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Metamorphic P-T evolution and fluid inclusion study of Bodonch, Zereg, Sharga and Altai areas, Southwestern Mongolia

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The Altai Orogen in the southwestern margin of the Central Asian Orogenic Belt (one of the largest accretionary and collisional orogen in the world) extends from Russia and East Kazakhstan to the west, through Northern China, to southwestern Mongolia to the east. It contains various volcano-sedimentary rocks that were deformed and metamorphosed under various pressure-temperature (P-T) conditions from greenschist to amphibolite and partly granulite facies. We report first detailed petrological and fluid inclusion data of pelitic schists and mafic rocks from Bodonch, Zereg, Sharga, and Altai areas, southwestern Mongolia, which occupy a significant part of the Paleozoic history of the Altai Orogen in the southwestern margin of the Central Asian Orogenic Belt (or Altaids), and discuss P-T evolution of the area.

Zereg, Sharga, and Altai areas contains mafic to ultramafic rocks and pelitic schists with various mineral assemblages such as amphibole + plagioclase + muscovite + chlorite + calcite, serpentine + olivine + chromium spinel + iron oxide, serpentine + olivine + clinopyroxene + talc, chlorite + muscovite + plagioclase + quartz + ilmenite. In the context of traditional terrain tectonics (Badarch et al., 2002) the belt belongs to the Hovd and Dariv terrains and classified as accretionary wedge and metamorphic belt with uncertain tectonic affinity.

Bodonch area contains pelitic schists and amphibolites with various mineral assemblages such as garnet + kyanite + staurolite + biotite + plagioclase, garnet + biotite + staurolite + cordierite, and amphibole + quartz + plagioclase + garnet + ilmenite.

We performed detailed petrologic, geothermobarometric and mineral equilibrium modelling studies on the rocks from Bodonch area and obtained peak P-T condition of 640-690^{0}C /6.3-10.7 kbar and clockwise path from the area. The peak high-pressure amphibolite-facies condition and clockwise P-T evolution of the area estimated for the first time in this study is consistent with available reports of other localities in the Altai Orogen outside Mongolia. Three categories of fluid inclusions have been observed in quartz: dominant primary and secondary inclusions, and least dominant pseudosecondary inclusions. As quartz in the samples are texturally associated with biotite, kyanite, and staurolite, which were probably formed during peak metamorphism, we regard that the primary fluid inclusions trapped in the quartz grains probably preserve peak metamorphic fluids. The melting temperatures of all the categories of inclusions lie in the narrow range of -57.5 to -56.6^{0}C, close to the triple point of pure CO_2. Homogenization of fluids occurs into liquid phase at temperature range between -33.3 to +19.4^{0}C, which convert into densities in the range of 0.78 to 1.09 g/cm^3. The results of this study, together with the primary and pseudosecondary nature of the inclusions, indicate CO_2 was the dominant fluid component during the peak amphibolite-facies metamorphism of the study area. Therefore, this is a rare example of CO_2 -rich fluid inclusions trapped in amphibolite-facies rocks.

Keywords: fluid inclusion, mineral equilibrium modeling, Altai Orogeny, Central Asian Orogenic Belt, Mongolia