Identification of the parent bodies of micrometeorites from the Widerøefjellet, Sør Rondane Mountains, by means of oxygen isotopes

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Introduction: Triple-oxygen isotopic data of micrometeorites (MMs) is a powerful tool commonly used to identify their parent bodies (e.g., Suavet et al. 2010). Secondary Ion Mass Spectrometry (SIMS) (Engrand et al. 2005; Taylor et al. 2005; Yada et al. 2005) and Laser Fluorination coupled with Isotope Ratio Mass Spectrometry (LF-IRMS) (Suavet et al. 2010; Cordier et al. 2011; Van Ginneken et al. 2017) are commonly used for in-situ analyses with moderate precision or fully-destructive high-precision bulk measurements respectively. Here, we present oxygen isotope bulk measurement of MMs from the Widerøefjellet, Sør Rondane Mountains, Antarctica, determined using Sensitive High Mass Resolution Ion Microprobe - Stable Isotopes (SHRIMP-SI) (e.g. McKibbin et al. 2016). The SHRIMP-SI in-situ technique has the advantage of offering intermediate precision (~0.3‰ for Δ^{17}O on San Carlos olivine, 2 S.D.), fast acquisition time and is semi-destructive.

Samples and methods: A set of 53 S-type cosmic spherules (CSs) from Widerøefjellet, Sør Rondane Mountains, Antarctica, having diameter ranging from 125 to 250 µm were analyzed. SHRIMP-SI analyses were carried out at the Research School of Earth Sciences of the Australian National University.

Results and discussion: Preliminary results show that the precision of SHRIMP-SI analyses allows good discrimination between parent bodies for MMs. On a δ^{18}O vs Δ^{17}O diagram, about 68% of the MMs have Δ^{17}O values ranging from -3.4‰ and -6.5‰ and are thus likely related to carbonaceous chondrites. About 9% of the samples exhibit Δ^{17}O values between 0.3‰ and 1.0‰ and are likely related to ordinary chondrites. Two particles (i.e. 4%) show δ^{18}O and Δ^{17}O above 45‰ and 1.5‰, respectively, and may be related to a ^{16}O-poor unknown parent body (the type 4 in Suavet et al., 2010). Five particles (9%) show ambiguous oxygen isotope signatures (i.e. multiple potential parent bodies). Two particles show Δ^{17}O values at 2.4‰ and 3.6‰, with δ^{18}O values at 23 and 43‰, respectively. Such high Δ^{17}O are consistent with a R chondritic parent body, which has never been observed amongst MMs. Interestingly, three particles exhibit extreme oxygen isotope signatures. Two have δ^{18}O values below -40‰, with slightly negative Δ^{17}O and one has a Δ^{17}O value of -13‰ with slightly negative δ^{18}O. We suggest that the two particles exhibiting extremely negative δ^{18}O values may have been contaminated by Antarctic ice. It remains unclear why only two particles out of 53 display such a contamination. The particle having a negative Δ^{17}O plots about +20‰ δ^{18}O with respect to the CCAM. Considering the mass dependent fractionation occurring during atmospheric entry that shifts the oxygen signature of MMs toward higher δ^{18}O values, we suggest that this particle may be related to CAIs having similar Δ^{17}O values (e.g. Krot et al. 2005). Excluding particles exhibiting extreme oxygen isotope compositions, these results are broadly in agreement with those for other sets of Antarctic MMs <250 µm (Cordier and Folco 2014).

Conclusion: We have carried out oxygen isotope analyses on a set of micrometeorites from the Widerøefjellet, Sør Rondane. Preliminary results show that about 70% are related to carbonaceous chondrites, which is consistent with previous studies of oxygen isotopes in MMs. Ordinary chondrites represent less than 10% of the parent bodies in this size range. The presence of ^{16}O-poor unknown parent body is consistent with other collections and size ranges, which suggest that the contribution of this parent body is not related to the size of the MMs it produces. R chondrites are considered as parent bodies of MMs for the first time. Three particles exhibit extreme oxygen isotope signatures that remain to be investigated.

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