CONSTRAINING THE PRECURSOR COMPOSITION OF THE WINONAITE PARENT BODY USING GEOCHEMICAL DATA

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Introduction: Primitive achondrites are characterised by chondritic mineral assemblages and bulk element compositions, but with textures that vary from high-grade metamorphic to those indicative of partial melting [1]. Winonaites are rare primitive achondrites that are related to silicate inclusions in IAB iron meteorites via their oxygen isotope compositions [2]. Winonaites and IAB silicate inclusions have textures and compositions which imply varying degrees of planetary processing, resulting from heterogeneous heat distribution through the parent body [1, 3].

Chondritic bulk element compositions and mineralogy, along with rare relict chondrules, suggest the winonaite precursor was chondritic, and mineral compositions are intermediate between E and H chondrites [1]. However, the winonaites have oxygen isotopes unlike any known chondrite class [2] and the precursor material was intrinsically reduced [4]. We aim to constrain the initial composition of the winonaite precursor.

Samples and Analytical Methods: We have samples of the winonaites Winona, Fortuna, QUE 94535, NWA 1463, Pontlyfni, Tierra Blanca and Hammadah al Hamra 193. Samples were analysed by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) at the Natural History Museum (NHM), London, to determine major-element composition. Trace-elements were analysed by ICP–Mass Spectrometry (ICP-MS) at the Open University (OU). For analytical techniques see [3]. Additionally, metals in the IAB iron meteorites Canyon Diablo, Four Corners, Mundrabilla, Toluca and Youndegin were analysed for major and trace-elements by electron microprobe (NHM) and laser-ablation ICP-MS (OU).

Discussion: The winonaites are characterized by relatively flat, unfractionated bulk element patterns, indicating that they have not been affected by silicate partial melting [3]. When normalized to Mg or Yb and ordered by volatility (50% condensation temperature, T_C) the winonaites show slight depletion in the majority of elements relative to CI. This is more pronounced for volatile elements ($T_C < \sim 900$ K), indicating an initially volatile-depleted precursor, similar to CM or CR chondrites. Refractory ($T_C > 1301$ K) elements in the winonaites also suggest a link to ordinary chondrites. However, an association with carbonaceous chondrites is suggested by oxygen isotope data for IAB silicate inclusions [5] and high C contents. Additionally, the winonaite parent body is unlikely to have evolved through melting or reduction of an ordinary chondrite-like body [4]. The winonaite precursor most likely had a volatile-depleted carbonaceous chondrite-like composition that is not sampled in current meteorite collections.

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