Trace Fossils in the Halkkavarre Section of the Dividal Group (?late Precambrian – Lower Cambrian), Finnmark

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The increasing abundance of trace fossils in the ?late Precambrian to Lower Cambrian sediments of the Dividal Group is comparable with that found in the laterally equivalent but much thicker succession to the east and provides further evidence of the gradual but rapid development of metazoan life at that time.

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Introduction

The study of trace fossils in late Precambrian to Cambrian sequences can provide considerable evidence towards the elucidation of animal evolution at that time. Banks (1970) has described the incoming and development of trace

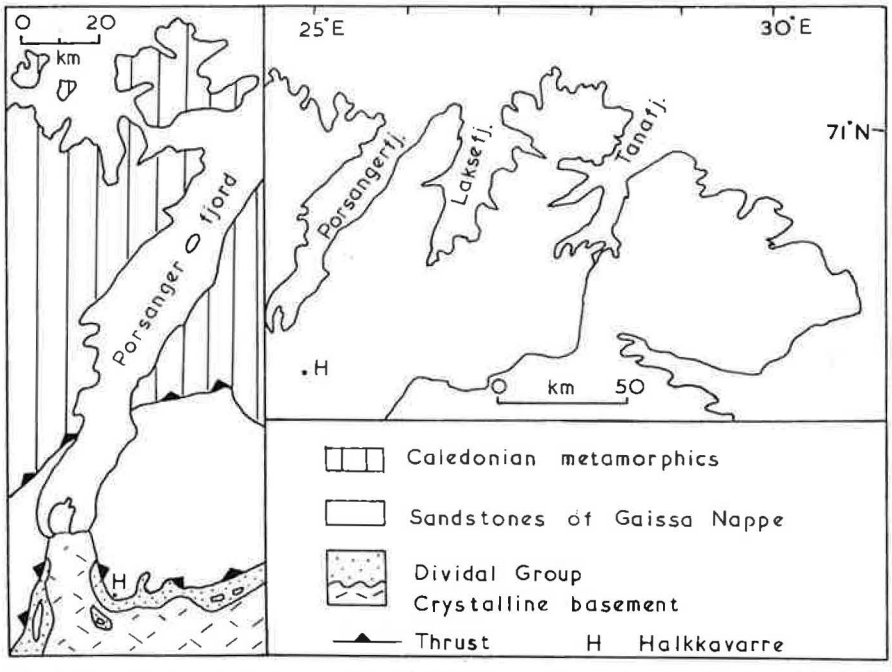

Fig. 1. Simplified geological map of Porsangerfjord (after Holtedahl 1931, Rosendahl 1945, and Føyn 1967).

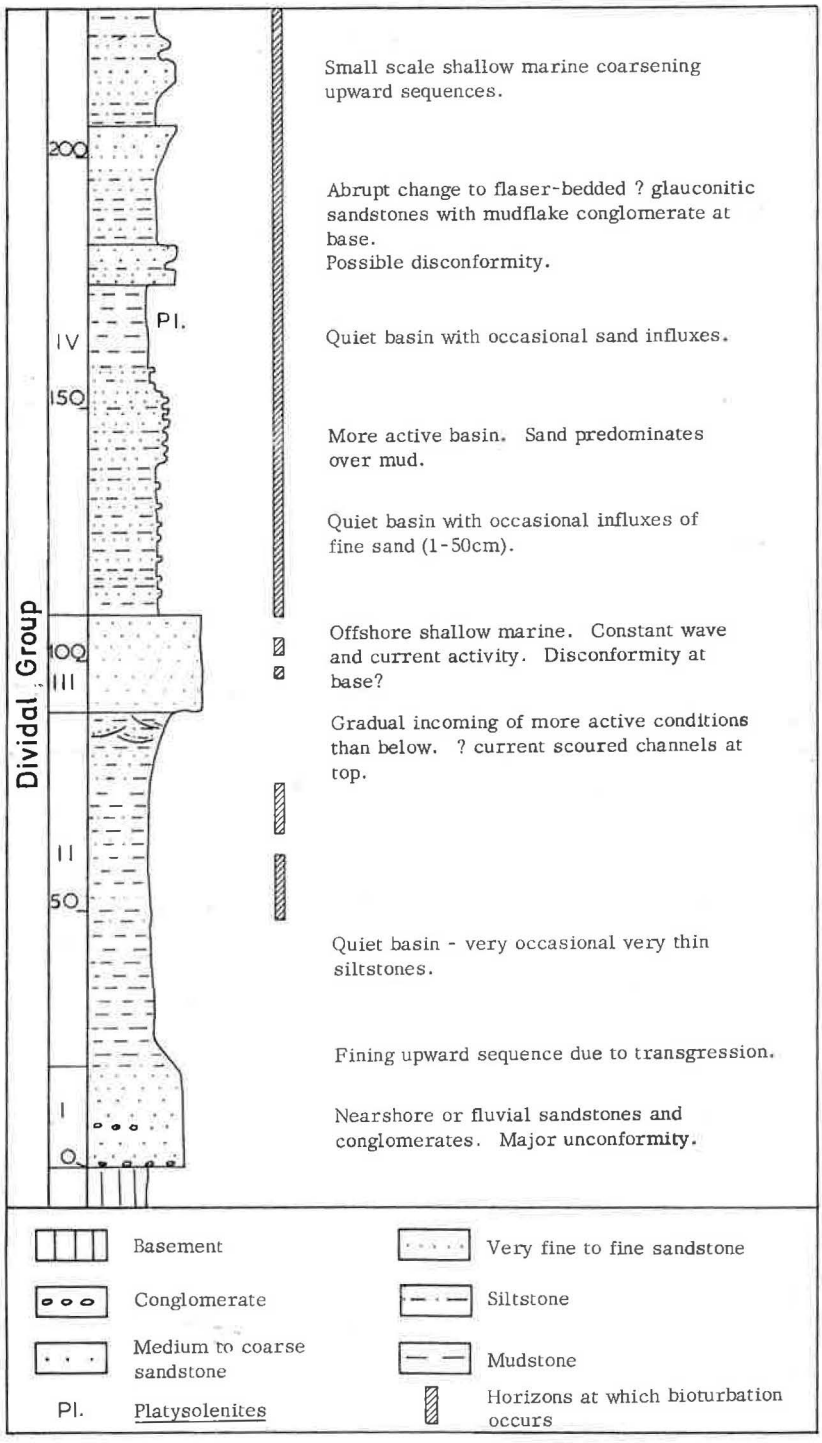

Fig. 2. Stratigraphical section in the Dividal Group at Halkkavarre showing the distribution of trace fossils.

fossils in such a sequence in the Tanafjord area of East Finnmark. The Dividal Group is the condensed lateral equivalent of the Stappogiedde Formation and Lower Breivik Member of Tanafjord (Føyn 1967, Banks et al. 1971) and is well exposed at Halkkavarre, 25 km SE of Porsangerfjord (Fig. 1). The aims of this paper are (1) to describe the trace fossils found in the Halkkavarre section, (2) to compare them with those found in the Tanafjord area, and (3) to briefly discuss their significance.

Stratigraphy

The Dividal Group at Halkkavarre is an autochthonous succession lying unconformably upon the Precambrian basement and overthrust by Precambrian sandstones, the Gaissa Nappe of Rosendahl (1945). It is 226 m thick and has been described by Holtedahl (1931), Føyn (1967), Banks et al. 1971), and

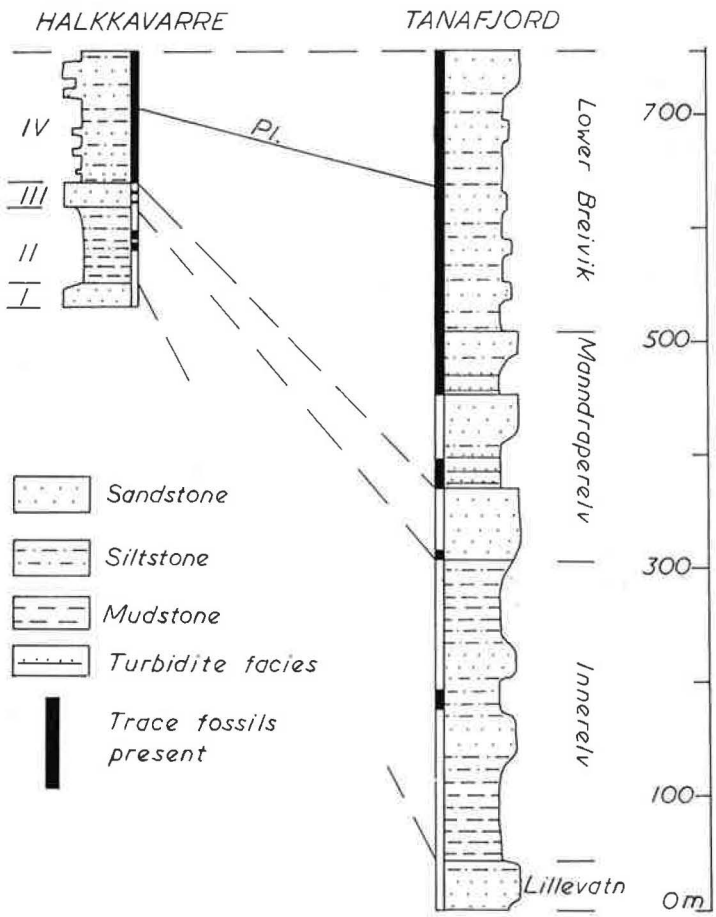

Fig. 3. Comparison of the Dividal Group at Halkkavarre with the laterally equivalent beds in the Tanafjord area. Dashed lines show lithostratigraphical correlation of Banks et al. (1971). Pl. = *Platysolenites* horizon.

Banks (1971). It has been divided into four informal units (members I–IV) (Fig. 2). Føyn (1967) found specimens of *Platysolenites antiquissimus* 65 m above the base of member IV, thus proving a Lower Cambrian age for the upper part of the succession (Hamar 1967). Lithostratigraphical correlation suggests that the lowest beds of the Dividal Group are likely to be slightly younger than the late Precambrian tillite formations of East Finnmark (Føyn 1967, Banks et al. 1971, Fig. 6). Two abrupt changes in lithology in the succession might mark slight disconformities, but this cannot be proved.

Trace fossils

Føyn (1967, p. 16) noted that biogenic activity was first seen in member II. This member is the lithostratigraphical equivalent and probably broadly the time equivalent of the Innerelv Member of the Stappogiedde Formation in the Tanafjord area (Fig. 3). The first trace fossils in the Tanafjord succession occur about half way up the Innerelv Member (Banks 1970). In member II small burrows are found as hypichnial and exichnial casts (classification of Martinsson 1970) on the bases of very thin-bedded siltstones and fine sandstones which occur in the upper half of the member. The most prominent type (Fig. 4 A) consists of cylindrical tubes, approximately 1 mm in diameter, which show a variety of different configurations. Two of these, short horizontal forms with Y-shaped branching and loosely coiled horizontal spiral forms (*?Helicolithus*), are particularly obvious. It seems that these burrows were made before the deposition of the overlying siltstone because some of them have been modified by current scour and the silstone is not bioturbated. The trace fossils shown in Fig. 4 A are very similar to forms in the Manndraperelv Member of East Finnmark (Banks 1970, Plate 1b).

In member III, which is probably laterally equivalent to the lowest sandstone unit of the Manndraperelv Member (Banks et al. 1971), biogenic structures are confined to a few sinuous epichnial grooves, 1–2 mm wide, which probably represent trails made over the sandy substrate.

Trace fossils are found throughout member IV, which is probably laterally equivalent to the upper part of the Manndraperelv Member and most of the Lower Breivik Member. In the lowest 25 m the sandstones show many sinuous hypichnial casts (width 1–2 mm) associated with some obscure endichnial burrows. Some delicate markings, consisting of sets of sub-parallel hypichnial grooves (Fig. 4 B), were found 20 m above the base of the member. The paired sets in the upper part of Fig. 4 B somewhat resemble *Rusophycus*, a trace fossil which is usually interpreted as the resting mark of a trilobite (Cloud & Nelson 1966). However, other arthropods may also be capable of making *Rusophycus* and similar bilobate structures (Radwanski & Roniewicz 1967, Bergström 1968). It seems likely that the markings of Fig. 4 B were produced by an arthropod bushing the sediment surface and at one point digging in shallowly with both sets of appendages to produce a 'proto–*Rusophycus*'.

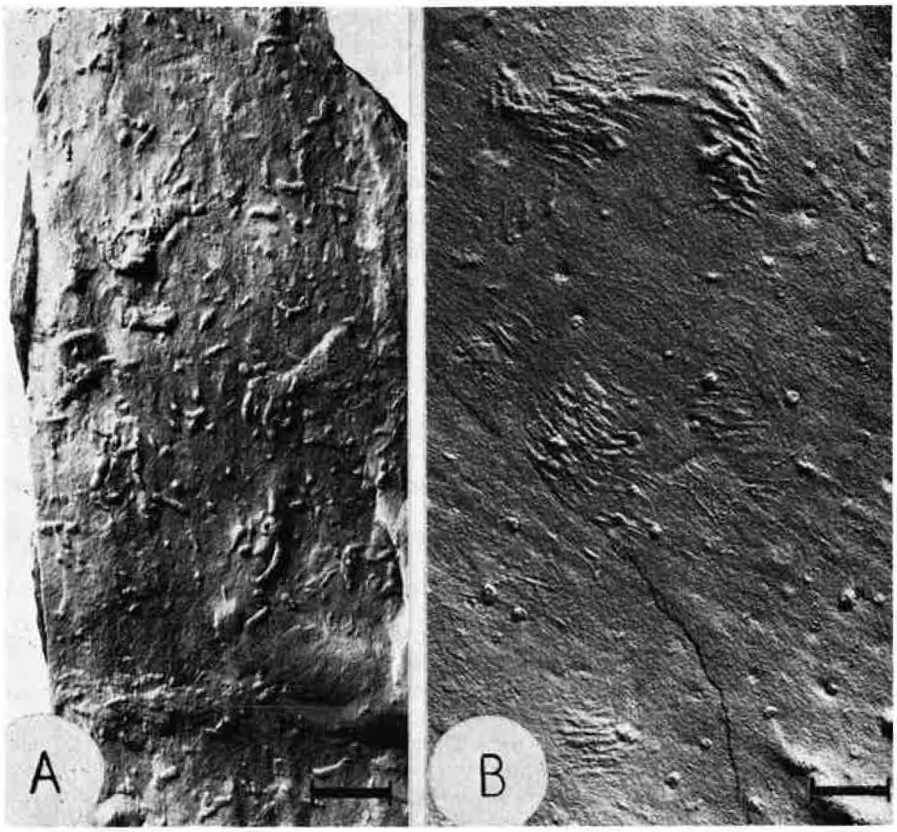

Fig. 4. A. Hypichnial and endichnial burrows, upper half of member II. Scale = 1 cm.
B. 'Proto-*Rusophycus*' (top) and associated sets of markings probably attributable to arthropods, member IV. Scale = 1 cm.

Discussion

The trace fossils of the Dividal Group show a broadly similar, although less well defined pattern of development to those in the equivalent beds in the Tanafjord area (Fig. 3). They exhibit a gradual but rapid increase in abundance and diversity within a clastic sequence which, whilst of variable aspects, was all deposited in a marine 'shelf' environment.

It is encouraging that similar trends in trace fossil development have been described in late Precambrian and Cambrian sediments in Australia (Glaessner 1969, Webby 1970), suggesting the possibility that this may be a world-wide feature. If so, this increase in biogenic activity can be interpreted as the result of a rapid evolution of metazoan life which began after the cessation of the late Precambrian glaciation and continued into Cambrian times. Further detailed collecting is required to ascertain the exact stratigraphical range and value of *Rusophycus* and other distinctive trace fossils in relation to the ranges of body fossils in the late Precambrian and early Cambrian. When this is done trace fossils may be found useful as time markers.

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