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RIVER-ICE FABRICS: PRELIMINARY RESULTS

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Abstract. Preliminary data indicate that fabric is developed in river ice. Crystal orientations are usually sub-parallel to the ice surface, and develop partly in response to stress generated by stream flow.

Résumé. *Structure de la glace de rivière: résultat préliminaire.* Les premières données indiquent qu'il existe une structure particulière de la glace de rivière. Les orientations des cristaux sont d'ordinaire presque parallèles à la surface de la glace et se développent partiellement en réponse aux efforts engendrés par le courant.

Zusammenfassung. *Flusseisgefüge: Vorläufige Ergebnisse.* Vorläufige Daten weisen darauf hin, dass sich im Flusseis ein Gefüge bildet. Die Kristalle sind gewöhnlich parallel zur Eisoberfläche orientiert und entwickeln sich teilweise in Abhängigkeit von der Spannung, die durch das fliessende Wasser hervorgerufen wird.

During the winter 1969–70, investigations of river ice were begun on the Plover River and Haymeadow Creek in northern Wisconsin. The studies involve investigation of water and ice chemistry, channel development under the winter ice cover and river-ice crystal fabrics. Preliminary work is completed on the river-ice crystal fabrics. Initial chemical work indicates that the fresh-water rivers under study are unpolluted and non-saline.

In studying thin sections of river ice using the Rigsby universal stage, numerous low-lying crystals (*c*-axes parallel or nearly parallel to the stage) were analyzed. From the published techniques for determining ice fabrics using the Rigsby stage, it appears that the problem of discriminating between the *a*- and *c*-axes of low-lying ice crystals was not considered. This is probably not critical in studies

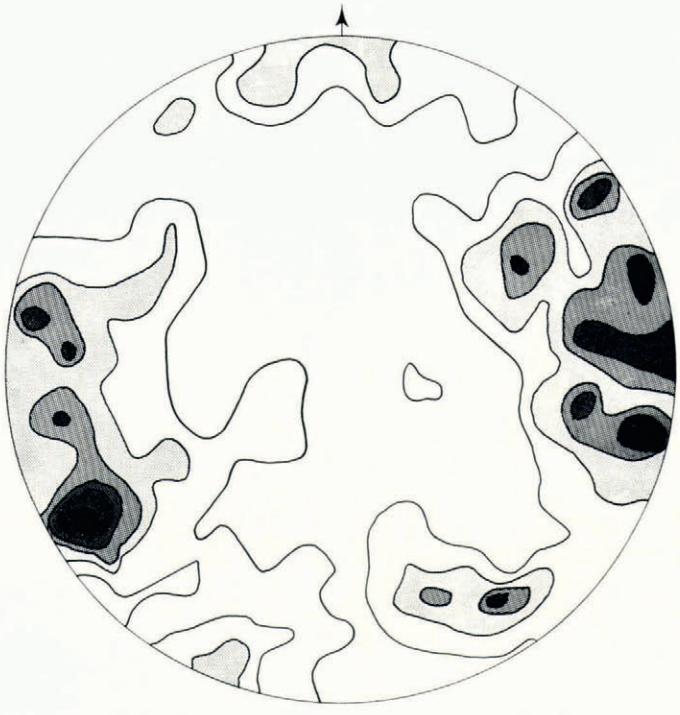

Fig. 1. Typical fabric from the Plover River illustrating dominance of low-lying crystals. Arrow indicates direction of stream flow. Lower hemisphere, equal area projection; 175 c-axes of river ice; contours 1-3-5-7-9-11% per 1% area.

where low-lying crystals occur infrequently. However, in river ice, where commonly more than 60% of the crystals are low-lying, it is necessary to discriminate between the *a*- and *c*-axes before determining location (azimuth) of the *c*-axis. To do so requires an accessory plate. A modified technique for determining ice-crystal orientations using the Rigsby stage with an accessory plate has been described by Hill and Lasca (1971).

From initial studies of river ice from the Plover River and Haymeadow Creek, it is apparent that fabric is developed in the ice. The *c*-axis of the river-ice crystals are (1) usually flat-lying, i.e. subparallel or parallel to the ice surface (Fig. 1), or (2) less commonly inclined as much as 30° from the vertical. In each case, the *c*-axis is generally orientated perpendicular to river-flow direction. During formation of ice crystals at the ice–water interface, crystal orientations are partly developed as a response to stress generated by stream flow, and to the configuration of the ice–water interface, which in part is probably controlled by the heat transfer occurring during crystallization. At time of crystallization, the maximum stress (σ_1) influencing crystal orientation is caused by stream flow. When flow-imparted stress (σ_1) and gravitational stress (σ_2), which is internal to the ice, are applied to the irregular, undulating ice–water interface, compressional and tensional forces develop. The forces in part determine crystal orientation. The resolution of σ_1 and σ_2 stresses cause flat-lying crystal orientations in river ice. Later, ice crystals may be re-orientated in response to stress fields developed as winter piling occurs.

From preliminary studies of river ice, the *a*-axis is frequently the axis of elongation. In addition, twinned crystals are found in most river-ice thin sections studied. Further study is necessary to determine whether twinning is caused by stress at the time of crystal formation or subsequent to formation.

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REFERENCE

Hill, J. R., *and* Lasca, N. P. 1971. An improved method for determining ice fabrics. *Journal of Glaciology*, Vol. 10, No. 58, p. 133–38.