LOOKING FOR THE CARRIER PHASE OF \(^{54}\text{Cr}\) IN THE CARBONACEOUS CHONDRITE ORGUEIL. L. Qin, C. M.O’D. Alexander, L. R. Nittler, J. Wang, and R. W. Carlson. Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, DC 20015. E-mail: lqin@ciw.edu.

Introduction: \(^{54}\text{Cr}\) anomalies are widely distributed in inner Solar System materials [1-6]. These variations have been attributed to nucleosynthetic effects. Astronomical models predict that \(^{54}\text{Cr}\), along with other neutron-rich nuclides, such as \(^{50}\text{Ti}\), 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 \(^{54}\text{Cr}\) largely rely on the identification of the carrier phase. Isolating and identifying the carrier phase of \(^{54}\text{Cr}\) 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 \(\mu\)m, O primary ion beam of \(~13\) pA intensity was rastered over \(25 \times 25\) \(\mu\)m\(^2\) areas. For each area, 16 sequential \(256 \times 256\) pixel images were obtained. Positive secondary ions of \(^{50}\text{Cr}^{+}\text{Ti}\), \(^{52}\text{Cr}\), \(^{53}\text{Cr}\), \(^{54}\text{Cr}^{+}\text{Fe}\), \(^{28}\text{Si}\) and \(^{56}\text{Fe}\) were detected simultaneously on six electron multipliers. \(^{28}\text{Si}\) was detected in order to aid in the identification of the mineralogy. \(^{56}\text{Fe}\) was used to correct interference from \(^{54}\text{Fe}\) on \(^{54}\text{Cr}\). We could not make any correction for the interference from \(^{50}\text{Ti}\) on \(^{50}\text{Cr}\). 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 \(^{54}\text{Cr}\) count rate to avoid background areas. Most of the regions have \(^{54}\text{Cr}^{/50}\text{Cr}\) (corrected for \(^{54}\text{Fe}\) interference) within two standard deviations from the mean values obtained within individual images. However, we detected several areas with positive \(^{54}\text{Cr}^{/50}\text{Cr}\) anomalies of 100 \% to 300 \%, deviating from the mean by 2 to 4 standard deviations. For one of these anomalous regions, a smaller area (\(5 \times 5\) \(\mu\)m\(^2\)) 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 \(^{54}\text{Cr}\) enrichments are probably much higher. In these areas, we did not detect resolvable anomalies in \(^{53}\text{Cr}^{/50}\text{Cr}\).