

Correlation of Autochthonous Stratigraphical Sequences in the Alta-Repparfjord Region, West Finnmark

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An outline of the geology of the area between Alta and the Komagfjord tectonic window is presented. Lithologies (including a tillite) constituting an autochthonous sequence are described from an area on the north-east side of Altafjord, and from their similarity to those of formations occurring in adjacent areas a revised regional stratigraphical correlation is proposed. An occurrence of biogenic structures appears to provide confirmatory evidence for an earlier suggested correlation with Late Precambrian sequences between west and east Finnmark.

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Regional setting; previous correlations

Our knowledge of the geology of the Alta district of west Finnmark owes much to the work of Høltedahl (1918, 1960) and Føyn (1964). The oldest rocks, the Raipas Group or Series (Reitan 1963a) of Precambrian (Karelian) age, are represented by a sequence of greenschist facies metasediments, metavolcanics and intrusives.

Lying unconformably upon the Raipas is a quartzite formation, a thin tillite, and a mixed shale and sandstone succession. Høltedahl (1918) referred to these autochthonous post-Raipas rocks as the 'Bossekopavdelingen', but Føyn (1964) later demonstrated the presence of an angular unconformity beneath the tillite and adopted this break as the border between what he termed the Bossekop Group and the overlying sediments, the Borrás Group. These were later referred to as sub-groups (Føyn 1967, Pl. VI). The Bossekop lithology is essentially a massive, white, quartzitic sandstone with subordinate shaly layers and, as such, is better termed a formation. The Borrás rocks also qualify for a designation of lower rank, and to conform with the regional terminology are here relegated to formation status.

To complete the geological picture, both the supracrustal Raipas Series and the autochthonous rocks are overlain with marked tectonic contact by allochthonous greenschist to almandine-amphibolite facies metasediments (Fig. 1). These need not concern us any further in this article.

Between 30 km and 70 km north-east of Alta, rocks of the Raipas Series are again encountered in the Komagfjord tectonic window (Reitan 1963b). Reitan differentiated two groups of rocks in this window, the Repparfjord Group and the Saltvann Group, the former being divided into four forma-

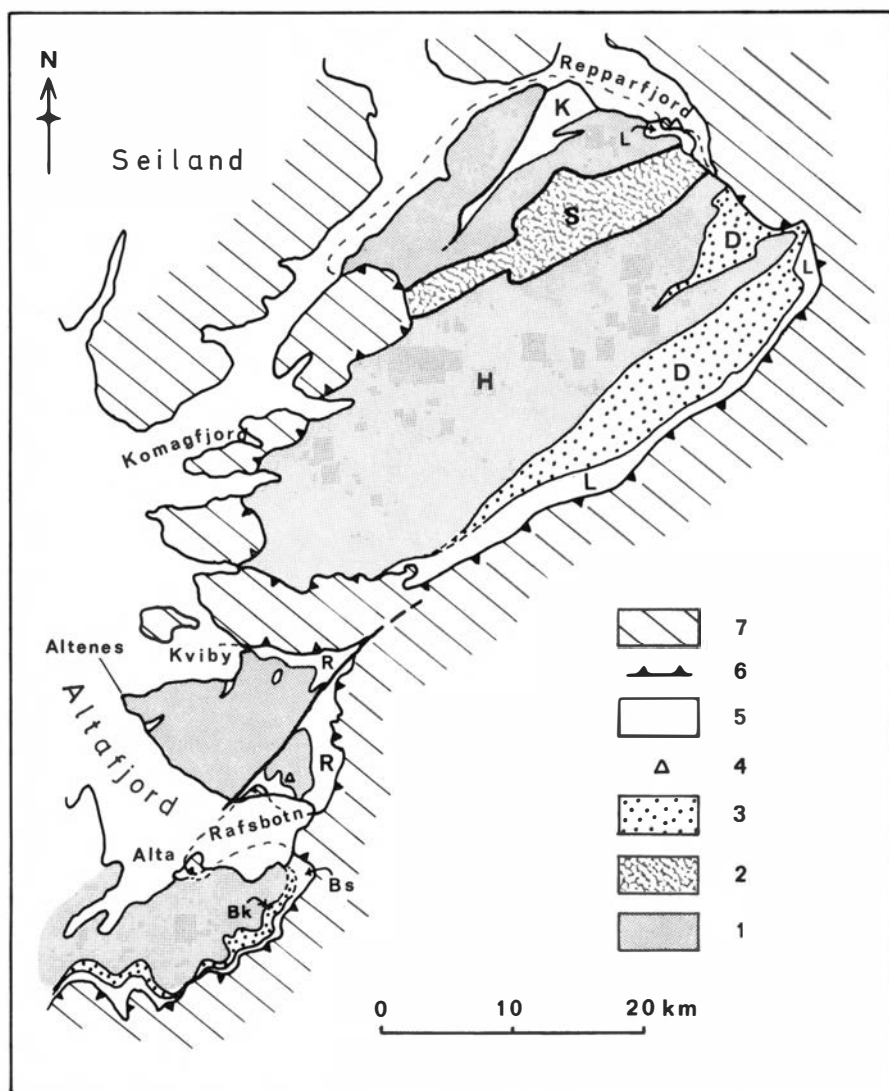


Fig. 1. Geological map of the Alta-Repparfjord region, simplified and partly modified. New data from part of the area south of Altafjord after A. Gautier and K. B. Zwaan (pers. comm. 1973).

1. Raipas Series (H – Holmvann Formation); 2. Saltvann Group (S); 3. Doggeelv Formation (D), Bossekop Formation (Bk); 4. Tillite locality just north of Rafsbøtn; 5. Borras Formation (Bs), Rafsbøtn Formation (R), Lomvann Formation (L) and Kvalsund Formation (K); 6. Basal thrust plane of the allochthon; 7. Allochthonous nappe-complex. Other faults or thrust-faults drawn with thicker lines.

tions. The oldest of these, the Holmvann Formation, is the most extensively exposed. Along the south-east side of the window, the Doggeelv Formation lies unconformably upon the Holmvann and this is succeeded, either conformably or with local unconformity, by the Lomvann Formation. The Doggeelv Formation is composed mainly of white orthoquartzite, whereas

the Lomvann Formation is basically an argillaceous sequence. On the north side of the window a black slate, the Kvalsund Formation, directly overlies the Holmvann Formation.

Reitan (1963b) recognized the similarity of the Holmvann Formation lithologies to the Raipas and other Karelian rocks in Sweden and Finland, and suggested a correlation of the Doggeelv, Lomvann and Kvalsund Formations with comparable Late Karelian sequences. Later, based on Føyn's (1964) observations at Alta, Reitan (1965) suggested an alternative correlation; that the Doggeelv and Lomvann Formations were possibly equivalent to the Bossekop 'Group'.

Recent mapping in the ground between the head of Altafjorden and the Komagfjord window has revealed some interesting features critical to a solution of this problem. These indicate that Reitan's (1965) alternative correlation is partially correct. A revision of the regional stratigraphic correlation of the autochthonous succession is however necessary, but before presenting this the principal features of the geology are outlined below.

The Rafsbotn-Kviby area

This is the area immediately NE of Altafjord which on the geological map of Norway (Holtedahl & Dons 1960) has been drawn as part of the Alta-Kvænangen tectonic window of Precambrian Raipas rocks. For convenience, this part of it is here called the Altenes window. Our mapping, in 1972, has shown that although Raipas metasediments and metavolcanics are predominant in this area, not all rocks beneath the basal thrust of the allochthon belong to this Karelian sequence.

Along the eastern and northern sides of the Altenes window, weakly metamorphosed slates and siltstones with some quartzitic and conglomeratic horizons occur between the Raipas rocks and the allochthonous nappe-complex (Fig. 1). This dominantly argillaceous sequence, here called the *Rafsbotn Formation*, is markedly unconformable on the Raipas rocks. The basal contact is also locally disturbed tectonically and folded such that small outliers of Rafsbotn Formation are present elsewhere within the Altenes window.

Folding, together with lack of continuous exposure, has rendered it impossible to measure the thickness of the Rafsbotn Formation directly. As a rough estimate a figure between 50 m (minimum) and 100 m is considered likely.

With the exception of the tillite outcrop described below, the formation begins with a discontinuous layer of conglomerate up to 1 m in thickness. For the most part this is a quartz conglomerate with well-rounded nut-sized pebbles. The outliers in the western part of the window rest, in inverted position, on gabbros, and there as much as 50 % of the pebble material is gabbroic; moreover, the pebbles often exceed 10 cm in size.

Above the basal conglomerate the Rafsbotn Formation is dominated by

cleaved mudstones, slates and siltstones of greenish and reddish colours. The different coloration is not restricted to particular niveaux, but alternates irregularly. In some localities the green and red are mixed so as to give the rocks a mottled appearance. Horizons of pale grey to reddish quartzitic sandstone, from a few dm to several metres in thickness, occur in various parts of the formation but are most frequent in the lower half. In several places graded bedding may be clearly demonstrated, particularly in the sandier units, and this denotes that the succession is the right way up. Thin layers of polymict conglomerate are occasionally found. The rocks are folded and a prominent axial planar slaty cleavage is developed in the argillaceous rocks.

In outcrops along the shore at Mosenes, near Rafsbotn, trace fossils have been found in grey-green siltstones and green mudstones. The precise stratigraphical position of this horizon cannot be safely ascertained, but it would appear to be somewhere in the middle of the Rafsbotn Formation. The trace fossils occur as infillings of vertical and horizontal burrows, essentially hypichnial, exichnial and endichnial casts (Martinsson 1965). The cylindrical burrow tubes are 2–3 mm in diameter. A variety of burrowing patterns are seen, often with Y-shaped branching (Fig. 2).

Tillite has been observed in only one locality, ca. 1 km north of Rafsbotn (Fig. 1). The tillite is exposed over an area measuring ca. 100 m × 50 m. It lies unconformably upon Raipas supracrustal rocks and reaches a maximum exposed thickness of about 2 m. The rock is reddish-brown in colour and is unsorted. Fragments constitute about 30 % of the lithology and comprise mainly greenschist, greenstone, mica schist, gneiss, hornfels, vein quartz and quartzites, many of these rock-types occurring in the subjacent Raipas Series. The largest clasts are about 30 cm in diameter.

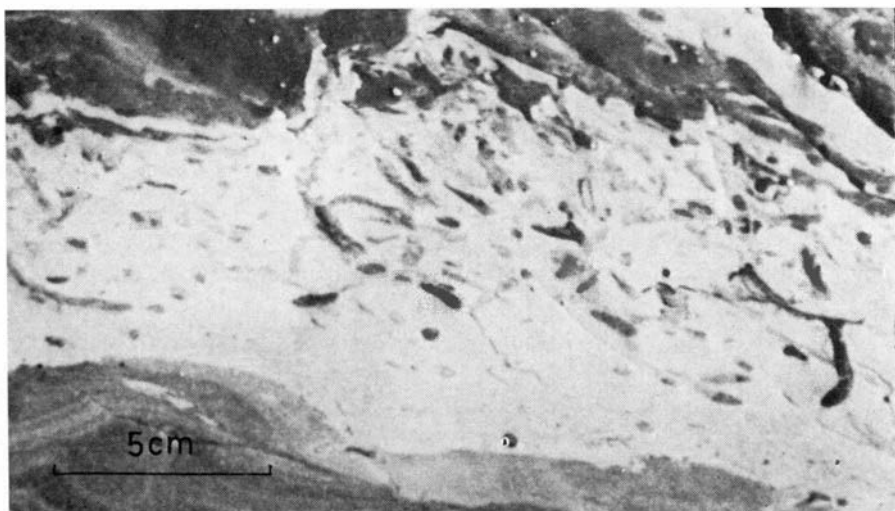


Fig. 2. Trace fossils from Mosenes, Rafsbotn. Exichnial casts showing various burrowing patterns in mudstone layer; Rafsbotn Formation.

SW

NE

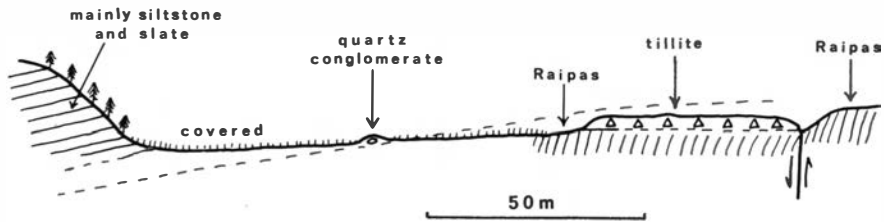


Fig. 3. Location of the tillite in relation to the Raipas Series and to the sediments of the Rafsbotn Formation. NE-SW profile across south-eastern slopes of Kobbefjell, ca. 1 km north of Rafsbotn. Vertical scale exaggerated.

Unfortunately the relationship of the tillite to the Rafsbotn Formation rocks is not directly observable – the nearest exposed part of the latter is a small outcrop of ‘basal’ quartz conglomerate 50 m away (Fig. 3). Field evidence and stratal dip values tend to suggest that the tillite may be located stratigraphically below the basal conglomerate, but the locations are such that this cannot be decided with any certainty. However, in view of the situation at Alta a few kilometres to the south, the tillite is here considered as representing the very base of the Rafsbotn Formation. Such a positioning is, indeed, warranted since the general lithology of the Rafsbotn Formation has here been shown to be virtually identical to that of the Borrás Formation.

Revised correlations

In addition to the actual mapping of the Altnes window and the allochthon immediately to the north and east, an examination of lithologies and structures occurring within the southern and eastern marginal parts of the Komagfjord window was also undertaken.

The most striking observation here is that the basic lithology of Reitan’s (1963b) Lomvann Formation in the vicinity of its disappearance beneath the basal thrust plane of the allochthon is more or less identical to that reappearing along the northernmost margin of the Altnes window, some 10 km further south-west. Mapping has also shown that the Lomvann Formation appears to lie unconformably upon the Holmvann Formation. Further to the north-east the white quartzitic Doggeelv Formation makes an appearance between the Holmvann and Lomvann Formations.

The results of this recent work thus point to the conclusion that the Lomvann, Rafsbotn and Borrás Formations are one and the same. The Kvalsund Formation *could* also be a facies equivalent, but this suggestion is more conjectural. Furthermore, we would concur with Reitan’s (1965) suggestion that the Doggeelv Formation is a correlative of the Bossekop Formation (Table 1).

Table 1. Correlation of the autochthonous successions in west Finnmark. T – tillite; Al.m. – allochthonous metasediments. Not drawn to scale.

Komagfjord tectonic window (Reitan 1963b)		Altenes window (present paper)		Alta area (Føyn 1964)	
Al.m.		Al.m.		Al.m.	
Lomvann Formation		Rafsbotn Formation		Borras Formation	T
		△ △ △ △ △		△ △ △ △ △ △ △ △	
Doggeelv Form.			T	Bossekop Formation	
Raipas Series		Raipas Series		Raipas Series	

Implications of this correlation are that the 100–150 m thick Bossekop Formation wedges out north of Alta, the quartzite being absent beneath the tillite north of Rafsbotn. It then reappears farther to the north as the Doggeelv Formation, thickening to a suggested 1500 m or more (Reitan 1963b) although in our opinion the original stratigraphic thickness was probably a good deal less. Although tectonic movements have modified the basal contact and perhaps removed part of the sequence, the authors in common with Reitan (pers. comm. 1973) consider the thickness changes to be essentially of a primary facies character. The tillite, likewise, is not a continuous feature. Its disappearance cannot be safely accounted for on the limited field evidence available, and a primary wedging out perhaps with some contemporaneous erosion is also thought to be the probable cause. There remains the possibility that equivalents of the Rafsbotn/Lomvann and Doggeelv Formations may occur on the NW flank of the Komagfjord window, but this must await detailed mapping.

Føyn (1964) suggested that the tillite of the Borras 'Group' could probably be correlated with the Upper Tillite of east Finnmark (Føyn 1937, Reading 1965). He noted a lithological similarity of the post-tillite Borras sediments to those occurring immediately above the Upper Tillite in the Stappogiedde Formation of the Vestertana Group (Reading 1965), and also considered the Borras to be equivalent to the lower part of the Hyolithus Zone or Dividal Group of inner Finnmark. Banks (1970) has described the trace fossils occurring in the Vestertana and succeeding Digermul Groups and has noted that the first undoubted trace fossils appear some 180–190 m above the Upper Tillite. These are passively filled, simple, vertical burrows in contrast to later more diversified forms.

Banks (1970) noted that the trace fossils, and presumably metazoan life in general, first appear in the Late Precambrian (?Lower Cambrian) of east

Finnmark soon after the cessation of glacial sedimentation. The discovery of biogenic structures in the Rafsbotn Formation, together with the presence of the tillite, thus adds weight to the evidence favouring correlation of the Rafsbotn, Borras and Lomvann sequences and part of the Stappogiedde Formation, as well as the lower part of the Dividal Group along the Caledonian front.

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