**ET Extraterrestrial Chromium at the Graphite Peak P/Tr boundary and in the Bedout Impact Melt Breccia**

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**Introduction:** Any major impact structure should include an extraterrestrial chemical signature such as platinum group elements (PGEs). The concentration of iridium (Ir) and other noble metals in K/T boundary sediments worldwide was key to the interpretation that an impact (asteroidal or cometary) occurred 65 myr ago (1,2). For instance, some researchers have argued that excess Ir and noble metals can be explained by enhanced volcanic activity (3). Extensive volcanism could provide a transport of mantle-derived metals that, like meteorites, have high concentrations of *noble metals*. However, the discovery of the Chicxulub crater, coincident with the K/T boundary suggests an ET source for Ir and noble gas metals in K/T sediments worldwide.

Several isotopic systems have also been used to search for an ET signature in K/T boundary sediments (e.g. osmium), the most diagnostic being the chromium (Cr) isotopic systematics (i.e. unlike osmium, Cr isotope values cannot be confused with terrestrial signatures; (4). Isotopic compositions of Cr in several K/T boundary sediments indicate an ET signature that is consistent with a carbonaceous-type impactor. Thus, chromium isotopes not only make a good ET signature, but it can also serve as a diagnostic tool for determining the type of impactor that collided with the Earth. This method has also been applied to Archaen impact deposits, impact melt samples and Late Eocene deposits (5).

**Graphite Results:** We have now measured the Cr isotopes in some of the isolated magnetic fractions (MF) found in the Graphite Peak P/Tr boundary. Our group and others have reported on the detection of Fe-Ni-Si-rich metal grains and impact spherules that accompany the meteorite fragments in the Graphite Peak P/Tr boundary section (6,7). We studied the Cr isotopic composition in the bulk magnetic fraction (MF) for Graphite peak (8). The concentrations of major and minor elements in the bulk MF are surprisingly similar to chondritic, with the exception of Ca. The isotopic data in Table 1 are presented in epsilon (ε) units, where 1ε is 1 part in $10^4$ and terrestrial ratios of $^{53}Cr/^{52}Cr$ are defined as $\varepsilon \equiv 0$. For high precision, in our method of data reduction we use a 'second order' mass fractionation correction based on the $^{54}Cr/^{52}Cr$ ratio (9). This correction assumes no excess or deficit of $^{54}Cr$, which is the case for most meteorite classes. Carbonaceous chondrites, however, have excess $^{54}Cr$ causing second order corrected ε(53) values to be negative. This is a convenient and precise way to distinguish carbonaceous chondrites from the other meteorite classes. Bulk MF reveals a clearly non-terrestrial Cr isotopic signature: $\varepsilon(53)_{corr}$= -0.13 ±0.04ε and falls outside the range of previously studied carbonaceous chondrites ( -0.3 - to -0.4ε). In other words, this isotopic signature has never been measured before and cannot be attributed to contamination. The most striking feature is the presence of a large excess of $^{54}Cr$ in the MF residue: $\varepsilon(54)_{raw}$= +8.10±0.78ε (the subscript 'raw' designates that the second order fractionation correction has not been applied). $^{54}Cr$ excesses of a comparable magnitude have been reported in the acid resistant residues of CI and CM chondrites. It is important to note, however, that the $\varepsilon(54)_{raw}$ in the MF residue is intermediate between values measured in the Ivuna (+13.2±0.20ε) and Murchison (+5.35±0.29ε) meteorites.

**Prelimary results on Bedout:** We have also evaluated the chromium isotopic compositions in the Bedout impact melt breccia. Previous investigations of the Yax-1 and Yucatan-6 cores have indicated only slightly elevated levels of chromium and iridium despite the elevated levels found in some K/T boundary sediments (10,11). This may be due to the nature of the samples (e.g. bulk powders containing an abundance of crustal material that would greatly dilute the ET signature). In order to concentrate a potential cosmic component for the Bedout breccia, we applied a differential dissolution. A 10-gram sample of Bedout breccia was first treated with HF. The residue was additionally treated with an $HF/HNO_3$ mixture at room temperature. This dissolution procedure left behind a minute (a few μg) acid-resistant residue enriched in Cr. This residue was dissolved in an $HF/HNO_3$ mixture at 180°C in a bomb. The Bedout residue revealed an extraterrestrial Cr isotopic composition. The corrected (see above) $^{53}Cr/^{54}Cr$ ratio is ~ -0.25ε.

More measurements are underway to confirm this result, however, it appears that a cosmic component has been detected in the Bedout breccia. This Bedout value differs slightly from the Graphite Peak value, probably due to our method of concentrating the Cr-bearing component in the acid-resistant residue, which is enriched in a meteoritic chromite-spinel phase. The apparent deficit of $^{53}Cr$ in the Bedout breccia implies a carbonaceous chondrite projectile and is consistent with the data obtained earlier for the Graphite Peak P/Tr sediments. If these data are confirmed then the previous measurements of the Graphite P/Tr sediments can be directly linked to the Bedout structure.

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**Table 1: Chromium Isotopes in Terrestrial and Extraterrestrial Samples**

| Sample | Cr, ppm | ε(53) |
|---|---|---|
| Terrestrial crust | ~185 | ≡ 0 |
| O-chondrites | ~3740 | 0.48±0.04 |
| E-chondrites | ~3100 | 0.17±0.03 |
| C-chondrites | 2650-3600 | -0.30 - -0.43 |
| K/T Sediments | ~133-990 ppm | -0.33 - -0.40 |
| P/Tr Sediments | ~300 ppm | -0.13 ±0.04 |
| Bedout Breccia | ~50 ppm | ~ -0.25 |