AMPHIBOLE ZONATION AS A FUNCTION OF *P-T-X*CO_2-*f*O_2 IN BLUESCHISTS FROM THE AUSTROALPINE RECKNER NAPPE (EASTERN ALPS, AUSTRIA)

KLIER, R. & TROPPER, P

Faculty of Geo- and Atmospheric Sciences, Institute of Mineralogy and Petrography, University of Innsbruck, Innrain 52, A-6020 Innsbruck, AUSTRIA
e-mail: peter.tropper@uibk.ac.at

Within the Austroalpine Reckner Nappe, blueschists with the mineral assemblage aegirine-rich clinopyroxene + riebeckite + muscovite + chlorite + albite + hematite ± biotite ± stilpnomelane ± calcite ± dolomite occur. This assemblage formed in carbonates as well as cherts at the contact to serpentinites and is thought to have formed during a Tertiary high-*P*/low-*T* metamorphic event with *P-T* conditions of ca. 350 °C and 1.0 GPa (DINGELDEY et al., 1997).

The amphiboles and clinopyroxenes show complex chemical zoning. Amphiboles show a zonation from riebeckite in the core to winchite or actinolite in the rims. Clinopyroxenes show a very irregular chemical zoning, are mostly aegirine-rich, but also show diopside- or jadeite-rich areas and contain abundant hematite inclusions in the core. Amphibole zoning can be explained by a combination of the following chemical vectors:
Riebeckit + Glaukophan => Arfvedsonit + Eckermannit $\square^{A}{}_{-1}(Al,Fe^{3+})^{M2}{}_{-1}Na^{A}(Mg,Fe)^{M13}$
Riebeckit + Glaukophan => Winchite => Tremolit + Actinolith $Na^{M4}{}_{-1}(Al,Fe^{3+})^{M2}{}_{-1}Ca^{M4}(Mg,Fe)^{M13}$, Arfvedsonit + Eckermannit => Tremolit + Actinolith $Na^{A}{}_{-1}Na^{M4}{}_{-2}(Al,Fe^{3+})^{M2}{}_{-1}\square^{A}Ca_2{}^{M4}(Mg,Fe)^{M13}$ In order to put quantitative constraints on the formation of the amphibole zonation, we evaluated three mineral equilibria in the system NCFMASHOC among the mineral assemblage $amphibole_{ss}$ + $clinopyroxene_{ss}$ + chlorite + calcite + dolomite + hematite + albite + quartz in *P-T-X*CO_2-*f*O_2 space. Textural observations indicate that the riebeckite-rich cores formed by a reaction involving the breakdown of the assemblage aegirine + hematite according to the following model reaction (1): 8 Aegirine + 24 Diopside + 6 Hematite+ 16 Jadeite +24 CO_2 + 12 H_2O -> 24 Calcite + 8 Glaucophane + 4 Riebeckite + 3 O_2. The reactions which lead to the formation of the amphibole zonation towards Ca-rich amphibole compositions are thought to be: 30 Dolomite + 2 Chlorite + 70 Quartz + 2 Riebeckite -> 4 Albite + 2 Actinolite + 8 Tremolite + 10 Calcite + 50 CO_2 + 1 O_2 (2) and 20 Aegirine + 130 Dolomite + 10 Chlorite + 310 Quartz -> 20 Albite + 4 Actinolite + 36 Tremolite + 50 Calcite + 210 CO_2 + 5 O_2 (3). The initial formation of amphiboles by reaction (1) requires in a *P-T* diagram either decreasing *P* or increasing *T*, in *T-X*CO_2 either decreasing *T* or increasing *X*CO_2 and in *T-log*fO_2 increasing T and decreasing fO_2. Reactions (2) and (3) require in *P-T* either decreasing *P* or increasing *T*, in *T-X*CO_2 either decreasing *T* or decreasing *X*CO_2 and in *T-log*fO_2 increasing *T* and decreasing fO_2.
These reactions indicate that *X*CO_2 and fO_2 play an important role, since amphibole formation requires increasing *X*CO_2 and the formation of Ca-rich amphiboles requires a decrease in *X*CO_2. In addition, all reactions require a decrease in fO_2 during the evolution of these rocks.

Reference

DINGELDEY, C., DALLMEYER, R.D., KOLLER, F & MASSONNE, H.-J. (1997): Contrib. Mineral. Petrol., 129, 1-19.