CO_2-recycling to the deep convecting mantle

F.E. BRENKER[1] , C. VOLLMER[2] , L. VINCZE[3], B. VEKEMANS[4], A. SZYMANSKI[1], K. JANSSENS[4], I. SZALOKI[5], L. NASDALA[6], W. JOSWIG[1] AND F. KAMINSKY[7]

[1]Institut für Geowissenschaften, Johann Wolfgang Goethe-Universität Frankfurt, 60054 Frankfurt, Germany, f.brenker@em.uni-frankfurt.de

[2]Max Planck Institute for Chemistry, Mainz, Germany, cvollmer@mpch-mainz.mpg.de

[3]Ghent University, Department of Analytical Chemistry, Belgium, Laszlo.Vincze@UGent.be

[4]University of Antwerp, Department of Chemistry, Belgium, bart.vekemans@ua.ac.be; koen.janssens@ua.ac.be

[5]Institute of Experimental Physics, University of Debrecen, Hungary, szaloki@tigris.klte.hu

[6]Institut für Geowissenschaften, Johannes Gutenberg-Universität, Mainz, Germany, nasdala@uni-mainz.de

[7]KM Diamond Exploration Ltd., Vancouver, Canada, felixvkaminsky@cs.com

Synchroton X-ray probe

We applied several in situ analytical techniques (S-XRF, S-XRD, Raman) [1-4] on syngenetic inclusions in diamonds from Juina (Brazil) originating from the lower part of the transition zone (> 580km) or even the lower mantle (> 670km). Our investigation yielded an unusual suite of "ultra-deep" diamonds, dominated by Ca-rich mineral inclusions. Walstromite-structured $CaSiO_3$ inclusions were identified in 13 cases. The most unexpected finding in these deep mantle diamonds was the detection of several syngenetic carbonate inclusions. The coexistence of a walstromite-structured $CaSiO_3$, and olivine with syngenetic calcite within the same diamond, together with the finding of a two phase assemblage of walstromite-structured $CaSiO_3$ and $CaTiO_3$-perovskite, leads to the assumption that the carbonate was incorporated into the diamond in the lower part of the transition zone (> 580 km depth) or even the lower mantle.

Implications

These findings unquestionably show that Earth´s global CO_2-cycle has an ultra-deep extension. The storage of carbonates in the deep mantle enable the release of huge amounts of CO_2 during mantle melting events, which may explain the coincidence of mass extinctions with the formation of large igneous provinces [5].

References

[1] Brenker F. E. et al.(2005) EPSL **236**, 579. [2] Vincze L. et al. (2004) Anal. Chem. **76**, 6786. [3] Vekemans B. et al. (2004) J. Anal. Atomic Spectr. **19**, 1302. [4] Nasdala L. et al., Eur. J. Mineral. 15, 931 (2003). [5] Wignal P. (2005) Elements **1**, 293.