A Seve duplex (Upper Allochthon) at the northern margin of the Grong district (Caledonides of central Norway)

REINHARD O. GREILING, ARMIN KAUS & KARL LEIPZIGER

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Tectonostratigraphic investigations revealed a unit of Seve lithology (Upper Allochthon) beneath the Köli units of the Grong district and above Middle Allochthon units (including the Dearka metapsammites) at the SW margin of the Børgefjell window. The Seve unit is composed of garnet mica schists, gneisses, fine-grained metabasites (the 'Gollomvatnet metabasites', GM), minor quartzites and marbles. According to 16 geochemically analysed samples, the GM are basalts and basaltic andesites and show a clear affinity to Seve metabasites, both for major and trace elements. The structural evolution is polyphase, with an early, pre-thrusting peak of metamorphism (amphibolite/greenschist grade). Thrusting under lower greenschist grade metamorphic conditions established the present geometry of the Seve unit as a foreland-dipping duplex. Subsequent intense folding (NE–SW, E–W, N–S) led to the present map pattern. An OFB/WPB transitional character of the GM may be related to early stages of crustal rifting. Subsequent collision tectonics led to metamorphism and thrusting of the Seve duplex into its present position.

R. O. Greiling, Department of Geology, University College Cardiff, P.O. Box 914, Cardiff CF1 3YE, U.K. Present address: Geologisch-Paläontologisches Institut der Ruprecht-Karls-Universität Heidelberg, Im Neuenheimer Feld 234, D–6900 Heidelberg, West Germany; A. Kaus & K. Leipziger, Institut für Geowissenschaften, Johannes Gutenberg-Universität, Postfach 3980, D–6500 Mainz, West Germany.

In a synoptic view, Zachrisson (1973) demonstrated a general wedge shape of the Seve Nappes (Upper Allochthon) in the eastern domains of the Scandinavian Caledonides, with their pinching out towards the west/northwest. Since then, a number of minor Seve units have been detected farther west beneath tectonically higher nappes of the Upper and Uppermost Allochthons and above metasedimentary and crystalline units of the Middle and Lower Allochthons (Gee et al. 1985a, b; Stephens et al. 1985). Both these latter crystalline rocks and some of the Seve rocks (e.g. gneisses) are probably derived from a pre-Caledonian, crystalline basement (Gee et al. 1985a; Stephens et al. 1985). There is therefore no general lithological distinction between Seve and tectonically lower rocks.

As a consequence, early reconnaissance mapping in the Grong district and its surroundings by Foslie (Foslie & Strand 1956; Oftedahl 1956) failed to acknowledge the presence of Seve units in the area, generally combining them with the crystalline basement rocks of the Grong basement culmination or the Børgefjell window. Later, isolated Seve units were discovered at the southern margin of the Grong district (Aukes et al. 1979; Kollung 1979) and within the Grong basement culmination (Andreasson & Johansson 1983). At the northern margin of the Grong district, Kollung (1979) attributed the Dearka metapsammites (Figs. 1, 2) to the Seve unit, although they are similar to Middle Allochthon metapsammites and are, therefore, generally included in the Middle Allochthon (see maps by Gee et al. 1985a, b; Fig. 1). Our tectonostratigraphic investigations at the Middle Allochthon tectonic level have revealed the presence of a further unit between the Middle Allochthon (including the Dearka metapsammites) and the Köli Nappes at the northern margin of the Grong district south of Namsvatnet (Figs. 1, 2). The lithology of that unit is almost identical to that of the (Seve-) Blåsjöälven Formation of Sjöstrand (1978), which is part of the 'western schist and amphibolite belt' of Trouw (1973) or Williams & Zwart (1977).

To support the lithological comparisons, we have tried to use the geochemical composition of the (suspected) Seve metabasites for a reliable

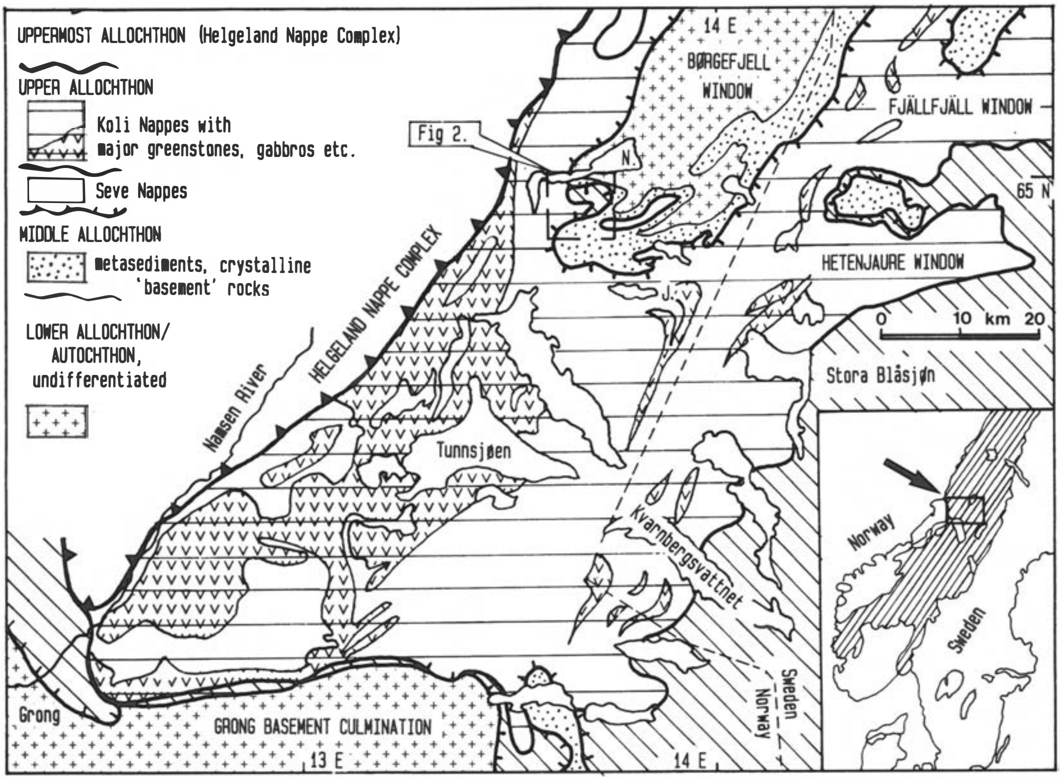

Fig. 1. Sketch map of the Grong district Upper Allochthon and surrounding units in the north-central Scandinavian Caledonides; compiled from Gee et al. (1985b), Halls et al. (1977), Sjöstrand (1978), Zachrisson (1969). The inset map shows its position in Scandinavia (Caledonides shaded). The various major tectonic units are separated by thrusts as shown in the legend. Note the regional ('Caledonian') NE–SW trend of major units and the general succession from lower units in the southeast towards higher units in the northwest. This regional structure is interrupted by the Grong basement culmination in the south and, to a lesser extent, by the Børgefjell, Fjällfjäll and Hehtajaure windows in the north. There, it is obvious that the Seve nappes or the Upper Allochthon wedge out towards west/northwest but reappear in isolated 'lenses' farther west. An example from the northern margin of the Grong district towards the Børgefjell window is shown in more detail in Fig. 2, the outline of which is indicated. G. – Gjersvik, J. – Joma, N. – Namsvatnet.

correlation with Seve metabasites elsewhere in the Scandinavian Caledonides. Therefore, in order conclusively to establish the presence of a Seve unit at the northern margin of the Grong district, we present not only a brief lithological description of the Seve rocks but also the geochemical characteristics of its metabasites. Subsequently, we give an account of the structural and metamorphic evolution and thrust geometry, and discuss the possible regional nappe tectonic implications of the new data.

Lithology

The succession of the Seve unit shown in Fig. 2 is lithologically dominated by garnet mica schists and garnet-bearing gneisses that show variable transitions and interlayering with each other. These rocks consist of 20–52% muscovite and/or sericite, around 40% quartz, 0–20% plagioclase and 5–10% almandine garnet that is sometimes chloritized. Common accessories are biotite, zoisite, titanite, hematite, ilmenite, tourmaline and calcite. Garnet forms generally 'augen', as do some plagioclase porphyroblasts. Muscovite and rare biotite porphyroblasts are subsequently deformed to flakes or lenses. Subordinate thin quartzite layers are distributed widely within the mica schists and gneisses. They are generally fine-grained with white to grey shading and fine banding, containing 70–80% quartz and around 20%

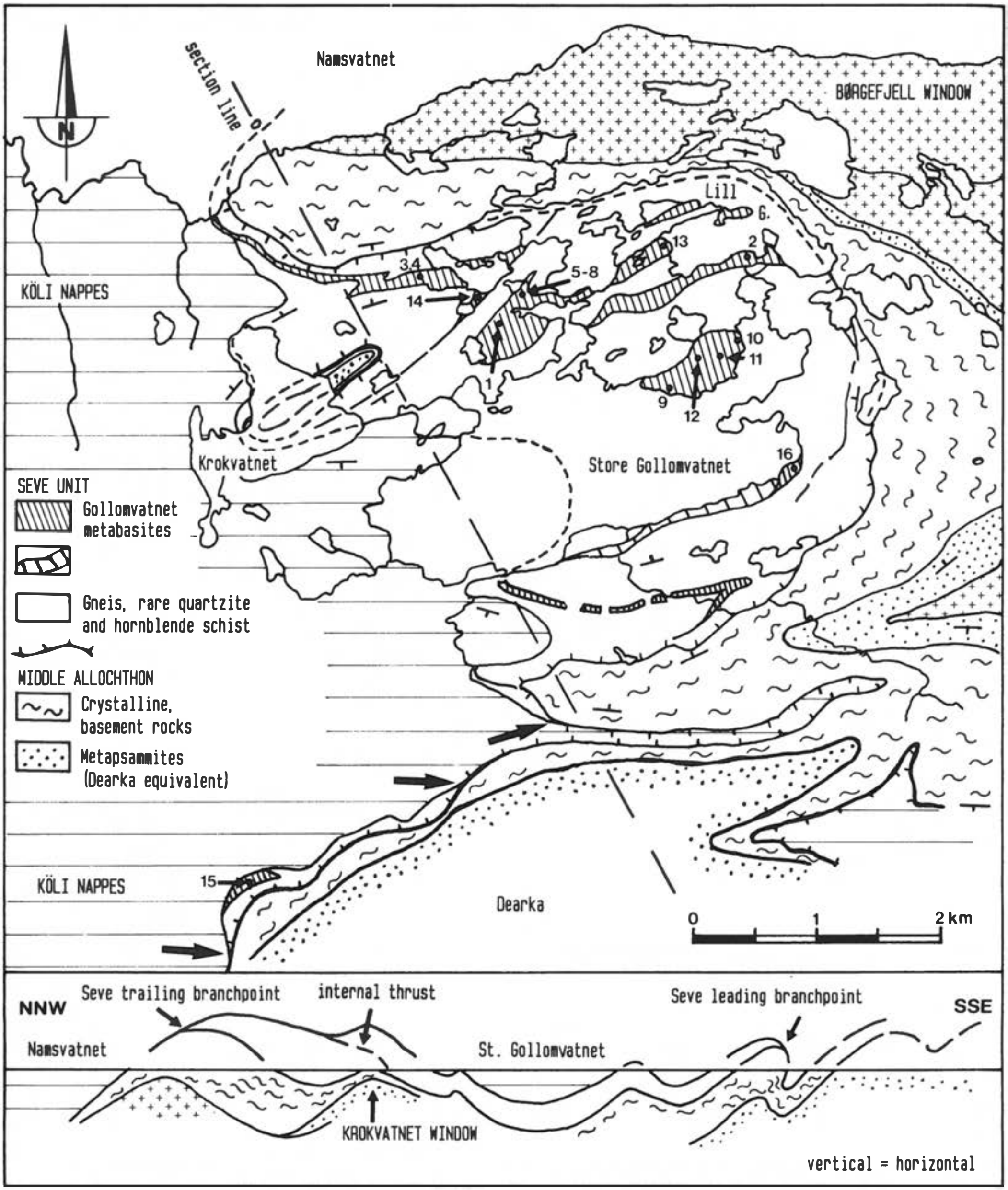

Fig. 2. Geological map (top) showing outline and major lithological units of the Seve duplex south of Namsvatnet. Numbered dots indicate the locations of samples used for geochemical analysis of the Gollomvatnet metabasites (see Table 1). The Seve basal (floor) thrust is shown as a barbed line, the roof thrust towards the Köli hangingwall as a thick line. Arrows show leading branch points of Seve floor and roof thrusts and define an ENE–WSW trending branch line at the leading edge of the Seve duplex. The Seve duplex consists of two horses, which are separated by a thrust trending from the eastern shore of Krokvatnet towards Lill Gollomvatnet (Lill G.) in the NE (thick line, about parallel with the duplex leading branch line). The Seve rocks are separated from the Dearka metapsammites of the underlying Middle Allochthon by strongly deformed, gneissic crystalline rocks. The metapsammites continue from Lill Gollomvatnet towards west but are too thin to show on the map. The map pattern is dominated by E–W or ENE–WSW trending folds (D6 of Table 2). The section (bottom) is drawn to be near-normal to these major folds and parallel to the NW–SE nappe transport direction. It shows floor and roof thrusts of the Seve duplex, which consists of two horses and is subsequently deformed by (inter alia) D6 folds.

sericite. The remaining mineralogy consists of titanite, hematite and chlorite. Rare marble horizons are white, relatively clean calcite rocks (approx. 90% calcite) with an even-grained texture on a millimetre scale and with a light-brown weathering surface. Mappable units are restricted to the southern shore of the lake Store Gollomvatnet (Fig. 2).

Amphibolites occur in 'layers', generally a few tens of metres thick, locally interfingering with the mica schists and gneisses. They are distributed mainly at the northern shore of Store Gollomvatnet and between Store and Lill Gollomvatnet (Fig. 2). Therefore, we refer to them as the Gollomvatnet metabasites according to their geochemical composition (see below). They are even-grained with grain sizes generally on the millimetre scale. The amphibolites are composed mainly of hornblende (30–65%) and plagioclase (around 30%) and 10–20% of the minor constituents zoisite, biotite, calcite, sericite, titanite, chlorite, quartz. Accessory minerals comprise mainly opaques such as hematite and ilmenite. At the contact towards the other rocks, the amphibolites sometimes contain garnet porphyroblasts. These porphyroblasts are related to a regional metamorphic event (see below) which overprinted and erased the primary contact relationships.

The relatively fine grain size and the flat lens shape of the amphibolite bodies, interfingering with probable shallow-water metasediments (marbles, quartzites), may imply an origin as extrusions or shallow-level intrusions. Besides the major Seve area shown in Fig. 2, two minor domains of garnet mica schists and gneisses were mapped to the northeast and northwest of the mountain Dearka. The latter domain also contains a small amphibolite body (sample no. 15, Fig. 2).

Similar mica schists exposed at the southern margin of the Dearka metapsammites (Kollung 1979; Fig. 1, N of Joma) represent further small-scale Seve units.

Geochemistry of the Gollomvatnet metabasites and their distinction from metabasites of adjacent tectonic units

Due to the metamorphic overprint and the high strain state, no primary textures are preserved in the Gollomvatnet metabasites (GM). It is thus impossible to compare them mineralogically or petrologically with other (mostly better preserved) metabasites that are frequent in units both structurally below and above. However, their geochemical characteristics allow a correlation with Seve metabasites elsewhere in the Scandinavian Caledonides and a distinction from metabasites of other tectonic units. For such a correlation, major element data and diagrams of Seve metabasites in adjacent Sweden (Kvarnbergsvattnet area, Sjöstrand 1978, see Fig. 1) trace element diagrams summarizing the Scandinavian Seve data (Stephens et al. 1985) and an analysis from a Seve metabasite at the Västerbotten Caledonian margin (Greiling 1985) were used. A comparison with data on higher (Köli) units compiled by Stephens et al. (1985) and Furnes et al. (1980) and on lower units compiled by Johansson (1980) and Greiling (1985) allows us to distinguish Seve metabasites from those of other units.

In order to avoid effects of secondary compositional changes as far as possible, we employed only those elements that are generally assumed to be reasonably immobile. Exceptions are Ca, K, Na, which have been used by Sjöstrand (1978) to characterize Seve metabasites in adjacent Jämtland, and thus provide a base for comparison. The composition of 16 analysed GM samples is summarized in Table 1 and in Figs. 3, 4 and 5. According to their silica contents, the GM are basalts and basaltic andesites (Streckeisen 1979). In the total alkali-silica diagram (Fig. 3A) they occupy the subalkaline field and, in particular, that of Seve amphibolites of the Kvarnbergsvattnet area (Sjöstrand 1978). By contrast, discordant metabasites of the underlying units (Middle Allochthon, Lower Allochthon, basement of the Børgefjell window and at the eastern Caledonian margin are mostly alkaline (Greiling et al. 1984; Greiling 1985; unpubl. data) and thus clearly distinct from Seve metabasites (Fig. 3A). An important exception, however, is the subalkaline dykes of the Särv unit (Middle Allochthon, see below).

The relationship between alkalis and CaO (Fig. 3B) also shows the GM to be comparable with the Seve metabasites of the Kvarnbergsvattnet area (Sjörstrand 1978). In the TiO_2–FeO^t/MgO diagram, the Skaergaard trend is common to both the GM and the Seve metabasites (Fig. 3C). Clearly distinct from the GM, Köli greenstones

Table 1. Geochemical analyses of Gollomvatnet metabasites, analysed by XRF and calibrated against international standards at MESA, Nottingham (now Caleb Brett, St. Helens, U.K.). Sample number in parentheses refer to outcrop numbers by A. Kaus and K. Leipziger in their unpublished Diploma theses (Mainz 1982). (n.d. = not determined).

Sample	1 (12)	2 (78)	3 (400A)	4 (400B)	5 (459)	6 (460)	7 (461A)	8 (461B)	9 (483)	10 (485)	11 (488)	12 (489)	13 (490)	14 (496)	15 (502)	16 (570)
SiO_2	47.75	49.61	51.56	50.88	48.79	50.99	49.17	49.93	52.81	49.90	50.29	48.41	51.84	48.91	49.55	51.81
Al_2O_3	14.85	15.77	15.25	15.37	14.62	14.20	14.91	15.46	11.58	13.79	14.84	14.21	14.61	15.14	14.92	11.56
TiO_2	1.22	0.96	1.13	1.09	1.49	1.14	1.11	1.45	1.86	1.74	1.53	1.59	1.24	1.37	1.25	1.71
Fe_2O_3	11.26	10.14	9.49	9.49	12.07	9.02	10.13	10.70	13.58	13.75	12.01	13.71	9.57	12.48	10.20	13.04
MgO	8.10	8.14	8.00	8.40	7.20	7.43	8.94	6.86	5.20	6.39	6.66	6.91	7.40	7.19	8.12	5.97
CaO	12.28	11.61	10.25	10.00	10.63	13.90	10.17	10.68	9.68	9.93	10.25	11.13	10.78	10.81	11.35	9.90
Na_2O	1.97	2.42	3.17	3.03	2.51	2.25	3.27	2.51	2.10	2.73	2.80	2.45	3.01	1.59	2.27	2.23
K_2O	0.90	0.77	0.45	0.53	0.95	0.23	0.74	0.97	0.41	0.54	0.65	0.42	0.58	0.57	0.58	0.85
MnO	0.17	0.15	0.13	0.14	0.18	0.12	0.17	0.15	0.22	0.19	0.16	0.21	0.15	0.18	0.17	0.28
P_2O_5	0.14	0.11	0.18	0.18	0.17	0.18	0.20	0.22	0.37	0.22	0.23	0.15	0.16	0.17	0.17	0.30
LOI	1.16	0.87	0.34	0.71	1.14	0.68	1.76	1.13	n.d.	0.53	0.75	0.72	0.69	1.20	1.79	n.d.
Total	99.80	100.55	99.95	99.82	99.75	100.14	100.57	100.06	97.81	99.71	100.71	99.91	100.03	99.61	100.37	97.65
Rb	24	21	5	7	34	1	26	21	11	14	22	10	8	18	18	15
Ba	157	69	36	53	149	12	139	194	74	109	98	30	75	52	87	93
Sr	244	248	227	204	215	566	231	318	106	121	246	147	382	211	246	123
La	7	5	10	8	1	2	7	13	18	11	6	4	3	3	10	12
Y	23	21	30	27	34	29	23	32	41	39	32	39	26	32	25	37
Co	37	44	35	42	36	26	40	33	36	38	41	47	35	45	45	41
Cr	202	331	313	349	164	227	353	197	74	99	204	96	237	202	319	81
Zr	98	65	111	111	90	108	118	137	145	127	147	106	115	91	109	120
Nb	8	4	12	9	12	10	13	14	18	14	15	4	10	11	10	16

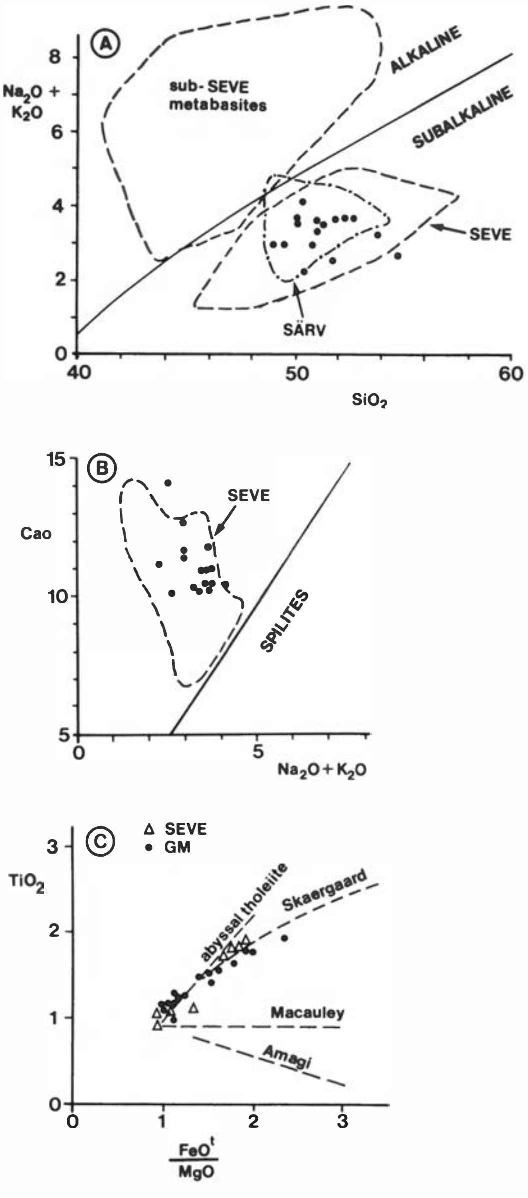

Fig. 3. Diagrams showing major element composition of the Gollomvatnet metabasites (dots; cf. Table 1). For comparison, the composition of other Seve metabasites is shown by triangles (C) or as fields delimited by broken lines (A, B), taken from Sjöstrand (1978). A: ($Na_2O + K_2O$)-SiO_2, dividing line taken from Irvine & Baragar (1971), Särv field from Solyom et al. (1979). 'Sub-Seve metabasites' field compiled from eight analyses of metabasites from the Baltic Shield adjacent to the Caledonian margin east of the present area, eight from Børgefjell 'basement' rocks, eight from Bångonåive 'basement' rocks and sixteen from the Stalon Nappe (Middle Allochthon, Greiling et al. 1984, Greiling 1985 and unpublished data). B: CaO–($Na_2O + K_2O$), dividing line taken from Papezik (1968; in Sjöstrand 1978). C: TiO_2–FeO^t/MgO, trend lines taken from Miyashiro (1975). Oxides in wt%, volatile free.

at adjacent Gjersvik (Fig. 1) show a trend of island arc tholeiites (Lutro 1979).

Major element composition demonstrates a distinction of the GM metabasites from underlying metabasites, except for the Ottfjället dykes of the Särv unit, which can only be distinguished from the GM by their trace element contents (Figs. 4 and 5). The latter holds true for some of the overlying, Köli greenstones, too.

The subalkaline/tholeiitic character of the GM is also evident from minor and trace element diagrams (Fig. 4). In the TiO_2–Zr/P_2O_5 diagram (Fig. 4A) the GM occupy the tholeiitic field, in contrast to Lower Köli greenstones (Stephens et al. 1985). In the Zr–Ti–Y diagram (Fig. 4B) the GM, plotting mainly in field B, are distinct both from the Ottfjället dolerites and the Lower Köli basalts, which occupy major parts of fields C and D in addition to field B (Stephens et al. 1985). The Köli Gjersvik greenstones (Fig. 1) again appear as island arc tholeiites (Lutro 1979). Remaining Köli greenstones of the Middle Köli Nappes (Remdalen Group and Stekenjokk Formation; Stephens et al. 1985) can be distinguished from the GM by their (partly) island arc tholeiite and within-plate basalt character in the Ti–Zr–Y and Ti–Cr diagrams (Fig. 4B, C). The Ti–Cr diagram (Fig. 4C) implies a MORB character for the GM, indistinguishable from that of Lower Köli or Ottfjället greenstones (Stephens et al. 1985). A diagram employing a normalization against MORB, as applied, for example, by Furnes et al. (1980) enables a distinction between the GM and Köli metabasites at Joma (Fig. 1) to be made by their contents of Cr, Zr, Ti, Nb and Ta. The Ta contents in the GM are distinctly higher than in the Joma (Köli) metabasites, whereas Cr, Zr, Ti and, in particular, Nb contents are lower in the GM (Fig. 4D).

For a further distinction of Seve metabasites from other greenstones the Zr/Y–Zr diagram was found useful (Greiling 1985). Seve and Särv/Ottfjället metabasites have relatively little overlap, except for the (subordinate) alkaline Ottfjället dolerites, which can be neglected here, since the GM are exclusively of subalkaline character.

Some of the diagrams imply a tectonic setting of the GM between within-plate and ocean ridge or as MORB (Fig. 4B, C). These contradictory results may be explained by a tectonic scenario of continental rifting and initiation of mid-ocean ridge magmatism, as is envisaged for both the Ottfjället dolerites (Solyom et al. 1979) and the

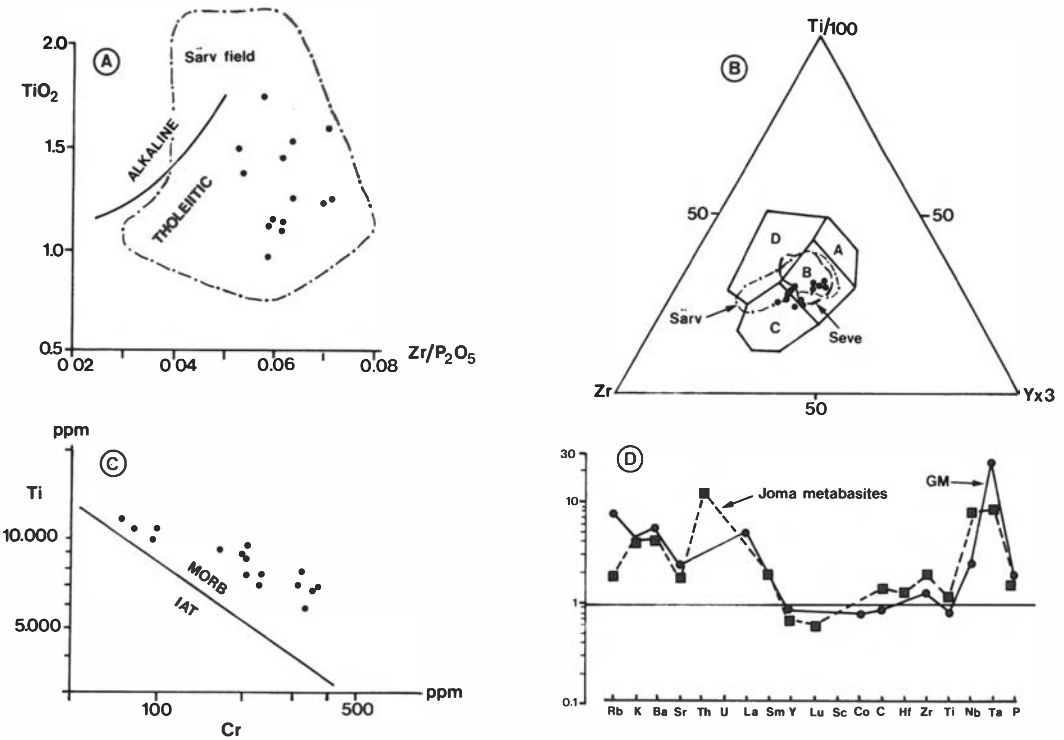

Fig. 4. Diagrams showing minor and trace element composition of the Gollomvatnet metabasites (dots). For comparison, the composition of other Seve metabasites is shown on diagram B as a field delimited by a broken line, as defined by Stephens et al. (1985). The Särv fields in diagrams A and B come from Solyom et al. (1979). In diagram D the MORB normalized composition of the Gollomvatnet metabasites is shown (dots connected by thick line), as opposed to that of adjacent Köli greenstones (squares connected by broken line), taken from Furnes et al. (1980). Because of possible high mobility, the elements Rb, K, Ba, Sr are not considered here. A: TiO_2–Zr/P_2O_5, dividing line taken from Winchester & Floyd (1976). B: Zr–Ti–Y, fields taken from Pearce & Cann (1973), a: island arc tholeiite, b: a + c + d, c: calc–alkali basalt, d: within plate basalt. C: Ti–Cr, dividing line taken from Pearce (1975). D: MORB normalized composition, taken from Furnes et al. (1980). Ta was analysed in samples 9 and 16 with an average of 2.5 ppm. Oxides in wt%, volatile free.

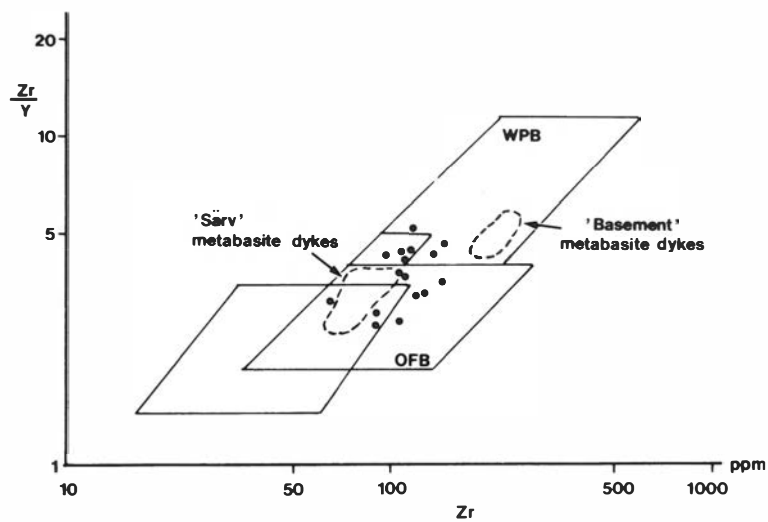

Fig. 5. Zr/Y–Zr diagram of Pearce & Norry (1979) showing the composition of the Gollomvatnet metabasites as dots. Fields of Särv unit metabasite dykes (alkaline dykes excluded) and of 'basement' metabasite dykes (including eight from the Børgefjell window) from Greiling (1985).

Seve metabasites (e.g. Andreasson 1987). This view is consistent with the trend of the GM in Fig. 3B, similar to the Skaergaard basites, for which also such a transitional tectonic setting is assumed (e.g. Brooks & Nielsen 1982).

Structure and metamorphism

Table 2 summarizes the structural history and critical metamorphic minerals of the Seve rocks. Due to intense deformation and metamorphism, unequivocal primary features are not preserved. The earliest recognizable fabric is seen only as internal S_i in garnet porphyroblasts, defined mainly by muscovite, biotite and quartz. Spiral shape of S_i documents an early, rotational deformation (D1) and syndeformational garnet growth. The S_i is not contiguous with the external, penetrative schistosity, S_e. S_e is, therefore, ascribed to a separate (post-D1) event of deformation (D2). Syn-D2 metamorphic conditions induced the critical mineral assemblage garnet + biotite + muscovite + hornblende + plagioclase. Garnet growth continued until after D2, as is obvious from garnet porphyroblasts across the D2-related penetrative schistosity (S2). S2 represents the regional schistosity in the Seve rocks. At the margins of the Seve units and towards an internal shear zone (Fig. 2) this schistosity is cut at a low angle by the planar fabric (S3) of the bounding mylonites that are obviously related to the major tectonic transport of the Seve units (D3).

The peak of metamorphism at the transition amphibolite/greenschist grade during D1 and D2 predated the mylonitic foliation and thus also the nappe transport (D3). Muscovite, biotite, plagioclase and minor chlorite indicating a lower greenschist grade formed during D3. Early linear features and isoclinal folds (D1–D3) are rare. Their original direction could be restored as approximately NW–SE (110–160°).

Table 2. Summary of structural and metamorphic 'phases'. D3 corresponds to the major (Seve) nappe transport. The column 'locality' gives UTM coordinates (grid 33W, VN, map sheet 1924 IV Röyrvik) for outcrops, where typical features of the respective deformation phases are exposed (most easily accessible by the private track to Krokvatnet). D5 and D7 are best developed in mica schists and phyllites. Consequently, the D5 and D7 localities refer to Köli phyllites west of the Seve duplex.

Phase	Folds, linear fabric	Cleavage, planar fabric	Metamorphic mineral assemplages	Locality
D 1		spiral S_i in garnet	garnet, biotite, muscovite, hornblende, plagioclase (D 1–D 2)	N 06740 E 36560
D 2	rare isoclinal folds, intersection and mineral lineations NW – SE	penetrative schistosity		N 07400 E 35800
D 3	lineations NW – SE	mylonitic foliation	biotite, muscovite plagioclase, chlorite	N 07060 E 34700
D 4	minor isoclinal folds regional folds NE – SW	schistosity, locally penetrative	biotite, muscovite, chlorite	N 07300 E 35600
D 5	open to tight folds, cm – km scale, NE – SW	crenulation cleavage, subhorizontal	local chloritization (D 5–D 7)	N 04500 E 33640
D 6	open, cylindrical folds cm – km scale, E – W, ENE – WSW	crenulation/fracture cleavage, generally steep attitude		N 06940 E 35480
D 7	chevron folds, cm – dm scale, N – S	fracture cleavage, steep attitude		N 04120 E 33980

A subsequent phase (D4) produced strongly vergent and recumbent tight folds with an axial surface schistosity generally parallel to S2. Their axial directions are now variable, an original NE–SW direction (60°) and an easterly vergence of the folds can be restored in places. Corresponding large structures have not been observed around Gollomvatnet, but from the regional context it is evident that these structures are related to the regional NE–SW trending folds (Zachrisson 1969; Roberts 1979), the Seve unit at Gollomvatnet being situated at the hinge of the regional antiform cored by the Børgefjell window.

Syn-deformational growth of muscovite, biotite and chlorite indicate prevailing greenschist grade conditions. Mineral growth ceased prior to the subsequent deformational phase, except for some chloritization.

The D4 elements are refolded by generally NE–SW trending asymmetric open to tight folds (D5). Rare, strongly vergent small-folds with subhorizontal axial surfaces appear to be overturned down-dip with respect to the earlier folds. The D5 folds, together with the subsequent major folds in E–W or ENE–WSW directions (D6) form the present map interference pattern of a type 1 (→ 2) (Ramsay 1967) or triangular type (Thiessen & Means 1980; Fig. 2). The D6 phase is probably succeeded by open, sometimes chevron-type N–S trending late minor folds (D7) with a steep axial surface. Since only few minor folds have been observed and the axial surface spaced cleavage is not widely distributed, no unequivocal cross-cutting relationships with D6 are present.

In particular the deformational sequence after the nappe transport (D3) is similar to that in the adjacent Seve–Köli areas towards the east (Zachrisson 1969), southeast (Sjöstrand 1978) and south (Roberts 1979) with NE–SW trending regional folds (D4) and subsequent, gravitationally induced (?) deformation (D5). An apparent local particularity is represented by E–W trending folds (D6), which may, however, link up with areas farther east, for example with the roughly E–W trending antiform of the Hetenjaure window (Fig. 1, Degen et al. 1989) and E–W trending folds at and beyond the eastern margin of the Seve nappe in Sweden (Greiling 1985).

Thrust geometry

Fig. 2 shows the distribution of Seve rocks with a general westerly dip, overlying lower units of the Børgefjell window towards E and SE and underlying higher units of the Grong District towards W and NW. Besides the main Seve area at the Gollomvatnet lakes, Seve rocks also occupy a minor area farther southwest, at the northwest slope of the mountain Dearka, beyond a synform cored by overlying Köli rocks (Fig. 2). Branch points are exposed at both limbs of the synform and allow us to construct a branch line at the leading, foreland directed edge of the Seve rocks. This leading branch line trends about ENE–WSW, approximately normal to the transport direction of the Seve Nappes, which is known from the regional context (e.g. Hossack 1983; Roberts & Gee 1985). Such a transport direction also accords with the trend of the observed pre- and syn-thrusting (D1–D3) lineations with a mean direction of 140°. These lineations are generally assumed to parallel the tectonic transport direction (e.g. Williams & Zwart 1977; Shackleton & Ries 1984). Approximately parallel to the leading branchline, a (D3–) shear zone extends from the lake Krokvatnet to Lill Gollomvatnet (Fig. 2). This shear zone with a general dip of about 30° towards ESE divides the Seve rocks into a structurally lower, southern horse and a structurally higher, northern one. Accordingly, the section on Fig. 2 reveals the Seve rocks to be composed of two horses which form a foreland-dipping duplex. Map and section (Fig. 2) also show a minor window at Krokvatnet, where crystalline rocks and metapsammites of the Middle Allochthon are exposed beneath the Seve duplex.

Discussion

Both the lithology of the tectonic unit at Store Gollomvatnet with garnet-bearing mica schists and gneisses, quartzites, marbles and metabasites, and the structural and metamorphic history imply a correlation with adjacent Seve units towards the east (Fig. 1, Sjöstrand 1978). The Gollomvatnet metabasite geochemistry also favours a relationship with Seve metabasites elsewhere in the Scandinavian Caledonides (Figs. 3, 4, 5). The limited size of the Seve unit and its isolated position (Fig. 2) make it impossible to relate it to either of the major eastern or western schist and amphibolite belts of the Seve nappes (e.g. Trouw 1973; Williams & Zwart 1977).

Southeast and east of Store Gollomvatnet the

Seve rocks overlie strongly deformed, crystalline 'basement' rocks (Fig. 2), which are comparable in composition, intensity of deformation and metamorphism, and structural position to those of the Middle Allochthon at the NE margin of the Børgefjell window (Greiling 1989) and at the eastern Caledonian margin in Sweden (Greiling 1985). These Middle Allochthon rocks separate the Seve unit from the Dearka metapsammites (Fig. 2). Therefore, the Dearka metapsammites are assumed here to constitute not a part of the Seve nappe (in contrast to Kollung 1979) but rather a (lower) unit of the Middle Allochthon.

The gneisses and metasedimentary rocks at the Seve unit around Gollomvatnet contain no unequivocal indications of their original geologic setting. However, geochemical data from the Gollomvatnet metabasites suggest a continental rifting/initial mid-ocean ridge tectonic environment for the Seve unit around Gollomvatnet. This unit presumably formed a part of the Baltica continental margin, which was subsequently deformed and metamorphosed during (Caledonian) Iapetus subduction and complex collisional tectonics between Baltica and Laurentia (see, e.g. Dallmeyer & Gee 1986; Stephens 1988 for details). Finally, the Seve unit was transported towards the SE onto the Baltic Shield during late Caldeonian nappe transport (e.g. Roberts & Gee 1985). During this nappe transport, the Seve unit was deformed into a foreland-dipping duplex consisting of two horses.

The interpretation of the Seve unit as a duplex relies on thrust tectonic models as envisaged by, for example, Hossack (1983) or Gayer et al. (1987). On the other hand, greenschist grade metamorphic conditions prevailed during thrusting (Table 2) and could have favoured a more ductile mode of deformation (e.g. Williams & Zwart 1977). Therefore, it cannot be totally excluded that other mechanisms, such as large-scale gravitational collapse or boudinage (e.g. Ramberg 1966, 1981; Gee 1978), contributed to the nappe movement. However, the only preserved structural evidence for gravitational deformation (subvertical compressional features, D5) originated clearly after nappe transport (Table 2, see also Zachrisson 1969; Roberts 1979) and the first alternative is therefore favoured.

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