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4 types of Ca-Amp found from Nove Dvory UHP eclogites and their origin, Moldanubian Zone of the Bohemian Massif

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Meta-mafic rocks underwent ultra-high pressure (UHP) conditions tend to be anhydrous with bi-mineralic mineral assemblage of garnet and omphacite (Schmidt & Poli, 1998). The studied sample, ND0107, collected at Nove Dvory, Czech Republic, also comprises mainly of garnet (Grt) and omphacite (Omp) with accessory minerals of rutile (Rt), ilmenite (Ilm), apatite (Apt). However, 4 types Ca-amphiboles (Amp-Ia, Ib, Ma, and Mb) are identified based on the different modes of occurrence. Amp grains identified in garnet are named Amp-I and those in the matrix are named Amp-M. Amp-I is subdivided into Amp-Ia and Amp-Ib. Amp-Ia (40um in long dimension) appears as a member of multi-phase solid inclusions (MSI) which show a sporadic distribution in garnet, and shows a close association with Omp maintaining UHP stage compositions with/without Rt. Amp-Ib (5-50um) appears as a member of aligned anhedral inclusions in Grt, associated with diopside (Di) and spinel (Spl), which are stable at relatively low pressure conditions. Amp-M occurs as a member secondary minerals developed between Grt and Omp, and it is subdivided into Amp-Ma and Amp-Mb based on whether they are associated with Pl or not. Amp-Ma (10um in long dimension) is developed interstitially between Grt and Omp and is not associated with plagioclase (Pl). The incipient stage of Amp-Ma formation can be represented by the alternation of idiomorphic Amp-Ma interspacing saw-blade shaped rim of garnet, and by subsequent transformation of saw-blade shaped part of garnet into fine-grained symplectite composed of Di, Spl, and hematite (Hem). Amp-Mb (>5-50um in long dimensions) is also developed interstitially between Grt and Omp but is associated with Pl. On the garnet-side of Amp-Mb, the fine-grained symplectite composed of Di, Spl, and Hem sometimes appears. The outline of the fine-grained symplectite resembles the saw-blade shaped rim of garnet which is interspaced by Amp-Ma, suggesting that Amp-Mb was formed at later stage of exhumation than Amp-Ma. Four types of Amp are mainly classified as pargasite (Prg). Amp-Ia and Ma are almost K-free but Amp-Ib and Mb contains up to 0.3pfu of K. Mg# ascends in the order of Amp-Ib, Ia, Mb, and Ma (70-82, 77-85, 80-93, 87-92, respectively). All types of Amp contain F as shown as follows; Ia: 0.07-0.2pfu; Ib: 0.02-0.28pfu; Ma: 0.10-0.16pfu; Mb: 0.05-0.16pfu, but a significant amount of Cl is identified only in Amp-Ib (0.10-0.30pfu). Modes of occurrence of Amp and compositions of neighboring Grt and Omp suggest that Amp-Ib, Ma, and Mb were generated by later stage fluid activity accompanying with decompositions of Grt and Omp. Since the studied eclogite is bi-mineralic at the UHP stage, K, F, and Cl in secondary Amp should be supplied by the infiltrated fluids. In contrast, Amp-Ia seems like to be equilibrated with Grt and Omp rather than to be generated by decomposition of Grt and Omp. The maximum pressure limit of Prg is known to be 2-3GPa (Gilibert, 1969), but it expands to higher pressures by incorporation of F in Prg (Holloway & Ford, 1975). High X_F (= F/(F+Cl+OH) >0.4) is required for Prg to be stable at the peak metamorphic conditions of Nove Dvory. However, Amp-Ia yields low X_F (<0.1), and thus is considered to be a prograde relict.

Keywords: UHP, eclogite, amphibole, fluid