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Fe-Ti mines and prospects in the Egersund area of the South Rogaland Igneous Province. Field report, 1995.

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REPORT

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Summary:

The current report summarize the summer of 1995 field work in the Sokndal area of the South Rogaland igneous province. It also provides some preliminary results on petrography. The field work was focused on revisiting and sampling of known Fe-Ti mines and prospects and Fe-Ti carrying plutons in the province. Much attention has been concentrated on deposits related to the Bjerkreim-Sokndal intrusion (the Mydland and Sokndal lobes) due to the proximity of the Tellnes plant and the possibility of deriving high quality (low Cr) ilmenite from oxide rich zones in the layered complex. The Storgangen dyke and, to lesser extent, the Blåfjell-Måkevatn pegmatite have been samples and investigated in detail. Storgangen was emplaced as a layered sill and subsequently deformed by inter-plutonic movements. The Bøstølen layered series, vaious noritic, oxidic and ilmeno-anorthositic dykes and lenses found within the Åna-Sira anorthosite have been sampled and described. Occurrences belonging to the Lakssvelefjell-Koldal sheet in the western part of the Egersund province is briefly commented on.

Keywords: Berggrunnsgeologi	Malmgeologi	Ilmenitt
Dypbergart	Anortositt	Fagrapport

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1 INTRODUCTION

The current report summarize the observations done during the summer of 1995 field work in the Sokndal area of the South Rogaland igneous province. It also provides some preliminary results on petrography. The field work was focused on revisiting and sampling of known Fe-Ti mines and prospects and Fe-Ti carrying plutons in the province. The survey took place during four weeks of June 1995. A subsequent visit was made in August, concentrated mainly on collecting oriented samples for paleomagnetic investigations (Nilsson and Schiellerup, in prep.). This work was initiated as part of the joint Norwegian geological survey-A/S Titania ilmenite program for south Rogaland, and as part of a doctoral thesis at the Norwegian university of science and technology.

Henrik Schiellerup.

Trondheim, January 1996

2 FE-TI OCCURRENCES IN THE EGERSUND PROVINCE.

2.1 THE BJERKREIM-SOKNDAL INTRUSION

2.1.1 THE MYDLAND LOBE

The «Mydland lobe» is generally considered part of the Bjerkreim-Sokndal intrusion. It has been described by Hermans (1975), Rietmaijer (1979) and Krause and Pedall (1985) as layered norites and leuconorites embodied by mangerites and quartz mangerites. Based on the cumulus assemblage and mineral chemistry Nielsen (1992) concluded that the Mydland layered norites correspond to the uppermost mega cyclic unit (IV) of the Bjerkreim-Sokndal intrusion.

The Mydland lobe (ML) forms a circular topographical low with the central part of the layered series being poorly exposed due to weathering and extensive farming. A minor survey was undertaken to determine the extent of igneous layering and Fe-Ti oxide rich zones in the layered series. The mapping was not intended to cover all ML but a detailed profile was sampled transecting the layered series, and some of the internal and external relations were established. The observations were somewhat at odd with previously published maps concerning classification of side rock and measure of anorthosite within the ML. A preliminary map, based on the '95 field work, is presented in Fig. 1.

To the east the Mydland lobe is in contact with laminated quartz mangerites displaying occasional layering. Lamination and modal layering are vertical, striking 9° W, which is parallel to the contact of the Mydland lobe, but discordant to modal layering within the lobe. The rocks are not especially leucocratic. The main contact is not very distinct as a number of jotunitic veins and dykes have intruded along the margin of the ML. The intensity of dyke injection within the ML increases toward the contact, but do not proceed into the quartz mangerite. A lot of interfingering seem to occur between ML leuconorites and quartz mangerites and the contacts are clearly intrusive. At contacts the quartz mangerite is deformed in several meter wide zones with mafic bands and minerals heavily sheared and elongated. The southwestern contact is made up by a thin sheet of fine grained jotunite, previously described as a chilled border facies (Rietmaijer, 1979). However the jotunite/norite contacts are intrusive and the fine grained rocks have to represent a later dyking event. The dyke has the same appearance as the rocks of the Eia-Rekefjord system when it comes to weathering color, grain size and hand lens scale mineral assemblage. The dyke separates ML norites and leuconorites from the Åna-Sira anorthosites in the same way that the Eia-Rekefjord intrusion separates Åna-Sira from the Sokndal lobe east of Hauge (see page 4). It is therefore assumed that the dyke is part of the Eia-Rekefjord intrusion. Further north on the western perimeter quartz mangerites are in contact with norites and leuconorites of the Mydland lobe.

No 100% evidence of way up in the layered series have been observed. Deformation related to xenolith impact, sharp intrusive contacts at the southeastern and southwestern perimeter combined with a seemingly continuous evolution into quartz mangerites to the north, implies that up sequence is toward north. Strike of modal layering in the ML cumulates is slightly curved from 39° E at the eastern contact to 109° E at the western contact. In the central part of the lobe strike is approximately east-west. In general modal layering is dipping in a northerly direction at 50-60° .

A stratigraphic section through the Mydland lobe cumulates is presented in Fig. 2. The lowermost cumulates in the layered series are laminated and mostly unlayered leuconorites constituting a homogenous cumulate pile up to 450 m thick. At the top of the basal leuconorites a 50 m thick xenolith rich zone appears with numerous large (up to several tens of meters in diameter) anorthositic blocks. The xenolith rich band can be followed along strike for about 1.5 km and thus reflects a chamber wide catastrophic event (e.g. roof collapse, stoping during replenishment) in the «Mydland magma chamber». Modal layering is developed up to a few tens of meters below the xenolith rich zone and is heavily disturbed by the impact of the xenoliths (Fig. 3). Mafic layers varies in thickness from a few mm to half a meter. A characteristic type of modal layering developed in this stratigraphic level is the rhythmic cm-scale layering shown in Fig. 4. Above the xenolith rich level small anorthositic blocks and fragments may occur but in minor amount. Unlayered norites make up the bulk of the cumulate pile above the xenolith rich zone but changes gradually into layered, oxide rich mafic norites and melanorites. From 250 to 550 m above the xenolith rich zone the cumulates are dominantly layered melanorites. Up sequence the melanorites turn into laminated norites and the intensity of modal layering decrease. The laminated norites constitute a rather narrow zone upon which the cumulates become more massif and develop a distinct inequigranular texture with cm-sized feldspar phenocrysts, set in a finer grained matrix. The feldspar phenocrysts are interpreted as mesoperthite crystals which are found in mangeritic rocks of similar appearance in other parts of the Bjerkreim-Sokndal intrusion.

In terms of ilmenite prospects the interesting part of the Mydland lobe is the central 350 m thick oxide rich noritic and melanoritic sequence. Mafic layered norites from the base of the zone can be followed along strike for 1.5 km but the areal extent has not been established in any further detail. Minor occurrences of more felsic norites and leuconorites may be found within this zone but in general the cumulates here contain between 25 and 50% oxides, dominantly ilmenite. The cumulus assemblage contain plagioclase, Ca-rich and Ca-poor pyroxene, ilmenite, magnetite and apatite with accessory (inter cumulus) rutile, pyrite and pyrrhotite. Exsolved phases are hematite (constituting up to 10% of hemo-ilmenite grains), spinel (hercynite, pleonast?) in magnetite and minor pentlandite in pyrrhotite. Noticeable is the lack of green chromian spinel, found several places in the Bjerkreim-Sokndal cumulates, indicating a low content of total Cr and therefore a low chromium content in cumulus ilmenite.

2.1.2 THE SOKNDAL LOBE

The Sokndal lobe is the southern major extension of the Bjerkreim-Sokndal intrusion. It was initially mapped by Michot (1960) and later maps have been published by Hermans (1975), Rietmaijer (1979), Krause et al. (1985) and Nielsen (1992). Nielsen (1992) generated a map of cumulate stratigraphy (to some extent) and intensity of modal layering. He constructed a cumulate stratigraphy along profiles through the layered series but found it difficult to map the individual cumulate zones in detail. It was concluded that the Sokndal lobe cumulates represent only the latest magma influx into the Bjerkreim-Sokndal magma chamber (MCU IV). The intensity of layering correlates well with maficity of the noritic cumulates and the map of Nielsen (1992) (Fig. 5) has been used as basis for the current investigations of the more oxide rich parts of the intrusion. Profiles across the most mafic parts of the intrusion have been collected and old mining sites revisited and sampled. Old sites of mining and noted prospects have been retrieved from Carlson (1945) and Krause et al. (1980).

The external contacts of the Sokndal lobe is for the most part between the Sokndal cumulates and the Eia Rekefjord intrusion (as probably in Mydland). Along the eastern flank the Sokndal lobe borders on the Åna-Sira anorthosite and for 1.5 km it is only separated from the Storgangen intrusion by a few meter wide anorthosite sheet. The question whether these two intrusions are more than just spatially related have so far not been completely settled. Both are ilmenite rich noritic cumulates crystallized from melts emplaced in or in between the anorthosite massifs (see page 7). Upwards in the stratigraphy the layered series evolves into mangerites and quartz mangerites that are highly contaminated residual melts (roof melt) from the crystallization of the layered series (Nielsen et al., in prep.).

The general shape of the lobe is that of a trough dipping and opening toward north but the structural data (strike and dip measurements on modal layering) are somewhat confused in detail (Nielsen, 1992, and current field work). Up sequence is toward the central quarzmangerite, and the cumulate sequence is similar to the stratigraphy in MCU IV of the Bjerkreim lobe (e.g. Schiellerup, 1991).

The most primitive rocks sampled in the Sokndal lobe during the current field work was an olivine and Ca-poor pyroxene bearing cumulate (disequilibrium!): pohimC (plagioclase, olivine, Ca-poor pyroxene, ilmenite, magnetite cumulate), cumulus magnetite being very minor. It contains intercumulus rutile, biotite and exsolved green chromian spinel in significant amounts 1-2 %. This olivine bearing cumulate was found in the southeasternmost part of the intrusion, east of the «Årstad gruve». Even though not exactly similar, this rock type presumably corresponds to the zone IVb cumulate (pomC) of the Bjerkreim lobe. However, zone IVb of the Bjerkreim lobe displays no coprecipitation of Ca-poor pyroxene and olivine (seen in MCU III) and is both more leucocratic and magnetite rich than its Sokndal lobe counterpart.

«Årstad gruve» is located in an at least 2 m thick lense or layer of almost pure oxide stratigraphically above the olivine bearing zone. Ilmenite and magnetite each make up about half of the rock along with accessory green spinel (3-4 %) plagioclase and Ca-poor pyroxene. Massive oxide layers are found at the base of both MCU III and IV in the Bjerkreim lobe but invariably below the olivine bearing zones. Due to an extremely poor exposure, the extent of the oxide lens cannot be established. However, no other massive oxide exposures have been found in the vicinity, and it seems that mining took place through a vertical shaft (synk) rather than along strike. The oxide lens or layer is therefore not likely to be a continuous feature.

All cumulates in the Sokndal lobe seem to contain cumulus magnetite (zone c, phiC, has not been identified) though the oxide assemblage in general is ilmenite dominated. In the southern part of the lobe (i.e. south of Soknoelven) cumulus Ca-rich pyroxene and apatite is absent. North of Soknoelven Ca-rich pyroxene and apatite are found higher in the stratigraphy (index minerals for zone e). Intensity of layering and maficity of the cumulates increase slightly through the layered series but is very unevenly distributed. Mafic and oxide rich layers and areas are found sporadically even in the relatively leucocratic lower part of the intrusion. Mafic norites in the southern (and lower part) of the cumulate stratigraphy are found in and southwest of Hauge center. These rocks have been densely sampled. In Hauge center a mine was abandoned prior to second world war, that had been initiated in a small oxide rich «dyke» (= oxide rich layer) (Carlson, 1945). Here, as in Årstad, Mining took place in a vertical shaft (80 feet deep) rather than along strike.

Northwest of Hauge, by Drageland, mafic gabbronorites can be followed for more than a km along strike. These have been sampled along with a profile at Rossland through the layered series, although this profile does not transect any obvious prospects.

Mafic cumulates were sampled at Årstadøyen, southeast of Hauge, where (small scale) mining took place in the first half of the century (Carlson, 1945). The mine could not be located, and mafic, oxide rich rocks were only evolved sporadically in the area.

In the upper part of the Sokndal lobe stratigraphy (zone e) there are a number of more or less continuous mafic and oxide rich sequences. The most prominent is the Bakka area (Fig. 6), where a road cut reveals a 50 m thick oxide rich sequence with pronounced modal layering. This area was noted as a prospect by Carlson (1945) and mining activity took place at some point here as well (the site of the activity has not been located). The sequence only contain very minor cumulus Ca-rich pyroxene at the base of the section but the amount of both Ca-rich pyroxene and magnetite increase up sequence. The whole sequence is rich in apatite, the cumulus assemblage being: plagioclase, Ca-poor and Ca-rich pyroxene, ilmenite, magnetite and apatite with accessory (inter cumulus or deuteric) biotite, pyrite and pyrrhotite-pentlandite. The oxide content seems to be up to 30 % or higher, somewhat less than the oxide content of the most oxide rich samples from the Mydland lobe. The zone is petrographically identical to the oxide rich central zone of the Mydland lobe and both are characterized by the complete lack of green chromian spinel. The extent of the zone along strike has not been established in detail. Nielsen (1992) states that it can be followed for two km in a southerly direction, whereas Kolderup (in Carlson, 1945) describes it as a dyke 10 m wide and 4.6 km long. For the 4.6 km to be true, Kolderup must have included another oxide rich sequence at Ørsland which is confined to a higher stratigraphic level (see below).

The ultramafic and oxide rich layers in the transition zone (TZ) described by Duchesne et al. (1987) was not visited during the '95 field season, but is an obvious prospect to be evaluated.

2.2 THE STORGANGEN INTRUSION

The Storgangen intrusion is one of the classic Fe-Ti mineralizations of the south Rogaland igneous province. It was mined extensively from 1916 to 1964 when production changed to the Tellnes mine (opened in 1960). The mineralogy of the intrusion has been described by Krause and Pape (1975) and a couple of stratigraphic profiles mapped and reported in detail by Krause and Pape, (1977). Systematic variations in plagioclase and Ca-poor pyroxene chemistry was noted by Krause et al. (1985).

The Storgangen intrusion is a relatively thin layered dyke emplaced and confined in the Åna-Sira anorthosite. The intrusion has a semi-circular shape and crops out over a length of approximately 4 km. The thickness varies from 2-3 m at the eastern and western termination up to a maximum of about 50-60 m in the central part. Mining produced an up to 70 m deep crevasse in which vertical sections through the dyke can be observed (Fig. 6).

The intrusion displays extremely well developed modal layering striking sub-parallel with the intrusion contacts. The layering is dipping in a northerly direction at an angle of 40 to 60° , and moving towards the western termination, strike and dip approaches that of the neighboring Bjerkreim-Sokndal intrusion. The Bjerkreim-Sokndal norites and related rock types crystallized from a much larger magma chamber and modal layering here initially developed sub-horizontally. The Storgangen intrusion are therefore likely to have originated as a sill-like body. An atectonic, post-crystallization gravimetric collapse of the Bjerkreim-Sokndal cumulates led to plagioclase recrystallization, and mobilization of oxides into pressure fringe like textures (Paludan et al. 1994). Deformation textures in Storgangen (Krause and Pape, 1975) are similar and probably formed through flexure of the «Storgangen sill» caused by the relative movement of Åna-Sira and Bjerkreim-Sokndal.

The contacts with the host anorthosite is always sharp and the anorthosite is often foliated in an up to some 10's of cm wide band along the contact. However, the ilmeno-norite of Storgangen does not display similar deformation and modal layering is developed, even on a small scale, sub-concordantly with the contact in the marginal zone. The foliation in the contact anorthosite therefore seems to result from the emplacement of the Storgangen magma and is not related to the subsequent interplutonic movements.

The Storgangen rocks are all cumulates displaying primary igneous textures on hand specimen scale. The mineralogy comprise plagioclase, Ca-poor and Ca-rich pyroxene, apatite, Fe-Ti oxides, green chromian spinel and minor sulfides (pyrrhotite-pentlandite, pyrite, chalcopyrite). Baddeleyite has been reported by Krause and Pape (1975). In a single petrographical section the cumulates appear to be phase layered with primary Ca-rich pyroxene only present in the upper part of the section. This is in accordance with up section being equivalent to stratigraphic up, and the hanging wall thus represents the roof of the Storgangen magma chamber. Apatite is a minor phase but does not seem to be stratigraphically confined. The rock types ranges from anorthosite, leuconorite and norite to melanorite with oxide contents varying from 0 to almost 100 %. The complete section is generally rich in oxides but the most extensive oxide rich zones occur in the lower 20-30 m of the stratigraphy.

Inclusions are generally few. Large anorthosite (in situ) inclusions occur as raft or lens like bodies interrupting the cumulate sequence especially in the upper part of the stratigraphy. These mega inclusions may be up to 10 m thick. Some of the raft like inclusions can be misinterpreted as modal layers but often contain tiny wedges of oxide rich norite injected into fractures parallel with modal layering. Isolated plagioclase mega-crystals may be found similar to the large euhedral plagioclases found in the surrounding anorthosite massif (Fig. 7). However, the large crystals found in Storgangen are euhedral themselves and are not part of any anorthositic inclusion aggregates. They are therefore not derived from the anorthosite but reflect a cogenetic relationship between the Åna-Sira anorthosite and the Storgangen ilmeno-noritic intrusion. Similar inclusions have not been observed in the Bjerkreim-Sokndal intrusion and any closer genetic relationship between the two intrusions is highly unlikely.

A number of offshoots from the main Storgangen dyke exist, always extending from the roof of the magma chamber. The most prominent offshoot, called «Sidegangen», can be followed more or less continuously for about 2 km in a northerly and northeasterly direction. A 2 m wide oxide rich dyke which appears to be an extension of the Sidegangen offshoot was mined at Frøytlef and Blåfjellskaret gruber. The offshoot dyke is very irregular in appearance with highly variable thickness (from some 30 cm to 3 m). It is generally well laminated, show primary igneous textures and is modally layered. The anorthosite in contact with the dyke is always deformed and foliated in an up to a meter wide zone along the contact. The rock types are not as diversified as in the main Storgangen intrusion and may generally be described as mafic, oxide rich norites with occasional layers and lenses of almost pure oxide. The presence of modal layering and side wall parallel lamination in a dyke, inferred to be emplaced vertically, give rise to specific problems in the interpretation of the emplacement and crystallization of the Storgangen magma.

2.3 THE BLÅFJELL-MÅKEVATN NORITE PEGMATITE

The Blåfjell-Måkevatn intrusion is a large irregular pegmatitic norite dyke emplaced in the Åna-Sira anorthosite. It was mined at several places (Blåfjell, Bryns skjerp, Laksedalen, Dalen gang) during the last century, the main activity taking place at Blåfjell gruber. Brief descriptions of mineralogy and a few geochemical data have been published by Krause and Pedall (1980) and Krause et al. (1985). Krause and Pedall reports the presence of differentiated rocks in dyke terminations and apophyses. Detailed maps of the prospects can be found in Carlson (1945).

The pegmatite is about 5 km long and oriented north-south and in general consists of oriented dm-sized Ca-poor pyroxenes set in a matrix of equally sized plagioclase crystals and interstitial oxide grains. The dyke is not normally mineralized but often branches into smaller segments that become modally layered and develop massive oxide rich layers and lenses. In the oxide rich parts large isolated plagioclase crystals may be seen floating in a matrix consisting of pure oxide. This especially applies to the dyke termination at Blåfjell. The width of the pegmatite varies between a few meters and 300 m. At branched and mineralized sections the width is no more than few tens of meters and the largest oxide bodies may be up to 10-20 meters thick.

The contacts between the pegmatite and the surrounding anorthosite are always sharp and the anorthosite may be foliated or even brecciated in a 15 cm wide zone along the contact (Fig. 8). At the southern termination of the Blåfjell-Måkevatn intrusion at Tellnesvatnet the dyke is transformed into disrupted and isolated oxide rich lenses. The lenses are elongated north-south, typically a meter wide and some tens of meters long, and are found rather sporadically along the strike of the pegmatite south of Tellnesvatnet.

Heavily mineralized sections are virtually free of Ca-poor pyroxene and the oxide assemblage consist of 80-90 % hemo-ilmenite. Magnetite with exsolved spinel and green chromian spinel make up the rest of the oxides. Plagioclase is the only abundant silicate and minor amount of sulfide (mainly pyrite and pyrrhotite) may be present as well.

2.4 THE BØSTØLEN INTRUSION

The Bøstølen intrusion is a small layered intrusion located to the west of the Blåfjell-Måkevatn pegmatite, the two intrusions lying roughly parallel, elongated north-south. This intrusion has not been investigated in detail during the '95 field season - a number of samples and a single profile north of Lonene have been collected. The presence of cryptic layering within the intrusion was reported by Krause and Pedall (1980).

In general the intrusion consists of leuconorite and norite with layers of oxide-pyroxenite. Layering is rarely intense but mafic layers tend to be isomodal and rather thick (up to almost a meter). They can be followed in the field for several hundred meters (Fig. 9). Modal layering strikes parallel with the intrusion contacts. The basal contact with the surrounding anorthosite is sharp with no deformation evident in either pluton.

2.5 THE FLORKLEV-ÅLGÅRD DYKE

A southeast-northwest striking dyke in Flordalen in the northernmost part of the Åna-Sira anorthosite was mined at two locations at the end of the last century (Florklev and Store Ålgård gruber). The dyke is poorly exposed apart from the sites of former activity. The width of the dyke is up to 15 m. The mineralogy is composed almost entirely of plagioclase and hemo-ilmenite with minor amounts of green spinel and biotite. The dyke may be classified as an ilmeno-anorthosite.

The dyke is characterized by an irregular modal layering with plagioclase and oxide rich layers and lenses. In oxide rich layers euhedral plagioclase crystals can be seen suspended in a matrix of pure hemo-ilmenite (Fig. 10). The restricted mineral assemblage makes the dyke rather unique among the Fe-Ti oxide occurrences in the Åna-Sira anorthosite.

2.6 RAUNSLID SKJERP

A 1,5-3 m wide modally layered noritic dyke can be found at several places intersecting road 44 south of the Tellnes deposit. The dyke is mafic and contains occasional oxide lenses and concentrations. The dyke was mined at a couple of locations some 100 m apart (Raunslid skjerp). The area is very poorly exposed and it was impossible to establish the exact relations between the 3 or 4 outcrops found. The investigation was limited to the collection of a few samples.

2.7 EASTERN ÅNA-SIRA

The southeastern part of the Åna-Sira anorthosite borders on a small irregular noritic intrusion with an associated north-south trending dyke system called Hogstad. The Hogstad cumulates are modally layered with layering dipping steeply towards east. The cumulates are rather mafic on the whole but during a brief survey it was concluded that these do not contain resource potential.

In the anorthosite immediately west of the intrusion, however, a number of known occurrences exist, of which at least two have been mined (Vardåsen, Skolla). The mineralizations are all small, the largest occurrence being found at Vardåsen. Vardåsen is an ilmeno-noritic lens approximately 100 m long, elongated north-south, and up to 10 m wide. The oxide content is very high - up to 90 % - in the main part of the lens. Hemo-ilmenite is the dominant oxide coexisting with minor amounts of magnetite and chromian spinel.

2.8 THE LAKSSVELEFJELL-KOLDAL SHEET

The Lakssvelefjell-Koldal sheet (Michot, 1960) is a few hundred meter wide zone found between the Egersund-Ogna anorthosite and the Bjerkreim-Sokndal intrusion to the east and between the former and the Håland anorthosite to the south. The sheet is made up by a strongly foliated noritic orthogneiss with up to meter wide bands of almost pure oxide. The oxide zones have been mined extensively since the 18th century and more than 30 sites of activity have been listed by Krause et al. (1985) along the Lakssvelefjell-Koldal sheet.

Only a couple of sites at the easternmost part of the zone at Kydlandsvatnet was visited during the '95 survey. The oxide layers may be considered to represent modal layering in a noritic intrusion remobilized or reworked during the emplacement of the neighboring plutons. Samples collected at Kydlandsvatnet consist of more than 80 % hemo-ilmenite with subsidiary amounts of plagioclase, Ca-poor pyroxene, biotite and chromian spinel. The samples does not contain magnetite. However, according to J.C. Duchesne (pers. comm., 1995) the oxide composition changes along the Lakssvelefjell-Koldal sheet and become increasingly magnetite rich towards west.

3 CONCLUSIONS AND FUTURE WORK

A number of Fe-Ti occurrences exist in the Egersund region of the South Rogaland Igneous Province. Most of these are hosted by noritic rocks in layered igneous complexes (Bjerkreim-Sokndal, Bøstølen, Hogstad and Storgangen intrusions as well as the reworked Lakssvelefjell-Koldal sheet) or in more homogenous Ti-rich intrusive dykes of noritic, ilmeno-anorthositic or mangeritic composition (The Tellnes, Raunslid and Florklev-Ålgård dykes). In the vicinity of major noritic intrusions minor, but rather pure, oxide bodies may be found hosted by the massif anorthosites (e.g. Vardåsen skjerp, west of Hogstad).

With the noticeable exception of the Tellnes dyke, the layered intrusives are by far the most interesting in terms of ilmenite potential. High quality (low Cr) ilmenite may be found in both the Sokndal and Mydland lobes of the Bjerkreim-Sokndal intrusion as well as in the previously mined Storgangen layered dyke.

The Mydland lobe was found to contain a 350 m thick stratigraphic section of layered ilmenite-rich melanorites and pyroxenites, with ilmenite contents in collected samples up to around 20%. Both the amount and quality of ilmenite are likely to vary significantly through the section and further work need to be done in assessing the extent of the oxide-rich cumulates in the field. The ilmenite "quality" will be determined by petrographical investigations and by electron micro probe analyses. The electron micro probe analyses will establish the cryptic variations through the layered series.

The Sokndal lobe provides a number of occurrences of oxide-rich mafic norites. 1: Southwest of Hauge center. 2: Between Soknoelven and Årstadtjørna in the southwestern part of the lobe. 3: Bakka (and Ørsland) in the northern part of the eastern flank. At the moment the Bakka locality seems to have the highest potential as an ilmenite source in the Sokndal lobe. Cryptic variation is distinct through the Bakka section and detailed micro probe work has to be undertaken. The Ørsland locality is set in more evolved cumulates and in addition to low Cr content ilmenites from here are likely to be lower in both Mg and Ti.

The Storgangen intrusion also consists of ilmeno-norite characterized by low-Cr ilmenite. It displays the highest volume of mineralized rocks outside Tellnes but may not be as easily mined as for instance the Bakka section. However, its importance as a candidate for high quality ilmenite should not be underestimated, and the chemical and textural variation within the intrusion further characterized.

Bøstølen is another Fe-Ti rich layered intrusion with a somewhat reduced mining potential. It has however not been studied in detail as a layered intrusion, and further mapping combined with a chemical study may change the picture. As the oldest of the noritic intrusions in the Åna-Sira anorthosite (including the Bjerkreim-Sokndal intrusion) a study may provide important clues to the genesis of the ilmenite carrying plutons in the area. For a successful genetic interpretation a comparative geochemical study must be undertaken involving at least three of the major ilmenite carrying plutons in the area; the Bjerkreim-Sokndal, Storgangen and Bøstølen intrusions. Plausible genetic models for these plutons can be generated on the basis of further mineral and whole rock geochemistry, as well as a number of isotope and REE analyses.

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FIGURES

Fig. 1. The Mydland lobe. Preliminary map showing rock types, structural data and intensity of modal layering.

Fig. 2. Stratigraphic section through the Mydland lobe layered series.

Fig. 3. The Mydland lobe. Slumped modal layering due to xenolith impact.

Fig. 4. The Mydland lobe. Rhythmic cm-scale modal layering in noritic cumulates from xenolith-rich zone.

Fig. 5. Geological map of the Sokndal lobe and neighboring plutons (Nielsen, 1992). The map shows the intensity of igneous layering which is roughly equivalent to the mafic content of the cumulates. Various cumulate types indicated.

Fig. 6. The Storgangen mine towards east - crevasse filled with tailings. The dark ilmeno-noritic dyke can be seen in the northern wall (left) with light colored hanging wall anorthosite on top.

Fig. 7. The Storgangen intrusion. Giant plagioclase megacryst (about 20 cm across). Notice depressed/draped modal layering around mono-crystalline and euhedral inclusion.

Fig. 8. Eastern contact between Blåfjell-Måkevatn pegmatite and anorthosite. Hammer lying across contact, that can be seen as a 15 cm wide zone of sheared and partly brecciated anorthosite. Notice the spotted appearance of the pegmatite due to dm-sized Ca-poor pyroxenes in plagioclase dominated matrix.

Fig. 9. Sletthei. Modal layering in the Bøstølen intrusion. Layering is defined by rather thick and continuous bands of mafic cumulates and can be recognized and followed at distance.

Fig. 10. The Florklev-Ålgård dyke. Ilmeno-anorthositic dyke displaying modal layering. Notice randomly oriented euhedral plagioclase crystals suspended in oxide matrix.

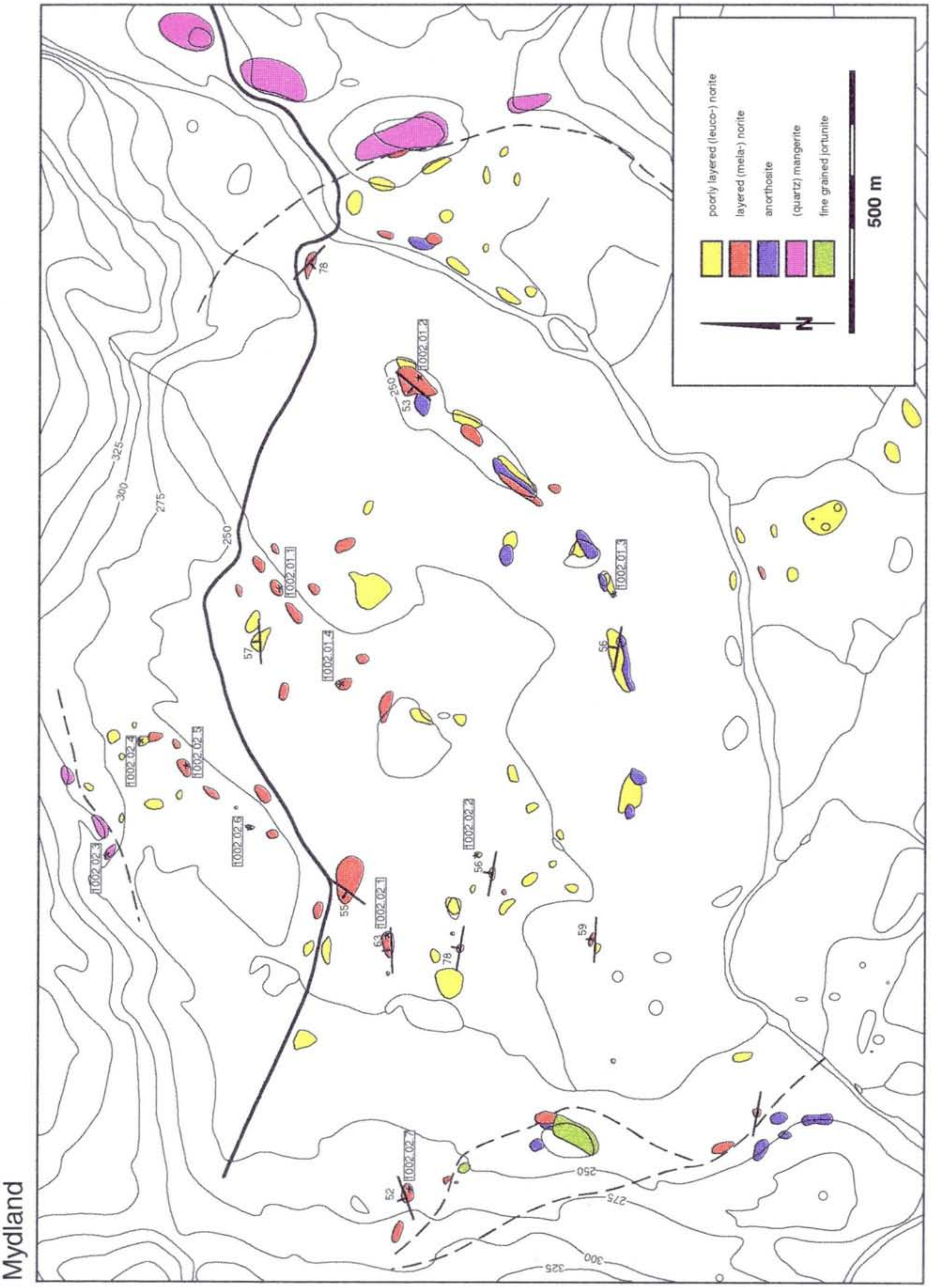

Mydland
poorly layered (leuco-) norite
layered (mela-) norite
anorthosite
(quartz) mangerite
fine grained jotunite
N
500 m
1002.01.1
1002.01.2
1002.01.3
1002.01.4
1002.02.1
1002.02.2
1002.02.3
1002.02.4
1002.02.5
1002.02.6
1002.02.7
250
275
300
325

Fig. 1

Mydland lobe: Stratigraphy. 1:10000

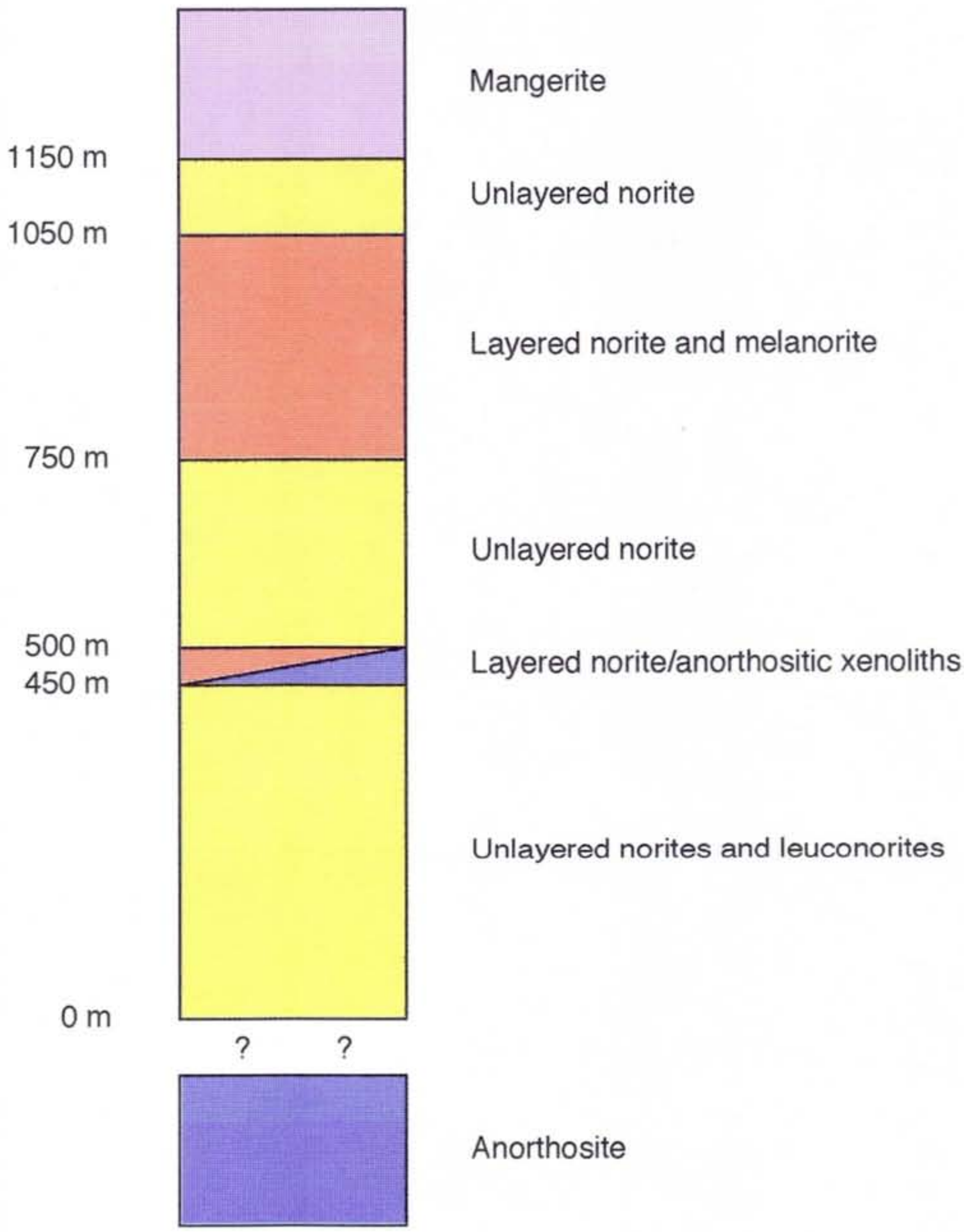
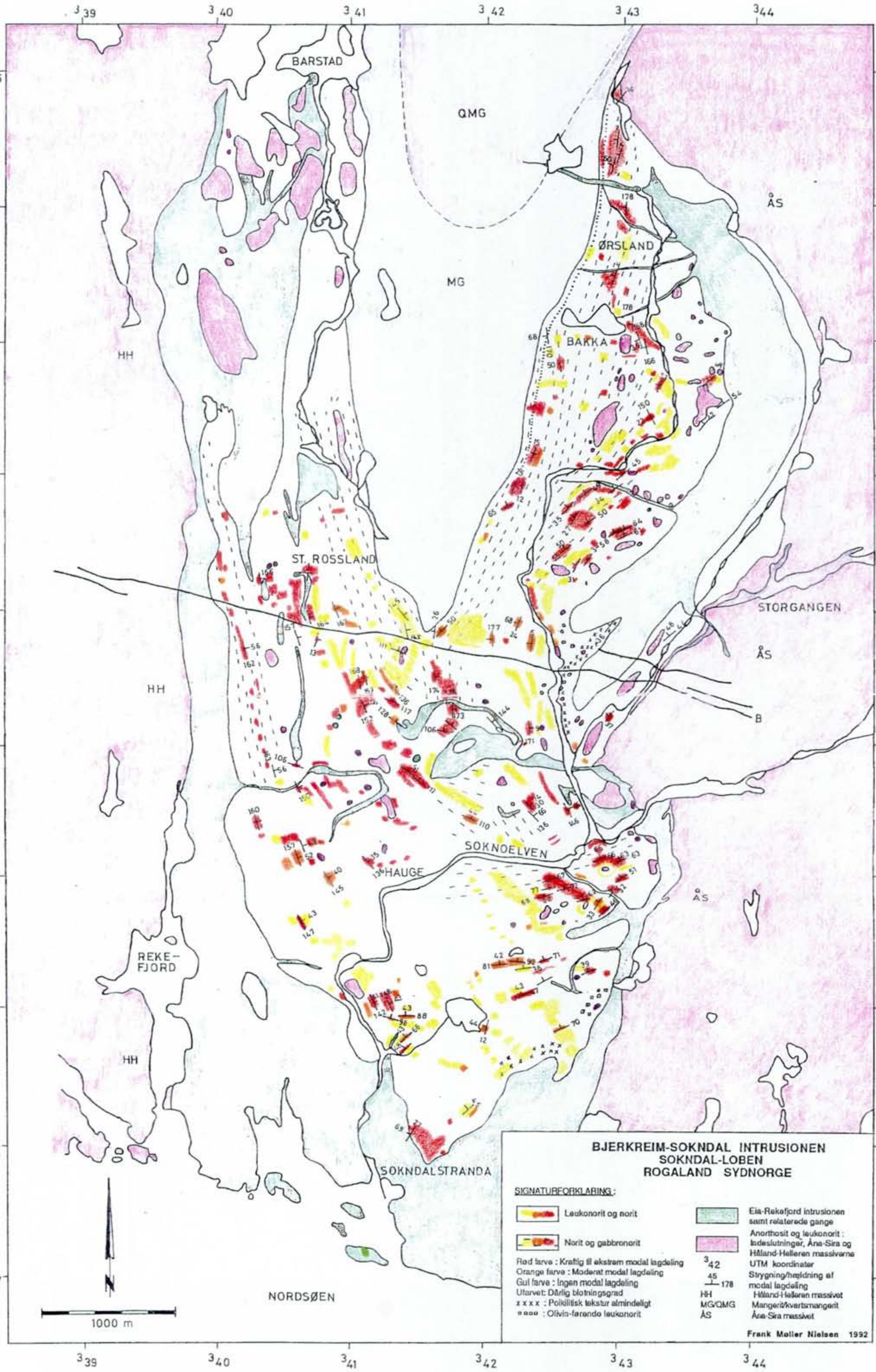


Fig. 2

Fig. 3, Fig. 4


BARSTAD
QMG
MG
ÅS
ØRSLAND
BAKKA
HH
ST. ROSSLAND
STORGANGEN
B
SOKNOELVEN
HAUGE
REKE-
FJORD
SOKNDALSTRANDA
NORDSØEN
1000 m
BJERKREIM-SOKNDAL INTRUSIONEN
SOKNDAL-LOBEN
ROGALAND SYDNORGE
SIGNATURFORKLARING :
Leukonorit og norit
Norit og gabbronorit
Rød farve : Kraftig til ekstrem modal lagdeling
Orange farve : Moderat modal lagdeling
Gul farve : Ingen modal lagdeling
Ufarvet: Dårlig blotningsgrad
x x x x : Poikilitisk tekstur almindeligt
▫▫▫▫ : Olivin-førende leukonorit
Eia-Rekefjord intrusionen samt relaterede gange
Anorthosit og leukonorit : Indeslutninger, Åna-Sira og Håland-Helleren massiverne
UTM koordinater
Strygning/hældning af modal lagdeling
HH Håland-Helleren massivet
MG/QMG Mangerit/kvartsmangerit
ÅS Åna-Sira massivet
Frank Møller Nielsen 1992

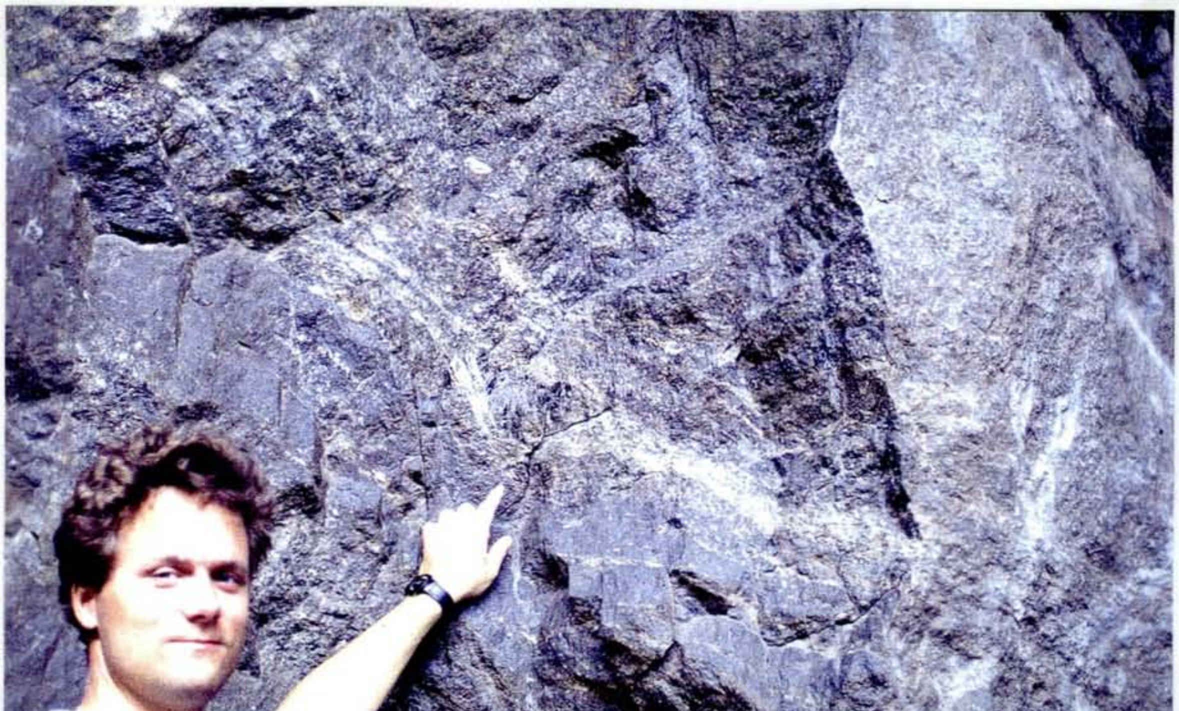


Fig. 6, Fig. 7

Fig. 8, Fig. 9

Fig. 10

APPENDIX A

Rapportutskrift fra ilmenitt-databasen

Bakka

Egersundfeltet

XUTM:	343450	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6474050	UTMsone:	32	Størrelse:	2
				Videreunders:	1

Delområde:	BSI	Hovedloknr:	1006	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1006.03	År:	1995
Id:	332	Banr:		Komnavn:	Sokndal

Bakkaprofilet. Tett profil langs meget mafisk vegskjæring og fortsettelsen opp i stratigrafien langs Bakkatjøma, hvor mafisiteten avtar. Presise UTM koordinater i prøvebeskrivelsene.

Blåfjell

Egersundfeltet

XUTM:	346900	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6471000	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1004	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1004.01	År:	1995
Id:	320	Banr:		Komnavn:	Sokndal

Langsgående profil fra Bøstøltjørna til Blåfjell gruber. Presise UTM koordinater i prøvebeskrivelseme. Alle prøver er pegmatittiske.

Blåfjell

Egersundfeltet

XUTM:	346500	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6470400	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1004	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1004.02	År:	1995
Id:	321	Banr:		Komnavn:	Sokndal

Fortsettelsen av Blåfjell over Oddrevatnet. Presise UTM koordinater i prøvebeskrivelsene.

Blåfjell

Egersundfeltet

XUTM:	346700	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6469450	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1009	Initialer:	HS
Bergartstype:	ilmeno-noritt	Underloknr:	1009.01	År:	1995
Id:	322	Banr:		Komnavn:	Sokndal

Mineraliseringer i Blåfjell omkring Tverfjell. Presise UTM koordinater i prøvebeskrivelsene.

Blåfjell

Egersundfeltet

XUTM:	346900	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6469450	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1010	Initialer:	HS
Bergartstype:	ilmeno-noritt	Underloknr:	1010.01	År:	1995
Id:	323	Banr:		Komnavn:	Sokndal

Fortsettelsen av Blåfjell mot Tellnesvatnet. Gangen oppsplittes i flere pegmatittiske soner med uregelmessige kontakter. Sør for Tellnesvatnet finnes bare isolerte oksydlinser som formodentlig er assosiert med Blåfjell. Presise UTM koordinater i prøvebeskrivelseme.

BSI-Haugland

Egersundfeltet

XUTM:	343500	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6471950	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	BSI	Hovedloknr:	1006	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1006.04	År:	1995
Id:	337	Banr:		Komnavn:	Sokndal

Lagdelt noritt fra Bjerkreim-Sokndal Intrusjonen, bare 10-15 m fra Storgangen LS. Imellom de to er det (muligvis) en tynn slire av Åna-Sira anortositt og umiddelbart vest for lokaliteten finnes Eia-Rekefjord monzonitter.

Bøstølen

Egersundfeltet

		XUTM:	346350	Kartblad:	1311.4	Ilmenittkategori:	0
		YUTM:	6468600	UTMsone:	32	Størrelse:	2
						Videreunders:	3
Delområde:	Åna-Sira	Hovedloknr:	1010	Initialer:	HS		
Bergartstype:	noritt	Underloknr:	1010.01	År:	1995		
Id:	325	Banr:		Komnavn:	Sokndal		

Tre prøver fra anortositten inn i de nederste 70 m av Bøstølen. Kontakten mellem de to er skarp. Kontakten ses dels som et fargeskift og dels som et markant skifte til laminerte bergarter. Anortositten er upåvirket i kontaktsonen - det ses ingen "interfingering" el. lign. Presise UTM koordinater i prøvebeskrivelsene.

Bøstølen

Egersundfeltet

		XUTM:	346400	Kartblad:	1311.4	Ilmenittkategori:	0
		YUTM:	6470550	UTMsone:	32	Størrelse:	2
						Videreunders:	1
Delområde:	Åna-Sira	Hovedloknr:	1005	Initialer:	HS		
Bergartstype:	noritt	Underloknr:	1005.01	År:	1995		
Id:	324	Banr:		Komnavn:	Sokndal		

Ved lysløypen. Relativ tynn lagdelt sekvens (Bøstølen layered series) som er begrenset opp mot Blåfjell pegmatitten. Lagdelingen opphører mot vest men ingen klar kontakt er funnet.

E-R gang i BSI

Egersundfeltet

		XUTM:	342100	Kartblad:	1311.4	Ilmenittkategori:	0
		YUTM:	6470750	UTMsone:	32	Størrelse:	2
						Videreunders:	3
Delområde:	Eia-R.	Hovedloknr:	1006	Initialer:	HS		
Bergartstype:	noritt	Underloknr:	1006.08	År:	1995		
Id:	340	Banr:		Komnavn:	Sokndal		

Monzonoritisk gang tilhørende Eia-Rekefjord systemet i BSI's lagdelte serie i Hauge.

Florklev-Ålg.

Egersundfeltet

		XUTM:	345000	Kartblad:	1311.4	Ilmenittkategori:	0
		YUTM:	6475950	UTMsone:	32	Størrelse:	2
						Videreunders:	3
Delområde:	Åna-Sira	Hovedloknr:	1007	Initialer:	HS		
Bergartstype:	ilmenoanortositt	Underloknr:	1007.01	År:	1995		
Id:	329	Banr:		Komnavn:	Sokndal		

Florklev-Ålgård forekomsten er en lagdelt ilmeno-anortosittisk gang med sterkt mineraliserte partier. Gangen er formodentlig 10-20 meter bred. Flere partier består av ren oksydmalm eller sterkt ilmenittiske soner med plagioklaskrystaller suspendert i en oksydmatriks. Mange anortositiske inneslutninger og klare intrusive kontakter. Gangens relasjon til sidestenen (anortositten) er ikke undersøgt i detalj. Presise UTM koordinater i prøvebeskrivelsene.

Hauge Nord

Egersundfeltet

		XUTM:	341950	Kartblad:	1311.4	Ilmenittkategori:	0
		YUTM:	6470700	UTMsone:	32	Størrelse:	2
						Videreunders:	3
Delområde:	BSI	Hovedloknr:	1006	Initialer:	HS		
Bergartstype:	noritt	Underloknr:	1006.08	År:	1995		
Id:	331	Banr:		Komnavn:	Sokndal		

Prøver fra området nord for Hauge. Prøvene er tatt for profil men er samlet i ombøyningssonen. Varierende lagdelingsintensitet. Stort sett alle prøver er mafisk lagdelt noritt. Presise UTM koordinater i prøvebeskrivelsene.

Hauge vest

Egersundfeltet

		XUTM:	340650	Kartblad:	1311.4	Ilmenittkategori:	0
		YUTM:	6470450	UTMsone:	32	Størrelse:	2
						Videreunders:	3
Delområde:	BSI	Hovedloknr:	1006	Initialer:	HS		
Bergartstype:	noritt	Underloknr:	1006.01	År:	1995		
Id:	330	Banr:		Komnavn:	Sokndal		

Prøver fra Hauge vest. Nøyaktige UTM koordinater i prøvebeskrivelsene. Området er karakterisert ved lagdelte til dels kraftig lagdelte og mafisk ilmenittiske soner. Prøvene er tatt for profil SV-NØ.

Hogstad

Egersundfeltet

XUTM:	354600	Kartblad:	1311.1	Ilmenittkategori:	0		
YUTM:	6462550	UTMsone:	32	Størrelse:	2		
				Videreunders:	3		

Delområde:	Åna-Sira	Hovedloknr:	1012	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1012.01	År:	1995
Id:	328	Banr:		Komnavn:	Sokndal

Lokaliteten dekker Vardåsen skjerp og selve Hogstad intrusjonen. Presise UTM koordinater i prøvebeskrivelsene.

Hogstad

Egersundfeltet

XUTM:	354800	Kartblad:	1311.1	Ilmenittkategori:	0
YUTM:	6463250	UTMsone:	32	Størrelse:	2
				Videreunders:	0

Delområde:	Åna-Sira	Hovedloknr:	1003	Initialer:	HS
Bergartstype:	noritt mm.	Underloknr:	1003.01	År:	1995
Id:	327	Banr:		Komnavn:	Sokndal

Prøver i og omkring Hogstadintrusjonen. I dette område treffes norittiske gangsegmenter som er intrusjonens forlengelse mot nord. Omkring gangene finnes rene oksyd segregasjoner. Området er meget dårligt blottet og relasjonerne uklare. Presise UTM koordinater i prøvebeskrivelsene.

Kydlandsvatnet

Egersundfeltet

XUTM:	332050	Kartblad:	1211.1	Ilmenittkategori:	0
YUTM:	6480000	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Lakssv.-Koldal	Hovedloknr:	1014	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1014.01	År:	1995
Id:	341	Banr:		Komnavn:	Eigersund

Oksydmalm fra gneisifisert norittisk intrusjon (Lakssvelefjell-Koldal). Oksydeme opptrer her som langstrakte linser av meget ren malm formodentlig dannet ved delvis remobilisering i et oprindeligt modal lagdelt intrusiv.

Mydland SØ

Egersundfeltet

XUTM:	350200	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6475650	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Mydlandloben	Hovedloknr:	1002	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1002.01	År:	1995
Id:	338	Banr:		Komnavn:	Sokndal

Sydøstlige del av Mydland. Prøver tatt for profil gjennom den lagdelte serie. En relativ tynn sone med kraftig lagdeling og regulære ilmenittiske bånd følger strøket syd for riksvegen. Umiddelbart under denne sone ses et nivå med store anortosittiske inneslutninger. Under inneslutningene er noritten felsisk og ulagdelt helt til kontakten (til monzonoritt). Presise UTM koordinater i prøvebeskrivelsene.

Raunslid

Egersundfeltet

XUTM:	347600	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6466000	UTMsone:	32	Størrelse:	2
				Videreunders:	1

Delområde:	Åna-Sira	Hovedloknr:	1011	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1011.01	År:	1995
Id:	326	Banr:		Komnavn:	Sokndal

Raunslid skjerp. Veiskjæring. 1,5 m bred norittgang med sporadiske oksydlinser eller -innslag.

Rossland

Egersundfeltet

XUTM:	340450	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6472900	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	BSI	Hovedloknr:	1006	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1006.09	År:	1995
Id:	334	Banr:		Komnavn:	Sokndal

Øst-vest profil ved Rossland bestående av bare tre prøver. Dårlig blotningsgrad og relativt felsiske prøver. Presise UTM koordinater i prøvebeskrivelsene.

Sent. Mydland

Egersundfeltet

XUTM:	349700	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6476200	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Mydlandloben	Hovedloknr:	1002	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1002.02	År:	1995
Id:	339	Banr:		Komnavn:	Sokndal

Sentrale, nordlige og vestlige del av Mydlandloben. Prøver tatt for profil gjennom den lagdelte serien. De mest mafiske og oksydrike bergarter opptrer i den sentrale del av loben og mafisiteten avtar mot nord og sør. Presise UTM koordinater i prøvebeskrivelsene.

Storgangen

Egersundfeltet

XUTM:	344600	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6472300	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1001	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1001.01	År:	1995
Id:	312	Banr:		Komnavn:	Sokndal

3 prøver i ca 15 m profil fra liggende kontakt.

Storgangen

Egersundfeltet

XUTM:	344350	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6472250	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1013	Initialer:	HS
Bergartstype:	noritt mm	Underloknr:	1013.01	År:	1995
Id:	319	Banr:		Komnavn:	Sokndal

Profil på tvers av Storgangen fra liggende til hengende, vinkelrett på modal lagdeling. Meterangivelser horisontalt fra liggende. Den modale lagdeling stryker 82E og faller 38N. I stedet for prøvenumrene 1013,01-10-15 benyttes her 1013,02-0-5.

Storgangen

Egersundfeltet

XUTM:	345000	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6473300	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1008	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1008.01	År:	1995
Id:	318	Banr:		Komnavn:	Sokndal

Prøver fra Sidegangen (1) og Sidegangens fortsettelse (2). På begge lokaliteter er gangen bare få meter bred. UTM for 1008,012 er: 34440; 647250

Storgangen

Egersundfeltet

XUTM:	343550	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6471850	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1001	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1001.06	År:	1995
Id:	317	Banr:		Komnavn:	Sokndal

Storgangens fortsettelse mod Aamodt. Gangen er ganske få meter bred.

Storgangen

Egersundfeltet

XUTM:	344400	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6472250	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1001	Initialer:	HS
Bergartstype:	noritt/anortositt	Underloknr:	1001.05	År:	1995
Id:	316	Banr:		Komnavn:	Sokndal

Prøver fra de sentrale dele av Storgangen i lateralt 400 m profil. UTM koordinater fra 34440; 647225 til 34460; 647230.

Storgangen

Egersundfeltet

XUTM:	345850	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6472400	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1001	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1001.04	År:	1995
Id:	315	Banr:		Komnavn:	Sokndal

Mellem Brekke og Aursland. Bare den øverste meter av gangen er blottet her mot hengende og består her av mafiske (pyroksenittiske) bånd.

Storgangen

Egersundfeltet

XUTM:	346500	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6472050	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1001	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1001.03	År:	1995
Id:	314	Banr:	0.0	Komnavn:	Sokndal

Storgangens fortsettelse etter Aursland: nå en 1-2 m bred gang med ilmenittiske indslag.

Storgangen

Egersundfeltet

XUTM:	344950	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6472350	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	Åna-Sira	Hovedloknr:	1001	Initialer:	HS
Bergartstype:	anortositt/noritt	Underloknr:	1001.02	År:	1995
Id:	313	Banr:		Komnavn:	Sokndal

2 prøver på hver side av liggende kontakt

Øyno-Kjelland

Egersundfeltet

XUTM:	341350	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6469050	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	BSI	Hovedloknr:	1006	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1006.02	År:	1995
Id:	335	Banr:		Komnavn:	Sokndal

Prøve fra Øyno sydøst for Hauge av lagdelt noritt. Et gammelt skjerp i dette felt ble ikke lokalisert.

Øyno-Kjelland

Egersundfeltet

XUTM:	341450	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6468250	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	BSI	Hovedloknr:	1006	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1006.05	År:	1995
Id:	336	Banr:		Komnavn:	Sokndal

Prøver fra Kjelland bestående av lagdelt (til dels kraftig) noritt. Området danner den sydligste spiss av Bjerkreim-Sokndal intrusjonen. Presise UTM koordinater i prøvebeskrivelsene.

Årstadtjørna

Egersundfeltet

XUTM:	342950	Kartblad:	1311.4	Ilmenittkategori:	0
YUTM:	6469600	UTMsone:	32	Størrelse:	2
				Videreunders:	3

Delområde:	BSI	Hovedloknr:	1006	Initialer:	HS
Bergartstype:	noritt	Underloknr:	1006.06	År:	1995
Id:	333	Banr:		Komnavn:	Sokndal

Årstadtjørnaprofilet. Profil fra riksveg 44 mot intrusjonskontakten ved Årstadtjørna. Profilet består av mafiske og kraftig lagdelte noritter. Prøve 1006,019 kommer fra Årsland skjerp og 1006,068 er troktolitt fra intrusjonens nederste kumulater. Presise UTM koordinater i prøvebeskrivelsene.

APPENDIX B

NR.	PRØVENR.	KARTBL. NR.	UTM-SONE	UTM-KOORD. ØST(m)	NORD(m)	LIT. KODE	STRAT. KODE	BERGARTSNAVN	TETTHET KG/M**3	SUSCEPT. SI (lab)	Q-VERDI	GEOL. ID.	ÅR
1	1001.01.01	13114	32	344600	6472300	M41		norite	4256	0.35311	0.32	SCH	95
2	1001.01.02	13114	32	344600	6472300	M41		norite	3902	0.43489	0.45	SCH	95
3	1001.01.03	13114	32	344600	6472300	M41		norite	3965	0.45601	0.40	SCH	95
4	1001.02.01	13114	32	344950	6472350	I80		anorthositic layer	2695	0.00578	32.66	SCH	95
5	1001.02.02	13114	32	344950	6472350	M41		layered	3928	0.37463	0.43	SCH	95
6	1001.03.01	13114	32	346500	6472050	M41		norite	3666	0.04098	6.56	SCH	95
7	1001.03.02	13114	32	346500	6472050	M41		norite	3995	0.41441	0.30	SCH	95
8	1001.04.01	13114	32	345850	6472400	M41		norite	3433	0.01174	46.36	SCH	95
9	1001.05.01	13114	32	344400	6472250	I80		anorthositic layer	2822	0.02733	0.68	SCH	95
10	1001.05.02	13114	32	344400	6472250	M41		norite	3474	0.18895	0.35	SCH	95
11	1001.05.03	13114	32	344400	6472300	M41		norite	3402	0.14787	0.61	SCH	95
12	1001.05.05	13114	32	344500	6472300	M41		norite	3572	0.26184	0.49	SCH	95
13	1001.05.06	13114	32	344600	6472300	M41		norite	4191	0.31976	0.18	SCH	95
14	1001.06.01	13114	32	343550	6471850	I56		layered	2960	0.06083	0.29	SCH	95
15	1002.01.01	13114	32	350050	6476000	I56		layered	3344	0.20694	2.61	SCH	95
16	1002.01.02	13114	32	350500	6475700	M41		norite	3649	0.26138	5.34	SCH	95
17	1002.01.03	13114	32	350050	6475300	I56		layered	2771	0.04988	0.60	SCH	95
18	1002.01.04	13114	32	349900	6475800	M41		norite	3287	0.21560	0.88	SCH	95
19	1002.02.01	13114	32	349450	6475800	I56		layered	3398	0.23909	0.62	SCH	95
20	1002.02.02	13114	32	349500	6475450	I56		leucocratic	2904	0.07751	1.68	SCH	95
21	1002.02.03	13114	32	349600	6476400	I28		hangerite?	2732	0.02691	0.45	SCH	95
22	1002.02.04	13114	32	349750	6476250	I56		leucocratic	3025	0.06513	0.54	SCH	95
23	1002.02.05	13114	32	349700	6476200	I56		layered	3311	0.15029	0.43	SCH	95
24	1002.02.06	13114	32	349600	6476050	I56		layered	3278	0.16229	1.10	SCH	95
25	1002.02.07	13114	32	348900	6475750	I56		layered	3398	0.30495	0.74	SCH	95
26	1003.01.02	13114	32	354800	6463000	I56		layered	2960	0.02900	1.71	SCH	95
27	1003.01.03	13114	32	354950	6463300	M41		norite	3467	0.67250	0.45	SCH	95
28	1004.01.01	13114	32	346750	6470500	I56		pegmatite	3016	0.00241	45.86	SCH	95
29	1004.01.02	13114	32	346850	6470450	M41		norite	4608	0.00844	124.87	SCH	95
30	1004.01.03	13114	32	347000	6470700	I56		pegmatite	2786	0.00389	7.86	SCH	95
31	1004.01.04	13114	32	346950	6470950	M41		pegmatite	4074	0.15257	2.51	SCH	95
32	1004.01.05	13114	32	347100	6471500	M41		pegmatite	4488	0.00990	79.42	SCH	95
33	1004.01.06	13114	32	347100	6471750	M41		pegmatite	4541	0.00880	40.19	SCH	95
34	1004.02.01	13114	32	346400	6470400	I56		pegmatite	2938	0.00460	8.63	SCH	95
35	1004.02.02	13114	32	346550	6470350	M41		pegmatite	3782	1.44703	0.95	SCH	95
36	1005.01.01	13114	32	346400	6470550	M41		layered	3934	0.14289	0.29	SCH	95
37	1006.01.01	13114	32	340550	6470500	I56		levcocratic	2880	0.05143	0.67	SCH	95
38	1006.01.02	13114	32	340550	6470500	M41		layered	3637	0.30535	0.27	SCH	95
39	1006.01.03	13114	32	340600	6470450	I56		layered	3439	0.26939	2.99	SCH	95
40	1006.01.05	13114	32	340850	6470200	I56		layered	3074	0.13774	0.45	SCH	95
41	1006.01.06	13114	32	340950	6470200	I56		layered	2911	0.09194	0.30	SCH	95
42	1006.01.07	13114	32	340850	6470300	I56		levcocratic	2804	0.03812	0.49	SCH	95
43	1006.01.08	13114	32	340650	6470550	I56		layered	2909	0.04433	0.64	SCH	95
44	1006.01.09	13114	32	340350	6471050	I56		layered	2999	0.06685	0.24	SCH	95
45	1006.02.01	13114	32	341350	6469050	I56		layered	3147	0.13546	0.16	SCH	95
46	1006.03.01	13114	32	343300	6474200	I56		layered	3147	0.18203	0.27	SCH	95
47	1006.03.02	13114	32	343300	6474150	I56		layered	3132	0.14215	0.40	SCH	95
48	1006.03.03	13114	32	343350	6474150	I56		layered	3343	0.24076	0.29	SCH	95
49	1006.03.04	13114	32	343350	6474100	I56		layered	3055	0.15445	0.34	SCH	95
50	1006.03.05	13114	32	343400	6474100	M41		layered	3615	0.26841	0.68	SCH	95
51	1006.03.06	13114	32	343400	6474050	M41		layered	3610	0.41753	0.32	SCH	95
52	1006.03.07	13114	32	343450	6474050	I56		layered	3307	0.21117	0.27	SCH	95
53	1006.03.08	13114	32	343450	6470000	I56		layered	3495	0.33159	0.78	SCH	95
54	1006.03.09	13114	32	343100	6474100	I56		layered	2928	0.10989	0.37	SCH	95

NR.	PRØVENR.	KARTBL. NR.	UTM-SONE	UTM-KOORD. ØST(m)	NORD(m)	LIT. KODE	STRAT. KODE	BERGARTSNAVN	TETTHET KG/M**3	SUSCEPT. SI (lab)	Q-VERDI	GEOL. ID.	ÅR
55	1006.03.10	13114	32	342950	6474100	I56		layered	2906	0.10292	0.22	SCH	95
56	1006.03.11	13114	32	342800	6475150	I56		layered	2890	0.06555	0.20	SCH	95
57	1006.04.01	13114	32	343500	6471950	I56		layered	2999	0.09245	0.20	SCH	95
58	1006.05.01	13114	32	341400	6468350	I56		layered	2762	0.00105	22.61	SCH	95
59	1006.05.02	13114	32	341500	6468150	I56		levcocratic	3280	0.07296	0.32	SCH	95
60	1006.06.01	13114	32	342750	6470050	I56		layered	3276	0.31659	0.56	SCH	95
61	1006.06.02	13114	32	342750	6470000	M41		layered	3660	0.11184	1.86	SCH	95
62	1006.06.03	13114	32	342750	6469950	I56		layered	3056	0.12815	0.53	SCH	95
63	1006.06.04	13114	32	342750	6469900	M41		layered	3593	0.35023	2.55	SCH	95
64	1006.06.05	13114	32	342800	6469800	I56		layered	3266	0.13945	0.68	SCH	95
65	1006.06.06	13114	32	342950	6469600	I56		layered	3298	0.00598	5.57	SCH	95
66	1006.06.07	13114	32	342750	6469350	I56		layered	3190	0.00406	8.20	SCH	95
67	1006.06.08	13114	32	342950	6469100	I56		troctolite	3103	0.09337	0.78	SCH	95
68	1006.06.09	13114	32	342850	6469200	M41		layered	4321	2.62515	0.20	SCH	95
69	1006.06.10	13114	32	342900	6470200	I56		layered	3374	0.25702	0.60	SCH	95
70	1006.06.11	13114	32	342850	6469100	I56		troctolite	3062	0.03828	1.28	SCH	95
71	1006.08.01	13114	32	342500	6470650	I56		layered	3279	0.22536	0.92	SCH	95
72	1006.08.02	13114	32	342400	6470900	I56		layered	3414	0.27994	0.46	SCH	95
73	1006.08.03	13114	32	342450	6471300	I56		levcocratic	2958	0.04241	1.79	SCH	95
74	1006.08.04	13114	32	342650	6471550	I56		levcocratic	3236	0.00738	10.31	SCH	95
75	1006.08.05	13114	32	342250	6470650	I56		levcocratic	2973	0.08023	0.21	SCH	95
76	1006.08.06	13114	32	342100	6470750	I28		jotunite	2812	0.08238	0.15	SCH	95
77	1006.08.07	13114	32	341950	6470700	I56		jotunite	2910	0.09890	0.20	SCH	95
78	1006.08.08	13114	32	340750	6470900	I56		jotunite	2841	0.02342	0.33	SCH	95
79	1006.08.09	13114	32	341000	6470700	I56		jotunite	3051	0.10159	0.30	SCH	95
80	1006.08.10	13114	32	341300	6470600	I56		jotunite	2923	0.09819	0.53	SCH	95
81	1006.09.01	13114	32	341000	6472650	I56		levcocratic	3022	0.10366	0.35	SCH	95
82	1006.09.02	13114	32	340450	6472900	I56		levcocratic	2964	0.00282	2.79	SCH	95
83	1006.09.03	13114	32	340250	6472700	I56		levcocratic	3206	0.00944	9.83	SCH	95
84	1007.01.01	13114	32	345000	6475950	M41		levcocratic	3886	0.00775	68.15	SCH	95
85	1007.01.02	13114	32	344650	6476450	M41		levcocratic	4563	0.01306	95.55	SCH	95
86	1008.01.01	13114	32	345000	6473300	M41		levcocratic	3871	0.45799	0.27	SCH	95
87	1008.01.02	13114	32	344400	6472500	I56		layered	2943	0.06059	4.45	SCH	95
88	1009.01.01	13114	32	346700	6469450	M41		layered	3749	0.60964	0.95	SCH	95
89	1009.01.02	13114	32	346550	6469250	M41		layered	3829	0.69621	0.30	SCH	95
90	1009.01.03	13114	32	346700	6469200	M41		layered	4152	0.79712	1.55	SCH	95
91	1009.01.04	13114	32	346550	6469100	M41		layered	4622	0.98701	0.27	SCH	95
92	1009.01.05	13114	32	346950	6469050	M41		layered	4622	0.00805	228.72	SCH	95
93	1009.01.06	13114	32	346900	6468350	M41		layered	4504	0.20777	2.28	SCH	95
94	1010.01.01	13114	32	346350	6468600	I80		layered	2664	0.00031	126.04	SCH	95
95	1010.01.02	13114	32	346350	6468600	M41		layered	2892	0.11033	0.62	SCH	95
96	1010.01.03	13114	32	346400	6468550	M41		layered	3666	0.91565	0.27	SCH	95
97	1010.01.04	13114	32	346900	6469450	I56		pegmatite	2850	0.00586	32.89	SCH	95
98	1010.01.05	13114	32	346850	6468350	M41		pegmatite	4365	0.16838	6.82	SCH	95
99	1010.01.06	13114	32	346800	6468100	M41		pegmatite	4351	0.03459	5.72	SCH	95
100	1010.01.07	13114	32	346750	6467850	M41		pegmatite	4616	0.53995	0.35	SCH	95
101	1010.01.08	13114	32	346850	6467700	M41		pegmatite	3785	0.05361	8.48	SCH	95
102	1011.01.01	13114	32	347600	6466000	I56		pegmatite	3364	0.00751	38.56	SCH	95
103	1012.01.01	13114	32	354400	6462460	M41		pegmatite	4390	0.02222	3.87	SCH	95
104	1012.01.02	13114	32	354850	6462650	I56		layered	3320	0.25825	0.39	SCH	95
105	1013.01.01	13114	32	344350	6472150	I80		layered	2706	0.00143	145.43	SCH	95
106	1013.01.02	13114	32	344350	6472150	I56		layered	3490	0.18400	0.17	SCH	95
107	1013.01.04	13114	32	344350	6472150	I56		layered	2974	0.04817	0.05	SCH	95
108	1013.01.05	13114	32	344350	6472200	M41		layered	3646	0.33043	0.16	SCH	95

NR.	PRØVENR.	KARTBL. NR.	UTM-SONE	UTM-KOORD. ØST(m)	NORD(m)	LIT. KODE	STRAT. KODE	BERGARTSNAVN	TETTHET KG/M**3	SUSCEPT. SI (lab)	Q-VERDI	GEOL. ID.	ÅR
109	1013.01.06	13114	32	344350	6472200	I80		anorthositic layer	2870	0.03994	1.60	SCH	95
110	1013.01.07	13114	32	344350	6472200	M41		norite	3597	0.27001	0.49	SCH	95
111	1013.01.08	13114	32	344350	6472250	M41		norite	3690	0.35600	0.87	SCH	95
112	1013.01.09	13114	32	344350	6472250	M41		norite	4019	0.63556	0.35	SCH	95
113	1013.01.10	13114	32	344350	6472250	I56		norite	3087	0.12056	0.48	SCH	95
114	1013.01.11	13114	32	344350	6472300	I56		norite	3305	0.26083	0.63	SCH	95
115	1013.01.12	13114	32	344350	6472300	I56		layered	3500	0.49656	0.52	SCH	95
116	1013.01.13	13114	32	344350	6472300	I56		layered	3225	0.18949	0.75	SCH	95
117	1013.01.14	13114	32	344350	6472350	I56		layered	3178	0.14580	0.45	SCH	95
118	1013.01.15	13114	32	344350	6472350	M41		norite	3631	0.30102	0.60	SCH	95
119	1014.01.01	12111	32	332050	6480000	M41		norite	4434	0.01187	46.98	SCH	95