Polycrystalline diamond inclusions in Jack Hills zircon: Carbonado?

HIROMI KONISHI, HUIFANG XU, MIKE SPICUZZA AND JOHN W. VALLEY

Dept. of Geology and Geophysics, University of Wisconsin-Madison, 1215 W. Dayton St., Madison, WI 53706, USA

Mineral inclusions in detrital zircons from the Jack Hills of Western Australia contain the only direct evidence about the earliest crust on Earth. Diamond inclusions were first reported in Jack Hills zircon by [1]. We have found that some zircons contain dark colored, rod shaped inclusions (~5 μm in diameter and several tens of μm long). We have investigated these inclusions using optical microscopy, scanning electron microscopy (SEM) / focused ion beam (FIB) system, and transmission electron microscopy. The rodlike inclusions are composed of polycrystalline diamonds (~1μm dia.) in random crystallographic orientation, a C-rich foliated mineral (probably graphite), an Al-oxide mineral (possibly corundum), a La/Ce- mineral (probably phosphate), and voids among the microcrystals. The texture and mineral assemblage are most like carbonado [2] vs. framesite or other forms of polycrystalline diamond. Carbonado is widely thought to form by meteorite impact on terrestrial continental crust [2].
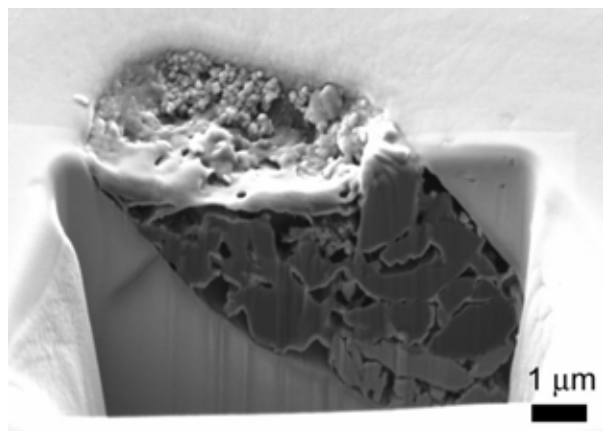

Figure 1: SEM image of a FIB-milled surface showing a polycrystalline diamond inclusion in zircon. Note that plucking and contamination above diamond complicates analysis from the polished surface.

[1] Menneken, M, Nemchin, AA, Geisler, T, Pidgeon, RT, & Wilde, SA (2007) *Nature* **448**, 917-920. [2] Heaney, PJ, Vicenzi, EP & De, S. (2005) *Elements* **1,** 85-89.

Development of a ^{58}Fe-^{57}Fe double spike for Fe isotopic analysis using a Nu Plasma 1700 MC-ICP-MS

J.G. KONTER[1,2]*, A.J. PIETRUSZKA[2] AND B.B. HANAN[2]

[1]Dept. Geological Sciences, University of Texas at El Paso, El Paso, TX 79968 (*correspondence: jgkonter@utep.edu)
[2]Dept. Geological Sciences, San Diego State University, San Diego, CA 92182

Fe isotope analysis by high-resolution MC-ICP-MS shows great promise for high precision measurements in natural materials. Specifically, the Nu Plasma 1700 is capable of high mass resolution, allowing complete separation of the Fe mass peaks from polyatomic (Ar-N-O) interferences, further augmented by the use of a desolvating nebulizer (DSN-100) to reduce liquid (O-N) introduction. In order to increase reproducibility, we developed a double spike technique to correct for mass-dependent fractionation resulting from chemical separation and/or instrumental artifacts.

The double spike composition was chosen based on an error analysis, which evaluated the potential precision using both iterative and non-iterative data reduction routines [1, 2], as well as different potential double-spike compositions. Using a full range of ^{57}Fe-^{58}Fe or ^{54}Fe-^{58}Fe double spike compositions, varying from pure double spike to pure standard, and randomly perturbed one thousand times up to the internal precision, the iterative data reduction with a ^{57}Fe-^{58}Fe double spike (0.1 mol fraction ^{58}Fe) is predicted to provide the best internal precision. Thus, we prepared such a ^{57}Fe-^{58}Fe double spike from high-purity enriched Fe isotopes, and then calibrated against a gravimetric standard.

Initial double spike analyses of several rock standards show an external precision of ~0.05‰ (2σ). Our analysis protocol currently consists of ~50 cycles at 15-20V signal intensities (^{56}Fe), simultaneously collecting masses 52, 54, 56, 57, 58, 60. Polyatomic interferences are avoided at a resolution of ~2500, and we monitor ^{52}Cr and ^{60}Ni to correct for interferences by ^{54}Cr and ^{58}Ni. Sample introduction in weak HNO_3 has a lower background and better washout in the DSN-100 than HCl. In addition, we found higher frequency of peak centering increased internal precision.

[1] Johnson & Beard (1999) *Int. J. Mass Spectrom.* **193**, 87-99. [2] Siebert *et al.* (2001) *Geochem. Geophys. Geosyst.* **2,** 10.1029/2000GC000124.