BL-3A/2015G639

X-ray diffraction analysis of micrometeorites recovered from Antarctic surface snow

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1 Introduction

Antarctic micrometeorites (AMMs) are tiny extraterrestrial material, originated from small ancient bodies which formed in the early solar system. Unmelted AMMs especially recovered from surface snow are much less affected by terrestrial alteration compared to ice-AMMs [1], thus appreciably preserve the mineral characteristics when they exist in the space. We analyzed snow-AMMs mineralogically using synchrotron X-ray, and then specified that of the parent body.

2 Samples and methods

Surface snow samples were collected at around Victoria lake in Antarctica by Korea Polar Research Institute in 2015. After melting and filtering of the snow, we identified AMMs by SEM/EDS. Then AMMs were attached to the top of carbon fiber (5um diameter) with a small amounts of glycol phthalate. Irradiating synchrotron X-ray for one hour at beamline 3A, we obtained the X-ray diffraction pattern and identified the mineral components. Only unmelted AMMs were embedded in epoxy resin and sliced to 70nm thick ultra-tin sections by ultra-microtome for FE-TEM/EDS analysis, after then remaining AMMs exposed on epoxy surface were observed by FE-SEM/EDS.

3 Results and Discussion

X-ray diffraction pattern of ROP5E10 shows that this AMM consists of crystalline pyrrhotite and olivine (Fig.1). Fe-sulfide is often aqueously altered in the Antarctic ice sheet and sulfur is liquated [2], thus the high abundance of pyrrhotite in ROP5E10 indicates low degree of terrestrial alteration. Fig.2 shows the presence of a magnetite rim on the surface of this AMM. This suggests that ROP5E10 didn't experience strong heating upon entering to atmosphere. Based on the following three reasons: (1) texture resembles porphyritic olivine chondrule, (2) Al-silicate glass exists between crystalline olivines, and (3) chemical compositions of olivines are relatively homogeneous and the FeO content is high (Fe/(Mg+Fe)=0.41~0.45), we identified ROP5E10 as a part of Type Ⅱ porphyritic olivine chondrule. According to Brearley and Jones (1998), Type Ⅱ chondrule in ordinary chondrites and enstatite chondrites are low FeO content (Fe/(Mg+Fe) ≦ 0.2) [3], while that in carbonaceous chondrites are Fe/(Mg+Fe) = 0.1~0.4 [3], similar to ROP5E10. Therefore we conclude that ROP5E10 is a Type Ⅱ PO chondrule originated from a non-hydrous C-type asteroid.

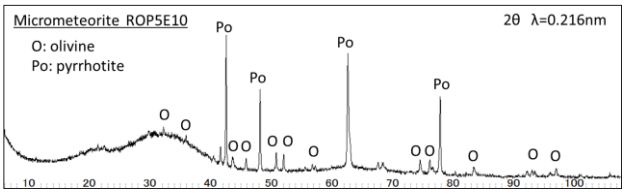

Fig. 1: X-ray diffraction pattern of ROP5E10.

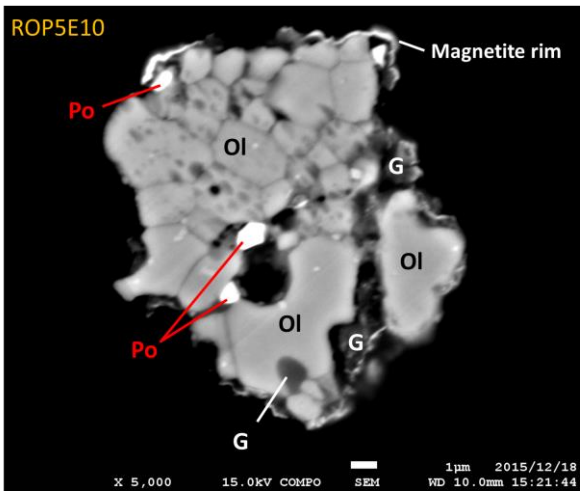

Fig. 2: FE-SEM backscatter electron image of ROP5E10. Several circular patterns surrounding the upper "Ol" are trace of microtome. Po = Pyrrhotite, Ol = Olivine, G = Al-silicate Glass.

Acknowledgement

We thank Drs. Nakao and Yamazaki for technical support during X-ray diffraction analysis.

References

[1] Duprat et al. (2007) Advance in Space Research 39, 605-611.
[2] Pratt A.R. and Nesbitt H. W. (1997) American Journal of Science 297, 807-828.
[3] Brearley A. J. and Jones R. H. (1998) Mineralogical Society of America 36, 1529-6466.

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