

An experimental investigation of the formation mechanisms of superdeep diamonds

A.R. THOMSON*, M.J. WALTER, S.C. KOHN,
G.P. BULANOVA AND C.B. SMITH

School of Earth Sciences, University of Bristol, Bristol, BS8
1RJ (*correspondence: (andrew.thomson@bristol.ac.uk)

The subduction of oceanic crust is not only a fundamental driving force of mantle convection, but also an integral part of the Earth's deep carbon cycle. Subducted material provides almost all of the return flow of carbon to the earth's interior [1]. Seismic tomography suggests that slabs can penetrate into the deep mantle, thus carbon can potentially be delivered into the transition zone and/or lower mantle and react with ambient mantle [2].

Recent studies of superdeep diamonds from the Collier-4 [3] and Juina-5 [4] kimberlite pipes in Brazil have found direct evidence for such processes. The diamonds show complex growth structures, are composed of isotopically light carbon (ranging up to -25‰) and contain mineral inclusions with compositions expected to form from a mafic protolith in the transition zone and/or lower mantle all of which are consistent with a key role of subducted material in their origin. It has also been observed that former calcium silicate perovskite inclusions have extremely enriched trace element abundances, with REE and HFSE up to 20,000 times primitive mantle [5]. Geochemical modelling suggests that inclusions, and their diamond hosts, crystallised from a low degree carbonated melt of subducted basalt in the transition zone upon reaction with ambient mantle [5].

This study aims to test the model of superdeep diamond growth by experimentally investigating the liquidus phase relations and reactions that occur when an oxidized carbonated melt interacts with reducing mantle peridotite. The bulk composition used to determine the appropriate melt composition represents ODP hole 1256D basalt samples containing 2.5wt% CO₂. Initial multi-anvil experiments at 20 GPa show that two immiscible melts, a Na-rich carbonate melt (~16wt% Na₂O) and a Na-bearing 'granite' melt (>70wt% SiO₂) coexist with majorite at 1400-1500°C. We will report on ongoing experiments in which these melt compositions are reacted with reducing peridotite .

[1] Dasgupta & Hirschmann (2010), *EPSL* 298, 1-13. [2] Rohrbach & Schmidt (2011), *Nature* 472, 209-212. [3] Bulanova *et al.* (2010), *Cont. Min. Pet.* 160, 489-510. [4] Walter *et al.* (2011), *Science* 334, 54-57. [5] Thomson *et al.* (2012), *Min. Mag.* 76(6), 2455.

Bacterial communities inside soil iron nodules

R.L. THORNE¹* A.H. KAKSONEN² AND R. ANAND¹

¹ CSIRO Earth Science and Resource Engineering, ARRC,
Kensington, WA,6151, Australia (*correspondence:
robert.thorne@csiro.au)

² CSIRO Land and Water, Underwood Ave, Floreat WA 6014,
Australia (anna.kaksonen@csiro.au)

Iron nodules are found in a wide variety of surficial environments across the globe [1, 2] and iron spherules of a similar size and morphology are even found within the sediments of Mars [3].

Iron nodules from soils in Western Australia are homogenous, compound and concentric and dominated by hematite and maghemite. Nodule formation has been attributed to weathering and the mobilisation and migration of Fe²⁺ in response to variations in redox potential and differential drying [1].

Bacterial communities within the soil nodules were investigated using cloning and sequencing of polymerase chain reaction amplified 16S rRNA genes. The results showed that the nodules contain a phylogenetically diverse bacterial community dominated by members of *Acidobacteria*, *Actinobacteria* and *Proteobacteria*.

The metabolic potential of uncultivated organisms within the soil nodules can be phylogenetically assessed by a comparison with related sequences from environmental clones or cultured bacteria. The results show that some clone sequences closely resemble cultured Fe-oxidising bacteria and clones from environments with high concentrations of iron. The combination of geochemical and bacterial studies can provide new insights into nodule formation and the role bacteria play in the mineralisation process.

[1] Anand (2002) *Aust. J. Earth Sci* 49, 3-162. [2] Reoloid *et al* (2008) *Sed. Geol* 203, 1-16 [3] Squyres *et al* (2004) *Science* 306, 1709-1714.