

Metamorphic age of the eclogites from the Lake Zone, SW Mongolia

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The Alag Khadny metamorphic complex in the Lake Zone, SW Mongolia, which is located in the central part of the Central Asian Orogenic Belt, consists mainly of orthogneisses and minor micaschists interleaving marbles including lenses of garnet-chloritoid schists of the Maykhan Tsakhir Formation. Eclogites occur as lenses and boudins in the matrix of orthogneisses and minor micaschists. The peak metamorphic conditions for the eclogites were estimated to be high P/T conditions of $T=590-610^{\circ}\text{C}$ and $P=20-22.5$ kbar (Stipska *et al.*, 2010), in contrast the pressure conditions of the garnet-chloritoid schists ($P=10-11$ kbar) are distinctly lower than those of the eclogites, whereas temperature conditions ($T=575-585^{\circ}\text{C}$) are similar (Otgonkhuu *et al.*, 2012).

We discovered the amphibole-rich veins (up to 5 mm in width) are developed in the eclogite bodies. Two types of amphibole-rich veins are distinguished based on the mineral assemblage, i.e. amphibole-sodic plagioclase-phengite (Amp-NaPl-Ph) vein and amphibole-quartz (Amp-Qz) vein. Amp-NaPl-Ph vein consists mainly of amphibole (barroisite), sodic plagioclase, phengite with minor amounts of titanite and quartz. Amp-Qz vein consists of quartz and amphibole (tremolite).

Amphiboles in the Amp-NaPl-Ph vein occur as subhedral prismatic crystals and they are up to 0.5 mm long. They show compositional zoning from barroisite ($\text{Si}=6.97-7.20$ pfu, $\text{Na}_B=0.52-0.68$ pfu, $\text{K}_2\text{O}=0.37-0.46$) cores to Mg-hornblende and/or edenite ($\text{Si}=6.56-7.41$ pfu, $\text{Na}_B=0.22-0.48$ pfu, $\text{K}_2\text{O}=0.18-0.74$) rims with rarely actinolite ($\text{Si}=7.50-7.57$ pfu, $\text{Na}_B=0.07-0.35$ pfu, $\text{K}_2\text{O}=0.10-0.26$) outer-most rims. Whereas the amphiboles in the Amp-Qz vein occur as subhedral prismatic crystals, up to 3 mm long in the matrix of quartz. They show compositional zoning from tremolite ($\text{Si}=7.58-7.62$ pfu, $\text{Na}_B=0.31-0.42$ pfu, $\text{K}_2\text{O}=0.09-0.14$) cores to Mg-hornblende rims ($\text{Si}=7.27-7.49$ pfu, $\text{Na}_B=0.17-0.44$ pfu, $\text{K}_2\text{O}=0.04-0.19$) with rare actinolite ($\text{Si}=7.50-7.67$ pfu, $\text{Na}_B=0.09-0.42$ pfu, $\text{K}_2\text{O}=0.06-0.16$) outer-most rims. Sodic plagioclases ($\text{An}=1-14$) in the Amp-NaPl-Ph vein are of anhedral grain, intercalated with amphiboles and phengites. Phengites ($\text{Si}=6.64-6.92$) in the Amp-NaPl-Ph vein occur as subhedral crystal, up to 0.5 mm across.

The geothermometer of amphibole-plagioclase (Holland and Blundy, 1994) and the geobarometer of Si content of phengite (Massonne and Schreyer, 1987) have been applied for the approximate $P-T$ conditions of Amp-NaPl-Ph vein developed in the eclogites. The cores of barroisite and intercalated plagioclase with highest anorthite component ($\text{An}=14$) suggest temperature conditions of $540-580^{\circ}\text{C}$. Si contents of phengite (6.64-6.92 pfu) suggest pressure conditions of >10 kbar.

We obtained K-Ar ages of the Amp-NaPl-Ph vein [603 \pm 15 Ma (amphibole) and 612 \pm 15 Ma (phengite)] and Amp-Qz vein [602 \pm 15 Ma (amphibole)], and we interpret the ages of c. 600 Ma as exhumation age of the eclogite bodies. The obtained ages of the eclogites are distinctly older than $^{40}\text{Ar}/^{39}\text{Ar}$ phengite ages of c. 540 Ma from the eclogites and garnet-chloritoid schists (Stipska *et al.*, 2010), which are located about 2 km east from the present localities of the veins. These suggest that the eclogites were once exhumed at c. 600 Ma from the high- P conditions and juxtaposed with the garnet-chloritoid schists, and the amalgamated sequence of metamorphic rocks was then exhumed together to shallower crustal levels at c. 540 Ma.

References:

- Holland and Blundy (1994) *Contributions to Mineralogy and Petrology*, 116, 433-447.
- Stipska *et al.* (2010) *Journal of Metamorphic Geology*, 28, 915-933.
- Massonne and Schreyer (1987) *Contributions to Mineralogy and Petrology*, 96, 212-224.
- Otgonkhuu *et al.* (2012) *Japan Geoscience Union Meeting 2011*, session S-MP46 (abstract).

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