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Dimensional Fabric and Ice Flow, Precambrian (Huronian) Glaciation

Abstract. The Huronian Cobalt tillite (Gowganda formation) exhibits a preferred dimensional orientation of embedded elongate rock fragments. The orientation is believed to be due to ice motion. Data from four localities show an alignment in about a north-south direction. Data are inadequate to locate center of ice dispersal.

That till commonly exhibits a preferred orientation of the stones embedded in it is now rather generally known. The fabric exhibited by elongate stones has been commonly used to deduce the direction of ice flow and is a readily mappable directional property. To date, success in mapping till fabric has been confined to the Pleistocene deposits.

It occurred to me that this method might also be applied to the tillites of the Precambrian Cobalt series in Ontario. These glacial formations are little altered and little deformed and are well exposed over an area in excess of 8000 square miles. Inasmuch as the tillite appears to have a dimensional fabric (*1*, p. 492), I made a number of fabric analyses this past summer.

A suitable outcrop, having a glacially polished (by Pleistocene ice) nearly horizontal surface, was chosen. A square yard was marked out and the azimuths of the *apparent* long axes of all fragments having a length-to-breadth ratio greater than 2 were measured. In general, such restrictions provided about 50 measurable stones. The fragments ranged in length from a few millimeters to several centimeters. The measured azimuths were plotted in 30-deg classes as circular histograms (Fig. 1). In several cases a second square yard was marked out and an additional 50 orientations were measured and plotted.

As is apparent from inspection of Fig. 1, a preferred orientation was found at all four localities. As is apparent also, the general orientation is roughly the same at all places, even though the observation points are many miles apart. The results are similar to those obtained by Dreimanis from his study of the dimensional fabric in an oriented hand specimen.

Several problems arise in making any interpretation of the diagrams. The long dimension measured is the apparent long axis, and not necessarily the truly longest dimension of the fragment. One can imagine shapes and orientations which might give misleading azimuths. The consistency of the results suggest that such anomalous azimuths are relatively unimportant.

It is possible, of course, that the fabric is imposed by deformation or is produced in some other way than by ice flow. In most places it is not possible to determine the dip of the bed involved, owing to the massive nature of the tillite. In general, however, dips in the areas studied are very low and the glacial pavements studied may be presumed to be parallel to the bedding. The near-horizontal position of the strata over large areas makes a deformational fabric improbable. The similarity of orientation found in the widely separated localities and the absence of any relation between the fabric and the known tectonic structures renders a tectonic origin of the fabric unlikely.

If the fabric is induced by ice flow, as seems probable, we do not know whether the ice moved from south to north or vice versa. It is of interest, however, that the direction of movement suggested by the fabric is essentially the same as that shown by cross-bedding in the overlying Lorrain quartzite, which in the Bruce Mines area indicates flow from northwest to southeast and in the Latchford area demonstrates a flow from north or a little east of north to the south. Did the Cobalt ice also move from north to south down the same slope? Or did the ice move upslope over long distances as did the Pleistocene glaciers of North America?

We can probably safely conclude that the pattern of ice flow in Huronian glacial times can be worked out from a study of the dimensional fabric exhibited by the stones embedded in the tillites and that it may be possible to establish a center of ice dispersal in these times as it is for the glacial deposits of the Pleistocene.

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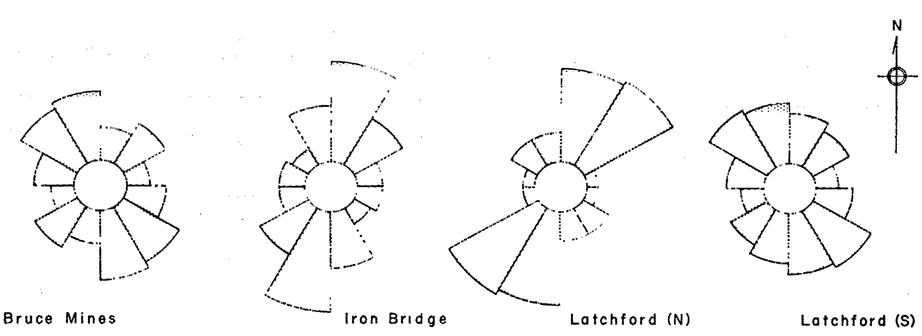

Fig. 1. Pebble orientation in Precambrian Cobalt tillite (Gowganda formation). Bruce Mines: lot 2, Con. VI. Keating Township, Ontario; Iron Bridge: highway 17, 4 miles east of Iron Bridge, Ontario; Latchford (N): highway 11, 2.2 miles south of Latchford, Ontario; Latchford (S): highway 11, 4.3 miles south of Latchford.

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