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Textural and chemical relationships between amphibole and peridotitic phases in Ichinomegata mantle xenoliths

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Ichinomegata is very well-known volcano within the petrological community. The volcano is located in north-western Honshu (Japan) and consists of three explosion craters, where basalt and calc-alkaline andesite hosting a variety of mafic and ultramafic xenoliths of deep-seated origin can be found. The locality represents the first, so far among the few, where mantle xenoliths from mantle wedge are brought to the surface by calc-alkaline s.l. lavas. Notwithstanding, after a first batch of studies back in the eighties, no recent studies have been carried out on this famous area. In this preliminary work, three amphibole-spinel-bearing peridotites (two harzburgites - ICH-02, ICH06 - and one cpx-poor lherzolite - ICH-08) are considered. Irrespective of the classification it is however to be noted that the modal content of cpx varies from 3 to 6%. A detailed petrographic studies, mainly focussing on the relationships between orthopyroxene (opx), clinopyroxene (cpx) and amphibole (amph), coupled with major and trace element analyses of the same phases were carried out. The three xenoliths range from protogranular to porphyroclastic and granoblastic in texture with a medium to coarse grain size. Olivine (Ol) and opx are usually strained, with opx showing abundant exsolution lamellae. Clusters of medium-grained and mainly strain-free ol and opx as well as fine-grained aggregates of anhedral opx, cpx and amph are common. On the basis of Fe/Mg partitioning between the peridotitic phases the thermal history of these samples has been evaluated, taking into account that the scarce presence of amphibole does not affects the results. A nearly perfect chemical homogeneity is shown for ol-opx and ol-sp pairs, while cpx is extremely zoned and not in equilibrium with the other minerals. All the samples are originally equilibrated at about 900°C, with the lowest temperature (about 850°C) recorded in the most depleted harzburgite ICH-02. This harzburgite has the most residual character with mg# (MgO/(MgO+FeOt) mol%) of ol and opx in the range of 0.91-093 and 0.90-0.91 respectively. $Al2O_3$ contents in opx are lower than 3.29 wt%. ICH-02 contains less than 3% of cpx with large intergranular and intragranular chemical zonation (i.e: Ti, Al and mg#). In contrast, the coexisting amphibole is compositionally homogeneous and shows the highest mg# (0.89-0.90) and the lowest Al and Ti contents. Coherently cpx and opx show the lowest HREE contents (YbN = 1.65-1.94 and YbN = 0.31-084 respectively)and slightly depleted to flat REE patterns. Amphiboles mimic the cpx patterns for the H-MREE, but results more depleted in LREE with respect to the coexisting cpx. The three phases are characterized by a remarkable Sr positive anomaly. The lherzolite ICH-08 represents the least depleted sample with the highest modal cpx content (ca. 6%). This fertile character is reflected in ol (mg# 0.90) and opx (mg# 0. 90; $Al2O_3$ = 2.67-5.36 wt%), but not in cpx (mg# 0.90-0.92) which has geochemical features similar to those of harzburgite ICH-06. The spinel $Al2O_3$ contents (49-55 wt%) would indicate a more fertile lithology than that represented by cpx-poor ICH-08 lherzolite. ICH-08 cpx and amph have the highest REE values and a steeply LREE- depleted profiles, accompanied by a Th and U large positive and a slightly negative Sr anomalies. Among the three samples amphiboles in ICH-08 are extremely depleted in Nb. Major element composition of peridotitic phases of ICH-06 is well comparable with those of ICH-08. Coherently, its cpx result homogeneous in trace elements contents with patterns similar to those of ICH-08. By contrast amphiboles show quite different REE contents, ranging from the most depleted to the most fertile compositions. They have however similar homogenous contents of the most incompatible elements (LILE, Th, U and Nb). On the whole, opx are similar in REE profiles with the Ti and Zr positive anomies commonly observed in the shallow lithospheric mantle. Amphiboles have lower mg# values with respect to the coexisting cpx, far from the Fe/Mg equilibria between the two phases. Spinels results too rich in aluminium with respect to the peridotite parageneses. Work is in progress in order to put this information in a coherent petrological framework, understand the process/es responsible for amphibole formation and highlight the textural and chemical relationships between the various phases and the physico-chemical conditions of the mantle wedge beneath Ichinomegata volcano.