Journal Geological Society of India, Vol 23, Mar, 1982, pp. 151 to 154

A study of the movement of beach sand at Nizampatnam bay by tracer techniques

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Abstract

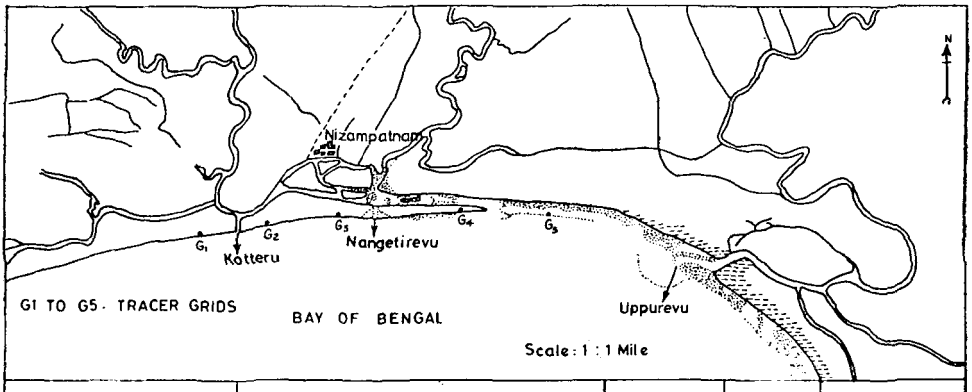
Study shows a predominant direction of sediment movement towards the northeast throughout the area stretching approximately 18 km. More rapid movement is seen in the eastern part of the bay which is closer to the mouth of the Krishna river. Grain velocity is on the increase the accretion of sand material is maximum resulting in greater progradation in this section of the bay.

Introduction

Nizampatnam bay is located on the east coast of India (Fig. 1) in the state of Andhra Pradesh in Guntur district and Rapalle taluq—between longitudes 80°35′

MAP SHOWING NIZAMPATNAM BAY

FIG: 1



METEOROLOGICAL DATA FOR MAY–JUNE 1980	WESTERN SEGMENT	CENTRAL SEGMENT	EASTERN SEGMENT
1 WAVE FRONT DIRECTION	NE	NNE	NE
2 LONGSHORE CURRENT DIRECTION	NE	NE	NE
3 ONSHORE WINDS DIRECTION	W TO E	W TO E	W TO E

and 80°45′ and latitudes 15°50′ and 15°55′. It was a thriving port in the 18th century and was later abandoned due to the problem of silting and progradation of land. Tracer analysis was carried out in the months of May and June 1980 to find out the net drift direction and direction of the longshore currents and on-shore winds and their contribution to the silting up of the Nizampatnam bay.

Morphology

Nizampatnam bay is a low-energy, prograding coast, with weak surf conditions and an average dune height ranging from 1.9 to 2 metres in the western and central parts and decreases to around 0.9 metres nearer the eastern extreme of the area. The eastern part of the area under study forms a part of the Krishna delta, and due to

the effeet of the confluence of river Krishna, maximum sand material is added to this section. Three tidal inlets dissect the beach into three segments (Fig. 1). Of these, Kotteru and Nangetirevu are feeders for the system of backwater canals and marshes located south of Nizampatnam town. The beach stretches from dune top to mean sea level to an average width of 125 to 160 metres. This distance is not the same throughout the area. In the western part of the area where stable conditions of deposition prevail, the beach has a maximum width of 160 metres. As one proceeds eastward the stretch of beach decreases and in the central part it averages 125 m. In the eastern part of the area the dunes are nearest to the sea, where active building up of the coast and progradation is maximum.

Sampling Methods

Fluorescent material (Rhodamine-B) was added to 3 to 6 kg of sand and using a liquid detergent wetting agent, mixed thoroughly. Sampling stations were fixed wherever the dynamic conditions were different in the area. Five sampling stations were taken in five different parts of the area. The sand was released between the swash and breaker zones. Release points were located at the up-current end of a sample grid, allowing the majority of samples to be taken in the area of greatest tracer transport.

Samples were collected on a gird pattern. Polythene material of 3″ × 4″ in size was coated with adhesive material and was pressed into the moving sand by means of a pole to which the polythene material was clipped. The first sample was collected ten minutes after tracer release and the last sixty minutes later, at all the five sampling stations in a 40′ × 30′ grid. 12 to 15 samples were collected from each of the five sampling stations.

The samples were observed under an ultraviolet lamp and the number of flourescent grains were directly counted. Tracer distribution charts were then prepared by applying a correction for a standard elapsed time using tracer concentrations per square inch (Ingle, 1966, Table I p. 44). The standard elapsed time chosen was from 15 to 50 minutes. The corrected results obtained in the counting of flourescent grains in each sample at each location in the grid are shown in Fig. 2.

Discussion

Maximum number of fluorescent grains counted in Grid. No. I was 55 grains per square inch in the ENE direction. The next highest is 32 grains/square inch in the NE part of the grid. In Grid No. II maximum number of grains per square inch observed was 19 and 12 both being in the NE and ENE directions. In Grid No. III also the same trend was observed. In Grids IV and V maximum 43 and 36, 78 grains per square inch respectively were counted in the northeast directions.

The general pattern of sediment movement is seen to be in a northeasterly direction throughout the area, which also is the direction of longshore currents (Fig. 1). The average grain velocity is 3 metres/minute and it increases as one proceeds eastwards in the area i.e., in Grids IV and V. There are more dynamic conditions of deposition in this section. Profile readings show maximum accretion in this part of the area.

Several different factors acting in co-ordination could produce this effect:

1) The effect of the confluence of the river Krishna emptying its load into the Bay of Bengal 15 km east of the area under study, as a consequence of which, the

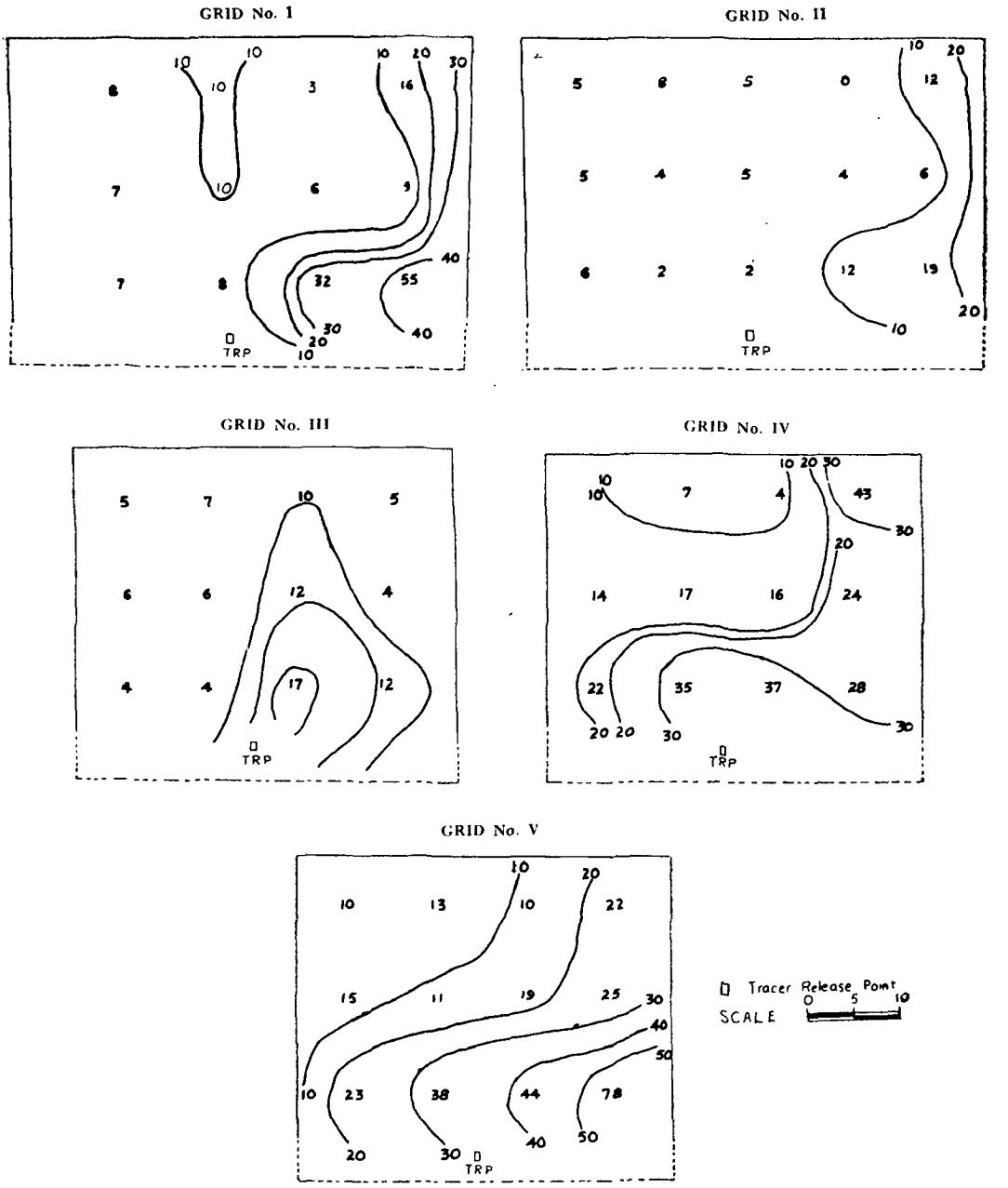


Figure 2. Tracer distribution chart showing tracer concentration per square inch.

tidal inlet got silted up very fast. This effect is seen by considerable changes in level taking place every day.

2) Idealized net drift relationships on a concave shoreline (Watson, 1971) like the one under study, have shown that onshore winds produce wave fronts normal to the wind directions. These wave fronts move shorewards and are completely refracted. As they break, the waves generate a longshore current due to their oblique approach to the shoreline. This current is strongest at the greatest distance from