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PETROGRAPHICAL CHARACTERISTICS OF THE ISBJØRNHAMNA
GROUP ROCKS (WEDEL JARLSBERG LAND, SPITSBERGEN)

Abstract: The Isbjørnhamna Group is the complex of mezozonal metasediments, more than 1000 m thick, outcropping in the N coast of Hornsund Fiord. The majority of the profile consists of paragneisses, mica schists, calcite-mica schists and calcite marbles. The rocks were metamorphosed twice: first progressively under conditions of kyanite, staurolite and chloritoid zones facial Barrow series, then retrogressively under conditions of greenschists facies.

Keywords: mica schists, thermobarometry, Isbjørnhamna Group, Spitsbergen

INTRODUCTION

Grenvillian mezozonal metamorphites crop out in the southern part of Wedel Jarlsberg Land north of Hornsund Fiord on Spitsbergen. They form an exotic tectonic block surrounded by epizonal, Caledonian rocks (Czerny et al. 1993). This complex is composed of metasediments which belong to Isbjørnhamna Group and are overlain by metavolcanites and metaarenites of Eimfjellet Group (Birkenmajer 1958, 1992). The Isbjørnhamna Group rocks were metamorphosed under conditions of amphibolite facies and contain garnets, staurolite and kyanite (Smulikowski 1960, 1965). Younger rocks of the Eimfjellet Group were metamorphosed under conditions of albite-epidote-amphibolite facies. The goal of undergoing research is to quantify the course, conditions and age of the metamorphic processes. This paper includes fieldworks and petrographical results and preliminary results of geothermobarometry.

METHODS

Sampling and fieldwork were carried on during the expeditions organized by the Department of Mineralogy, Petrography and Geochemistry AGH University of Science and Technology in summer of 2002 and 2003. In 2002, samples were collected in three areas: in the centre of Ariebreen megaantictline (in Skålfjelldalen and Revdalen region), on its western limb (along the coast) and on its eastern limb (on Fugleberget). Next year the efforts were concentrated on Revdalen Formation rocks. The samples of mica schist were collected along their strike. From 60

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samples collected in the field 41 were chosen for thin sections and 9 samples for thermobarometry.

Carbon-coated polished specimens were analyzed on the Jeol JXA-50A microprobe in Department of Mineralogy, Petrography and Geochemistry EMP laboratory, at the AGH University of Science and Technology using 15kV accelerating potential and 20nA beam current. On the standards and on the samples 40s long measurements were made in triplicates. Garnet-biotite geothermometer (Bhattacharya et al. 1992) with pyrope-almandine mixing parameters from Hackler & Wood (1989), and GASP geobarometer based on Koziol & Newton (1988) calibration were used.

CHARACTERISTICS OF ISBJØRNHAMNA GROUP ROCKS

The Isbjørnhamna Group contains metamorphic clastic and carbonate rocks. Three units are distinguished within the Group: Skoddefjellet, Ariekammen and Revdalen Formation (Birkenmajer 1958). Excellent preservation of layering underlined by a mimetic penetrative foliation is characteristic for these rocks.

Skoddefjellet Formation, more than 800m thick, consists of mutually layered (in scale cm and/or dm) paragneisses and metapelites. In the lower parts of the profile (and in the eastern area) paragneisses prevail. In the western area and upper parts of the profile schist content increase reaching up to 50% by volume. Feldspar rich paragneisses varieties resemble feldspar quartzites and the rocks rich in phyllosilicates are flaky gneisses type. Typical paragenesis for paragneisses and schists is $Q+Pl+Bt+Ms\pm Grt\pm Chl$ (accessory tourmaline, sphene, apatite, zircon, ilmenite, hematite, magnetite) but plagioclases (oligoclase) amount increase in paragneisses while schists contains more garnets (up to 3mm in diameter).

Ariekammen Formation is distinct and delineated by the presence of carbonate rocks. A thickness of the whole formation is estimated at 200-400m. The formation consists mostly of carbonate-mica schists with irregular layers of mica schists and paragneisses of Skoddefjellet type. Furthermore, in the middle of the profile, non continuous horizon (0 to 70m thick) of yellow and white calcite marbles is present. Carbonate-mica schists have fine lamination (in scale of cm), cavernous weathered surface and often contain large blasts of garnets (up to 6cm!). Typical paragenesis of these rocks is $C+Q+Bt+Grt+Pl+Ms\pm Ep$ (the same accessory minerals as in Skoddefjellet Fm.), with Ca enriched plagioclase (andesine). Moreover, in some varieties of schists, scapolite (mejonite variety) is present. Paragneisses and mica schists, which belong to this formation, contain epidote-clinozoisite, andesine and occasionally scapolite.

Revdalen Formation is the uppermost part of the Isbjørnhamna Group. It is a uniform sequence of rusty weathering mica schist (thickness up to 200 m). These rocks contain $Q+Pl+Bt\pm Ms\pm Grt\pm Chl$. Both, two-mica and only biotite varieties of described schists are known. In some samples staurolite is present, in the others kyanite, and locally chloritoid (with chlorite but without biotite). Explicit mineral zonation is apparent: in the centre of the region (Skålfjelldalen and Revdalen),

which is the core of Ariebeen megaanticline, kyanite is present in the schists; on the western (Rotjesfjellet, Torbjørnsenfjellet, Gangpasset) and eastern (Eimfjellet, Skålfjellet) limbs of the structure staurolite is present; and only in the extreme western part of region (Skjerstranda area) chloritoid was found.

Signs of diaphthoresis are very common in the Isbjørnhamna Group rocks and are apparent as chloritization of garnets and biotites, sericitization of plagioclases, kyanite, scapolite, and disintegration of bigger blasts of muscovite. Retrogression results in lenses or layers of silver-greenish chlorite-sericite schists.

PRELIMINARY RESULTS OF THERMOBAROMETRY

Garnet bearing mica schists (with slightly retrogressive changes) were chosen for thermobarometry. In these rocks, garnets usually occur as anhedral blasts showing s-form or diagonal to foliation inclusions of quartz as evidence of syntectonic rotation. Besides quartz, biotite, muscovite, hematite-ilmenite and rarely thin needles of rutile occur as inclusions in garnets. Biotite is present in few textural types: a) coarse-blastic biotite within foliation planes and as inclusions in garnets; b) large, deformed porphyroblasts of biotite transversal to foliation; c) biotite within the garnet pressure shadows and partly replacing garnets; d) retrogressive biotite which occurs with chlorite in the veins in garnets (Majka 2003). Mineral pairs of inclusions of biotite in the outer parts of anhedral garnet were used for geothermometry.

Table 1. Results of thermobarometric analyses of Isbjørnhamna metapelites.

Sample	Locality	Temperature	Pressure
Sp-124/02	Revdalen Fm.; Revdalen valley interior; core of Ariebeen megaantyclyne	620 °C	9 kbar
Sp-103/02	Skoddefjellet Fm.; coast plain; W-limb of Ariebeen megaanticline	548 °C	-
Sp-126/02	Skoddefjellet Fm.; Fugleberget; E-limb of Ariebeen megaanticline	552 °C	-
Sp-106/02	Revdalen Fm.; Gangpasset; W-limb of Ariebeen megantyclyne	363 °C	-

Results are consistent with petrological observations (Tab. 1). Sample from the kyanite zone in the core of Ariebeen megaantyclyne yielded the highest temperature of 620°C. Lower temperatures were recorded by the samples in the limbs of the structure. The lowest temperature of 363°C is probably a result of retrogressive overprint. The relatively high pressure of 9kb was determined for one sample only (Sp-124/02) and awaits confirmation.

CONCLUSIONS

In the Isbjørnhamna Group rocks two metamorphic events were recorded: first amphibolite facies metamorphism (Barrow facial series), probably Grenvillian, and second retrogressive greenschists facies metamorphism, probably Caledonian. Systematic detailed mapping allowed for identification of three mineral zones within Revdalen schists: kyanite, staurolite and chloritoid. The extend of these zones can be correlated with major tectonic structures (megafolds of D4 stage, Czerny et al., 1993).

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