Clast studies in the Late Precambrian Moelv Tillite and Osdal Conglomerate, Sparagmite Region, south Norway

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Frequencies of clasts > 2 cm have been determined in 48 localities of the Moelv Tillite and in 20 localities of the underlying fluvial Osdal Conglomerate. Clast roundness for the individual lithologies was visually estimated. The clast material from the formations is consistent with glacial and fluvial transport from the east towards the west. There is no marked difference in the clast content between the basal tillite and the glacial shale facies of the Moelv Tillite; neither is there between autochthonous and thrust units of the glacial formation. Provenance of clast material and the character of the Varangian glaciation in south Norway are discussed.

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Palaeogeographical reconstructions showing ice movement directions and extent of glaciation during the Late Precambrian in the North Atlantic/European region have been made by Chumakov (1971), Chumakov & Cailleux (1971), and Spencer (1975). The uncertainties involved are due to incomplete chronological correlation of widely spaced glacial units and scarce information on lateral facies variations, glacial striae, glacial fabric, and provenance. The present clast study is a contribution to the basic data needed for further progress in understanding the Varangian glaciation(s).

The data of Nystuen (1976a, b) and Sæther (1976) are combined with additional results obtained from other localities, both in the Moelv Tillite and in the underlying Osdal Conglomerate. Earlier information on the clast material of the Moelv Tillite from the eastern part of the Sparagmite Region is found in Holtedahl (1921), G. Holmsen (1935), P. Holmsen (1943, 1954), P. Holmsen & G. Holmsen (1950), Oftedahl & G. Holmsen (1952), and P. Holmsen & Oftedahl (1956).

Geological setting, stratigraphy, and sedimentary facies

The traditional model of the Late Precambrian sedimentation in southern Norway includes western and eastern 'sparagmite basins' formed by rifting within the Baltic Shield (see Bjørlykke et al. 1976). The Engerdal, Osen, and Rendal fault zones, at present revealing Late- or Post-Caledonian features, are supposed to be nearly coincident with Late Precambrian basin faults. The present study is restricted to the area between the Rendal fault zone (RFZ) and Norwegian – Swedish border (Fig. 1). The bedrock comprises a thick thrust basinal sequence of Late Precambrian to Ordovician strata and a corresponding, but much thinner sequence lying autochthonously on the crystalline basement (Fig. 2). The relative, horizontal displacement between these two structural units is uncertain; distances varying from some few kilometres to over 100 kilometres have been discussed (*e. g.* Oftedahl 1943, Bjørlykke et al. 1976). The term 'basin' in this paper is applied in a strictly sedimentological sense, as the depositional environment of the basin-facies sequence. The stratigraphy and general sedimentary history of the Late Precambrian sedimentary rocks, the Hedmark Group, have been briefly reviewed by Nystuen (1976a, b).

The Moelv Tillite consists of two main facies (Nystuen 1976a, b). The *basal tillite* is a diamictite, deposited subglacially from grounded ice sheets or glaciers. *Glacial shale* or *mudstone* is a laminated pelite containing ice-dropped stones. The facies includes probably both

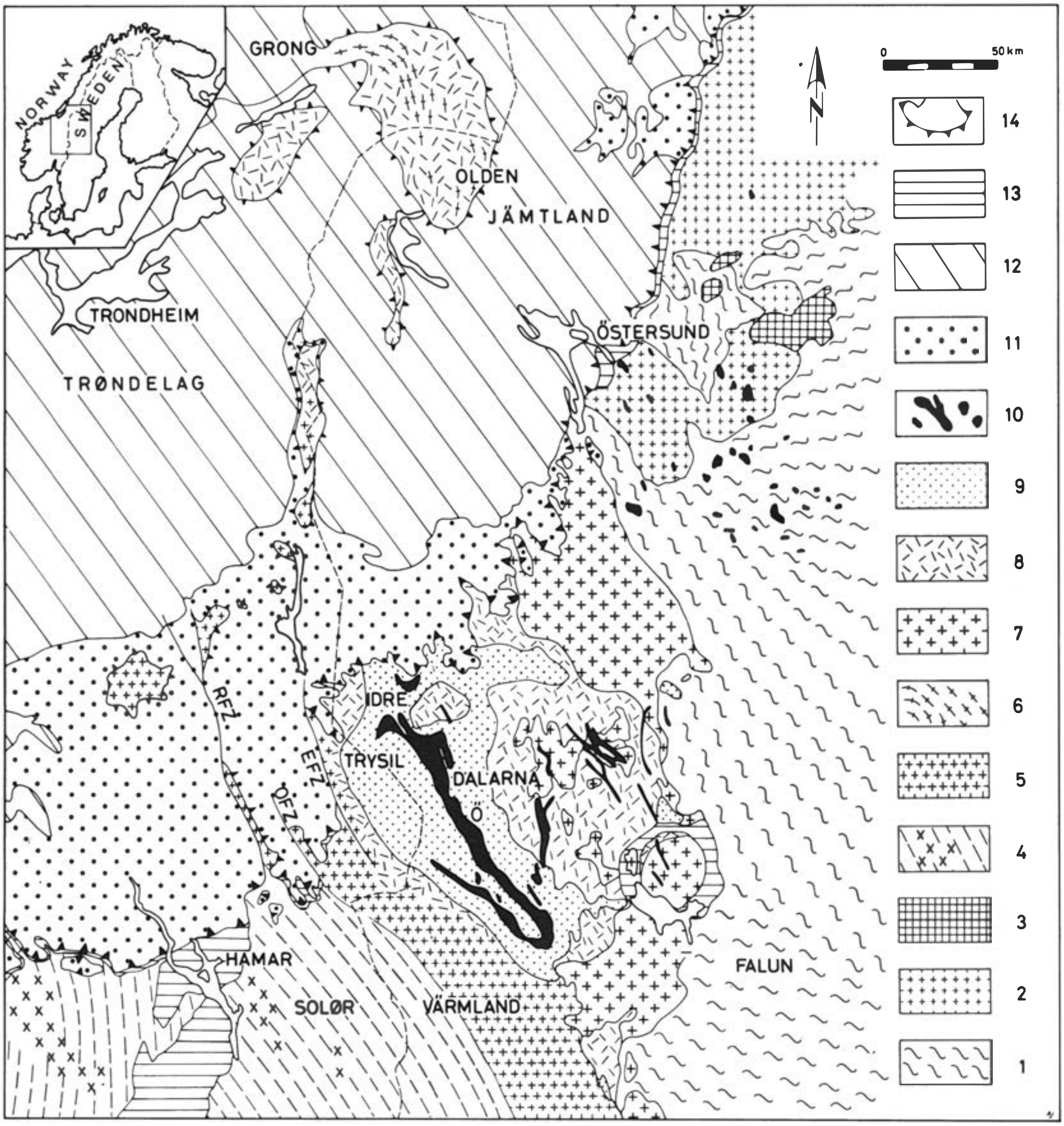

Fig. 1. Simplified map of the Sparagmite Region and adjacent parts in Norway and Sweden. Mainly after Holtedahl & Dons (1960) and Magnusson et al. (1960). 1 Svecofennian metasediments and associated igneous rocks. 2 Late- or Post-Svecofennian granites in Norrland. 3 Gabbro, diorite, syenite, and granite in the Ragunda – Nordingrå area. 4 Gneisses with amphibolites and hyperites; granites indicated by crosses. 5 Trysil – Värmland granites. 6 Olden – Grong granites. 7 Sub-Jotnian Dala granites. 8 Sub-Jotnian porphyries. 9 Jotnian Dala Sandstone. 10 Jotnian to Post-Jotnian dolerites (diabases) and basalt (Ö = Öje Basalt). 11 Late Precambrian sedimentary rocks within the lowermost Caledonian thrust units. 12 Unspecified Precambrian – Palaeozoic rocks (nappe units and basement) within the Caledonian mountain chain (Kvitvola nappe in the Sparagmite Region not shown). 13 Palaeozoic rocks outside the Caledonian nappe front (thin sequences with restricted extent not shown). 14 Major thrust planes above Precambrian basement rocks. RFZ Rendal fault zone. OFZ Osen fault zone. EFZ Engerdal fault zone.

glaciolacustrine and glaciomarine depositional environments (Nystuen 1976b).

The Osdal Conglomerate occurs in the uppermost part of the arkosic Rendal Formation (Nystuen 1978) beneath the Moelv Tillite (Fig. 2). The conglomerate underlies the Moelv Tillite in the west but is lacking in most places in the eastern part of the sequence. This could be due to erosion prior to deposition of the Moelv Tillite, or to primary absence of the conglomer-

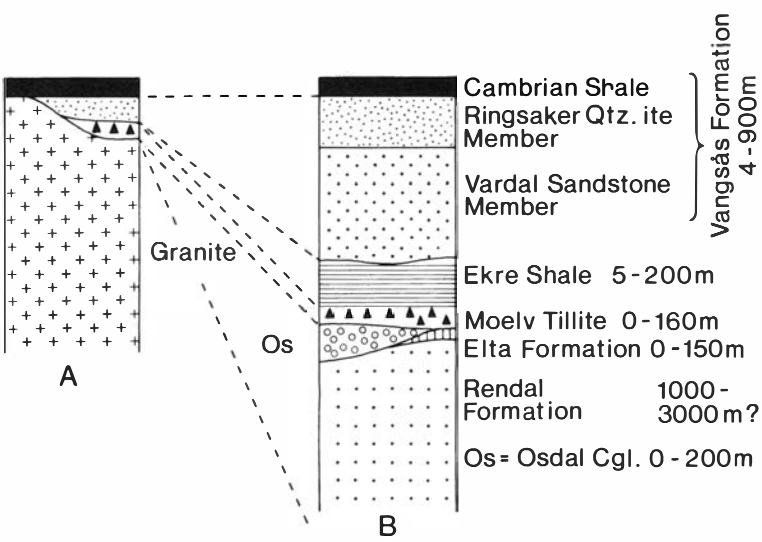

Fig. 2. Simplified diagram showing the stratigraphy of the Late Precambrian Hedmark Group in the area east of the Rendal fault zone (RFZ). A = autochthonous sequence. B = thrust strata of basinal facies.

ate in this part of the basin. The Osdal Conglomerate is characterized by rounded to well-rounded, tightly packed and locally imbricated clasts. Cut-and-fill and channel structures are present, likewise intercalated cross-bedded sandstone beds. Fining-upward sequences are developed. These features suggest that the conglomerate is of fluvial origin, deposited by braided, high-energy flood streams, probably as coalescing gravel and boulder fans. The arkosic sandstone of the Rendal Formation is also a fluvial deposit (Nystuen 1976b). Orientation of cross-bedding, channel-structures and stone-imbrication indicates transport from east to west for both the sandstone and the conglomerate.

Clast lithologies and provenance

The Moelv Tillite and the Osdal Conglomerate contain practically the same types of clasts. Only those major petrographical characteristics believed to be critical in a discussion of source areas are mentioned here.

Granite comprises several sub-types, but the clast group is dominated by red, coarse-grained granite with microcline perthite as the dominant feldspar. Additional feldspars may be albite and greenish oligoclase, more or less altered by sericitization and saussuritization. The quartz is white or blue. Biotite is usually altered to chlorite. Medium-grained and light granites also occur as well as a few augen-granites. Most granite types are massive; foliated varieties have occasionally been found.

Comparable granites form the bedrock in the Precambrian ridge along eastern side of Rendalen, east and southeast of the sparagmite area in the Trysil – Engerdal districts and in the Precambrian windows (Fig. 1). Similar types of granites also occur within the anticlinal structures further north along the Norway/Sweden border, up to Grong – Olden.

Aplite is a microtextured granite with pale reddish or light greyish colours. Some scattered phenocrysts of red alkali feldspar or plagioclase may occur. Irregular masses of aplite up to some tens of metres across have been recognized within all the granite areas mentioned above.

Porphyry and *felsite* include rhyolitic volcanic rocks with a number of textural varieties and colours (red, pink, yellowish grey, light and dark grey). Aphyric felsites may be structureless or flow-banded. The phenocrysts are red alkali feldspar or quartz, or both are present. They are normally small, 2 – 5 mm in diameter. The porphyries and felsites are undeformed, but some clasts consist of tectonically pre-Caledonian foliated varieties.

Dala Porphyries cover wide areas in Trysil and Dalarna east of the Sparagmite Region (Fig. 1). Porphyries also occur within the Precambrian basement further north in the easternmost part of Trøndelag and in western Jämtland. It must be stressed that all lithological varieties among the

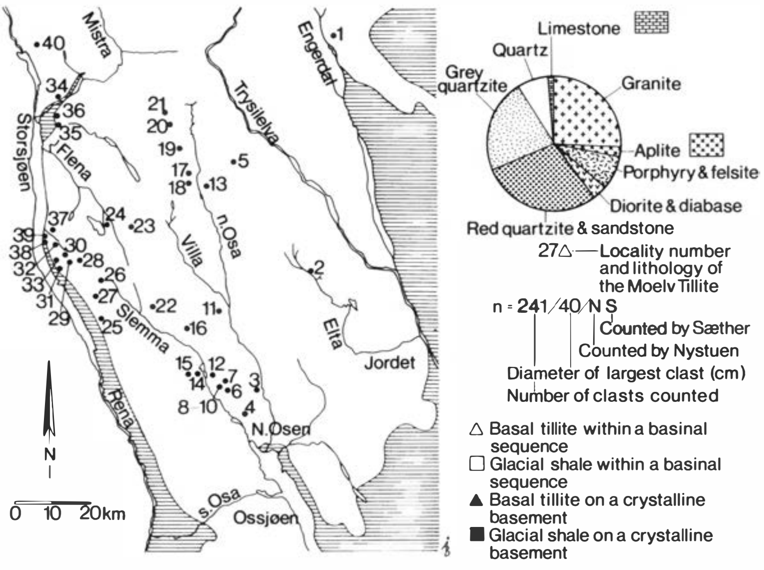

Fig. 3. Localities in which frequencies of clast lithologies in the Moelv Tillite have been determined are numbered from east to west. The areas of Precambrian basement are shown by horizontal ornamentation. The circle diagram presents the average of all diagrams in Fig. 4.

clasts have been observed within the Trysil porphyry area (Nystuen 1976c).

Diorite is medium- to coarse-grained, massive and unfoliated with hornblende as the major mafic mineral. Some clasts may be gabbros, but both plagioclase and pyroxene are altered.

Dioritic rocks occur as smaller bodies from a few to several hundred metres across within the granite areas mentioned above. Gabbros comparable with the hyperites of the Solør – Värmland gneiss region (Fig. 1) have not been recorded among the clasts.

Diabase designates several fine- to medium-grained, ophitic to sub-ophitic mafic rocks. In addition to plagioclase and pyroxene, olivine is a common mineral in diabase clasts at locality 2 (Figs. 3 and 4).

Diabase dykes, up to 300 m wide and running N-S, penetrate the Dala Porphyries and the Dala Sandstone. Intrusions of sills also occur. Similar basic rock bodies are also present within the basement of the windows to the north and further NE in Sweden. Rocks of this group have a probable age of 1000 – 1350 Ma (Welin & Lundqvist 1975) and are the youngest known extrabasinal source rocks.

No stones have been found which could be referred to the very characteristic Öje Basalt at present cropping out in a wide area in Dalarna.

Greenstone clasts have been recognized in only a few specimens in localities 6 – 10 (Fig. 4), 47 and 48 (Fig. 5). The greenstone is foliated, but this structure is evidently of Caledonian origin as regards the northernmost localities. A single clast consisting of greenstone-breccia has been reported from locality 12 (Fig. 4) (Nystuen 1976b).

Greenstone and greenstone-breccia outcrop within the porphyry area in Trysil (Nystuen 1976c). Between Rendalen and Glomma, 10–15 km SSW of localities 47 and 48 (Fig. 5), the Moelv Tillite rests with a primary contact on a greenstone which is clearly a metabasalt, very likely of intrabasinal origin and belonging to the Hedmark Group. Fragments of this metabasalt are abundant in the overlying basal tillite; the clasts encountered at localities 47 and 48 may have a similar intrabasinal source.

Red quartzite and sandstone include clasts ranging in composition from very fine-grained quartz-cemented orthoquartzite to coarse-grained feldspathic sandstone with a phyllosilicate matrix. A finely divided, hematitic substance produces the colour. Detrital heavy minerals are iron ore minerals, zircon, tourmaline, and epidote. Clastic sand grains are generally rounded to well-rounded. A clast of agate, or jasper, conglomerate was found associated with red sandstone fragments at locality 11 (Fig. 4).

The Jotnian Dala Sandstone, covering several thousand square kilometres to the east of the Sparagmite Region (Fig. 1), is very likely the source rock of this group of clasts. Agate, and jasper conglomerates also occur within the Dala Sandstone (Hjelmqvist 1966).

Grey quartzite and sandstone comprise sev-

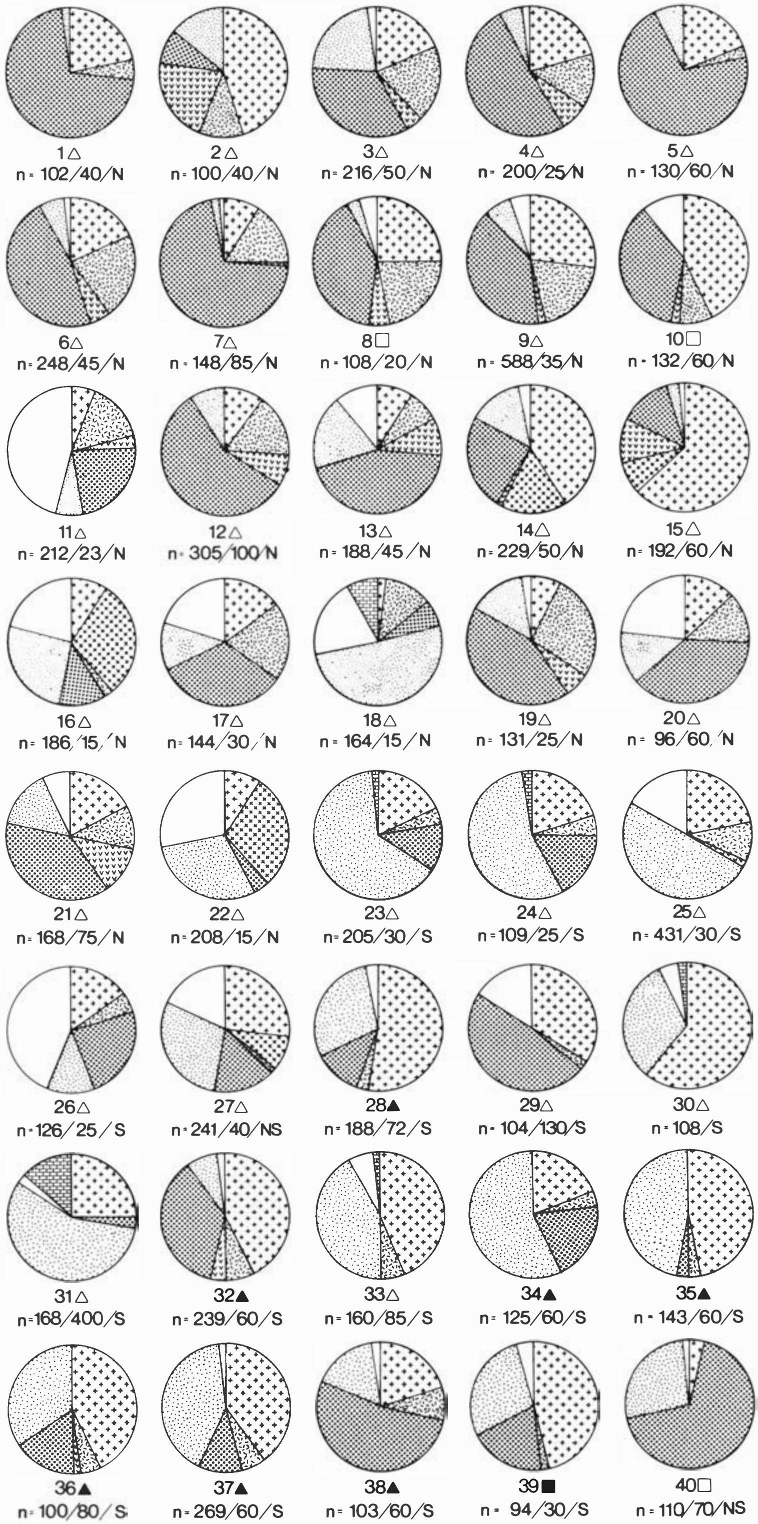

Fig. 4. Frequencies of clast lithologies in the Moelv Tillite, southern part of the eastern sparagmite area. For legend, see Fig. 3.

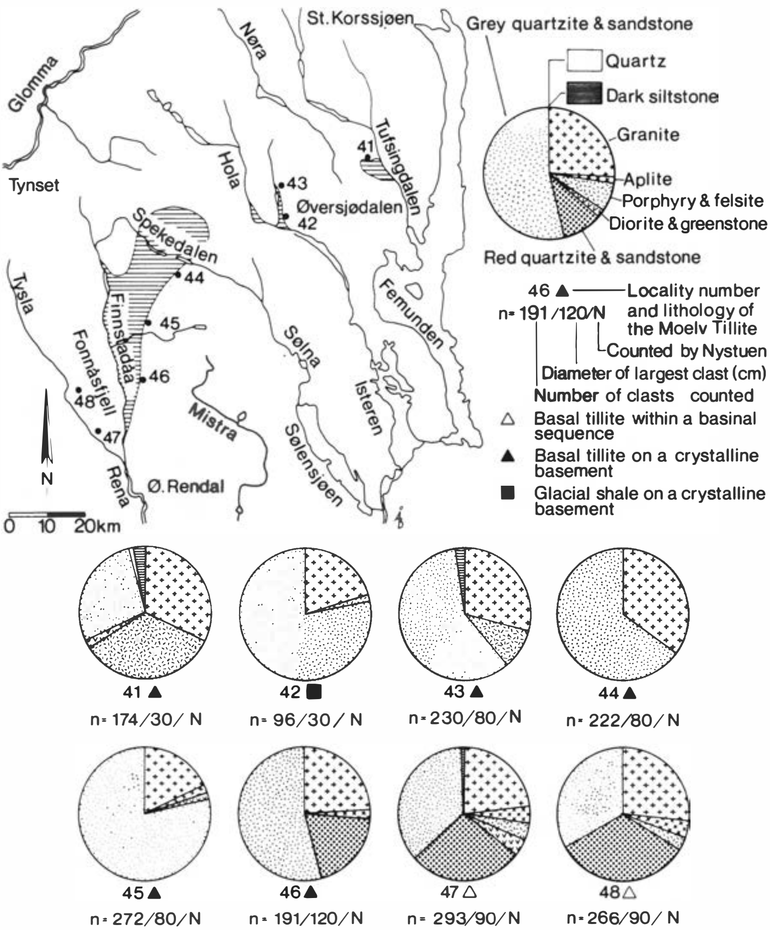

Fig. 5. Frequencies of clast lithologies in the Moelv Tillite, northern part of the eastern sparagmite area. The circle diagram in the legend presents the average of all diagrams in the figure. The areas of Precambrian basement are shown by the horizontal ornamentation.

eral subtypes which can be referred to two main groups. Metaquartzites display recrystallized textures with metamorphically formed muscovite, epidote or clinozoisite. In other grey quartzite clasts the clastic texture is well preserved, and apart from the colour, these closely resemble the red ones.

In the northernmost localities (Fig. 5) this clast group is dominated by a light grey to almost white, medium- to fine-grained feldspathic sandstone. Laminae with dark mineral concentrations define a plane-parallel stratification or cross-bedding.

The Dala Sandstone is probably also the source rock of the unmetamorphic grey quartzite and sandstone. The light grey sandstone north of Idre in northern Kopparberg County appears to be virtually identical with the grey sandstone clasts found in Tufsingdalen and Øversjødalen localities.

The provenance of the metaquartzites is less certain. Some of these clasts may well be multicyclic pebbles, possibly derived from distant quartzite beds further east in the Baltic Shield. Outcropped metamorphic equivalents of the Dala Sandstone or older quartzite units may also have been more extensive during Late Precambrian time.

Quartz is colourless, milky or, more seldom, pink or smoky vein quartz. No further studies have been performed on its petrography.

Quartz veins, being up to 30 – 40 cm wide, have been observed in the coarse-grained granite, but widths of 2 – 5 cm are most common. Much thinner quartz veins also occur in the deformed and folded porphyry rocks and Dala Sandstone in the Trysil area.

Intrabasinal clasts in the Moelv Tillite consist of ice-dropped till and gravel fragments, while in both units irregular sandstone lumps, shale, dark

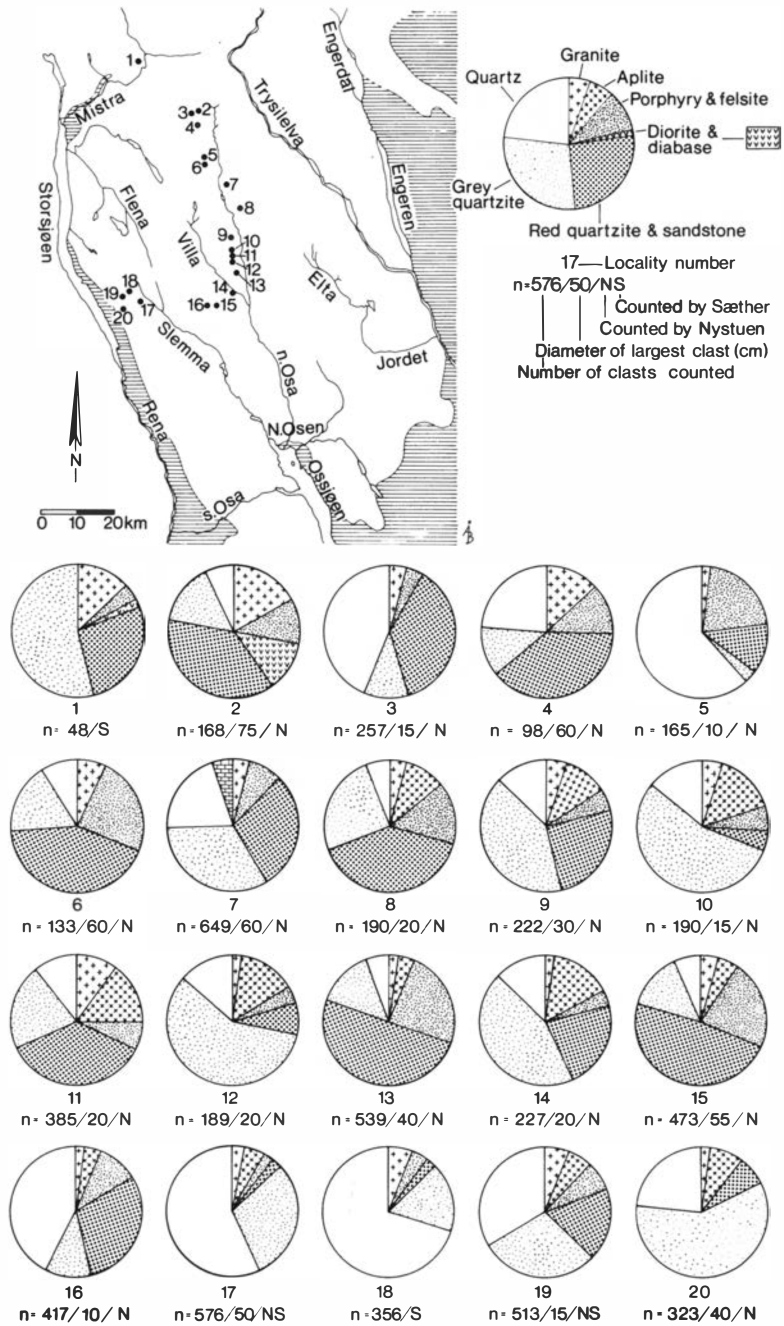

Fig. 6. Frequencies of clast lithologies in the Osdal Conglomerate. The circle diagram in the legend presents the average of all diagrams in the figure. The localities are numbered from north to south. The areas of Precambrian basement are shown by the horizontal ornamentation.

siltstone, and limestone are met with.

Limestone underlies the basal tillite facies at locality 23 (Fig. 4), and limestone and dark siltstone occur locally beneath the Osdal Conglomerate, as at locality 7 and north of localities 2 and 3 (Fig. 6).

Clast frequencies

The areal extent of each exposure on which clast frequencies were sampled was generally restricted to some few square metres, and all clasts with a longest visible diameter of 2 cm and larger were counted. Depending upon the orientation of the exposed surface relative to bedding, the sampling areas comprised stratigraphical intervals ranging from nearly zero up to c. 3 – 4 m. In only a few cases has it been possible to select the sites at well-defined stratigraphical levels within the rock units. For this reason only a few general tendencies of vertical variation have been discerned.

The reproduceability of the frequency determinations was found to be within about 5 – 10%. The greatest uncertainties concern related lithologies, such as light grey and light red sandstone, or felsite and aplite.

Moelv Tillite

The Moelv Tillite displays considerable variation in clast frequency (Figs. 4 and 5). This appears to be independent of whether the Moelv Tillite is represented by the basal tillite or the glacial shale facies. Furthermore, it must be noted that no drastic changes in clast assemblage are observed when going from basinal to basement localities (Figs. 3 and 4). High proportions of granite clasts are present in basinal positions as well as in those tillites resting upon the crystalline basement. However, in some of the latter cases, i.e. localities 44, 45, and 46 (Fig. 5), the granite content was observed to be markedly highest in the lowermost 0.5 – 1 m of the tillite. The till has evidently received fragments picked up from the local basement.

The proportion of porphyry and felsite clasts tends to decrease westwards, a trend also recognized by P. Holmsen (1954).

The relative abundance of red and grey quartzite and sandstones varies greatly throughout the area. In the northern localities grey sandstones and quartzites are the only arenaceous clast types from Tufsingdalen to west of Spekedalen (Fig. 5, localities 41 – 45). Red quartzite and sandstone are found again at locality 46, while in the two localities east of Tysla (localities 47 and 48) the clast assemblages are nearly the same as the average for the Moelv Tillite as a whole (Table 1).

The quartz content is low in most of the eastern localities and also where the Moelv Tillite overlies crystalline basement (Figs. 4 and

Table 1. Average clast content of the Moelv Tillite and the Osdal Conglomerate, calculated from the frequencies obtained in the localities of Figs. 3-6.

Clast lithology	1		2		3		4	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Granite	26	2-61	22	2-61	37	17-53	5	2-17
Aplite	2	0-30	3	0-30	0		6	0-15
Porphyry & felsite	8	0-27	9	0-27	5	3- 8	10	0-24
Diorite & diabase	3	0-21	3	0-21	1	0- 4	1	0-12
Red quartzite & sands.	26	0-71	30	0-71	22	3-53	26	2-50
Grey quartzite	28	0-66	23	0-66	34	8-56	28	3-59
Quartz	7	0-46	9	0-46	1	0-2	24	3-71
Limestone	0	0-13	1	0-13	0		0	0- 5

(1) Moelv Tillite, all localities, 1-48 (8963 clasts).

(2) Moelv Tillite, basal tillite facies in basinal position, 31 localities (6167 clasts).

(3) Moelv Tillite, basal tillite facies on basement, localities 28, 32, 34-38 (1167 clasts)

(4) Osdal Conglomerate, 20 localities (6118 clasts).

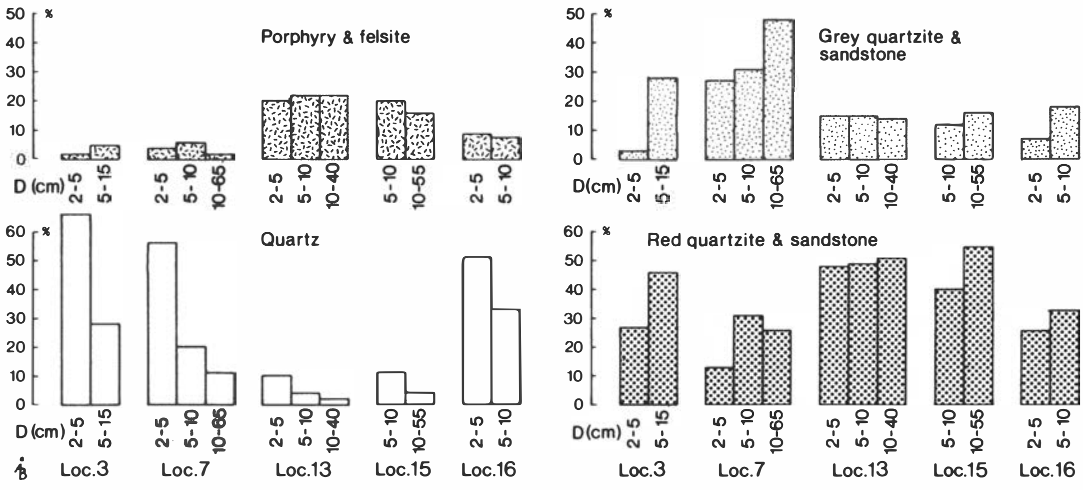

Fig. 7. Histograms showing frequencies of various clast lithologies in different clast size fractions (D = diameter) in the Osdal Conglomerate.

5). The highest proportions are present in basinal localities in which the Osdal Conglomerate is lying beneath or is believed to be (Fig. 4, localities 11, 13, 16, 17, 18, 20, 21, 22, 25, 26 and 27). The quartz is virtually restricted to the pebble fraction.

Some exceptionally high proportions of certain clast lithologies occur locally. At locality 2 (Fig. 4) diabase clasts, partly olivine-bearing, make up 21% of the total clast assemblage. Similarly, at locality 15 (Fig. 4), coarse-grained hornblende diorite accounts for 11% of the sample. Such anomalies may indicate the presence of 'block trains' from source rocks that were easily exposed to glacial erosion in outcrops of local extent. Limestone underlies the basal tillite at localities 23 and 24 (Fig. 4) while at the other limestone clast localities (18, 30, 31) a limestone unit has been mapped in the field close beneath the stratigraphical level of the Moelv Tillite. The limestone fragments are everywhere concentrated in the lowermost part of the formation.

Osdal Conglomerate

The clast frequencies also display considerable variation within this unit (Fig. 6). The most conspicuous difference from the Moelv Tillite is a greater proportion of the more mechanically resistant extrabasinal stones (quartzites, quartz, aplite) whereas granite clasts are much less frequent. Diorite, gabbro, and diabase, being the softest extrabasinal clast lithologies, have been recognized in negligible amounts, commonly less than one percent.

The regional distribution of aplite tends to be very similar in both the Moelv Tillite and the Osdal Conglomerate. The latter unit is enriched in this clast type relative to granite and porphyry, especially at the localities between the rivers Nordre Osa and Villa (Fig. 6, localities 8 – 14). High aplite values are met within the Moelv Tillite a few kilometres further west (Fig. 4, localities 16, 22).

Limestone clasts are abundant in the lowermost part of the conglomerate farthest north in the valley district of Nordre Osa. In this area the Elta Formation is believed to underly the conglomerate.

Some of the variations in clast frequency reflect the actual sorting and clast-size of the conglomerate. The relation between clast size and frequency was studied at five localities by dividing the total clast assemblage into two or three size-classes and counting each class separately (Fig. 7). Compared with the other clast lithologies, the frequency of quartz as a function of clast-size is very distinct. This is easiest explained as a feature inherited from the source rock, namely the width of the quartz veins. No other clast type would be restricted in abundance by dimensional limitations of its source rock. The quartz dilutes the frequencies of the other clast types, an effect varying with the coarseness and sorting of the conglomerate.

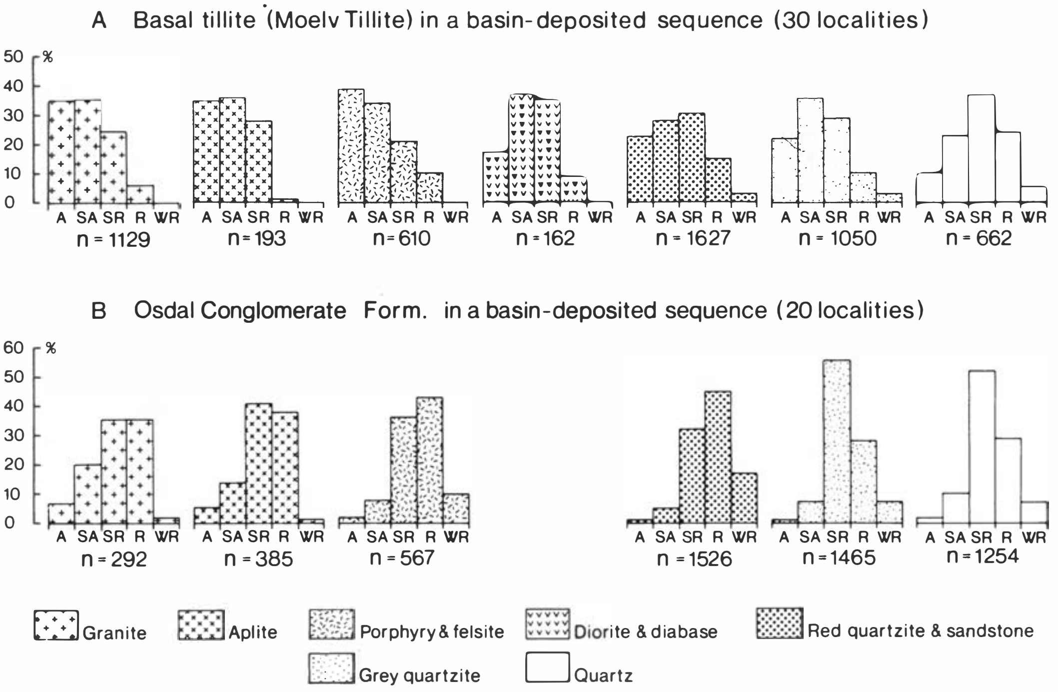

Fig. 8. Histograms showing roundness distribution of various clast lithologies in the Moelv Tillite and in the Osdal Conglomerate. Roundness classes are according to Pettijohn (1957):
A = angular, SA = subangular, SR = subrounded, R = rounded, WR = well rounded. n = number of clasts.

The clast frequencies of the Moelv Tillite are much less susceptible to such relations due to the very poor sorting of the glacial beds (Nystuen 1976b:18).

Roundness and shape

Clast roundness was determined for 30 localities of the Moelv Tillite and 20 of the Osdal Conglomerate. All localities are located within the basinal sequence. The roundness classes of Pettijohn (1957) were applied and the roundness of each clast lithology estimated visually. No significant pattern of regional variation could be demonstrated and all the data are included in the histograms in Fig. 8.

Most of the basal tillite clasts are clearly skewed towards the angular side of the histograms whereas the conglomerate clasts are dominated by classes of higher roundness. This dissimilarity reflects the different modes of debris transport, i.e. glacial and fluvial.

The roundness differences within each of the two sedimentary units are mainly due to differences in mechanical properties (Nystuen 1976b). The tendency of quartz clasts in the Moelv Tillite to be better rounded than the other lithologies is probably due to a relatively high content of reworked fluvial quartz pebbles. Well-rounded and multicycled pebbles are also represented among the quartzite clasts.

Moelv Tillite clasts very often exhibit trigonal, pentagonal, and polygonal outlines when the maximum projection area is viewed. Out of the randomly sampled stones in Fig. 9, there are clasts shaped like pyramids, double pyramids, and flatirons. Four of these clasts have distinct striations. Only one striated stone has previously been reported from the Moelv Tillite (Bjørlykke 1974). In those localities where clasts can be loosened from the tillite matrix, striated clasts will probably be rather common.

The stones in the fluvial Osdal Conglomerate are mostly ellipsoidal or nearly spheroidal in shape, irrespective of lithology. The limestone

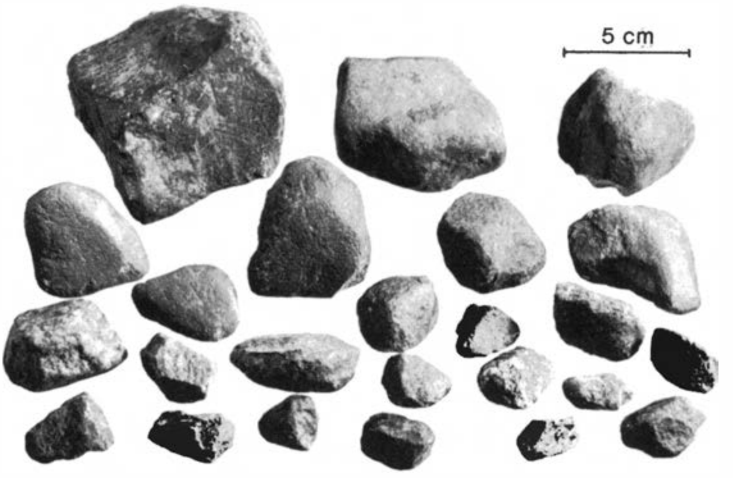

Fig. 9. Randomly sampled stones of red Dala Sandstone from the Moelv Tillite (basal tillite facies). Glacial striae are present on several of them and are best visible on the largest one. Andrå, east of Storsjøen. Rendalen.

fragments are an exception to this rule; these are usually thin slabs with irregular outlines.

Discussion

Holtedahl (1921, 1922) concluded on the basis of clast lithology that the Moelv Tillite material had been transported from the Precambrian terrain lying immediately east of the present position of the basinal sequence. This statement was later reiterated by P. Holmsen (1954). Fabric studies in the basal tillite within the basinal sequence also indicate a primary glacial transport from the east to the west (Nystuen 1976b).

The very close correspondence in the clast assemblages between Moelv Tillite in autochthonous position and in folded and thrust basinal sequence proves a common provenance for the whole glacial formation in the area. If the basinal sequence has been horizontally displaced a great distance from the north (more than 100 km), then the characteristic provenance suite of red coarse-grained granite + aplite, diorite + gabbro, diabase, porphyries, and Dala Sandstone must have existed within the Precambrian basement far to the north in Jämtland and eastern Trøndelag. All of these rock types except the Dala Sandstone are present within the Precambrian bedrock in the Trøndelag – Jämtland area (Fig. 1). However, within the Vakko Group in Norrbotten, northern Sweden, there are sandstones, quartzites, and conglomerates (with jasper) whick are very similar to the Dala Sandstone sediments (Ödman 1957). The presence of smaller areas with Jotnian sandstone further east in Sweden, in Finland and adjacent districts of the USSR (Rankama 1963) also indicates a previous wider extent of such sandstones on the Baltic Shield.

The total absence of gneiss, amphibolites, various metasupracrustal rocks, and hyperite lithologies among the clasts – a rock suite characteristic of the region to the south and southeast of the Sparagmite Region (Fig. 1) – excludes glacial transport from the south. Furthermore, the lack of definitely long-transported exotic clasts which could be referred to source rocks far east on the Baltic Shield must be emphasized. This fact, together with the simple Moelv Tillite stratigraphy indicating a single glacial event (Nystuen 1976b, Bjørlykke et al. 1976), does not favour thick Varangian ice-sheets covering the Baltic Shield during an ice age that should have lasted for 10 – 30 Ma as suggested by Spencer (1975). Compared with the repeated ice-sheet glaciation during the about 2 Ma Pleistocene epoch, it is very likely that a great number of ice-sheet glaciations would have occurred during a time span of 10 – 30 Ma. With a radial flow pattern from their central parts (Chumakov & Cailleux 1971), such ice-sheets would probably have given rise to thick and complex glacial deposits with far-transported erratics in depositional basins located in the peripheral parts of the continent (see Gillberg

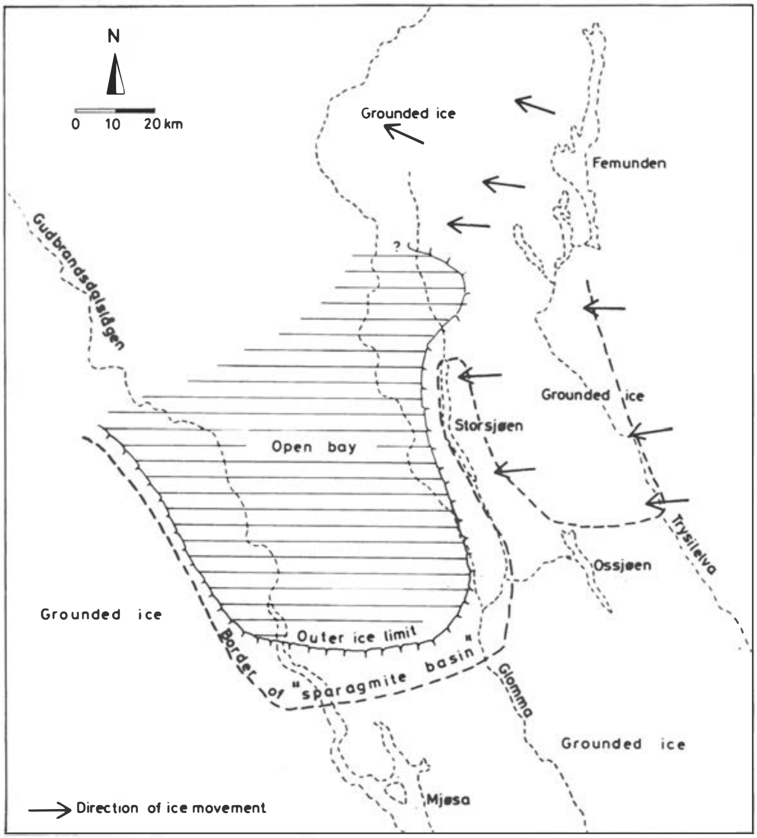

Fig. 10. Non-palinspastic map showing the interpreted maximum extent of glacier ice within the 'sparagmite basin'. Ice movement directions in the east are interpreted on basis of stone content in the Moelv Tillite. Revised from Nystuen (1976b).

1977). This is not the case for the Late Precambrian of southern Norway.

The close correspondence in clast content between the Moelv Tillite and the Osdal Conglomerate (Table 1) strengthens the impression of a rather local provenance for the glaciogenic sediments. In fact, the average clast assemblages of the two units are mostly equal. This is also valid for the granite and quartz clasts when these two lithologies are grouped together and taken as debris from the same source rock, granite with quartz veins. The coarse material of the conglomerate may have been deposited from flood streams flowing down to the basin from an adjacent highland area to the east. The same highland area was subsequently glaciated; glaciers converged on a basinal plain covered with boulder- to sand-sized debris and extended across it to the sea in the west (Fig. 10). The variations in clast frequency reflect dissimilarities in bedrock, topography, and glacial erosion in the glaciated districts and varying amounts of incorporated intrabasinal material.

The similarities in clast composition between the Moelv Tillite and the Osdal Conglomerate could also indicate that the conglomerate originated as a glaciofluvial deposit; the material would be rounded and redeposited till debris. The sedimentation might have been proglacial along an ice-margin running N-S in the basin. After an intermittent retreat, the glacier ice advanced far into the basin and laid down the Moelv Tillite. An early glaciation might also have been restricted to a highland area bordering the basin. By glacier melting, powerfully flooding streams transported the reworked till debris into the basin.

The present studies do not support the idea of a locally glaciated crystalline ridge along Rendalen during the deposition of the Moelv Tillite (Nystuen 1976b), but rather a continuous westward ice movement across the basement. The lateral distribution of the glacial facies of the Moelv Tillite within the basinal sequence must be seen as independent of the present position of the thrust rocks (Fig. 10).

Conclusion

The clast assemblage of the Moelv Tillite in the area east of the Rendal fault zone (RFZ) shows a glacial transport from the east towards the west. Irrespective of the original position of the basinal sequence, the clast lithologies strongly indicate source areas lying less than about 150 km from the depositional area. The clast composition is easily explained by suggesting a derivation from the Precambrian bedrock in the Trysil – Dalarna area, but similar source rocks are also present further north on the Baltic Shield. The clast lithologies in the thrust Moelv Tillite and the Osdal Conglomerate would thus be consistent also with an allochthonous origin for these rocks. The short-transported character of the till debris is demonstrated by its great similarity with the clast assemblage of the fluvial (or glaciofluvial) Osdal Conglomerate. The coarseness of this conglomerate is suggestive of a maximum of some tens of kilometres of transport. Variation in clast frequency within the Moelv Tillite is due to bedrock relations and topography within the glaciated area and degree of incorporation of older basin-deposited material in the glacier ice. Anomalously high concentrations of some clast lithologies can be explained as 'block trains' from extrabasinal source rocks or local enrichment of stones from the Osdal Conglomerate, underlying friable sand beds or limestone and shale horizons belonging to the Elta Formation.

Clast material and Moelv Tillite stratigraphy indicate that the glaciation mainly was a single, non-recurring event. It was probably located in highland areas bordering the 'sparagmite basin'. None of the observations demand large-scale, continental ice-sheet glaciations lasting for several millions of years.

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