TEXTURES AND COMPOSITIONS OF OPAQUE PHASES OF JINJU H5 CHONDRITE

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Introduction: Along with silicates, opaque phases including metal and sulfide are major components of ordinary chondrites; kamacite, taenite and troilite are three most common opaque minerals [e.g., 1, 2]. In addition to these major opaque minerals, chromite, merrilite, tetrataenite, near Ni-free kamacite and metallic Cu are minor or rare but often found in ordindary chondrites [2-6]. Jinju, the most recent meteorite fall in Korea (May 2014), is a H5 chondrite with unusually high porosity and numerous subhedral or euhedral vug-filling minerals [7]. Since Fe-Ni metal is one of the vug-filling minerals, we have studied petrographic characteristics and chemical compositions of the opaque minerals in Jinju in order to understand the process that formed the high-porosity.

Analytical Methods: Polished thin sections of Jinju were metallographically studied by optical microscope and JEOL JSM-6380A scanning electron microscope. Chemical compositions of metals and triolites are analized by JEOL JXA-8530F field emission electron microprobe under analytical condition of 15kV, 20nA and spot size of ~3 μm at Korea Polar Research Institute. Siderophile elemental images of selected opaque assemblages were obtained using resistive anode encoder (RAE) detector of Cameca IMS 7f Auto at KBSI.

Results and Discussion: Majority of Fe-Ni metal and troilite in Jinju are those of typical equilibrated ordinary chondrites reported in various previous studies. Rare occurences are taenite grains containing fine mixture of kamacite + tetrataenite + troilite ± metallic Cu.

Opaque minerals make up ~11 vol.% of Jinju with Fe-Ni metals (~7.6 vol.%), troilite (~3.5 vol.%) and minor chromite, merrilite and scarce metallic Cu. Most of them, especially large grains or assemblages, are placed outside of the relic chondrules. Fe-Ni metals occurr as kamacite, taenite and taetrataenite phases. The most dominant opaque phase is kamacite having irregular margins with grain size up to ~1.5 mm. Taenite and tetrataenite are smaller in size (typically ~100 μm). Taenite is often observed in void space as subhedral or euhedral crystals. Tetrataenite is rare but occured at the grain boundary of associated kamacite or troilite. Troilite is common with irregular shape of ~300 μm.

Majority of taenite grains are inclusion-free, while some contain irregular-shaped and fine-grained (> 20 μm) kamacite, tetrataenite and troilite with or without metallic Cu. The assemblage is similar to that of Cu bearing assemblage 2 (adjacent to small triolite grains inside Ni-rich metal) of [5]. From two thin sections studied, we found 32 taenite grains containing such inclusions; 8 of them have metallic Cu. Since typical size of metallic Cu is < 10 μm, the occurrence of Cu may simply depends on the cutting direction of taenite. Note that metallic Cu is very scarce (~ 0.0001 vol.%) in Jinju and only situated in this assemblage. Many of these taenite grains have zoned textures where low-Ni taenite surrounded by high-Ni one. In low-Ni taenite core, fine and irregular shaped kamacite, tetrateanite and troilite are found with or without metallic Cu. Electron microprobe data show that in this assemblage kamacite grains are low in Ni (2.28-3.36 wt.%), while troilite rather high in Ni (0.28-0.72 wt.%). The low Ni contents in kamacite and high Ni troilite may indicate high temperature assemblage [8]. Shape of troilite-metal interface is similar to eutectic texture. Thus the assemblage may have formed by localized metal-troilite melting possibly by shock, as inferred by [5]. Five of Cu-bearing ordinary chondrites in [5] have porosity data by [9]. When we plot Cu abundance against porosity of these chondrites with Jinju, there is a week but noticeable positive correlation. Thus formations of both Cu-bearing assemblage and high porosity may have related with shock event.

We have obtained isotope images of some siderophiles (Fe, Ni, Co, Cu, Ge, Ga) from these opaque assemblages using resistive anode encoder (RAE) detector of Cameca IMS 7f. Preliminary results show the distributions of these elements as expected from previously known partition coefficients [e.g., 10]. We plan to do additional work to obtain better resolution images.

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