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RESEARCH ARTICLE

A STUDY ON MORPHODYNAMIC CHARACTERISTICS AND GRAIN SIZE DISTRIBUTION OF COASTAL SEDIMENT BETWEEN MANDAPAM AND VALLINOKKAM, TAMILNADU, INDIA

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ABSTRACT

Morphodynamic classification of beaches has achieved widespread acceptance in both geological and geomorphological literature. Geomorphologic characters of the beaches are shaped by wave's actions directly or indirectly and ultimately induce the sediment transport and the morphological features are curved in relation to beach profiles. Beach morphodynamics is the reaction and interaction of wave height, wave period, tidal range, dune height etc. The aim of the study is to determine the morphodynamic changes based on beach profile, swell characters and granulometric study along the coastal areas of Mandapam to Vallinokkam of Ramanathapuram district located in eastern part of southern Tamilnadu. Morphodynamic condition and changes along the coastal length of 50km are recorded. The distribution of grain size parameters along coastal stretch reveals that the mean grain size of sediments in dune, berm, slope and water level are mainly of medium, fine to coarse grain, moderately sorted, very fine skewed and very leptokurtic to mesokurtic in nature. The Inter-relationship of various parameters shows the natures of sediments in slope, berm and dune having dominance of fine grain to coarse sand distribution. The significance emphasises that the modern sediments in the study area are deposited based on rolling and suspension in field and by mixing of different sizes and class of sediments by wave action. Morphodynamic condition along the study area is characterized as high energy gradient, convex profiles and reflective beaches.

INTRODUCTION

A geomorphologic character of the beaches indirectly and ultimately brings about sediment transport and changes the beach morphology. Beaches act as buffer to wave energy and they are sensitive to any changes and record the variations in the form of sedimentation pattern and morphological changes. This morphology of a beach depends on various parameters and the formation of a beach depends on the function of its sediment characteristics, the natural beach topography and the immediate wave, tide and wind conditions. Several authors have attempted to explain profile variation in terms of sediment size via fall velocity and wave characteristics. However, the study of morphodynamic state of beaches helps in forecasting coastal erosion, marine flooding, siltation etc. In the Rameswaram island, fine geomorphic surfaces, marked by physiognomies land forms and lithology have been \made out. The cuspate foreland of the island, made up of calcareous, sandstone, shell sandstone and shell limestone, is named Pamban surface. The overlaying Teri sand constitutes the sambaimadam surface. The semi-circular promontory in the northern part of the island by tidal deposits indicates the Gandhamanaparvatham surface Subramanian and Selvan (2001). Here, the formulation traced includes shell limestone and sand stone landforms including palaco-beach ridges, barrier dunes and sand dune complexes. The coastal surface (Dhanushkodi surface) is marked by both accretionary and erosional features.

Direct impacts of formation are related to geomorphologic process that becomes active erosion, sediment transport and deposition. These processes are mostly wind-induced by the generation of waves with subsequent shore erosion, aeolian activity and sediment deposition. Vilmundardottir *et al.,* 2010; James *et al,* 2002; Vogt 1978. The erosion-deposition period can be divided into three phase origin, erosion and equilibrium. The development from erosion phase to equilibrium between land and water level requires decades, depending upon local condition. Thus, grain size trends may contain information on sediment transport. Many investigators have attempted to use grain size data for identifying sediment transport pathways Gao, (2011) (e.g. Pettijohn *et al.,* 1972,) McLaren and Bowles, 1985), (Lanckneus *et al.,* 1992).

Growing populations and their associated developments are placing enormous pressure on coastal resources. Effective environmental planning, conservation and protection, aim at mitigating economic and environment impacts, which require an understanding of the way that terrestrial and marine processes operate and interact in the coastal zone Robert.

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G Hatfield *et al.,* (2010), Morton, (1979), Hanson and Lindh (1993). Coastal environments often appear to experience little net erosion or accumulation, but they can be highly transient environments resulting from a deligate balance between sediment influx, storage and loss. Subtle modifications affecting any of these individuals components can affect their equilibrium, form and existence Robert.G Hatfield *et al.,* (2010), Morton, (1979), Gioson *et al.,* (1999), Wallace *et at.,* (2009), which in turn can have serious economic and environmental ramifications including the loss of habitat and reduction in ecological status Robert.G Hatfield *et al.,* (2010), Kennish, (2001), Brown and McLachlan, (2002), Lotze *et al.,* (2006), Schalacher *et al.,* (2007). Which in turn can have serious economic and environmental ramifications including the loss of habitat and reduction in ecological status Robert Hatfield *et al.,* (2010), Kennish, (2001), Lotze *et al.,* (2006), schalacher *et al.,* (2007). Since, a large number of grain size parameters are required to represent any grain size distribution Blatt *et al.,* (1980), Nevertheless, if a small number of parameters are used, then the number of possible trends will help to identify an appropriate grain size trends, which contain information on net transport pathways, based upon an examination of a group of grain size trends formed using the most-commonly used grain size parameters (i.e. mean grain size, sorting coefficient and skewness). The outward features often produce the zones of shingle, coarse and fine sand parallel to the shoreline, sometimes with a steep upper beach separated by a break of slope, often caused by a seepage line, from a flatter lower beach. Long-shore variation in mean particle size is also common along beaches. This variation may relate to grain size features, local discontinuities in the beach slope and the lateral wave energy Yesim Celikoglu *et al.,* (2004), Van Hijum and Pilarczyk, (1982, Kamphuis (1991).

Sediment transport is closely coupled with sediment sorting and depositional processes, and for highly transient coastal sediments, spatial variations in the degree of sorting can also help to identify the responsible formative processes Robert .G Hatfield *et al.,* (2010), Frihy *et al.* (1995), Frihy and Dewidar (2003). The beach face is the sub-aerial beach sector, below the berm, that presents the steepest slope. This sector is exposed to wave swash that is responsible for sediment transport. Beach face gradient in relation to sediment transport and beach profile evolution has been studied from different perspectives: (i) by considering the beach face sediment characteristics, sediment grain size and sorting Heitor Reis and Cristina Gama (2010), Bagnold, (1940), Bascom, (1951), Wiegel, (1964), Turner, (1995) Wilson *et al.,* (2008) Wave breaking and broken waves induce turbulent flows which stir up sediment, allowing transport by the mean flow and long and short waves. The cross-shore mean flow, or undertow, is generated by momentum flux. Balddock T.E, *et al.,* (2010) Roelvink and Stive, (1989), Nielsen, (2009) The grain-size distribution therefore provides evidence of wind sorting processes Jiaquong Zhang *et al.,* (2011), Purkait (2010) and provides important clues that distinguish among various complex surface morphologies based on statistical parameters that describe the size distribution sources of suspended sediments, and net transport patterns .Gao.S *et al.,* (2011), Al-Hurban *et al.,* (2008), Jiaquong Zhang *et al.,* (2011), Kurashige and Fusejima, (1997), Gao.S *et al.,* (2011), Gao and Collins, (1992).

Study Area

Coastal segment from Mandapam to Vallinokkam of Ramanathapuram District is selected for study, which stretches to a distance of about 50 kms and is located between 9° 05' and 9° 50' North of Latitude and between 78° 10' and 79° 27' East of Longitude. It covers the geographical area of 4175.00 Sq. km. Geology of the area is covered by the unconsolidated sediments of Quaternary age except in the north-western part, where isolated patches of Archaen Crystallines and Tertiary sandstone are exposed. A major part of the district is covered with the fluvial, fluvio-marine, Aeolian and marine sediments of Quaternary age. The geomorphology of the study area is classified as gently sloping plain except for remnant hills in the western area. Quaternary studies have brought out various erosional and depositional landforms of fluvial and marine regimes. The fluvial landforms comprise flood plains of Vaigai, Varshalei, Pambar, Kottakkarai and Gundar rivers. The marine landforms comprise sand mounds (Teri's) and barrier dunes along the present coast. The erosional processes are manifested in the form of pediments and pedipalin around Kamuthi. Subramanian and Selvan (2001). (Fig. 1)

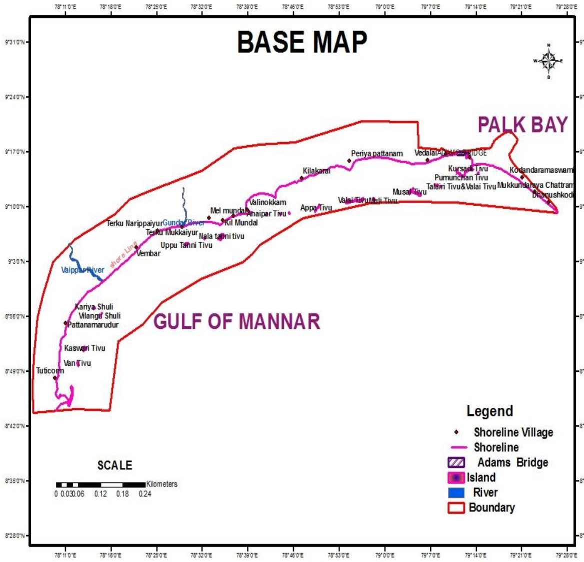


Fig 1. Study Area.

METHODOLOGY

A detailed study was conducted from the hinterland to the breaker zone along the coastal region between Mandapam to Vallinokkam. Nearly 38 stations were located for sampling, each station with 400m space interval and based on different morphological characteristics showing different feature (Coral fragment, shelf fragment, beach rock, fine grain). In each location, 4 sampling spots were fixed on the basis of geomorphologic units like Waterlevel, slope, berm and dune with 4m space interval perpendicular to the coast. Basic field data is collected to determine the beach gradient, beach width, the berm shape index and surf parameter of the study area and beach profiling was done by basic profiling methods. Each profile extended from a fixed point (baseline) and the levelling measured is adjusted to MSL Datum using fixed beach mark of known elevation, located behind the beach area. The present study is mainly concentrates on the land ward part of beach profiles length (in meters) measured between the shoreline and baseline during successive surveys. The sediment analysis and data processing is done as per the standard procedure. Totally 108 sediment samples were collected from 38 stations during the summer season (March 2011) from Mandapam to Vallinokkam coastal tracts. In laboratory, the dried samples were divided into sub samples and weighted and treated with HCL to remove shell and organic content, washed with fresh water and rinsed with distilled water and dried. Dry sieving analysis was performed by using a series of sieves ranging in the mesh size from 25 to 325 sieve intervals and grain size analysis was determined according to the Folk and Ward (1957). The grain size distribution pattern of sieve data along the coastal stretch is done by Graindist Software version 1.07 Simon .J *et al.,* (2001), Koldijk, (1968), Davis and Ehrlich, (1970), Jaquet and Vernet, (1976), Swan *et al.,* (1978), Simon, (2001).

The morphological variations perpendicular to the shore can be recorded as the relative wide, flat upper part is the berm, followed by a narrow steep slope zone with gently sloping low part called the beach face slope. Beyond the berm, towards land, the flat surface is called the backshore and the up heaved part dune. The relative positions of these morphological features depend upon the hydrodynamic conditions of the beach environment. Morphodynamic beach models of reflective, dissipative and intermediate beaches act as buffers to wave energy. They are sensitive to any changes and the variations are recorded in the form of sedimentation pattern and morphological changes. However, the study of morphodynamic states of beaches helps in forecasting coastal erosion, marine flooding, siltation etc.

Erosion Characteristics

The coastline has been the most dynamic element over the last 1000 years. It's varied form reflects the complex interaction between forcing processes – predominantly waves, but also tides, winds, and estuary flows – with the shoreline and near shore morphology and materials, leading to the establishment of zones of high energy (wave convergence) and low energy (wave divergence). Simple cells comprise an arrangement of sediment source areas (e.g. eroding cliffs and the sea bed), areas where sediment is moved by coastal processes and sediment sinks (e.g. beaches, estuaries or offshore sinks). Along a particular stretch of coast there may be a series of such cells, often operating at different scales. The energy arriving at the coast is considerably larger and more variable than to land-based systems. The combination of variable energy inputs and mobile sediment lead to morphological adjustments, ranging from beach profile changes over the course of a single storm to long-term changes in response to factors such as relative sea-level rise. A number of modes of change can be recognized Yang *et al.,* (2008), Pethick, (1992).

Beaches adjust their profiles to provide the most efficient means of dissipating incoming wave energy. This is often seen during and after storm events, where strong winds generate high, steep waves which frequently result in the seaward transport of beach material to an area where the water velocities allow sediment deposition. Typical characteristics of an eroded beach include a lowered beach face slope, the absence of beach forms such as berms, erosion scarp(s) along the backshore/fore dune, diminished or non-existent near shore bar, and a concentration of heavy minerals as a lag on the beach face. Following the return to normal conditions with relatively lower wave energy, waves transport sand from offshore back to the beach. Winds may then dry and transport the sand landwards to rebuild the upper beach and fore dune (if eroded). The occurrence of short term fluctuations on a soft coast does not necessarily mean that an erosion problem exists. By definition, a long term translation in coastline must be identified for soft coasts to be classified as eroding. Generally the rebuilding process takes much longer than erosion events, and sometimes the beach does not have sufficient time to rebuild between erosive episodes. (Fig. 2)

Beach profiling is one of the methods used to measure dune, beach and offshore sand levels. Measurements are taken from the identified 38 permanent stations that have been established along the coast zone. These sites have cross-section profile lines that traverse the active beach offshore. They have fixed control points defining their position, which are recorded in the field. Beach profiles were measured with the help of survey equipments. The gradient of the beach face, the sloping portion of the beach profile between berm crest and breaker zones were measured from this zone. Based on the survey, gradient, beach width, berm shape index and surf scale parameter were calculated. (Table 1) The gradient of the profile was determined as the tangent of the angle the shore face makes with horizontal marking (Sabeen H.M 1997). The beach width, "l" is the horizontal distance between the origin and the point at which the beach profile meets the X-axis. Breaker height is determined and the recorded breaker height was the measurement plus ten percent as described by Bascom (1964). Breaker period was recorded as the time (in seconds) it took for 11 waves crests (10 complete waves) to pass a fixed stationary point. The first crest was the starting time and the 11th crest the stop time. Berm shape index which gives the nature of the profile, can be calculated from the formula $S=1-2(l/l')$ where l and l' are determined from beach profile as illustrated in the Sunamura (1989). $S=0$ represents straight profile; $S>0$ represent concave profile and $S<0$ represent convex profiles. The surf scaling parameter for each profile was determined using the following equation $\S=abw^2/gTan^2\ \beta$, where '§' the surf scaling parameter, 'ab' is the breaker amplitude, 'w'is the incident radiation frequency ($w=2\pi/T$, T is the period), 'g' is the acceleration due to gravity and 'β' is the beach gradient and the beaches are classified as Guja and Inmann (1975) and Carter (1988). (Fig.3)

Reflective - § ranges from 0.1 to 2.5
Intermediate - § ranges from 2.5 to 20.0
Dissipative - § ranges from 20.0 to 200.0

RESULTS AND DISCUSSION

Sediment distribution

The morphodynamic of beaches and the point of their susceptibility to erosion are identified from the field data. The geomorphological features present in the study area includes the water level , slope, berm, dune and cusps of small size and in general the study disclose, that the gradient of the beach varies from 0.89to 0.18 and which exhibit high gradient. The berm shape Index value is recorded as -6 and -3. The surf scale parameter show the value of 0.790 and 0.002.The result shows nearly 100% as high gradient, berm shape index exhibit convex profile and surf scale parameter the beach is recognized as the Reflective beach. The grain size distribution of water level is characterized by mean grain size ranging from 0.61 ø to 3.11 ø, which is classified as very fine sand. Sediment sorting ranges from 1.32 ø to 2.50ø, which classified as very poorly sorted to poorly sorted. Skewness values range from-0.78 ø to 0.57ø, given as very coarse skewed to fine skewed .The Minimum and Maximum of kurtosis values are 3.19ø to 0.60 ø respectively. which shows very platykurtic to Very leptokurtic .The sample of water level have an average mean grain size of 2.00 ø .sorting of 1.83 ø, skewness of 0.004ø,and kurtosis values1.30 ø. The samples are classified as Fine sand, poorly sorted, symmetrical, and Leptokurtic .The grain size distribution of slope is characterized by mean grain size ranging from 0.811ø to 2.82 ø, which is classified as fine sand. Sediment sorting ranges from 0.1.28 ø to 2.63ø, which is classified as very poorly sorted to very poorly sorted. Skewness values range from -0.67 ø to 0.59ø given as fine skewed to course skewed. The minimum and maximum of kurtosis values are 0.65ø to 1.81 ø respectively, which shows very platykurtic to Very leptokurtic. The samples of slope have an average mean grain size of 2.1 ø, sorting of 0.1.79 ø, skewness of –0.65ø and kurtosis values of 1.02 ø The samples are classified as Fine, poorly sorted, Fine Skewed and mesokurtic. (Table 2)

The mean grain size of berm values ranges from 1.20ø to 2.92 ø, which is classified as fine sand. Sediment sorting ranges from 1.33 ø to 2.01ø, which is classified as very poorly sorted to poorly sorted, where as skewness values ranges from 0.40 ø to- 0.43 ø, which is exhibits very fine skewed to coarse skewed. The kurtosis values represents a value between 0.71 ø to 1.64 ø respectively and given as platykurtic to very leptokurtic. The samples of berm have an average values of mean grain size of 2.32 ø, sorting of 1.62 ø, skewness of 0.71ø and kurtosis of 1.08ø. From the above values the samples are categorized as fine sand, poorly sorted, Fine skewed and Mesokurtic in nature. In dune the grain distribution ranges from 1.28 ø to 3.19ø, which is classed as very fine sand. Sediment sorting ranges from 1.34 ø to 2.13ø, which is very poorly sorted to poorly sorted. Skewness values ranges from 0.41ø to- 0.22ø, which is very fine skewed to very course skewed. The kurtosis values are 0.66ø to 2.18 ø respectively and given as very platykurtic to very leptokurtic. The samples of dune have an overall average mean grain size as 2.48ø, sorting of 1.62 ø, skewness of 0.06 ø and kurtosis of 1.27 ø. Based on the above values it is characterized as fine sand, poorly sorted, symmertical and leptokurtic. (Fig.4)

In the surf zone under erosive conditions, all the sediment transport data indicates consistent offshore transport and free long waves tend to reduce the offshore sediment flux in comparison to monochromatic waves. Under accretive condition, all the transport data consistently indicate onshore transport, and the tendency for beach accretion or erosion is well parameterized by the variation in the relative fall velocity, again as observed. The free long waves widen the swash berm and generally move it onshore, and also decrease the amplitude of the long shore bar in the surf zone. Overall, free long waves tend to reduce average monochromatic short wave heights in the inner surf zone for these beach slopes and wave conditions Udhaba DORA *et al.,* (2011), Baldock and O'Hare, (2004), so the observations are consistent with an overall reduction in the short wave energy reaching the shoreline. These results suggest some consistency with the

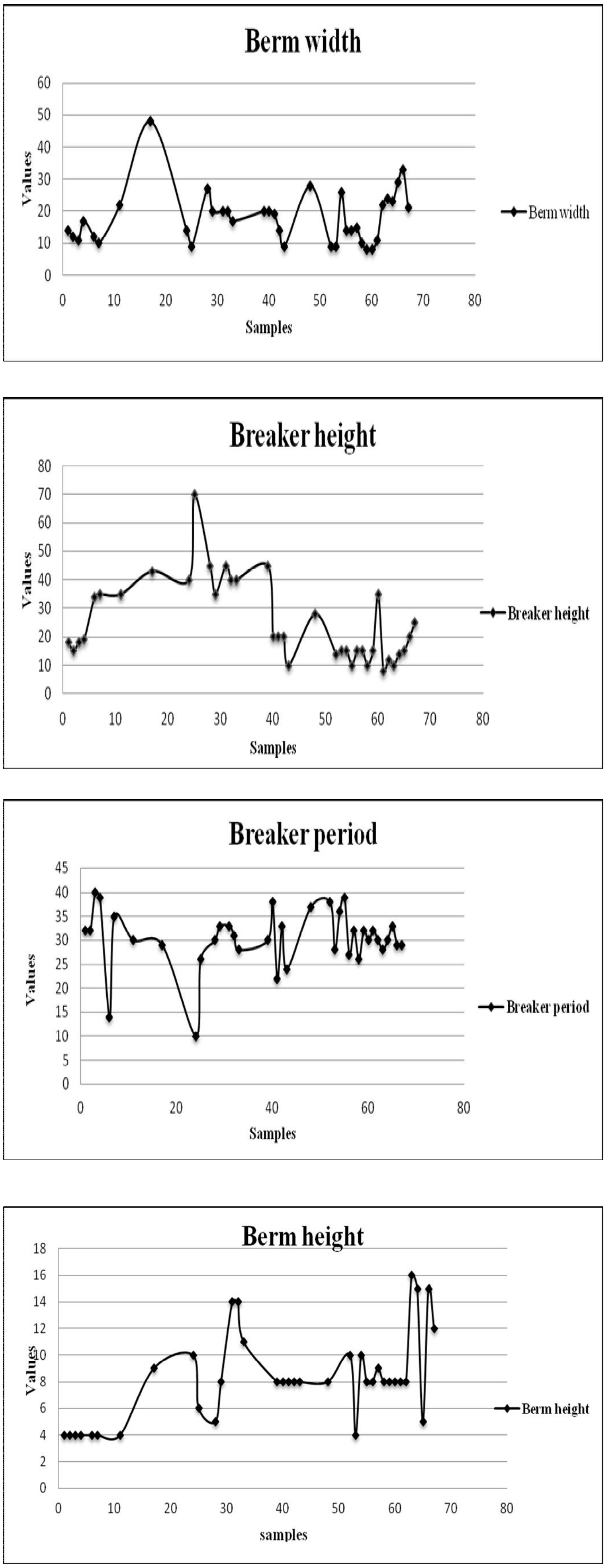
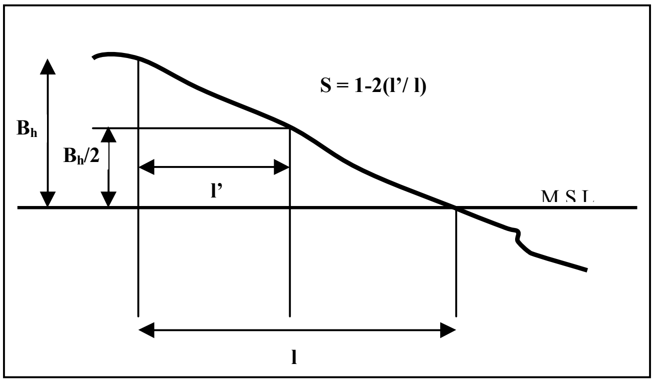


Fig. 2 Showing Variation in Berm Width, Breaker Height, Breaker Period,Berm Height.

conceptual model of Baldock T.E *et al.,* (2010), Shi and Larsen (1984), stating that transport by wave groups outside the surf zone is based toward offshore transport, and with Baldock *et al.,* (2010), Klopman's (1994) observations outside the surf zone using a narrow-banded wave group.



B$_h$ - Relief of berm, **S** - Berm shape index, **l** - The horizontal distance of berm at m.s.l, **l'**- The horizontal distance projected to the beach slope from half the relief of berm

Fig. 3 Schematic diagram for the calculation of Berm Shape Index

This is similar to the different timescales between storm erosion and long term beach recovery; storm waves erode sediment more intensively and rapidly than swell waves which can return the sediment back onshore, again because the energy levels are lower during the accretive phase. The increased run-up from larger waves in the groups also tends to smooth the swash berm and move it onshore. The greater onshore transport in the swash zone is consistent with the model of Baldock *et al.,* (2010), Simmonds *et al.* (1996), which is proposed to promote the growth of intertidal features and swash berms. Inside the surf zone, the bichromatic wave groups can induce free long waves through the modulation of the breakpoint Baldock T.E *et al.,* (2010), Symonds *et al.,* (1982), but the behaviour of the incident bound long wave remains unclear, being either released as a free wave, or remaining a forced wave that dissipates in conjunction with the dissipation of the short waves Baldock T.E *et al.,* (2010), Baldock, (2009).

The grain size classification in the study area is consolidated within 38 location and categorized as the medium to fine sand by highlighting the importance of the study. Nearly 92% dominates as fine sand particles, that are transported from up drift to down drift region Yesim Celikoglu *et al.,* (2004), Asar *et al.,* (1997).The mean grain sizes of fine sand pattern is with the view that ripple reworking and re-suspension winning fine sediments from the bed throughout the season. Law*et al.,* (2008), Wiberg *et al.,* (1994). This fine grain material is kept in suspension by wave orbital motions (or) size of fine sand in dune, where wind speed is lower. J.Q Zhang *et al.,* (2011).

All the sediment samples collected from the leeside part of crest sample exhibit 40% with the moderately sorted, well sorted with 13%, moderately well sorted as 29% and the remaining15% as poorly sorted in nature. This may be due to be sorting of shoaling waves, the primary mechanism for sediment re-working on wave dominated shore line wave sorting can be visualized by the progressive changes of individual grain size abundance patters from the beach seaward to the inner shelf Liu J.T *et al.,* (2000), Liu and Zarillo, (1989), Liu and Zarillo, (1993) and in wind ward slope were the sediments of coast will be sorted throughout the dune surface with greatest sorting at the upper toward slope and decreasing sorting towards the toe of the slope. The sorting of the dune sand become well toward the main crest is very well sorted. Standard Deviation measures the sorting of sediments and indicate the fluctuation in the kinetic energy or velocity condition of the depositing agent Udhaba DORA .G *et al.,* (2011), Sachu, (1964), Jiaquong Zhang *et al.,* (2011), Hasi 1998, Wang (1996). Whereas all sediment on the beaches of the east coast of India is moderately sorted sands. Here the sediment samples were identified as moderately sorted and moderately well sorted with the influence of relatively high wave energy condition, and more sample were found as well sorted. The present analysis shows that sorting character of sediment environment was decreasing with increasing wave energy. Udhaba DORA.G *et al.,* (2011), Chakabartic, (1977), Chandhri *et al,* (1981)

The skeweness character shows coarse skewed to very fine skewed with 12% respectively. The coarse dominated grain show 30% with fine skewed as 11%, nearly symmetrical with 26% and very coarse grain with 19%. The skewness of this type of sediments are dominated by coarse skewed, and positively skewed (the second). On the probability cumulative frequency curves of the grain size distribution, one or two bed load transport components can be identified Xuegu wang and Xiankunke, (1997), Visher (1969). And another reason, most values show the positive skewed zone and remaining are negatively skewed. The dominance of coarse sand sediments along the coastal track in which wave region is characterized by short period waves, which give rise to erosion. Coarse grain size and poor sorting nature indicates high energy environment and the higher energy levels permit deposition of coarse sediments as well as transportation of a much wider range of finer sediments Udhaba DORA *et al.,* (2011), Bryant,(1982). And another basis may be the grain size distribution of the dune sand is generally strongly fine skewed towards the crest and on the other side. At the two crests, where the sand dune have a nearly symmetrical in grain size distribution, fine sand fraction dominated in all samples ,comprising 80% to 94.5%by weight of the grain size distribution and this corresponds well with values for Aeolian sediments (Ahlbrandt,1979).

The kurtosis along the shoreline of all the samples varied in between very Platykurtic 3% to very leptokurtic14%. Most of the sample was shown as Platykurtic 25%, mesokurtic29% and leptokurtic 25%. The extreme high or low values kurtosis imply that part of the sediment achieved its sorting else were in a high energy environment. Udhaba DORA *et al.,* (2011) Friedman (1962), Blott and Pye (2001). The Kurtosis is very platykurtic to mesokurtic respectively and the reason the majority of the sediment are medium to fine grain size. It may be due to the influence of the fluvial sediment and the mostly of mesokurtic ,moderately sorted and the leptokurtic nature resulting from mixing pre-dominant population with very minor amounts of coarse and fine material and the due to mixing of different size class of sediment by wave action.

In this zone the fine grain sediments are moving towards deeper region and coarse grain towards shallow region, so the grain sizes in this zone are limited to only fine sized class of sediments, which exhibit better kurtosis Jesper Bartholdy *et al.,* (2007), Folk and Ward, 1957). Linear discriminate

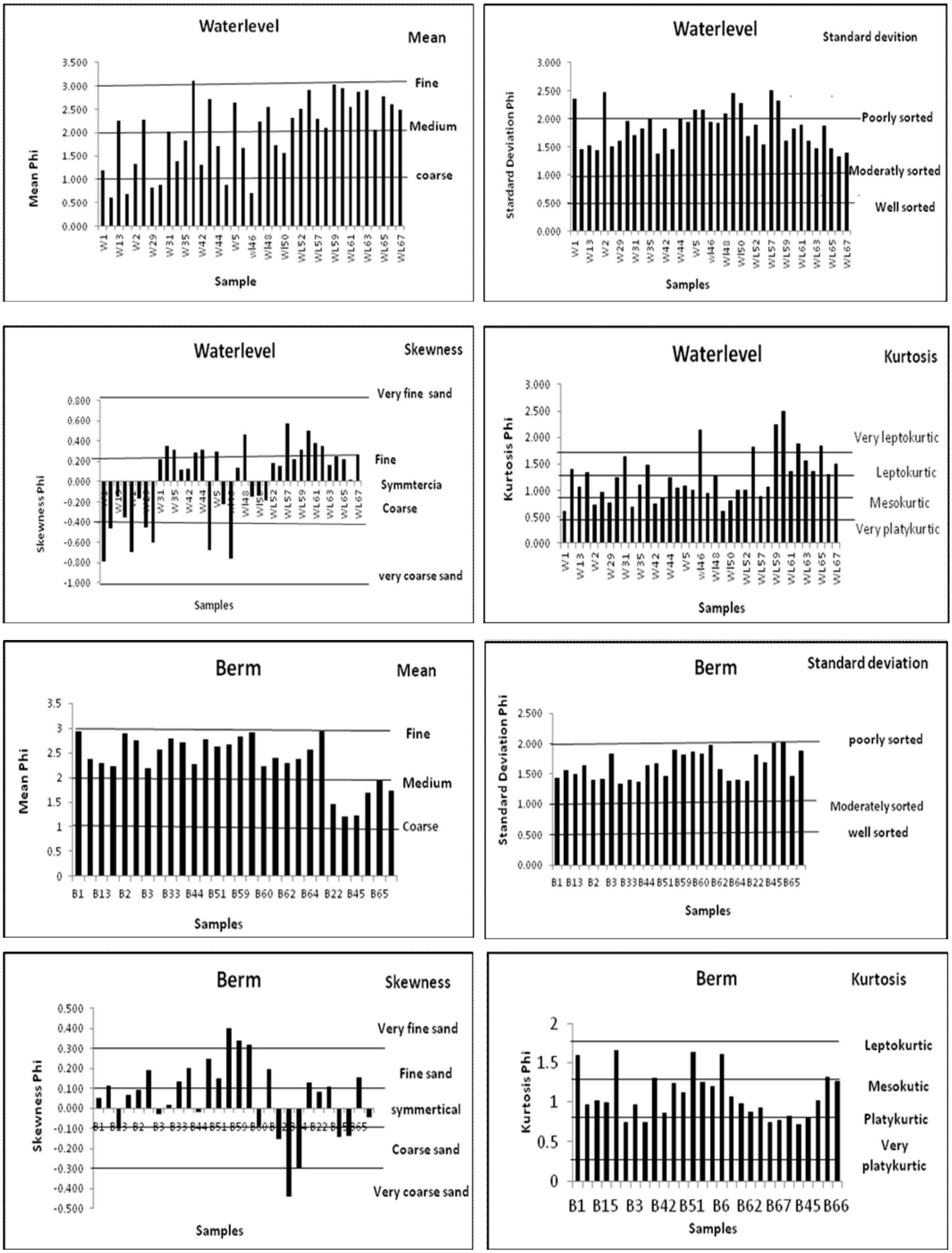


Fig. 4 Showing Variation for in Waterlevel , Slope, Berm, and Dune in Bar Diagram.

Table 1 Showing the Parameters beach width, Breaker height, Breaker Period, Berm height

Location	Berm width	Gradient (Tan)	Breaker height	Breaker period	Berm height	Berm shape index	Incident radiation	Surf scale Parameter
1	14	0.28	18	32	4	-4.6	0.19	0.005
2	12	0.33	30	32	4	-6	0.19	0.014
3	11	0.36	19	40	4	-3.3	0.15	0.005
4	17	0.23	19	39	4	-3.7	0.16	0.002
6	12	0.33	34	14	4	-4	0.44	0.073
7	10	0.4	35	35	4	-4	0.17	0.016
11	22	0.18	35	30	4	-3.67	0.2	0.004
17	48	0.18	43	29	9	-3.69	0.21	0.006
24	14	0.71	40	10	10	-3.11	0.63	0.79
25	9	0.67	70	26	6	-3	0.24	0.168
28	27	0.29	45	30	5	-3.6	0.21	0.007
29	20	0.4	35	33	8	-3.64	0.19	0.02
31	20	0.7	45	33	14	-3.64	0.29	0.189
32	20	0.7	40	31	14	-3.64	0.2	0.08
33	17	0.65	40	28	11	-3.78	0.22	0.083
39	20	0.4	45	30	8	-3.64	0.21	0.032
40	20	0.4	20	38	8	-3.33	0.17	0.009
41	19	0.42	20	22	8	-4.22	0.29	0.03
42	14	1.78	20	33	8	-3.11	0.19	0.023
43	9	0.89	10	24	8	-4.5	0.26	0.054
48	28	0.29	28	37	8	-4	0.17	0.006
52	9	1.11	14	38	10	-3	0.17	0.05
53	9	0.89	15	28	4	-3	0.22	0.058
54	26	0.38	15	36	10	-3.71	0.17	0.006
55	14	0.57	10	39	8	-4.67	0.16	0.008
56	14	0.57	15	27	8	-4.67	0.23	0.026
57	15	0.6	15	32	9	-5	0.2	0.022
58	10	0.8	10	26	8	-4	0.24	0.037
59	8	1	15	32	8	-4	0.2	0.055
60	8	1	35	30	8	-4	0.21	0.157
61	11	0.73	8	32	8	-2.75	0.19	0.015
62	22	0.36	12	30	8	-4.4	0.21	0.006
63	24	0.66	10	28	16	-4	0.22	0.021
64	23	0.65	14	30	15	-4.6	0.21	0.026
65	29	0.52	15	33	5	-4.14	0.19	0.014
66	33	0.45	20	29	15	-4.12	0.22	0.02
67	21	0.57	25	29	12	-4.2	0.22	0.04

function was tabulated using all the statistical parameters, which exhibit a dominant beach process under shallow marine condition and depositional condition of sediments reveal beach and river processes along the study area.

CONCLUSION

Grain size analysis and distribution of water level, slope, berm, and dune show a leading of medium to fine sand particles of the sediments. The graphic mean value indicates the dominance of fine sand particles followed by near symmetrical and moderately sorted to fine skewed. Most of the samples confirm the bimodal character. The samples collected at the bottom of the zone are by shoaling waves and fine sand carried is out to near shore region by wave action. The most suitable statistic for describing the sorting characteristics of sedimentary rocks is clearly seen from the analysis of the cumulative curves and can be used as an index of sorting in the sediments. Most of the location reveal moderately well sorted in different proportion. This is because of the greatest turbulent wave action and rip currents which are common in these zones.

The skewness is the environmental sensitive parameter, which can be attributed due to winnowing action of waves for sediments covering the shore. In surf zones the waves become stronger and surf current also present, so the total activity is greater in this zone, half of the near shore sample exhibit coarse skewed (negative skewed) and other half very fine skewed nature (positive skewed).The kurtosis is supposed to be an important textural parameter for most of the samples, which shows the platykurtic, leptokurtic and mesokurtic in nature of grains due to mixing of different size class of sediment by wave action. In this zone the water movement is altering, so the fine grain sediment is moving towards deeper region. The geomorphologic feature present in the study area includes dunes, wave cut platforms, beach width, cusps of small size and in general the total study area discloses that the gradient of the beach is high. The beach classification is done as convexity or concavity of the profile based on the accretion or erosion of the area. In the study area nearly 100%of the berm shape index exhibits convex profile and high gradient beach and based on the profile index the beach in the study area is classified as reflective beach. Beach morphological state cannot solely be described in terms of mean wave, tide and sediment conditions, but these variables do provide a first order-explanation for the observed beach variability in nature. Beach classifications based on various sediment environmental parameters are essential, and should be used as tools for understanding morphodynamic condition of the beach.

Table 2 Showing the Parameters Mean,Sorting,Skewness,Kurtosis

Location	Folk and Ward Method				Depositional of Environment				Remarkes
	Mean	Sorting	Skewness	Kurtosis	Y1	Y2	Y3	Y4	
W1	1.185	2.357	-0.787	0.6	7.99574	170.2669	-16.429	-2.21991	Innershelf
S1	2.479	1.289	0.098	1.278	-0.29747	148.955	-11.005	8.692709	Innershelf
B1	2.923	1.431	0.047	1.596	-0.26315	170.1893	-11.8578	10.30059	Innershelf
D1	3.197	1.431	-0.223	1.26	-1.72741	163.3134	-10.4667	6.895267	Quiet water
W2	1.328	2.475	-0.689	0.728	8.117502	184.3712	-17.8909	-0.82994	Quiet water
S2	2.274	1.581	0.495	1.818	2.371883	182.1146	-15.5406	13.95973	Innershelf
B2	2.892	1.39	0.09	1.649	-0.22606	168.7617	-11.7155	10.85994	Innershelf
D2	2.85	1.568	-0.068	2.189	2.587891	186.9484	-12.4898	12.55317	Innershelf
W3	0.877	1.959	-0.602	1.235	9.21895	154.4025	-13.9067	2.320961	Innershelf
S3	2.17	1.812	-0.024	0.97	2.03283	170.5724	-15.0922	5.811073	Innershelf
B3	2.177	1.818	-0.028	0.965	2.023558	170.8621	-15.1172	5.756234	Innershelf
D3	3.116	1.488	0.122	1.761	-0.38044	181.3716	-12.6615	11.79083	Innershelf
W5	2.635	2.15	0.292	1.086	1.329811	207.9076	-19.4577	8.747605	Quiet water
S5	1.966	2.333	0.212	0.651	3.20285	199.9275	-20.878	5.349012	Innershelf
B5	2.756	1.658	0.247	1.117	-0.73154	177.2508	-14.8962	8.893065	Innershelf
D5	2.781	1.562	0.169	0.943	-1.56006	166.6883	-13.6739	7.503811	Innershelf
W6	1.686	2.152	-0.22	0.998	5.515007	182.3162	-17.251	4.151454	Innershelf
S6	2.364	2.003	0.285	1.002	1.506982	192.3573	-18.2228	8.120565	Innershelf
B6	2.901	1.863	0.317	1.608	0.892822	203.2969	-16.9636	11.98524	Innershelf
D6	2.497	2.139	0.41	1.032	1.366192	206.1721	-19.9842	9.162733	Quiet water
W12	0.617	1.447	-0.46	1.4	8.46632	122.3155	-10.181	4.170749	Innershelf
S12	1.414	1.983	-0.063	0.79	4.888131	165.9296	-16.6244	3.97915	Innershelf
B12	2.367	1.555	0.113	0.966	0.085355	159.1803	-13.4556	6.953335	Innershelf
D12	2.52	1.446	-0.033	0.967	-0.55789	151.777	-11.7429	6.131289	Innershelf
W13	2.266	1.521	-0.145	1.067	1.164482	152.5085	-11.9144	5.688767	Innershelf
S13	2.284	1.494	-0.097	1.014	0.739674	150.9401	-11.9138	5.756767	Innershelf
B13	2.284	1.494	-0.097	1.014	0.739674	150.9401	-11.9138	5.756767	Innershelf
W15	0.686	1.441	-0.349	1.345	7.797486	124.0047	-10.6566	4.683367	Innershelf
S15	1.104	1.837	-0.399	0.923	6.558448	147.8442	-13.7816	2.258304	Innershelf
B15	2.215	1.639	0.066	0.993	1.118592	161.9248	-14	6.633945	Innershelf
D15	2.298	1.628	0.017	1.262	1.716774	166.6068	-13.6303	7.796851	Innershelf
W22	2.273	1.507	-0.162	0.97	0.819544	149.5929	-11.7116	5.074384	Innershelf
S22	2.696	1.454	0.258	0.826	-2.20333	157.7218	-13.1935	7.472015	Innershelf
B22	1.444	1.812	0.081	0.814	3.921107	158.1549	-15.8135	5.161433	Innershelf
W29	0.818	1.598	-0.455	0.753	6.286753	123.5439	-11.5082	0.870952	Innershelf
S29	1.019	1.821	-0.473	0.753	6.431885	141.0119	-13.3162	0.80409	Innershelf
B29	2.75	1.409	0.188	0.74	-2.68342	152.7736	-12.449	6.603165	Innershelf
W31	2.035	1.698	0.221	1.626	3.628852	177.4993	-15.2944	10.87564	Innershelf
S31	2.577	1.531	0.214	0.876	-1.24401	161.0239	-13.6821	7.319642	Innershelf
B31	2.549	1.338	0.016	0.745	-1.85863	141.8772	-11.0344	5.352693	Innershelf
W32	1.378	1.821	0.35	0.685	3.230487	160.2422	-17.2409	6.247493	Innershelf
S33	1.845	1.472	0.538	1.688	3.003122	166.5875	-14.9199	13.29374	Innershelf
B33	2.777	1.401	0.132	1.307	-0.93325	162.0799	-12.0612	9.246821	Innershelf
W35	1.823	1.993	0.309	1.094	3.636137	185.3306	-18.4001	8.379564	Innershelf
S35	1.552	1.942	0.398	0.711	3.03755	172.2701	-18.4829	6.780514	Innershelf
W36	3.119	1.369	0.116	1.479	-1.6991	168.2681	-11.603	10.31156	Innershelf
S36	2.61	1.883	0.314	0.922	-0.12549	187.3465	-17.2448	8.117362	Quiet water
W42	1.315	1.817	0.126	0.734	4.053265	155.8274	-16.1241	4.950021	Innershelf
S42	2.276	1.772	0.028	1.648	3.506519	183.0442	-14.9314	9.839487	Innershelf
B42	2.693	1.364	0.198	0.862	-2.2888	151.3355	-12.1094	7.289522	Innershelf
D42	2.793	1.348	0.253	1.242	-1.63933	159.8349	-12.189	9.748134	Innershelf
W43	2.727	1.456	0.282	0.861	-2.24874	159.3974	-13.3155	7.83683	Innershelf
S43	2.72	1.454	0.317	0.87	-2.27517	159.9404	-13.4683	8.112338	Innershelf
B43	1.204	1.686	0.104	0.717	3.959664	144.7783	-14.8983	4.681841	Innershelf
D43	2.248	1.632	-0.013	1.311	2.126691	166.4718	-13.5318	7.820826	Innershelf
W44	1.711	1.999	0.311	1.244	4.523914	186.7961	-18.4863	9.103577	Innershelf
S44	2.687	1.367	0.179	0.805	-2.39263	150.037	-12.0501	6.853485	Innershelf
B44	2.259	1.63	-0.016	1.233	1.844458	164.9744	-13.4943	7.393309	Innershelf
D44	1.286	1.826	0.143	0.661	3.932211	154.9568	-16.302	4.654123	Innershelf
W45	0.886	1.936	-0.672	1.045	8.653809	148.2582	-13.3676	0.863211	Innershelf
S45	2.345	1.569	-0.025	1.071	0.827104	159.1649	-12.8995	6.559796	Innershelf
B45	1.226	1.995	-0.139	0.791	5.759844	162.4118	-16.4112	3.3289	Innershelf
D45	2.277	1.512	-0.179	1.081	1.205516	151.7536	-11.6672	5.554898	Innershelf
wl46	0.716	1.943	-0.758	3.191	16.14785	184.2237	-12.9583	11.52059	Innershelf
S46	0.811	1.864	-0.671	1.173	9.047807	144.6902	-12.7524	1.520347	Innershelf
B46	1.685	2.012	-0.136	1.022	4.898486	175.0537	-16.4352	4.897705	Innershelf
Wl47	2.245	1.914	0.136	0.934	1.69972	180.6845	-16.7491	6.70665	Innershelf
Wl48	2.552	2.087	0.459	1.265	1.601554	208.7858	-19.7374	10.78529	Innershelf
Wl49	1.737	2.45	-0.143	0.605	5.050656	196.8133	-20.2417	2.506188	Innershelf

Wl50	1.556	2.267	-0.132	0.797	5.593576	185.6636	-18.7307	3.538633	Innershelf
S50	2.344	1.788	-0.089	1.121	1.926399	173.2921	-14.5015	6.30159	Innershelf
Wl51	2.307	1.69	-0.185	1.009	1.548141	162.5088	-13.1978	5.077022	Innershelf
S51	2.524	1.494	-0.489	0.917	0.390867	145.7998	-9.93227	2.782425	Innershelf
B51	2.606	1.466	0.145	1.623	0.881171	169.7845	-12.7318	10.85507	Innershelf
WL52	2.5	1.894	0.181	1.006	0.846862	185.4982	-16.7197	7.57992	Innershelf
WL55	2.913	1.529	0.15	1.813	0.599187	182.3619	-13.2138	12.09276	Innershelf
S55	2.247	2.03	-0.039	0.855	2.236811	183.6771	-16.9111	5.066274	Innershelf
WL57	2.29	2.509	0.57	0.891	2.704416	227.535	-24.0744	9.189778	Innershelf
S57	2.072	1.9	0.059	0.954	2.489756	176.0092	-16.2976	6.175072	Innershelf
WL58	2.103	2.317	0.219	1.052	3.892952	208.6129	-20.7189	7.626687	Innershelf
S58	2.587	1.875	0.329	1.191	0.734246	191.6614	-17.2355	9.62677	Innershelf
B58	2.654	1.881	0.401	1.249	0.549273	195.5225	-17.6229	10.46579	Innershelf
WL59	3.041	1.601	0.307	2.233	1.388123	199.644	-14.5486	15.43348	Innershelf
B59	2.816	1.812	0.335	1.195	-0.3156	191.3235	-16.6497	9.880609	Quiet water
WL60	2.96	1.816	0.494	2.492	2.889008	220.7209	-17.3621	17.92231	Innershelf
S60	2.016	2.631	-0.009	0.715	4.786879	217.4758	-22.3924	4.115751	Quiet water
B60	2.219	1.826	-0.082	1.067	2.336289	172.9854	-14.9108	5.959749	Innershelf
WL61	2.554	1.889	0.375	1.364	1.342135	196.102	-17.5858	10.82487	Innershelf
S61	2.525	1.992	0.37	1.018	0.76293	195.9488	-18.494	8.898462	Innershelf
B61	2.379	1.969	0.193	0.975	1.434195	188.1304	-17.4654	7.379618	Innershelf
WL62	2.873	1.611	0.348	1.88	0.839282	191.9298	-14.9061	13.71986	Innershelf
S62	2.202	2.216	0.595	0.817	1.654462	205.9733	-21.6568	9.02543	Innershelf
B62	2.277	1.571	-0.15	0.877	0.732378	152.3875	-12.3386	4.641386	Innershelf
WL63	2.924	1.464	0.165	1.556	-0.5144	173.7425	-12.7239	10.863	Innershelf
S63	2.219	1.745	-0.014	0.992	1.657214	167.5099	-14.5375	6.053451	Innershelf
B63	2.366	1.377	-0.439	0.92	0.431721	136.6091	-9.19992	3.063494	Innershelf
WL64	2.059	1.865	0.245	1.362	3.291207	184.4427	-16.886	9.589811	Innershelf
S64	2.105	1.679	-0.019	1.481	3.354791	170.3414	-13.9461	8.553683	Innershelf
B64	2.553	1.396	-0.296	0.738	-1.033	139.9629	-10.0121	3.19055	Innershelf
WL65	2.784	1.477	0.217	1.844	0.823496	178.6511	-13.1143	12.63184	Innershelf
S65	1.698	2.285	-0.035	0.7	4.652591	189.0622	-19.3297	3.772969	Innershelf
B65	1.936	1.451	0.15	1.318	2.254683	152.78	-12.8326	8.797129	Innershelf
WL66	2.606	1.326	0.014	1.303	-0.36336	152.2801	-10.876	8.335251	Innershelf
S66	2.828	1.35	0.224	1.165	-1.93337	158.584	-12.0608	9.171688	Innershelf
B66	1.719	1.878	-0.043	1.257	4.816908	172.7687	-15.6861	6.846787	Innershelf
WL67	2.488	1.394	0.26	1.494	0.390331	162.8765	-12.699	10.89319	Innershelf
S67	2.829	1.509	0.054	0.751	-2.28367	158.3053	-12.6394	5.77065	Innershelf
B67	2.922	1.38	0.125	0.77	-3.18476	152.9206	-11.8293	6.465802	Innershelf

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