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Genesis of a Na-Ca rich layer near Traföß: evidence from mineralogical and stable isotope data

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The Traföß ultramafic rocks of the Speik unit are situated on the northeastern edge of the Gleinalm metamorphic core complex. The Traföß ultramafics are serpentinites with antigorite and crysotile as main minerals. Characteristic for these serpentinites are the presence of layered ultramafics with clinopyroxene, olivine and actinolite rich levels (Neubauer, 1988). On the Mur valley, near Traföß, within the serpentinites, a 50 cm thick white-greenish layer occurs. For this unit, it is the only occurrence of this rock type. The green spots are composed by amphibole, chlorite and subordinately pyroxene, the white areas consist of zeolites, feldspar and calcite.

The chemistry of amphiboles indicates that they belong to the actinolite, pargasite/edenite group. The pyroxene is an augite, most probably with a magmatic origin. The white matrix is composed of zeolites and feldspars. X-Ray data indicate the presence of Natrolithe $Na_4Al_4Si_6O_{20}*4H_2O$ and Thomsonite $(Ca,Na,Sr)_{12}(Si,Al)_{40}O_{80}*24H_2O$. Microbeam analyses indicate the presence of Sr-Thomsonite $(Sr_{7,06}Na_{4,34}Ca_{0,50})_{11,90}(Al_{18,44}Si_{21,28})_{39,72}O_{40}$*. World wide, beside Traföß, Sr-Thomsonite has been found only on the Kola peninsula, which is its type locality. In the zeolite matrix, 20 microns large Celsian $(Ba_{0,94}Ca_{0,04}Na_{0,02}K_{0,01})_{1,01}(Al_{1,94}Si_{2,05})_{3,99}O_8$* inclusions are present. Subordinately, native copper, magnetite, chromite, ilmenite, a silver gold alloy as well as zircon and titanite were put in evidence. The zeolites and feldspars are partially replaced by calcite. The contact to the serpentinite is characterized by the presence of some tenth of centimeter thick zone with amphibole and chlorite.

The isotopic values of antigorite show high δD (52 - 68‰) and low $\delta^{18}O$ values. These values are characteristic for oceanic serpentinites formed at moderate temperature (350°C±50) in the presence of a fluid dominated by oceanic water. As the system evolved during amphibolite facies metamorphism without the participation of an external fluid, the primary ocean floor isotopic signature has been preserved. The δD values of actinolite and chlorite within the transition zone and the green-white layer show lighter values, between -69 to -95‰. These values are interpreted to represent local infiltration of an external fluid during the formation of the metasomatic body. Further investigations on oxygen and carbon isotopic signature of silicates and carbonates are in progress.

Discussions: The described mineral association of the white-green layer is interpreted to represent a metasomatised magmatic layer within the serpentinites. Such metasomatic bodies within the serpentinites are known as rodingite. Generally they are enriched in Ca, and composed of Ca-rich phases as grossular, vesuvian, clinozoizite, Ca-amphibole etc.. In this case, the described metasomatic body is characterized by the presence of Ca- as well as of Na-rich phases. The Sr- and the Ba-contents are also much higher than these of the surrounding rocks. Augite and Chromite are interpreted as the only primary magmatic relicts. Actinolite and chlorite are formed during metamorphism, and replaced during the cooling path with zeolites and calcite. The isotopic signature of serpentinites shows the preservation of the primary signature of an oceanic serpentinite. Local infiltration of an external fluid was responsible for the formation of the metasomatic body.

The described rocks display parageneses different to the typical ones for rodinigites or albitites. We propose the following steps for the formation of the above described rocks found at Traföß:

1) Metasomatism of the serpentinite hosted protolith (mafic rock protholit?). The rock was formed under low oxygen fugacity as indicated by the presences of copper. Hydrogen isotopic composition of host rocks is characteristic for oceanic serpentinites formed at moderate temperatures (350°C±50) in the presence of a fluid dominated by oceanic water. As the system evolved during amphibolite facies metamorphism without the participation of an external fluid, the primary ocean floor isotopic signature has been preserved.

2) During regional metamorphism, amphiboles, feldspars and chlorite formed within the metasomatic body. The hydrogen isotopic values, much lower of that of the host rock, are interpreted to indicate local infiltration of an external fluid during amphibolite facies metamorphism. The small actinolite-chlorite-zone between the host rock and the metasomatite could represent an altered serpentinite.

3) During retrograde cooling, the feldspars were replaced by zeolites and finally by calcite. The extensive zeolitisation suggest high fluid availability on the retrograde metamorphic path. The presence of calcite indicate that, at least during the last mineral building

phase the CO_2 fugacity of the fluids was high. The isotopic composition of the calcite supports formation temperatures lower than 100°C.

References

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