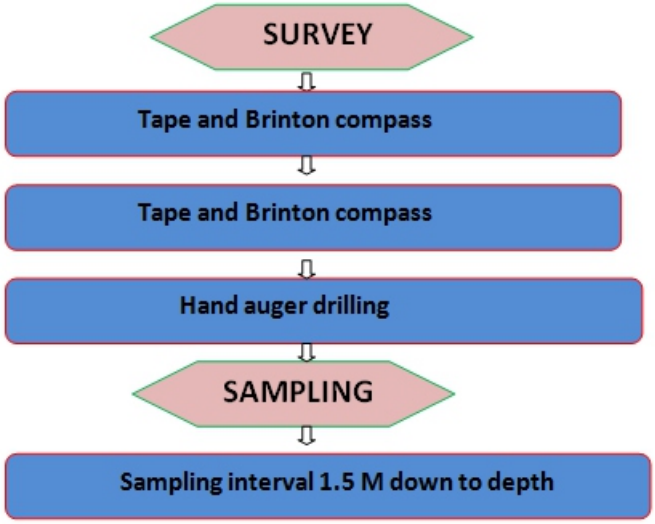
Beach ridge is flanked by either plain sand or sand dunes at places. Embryo dunes formed at the base of beach ridge with some creepers.

EXPLORATION TECHNIQUES IN HEAVY MINERAL RESOURCE EVALUATION:

Placer mineral deposits are evaluated in two stages i.e. field and Laboratory and the generalized flow sheet is given below and each individual general methods are described in brief.

Field Investigations:



Survey:

Tape and Brinton compass method was adopted to carry out the survey work. A Coastal stretch of 1000m north of Kidisingi village has been taken up for evaluation. Boreholes were planned at a grid interval of 200x50m. N450W-S450E three grid lines at an interval of 200m were aligned and along each line, bore holes were fixed at an interval of 50m apart making the grid pattern of 200x50m.

Drilling and sampling:

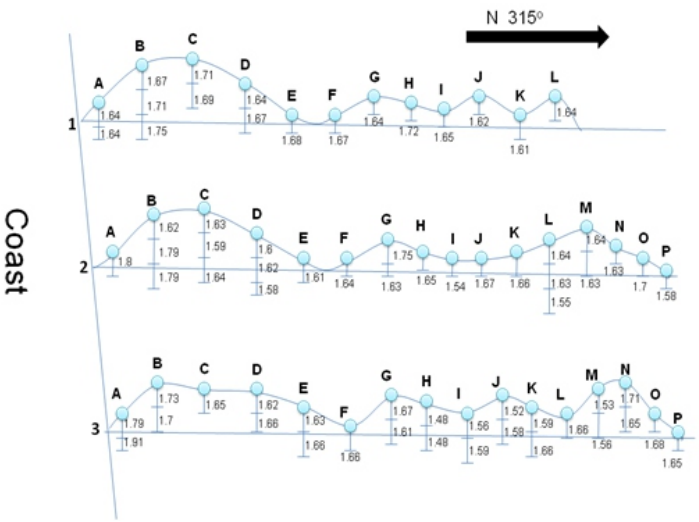
The objective of the drilling is to understand the thickness of the sand column, a third dimension which is required for calculation of resources. Drilling carried out up to water table zone and hand augers were used. The length of the auger is 1.50m and samples were collected at an interval of 1.50m down to depth till the interception of the water table.

By coning and quartering a representative sample was collected from each depth zone. Like this total 70 number of individual samples were collected. Each sample brief lithology is also noted.

Determination of Bulk Density:

Bulk density is an important factor in mineral reserve estimation. It is defined as the weight of the raw sand per unit volume and is represented in gms/cc. It is also referred as the tonnage factor, and is represented in tones/m3. A number of factors influence of the bulk density as heavy mineral concentration, In general the sample is filled in a container of 150cc volume. Samples are generally splitted by using Jhones splitter to avoid sample error.

Two values were taken for each sample and the average is taken for the final bulk density. Like this total seventy individual sample bulk density was determined and the variations of the bulk density with depth along the three profile lines are given in the Fig.Like this bulk densities for the three composite samples were also determined.



Composite sample results

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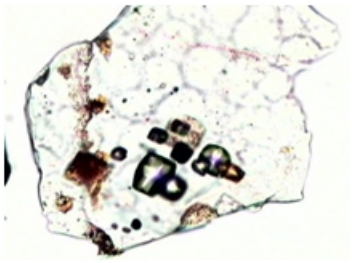
Composite sample no	Slime (%)	Shell (%)	THM (%)	Magnetics (%)	Nonmagnetic (%)
CS-1(Fore)	0.9	0.19	29.99	24.00	5.58
CS-2(Inter)	1.23	0.54	27.22	18.54	6.71
CS-3(Rear)	1.23	0.55	25.41	16.22	7.5

Mineralogical studies:

It is one of the most important parts of reserve estimation as the mineral identification and estimation of grade is dependent on it. Both the quality of microscope used and the individual carrying out the studies is important in petro logical work. A representative sample of Magnetic and Nonmagnetic fraction containing roughly 500 grains and maximum of 1000 grains of each fraction are identified and counted.

Ilmenite

Rutile



Garnet

Sillimanite

Zircon

Composite block area, volume and tonnage:

Composite block No	Area (sq.mts)	Thickness (mts)	Volume Cubic centimeters
CS- 1 (Frontal)	2,60,000	6.86	17,83,600
CS- 2 (Inter)	2,40,000	1.008	9,07200
CS- 3 (Rear)	2,00,000	1.75	12,25,000

INDIVIDUAL HEAVY MINERAL SEPARATION TECHNIQUES:

Based on the physical properties of the minerals like gravity, magnetic, electrical, surface tension individual minerals will be separated from the heavy mineral concentrates. The procedure for each process is discussed below.

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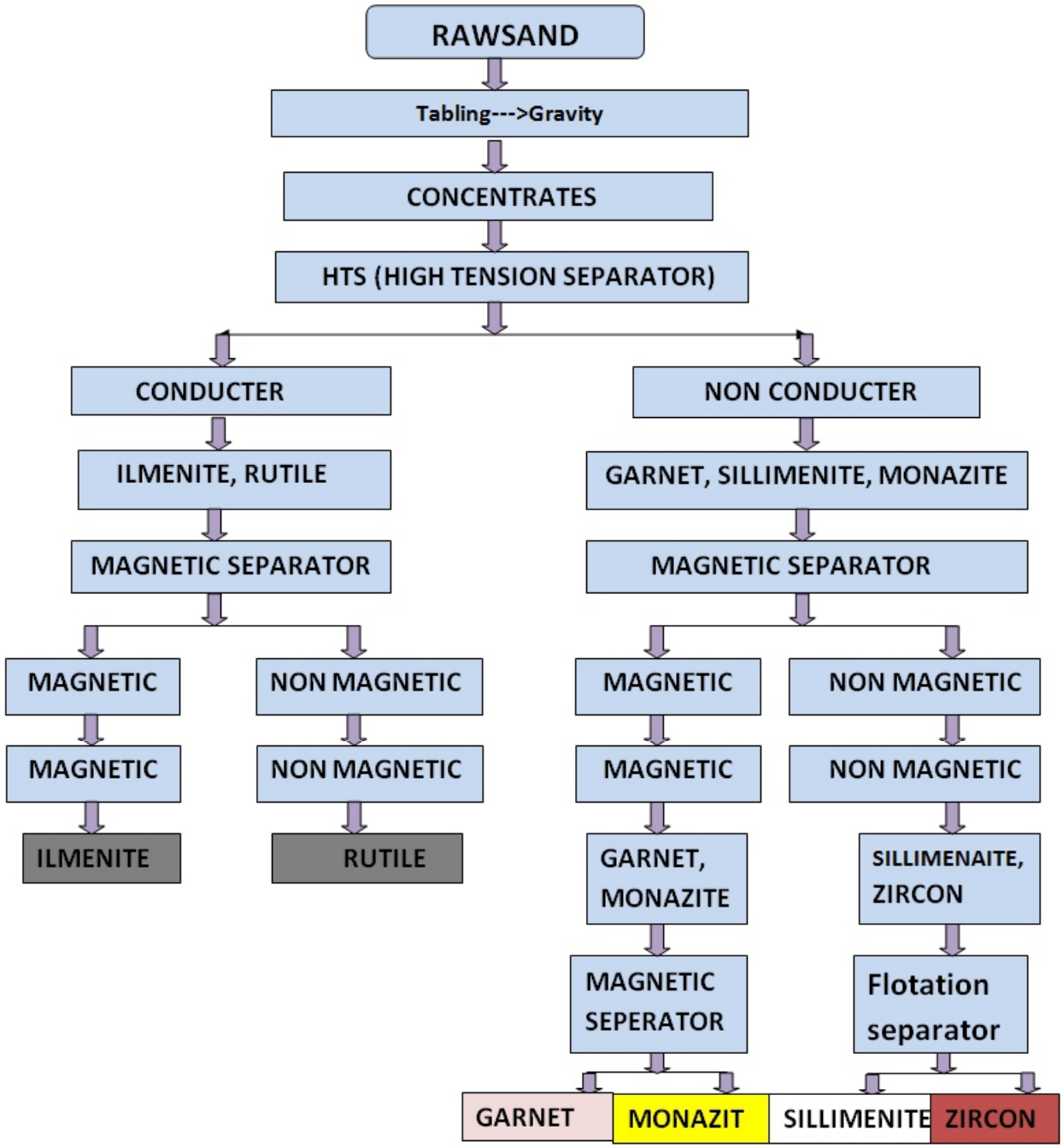

Tabling:

Wet table consists of an inclined deck fitted with riffles. With given reciprocating motion at right angle to the flow of water, heavier minerals settle down in the riffles and concentrates are carried along the diagonal line of the table. The lighter minerals cannot settle in the riffles and are washed along with the water as tailings.

RED:

Rare earth Drum Separators: Rare earth drum separator (REDS) is a kind of magnetic separator which separates the minerals on the basis of their difference in magnetic properties. It works on similar principle as the Induced roll magnetic separator but it differs in its basic construction and its operation. In this the magnetic field is produced by permanent magnets.

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The magnetic element is constructed with the help of blocks of Neodymium Iron and Boron ceramic magnets, Iron or steel pole are not used in this configuration i.e. an ironless design. The magnetic element consists of five main magnetic poles; each pole consists of two magnetic blocks. There are also two trailing poles to provide "Diminishing" magnetic field intensity.

This configuration generates a peak magnetic field intensity of 6-7 Kilogausses on the drum surface. The magnetic circuit remains stationary within the drum shell and spans an arc of approximately 1200. A release mechanism is provided to dislodge minor amounts of ferromagnetic material from the drum surface.

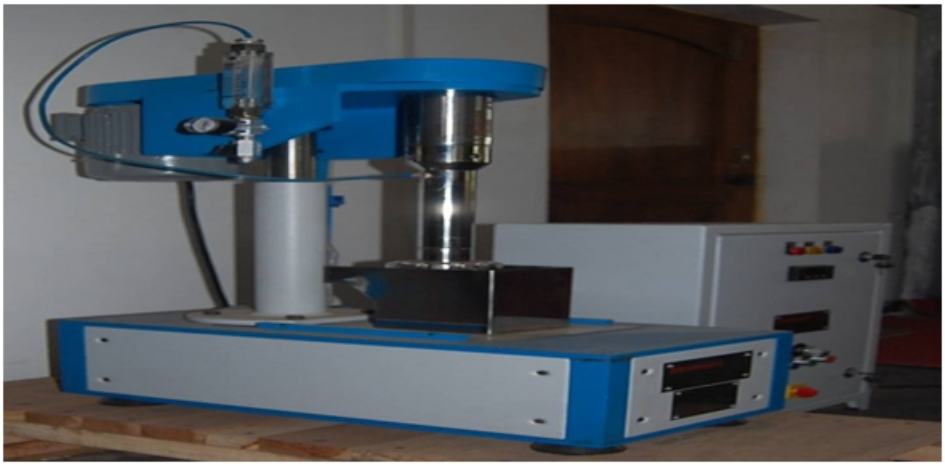
Rare Earth Drum Separator (RED)

Flotation:

Flotation is a process where the desired mineral particles in pulp are selectively floated by their attachment to rising bubbles. In, slurry containing sillimanite and quartz is conditioned in the first stage with sodium silicate, Oleic acid and soda ash.

Operating parameters are:

1) Slurry pH
2) Air pressure
3) Froth depth 4) Reagent dosage 4) Air flow 5) Feed rate 5) Quantity of wash water.



Flotation machine

CONCLUSION:

Khondalites and gneisses in the hinterland areas are subjected to weathering under tropical climatic conditions leading to the transformation of khondalites into low level laterite are the prime source rocks which are contributing the concentration of heavy minerals along this tract.

Red sediments present as dethatched patches just adjacent to laterites are the derivatives of laterities. Based on the position of the dunes with reference to the coast, the dunes have been classified into fore, rear and inter dunal depression zones with varying widths. Compositionally, the sand consists of lights (72.33 to 72.54%), Heavy minerals (25.41 to 29.99%), slime

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(0.89 to 1.23%), shell (0.19 to 0.95%) and magnetite (0.08 to 0.10%).Ninety percent of the heavy minerals constitutes of three major minerals of ilmenite, garnet and sillimanite with sub-ordinate amounts of rutile, zircon, monazite and pyroxene& amphiboles. The average width, thickness and bulk density of the raw sand in frontal, inter and rear dunes are (350m, 2.95m, 1.64gms/cc), (700m, 1.08m, 1.62gms/cc), (450m, 1.75m, 1.61gms/cc) respectively. Based on the industrial applications, these minerals can be classified into. Titanium minerals (ilmenite, rutile and leucoxene), nuclear minerals (monazite and zircon), abrasive mineral (garnet) and refractory mineral (sillimanite). More than 95% of the titanium minerals produced is used in making TIO2.

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