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High-pressure metasomatism in the mantle wedge: insight from the Ti-clinohumite-bearing ultramafic rocks of the Maksyutov Complex, south Ural Mountains, Russia

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Metamorphic fluids released from the subducting plates are crucial for metamorphic, metasomatic and magmatic processes that operated in subduction zone settings. A record of these processes in the mantle wedge rocks is limited, however, because the ultramafic rocks are not widespread in (U)HP metamorphic complexes or they have been affected by considerable alteration during the retrogression. Here we report results of the detail petrologic study of the meta-ultramafic rocks from the Middle Paleozoic Maksyutov Complex. The Complex is divided in three fault-bounded lithologic units [1,2]: polymetamorphic HP–UHP unit #1, consisting of micaschists and quartzites (including diamond-bearing varieties [3]) containing boudins and lenses of eclogites and meta-ultramafic rocks; a meta-ophiolitic unit #2 that experienced blueschist-facies metamorphism and greenschist-facies retrogression; and, #3 a metasedimentary blueschist-facies Yumaguzinskaya unit.

Ultramafic boudins (from 10 m to 200 m in size) are concordant with the country rocks (metasedimentary rocks) of the HP–UHP unit. Fresh samples are composed predominantly of a granoblastic aggregate of olivine grains with accessory chromian spinel. The olivine contains inclusions of Ti-clinohumite and ilmenite. Most of the ultramafic rocks are characterized by three types of high-pressure, fluid-controlled replacements of olivine: (1) prismatic orthopyroxene crystals commonly with radial aggregation; (2) intergrowths of orthopyroxene and magnesite; and, (3) aggregates of Cr-rich chlorite and magnesite. Based on the textural observations, all the replacements were occurring in the rock simultaneously at the beginning of exhumation stage, thus implying that activities of CO_2 and H_2O in the COH fluid have been variable on a local scale (less than cm), likely due to buffering of the fluid components by the mineral reactions. Growth of the orthopyroxene at the expense of olivine might be explained by the high-pressure reaction between olivine with silica (in fluid), whereas the development of the orthopyroxene–magnesite association is due to the reaction of olivine with CO_2 fluid [4]. The most retrogressed samples are represented by tremolite–chlorite schists, which indicates an influx of Ca- and Al-bearing hydrous fluid at LP/LT conditions.

The complex petrotectonic evolution of the meta-ultramafic rocks and the sources of COH fluids (in carbonate-free complexes) will be discussed within the scope of the development of a subduction channel.

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