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TALC – TREMOLITE - CALCITE PARAGENESIS FROM THE CONTACT METAMORPHOSED DOLOMITES (NW ROMANIA)

The intrusion of the Upper Cretaceous-Lower Palaeocene granodiorites (Cioflica et al. 1995) into the Middle Triassic dolomites in the North Apuseni Mts. (NW Romania, Bihor Mountains) generated an extensive zone of contact alterations.

The contact aureole is complex and composed of skarns in the inner part and predazzites in the outer part (Fig. 1). Its width ranges from tens up to 400 meters. The skarn zone is built mainly of carbonates with forsterite, garnet, diopside, chlorites, phlogopite, serpentine and magnesioferrite, whereas the predazzite zone is composed of calcite, brucite and dolomite (Bleahu et al. 1981; Marincea 1992; Ionescu 1987; Ghergari and Ionescu 2000; Ionescu and Ghergari, 2001).

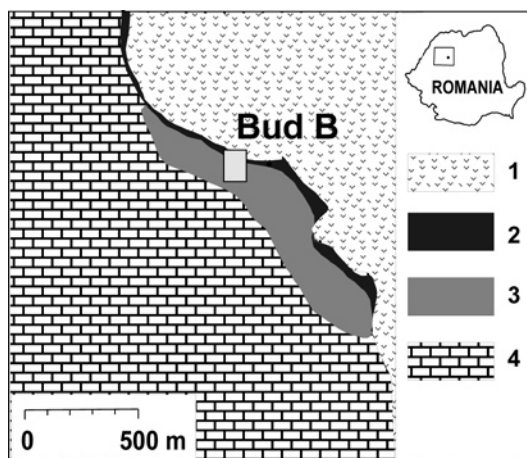


Fig. 1. The geological map of the Budureasa area with talc-tremolite occurrence (1 - granodiorite; 2 - skarn zone; 3 - predazzite zone; 4 - Triassic dolomites and limestones, Bud B - sample described).

The skarn zone of contact aureole ranges from 2 m up to 6 m of width and is mineralogically differentiated. Thirty samples have been collected in this zone, from several outcrops near Budureasa village. The aim of the study was the detailed mineralogical characteristics

of the mineral assemblages and paragenesis developed in the altered rocks, as well as the reconstruction of the TX_{CO_2} paths of the contact metamorphism. Hereby the talc-tremolite-calcite paragenesis, present in one sample from the outer part of the skarn zone of the contact aureole is described.

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METHODS

All samples were analysed by powder X-ray diffractometry (XRD) by means of a X'Pert APD Philips diffractometer, CuK α radiation and a graphite monochromator. The observations of crystal habits were performed with a Hitachi S-4700 scanning electron microscope (SEM) coupled with an energy dispersive spectrometer EDS (Noran Vantage) and petrographic microscope. BIO-RAD Fourier Transform Spectrometer (FTS 135) equipped with a Michelson interferometer was employed for infrared absorption analyses.

RESULTS

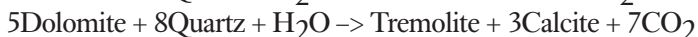
In the outermost part of skarn zone small lenses (some centimetres) of calc-silicate rock containing white fibrous mineral (tremolite) were noted. The XRD analyses allowed the identification of prevailing calcite and talc ($d_{hkl} = 9,38\text{\AA}$, $4,68\text{\AA}$; $4,56\text{\AA}$; $3,11\text{\AA}$). Additionally tremolite ($d_{hkl} = 9,38\text{\AA}$; $4,57\text{\AA}$; $3,34\text{\AA}$; $3,12\text{\AA}$, $2,51\text{\AA}$, $1,67\text{\AA}$ and $1,51\text{\AA}$), quartz and dolomite were detected. The FT-IR absorption spectroscopy data confirmed the XRD identification.

Microscope observations revealed abundant talc and carbonates with rare tremolite and quartz crystals. Talc crystals, of a size of micrometres up to one millimetre are intergrown with calcite (up to 2 mm) and colourless tremolite fibres. In the studied rocks tremolite crystals (up to 5 mm of length) are scarce (<5 vol. %) and forms fan-like structures. Petrographic and scanning electron microscope observations revealed that calcite, talc and tremolite are in mutual contact indicating that they constitute mineral paragenesis.

EDS point analysis show that talc from Budureasa is pure magnesium silicate, whereas tremolite contains small amounts of aluminium as well as chlorine.

DISCUSSION

The contact metamorphism of high-Mg rocks, in the presence of hydrous metamorphic fluids, led to the crystallisation of many hydrous mineral phases, including talc and tremolite. The presence of calcite and dolomite in all studied samples indicates that they were excess minerals in the alteration process. In the dolomites, during the contact metamorphism with the presence of silica, in low-pressure subvolcanic conditions, talc and tremolite may form in the following reactions:



The record of the talc and tremolite paragenesis suggests that the equilibrium conditions of the following reaction were established:



This univariant reaction was observed in a wide range 0.05 to 0.5 of mole fractions of CO_2 (X_{CO_2}) and at temperatures below 450°C (Fig. 2, solid line) Bucher and Frey (1994). The higher temperature bivariate field (marked as "tremolite" Fig. 2) requires talc dispersal.

SUMMARY

Talc-tremolite-calcite paragenesis occurs in association with quartz and dolomite in the outer zone of the contact aureole, caused by the intrusion of the Upper Cretaceous-Lower Paleocene granodiorite pluton into the Anisian dolomites. The presence of this paragenesis suggests low temperature (<450°C) metamorphic conditions. The composition of metamorphic fluid might have varied in the range of low X_{CO_2} , suggesting an open system conditions.

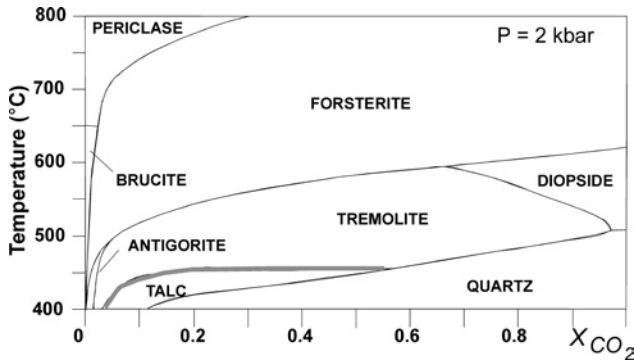


Fig. 2. TX_{CO_2} phase relationships in altered carbonates containing excess dolomite and calcite (Bucher and Frey 1994), with metamorphic reaction representing calcite-talc-tremolite paragenesis.

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