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# REPORTS ON CURRENT WORK

## EROSION BY CONTINENTAL ICE SHEETS*

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ABSTRACT. Some of the problems with earlier theories for erosion and transport by ice sheets are discussed, and it is noted that those theories cannot simply account for the often-reported finding that most till is derived from bedrock only a few tens of kilometers up-glacier. Considerations of the mass balance of debris in transport lead to the conclusion that ice sheets are capable of transporting most debris only a short distance.

The theory that the break-up of bedrock is mostly a preglacial process is developed. The advancing ice sheet collects the debris and then deposits it after a short travel. As the ice sheet first advances over the regolith, debris is frozen onto the base and is carried until basal melting due to geothermal and frictional heat causes lodgment till deposition. Most debris is deposited during the advance of the ice sheet and is carried only a short distance. A generally small amount of debris is carried at higher levels and is deposited during ice standstill and retreat as melt-out and ablation tills.

The present theory makes many predictions, among them, that most till units are not traceable over long distances, that thick till sequences represent unstable glacier margins and not necessarily long periods of glacier occupation, and that lodgment tills are to be interpreted in terms of ice advances and ablation tills in terms of ice retreats.

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## DISCUSSION

T. J. KEMMIS: I wonder if you would care to comment on how your mechanism fits the stratigraphic record left by the Laurentide ice sheet in North America? Your contentions, both of a single erosional process by continental ice sheets and of incorporation only of regolith, seem incompatible with the record left by continental ice sheets in mid-western North America. For example, an unpublished map of Hoiberg shows that the Sangamon interglacial soil in Illinois is present beneath later Wisconsin-age glacial deposits for a distance of 80 km back from the Wisconsin front, indicating that much of the existing pre-Wisconsin material was *not* incorporated at over a distance of 80 km up-glacier from the Wisconsin margin. Several detailed stratigraphic studies of tills in the glaciated lowlands of North America (e.g. Willman and Frye, 1970; Karrow, [c1976]) have shown the stratigraphic succession to consist of a sequence of texturally and mineralogically distinct calcareous tills. It is hard to envisage how these tills, which are found in the sub-surface to successively overlie one another over widespread areas (on the order of hundreds of square kilometres), could result solely from the incorporation or regolith.

I. M. WHILLANS: The main point is that there are some important problems with till provenance. I suggest regolith freeze-on as an important mechanism. Certainly some areas were covered but not eroded.

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The stratigraphic descriptions for Illinois define members that cover areas of the order of 50 km by 100 km ($10^3$–$10^4$ km$^2$). Perhaps each member is to be associated with a single glacial advance or perhaps each bed represents an advance (a bed is a subdivision of a member). It would be very interesting to determine if the compositional variations within each member can be related to a similar pattern in the bedrock and other pre-existing deposits.

## REFERENCES

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# PLOUGH MARKS IN THE WEDDELL SEA

*By* Olav Orheim

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Abstract. The 1976/77 Norwegian Antarctic Research Expedition carried out studies of the sea bed by side-scan sonar. The equipment was operated from the expedition vessel down to about 350 m depth by personnel from the Continental Shelf Institute, Trondheim. Various types of plough marks mostly ranging from 10 to 100 m in width were observed. These included several generations of crossing plough marks as well as plough marks with abrupt changes in trend reflecting changing iceberg motion. The investigations will be expanded during the 1978/79 expedition to include towing at greater depths, and mapping of sea-bed morphology by mosaic towing patterns.

## DISCUSSION

D. E. Thompson: What is the size of your side-scan swath before resolution is lost?

O. Orheim: Typically we were scanning from 50–100 m above the sea bed giving good resolution imagery of the bed over a 300 m wide swath to each side.

# ICE-SHEET EROSION—A RESULT OF MAXIMUM CONDITIONS?

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Abstract. Understanding the relationship between the morphology of former ice-sheet beds and glaciological processes is handicapped by the difficulty of establishing which stage of a cycle of ice-sheet growth and decay is responsible for most erosion. Discussions at this conference and in the literature display a variety of opinions, some favouring periods of ice-sheet build up, others periods of fluctuations, and still others steady-state maximum conditions. Here it is suggested that there is geomorphological evidence which points to the dominance of maximum conditions.

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