LOOKING FOR THE CARRIER PHASE OF ^{54}Cr IN THE CARBONACEOUS CHONDRITE ORGUEIL.

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Introduction: ^{54}Cr anomalies are widely distributed in inner Solar System materials [1-6]. These variations have been attributed to nucleosynthetic effects. Astronomical models predict that ^{54}Cr, along with other neutron-rich nuclides, such as ^{50}Ti, are produced in a neutron-rich environment at or near nuclear statistical equilibrium in both Type Ia and Type II supernovae [7,8]. Further constraints on the nucleosynthetic source of ^{54}Cr largely rely on the identification of the carrier phase. Isolating and identifying the carrier phase of ^{54}Cr anomalies is an outstanding problem in cosmochemistry. We have recently started to search for the carrier phase by in-situ NanoSIMS analyses of a residue separated from the C1 chondrite Orgueil.

Methods: The original CsF/HCl Orgueil residue was ashed in an O-plasma to remove C. The remaining minerals were dispersed as a liquid suspension onto a gold substrate. A quick SEM examination of the mount shows that the mineral assemblage includes mostly sub-micron chromite and Cr-rich spinel, and a small amount of SiC. Isotope measurements were made on a Cameca NanoSIMS 50L in multi-collection mode at the Carnegie Institution. A 0.5-0.7 µm, O^- primary ion beam of ~13 pA intensity was rastered over 25×25 µm^2 areas. For each area, 16 sequential 256×256 pixel images were obtained. Positive secondary ions of ^{50}Cr+^{50}Ti, ^{52}Cr, ^{53}Cr, ^{54}Cr+^{54}Fe, ^{28}Si and ^{56}Fe were detected simultaneously on six electron multipliers. ^{28}Si was detected in order to aid in the identification of the mineralogy. ^{56}Fe was used to correct interference from ^{54}Fe on ^{54}Cr. We could not make any correction for the interference from ^{50}Ti on ^{50}Cr. The spatial resolution of these isotopic images was largely limited by the primary beam size.

Results: We obtained about 30 isotope images, covering tens of thousands of grains. For each image, we defined regions of interest with high ^{52}Cr count rate to avoid background areas. Most of the regions have $^{54}Cr/^{52}Cr$ (corrected for ^{54}Fe interference) within two standard deviations from the mean values obtained within individual images. However, we detected several areas with positive $^{54}Cr/^{52}Cr$ anomalies of 100 ‰ to 300 ‰, deviating from the mean by 2 to 4 standard deviations. For one of these anomalous regions, a smaller area (5×5 µm^2) around this region was reimaged and we confirmed the anomaly. Comparing these isotope ratio images with SEM images, the anomalous areas typically contain one or a few grains of chromite and Cr-rich spinel of < 200 nm. Because the typical grain size is smaller than the beam size, the actual ^{54}Cr enrichments are probably much higher. In these areas, we did not detect resolvable anomalies in $^{53}Cr/^{52}Cr$.

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