Fe-VERMICULITE PSEUDOMORPHS AFTER BIOTITE CRYSTALS FROM GRANODIORITES OF THE BRNO MASSIF (CZECH REPUBLIC)

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The occurrence of columnar euhedral “biotite” crystals with focus on their crystallochemical properties, mineral inclusions and alteration products from granodioritic rocks of the “Kralovo Pole” unit, Brno Massif, have been studied. Micromorphological descriptions, microprobe analysis and X-ray powder diffraction were used to investigate the chemical and structural changes and the mechanism of biotite breakdown into Fe-rich vermiculite during the alteration processes.

Apatite, ilmenite, magnetite, K-feldspar and oligoclase (plagioclase I) that developed at stages of magma crystallization represent the most abundant mineral inclusions in vermiculitized biotite crystals. Growth of secondary inclusions, represented by Fe-oxy-hydroxides, albite (plagioclase II), rutile and titanite, was caused by low-temperature hydrothermal reactions.

Biotite alteration products display a wide range of chemical compositions. Two main types of alteration products have been distinguished. Textural relationships suggest that the prevailing alteration type I is isovolumetric, without the evidence of apparent chemical zonal distribution and it primarily involves exchange of the interlayer K. The empirical formulas indicate that the altered biotite are essentially relatively free of octahedral Al, and that the tetrahedral sheets of biotite have a similar Si:Al ratio.

Examples of the slightly altered biotite from Brno-Židenice and Brno-Líšeň occurrences (calculated on 11 O):

$(K_{0.56}\ Ca_{0.05}\ Ba_{0.01}\ Na_{0.01})_{\Sigma 0.63}\ (Fe_{1.45}\ Mg_{1.14}\ Ti_{0.23}\ Al_{0.12}\ Mn_{0.02}\ \square_{0.04})_{\Sigma 3}\ (Si_{2.85}\ Al_{1.15})_{\Sigma 4}\ O_{10}\ [(OH)_{1.99}\ Cl_{0.01}]_{\Sigma 2}$;
$(K_{0.33}\ Ca_{0.10}\ Na_{0.01})_{\Sigma 0.44}\ (Fe_{1.47}\ Mg_{1.14}\ Ti_{0.24}\ Al_{0.12}\ Mn_{0.02}\ \square_{0.01})_{\Sigma 3}\ (Si_{2.86}\ Al_{1.14})_{\Sigma 4}\ O_{10}\ [(OH)_{1.98}\ F_{0.01}\ Cl_{0.01}]_{\Sigma 2}$.

Examples of the most altered biotite from Brno-Židenice and Brno-Líšeň occurrences (calculated on 11 O):

$(Ca_{0.16}\ K_{0.03}\ Na_{0.02})_{\Sigma 0.21}\ (Fe_{1.90}\ Mg_{1.08}\ Al_{0.22}\ Ti_{0.03}\ Mn_{0.02})_{\Sigma 3.25}\ (Si_{2.85}\ Al_{1.15})_{\Sigma 4}\ O_{10}\ (OH)_2$;
$(Ca_{0.32}\ K_{0.13}\ Na_{0.02})_{\Sigma 0.47}\ (Fe_{1.40}\ Mg_{0.96}\ Ti_{0.31}\ Al_{0.12}\ Mn_{0.02}\ \square_{0.19})_{\Sigma 3}\ (Si_{2.86}\ Al_{1.14})_{\Sigma 4}\ O_{10}\ [(OH)_{1.93}\ F_{0.07}]_{\Sigma 2}$.

From the structural point of view, it is evident that only vermiculite is the alteration product of biotite crystals. On the basis of X-ray diffraction data, mixed structures are not present there.

During alteration type II some phases develop along cleavage planes, initially near the edges of biotite crystal, but then strongly permeating into the body and subdivided segments. This process involves intensive cation exchange generally resulting in the decrease in interlayer K, Fe^{VI}, Al^{VI} and increase in interlayer Ca and tetrahedral Si. The values of octahedral Mg and Al are variable.

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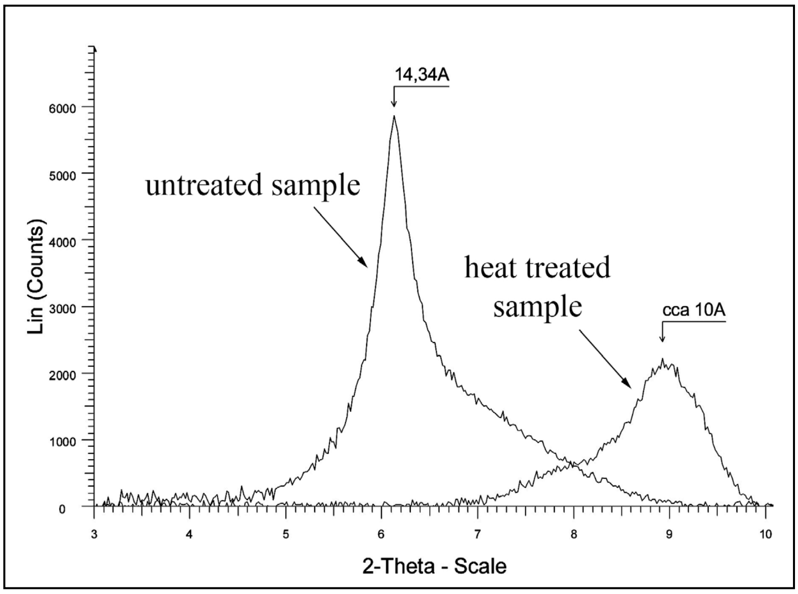

Fig. 1. *Shift of the basal 002 diffraction of vermiculite after heat-treatment of sample at 500°C and duration for 1 hour. Euhedral “biotite” crystal from Brno-Líšeň.*