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Sedimentology of the Glacial Sands and Lake Terrace Sediments from Schirmacher Oasis and Sea Bed Sediment off Princess Astrid Coast, Queen Maud Land, Antarctica

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ABSTRACT

Grain size analysis heavy mineral studies clay mineralogy and surface textural studies of quartz grains have been carried out on the offshore seabed sample from 215 m depth at 11°53 E - 69°57 S glacial sands and lake terrace sediments from the Schirmacher Oasis Queen Maud Land. Grain size of the sea bed sediments varies from coarse sand to clay size. Probability curve corresponds to marine shelf environment. Glacial sediment shows grain size variation from coarse sand to clay grade. Horn blende zircon garnet tourmaline kyanite epidote staurolite and hypersthene form the heavy mineral suite. llhte with subordinate chlorite are main clay minerals in lake terrace and offshore sediment. Plagioclase and phillipsite are also noted. Study of quartz grain surface textures by SEM show conchoidal fracture and V-shaped depressions. A probable glacial origin of the sands are inferred.

INTRODUCTION

Present study deals with the sedimentological aspects of one offshore sea bed sample twelve land glacial sand samples and four samples from lake terraces of Schirmacher Oasis Queen Maud Land collected during the Third Antarctic Expedition. Most of the area is covered by thick ice Offshore sea bed sample was collected near the *MV Finnpolaris* wooring place. Glacial sands have been collected from the Schirmacher Oasis. Schirmacher Oasis has an area of 35 sq km.

This study includes grain size analysis X-ray study of clay minerals heavy mineral studies and surface grain studies of quartz by SEM. Clay mineral slides were run between 2° to 30° on a Philips PW 1730 X-ray diffractometer using Nl filtered Cu K2 radiation. Grain size analysis were carried out at ¼ø interval. Details of the geology of the area has been dealt in Sudipta Sengupta (1986).

GRAIN SIZE ANALYSIS

Sea-bed sediment (Grab sample 21 5 m depth)

Grain size varies from coarse sand to clay size. Proportion of sand silt and clays are 90 12%, 9 05% and 0 82% respectively. Mean size of sediments at 2 8ø (Table 1) indicate a fine sand grade Sorting figure at 0 86ø indicates that the sands are 'moderately sorted ' (Folk & Ward, 1957). Sediments show positive skewness, value being 0 16ø. The kurtosis value 1 430 points to the lepto kurtic nature of the grains.

Glacial sediments

Grain size varies from coarse sand to clay grade and are moderately sorted. Samples, 1,3 and 6 are nearly symmetrical, while rest are positively skewed, except sample No 12 which is negatively skewed. The samples are lepto-kurtic to mesokurtic.

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TABLE 1

Grain size analysis parameters of Sea Bed & Glacial Sediments

Sample No	*ϕ1*	*ϕS*	*ϕ16*	*ϕ25*	*ϕ50*	*ϕ75*	*ϕ84*	*ϕ95*	*Mean Mz*	*SD*	*SK I*	*KG*
A. SEA BED SEDIMENT												
SB-1	0.5	1.15	1.95	2.35	2.9	3.35	3.55	4.2	2.8	0.86	-0.16	1.43
B. GLACIAL SEDIMENTS												
1	0 86	1 40	1.80	2.00	2.35	2.70	2.95	3.55	2.37	0.62	0.08	1.26
2	0 40	0 75	1.15	1.35	1.82	2.45	2.70	3.40	1.89	0.79	.15	.98
3	0 2	0 80	1.30	1.50	1.95	2.40	2.70	3.40	1.98	0.74	0.09	1.18
4	0 2	0 57	0.98	1.17	1.60	2.10	2.30	3.00	1.63	0.70	.11	1.07
5	0 45	0 75	1.07	1.20	1.60	2.05	2.40	3.20	1.69	0.70	0.25	1.18
6	0 95	1 35	1.75	1.95	2.40	2.80	3.10	3.68	2.42	0.69	0.07	1.12
7	0 45	0 90	1.40	1.60	2.20	2.80	3.15	4.40	2.25	0.97	0.17	1.20
8	0 2	0 60	1.10	1.30	1.80	2.35	2.70	3.50	1.87	0.84	0.15	1.13
9	0 45	0 85	1.20	1.40	1.90	2.55	2.90	3.60	2.00	0.85	0.21	0.98
10	0 3	0 72	1.10	1.25	1.75	2.30	2.60	3.30	1.82	0.77	0.17	1.01
11	0 55	0 95	1.35	1.52	2.00	2.55	2.90	3.75	2.10	0.81	0.21	1.14
12	0 05	0 41	1.14	1.36	1.95	2.55	2.80	3.46	1.96	0.88	-4.91	1.05

HEAVY MINERALOGY

Sea-bed sediments

Hornblende (38.74%), garnet (18.87%), tourmaline (12.58%), zircon (5.26%), epidote (3.97%), zoisite (2.65%), sphene (2.32%), kyanite (1 .33%), staurolite (0.99%), chlorite (0.99%), hypersthene (0.66%), rutile (0.33%), chloritoid (0.33%) forms the heavy mineral suite.

Similar assemblages are seen in the Glacial sands. Angularity of the grains and lack of alteration indicate that these heavy minerals are of first cycle and have undergone less transportation.

CLAY MINERALOGY

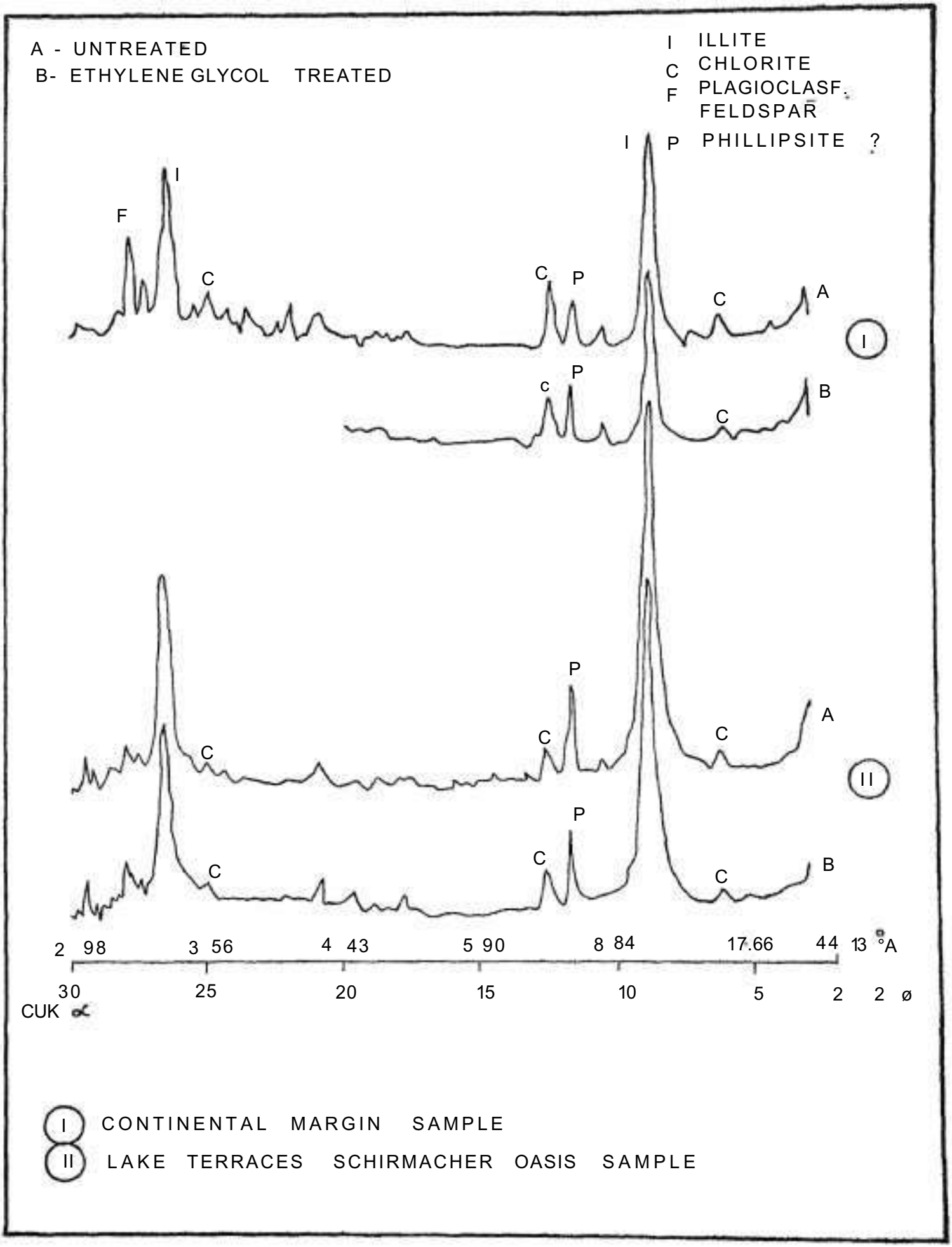
Clay mineral suite of the continental margin comprise dominant illite (88%) with subordinate chlorite (12%). The minerals show good crystallinity (Fig. 1)

The lake terraces on Schirmacher Oasis show similar suite of clay and non-clay minerals. Illite is dominant (95-97%) with subrodinate chlorite (3-5%).

Individually the clay minerals are not environmentally sensitive but as a suite the illite-chlorite assemblages are considered to be associated with marine environment in the cold regions (Grim 1953).

Mineralogy of the sea-bed clays and clays of lake terraces are of the same indicating a similar provenance.

Siddiquie and Hashimi (1982) have reported smectite from 12°E. Ridge, but the same is absent in the present area.



I CONTINENTAL MARGIN SAMPLE

II LAKE TERRACES SCHIRMACHER OASIS SAMPLE

Fig. 1

Fig 1 Angua na u e o quartz grains
Fig 3 Typcal concho dal f ac u e n quartz grains

Fig 2 V shaped pa e n n quartz grains
Fig 4 Close ew o he sub pa a e s eps

SURFACE GRAIN STUDIES OF QUARTZ

Quartz grains are subangular and fresh and show abundant conchoidal fracture subparallel linear steps striations (PI I, Fig 1 & 3) and few V-shaped depressions (PI I, Fig 2) Conchoidal fractures are unevenly distributed and vary in shape and size (PI I Fig 3 & 4). Large conchoidal fractures are considered to be of glacial origin. V-shaped depressions indicate effect of some subaqueous transport (Krinsley and Doom Kamp, 1973, Cater 1984). The presence of V-shaped pattern and abundance of glacial surface textures in the sea-bed as well as glacial sands from Schirmacher Oasis indicate that these sediments are deposited in the glacial environment and in the subaqueous solution.

CONCLUSIONS

1 Sea bed sediments contain high percentage of sand (90 12) followed by silt (9 05) and clay (0 82). The sand is fine grained and is moderately sorted.

2 Fine to medium sand are abundant in the glacial sediments. Grain size varies from coarse grained sand to clay grade.

3 Heavy mineral suite of offshore and glacial sands of Schirmacher Oasis comprises of hornblende garnet tourmaline zircon epidote zoisite sphene kyanite staurolite chlorite hypersthene rutile and chloritoid. These minerals are of first cycle.

4 The main constituents of the clay minerals in tne offshore and lake terrace are illite with subordinate chlorite.

5 Surface texture of quartz grains indicate glacial textures like subparallel steps and striations and conchoidal fracture. The V-shaped marking indicate subaqueous transport.

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REFERENCES

Cater J M.L. 1984. An application of SEM of Quartz sand surface textures to the environmental diagnosis of Neogene carbonate sediments, Finestrat Basin, SE Spain. *Sedimentalogy 31*,717-731.

Folk R.L. and Ward W C, 1957, Brazos river bar, a study in the significance of grain sized parameters. Jour. Sed Petro 27(1); 3-26.

Grim R E , 1953; *Clay mineralogy* Mcgraw Hill Book C. O. INC, 1-384 p.

Krinsley, D H and Doornkamp, J. C, 1973;*Atlas of quartz sand surface texture,* the University Press Cambridge, 291 p.

Siddiquie H.N and Hashimni N.H., 1983; Sedimentology of the sea bed sediments from the 12°E Ridge, Princes Astrid Coast Queen Maud Land, Antarctica; Scientific report of the First Antarctic Expedition, Deptt., of Ocean Development, Delhi Pub. (1), 164-171.

Sudipta Sengupta, 1986; Geology of Schirmacher range (Dakshin Gangotri), East Antarctica (in this volume).