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THE METAMORPHIC EVOLUTION OF THE TARNTAL NAPPE

by

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The Tarntal Nappe is a complex geologic unit which consists of low-grade metamorphic sediments and a dismembered ophiolite body, and is tectonically emplaced between the contact of the Austroalpine Innsbrucker Quarzphyllitnappe and the Penninic Glocknernappe at the northern margin of the Tauern Window (Tirol, Austria). During the Alpine metamorphic overprint, blueschists formed at the contact between the metasedimentary units and the ultramafic units of the ophiolite within the Tarntal Nappe. DINGELDEY (1997) obtained metamorphic peak P-T conditions of 350°C and 8 to 10.5 kbar. The age of the metamorphic overprint was dated with 40-50 Ma depending on the tectonic position of the samples. It was the aim of this study to establish the P-T path of the blueschists based upon textural relations and thermobarometric calculations, since these rocks represent the most interesting rocks and are characterized by the following mineral assemblage: albite + Mg-riebeckite + chlorite + stilpnomelane + hematite + quartz + muscovite ± calcite ± aegirine ± biotite ± talc ± tourmaline.

The P-T path was constrained based upon the following observations:

(1) Textural observations indicate that the aegirin-rich clinopyroxenes formed along the prograde P-T-path along the reaction albite = jadeite - aegiriness + quartz.

(2) Further P increase at constant T lead to the overstepping of the following reaction around 11 kbar: clinochlore + 3 phlogopite + 15 quartz = 2 celadonite + muscovite + 4 talc which was experimentally calibrated by MASSONNE & SCHREYER (1989). This reaction represents the lower P limit of the assemblage phengite + talc in the presence of chlorite, phlogopite and quartz, which was actually found in one sample.

(3) During the prograde metamorphic evolution, a possible change in the fluid composition resulted in a shift of the following reaction towards higher T: 8 aegirine + 24 diopside + 6 hematite + 16 jadeite + 24 CO_2 + 12 H_2O = 24 calcite + 8 glaucophane + 4 riebeckite + 3 O_2.

This lead to the formation of amphibole (riebeckite-glaucophane)-bearing assemblages instead of clinopyroxenes (aegirine-jadeite) and can be achieved by either an increase in $a_{(H2O)}$ or a decrease in f_{O2}. Thus this shift easily explains the textural relationship between the praedeformativly grown clinopyroxenes and the syn- to postdeformativly grown amphiboles.

(4) P-T conditions of 13 kbar and 370°C have been calculated for the assemblage phengite + muscovite + biotite + chlorite + talc with the thermodynamic dataset of BERMAN (1988, 1992, written comm.) and the dataset of MASSONNE (1997, written comm.). Using the dataset of HOLLAND & POWELL (1998) for the yields 12 kbar and 300°C. These data represent the P-peak of this metamorphic overprint.

(5) The chemical zonation of the amphiboles with Mg-riebeckite in the core and winchite or actinolite composition in the rims can be explained by a P decrease and thus overstepping of the following reaction: 30dolomite + 2chlorite + 70quartz + 2riebeckite = 4albite + 2actinolithe + 8tremolite + 10calcite + $50CO_2$ + $1O_2$

References

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