PETROGRAPHIC SEARCH FOR THE CARRIERS OF ISOTOPICALLY ANOMALOUS CHROMIUM IN CARBONACEOUS CHONDRITES.
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Electron probe studies were performed on a thin section from the Kainsaz (CO3.2) meteorite in order to identify phases for Cr isotopic studies with the purpose of identifying the potential carrier phase(s) of the observed ^{54}Cr anomalies in carbonaceous chondrites and for ^{53}Mn-^{53}Cr dating of refractory inclusions.

Introduction: Leaching studies [1-4] have demonstrated the existence of Cr with an excess of ^{54}Cr in unequilibrated carbonaceous chondrites. It is important to localize the carrier of this anomalous Cr and to test it for anomalies in other elements, especially O. Although the ultimate carrier probably consisted of presolar grains, we suggest that it may be possible to discover objects (e.g., chondrules) sufficiently enriched in the carrier to show significant anomalies, thus allowing research on additional elements.

Several leaching experiments have shown that phases dissolved in weak acids (acetic acid, nitric acid) display small ^{54}Cr deficits of about 5-6 ε-units, while phases progressively dissolved in stronger acids (hydrochloric acid, hydrofluoric acid) show strong ^{54}Cr excesses up to 250 ε-units [1-5]. The highest excesses are found in CI and CM meteorites (e.g., Orgueil, Murchison). One interpretation of the observed anomalies is that there is at least one nucleosynthetic component rich in ^{54}Cr that was not homogenized with other nucleosynthetic components that make up the solar mix. Nichols et al. [5, 6] suggested that the ^{54}Cr-enriched carrier is a non-magnetic, fine-grained phase of low density, and that it could be a presolar phase. In previous experiments, mainly with leaching and chemical dissolution [7], direct mineralogical and chemical information regarding the carrier phase was lost.

The main focus of this work is to determine and to characterize Cr-rich particles and other potential carrier phases in primitive carbonaceous chondrites by electron probe, to physically separate the detected Cr-rich phases and other coexisting phases for subsequent isotopic studies with the purpose of identifying the possible carrier phase(s) for the observed Cr-isotopic anomalies. In this study we chose Kainsaz because it is a highly unequilibrated fall and because CO chondrites experienced much less aqueous alteration than CV chondrites, such as Allende.

Results: In our reconnaissance work, we mapped a 1 mm^2 area of the thin section for the elements Fe, Mg, Si, Cr, Ca, Al, Mn, K, Na, and Ti by electron probe. Based on the Cr element map, we chose some Cr-rich particles for further electron probe analysis. We are also characterizing chondrules, matrix material, metals etc. In addition to the typical silicate mineral phases and metal grains (olivine, low-Ca pyroxene, kamacite, tetrataenite), chromite ($FeCr_2O_4$) is a common accessory phase. It occurs as single grains within the matrix, within olivine particles as well as in thin rims around Fe-rich particles within chondrules.

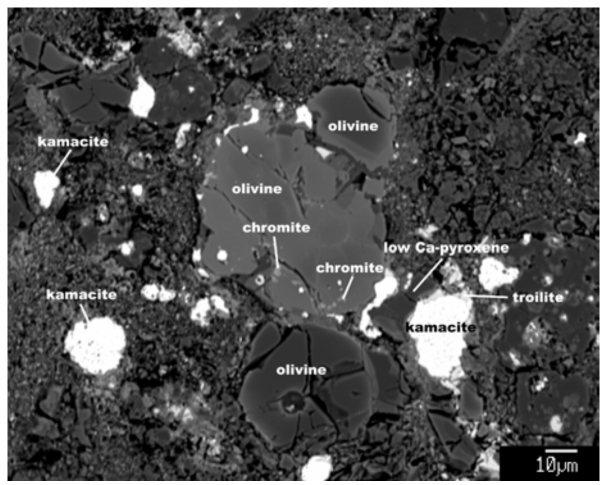

Figure 1: BSE image shows typical silicate, metal, and sulfide phases of Kainsaz; note the chromite grains within the chondrule olivine.

Conclusions and future work: Leaching experiments from several authors have shown that the highest ^{54}Cr excesses can be found in the HCl leaching step. The disadvantage of this procedure is that all information regarding the dissolved materials is lost. It has been suggested that the carrier of the Cr anomaly could be a type of a presolar grain that is soluble in acids. Therefore, our goal is to devise a different technique for identifying phases that may have significant Cr isotopic anomalies. Because it is quite possible that the carrier material is not a Cr-rich particle, we will also study particles having average Cr contents.

Our plan is to separate and investigate diverse particles (e.g., low-FeO chondrules, high-FeO chondrules, chromite-rich chondrules, unusual inclusions, refractory inclusions, matrix, etc.) from carbonaceous chondrites. We will use TIMS to measure Cr isotopes on portions of the particles and petrographic techniques to characterize them. If Cr isotopic anomalies are discovered, the remaining portions of the particles can be used for other studies that can help clarify the nature of the presolar carriers.

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