Mn-Cr systematics of D'Orbigny revisited

K. YAMASHITA [1*], M. TANIMIZU[2,3], S. YONEDA[4], N. TOMIOKA[3], K. NAGAO[5]

[1] Graduate School of Natural Science and Technology, Okayama University (*correspondence: kty@cc.okayama-u.ac.jp)
[2] School of Science and Technology, Kwansei Gakuin Univ.
[3] Kochi Institute for Core Sample Research, JAMSTEC
[4] National Museum of Nature and Science
[5] Geochemical Research Center, University of Tokyo

For almost a decade, the angrite D'Orbigny has been used as an important anchor for Mn-Cr chronometry. While the U-Pb age of D'Orbigny is now tightly constrained [1, 2], very few high-precision data for $(^{53}Mn/^{55}Mn)_0$ have been reported since the study of Glavin et al. [3]. A major concern about the $(^{53}Mn/^{55}Mn)_0$ reported in Glavin et al. [3] is the use of second-order fractionation correction assuming terrestrial $^{54}Cr/^{52}Cr$ ratio. It has been shown by Trinquier [4] that the $\varepsilon^{54}Cr$ of angrite is anomalous ($\varepsilon^{54}Cr = -0.36 \pm 0.07$), so the use of such fractionation correction will result in a positive shift of the $\varepsilon^{53}Cr$ values. Furthermore, if the errors associated with the $^{54}Cr/^{52}Cr$ ratios have not been propagated to the $\varepsilon^{53}Cr$ values, the stated uncertainty will be an underestimated value. Recently, McKibbin et al. [5] reported $(^{53}Mn/^{55}Mn)_0$ of $(3.54 \pm 0.18) \times 10^{-6}$ from the analysis of olivine using SIMS. However, the large uncertainty lowers the resolution of the Mn-Cr ages, making it less useful for cosmochemical studies.

Here we report high-precision Cr isotope data of whole-rock and mineral separates physically and chemically separated from D'Orbigny. The Cr isotope ratios were measured using TRITON Plus following the method described in [6]. Our new data show that the $\varepsilon^{54}Cr$ values of the mineral separates are not uniform, possibly due to spallation effect. The $\varepsilon^{53}Cr$ values are correlated with the $^{55}Mn/^{52}Cr$ ratios, defining a preliminary isochron whose slope corresponds to a $(^{53}Mn/^{55}Mn)_0$ of $(3.35 \pm 0.04) \times 10^{-6}$. We have also determined the noble gas composition of the sample to calculate its exposure age, which was then used to investigate the contribution of spallation reaction on the $\varepsilon^{53,54}Cr$ signatures. Further chronological implications of these new results, together with additional data from the analysis currently in progress, will be presented.

[References] [1] Amelin (2008) *GCA* **72**, 221-232. [2] Brennecka et al. (2012) *PNAS* **109**, 9299-9303. [3] Glavin et al. (2004) *MAPS* **39**, 693-700. [4] Trinquier et al. (2007) *ApJ* **655**, 1179-1185. [5] McKibbin et al. (2015) *GCA* **157**, 13-27. [6] Yamakawa et al. (2009) *Anal. Chem.* **81**, 9787-9794.