Evidence for the role of carbonate melts in the origin of superdeep diamond inclusions from the Juina-5 kimberlite, Brazil.

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Over the past 30 years multiple studies of inclusions in naturally occurring diamonds have observed minerals which must have formed at sublithospheric depths in the earth [1]. In a recent study [2], lower mantle minerals interpreted to have formed in a basaltic protolith were found as inclusions in diamonds from the Juina-5 kimberlite, Brazil. These inclusions demonstrate subduction of ocean floor material into the lower mantle, and implicate diamond formation in the deep mantle from carbon-bearing fluids or melts.

This study reports the finding and analysis of new inclusions from the Juina-5 kimberlite. We find multiple examples, to complement those previously reported, of phases corresponding to those stable in a basaltic protolith at transition zone and lower mantle pressures. Most inclusions have undergone retrograde reactions and/or unmixing during acsent to the surface. Inclusions include several examples of unmixed NAL phase, iron-rich phases similar to TAPP, and multiple calcium- and titanium-rich phases with perovskite stoichiometry.

During the study samples have been analysed both by electron microbe and SIMS to determine major and trace element compositions. Early results show that the calcium perovskite phases are highly enriched in incompatible elements including REE and HFSE, but are depleted in LILE. The trace element enrichments and abundance patterns are very similar to Ca-Ti-perovskite inclusions found in the Collier-4 kimberlite [3], located approximately 50km from Juina-5. Consistent with previous results [3], we interpret these inclusions as crystallisation products of small degree melts from subducted carbonated basaltic crust. Melting of carbonated basalt may occur in thermalized lithosphere stranded in the transition zone or lower mantle [4]. The melt can then be reduced upon infiltration into surrounding mantle, which is reducing and likely bearing a free metal phase; the carbonate component of the melt is thus reduced and forms diamond by redox freezing [5].

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Removal of volatile groundwater contaminants in vertical soil filter systems: quantitative process analysis

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Biodegradation of groundwater contaminants is a common remediation strategy but the assessment of the remediation success is challenged by abiotic processes leading to contaminant concentration reductions without the desired destructive mass removal. In unsaturated subsurface systems volatile contaminants might enter the soil air and such volatilization might eventually be a significant contribution to contaminant mass removal and to emissions of contaminants into the atmosphere. Any assessment of the fate of volatile contaminants in such systems thus needs to distinguish between the contribution of biodegradation and of volatilization to observed contaminant removal.

The present study focuses on the processes controlling the removal of benzene and MTBE from groundwater applied to pilot scale vertical flow filter systems. The soil filter systems were intermittently irrigated by the contaminated groundwater which led to a highly transient flow and transport system. Measured contaminant concentrations indicated a high mass removal [1] but did not allow for a quantitative assessment of individual removal processes due to the high spatio-temporal dynamics of the systems. To obtain such quantitative analysis conservative solute tracer tests, stable isotope fractionation and measurements of natural radon concentration in the treated groundwater [2] were used as additional data basis for a reactive transport modeling approach. Numerical simulations using the model MIN3P considered variably saturated flow, the transport of species in the water and the gas phase as well as the biogeochemical transformation of reactive species.

The model allowed for reproducing the experimental data and the model results suggest that for the investigated volatile compounds biodegradation is the dominating mass removal process with volatilization contributing only to minor or negligible amounts. These results indicate that also gas phase gradients of volatile compounds can be affected by biodegradation suggesting the unsaturated zone to act as a biofilter for contaminants in the soil air.

[1] Van Afferden (2011) *Water Research* **45**, 5063-5074.
[2] De Biase (2011) *Ecological Engineering* **37**, 1292-1303.