



SYMPOSIUM - ANNUAL MEETING



PROCEEDING

*MAGMATISM, METAMORPHISM AND METALLOGENY OF THE
VARDAR ZONE AND SERBO-MACEDONIAN MASSIF*



*PLATE TECTONIC ASPECTS OF ALPINE METALLOGENY
IN THE CARPATHO-BALKAN REGION*

Edited by:
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Mineral equilibria in high-temperature gneisses of the Valandovo - Bogdanci low - pressure metamorphic complex, Macedonia

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Abstract

Based on mineral associations determined in high - temperature muscovitic gneisses of the Valandovo - Bogdanci low - pressure metamorphic complex two metamorphic zones are distinguished: andalusite - muscovite and sillimanite - muscovite - K - feldspar.

Mineral associations distinguished for andalusite - muscovitic zone indicate T from 570 to 610 °C and P = 3.5 - 3.75 Kb, whereas for sillimanite - muscovitic - K - feldspar higher T ranging from 650 to 670 °C and P = 3.5 - 3.75 Kb.

The occurrence of high - temperature low - pressure rocks in a wide elongated belt point to typical Abakuma type of regional metamorphism.

Introduction

The Valandovo - Bogdanci low - pressure metamorphic complex is situated in the southeastern part of Republic of Macedonia according to the tectonic reorganization of Macedonia, Arsovski (1996) belongs to the Vardar zone.

Our study of the Valandovo - Bogdanci low-pressure metamorphic complex indicates, that it is composed of intercalated high - temperature cordierite - sillimanite (andalusite) - mica, biotite - muscovite and garnet - mica paragneisses, porphyroblastic mica orthogneisses, para - and orthoamphibolites, calc - silicate rocks and clinopyroxene - hornblende - garnet - wolastonite - vesuvianite - bearing impure and pure marbles, correspond to the middle and upper parts of amphibolite facies. Metamorphic degree of these rocks

almost does not change over the large distance, but in the studied area we managed to establish two metamorphic grades - andalusite - muscovite and sillimanite - muscovite - K - feldspar zones, based on associations of muscovite - bearing gneisses.

Mineral equilibria in high - temperatures gneisses

The andalusite - muscovite zone was detected in the Valandovo area coarse - grained andalusite, fibrolitic sillimanite, muscovite, biotite, garnet and plagioclase area stable in Ms - gneisses. Garnet is iron and manganese rich and its grains are either homogeneous, or preserve the prograde zoning in the middle parts of crystals (increasing Mg and decreasing Mn content), and the retrograde zoning in the rim (an opposite trend), (Fig. 1). Grt contain a lot of Bt inclusion. Study of their compositions and Bt - Grt geothermometry (Kleemann, Reinhardt, 1994) allow to determine temperature (T) crystallisation: from 576 °C in the core and up to 614 °C in the middle of garnet grains. Mineral equilibria of Ms - bearing rocks are shown on (Fig.2,1), (AKFM diagram); cordierite was not found due to absence of Mg - rich rocks, staurolite is already not stable. But in Ms - free rocks cordierite ($X_{Fe} = 40\%$) is present; sometimes Cor contains very fine relics of staurolite. In these rocks association Grt + Cor + And (Fibr) is characteristic (Fig. 2.2), (AFM diagram). Equilibrium coexistence of And and Fibr, presence of St only in Ms - free rocks points, that temperature conditions of this zone correspond to intersecting of $And \rightarrow Sil$, and $St + Qtz \rightarrow Cor + Grt + Al_2SiO_5$ lines on P - T

plot. According to geothermobarometric data and petrogenetic grid for metapelites (Кориковски, 1979), P - T estimates of andalusite - muscovite zone are: T = 570 - 610 °C, P = 3.5 - 3.75 Kb.

Gneisses of sillimanite - muscovite - K - feldspar zone were studied in the Bogdanci and Stojakovo area. In spotted cordierite - mica

rocks only the prismatic sillimanite is stable in association with cordierite, muscovite, K - feldspar, plagioclase (Fig. 3.1). The iron - rich cordierite ($X_{Fe} = 49-50\%$) forms large porphyroblasts up to 2 cm in size. Garnet was not found only owing to absence of Mg - rich gneisses in this area.

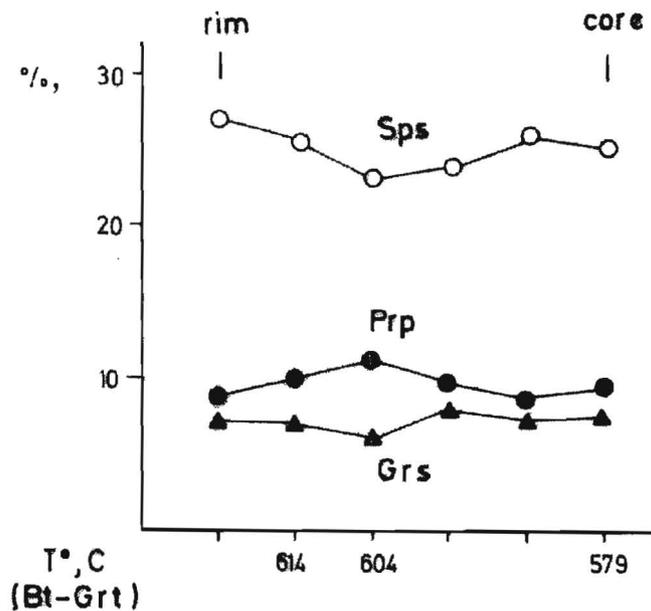


Fig.1. Compositional profile in the garnet grain from an andalusite - garnet - mica gneiss: the weak prograde zoning from core to middle, and the retrograde zoning in the outer part.

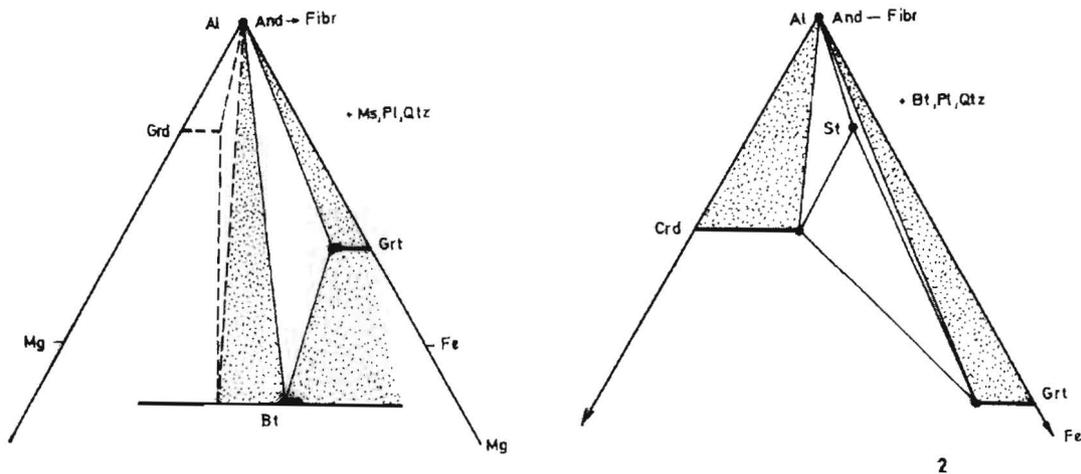


Fig.2. Associations of gneiss from the andalusite - muscovite zone: Ms - bearing (AKFM diagram)(1), and Ms - free (AFM diagram)(2).

Gneisses of sillimanite - muscovite - K - feldspar zone were studied in the Bogdanci and Stojakovo area. In spotted cordierite - mica

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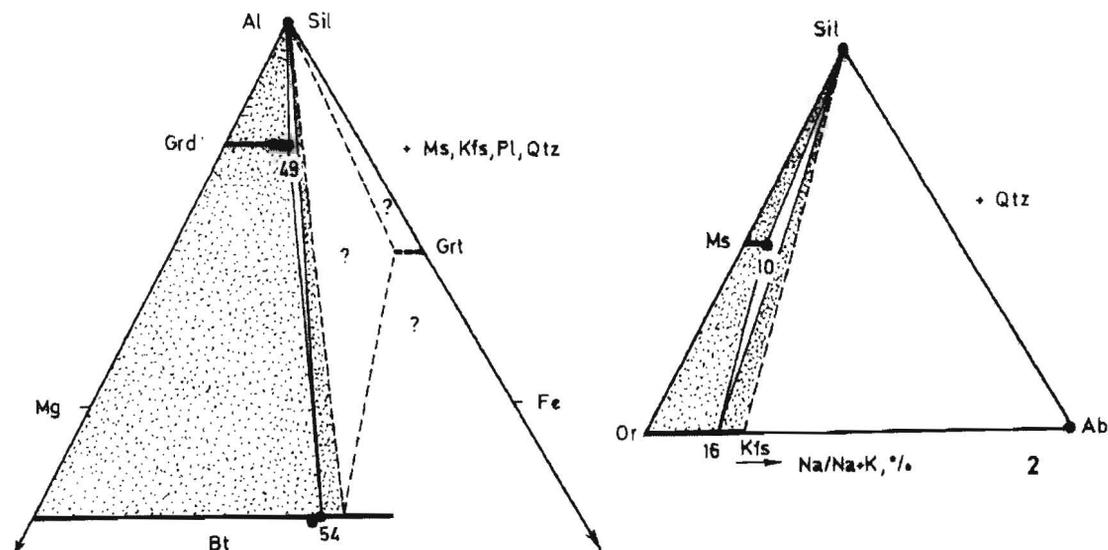


Fig.3. Associations of Ms - Kfs - bearing gneisses from the sillimanite - muscovite - K-feldspar zone: on AKFM (1) and Sil - Ab - Or (2) plots.

Stability of Sil + Kfs + Ms + Qtz association means that temperature conditions approached the upper limit of stability of Ms + Qtz, where only Na and Mg, Fe - poor muscovites are preserved (Fig. 3.2), and Ms + Ab were replaced by association Kfs + Sil crystallization of the very ferrous cordierite and Sill + Kfs + Ms, evidence of a partial melting indicates that P - T conditions of this zone are: T = 650 - 670 °C, P = 3.5 - 3.75 Kb.

Extensive occurrence of the high - temperature low - pressure rocks of the Valandovo - Bogdanci complex over the wide territory means that it is the typical Abakuma - type regional metamorphism. Mineral associations and P - T conditions this complex is very close to the Main metamorphic aureole studied by Guidotti (1970, 1974).

Conclusion

Two metamorphic zones are distinguished in the Valandovo - Bogdanci low - pressure complex: andalusite - muscovitic that metamorphosed at T from 570 to 610 °C and P = 3.5 - 3.75 Kb, and sillimanite muscovitic - K - feldspar zone metamorphosed at 650 - 670 °C and P = 3.5 - 3.7 Kb.

Mineral associations and the elongated occurrence of high - temperature low - pressure

rocks of the Valandovo - Bogdanci metamorphic complex in a wide belt indicate that it is a typical Abakuma type of regional metamorphism.

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