HIGH-SPATIAL-RESOLUTION CHROMIUM ISOTOPIC MEASUREMENTS OF NANO-OXIDES FROM ORGUEIL.

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Introduction: Tiny (~100 nm) ^{54}Cr-rich "nano-oxide" grains of likely supernova origin have been previously reported in acid residues of the Orgueil meteorite [1,2]. A heterogeneous distribution of these grains in the early Solar System, perhaps related to size sorting and/or direct supernova injection into the protosolar disk, is a likely explanation for ^{54}Cr/^{52}Cr variations observed at bulk meteorite scales. However, the grains are still poorly characterized, largely due to their small size, and exacerbated by the relatively poor spatial resolution (~400-800 nm) of the duoplasmatron O^- ion source used for the prior NanoSIMS studies. Since the beam size was much larger than the analyzed grains, measured anomalies (^{54}Cr/^{52}Cr up to 2.5 times solar) were lower limits due to contributions of signals from neighboring grains on the sample mounts. Moreover, while O isotopic ratios could be highly diagnostic of the nucleosynthetic origins of the grains, such data are not yet available for any ^{54}Cr-rich grains. We previously reported the use of a ~100-nm Cs^+ beam to simultaneously measure O and Cr isotopes in Orgueil nano-oxides, detecting Cr as CrO^- [3] However, our initial report of extreme ^{54}Cr anomalies by this technique was found to be spurious, due to an unrecognized $^{35}Cl_2$ interference on ^{54}Cr^{16}O. Here we report additional searches for ^{54}Cr-rich grains in Orgueil, using both the Cs^+/CrO^- method and a new high-brightness O^- ion source that allows for NanoSIMS Cr-isotope measurements with 100-nm resolution.

We used the Carnegie NanoSIMS 50L with the methodology described in [3] to map several tens of thousands of μm^2 of the same crowded Orgueil acid residue mount studied by [2,3] in O and Cr isotopes, with the addition of ^{35}Cl to the mass list to monitor a possible Cl interference. In addition, we performed preliminary measurements with the new Hyperion RF plasma ion source (Oregon Physics) installed on a NanoSIMS 50L at Cameca. A 100-nm, 4-pA O^- beam was scanned over 19 15×15 μm areas with simultaneous detection of $^{27}Al^+$, $^{52,53,54}Cr^+$ and $^{56}Fe^+$ ion images. For both sets of measurements, we corrected for the Fe contributions to the ^{54}CrO or ^{54}Cr signals.

The Cs^+ measurements identified numerous O-anomalous grains [4], but no unambiguously ^{54}Cr-rich grains. In contrast, the high-resolution O^- measurements identified a 250-nm grain with a measured anomaly of δ^{54}Cr ~400±40‰ (and normal δ^{53}Cr=6±14‰). However, this grain is sitting in a pile and is thus subject to severe isotope dilution; we estimate that its true δ^{54}Cr is at least 1500‰. This grain would not have been identified with a duoplasmatron source. Comparison of the Cs^+ and O^- data indicates that the useful yield for Cr isotopes by the latter method is a factor of 5-10 times higher than that for the former. This may explain the lack of anomalous grains identified by the Cs^+ method. This study demonstrates that the high-resolution NanoSIMS measurements enabled by the Hyperion source have great scientific potential for presolar grain studies.

References:[1] Dauphas N., et al. 2010. *Astrophysical Journal,* 720*:* 1577-1591.[2] Qin L., et al. 2011. *Geochimica Cosmochimica Acta,* 75*:* 629-644. [3] Nittler L. R., et al. 2012. Abstract #2442. 43d Lunar and Planetary Science Conf. [4] Nittler L. R., et al. this volume.