Geophysical Research Abstracts
Vol. 12, EGU2010-10225, 2010
EGU General Assembly 2010

Weertman cracks and the fast extraction of diamonds from the Earth's mantle with a speed of about 800 km/h

Holger Sommer (1), Klaus Regenauer-Lieb (2,3), and Oliver Gaede (2)

(1) University of the Free State, PO Box 339, Bloemfontein 9301, South Africa, (2) School of Earth & Enviroment, The University of Western Australia, Perth, Western Australia 6009, Australia, (3) CSIRO Earth's Sciences and Recourse Engineering, PO Box 1130, Bentley, WA 6102, Australia

First evidence from the Jwangeng diamond mine in South Botswana reveals a possible mechanism of near-sonic speed diamond extraction. Our data support the formation of Weertman cracks as a transport mechanism for the diamond bearing kimberlitic-melt from the Earth's mantle to the surface. Weertman cracks are vertical fluid filled cracks, which can move with a velocity of about 800 km/h. External stress fields facilitate the propagation of a Weertman crack, but it is essentially driven by the buoyancy or gravitational potential energy of the fluid. A Weertman crack can never overshoot (propagate faster than) the fluid, without losing its driving force. Therefore, we use properties of the fluid to estimate upper limits for the propagation velocity of a Weertman crack. We present new data that support the hypothesis that Weertman cracks can be responsible for the extraction of diamonds. Arguments for Weertman cracks are threefold: 1) The geometry of kimberlite pipes closely resembles the shape predicted by Weertman cracks; 2) Like Weertman cracks kimberlites themselves never develop an explosive stage besides the mechanism due to contact with groundwater; the melt often gets trapped near the Earth's surface; 3) The speed of the uplift of the diamonds from >150 km depth must be larger than 800 km/h to explain preservation of diamonds themselves and our OH-diffusion profiles in garnet and our calculations recorded from quenched diamondiferous host rock.