GEOMORPHIC NATURE OF SOME UNCONSOLIDATED DEPOSITS IN THE LANGHOVDE AND SKARVSNES AREAS, SÔYA COAST, EAST ANTARCTICA

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Abstract: Some characteristic features of fluvioglacial deposits and a glacial drift in the coastal ice-free areas on the Sôya Coast, Lützow-Holm Bay are described and discussed on the basis of the data obtained by field survey in 1981. Two types of fluvioglacial deposits in the Langhovde area indicate that the ice sheet would have receded from the area, leaving small ice masses in small rock basins, and that the flood plain type deposits were deposited during the last 6000 years, considerably later than the former event. A glacial drift found in a part of the Skarvsnes area is notably thick in comparison with those in other areas and is thought to have been deposited by the ice sheet as lodgement till on the basis of its depositional facies. The lodgement till and plastically scoured surfaces of bedrock show that the erosion and deposition by the wet-based ice sheet took place in this region during the last expansion of the ice sheet.

1. Introduction

Unconsolidated deposits in the coastal ice-free areas on the Sôya Coast, Lützow-Holm Bay, are 1) glacial drifts, 2) elevated marine sediments, 3) eolian deposits, 4) disintegrated debris, and 5) fluvioglacial deposits. They are not much in quantity but are distributed widely in the region. Their mode of occurrence and amount vary in each ice-free area in some degree according to position to the ice sheet, size, and topography of the area concerned.

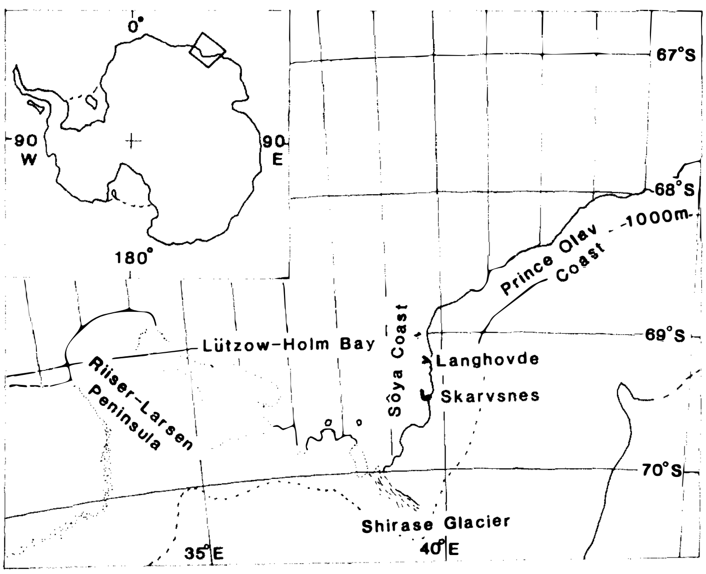

Fig. 1. Location map of the Sôya Coast.

Geomorphological characteristics of elevated marine sediments have been frequently discussed (YOSHIDA, 1970; FUJIWARA, 1973; MORIWAKI, 1976; OMOTO, 1977; HAYASHI, 1979). However, only a little attention has been paid to other deposits. In 1981, the author carried out a short field survey in the Langhovde and the Skarvsnes areas (Fig. 1) and obtained some data on fluvioglacial deposits in the former area and a glacial drift in the latter. This paper outlines the result of the field survey and discusses briefly their geomorphic implications.

2. Fluvioglacial Deposits in Langhovde

The Langhovde area, the second largest ice-free area in this region, forms a glaciated hilly mountain with maximum height of 500 m. Depressions and rises are developed conformably with geologic structures of gneissic bedrock. In particular, long straight depressions along joints or fractures are remarkable. The area is divided by the Naka-no-tani Valley glacial trough into two parts; the northern Langhovde and the southern (YOSHIKAWA and TOYA, 1957). The northern Langhovde is detached more

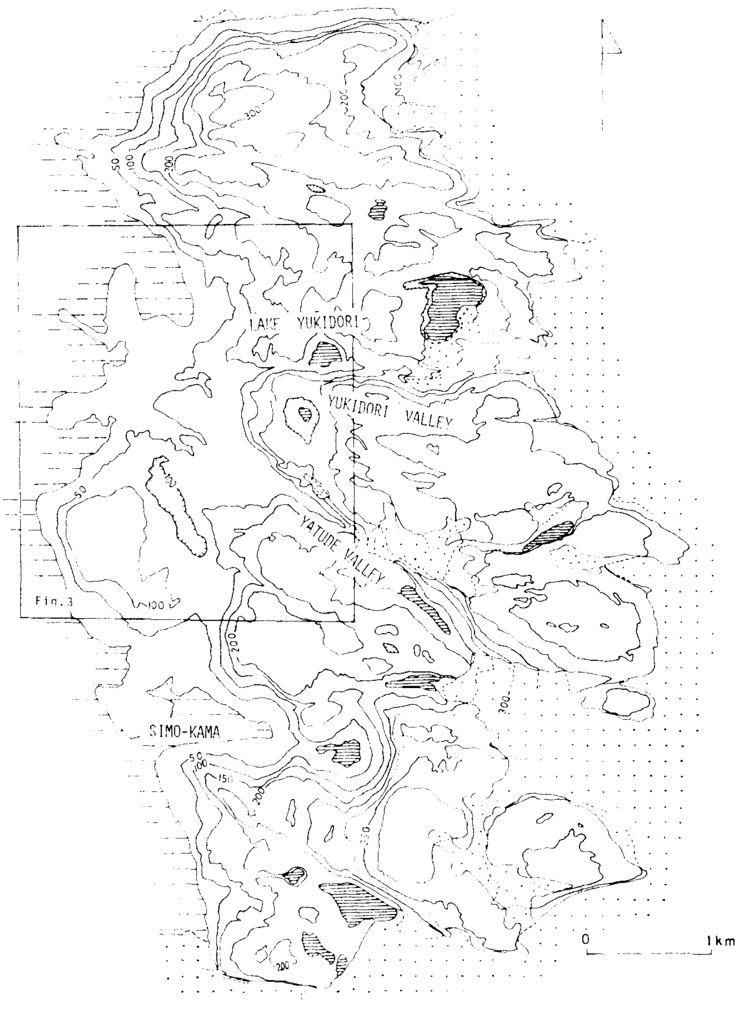

Fig. 2. Sketch map of the southern Langhovde area (Contour interval; 50 m).

from the ice sheet than the southern Langhovde and almost free from snow and ice. Unconsolidated deposits are eolian sand cones, elevated marine sediments and sparsely distributed thin ground moraines. On the other hand, the southern Langhovde is situated more closely to the ice sheet and has small ice-tongues and drift-snow ice fed directly or indirectly by the ice sheet. Unconsolidated deposits are more abundant than in the northern Langhovde. Especially, fluvioglacial deposits are noticeably distributed in this area in comparison with other ice-free area on the Sôya Coast.

In the lower reaches of the Yatude Valley and the Yukidori Valley in the middle southern Langhovde, fluvioglacial deposits spread out on rather flat valley floors where the very narrow upper reaches are abruptly widened (Figs. 2 and 3). They consist of sand and gravels of various sizes from boulder to pebble, and many of gravels are more or less rounded. They are slightly cut by small meltwater streams at their lateral margins to form indistinct low terraces. Surface deposits of the terraces were a little stained by weathering. These valleys are connected to the sea through very small gorges which form knick points. Small dissected deltaic-fans are found at the mouth of

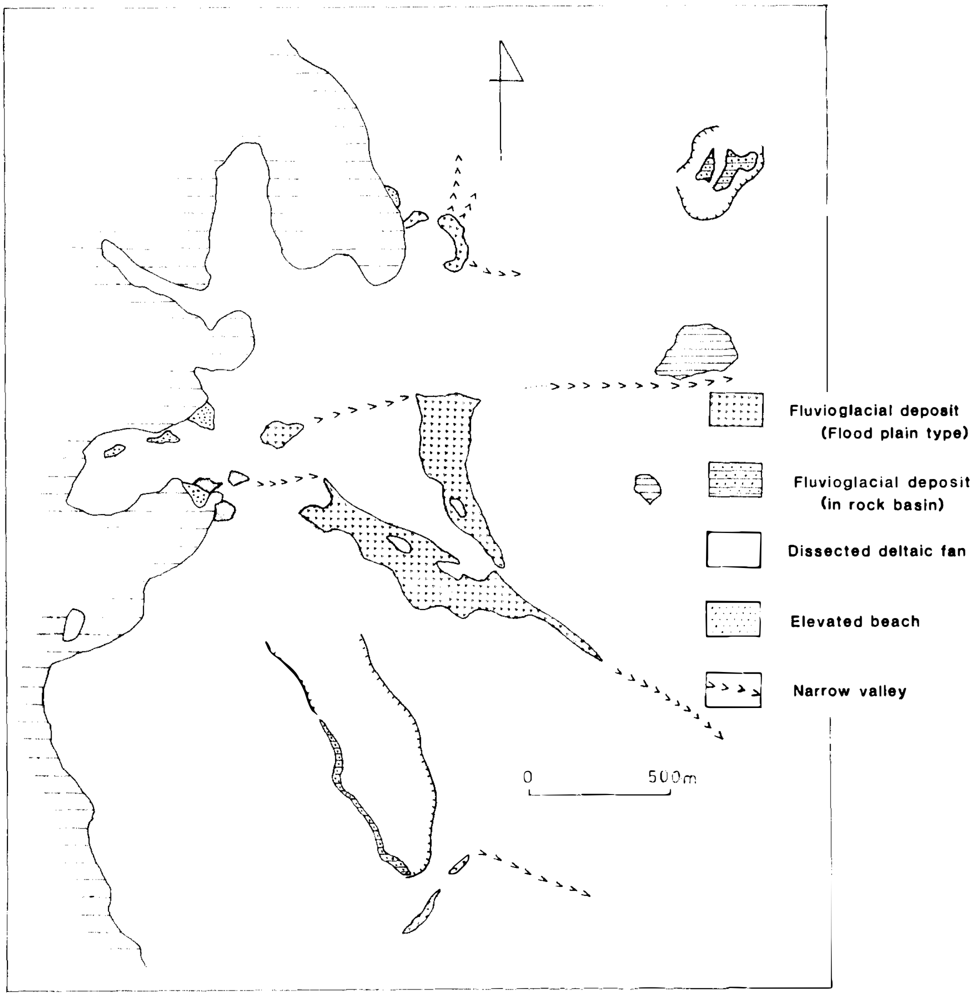

Fig. 3. Distribution of fluvioglacial, deltaic fan, and elevated beach deposits which are described in the text.

the Yatude Valley just downstream from the gorge (Fig. 3). Altitudes of the fans are about 17, 9, and 7 m above sea level. These levels are in consistent with those of elevated beaches formed during the last 6000 years (YOSHIDA, 1983). Therefore, most of the deposits were formed during that period. The present meltwater streams appear to be incapable of transporting larger rock debris. Meltwater would have been much more abundant during the formation of the deposit than today.

Fig. 4. Horizontal fluvioglacial deposit (middle distance) in a rock basin.

Other modes of occurrence of fluvioglacial deposits are found in some small rock basins eroded by areal scouring (SUGDEN and JOHN, 1976) of the ice sheet. A long and narrow bank of debris lies almost horizontally on the gentle slope of a rock basin which is situated at 700 m north of the Simo-kama cove (Figs. 3 and 4). The basin is 1 km long, 300 m wide and 60 m deep and extends to north-northwest. But the exhumed glacial striation beneath a thin morainic deposit indicates the former ice flow from east to west. The bank of debris covers part of a morainic deposit. A mode of occurrence and depositional feature of this bank suggest that the bank was formed by meltwater at the marginal zone of an ice mass which occupied the basin up to the level of the bank (50 m above its lowest bottom) at that time. Similar topography could be produced on a perennially frozen lake. But the basin would not allow the formation of such lake at that level, because part of the basin wall is lower than that level.

Another example of fluvioglacial deposits that flowed into an ice-filled depression may be found in the small depression 500 m north of Lake Yukidori. Here, terminals of two lobes of fluvioglacial deposits seem to have been blocked by an ice mass to form low cliffs. Some other depressions also might have been occupied by such body of dead ice just after the ice sheet retreat, though field evidence has not been ascertained. A cirque glacier formed during the ice sheet retreat (YOSHIKAWA and TOYA, 1957), would have been an active ice mass in the same or slightly earlier age.

3. Glacial Drifts in Skarvsnes

Skarvsnes, the largest ice-free area on the Sôya Coast, is a hilly land with the maximum height of 400 m, but most part of the area is less than 300 m high. The topography is also characterized by glacially smoothed surfaces similar to that of Langhovde. However, straight depressions along joints and fractures are not so conspicuous. Glacial grooves and striation are more frequently preserved than those in Langhovde, indicating that the weathering of bedrock is less advanced.

Remarkable unconsolidated deposits in Skarvsnes are elevated beach deposits and thin glacial drifts. Elevated beaches are widely distributed along indented coastlines and in small inland basins which had been formerly arms of the sea, and are marked with small steps and low cliffs in places. Abundance of the elevated beaches is partly accounted for by the wide distribution of glacial drifts.

Glacial drifts are in general thin ground moraines which are distributed sporadically but widely both on rises and depressions over the whole area. However, somewhat exceptionally thick drift is found near the easternmost head of Osen (bay) (Fig. 5). It was noticed in 1975 (HAYASHI, personal communication), but not surveyed before 1981. It is worth noting because of its peculiar features.

The easternmost arm of Osen occupies a partly drowned glacial trough (or cirque-like depression) 1200 m long and 500 m wide. The trough head abruptly cut the

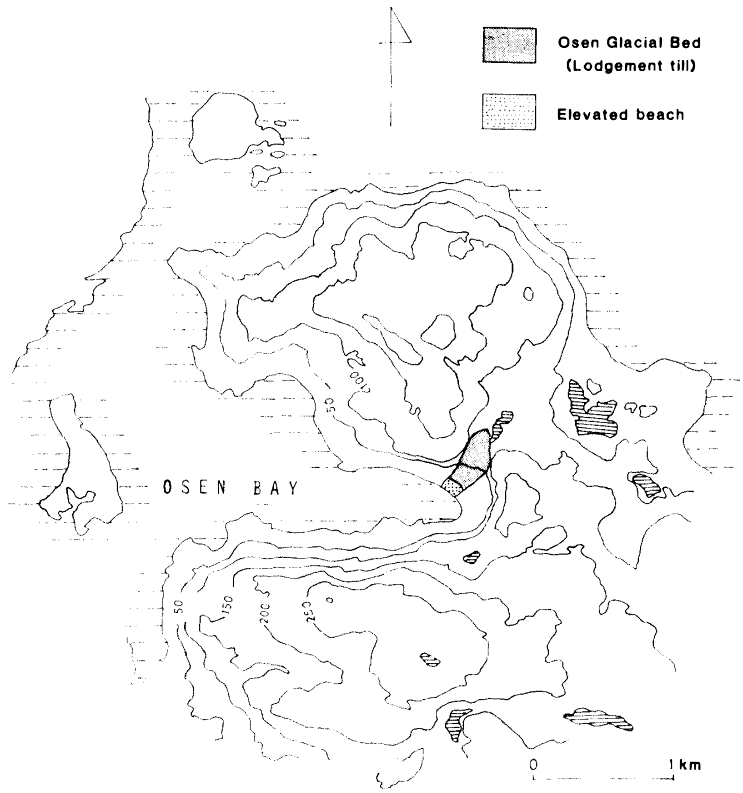

Fig. 5. Sketch map of part of the Skarvsnes area showing the location of lodgement till (Osen Glacial Bed).

glacially scoured, uneven upper surface. The relative heights of the trough wall above sea level range from 130 m to 250 m according to relief of surrounding upper surface. A northern part of the trough head is broken by a shallow depression on the upper surface. The glacial drift in question is distributed from a part of this shallow depression to the lower part of the trough head, from 90 m to 10 m or lower above sea level.

The thickness of the drift sheet is not clear because its contact to bedrock or to other formation cannot be seen. But the topographic situation suggests the thickness of around 10 m. Part of the sheet was cut by erosion to form vertical cliffs 2 to 4 m high (Fig. 6). The deposit consists of slightly compacted sand and silt mixed with angular to subangular gravels of granule and pebble size. Cobbles and boulders up to 50 cm in diameter, more or less rounded, are also included, but they are not so aboundant as those in ground moraines distributed in other areas. Sorting of particles is hardly seen throughout the outcrop section. But the joint-like horizontal and vertical cracking occurs frequently on the surface of the outcrop (Figs. 7 and 8). Cobbles and boulders appear to show faint orientation; that is, the long axis of a gravel extends towards downstreams. The drift sheet is overlain thinly by gravels of various size. The gravel bed contains weathered cobbles and boulders and seems to have been deposited as ablation till.

The above features strongly suggest that the drift might have been formed by a wet-based glacier as lodgement till. Exotic boulders in it indicate that the ice responsible for deposition was not of a local glacier but of the ice sheet. Lack of water-washed facies in almost all part of the till shows that the amount of meltwater beneath the ice sheet was not much.

The drift is situated at the valley floor and the trough head eroded probably by ice flow in the ice sheet. It would not have been affected by the re-advance of the ice sheet since its formation, because there is no sign of erosion or deposition by the ice sheet. The marine agency modified the drift below 10 m high into elevated beaches. Therefore, the drift might have been formed during the last ice sheet expansion which pre-dates 30000 years ago (YOSHIDA, 1983), though any direct evidence of formation time has not been obtained. Lodgement till or partly stratified till ever reported is mostly of considerably older time (MERCER, 1972; BARRETT and POWELL, 1982) than this till.

The name Osen Glacial Bed is proposed for the drift here, because of its peculiar feature. Occurrence of glacial deposits having the same characteristics as the Osen Glacial Bed has not been known at any localities in ice-free areas around Lützow-Holm Bay. However, some of sporadically distributed deposits, part of them being attributed seemingly to marine sediments, should be re-examined referring to the Osen Glacial Bed.

The basal condition of the ice sheet is important for glacial erosion. In the Lützow-Holm Bay region, areal scouring by the ice sheet as well as linear erosion apparently took place. Plastically moulded glacial grooves with striation suggest erosion by wet-based ice sheet (YOSHIDA, 1983). The Osen Glacial Bed indicates also that the bottom of the ice sheet was in the condition of pressure melt. However, no indication of much water is found, unlike the case of the Dry Valleys region where many eskers are known in the Ross Sea Drift deposited by the grounding Ross Ice Shelf during the

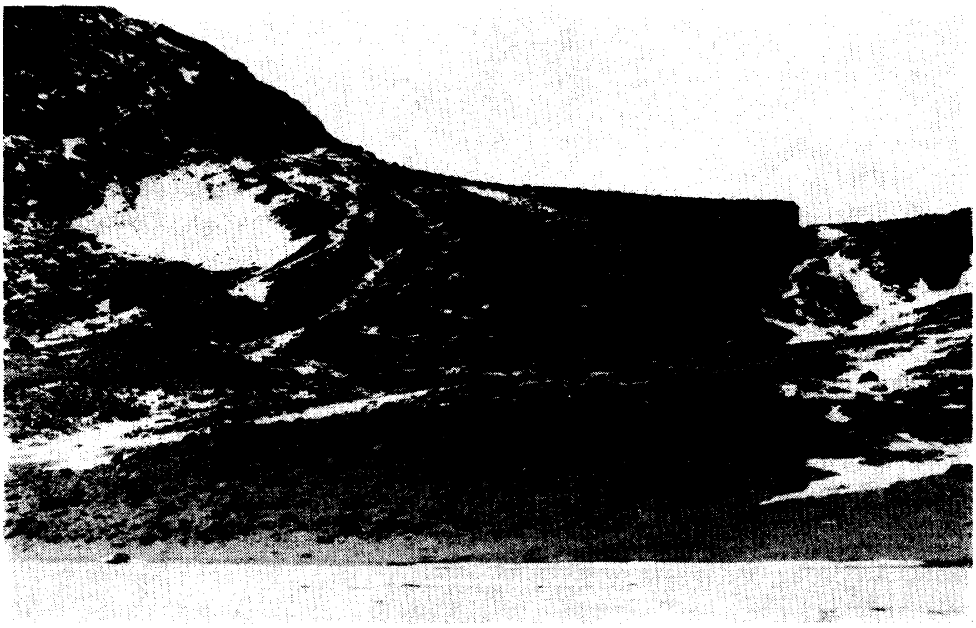

Fig. 6. The easternmost head of Osen (bay) showing lodgement till.

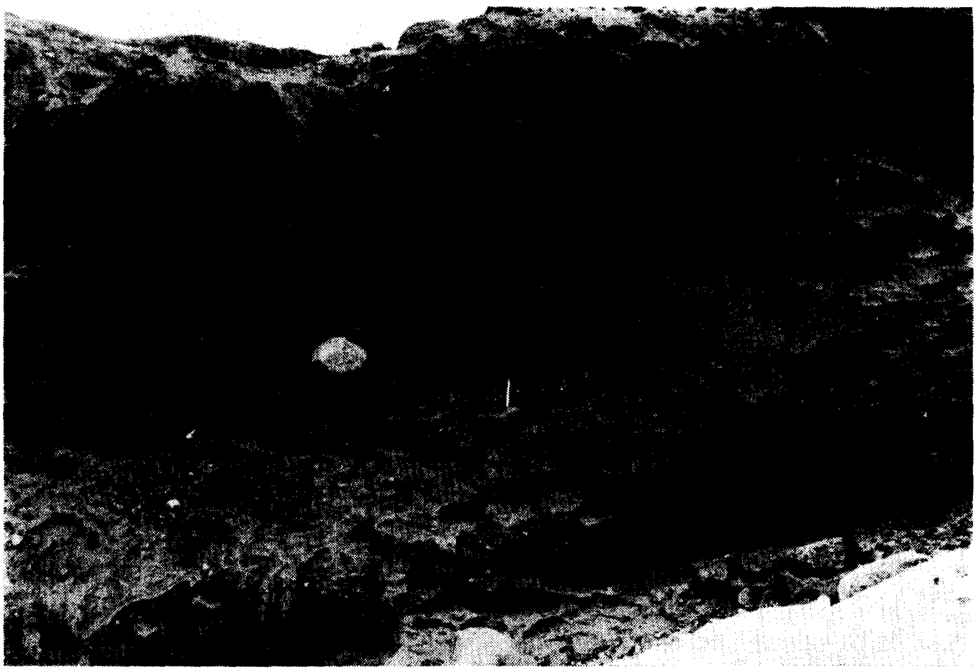

Fig. 7. An outcrop of lodgement till.

last glaciation (STUIVER *et al.*, 1981). The Osen Glacial Bed may indicate the critical condition from cold-based to warm-based glacier beds. It is well known that considerable parts of the present Antarctic Ice Sheet bed are in a melting condition (for example, BUDD *et al.*, 1970). Part of the Shirase drainage basin is shown to flow by basal sliding (MAE and NARUSE, 1978). However, it is still uncertain whether the coastal area covered with thin ice is areally in a melting condition at present. It is a

Fig. 8. A close up of part of Fig. 7.

future problem to clarify whether the Osen Glacial Bed was formed under the specific condition of the ice sheet in the past or under the usual condition prevailing from the past to present.

4. Concluding Remarks

There are several kinds of unconsolidated deposits in the coastal ice-free areas of Lützow-Holm Bay. In the Langhovde area, the modes of occurrence of fluvioglacial deposits in small rock basins suggest that the retreat of the ice sheet would have progressed, leaving detached small ice masses in these rock basins. Following a lapse of some time other fluvioglacial deposits were formed as flood plain deposits in some parts of valley floors. Most of them were deposited during the last 6000 years. Meltwater at that time was probably more abundant than that at present.

In the Skarvsnes area, a noticeable glacial drift was found in a glacial trough. Its characteristic features indicate that it could have been deposited as lodgement till beneath the ice sheet during the last ice sheet expansion. The lodgement till (named Osen Glacial Bed) and the features of areal scouring with glacial grooves show that the bottom of the ice sheet was in the condition of pressure melt. However, the amount of water underneath the ice sheet would not be much, as inferred from the till facies.

Acknowledgments

The author would like to express his sincere thanks to the members of the wintering party of JARE-22 for their cooperation in the field survey.

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(Received April 8, 1983; Revised manuscript received May 27, 1983)