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Is there really carbon in the detrital zircons from Jack Hills, Western Australia?

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We have previously reported the discovery of graphite and diamond inclusions in detrital zircon grains from the Jack Hills in Western Australia, with the oldest inclusion-bearing zircon being 4,252 Myrs (Menneken et al. 2007). When the diamond inclusions were first identified by Raman spectroscopy, several characteristics were taken as evidence against possible contamination from diamond polishing powder used to prepare the samples. Some diamond inclusions appeared larger than the grain-size of the diamond polishing powder, while most of them were associated with graphite. Raman spectra of the diamond inclusions were clearly different to those from diamond particles in the polishing powder. Also, the extremely large spread of carbon isotope compositions of the diamond-graphite composite inclusions with δ^{13}C values extending from -58 to -5 per mil argued against contamination, as both synthetic and natural diamonds have a narrow range of carbon isotope composition (Nemchin et al. 2008). In this study, we have applied transmission electron microscopy (TEM) and Raman spectroscopy on focussed ion beam sections cut from a fully embedded diamond inclusion and a fully embedded carbon inclusion in two zircon grains from Jack Hills. Results show that the graphitic material is not a solid inclusion, but covers the walls of a void as a 10-20 nm thick layer. Since we identified numerous CO_2 inclusions in the same host zircon by Raman spectroscopy, it is likely that this inclusion was once filled with CO_2 On the other hand, similar to a study by Dobrzhinetskaya et al. (2014), performed on surface diamond-graphite inclusions from one of our samples, we found that the embedded diamond inclusion consists of several hundred nano-meter large angular diamond fragments mixed with some gold particles. This is strong evidence that the embedded diamond particles originated from the diamond polishing powder. The diamond particles could enter the cavity through an opening 2 – 3 μm wide. Previously, we considered it impossible to remove and insert apparently larger solid minerals through such narrow openings during the polishing process. However, newly discovered CO_2 inclusions along with graphite in Jack Hill zircons indicate that diamond grains from the polishing paste likely entered into cavities that were originally filled with CO_2 and coated with graphite-like carbon, generating artificial graphite-diamond composite inclusions

Dobrzhinetskaya et al. (2014) Diamonds in Earth's oldest zircons from Jack Hills conglomerate, Australia, are contamination. Earth Planet. Sci. Lett., 387, 212.

Menneken et al. (2007) Hadean diamonds in zircon from Jack Hills, Western Australia. Nature, 448, 917.

Nemchin et al. (2008) A light carbon reservoir recorded in zircon-hosted diamond from the Jack Hills. Nature, 454, 92.