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Research Article

TEXTURE AND MINERAL SEPARATION AND PROVENCE ANALYSIS – A CASE STUDY FOR KERALA WEST COAST, INDIA

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ABSTRACT

Coastal are ever dynamic and change over space and time. The State of West coast Kerala a coast line approximately 500kms long and various morphology and morph dynamics change may range from a fewer minutes to longer centuries and from a few meters to larger area, even worldwide. Hardly, these changes are continuous and constant. Inconsistency as observed in these changes, both in space and time, is functioned at the influence of various factors like the types of shorelines such as Inland, offshore, rocky shore and bay, nature of oceanic or sea waves that pass by the coast, variations in tides, nature and strength of storms, changes in sea levels and finally the anthropologic activities. The future has last the coastal ecosystems. As the technology continues to improve, the cost savings and enhanced data collection is continue to improve as well. The present project is aimed to carryout mapping of potential Coastal stretches for placer minerals using high resolution Satellite image and data integration in GIS and Sediment logical studies like texture and mineral separation and Provence analysis were carried out along the western coast of Kerala especially on several aspects of surface sediments.

INTRODUCTION

Generally Coastal are ever dynamic and change over space and time. The State of West coast Kerala a coast line approximately 500kms long and various morphology and morphdynamics change may range from a fewer minutes to longer centuries and from a few meters to larger area, even worldwide. Hardly, these changes are continuous and constant. Inconsistency as observed in these changes, both in space and time, is functioned at the influence of various factors like the types of shorelines such as Inland, offshore, rockyshore and bay , nature of oceanic or sea waves that pass by the coast, variations in tides, nature and strength of storms, changes in sea levels and finally the anthropologic activities. The future has last the coastal ecosystems. (Ajith.G.Nair, June 2001)

Sedimentlogical studies were carried out along the western coast especially on several aspects of surface sediments, attempts on the vertical variation of the sedimentary characteristic of the beach ridges and the intervening swales are insufficient. Hence a research programme was carried out in account the salient sedimentological & mineralogical aspects of the coastal plain sediments in respect of the The major coastal geomorphological features found in the study area are: 1. Planated Beach Ridges, 2. Swales, 3. Relict Beach Ridges and 4. Backwaters.5.mangroves, 6.intertidal mudflats of west Kerala region. (Palanivel Kathiresan, July 2018)(Smita Priyadarsini Rout, 2018)The findings are presented in below,

Aim & Objective

The Main objectives

- To plot Sample Location Map & To identify the Sedimentology - Grain Size analysis (Sieve)
- To see how a river's/ ocean sand-sized sediment fraction reflects its source.
- To differentiate Heavy mineral separation using bromoform(2.89 sp.Gr)
- to define differences in density and magnetic properties among minerals; Heavy mineral separation using Frantz Isodynamic magnetic separator
- To identify the K%, U (ppm), Th (ppm) Using Gamma ray Spectrometry
- to identify mineral grains under the Leica Petrological - optical microscope identification minerals

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Study Area

The study area extending from Kochi in the south to Kasaragod in the north of Kerala covering a Coastal Length of 343 km (Fig.1)

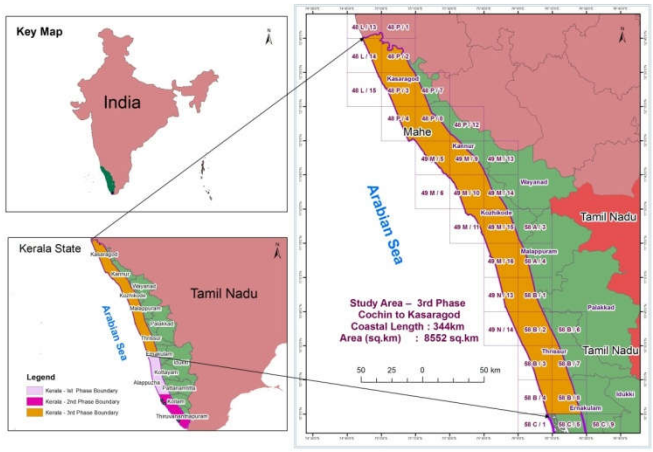

Figure 1 Study area Map – Kerala West coast

MATERIALS AND METHODS

The various methods employed in the collection, processing and analysis of sediments samples used for this investigation. The present investigation consists of two phases, namely, field survey and laboratory investigations. (Babu, N., Seralathan, P., (2005))

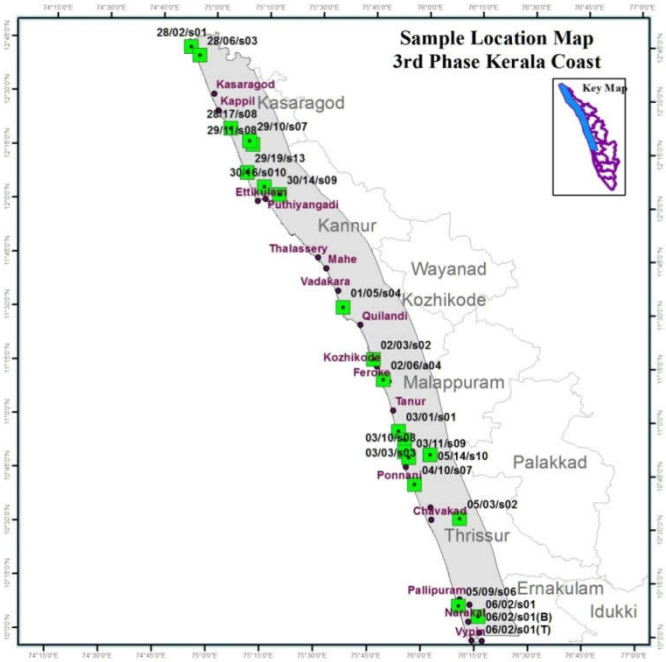

Figure 2 Selected Sample Location Kerala West coast

Table 1 Sample Location

S_No	Sample Id	x	y	Location	Date	Geomorphology /Remarks
1	28/17/s08	12.34	75.07	Kadapuram	28/04/16	Beach Ridge
2	06/02/s01(m)	10.09	76.27	Putharpally	6/5/2016	Beach Ridge(7m depth)
3	05/14/s10	10.84	76.04	Kuttippuram (Ponnani River)	4/5/2016	Beach Ridge (2.5m depth)
4	28/02/s01	12.72	74.88	Manjeshwar Beach	28/04/16	Beach Sand
5	05/09/s06	10.14	76.18	Cherai beach	5/5/2016	Beach (.6mt depth)
6	06/02/s01(T)	10.09	76.27	Varapuzha	6/5/2016	Beach Ridge (7m depth)
7	06/02/s01(B)	10.09	76.27	Putharpally	6/5/2016	Beach Ridge (7m depth)
8	28/06/s03	12.68	74.92	Mulinja river	28/04/2016	Alternate layers of coarse grained and fine grained sand found along the river bank
9	29/19/s13	12.14	75.15	EdayilKadavu	29/04/2016	Relict Beach Ridge
10	29/11/s08	12.27	75.18	Thjashwini River(Kaiyur)	29/04/2016	Flood Plain
11	01/05/s04/ (01/08/s07)	11.52	75.62	Chombala Beach(Payyoli, Near Railway Gate)	1/5/2016	Beach Ridge(2m depth)
12	03/01/s01	10.95	75.89	pattaruparambu	3/5/2016	Plannated Beach Ridge (2m depth)
13	03/03/s03	10.91	75.92	Pachothri	3/5/2016	Meander Scar
14	03/10/s08	10.85	75.92	mangalam (fluio marine)	3/5/2016	Fluvio Marine Landform
15	04/10/s07	10.70	75.97	Palappatti west	4/5/2016	Beach Ridge (2.5m depth)
16	05/14/s10(t)	10.84	76.04	Ponnani river (Kuttippuram)	'04/05/16	Point Bar
17	05/14/s10(4)	10.84	76.04	Ponnani river	4/5/2016	Point Bar
18	05/14/s10(2)	10.84	76.04	Ponnani river	4/5/2016	Point Bar
19	05/14/s10(3)	10.84	76.04	Ponnani river	4/5/2016	Point Bar
20	02/03/s02	11.28	75.76	Kamburam Beach, Konad	2/5/2016	Beach (2m depth)
21	02/06/a04	11.19	75.81	Naduvattam	2/5/2016	Beach Ridge(3m depth)
22	03/11/s09	10.82	75.94	Athanappadi	3/5/2016	Alluvial Plain(1m depth)
23	30/16/s010	12.07	75.24	Thalayi	30/04/2016	Beach Ridge (2m depth)
24	30/14/s09	12.04	75.31	Kottila	30/04/2016	(Beach ridge or point bar) - Mud flat should be changed with a suitable name
25	29/10/s07	12.29	75.16	Erikkulam	29/04/2016	Point Bars(2m depth)
26	05/03/s02	10.54	76.18	Puzhakkal South	5/5/2016	Paleo Lagoon overprinted by alluvial plain(2mt depth)

Field survey: A total of 26 selected sediment samples were collected along the (R.KATHIRAVAN, April 2018)beach ridges at west coast of Kerala (Fig.2.1). Within the coastal plain areas, five prominent sub environments such as beach ridges, swales, Planted beach ridges Dunes& mud flats have been selected and representative sediment samples were collected. The sampling was carried out May 2016. The time interval between sampling was minimized as much as possible to get better accuracy. All samples were carefully transferred to neatly labeled polyethylene bags and were brought to the laboratory and kept in an inert atmosphere till further processing or analysis. Utmost care was taken not to contaminate the samples during collection and handling.

Sediment Texture Analysis

The mechanism of transportation and deposition of unconsolidated sediments can be deciphered from the granulometric studies. Hence exhaustive research has been carried out on grain size characteristics for the past six to seven decades. Extensive works by various researchers from different parts of the globe have revealed that there has been significant correlation between size frequency distribution and depositional processes.(Rajith, November 2006)

Beach/fluvial Sand samples were washed, dried and subjected to coning and quartering and a representative portion (about 100 gm) was subjected to dry sieving. Each sample was sieved for 15 minutes on a mechanical Ro-Tap sieve shaker using a standard set of ASTM Endecott sieves at half phi interval. The fractions left over in each sieve were carefully transferred, weighed and cumulative weight percentages were calculated. The cumulative weight percentages of the above analyses were plotted against the respective grain sizes (in phi units) on a

probabilitychart. The grain size parameters such as mean size, standard deviation, skewness and kurtosis were calculated following Folk and Ward (1957).(Rajan, November 2006)

Table 2 Grain Size Analysis – Folk & Ward Method Using Gradistat

S.No	Sample no	y	x	Mean (x)	Sorting (s)	Skewness (sk)	Kurtosis(K)	Description1	Desn2	Desn3	Desn4
1	28/17/s08	12.34	75.07	1.553	0.678	-0.07	1.147	Medium Sand	Moderately Well Sorted	Symmetrical	Leptokurtic
2	06/02/s01	10.09	76.27	2.363	0.393	0.097	1.359	Fine Sand	Well sorted	Symmetrical	Leptokurtic
3	05/14/s10	10.84	76.04	1.008	0.736	0.149	1.262	Medium Sand	Moderately Sorted	Fine Skewed	Leptokurtic
4	28/02/s01	12.72	74.88	1.12	0.901	0.175	0.805	Medium Sand	Moderately Sorted	Fine Skewed	Platykurtic
5	05/09/s06	10.14	76.18	2.089	0.779	-0.254	1.61	Fine Sand	Moderately Sorted	Coarse Skewed	Very Leptokurtic
6	06/02/s01(T)	10.09	76.27	2.132	0.516	-0.289	2.059	Fine Sand	Moderately Well Sorted	Coarse Skewed	Very Leptokurtic
7	06/02/s01(B)	10.09	76.27	2.749	0.447	0.045	1.226	Fine Sand	Well sorted	Symmetrical	Leptokurtic
8	28/06/s03	12.68	74.92	1.412	1.088	-0.464	1.042	Medium Sand	Poorly Sorted	Very Coarse Skewed	Mesokurtic
9	29/19/s13	12.14	75.15	2.184	0.59	-0.235	1.935	Fine Sand	Moderately Well Sorted	Coarse Skewed	Very Leptokurtic
10	29/11/s08	12.27	75.18	3.068	0.592	-0.1	1.204	very fine Sand	Moderately Well Sorted	Symmetrical	Leptokurtic
11	01/05/s04	11.52	75.62	1.317	0.907	0.077	0.703	Medium Sand	Moderately Sorted	Symmetrical	Platykurtic
12	03/01/s01	10.95	75.89	1.623	0.796	-0.267	0.768	Medium Sand	Moderately Sorted	Coarse Skewed	Platykurtic
13	03/03/s03	10.91	75.92	2.006	0.899	-0.317	1.258	Fine Sand	Moderately Sorted	Very Coarse Skewed	Leptokurtic
14	03/10/s08	10.85	75.92	2.249	0.573	-0.23	2.417	Fine Sand	Moderately Well Sorted	Coarse Skewed	Very Leptokurtic
15	04/10/s07	10.70	75.97	1.576	0.884	-0.273	0.804	Medium Sand	Moderately Sorted	Coarse Skewed	Platykurtic
16	05/14/s10(t)	10.84	76.04	0.379	0.895	0.059	1.35	coarse Sand	Moderately Sorted	Symmetrical	Leptokurtic
17	05/14/s10(4)	10.84	76.04	0.796	0.877	0.04	1.368	coarse Sand	Moderately Sorted	Symmetrical	Leptokurtic
18	05/14/s10(2)	10.84	76.04	0.261	0.934	-0.2	1.108	coarse Sand	Moderately Sorted	Coarse Skewed	Mesokurtic
19	05/14/s10(3)	10.84	76.04	0.024	0.882	-0.071	0.9	coarse Sand	Moderately Sorted	Symmetrical	Platykurtic
20	02/03/s02	11.28	75.76	2.13	0.589	-0.3	2.177	Fine Sand	Moderately Well Sorted	Very Coarse Skewed	Very Leptokurtic
21	02/06/a04	11.19	75.81	1.503	1.379	-0.55	1.019	Medium Sand	Poorly Sorted	Very Coarse Skewed	Mesokurtic
22	03/11/s09	10.82	75.94	1.87	1.212	-0.434	1.146	Medium Sand	Poorly Sorted	Very Coarse Skewed	Leptokurtic
23	30/16/s010	12.07	75.24	1.93	0.773	-0.35	1.138	Medium Sand	Moderately Sorted	Very Coarse Skewed	Leptokurtic
24	30/14/s09	12.04	75.31	1.159	1.113	0.13	0.901	Medium Sand	Poorly Sorted	Fine Skewed	Mesokurtic
25	29/10/s07	12.29	75.16	2.34	0.642	-0.035	1.925	Fine Sand	Moderately Well Sorted	Symmetrical	Very Leptokurtic
26	05/03/s02	10.54	76.18	0.859	1.384	-0.017	0.805	coarse Sand	Poorly Sorted	Symmetrical	Platykurtic

Beach ridges/fluvial the grain size variation of the beach ridge sands are presented in Table and presented .In this mean size ranges from 0.024 to 3.068 (coarse to very fine sand). The sediments are moderately well sorted to moderately sorted (SO = 0.393 - 1.384), skewed in a wide range - fine skewed to very coarse skewed (0.175 to -0.55) and the kurtosis values range between 0.703 and 2.417 i.e., platykurtic to very leptokurtic.

Heavy minerals Separation using Bromoform

For heavy mineral separation, the already sieved samples for textural analysis were used. Before separation the respective sand fraction of each class medium sand (+45 and +60 mesh), fine sand (+80and +120 mesh), very fine sand (+170and +230 mesh) was thoroughly mixed and coned and quartered. Heavy minerals were separated from the lighter ones in three sand fractions using bromoform (CHBr3 - specific gravity: 2.85)and separating funnel. The minerals thus separated were washed with acetone and water driedand weighed to find out the total heavyand light mineral contents.

Examine the two fractions (light and heavy) Heavy mineral % , then under a microscope and determine the mineralcomposition and percentages for each fraction.

Table 3 Selected 17 Samples Heavy Minerals wt. (%)

Location	Sample Id	Total Sediments in gm.	Heavy Mineral in gm.	Total Wt. (%)
P2	06/02/S01(m)	96.65	8.51	8.80
P4	28/02/S01	46.83	2.81	6.00
P10	29/11/S08	15.945	2.655	16.65
P11	01/05/S04	53.005	1.7	3.21
P12	03/01/s01	52.385	1.75	3.34
P13	03/03/s03	59.83	1.055	1.76
P14	03/10/s08	79.14	3.22	4.07
P15	04/10/s07	60.735	2.58	4.25
P17	05\14\s10(4)	30.445	9.23	30.32
P18	05\14\s10(2)	16.745	2.465	14.72
P19	05\14\s10(3)	10.105	1.485	14.70
P20	02/03/s02	91.095	10.5	11.53
P21	02/06/s04	47.725	1.89	3.96
P22	03/11/s09	34.735	1.845	5.31
P24	30/14/s09	40.52	2.14	5.28
P25	29/10/s07	48.005	3.195	6.66
P26	05/03/s02	27.31	3.155	11.55

Heavy mineral separation using Frantz Isodynamic magnetic Separator

This mineral separation step will use just the heavy mineral fraction. Here, separation of the magnetic from non-magnetic minerals is accomplished using a Frantz isodynamic separator. First, to remove the extremely magnetic minerals, such as magnetite, from the heavymineral fraction we will use a free-fall magnetic separation. Attach a paper cone to thefront of the Frantz which has had its magnet rotated into a vertical position.

Place allmagnetic fractions and the fall non-magnetic fraction in separate vials labeled according toamp setting. Examine all fractions, magnetic and non-magnetic under binocular microscope and determine mineral composition and estimate percentages. First, place the non-magnetic free-fall sample in the Frantz cup making sure it is closed, tum up current to 0.3A; and turn on vibrating mechanism. Open the cup enough to allowgrains to vibrate freely down the trough through the magnet and into the collection cups. Collect magnetic and non-magnetic fractions. Remember the magnetic fraction is alwaysthe one pulled uphill, i.e., the one in the cup at the highest angle, closest to the analyst. Always place the non-magnetic fraction back in the Frantz cup. Repeat the non-magnetic and magnetic separation at 0.4A, 0.8A, and 1.5A. Weigh all fractions, magnetic and non-magnetic, for each sand sample to determine totalloss during separation. Use Table to identify the minerals present in each magnetic fraction. Examine all fractions, magnetic and non-magnetic under binocular microscopeand determine mineral composition and estimate percentages.

Table 4 Medium - Isodynamic Separator Analysis

S.no	Sample Id	Medium Hand Magnet	0.4 amp	0.8amp	1.5amp	Non_magnetic
1	P21	0	0.335	0.03	0.03	0.11
2	P13	0.001	0.015	0.02	0.03	0.025
3	P18	0.055	1.125	0.13	0.01	0.015
4	p15	0.01	0.265	0.09	0.02	0.055
5	p20	0.04	0.16	0.09	0.005	0.09
6	p25	0.02	0.01	0.015	0.005	0.04
7	p11	0.05	0.105	0.08	0.005	0.03
8	p10	-	-	-	-	-
9	p-22	0.02	0.08	0.045	0.005	0.005
10	p-17	0.025	0.415	0	0.005	0.005
11	p-12	0.07	0.035	0.05	0.005	0.05
12	p4	0.015	0.39	0.025	0.024	0.045
13	p14	0.01	0.075	0.135	0.005	0.02
14	P2	0.045	0.135	0.065	0.01	0.05
15	P19	0.03	0.485	0.26	0.08	0.015
16	P24	0.005	0.045	0.155	0.005	0.005
17	P26	0.47	0.145	0.1	0.005	0.035

Table 5 Fine - Isodynamic Separator Analysis

Sample Id	Fine Hand Magnet	0.4 amp	0.8amp	1.5amp	Non_magnetic
P21	0	0.98	0.06	0.005	0.09
P13	0.02	0.21	0.045	0.005	0.08
P18	0.115	0.97	0.05	0.005	0.02
p15	0.1	1.51	0.11	0.125	0.065
p20	0.37	6.57	0.31	0.005	0.05
p25	0.28	1.42	0.15	0.055	0.04
p11	0.09	0.78	0.08	0.005	0.08
p10	0.035	0.235	0.07	0.005	0.015
p-22	0.125	1.03	0.045	0.02	0.01
p-17	0.76	4.165	0.095	0.02	0.06
p-12	0.095	0.71	0.03	0.04	0.11
p4	0.15	1.17	0.615	0.015	0.06
p14	0.205	1.195	0.88	0.01	0.045
P2	0.715	3.97	0.595	0.01	0.065
P19	0.245	0.49	0.21	0	0
P24	0.055	0.635	0.695	0.705	0.035
P26	1.165	0.65	0.075	0.05	0.05

Table 6 Very Fine - Isodynamic separator Analysis

Sample Id	Very Fine Hand Magnet	0.4 amp	0.8amp	1.5amp	Non_magnetic
P21	0.01	0.17	0.07	0.005	0.065
P13	0.12	0.415	0.01	0.005	0.09
P18	-	-	-	-	-
p15	0.04	0.275	0.04	0.001	0.065
p20	0.36	2.405	0.025	0.005	0.025
p25	0.32	0.875	0.055	0.03	0.065
p11	0.075	0.31	0.02	0.005	0.04
p10	0.26	1.97	0.055	0.005	0.02
p-22	0.03	0.4	0.005	0.001	0.02
p-17	0.225	0.415	0.17	0.02	0.045
p-12	0.205	0.555	0.1	0.05	0.05
p4	0.05	0.085	0.055	0.005	0.035
p14	0.33	0.49	0.06	0.005	0.025
P2	0.535	2.11	0.09	0.005	0.175
P19	0	0	0	0	0
P24	0.04	0.235	0.21	0.005	0.015
P26	0.21	0.145	0.02	0.025	0.03

A total of 17 selected sediment samples were collected along the beach ridges at west coast of Kerala. The isodynamic analysis result Medium, Fine, and very Fine for maxium and Minium in grms below mentioned

Table 7 Medium - Isodynamic Separator Analysis

Minium (gm.)	0	0.01	0	0.005	0.005
Maxium(gm.)	0.47	1.125	0.26	0.08	0.11

Table 8 Fine - Isodynamic Separator Analysis

Minium (gm.)	0	0.21	0.03	0	0
Maxium(gm.)	1.165	6.57	0.88	0.705	0.11

Table 9 Very Fine - Isodynamic separator Analysis

Minium (gm.)	0.01	0	0	0	0
Maxium(gm.)	0.535	2.405	0.21	0.05	0.175

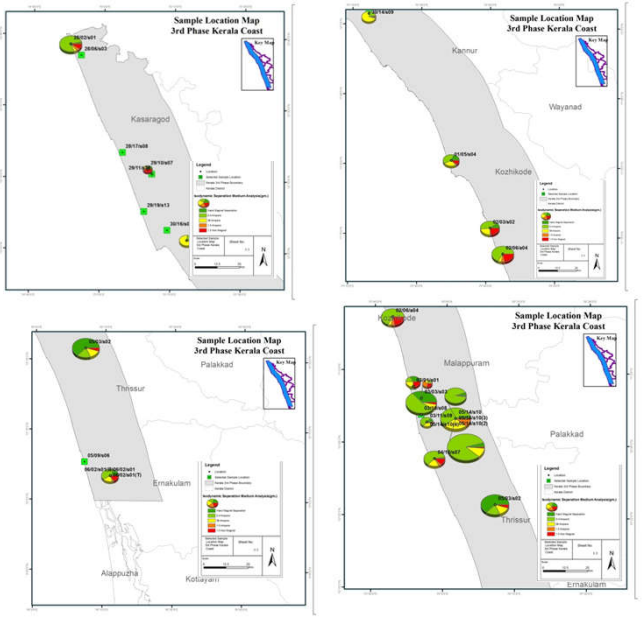

Figure 3 Map Shows Sample id – K(%), U(PPM) and Th(PPM)

Mineral Identification using Leica Petrological - optical microscope

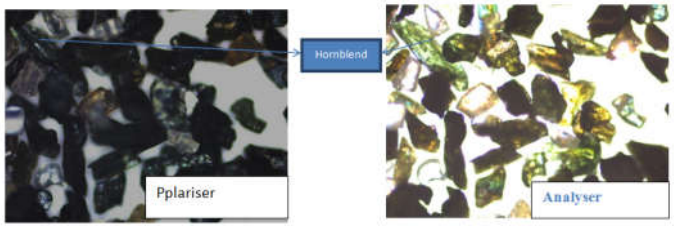

Figure 4 Shows Sample id P15/1.5amp/ Very fineHeavy's Minerals

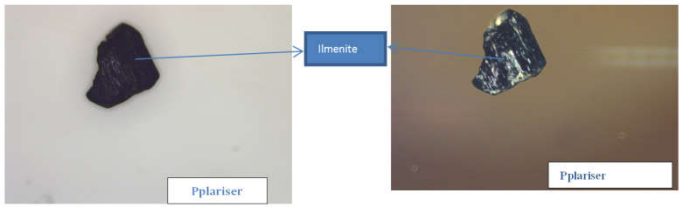

Figure 5 Shows Sample id P4/Medium/Heavy Minerals

Figure 6 Shows Sample id P13/heavy medium/0.4/ILMENITE

RESULT AND CONCLUSION

The present study addresses to understand the sedimentological properties of the coast of West Kerala coast, to bring out the relationship between the textural &mineralogical characters with that of the respective environment.

The grain size study of the beach ridge sediments from different location has been investigated, which enabled to understand the grain size variations with few (1-2) meters depth. The sediment samples from various sample location of the beach ridges indicate that the sediments. In this mean size ranges from 0.024 to 3.068 (coarse to very fine sand). The sediments are moderately well sorted to moderately sorted (SO = 0.393 - 1.384), skewed in a wide range - fine skewed to very coarse skewed (0.175 to -0.55) and the kurtosis values range between 0.703 and 2.417 i.e., platykurtic to very leptokurtic. The beach ridges in the study area constructed from near shore sand supplies by infilling the shallow sea that served as an important trap for the river borne sediments supplied from the rivers that drain the area.

Textural classification of sediments has been worked out for .1. Planated Beach Ridges, 2. Swales, 3. Relict Beach Ridges and 4.Backwaters.5.mangroves, 6.intertidal mudflats sediment above 5 environments record high proportion of sand content and the predominant sediment type is sandy silt mud.

The total heavy mineral percentage shows prominent enrichment in fine sand and very fine sands. The major minerals are o hypersthene, ilmentie, magnetite, hornblende, and zircon.

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