Discovery of a CO2 Inclusion in a Detrital Zircon from Jack Hills, Western Australia

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Detrital zircon grains from Jack Hills, Western Australia, are the oldest preserved material of the early Earth and therefore represent valuable material for studying early Earth processes. The systematic investigation of inclusions in these zircon grains has led to the discovery of microdiamond and graphite inclusions (Menneken et al. 2007). Although the origin of these carbon inclusions is not yet known, their presence and characteristics indicate relative cool conditions at the very early stage in the Earth's evolution. Here we present the discovery of another carbon inclusion, namely CO_2, by micro-Raman spectroscopy, in a Jack Hills zircon grain with an U-Pb concordia age of 3367 $\pm$ 9 (2σ) Ma. The inclusion contains almost pure CO_2 with traces of N_2. From the frequency difference of the upper and lower Raman band of the Fermi diad of CO_2, we calculated a CO_2 density of 0.84 $\pm$ 0.01 g/cm^3. With zircon crystallisation temperatures between 667 and 681 $^\circ$C, as estimated from the Ti-in-zircon thermometer (Ferry & Watson 2007), and the equation of state for CO_2 from Span & Wagner (1996) we obtain a minimum pressure of 3 kbar. The rare earth element pattern of the zircon resembles those that have been obtained from other Jack Hills zircon grains (e.g., Wilde et al. 2001). The *P-T-X* conditions are thus compatible with zircon growth from an evolved granitic magma under amphibolite- to granulite-facies conditions and do not indicate high pressure conditions. The genetic link between the diamond/graphite inclusions and the CO_2 is yet unresolved and will be an issue for future studies.

References

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