Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06884, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06884
EGU General Assembly 2008

Impact on Mantle Dynamics from Korteweg Stresses in Concert with Giant Fluctuations

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Recent research on fluid-dynamics has shown that the constitutive relationship used in the modeling of geodynamical flow problems with strongly variable physical properties should have additional terms able to reproduce giant fluctuations observed in laboratory experiments, very similar to spinodal decomposition but for miscible interfaces. It has also been pointed out the new terms should be present in the stress tensor, known in the literature as Korteweg stresses (K-stresses), arising at diffuse interfaces and that can best be explained in terms of density gradients. Such terms have already been mentioned in the literature for more than one hundred years, but have not received attention recently until a combination of experimental and numerical evidence have confirmed their existence. We will discuss the important potential role these new physical phenomena have for geophysics and its many ramifications in geodynamics, ranging from mantle convection to earthquakes and magma dynamics.