Mantle layering beneath Angola

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Three pipes Caquele, Camitongo 1 and 2 reveal close geothermal condition and layering with 10 major horizons but different mantle lithology despite on close mineralogy . TP conditions close to 35mv/m2 in middle part, heating in basement up to 55 kbar and other features are similar to Catoca pipe. Mantle columns have individual geochemistry suggesting pervasive metasomatism in lower part of mantle. Caquelle CPx with lherzolitic REE are LILE – enriched while Camitongo 1-2 are less in LILE and HFSE with Pb dips. Ilmenite trend tracing the mantle column from bottom up to shallow mantle evolve to Fe- ilmenites and correlate in depth with the abundance of clinopyroxenes in the mantle as well as the general ilmenite TRE abundance.

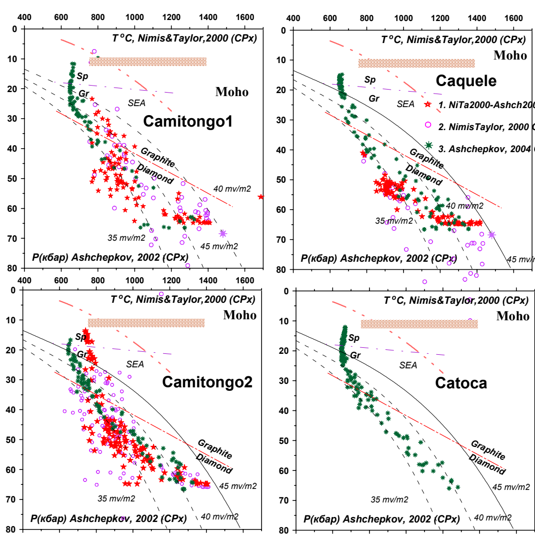

Figure 1. TP conditions of the Angola pipes.

Acknowledgements

Grants RFBR : 03-05-64146, 03-05-65083

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Equilibrium thermodynamics: Applications to mantle geodynamics

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Geodynamic (Gd) continuum flow models have being extensively used to understand chemical and physical processes in the Earth mantle. A severe limitation of Gd modelling is that petrological and mineralogical data are seldom used to constrain the physics of the model itself and the results from the numerical simulations are not easily and directly compared with geochemical observations. The most straightforward approach to improve Gd simulations is to incorporate chemical thermodynamics (Td) in the form of Gibbs free energy minimization within the local equilibrium approximation. Phases composition and abundance are then retrieved as a function of space and time. Once these quantities become available, they are used to put constraints on the physics of the flow model, making the Td and the Gd parts intimately coupled. Few applications of the method are outlined here. 1) We applied the method to simulate dynamic equilibrium melting processes using a modified version of the Td database developed by Ghiorso et al. (G3, 2003) in combination with a multiphase flow model where melt transport is uncoupled from mantle dynamics. Focusing of melt from off-axis regions toward the surface is mainly obtained through flow at the base of the lithosphere-asthenosphere boundary. The importance of the latent heat of melting will be enphasized in the discussion. 2) In the recent past there have being rumors questioning the existence of plumes and convection in the mantle. We are using the best (and only) self-consistent Td database for high pressure high temperature mineral phases developed by Saxena (GCA, 1996) to constraint the compressible flow model and geodynamics of the Earth mantle. While results are not considered indisputable, it is expected that divergent conclusions should be based on the same quantitative foundations. 3) We are also briefly tackling the controversial and unsolved questions related to the formation of the D'' layer and core mantle boundary interaction. Combining Saxena's Td database extended to pure iron phases and a fully compressible multiphase transport model, we are exploring the chemical interaction between core and mantle materials and investigate the mechanism of iron enrichment found recently in plumes materials. An extended version of the model introduced here is presented in session (SS-18) to investigate non-equilibrium diffusion controlled melting