

## Multiple events of metamorphism in lenses of eclogite within marbles of Maykhan Tsakhir Formation, Lake Zone, Mongolia

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The eclogite-bearing Alag Khadny metamorphic complex in the Lake Zone, SW Mongolia located in the central part of the Central Asian Orogenic Belt, consist mainly of orthogneisses which interleaving with marbles including lenses of garnet-chloritoid schists of Maykhan Tsakhir Formation. Eclogites have two modes of occurrence, i.e. lenses and boudins *eclogite-1* in orthogneisses and *eclogite-2* in marbles. Thermocalc calculations for the peak eclogite facies metamorphism for *eclogite-1* with the assemblage of Grt + Omp + Brs ± Ph ± Ep yielded 570-630 °C and 22-25 kbar (Javkhlan et al., 2013a). In contrast, pressure conditions of the garnet-chloritoid schists (10-11 kbar) are distinctly lower than those of the eclogite-1, whereas temperatures (560-590 °C) are similar (Javkhlan et al., 2013b).

*Eclogite-2* in marbles consists of small grains of garnet (<0.1 mm) and omphacite with minor amounts of amphibole, epidote, paragonite, plagioclase, chlorite, calcite, biotite, quartz, titanite and rutile. The matrix of *eclogite-2* shows a pseudomorphous texture, where small grains of garnet crowd cemented by titanite forming isomorphous round shape. Some of cores of garnet grain contain relics of garnet ( $X_{Ca}=0.32-0.42$ ;  $X_{Mg}=0.06-0.08$ ) indicating previous mineral were larger porphyroblastic garnet. In addition, small grains of omphacite forming rectangular prismatic nature surrounded by garnet grains.

Garnet grains have compositionally zoning with core ( $X_{Ca}=0.08-0.20$ ;  $X_{Mg}=0.10-0.16$ ), mantle ( $X_{Ca}=0.24-0.39$ ;  $X_{Mg}=0.08-0.17$ ), rim ( $X_{Ca}=0.22-0.26$ ;  $X_{Mg}=0.18-0.23$ ) and outer-rim ( $X_{Ca}=0.20-0.22$ ;  $X_{Mg}=0.12-0.18$ ). Few omphacites preserved their core ( $X_{Jd}=0.27-0.31$ ;  $Fe_2O_3=1.34-2.22$  wt%) whereas most of grains have compositional heterogeneity with  $X_{Jd}$  from 0.34 to 0.48 ( $Fe_2O_3=0.04-2.31$ ) and locally with rims of higher  $Fe_2O_3$  (3.79 wt%)-bearing omphacite ( $X_{Jd}=0.32$ ). Omphacites partially replaced by symplectites of Pl (An=15-17), amphibole (Ed, Act, Mg-hbl) and Ep. Three types of amphibole are distinguished by their texture, amphibole (Amp1) [zoned with Act ( $X_{Mg}=0.79-0.81$ ) core, Brs ( $X_{Mg}=0.54-0.69$ ) mantle and rims with Ts, Mg-Trm and Prg in compositions] coexisting with Grt and Omp, poikiloblastic barroisitic amphibole (Amp2) ( $X_{Mg}=0.65-0.75$ ) containing eclogitic minerals of Grt and Omp with their symplectitic assemblage and finally actinolitic amphiboles (Amp3) partially replacing Omp and Grt.

Based on the textures we distinguished two metamorphic events, i.e. eclogite facies metamorphism and poikiloblastic barroisitic amphibole metamorphism. The peak eclogite facies metamorphism characterized by assemblages of Grt (mantle) + Omp + Amp1 (Brs) + Ep + Pg + Rt. Thermocalc calculation yielded  $487 \pm 46$  °C and  $19.7 \pm 2.1$  kbar (sigfit=1.80). Thermocalc calculation of Grt (rim) + Omp (rim) + Amp1 (Mg-Trm) + Ep + Pl yielded  $666 \pm 45$  °C and  $13.7 \pm 1.6$  kbar (sigfit = 2.11) suggesting a decompression stage after the eclogitic metamorphism. The poikiloblastic barroisitic Amp2 shows decreasing Si (7.01-6.69 pfu) and increasing NaB (0.61-0.70 pfu) from core to rim, suggesting that the Amp2 grew after the peak eclogite facies metamorphism, and probably during the second prograde metamorphic event. Approximate P-T conditions of the poikiloblastic barroisitic Amp2 are estimated as 5-7 kbar at c. 450 °C.

<sup>40</sup>Ar/<sup>39</sup>Ar muscovite ages for eclogites ( $543 \pm 3.9$  Ma) in marbles (probably eclogite-2) and the garnet-chloritoid schists ( $537 \pm 2.7$  Ma) were determined (Stipska et al. 2010). K-Ar ages for eclogite-1 [ $603 \pm 15$  Ma,  $602 \pm 15$  Ma (Amp) and  $612 \pm 15$  Ma (Ph)] within orthogneisses have been obtained (Javkhlan et al., 2014). These ages are interpreted as the exhumation ages for the eclogites (-1 and -2) and the garnet-chloritoid schists.

The peak temperature conditions of eclogite-2 considerably lower than eclogite-1 whereas the pressure conditions are similar. The peak P-T conditions garnet-chloritoid schists are correlated with the poikiloblastic Amp2 metamorphism of the eclogite-2.

Keywords: eclogite-2, pseudomorphous texture, garnet-chloritoid schists, Maykhan Tsakhir Formation, Lake Zone, SW Mongolia