LARGE Cl/F VARIATIONS OF APATITES FROM IMPACT MELT PORTION IN L-MELT BRECCIA NORTHWEST AFRICA 7251.

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Introduction: Apatite is the major volatile-bearing mineral in meteorites. The large Cl/F variations in apatites have been reported in several differentiated meteorite samples, such as martian samples [1,2], but was rarely observed in ordinary chondrites and primitive achondrites [3,4]. Here we report apatites with large Cl/F variations found in the impact melt portion of Northwest Africa (NWA) 7251.

Petrography: NWA 7251 mainly consists of three parts: the chondrite host, impact-melt portion (IMP) and impact melt vein (IMV). It was previously classified as an L-melt rock [5]. Due to the occurrence of chondritic portion, we consider that the classification of "melt breccia" is more appropriate for NWA 7251. The host is an L4 chondrite with a shock degree of S4. Apatites in the host occur as anhedral-to-euhedral grains with sizes up to 60 µm (Fig.1a). They are usually intergrown with irregular Fe-Ni metals and troilite nodules. The impact melt portion has a fine-grained igneous texture, composed of euhedral olivine, pyroxene phosphate, Fe-Ni metal and troilite set in interstitial albitic glass, with some olivine/pyroxene-rich fragments and vesicles. Apatites in the IMP usually occur as clusters and are small in grain size (<20 µm). They are intergrown with interstitial albitic glass or metals (Fig.1b). Locally, some merrillite grains are rimmed by apatites (Fig.1c). Compared to IMP, the impact melt vein has similar mineral chemistry but with much small grain sizes (<10 µm). Most apatites in the IMV are anhedral-to-subhedral grains with sizes of <10 µm and associated with metal-sulfides droplets (Fig.1d). The detailed petrography and mineral chemistry was described in [6].

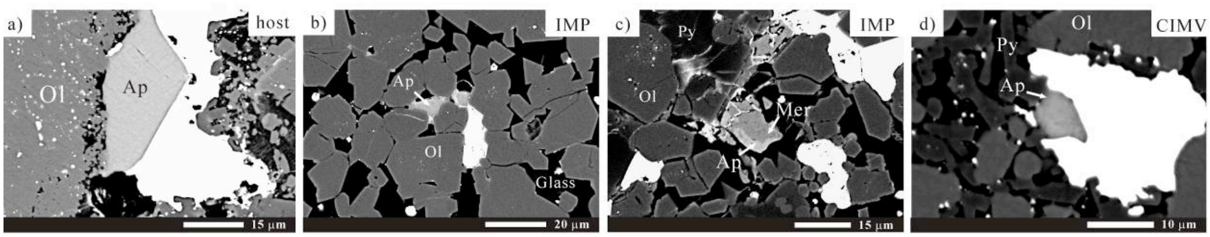

Fig.1. BSE images of apatites in chondrite host (a), impact melt (b-c), and impact melt vein (d) in NWA 7251

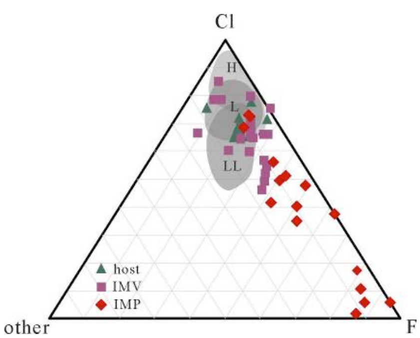

Fig.2. Apatite atomic Cl-F-Other anion ternary diagram for NWA 7251.

Apatite mineral chemistry: The apatites in the host are Cl-rich (most with Cl/F=2.7-4.1) and lack of hydroxyl components, plotting into the L chondrites field in apatite atomic anion ternary diagram (Fig.2). In comparison, apatite grains in the IMV have a large compositional range up to F-rich (Cl/F=1.2-14.0). Those in the IMP have an even wider range of Cl/F from 0.1 to 3.6, which is independent of grain sizes and coexisting phases (minerals/glass). The coexistence of two Ca-phosphates in IMP and overgrowth of apatites on merrillite grains suggests that the apatites crystallize from a halogen-rich melt/fluid after the formation of merrillites [7]. The large variation of Cl/F ratios is unusual in apatite of chondrites and primitive achondrites [3,4]. Several processes, such as igneous process (e.g., fractionation), degassing or addition of metasomatic fluids could cause the large variations of Cl/F ratios in apatite. The degassing is more likely in NWA 7251 due to the occurrence of vesicles in the IMP, as indicated by several martian samples [1,2].

References: [1] McCubbin F. M. et al. 2015. *Elements* 11:183-188. [2] McCubbin F. M. et al. 2013. *MAPS* 48:819-853. [3] Lewis J. et al. 2016.*MAPS* 51:1886-1913. [4] Keil K. 2014. *Chemie der Erde* 74:311-329. [5] Ruzicka A. et al. 2015. *MAPS* 50:1-136. [6] Li et al. 2016. *MAPS* 51 (Suppl.): 6043. [7] Shearer C. K. et al. 2011. *MAPS* 46:1345-1362.

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