CRYSTALLIZATION HISTORY OF THE NORTHWEST AFRICA 7203 ANGRITE.

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Introduction: Angrite constitutes one of the oldest basaltic achondrite groups and shows ususual mineral assemblages due to depletion in alkaline elements and enrichment in refractory elements [1]. Angrites lack shock metamorphism except for NWA 1670 and NWA 7203, and are therefore widely employed as useful time anchors [2]. In our previous study we reported shock metamorphism in NWA 7203 and suggested the importance of this sample to understand the evolution of the angrite parent body [3]. NWA 7203 shows a quenched texture and its grain size exhibits large variations, but the formation process of this texture is unclear [4]. In this study, we performed detailed mineralogy of NWA 7203 in order to clarify the crystallization history of this interesting angrite.

Results: NWA 7203 is mainly composed of dendrites consisting of intergrowth of olivine and anorthite, and pyroxene fills in between the dendrites. Grain size varies from fine grains (~1 µm) to coarse grains (>100 µm) (Fig. 1). The fine-grained areas show radial textures that grew into coarse-grained areas. We estimated bulk compositions of both fine-grained and coarse-grained areas by EPMA grid analyses of each area. The bulk composition of the fine-grained area is slightly more Fe-rich (SiO_2=41, Al_2O_3=14, FeO=23, MgO=7, and CaO=15) than that of the coarse-grained area (SiO_2=41, Al_2O_3=15, FeO=21, MgO=7, and CaO=15) (all in wt%). Olivines (except xenocrysts) in the fine-grained area are Fo_{54-4}, while those in the coarse-grained areas are Fo_{59-0}, which is consistent with more magnesian bulk composition of the coarse-grained area. On the other hand, pyroxenes in the fine-grained area are Mg#=0.50-0.22, while those in the coarse-grained area are Mg#=0.44-0, which is different from the olivine result. We found rare Mg-rich olivine grains (Fo_{64}, size: ~0.1 mm) in the fine-grained area. One such a grain shows a blade shape (~1 mm long, ~20 µm wide) intergrown with anorthite with the core of Mg-rich olivine (Fo_{64}) (Fig. 1).

Discussion and Conclusion: The texture of NWA 7203 (e.g., large variation of grain sizes) is unusual and could not be formed by simple fractional crystallization because coarse-grained areas are more Mg-rich than fine-grained areas. It is texturally evident that fine-rained areas first crystallized and coarse-grained areas subsequently formed as shown by the radial texture in the fine-grained areas. This is contrary to what is observed for olivine compositions since olivine is more Mg-rich in coarse-grained areas than fine-grained areas. Another important observation is the presence of Mg-rich olivine grains in the fine-grained areas. We interpret that they are xenocrysts as found in other quenched angrites. However, the texture of NWA 7203 olivine xenocrysts are different from other samples and Cr_2O_3 is not so high (up to 0.1 wt%) unlike other angrites' xenocrysts (e.g., Asuka 881371: mm-sized large grains and >0.3 wt% Cr_2O_3) [5]. We consider the crystallization history of NWA 7203 as follows (Fig. 2). First, fine-grained areas rapidly crystallized with Mg-rich olivine xenocrysts as crystallization seeds, and then coarse-grained areas were subsequently formed. However, it is required to consider some process to change the melt composition of the coarse-grained areas into more Mg-rich than that of the fine-grained areas. One explanation is the incorporation of Mg-rich melt (e.g., magma mixing) because coarse-grained areas have more Mg-rich bulk composition.

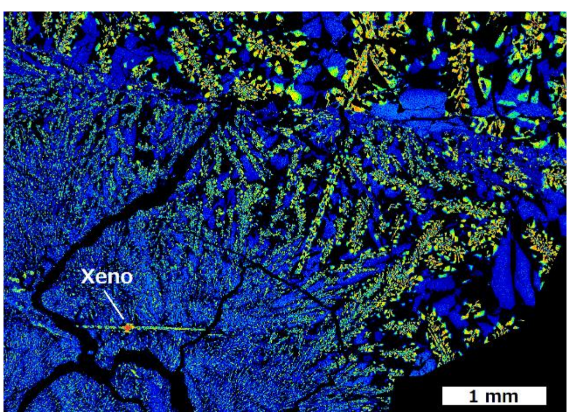

Fig. 1. Mg X-ray map of NWA 7203. Mg-rich olivine xenocryst is present ("Xeno") at the lower left.

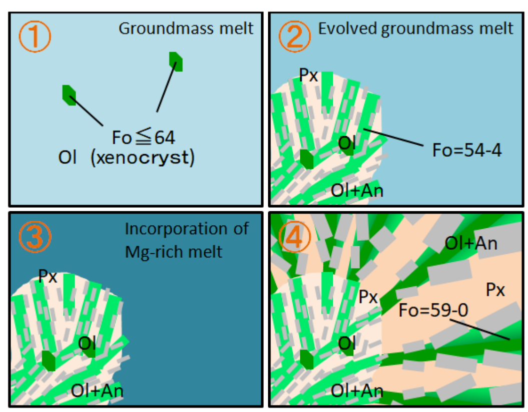

Fig. 2. Crystallization history of NWA 7203.

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