Stratigraphy of the Otta-Vågå tract and regional stratigraphic implications

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Sturt et al. (1991) and Bøe et al. (1993) have described a first-order stratigraphic unconformity beneath the Sel Group in the Otta-Vågå map areas (1:50,000 sheets 1618 I, 1718 I). This unconformity separates the Sel Group from a substrate of the Vågåmo Ophiolite which was already thrust in, on the Ottadalen Thrust, onto a basement-cover couplet of the Rudihø Gneiss Complex (Baltic continental crust) and the unconformably overlying cover succession of the Heidal Group. The Heidal Group had undergone a complex tectonometamorphic evolution, and the ophiolite was folded, prior to uplift, deep erosion and deposition of the Sel clastic wedge which includes continental, fan-deltaic and marine sediments. The sub-Sel unconformity and conglomerate composition indicate that the Sel Group is a terrane-linking succession, showing that the Vågåmo Ophiolite had already been obducted onto a former westward extension of the Fennoscandian Shield prior to the Scandian thrusting of the Otta Nappe. During fieldwork in the summer of 1994, a perfect example of the unconformity between the Heidal Group and serpentine conglomerate (Otta conglomerate facies) was discovered at Grønlii (fig. 2 in Bøe et al. 1993). The conglomerates rest on an irregular surface cut into a substrate of polyphasally deformed Heidal calc-silicate gneisses and psammites, though at this locality no indication of preserved regolith is present.

The northeastward extension of the mapping into map-sheets Hjerkinn (1519 III) and Folldal (1519 II) has allowed the unconformity to be traced into these areas, and provides additional evidence as to the nature of this unconformity. The unconformity can, in fact, be traced from the Vågå-Otta tract across the river Lågen and mapped semi-continuously along the northside of Grimsdalen until it is exposed in the streams Verkesåe and Buåe (Fig. 1). The mapping shows that the unconformity is stratigraphically down-section from the Folldal volcanite (Fundsjø Group), although the rocks are structurally inverted. The streams Buåe and Verkesåe were stratigraphically logged, each for some 1.25 km above the unconformity, and the logs are presented as Fig. 2.

The log from the stream Verkesåe (Fig. 2) shows the basal sediments to be typical schists and phyllites of the Sel Group reposing on polyphasally folded semi-psammites of the Heidal Group, replete with garnets up to 1.5 cm in diameter. The Sel schists and phyllites have distinctly preserved, delicate bedding structures and pass up into well-bedded sandstones which preserve sporadic examples of cross-bedding showing downward facing. The Sel sediments show an initial coarsening-upward succession culminating in a massive coarse conglomerate some 150 m thick. This is a poorly sorted, clast-supported conglomerate of the Skardshøi type (Bøe et al. 1993) containing sub-angular clasts with a maximum clast diameter around 20 cm. The clasts comprise mainly quartzite, psammite, semi-psammite (sometimes garnet-bearing), calc-silicate gneiss, vein quartz, brown limestone/dolomite and banded amphibolite. These clasts preserve abundant evidence of pre-pebble deformation and strongly reflect the lithologies of the Heidal Group. In addition there are clasts of basic and acidic volcanic rocks which show no signs of pre-pebble deformation as do a number of clasts of what we interpret as metamorphosed ferrosaprolite. The overall characteristics of the log are of a fine-grained succession (fine-grained sandstones, schists and phyllites) making up to 50% of the section, limestone 5% and conglomerate 40%, producing an almost bimodal fine/coarse succession. At various levels in the succession, well-preserved sedimentary structures (cross-bedding, channels, grading, etc.) can be observed, all indicating a consistent downward-facing stratigraphic polarity and indicating at best only limited repetitions by folding.

The log from the stream Buåe shows many similar facies, although here schists and phyllites represent some 55% of the section, conglomerate 15% and limestones (dolomites) 10%. A major difference in this log is that lavas, tuffs and volcaniclastic sandstones, with interbedded schists, phyllites and thin limestones/dolomites, occupy a

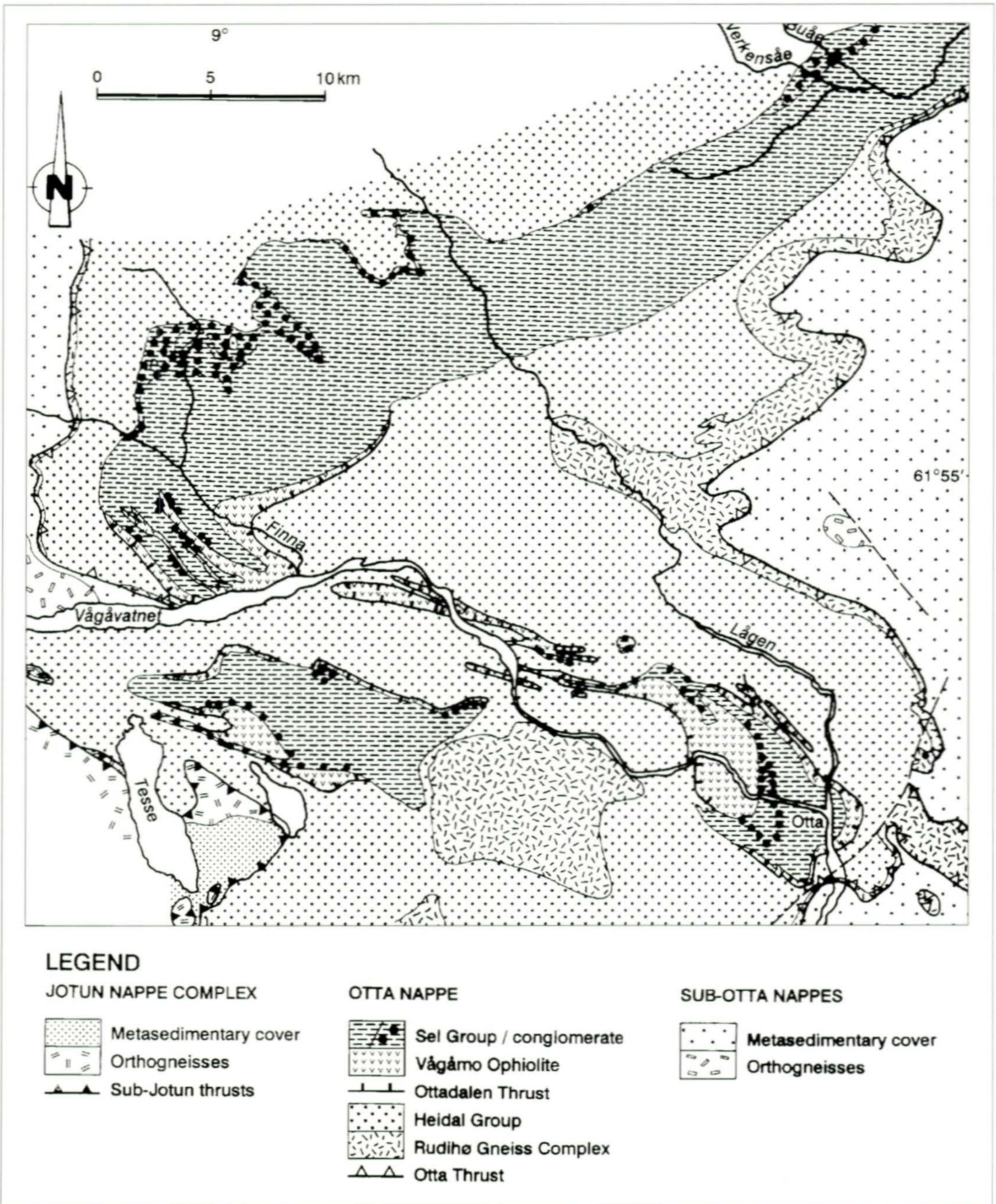

Fig. 1. Geological map of the Vågå-Otta-Grimsdalen area.

little over 200 m of the column. The lavas are greenstones with scattered crude pillows, though the thin tuff horizons are bimodal basic/acidic types. This represents the first appearance of the Folldal volcanite (Fundsjø Group). Similar findings were made by Bjerkgård & Bjørlykke (1994 a & b) where they describe bimodal basic/acid tuffs in the Åsli Formation (traditionally the upper part of the Gula Group), beneath the main Folldal volcanic succession. This led Bjerkgård & Bjørlykke (op.cit) to propose that the Åsli Formation is not part of the Gula Group (Heidal equivalent) and that the top of the Gula Group is probably at the contact between the Åsli and Singsås Formations. Reconnaissance mapping by two of us (D.M.R. and B.A.S.) has indicated that the top of the Gula Group is, at least in part, at a somewhat lower level than this formational boundary.

The comparison between the logs of the two streams, separated only by 3-4 km, shows considerable lateral facies variation, though the main conglomerate and limestone/dolomite horizons can be recognised. Such rapid facies changes have been emphasized in Bøe et al. (1993) in their analysis of the lower part of the Sel Group. The basal deposits of the Sel Group in Grimsdalen are interpreted as marine.

During the mapping, a major but impersistent horizon of metamorphosed ferrosaprolite including, near its top, local developments of metamorphosed lateritic rocks has been identified immediately beneath the basal deposits of the Sel Group. These rocks may represent relics of a formerly extensive blanket of regolith produced by chemical weathering, e.g. resembling that developed during the Tertiary in western Australia (Anangetal 1993). The regolith represents an alteration of various members of the Heidal Group. Such regoliths in their unmetamorphosed state are dominated by clay minerals which, during the erosion of the uplifted terrane, will be rapidly re-sedimented to produce clays, marls, etc. This process would provide a logical explanation for the pattern of fine-/coarse-grained sediments in the basal Sel Group; the fine-grained sediments representing, to a large extent, re-sedimented fines from the regolith and the conglomerate inputs relating to tectonic movements and fault-scarp evolution in the hinterland. The conglomerates of the Grimsdalen area are interpreted as mass-flow deposits in a marine succession, possibly resulting from episodic sediment transport from the adjacent land area (see also Bøe et al. 1993). The major difference in thickness of the conglomerates between Verkesåe and Buåe probably indicates that the Verkesåe section, at the beginning of deposition, was closer to the centre of a pre-Sel palaeovalley. The limestones/dolomites with sigmoidal cross-bedding in the upper part of the succession are predominantly shallow-marine deposits, though water depths during deposition probably varied due to tectonic instability and eustacy.

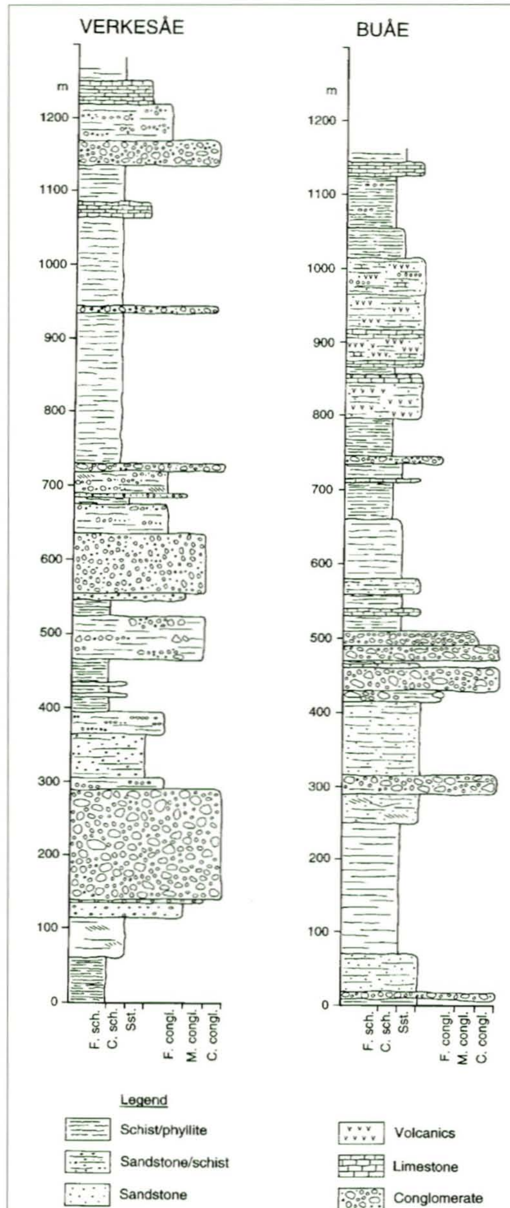

Fig. 2. Simplified stratigraphical sections through the lowermost part of the Sel Group at Verkesåe and Buåe in Grimsdalen. The sections start at the boundary between the Heidal and the Sel Groups. See Fig. 1 for location of the sections.

The discovery that the Folldal volcanite (Fundsjø Group) are, in fact, up-sequence developments within the Sel Group is of considerable importance and indeed gives more precision to the dating of the major unconformity. Bøe et al. (1993) show the age control of the unconformity to have an upper limit at the Arenig/Llanvirn boundary based on the Otta fauna. Recent U/Pb zircon dating of the Folldal Trondhjemite has given an age of 488 ± 2 Ma (Bjerkgård & Bjørlykke 1994a), i.e. a date virtually at the Tremadoc/Arenig boundary, thus providing a more accurate upper age constraint for the unconformity. The Vågåmo Ophiolite must thus be older than this boundary, though probably younger than ca. 505 Ma. The latter age is shown by Mørk et al. (1988) to indicate the timing of eclogite-facies metamorphism in the Seve Nappe. This metamorphism is a reflection of the subduction of part of the Baltoscandian miogeoclinal assemblage during Late Cambrian / Early Ordovician times, probably resulting in ophiolite obduction.

Discussion

The major terrane-linking unconformity at the base of the Sel Group can be traced through Grimsdalen into the Folldal area. The minimum age constraint for the unconformity is at the Tremadoc/Arenig boundary. Reconnaissance mapping northwards into the western Røros region shows that this pattern persists. The Folldal volcanite (Fundsjø Group) are demonstrated to represent volcanic effusion into the Sel sedimentary basin and to have developed above continental crust. Bjørlykke et al. (1993) have shown how the signature of the Pb-isotopes in sulphide ores hosted by the volcanite of the Fundsjø Group, in the Folldal-Røros tract, reveal considerable contamination by continental crustal rocks of Fennoscandian Shield type, which is certainly compatible with the results of this study.

The stratigraphic results cast considerable doubt on the status of the so-called Gula Group and it is obvious that a major revision of the upper limit of the Gula Group must be made.

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