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Grain Size Characteristics & Chemical Composition of Coastal Sands of Chirala, East Coast of India

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The moment and percentile measures indicate the depositional conditions in near shore marine environment for the Chirala white sands. Based on gradational changes in sands and linear nature of the belt extending parallel to the coast, the sand belt is identified to be a sand bar. The growth of the sand bar running parallel to the ancient coast line is related to the action of longshore currents. Grain size distribution and chemical constituents have indicated that the bulk sands and beneficiated sands are useful in foundry jobs and production of green bottle glass respectively.

White sands, containing a high percentage of silica, occur near Chirala along the east coast of India. The characteristics of the white sands for industrial purpose have been described[1,2]. In the present investigation, grain size characteristics and chemical composition of coastal sands of Chirala have been studied to understand the environment of deposition and their industrial importance.

Materials and Methods

The investigated area is a part of the coastal plain, comprising sand bars, sand flats and marshy grounds. Sand samples (120) were collectea from 45 km sand belt between Chinnaganjam and Karlapalem (Fig. 1) following Otto's[3] sedimentation unit. Samples were analysed for textural variations. Sediment samples were washed in the laboratory to remove salt, dried, coned, quartered and sieved using $\frac{1}{2}\ \phi$ interval[4]. The moment measures[5] and percentile measures[6] were computed. Bivariate scatter plots[5,6] were drawn with a view to describing grain size distribution and the depositional environment of the white sand bar. Chemical constituents, viz. SiO_2, Al_2O_3 and Fe_2O_3 were determined[7].

Results and Discussion

Cumulative curves drawn have distinguished 3 varities of sands, viz. fine, medium and coarse sands. Textural analyses of these are given in Table 1. Mean size *vs* standard deviation plot (Fig. 2) shows improvement in sorting with decrease in mean size of the sands. The plots skewness *vs* $<62\ \mu m$ percentage (Fig. 3) indicates that the sediments fall in river and beach environments, suggesting that the river transported sediments are subjected to wave action along the shore.

Depositional environment—Apparent decrease in grain size and improvement in sorting of sediments towards Karlapalem and low percentage of coarse fractions in the sands of the latter indicate the sorting effect of waves and subsequent transport by longshore currents from SW to NE direction. The Gundlakamma, a medium sized river joins the Bay of Bengal about 14 km SW of the sand belt and appears most likely to have transported the sediment.

Distribution of mean grain size and standard deviation values of sediments, elongated nature of the sand belt parallel to the coastline and low percentage of fines (<0.062 mm) suggest that the sediment was kept in motion by longshore currents and deposited as a near shore bar, further acted upon by predominant winds from SE.

Mineralogy and chemical composition—Different varieties of silica sands are subjected to sieving. After sieving the coarse and medium sands, it is found that 90% of the sand is collected in mesh sieves 25, 35, 60 and 100, and 90% of fine silica sands are retained in the mesh sieves 35, 60, 100 and 120.

Mineralogy of the sands was studied to ascertain the nature of impurities associated with quartz in the sands. The results indicate that quartz is the predominant mineral in silica sands. Besides the quartz, feldspar is present in appreciable amounts. Ilmenite, magnetite, hornblende, epidote and zircons are present in minor quantities. Garnet, tourmaline and rutile occur as traces. High percentage of heavy minerals are found in fine sands when compared to the coarse sands and collected in finer sizes. It indicates that the simple processing has improved the silica content and eliminated the impurities.

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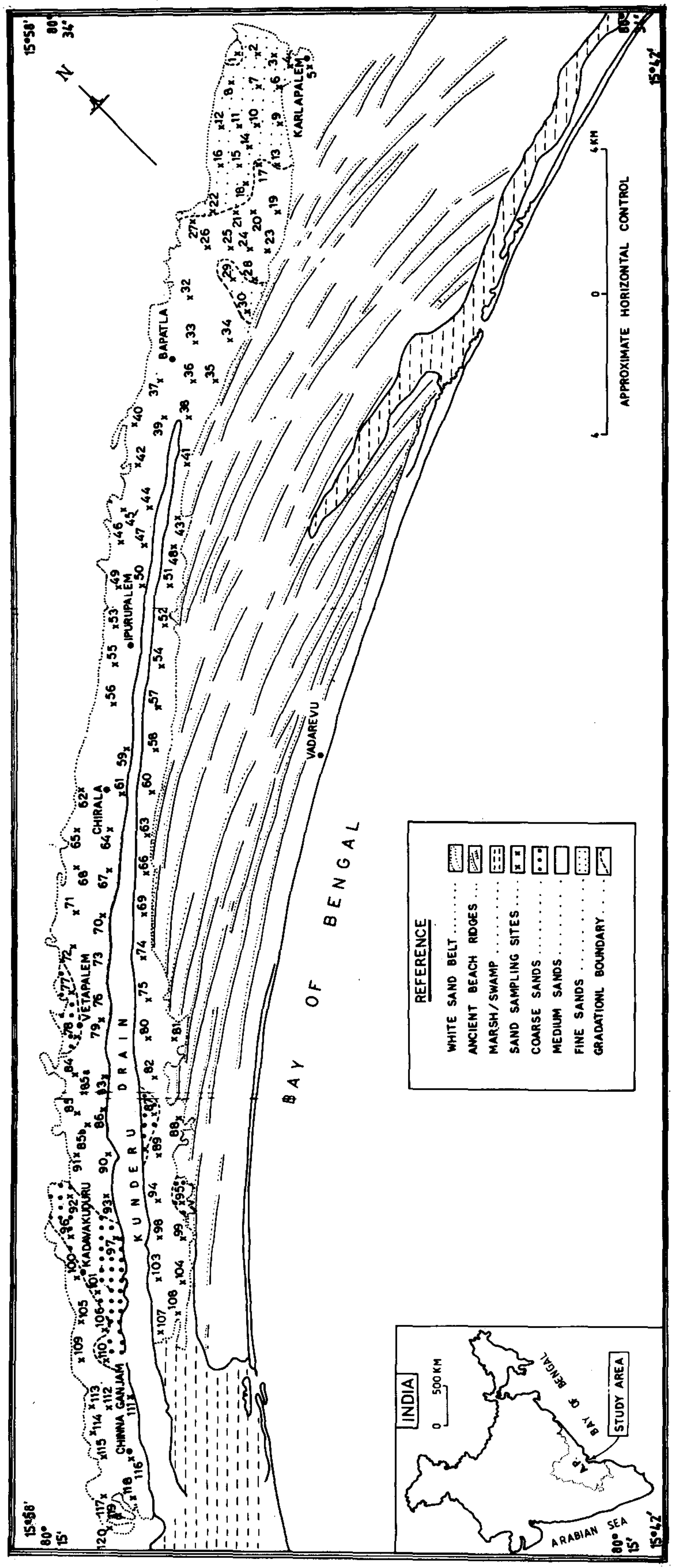

Fig. 1—Location of samples and grain size distribution

Table 1—Textural Parameters of Coarse, Medium and Fine Sands

	Percentile measures		<62 μm	Moment measure (Skewness) (ϕ)
	Mean size (ϕ)	Standard deviation (ϕ)		
Fine sand range	1.86-2.23	0.44-0.63	0.03-0.60	−0.19-0.40
Medium sand range	1.09-1.95	0.52-0.84	0.00-0.55	−0.40-0.57
Coarse sand range	0.71-1.45	0.57-0.82	0.00-0.35	−0.19-0.40

Table 2—Chemical Constituents of Bulk and Processed Sands

[Results expressed in weight percentage]

Chemical constituents	Coarse sand		Medium sand		Fine sand		Green bottle glass	Foundry jobs
	Bulk	Processed	Bulk	Processed	Bulk	Processed		
SiO_2	91.32	92.13	84.85	85.64	87.58	88.52	80	78
Al_2O_3	4.89	3.79	7.28	6.14	4.50	3.38	3-6	10-13
Fe_2O_3	0.30	0.08	1.89	0.14	1.39	0.25	0.3-1.0	2-3

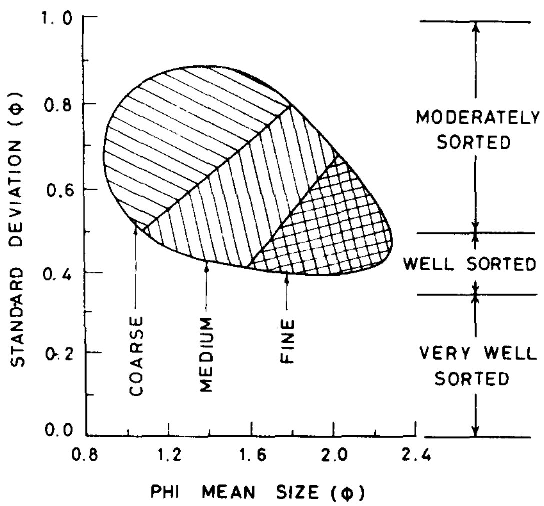

Fig. 2—Mean size *vs* standard deviation

Results of chemical analyses of bulk and processed sands are shown in Table 2. The Chirala sands have more than 84% SiO_2. Al_2O_3 and Fe_2O_3 are below 7.3 and 2% respectively. SiO_2 of glass making sands, in general, should be 97-99% for manufacturing high grade colourless glass, and 80-90% for inferior type, such as green bottle glass[1]. Al_2O_3 and Fe_2O_3 should not be >0.1% for the production of high grade glass and whereas these are allowed up to 7% for the green bottle glass[1]. Sand with higher contents of Al_2O_3 (13%) and Fe_2O_3 (2-3%) and with silica content around 80% are suitable in foundry jobs[1]. The silica sands from the study area as such are found to be useful in foundry jobs and the beneficiated sands have the required specifications to produce the green bottle glass.

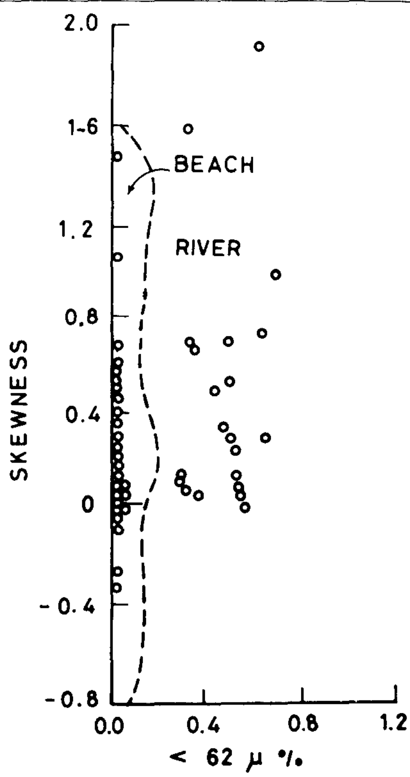

Fig. 3—Skewness *vs* <62 μm percentage

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References

1 Jacob K, *Rec Geol Surv India*, 82 (1956) 603.
2 Rao M G, *Indian Minerals*, 27 (1973) 60.
3 Otto G H, *J Geol*, 41 (1938) 569.
4 Folk R L, in *Petrology of sedimentary rocks* (Hamphill, Austrin, Texas) 1968.
5 Friedman G M, *J Sed Petrol*, 37 (1967) 327.
6 Folk R L & Ward W C, *J Sed Petrol*, 27 (1957) 3.
7 Groves A W, *Silicate analysis* (Thomas Murby & Co, London) 1937, 230.