Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Non-Boussinesq Rayleigh-Benard linear stability[1] THIERRY ALBOUSSIERE, YANICK RICARD, Laboratoire de Geologie de Lyon, universite de Lyon, CNRS, ENS de Lyon, France — The simplest Rayleigh-Benard configuration consists in a horizontal fluid layer maintained at a higher temperature on the under side, with no shear stress on its boundary. In the Boussinesq approximation, Rayleigh obtained an analytic value, $27\pi^4/4$, for the critical stability threshold of a dimensionless parameter which now bears his name. There are two ways to go away from the Boussinesq approximation: when there is a significant temperature difference across the layer compared to the average thermodynamic temperature, or when gravity creates a significant compression of the fluid near the bottom. We have determined an approximate analytical expression for the critical Rayleigh number depending on the those two non-Boussinesq causes. We have also determined the critical threshold for the intermediate model called the 'anelastic liquid approximation' in which the adiabatic temperature gradient is taken into account, while density flucuations are assumed to be solely due to temperature fluctuations. It is found that a small product αT (thermal expansion coefficient times temperature) does not make the anelastic liquid approximation any better, for a Grüneisen parameter close to unity.

[1]TA acknowledges support from the PNP program of INSU (CNRS)

Thierry Alboussiere
CNRS

Date submitted: 31 Jul 2015 Electronic form version 1.4