Constraints on the origin of primitive achondrites from NWA 6704

Y. HIBIYA[1*], T. IIZUKA[1], K. OZAWA[1], A. YAMAGUCHI[2]

[1]The University of Tokyo, Tokyo 113-0033, Japan (*correspondence: yuki-hibiya@eps.s.u-tokyo.ac.jp)

[2]National Institute of Polar Research, Tokyo 190-8518, Japan

NWA 6704 is an ungrouped primitive achondrite found in 2010. This achondrite, with its ancient U-Pb age of 4563.75 ± 0.41 Ma [1], provides a unique opportunity to study the differentiation of planetesimals in the very early stage of solar system evolution. To better understand its formation processes, we have conducted a mineral-chemical study using SEM-EDS-EBSD and EPMA. Furthermore, we have determined $\varepsilon^{50}Ti$ using MC-ICP-MS to investigate genetic relationship of this meteorite and other grouped meteorites.

The texture is represented by aggregates of orthopyroxene (opx) megacrysts up to 1.6 cm in length ($Fs_{41}En_{56}Wo_3$) with interconnected hollows filled with finer interstices including olivine (Fa_{53}), chromite (#Cr~0.93), awaruite, feldspar ($Ab_{92}An_5Or_3$) and whitlockite. Some Fe-rich olivines occur as vermicular inclusions in one place of each opx megacryst. The vermicular olivine is considered to be a relict decomposition product of the precursor pyroxene through abrupt heating to cause incongruent melting (ca.>1300°C; [2]) followed by rapid cooling, which is most plausibly realized by impact. On the other hand, later slow cooling is suggested from the geospeedometry based on Mg-Fe exchange between chromite and silicate phases [3, 4].

Ti as well as Cr was successfully extracted from NWA 6704 chromites with a new five-step column chromatographic procedure. The obtained $\varepsilon^{50}Ti = 2.28 \pm 0.23$ is plotted within the range of carbonaceous chondrites. This finding, together with the $\Delta^{17}O$ and $\varepsilon^{54}Cr$ values of NWA 6704 [5,6], strongly suggests its genetic link with carbonaceous chondites. Collectively, our results suggest that NWA 6704 was formed by impact-induced melting of a carbonaceous chondrite-like asteroid at about ≤ 3.55 Ma (after CAI formation; U-Pb age). This and the inferred thermal history suggest that a high internal temperature of the parent body owing to ^{26}Al decay was augmented by impact to have achieved abrupt heating up to above liquidus, followed by rapid cooling and later slower cooling by blanketing effect of impact ejectas piled up on the parent body.

[1] Iizuka et al. (2013) *LPSC* 44, #1841 [2] Tsuchiyama et al. (1986) *JVGR* **29** 245-264 [3] Fabriès (1979) *CMP* **69** 329-336 [4] Ozawa (1984) *GCA* **48** 2597-2611 [5] Irving et al. (2011) *MetSoc* 74, #5231 [6] Sanborn et al. (2013) *MetSoc* 76, #5220