

## Uniform Os isotopic composition in early-formed planetesimals

R.J. WALKER

Dept. of Geology, University of Maryland, College Park, MD 20742, USA (rjwalker@umd.edu)

The isotopic compositions of some elements, such as W, Ru and Mo, vary among early-formed planetesimals. These variations likely reflect incorporation of different proportions of matter from diverse nucleosynthetic sources, and could be the result of accretion from a poorly mixed nebula, accretionary processes that favored isotopically distinct components, and/or late injection of isotopically diverse matter to the nascent Solar System. Constraints placed on the level of isotopic variability among early-formed planetesimals for additional elements with different chemical characteristics and nucleosynthetic origins may help to elucidate the dominant processes. Osmium is an important element to add to this list as it is one of the most refractory elements, yet is volatile in oxidized forms. Further, separate *s*- and *r*-process enriched components have been shown to exist in low metamorphic grade chondrites. Although, bulk chondrites show no measurable Os isotopic anomalies, early formed iron meteorites are also fertile hunting grounds. Isotopic anomalies for a number of elements are present in irons. For Os, certain irons from groups IAB, IIAB, IIIAB, IVA and IVB also show well resolved anomalies in  $\epsilon^{190}\text{Os}$ ,  $\epsilon^{189}\text{Os}$  and  $\epsilon^{186}\text{Os}$ . These anomalies, however, differ from anomalies observed in components extracted from chondrites, and are attributed to variable exposure of the irons to cosmic rays. Of note, each of the major iron groups contains at least one member with no resolved Os isotopic anomalies. We conclude that Os was homogeneously distributed on the scale of planetesimal accretion within the current level of resolution ( $\sim \pm 5$  ppm for  $\epsilon^{190}\text{Os}$ ). This contrasts with heterogeneity in other siderophile elements, such as W, Ru and Mo. Given that W and Os are similarly refractory, this may indicate that anomalies present for other elements in irons resulted from selective incorporation of mineralogic hosts, rather than large scale nebular heterogeneity.

## Nuclear forensic analysis of trinitite at high spatial resolution

C.M. WALLACE\*, A. SIMONETTI, AND P.C. BURNS

Department of Civil Engineering and Geological Sciences, University of Notre Dame, Notre Dame, IN 46556, USA (\*correspondence: cwallac1@nd.edu)

The world's first atomic bomb, the Trinity "gadget" was detonated on July 16, 1945. The explosion resulted in partial melting of the surrounding desert sand, which subsequently fused into blast-melt glass known as trinitite. Recent investigations of trinitite have been conducted using a variety of analytical techniques, including EMPA, SEM, SIMS, XRF, and light microscopy [1,2]. This study includes preliminary results from optical microscopy, SEM, and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Optical microscopy was used in order to "map" thin sections of trinitite and distinguish remnant crystalline grains and inclusions from the surrounding glassy matrix. SEM was conducted on samples prior to thin sectioning in order to image surface morphology. Quantitative spot analyses were subsequently performed via LA-ICP-MS in order to determine the trace element/radionuclide compositions of different phases. The LA-ICP-MS results to date confirm the "supergrade" nature of the plutonium and the presence of a natural uranium tamper in the Trinity device. In addition, plutonium-rich areas are characterized by higher REE abundances and correlate negatively with the fission product  $^{137}\text{Cs}$ . Trace element abundances are extremely variable within individual crystal grains (hundreds of microns). The relationship between Pb isotope ratios and Pu abundances is somewhat ambiguous, i.e. they do not correlate positively in all of the trinitite phases. Future work will include isotopic analysis using a LA-multi-collector-ICP-MS instrument configuration.

[1] Fahey *et al.* (2010) *PNAS* **107**, 20207-20212. [2] Eby *et al.* (2010) *Geology Today* **26**, 180-185.