Petrology and geochemistry of the lowest FeO ordinary chondrite, Yamato 982717: Implications to compositional diversity of ordinary chondrites

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Ordinary chondrites (OCs) are the largest meteorite clan, comprising approximately 87% of the global collection and 78 % of all falls. They are characterized by similar bulk chemical and oxygen isotopic composition, mineral compositions and petrologic textures. OCs are generally classified into three chemical groups, H, L, and LL mainly on the basis of Mg' in major minerals such as olivine and pyroxene, and the bulk siderophile element abundances. However, some OCs do not fit into these groups. There are intermediate groups and low or higher-FeO groups such as L/LL and L/H. The low FeO groups OCs include "low-FeO OC" (e.g., Wasson et al. 1993). Here, we present a petrologic, geochemical, and oxygen isotopic study of the lowest FeO ordinary chondrite, Yamato (Y) 982717 (Yamaguchi et al. 2013). Y 982717 shows a chondritic texture composed of chondrules and chondrule fragments, and mineral fragments set in a finer-grained, clastic matrix, similar to H4 chondrites. The compositions of olivine ($Fa_{11.17 \pm 0.48 (1\sigma)}$) and low-Ca pyroxene ($Fs_{11.07 \pm 0.98 (1\sigma)}Wo_{0.90 \pm 0.71(1\sigma)}$) are significantly more magnesian than those of typical H chondrites ($Fa_{16.0\text{-}20}$, $Fs_{14.5\text{-}18.0}$), as well as other known low-FeO ordinary chondrites ($Fa_{12.8\text{-}16.7}$, $Fs_{13\text{-}16}$) (Brearley and Jones 1998; Wasson et al. 1993; Troiano et al. 2011). However, the bulk chemical compositions such as lithophile and moderately volatile elements (e.g., REE, Zn) are within the range of ordinary chondrites. The bulk siderophile element compositions (Ni, Co) are within the range of H chondrites, distinguished from L chondrites (e.g., Kallemeyn et al. 1989). The oxygen isotopic composition is also within the range of H chondrites (Clayton et al. 1991). The lack of reduction textures indicates that low olivine Fa and low-Ca pyroxene Fs are characteristics of the precursor materials not due to reduction during thermal metamorphism. We suggest that the H chondrites are more compositionally diverse than has been previously recognized.

References

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