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STUDY OF LITTORAL SAND MIGRATION ALONG THE WEST COAST OF AHNMYEON ISLAND, KOREA

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ABSTRACT

A marine geological investigation of the glass sand deposit in the beach along the west coat of Ahnmyeon Island, South Chung Cheong Province, Korea was carried out to solve the problem of sand material migration, textural properties of the sands and the glass sand reserve for future exploitation.

Several box coring analyses by means of the internal sedimentary structure,i.e., cross-stratification show significantly that most sands are moving and accumulating along the mean vector direction of N20°E-N60° E in the area investigated. The average mean size of the sand sediments in the area studied ranges from 0.212mm to 0.275mm. The mechanism of sand migration in the area is considered to be interplay between longshore drift and flood tidal current.

The sorting value of the sands ranges from 0.24 to 0.50. Therefore, these sand sediments are characterized to be "well sorted". The average chemical composition of the glass sand in the area is the following: SiO_2:−90.8%, Al_2O_3:−2.18%, Fe_2O_3:−0.73%, CaO:−1.79%. The binocular microscope examination of the sands show that most of the sands are characteristically ice-clear quartz in mineral composition and their count percentage is mostly 92% or 96%.

INTRODUCTION

Efforts to investigate the movement of littoral or nearshore marine sediments, especially sand-sized sediments have continuously been concentrated over the past decade. For the movement study, sedimentologists, coastal engineers and oceanographers have long tried to understand the dynamic conditions of sand movement from the viewpoint of practical interest or with the basic scientific knowledge. Furthermore, with the development of radioactive and fluorescent-tracing techniques there has been an active tendency to attack the sand migration problems.

Within the complex energy fields of a nearshore and tidal flat, wind and waves as well as tide effects play a role in the erosion, transport and deposition of sediment. The textural properties,i.e., sorting and mineralogic composition and the sedimentary bedforms are either partially or completely controlled by these interacting energy. Newton and Werner(1969) attacked the question opened by the extensive hydrologic and geodetic works in the tidal flat area, NW of Cuxhaven, Deutschland in order to understand what information could be gained from investigating the sediments directly. Finally they concluded that the individual sedimentary bedforms which reflect the sediment movement at the time of deposition can be compared to the already established hydrologic vectors. Park(1973) also investigated the sediment transport directions in the intertidal channel sand bodies in the tidal environment along the west coast of Schleswig-Holstein, Deutschland by analyzing the sedimentary forms, especially sandwaves and their internal structures.

In this paper the writer tried to analyze the sedimentary bedforms and their internal structure on the foreshore sand deposit along the west coast of Ahnmyeon Island to find the sand migration direction. In addition to the sand movement problem, the textural parameter of the beach sands was considered. Index map of the study area is shown in Figure 1.

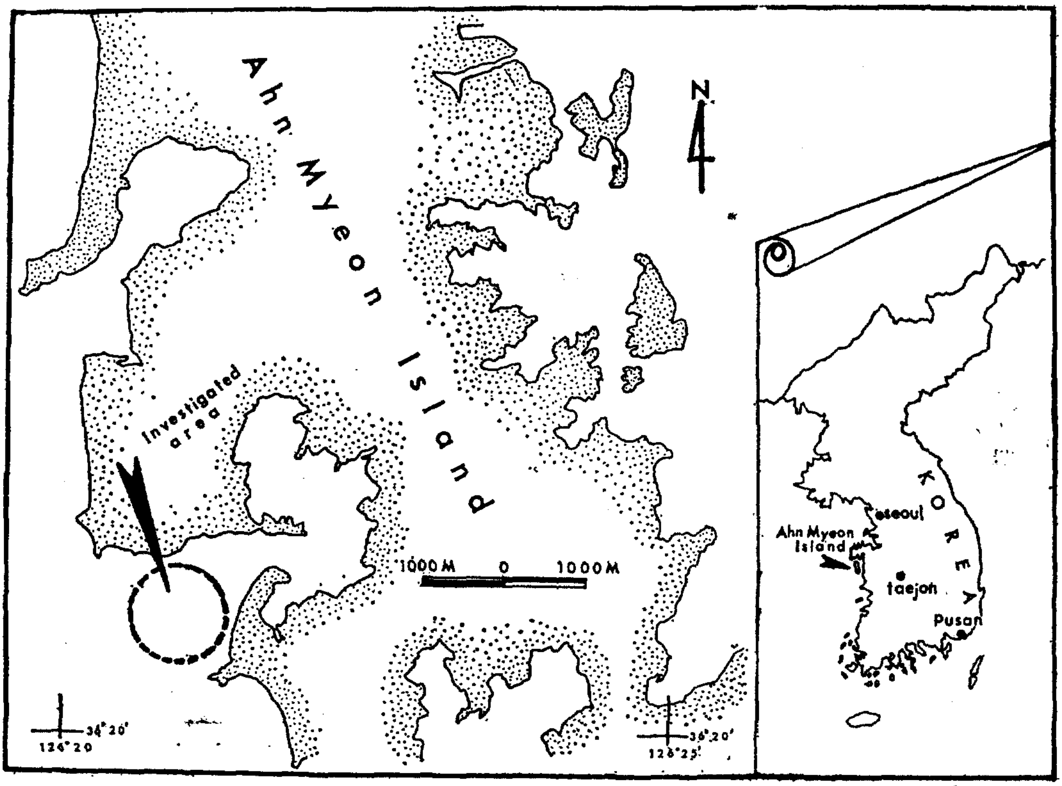

Fig. 1. Index map and the investigated area.

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SETTING

The broad tidal flat areas are developed along the Yellow Sea coast of Korea and the tidal range is significantly very high. Furthermore, hundreds of small and large islands are irregularly developed along the coast, which is well known as one of the typical ria coasts in the world.

The coast is considered to be transgressive coast with the rate of 0.426mm a year for the past

4,000 years.(Park, 1969)

The present beach systems along the Yellow Sea coasts of Korea including the beach investigated this time seem to be controlled by type of shoreline physiography, bedrock geology, expoure to current and waves, and sea level changes. In fact, furthermore, the investigated beach zone is characterized by a tidal beach and re-orientation of the coastline.

The tidal range of the water on the beach is 400-520 cm. Breakings of spilling and planging type were observed on the beach depending on the wave conditions.

SEDIMNT ATTRIBUTES

About 20 representative sediment sample collected from the beach area have been analyzed for grain-size distribution by sieving to $1/4\phi$ sizes. The textural parameters, i.e., mean and sorting(standard deviation) based on Folk (1968) formula are the following:

Table 1. Sorting and mean size

Sampled area	Mean range (in Phi)	Sorting range
Foreshore seaward margin	1.92—2.19	0.24—0.38
Foreshore proper middle area	2.15—2.28	0.38—0.50

The sorting values in the foreshore seaward margin range from very well sorted to well sorted(σ_1=0.24-0.38). However, the values in the foreshore proper middle area range from well sorted to moderately well sorted(σ_1=0.38-0.50). The cause of such sorting value difference is considered to be more active effects of breaking waves and longshore current in the foreshore seaward margin than in the foreshore proper middle part. However, based on the average sorting values, the investigated beach sands are well sorted as Mason & Folk(1958) and Friedman(1961) explained in their investigation of beach sands. The mean size of the sands in the foreshore seaward margin is coarser than that in the foreshore proper middle area. The reason seems to be due to differential physical energy level in the area concerned.

Figure 2 is a plot of first percentile versus inclusive standard deviation. As shown in Figure 2, all the samples are included in the range of beach environment based on the dividing line by Friedman(1967).

The C and M parameters were computed from the cumulative curves and C.M diagram was contructed from these data. The diagram is shown in Figure 3. The dashed line range is

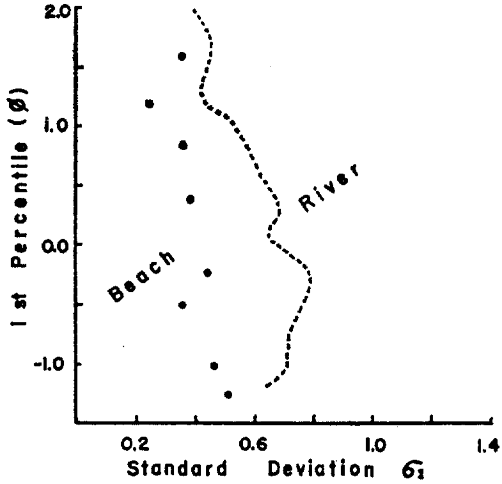

Fig. 2. Plot of first percentile versus inclusive graphic standard deviation. Boundary line after Friedman (1967).

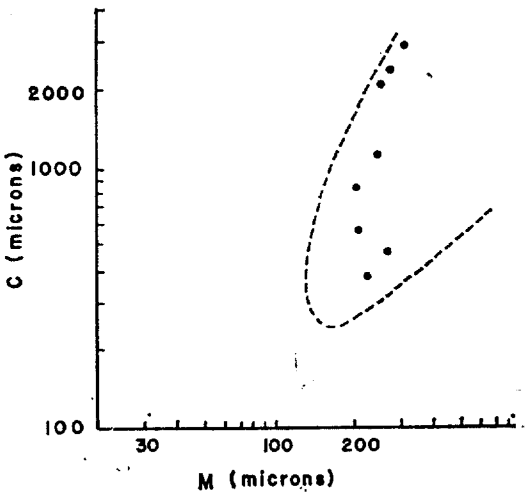

Fig. 3. CM diagram, Delineated area after Passega (1957).

drawn after the basic pattern of beach deposition given by Passega(1957).

The roundness values of the quartz grains ranging in 0.297mm-0.250mm in diameter were computed according to the Powers roundness scale(1953). As shown in Table 2, the representative roundness values from six sampling stations in the beach area range from 0.27 to 0.328.

Table 2. Roundness values of quartz grain

Sample station	1	2	3	4	5	6
Average roundess value	0.277	0.328	0.306	0.299	0.252	0.290

The mean values of roundness, therefore, indicate that these beach quartz sands are mostly subangular (0.25-0.35).

MOVEMENT OF BEACH SANDS

Field examination of rippled bedforms, mainly sand waves on the beach indicates that the directions of asymmetries of the foreshore sandwaves are landward.

The sandwaves are mostly 22-25 meters in wave length and 30-42 cm in wave height. The main strike-direction of the wave crests ranges from N 10°W to N 15° W. All sandwave crests are not parallel to shore.

The box-cores taken from these sandwaves were oven-dried at 100°C and impregnated with Paraffin casting resin to obtain the relief casts pictured(Fig. 4 & 5). The internal sedimentary structures ef the sandwaves, that is, cross-stratification are mostly tablular, lenticular and herring-bone cross-stratification. Most of cross-bedding sets have 12 degree to 20 degree in angle.

To obtain the sediment transport vectors, both the general distribution of the sedimentary forms and the internal structures were examined. Based on the examination and calculation it is known that most sands in the area are moving and accumulating along the mean vector direction of N 20°E-N60°E, probably by an interplay of longshore drift and flood tidal current. Figure 6 shows the box-cores orientation and mean vector of the internal cross-stratification in a sandwave in the area investigated.

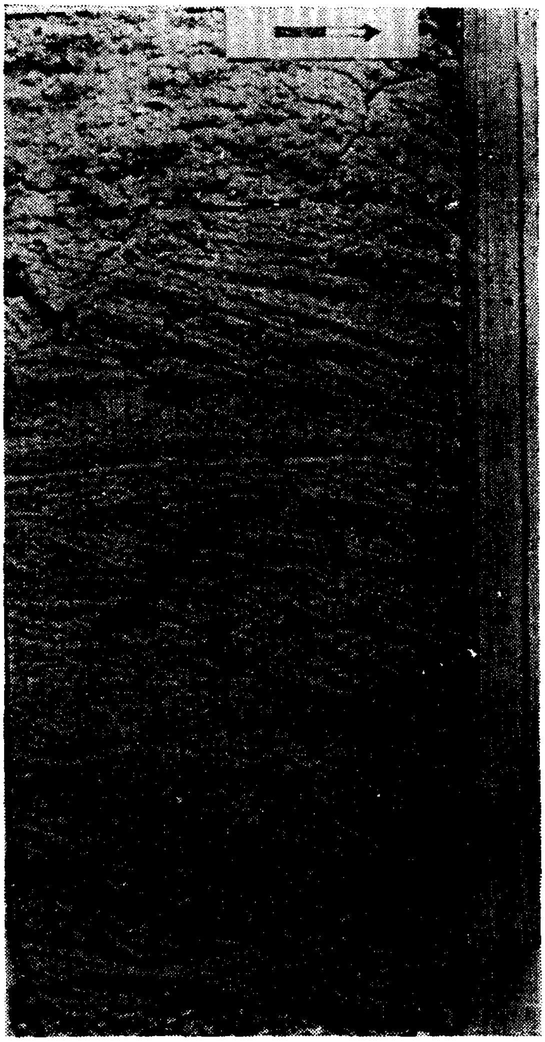

Fig. 4. Section of box-core taken at crest of sandwave showing unidrectional internal structure except a part of herring-bone cross-stratification set. Note predominance of landward (arrow) dipping laminae.

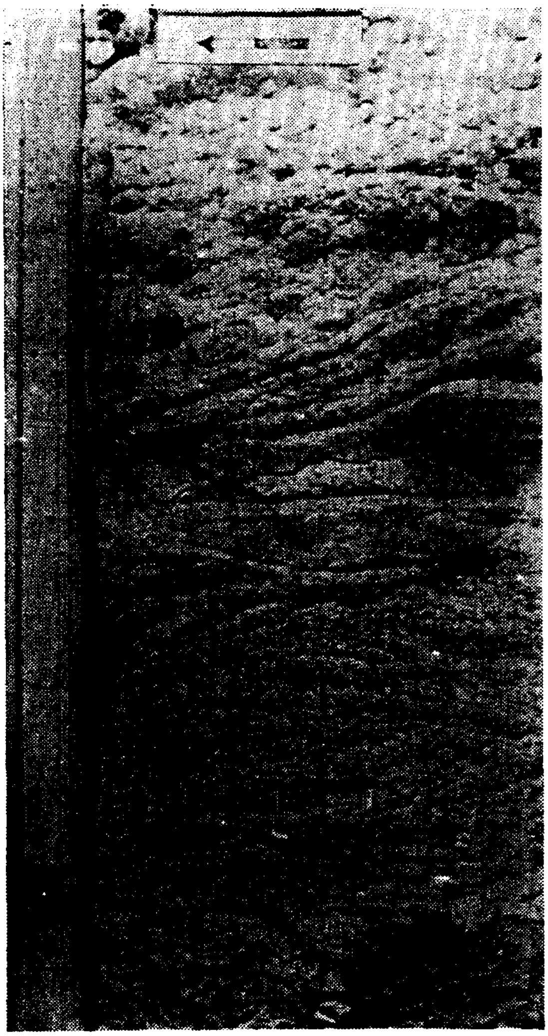

Fig. 5. Box-core showing "semi multi-phase" internal lamination. Arrow indicates landward side.

CONCLUSIONS

1. The beach sands in the area studied are moving and accumulating along the mean vector direction of N20°E-N60°E.
2. The mechanism of landward sand migration in the area investigated is considered to be interplay between longshore-drift and flood tidal current.
3. Based on the textural parameters of the beach sands the following characters are found:
   (1) The sediments are medium-fine grained sands.
   (2) The sands are well sorted with the sorting value of 0.24-0.50.
   (3) The pair values of first percentile versus inclusive standard deviation indicate a good agreement that recent depositional environments can be discriminated by the textural parameters.
4. Most sands are characteristically clean quartz sands in mineral composition and their count percentage is 92% or 96%.

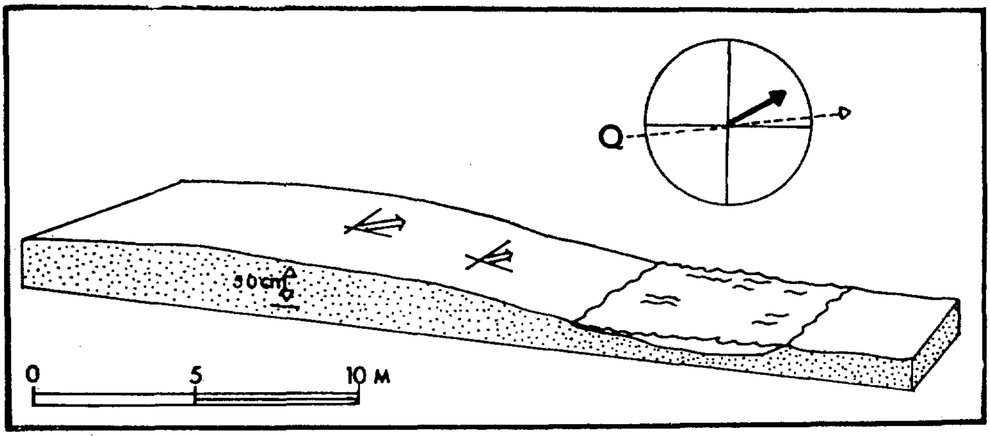

Fig. 6. A sandwave showing box-cores orientation and mean vector of cross-stratifications. Q indicates landward asymmetry direction of sandwaves. Vertical scale exaggeration is 1.7 times.

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