Geophysical Research Abstracts, Vol. 7, 06810, 2005 SRef-ID: 1607-7962/gra/EGU05-A-06810 © European Geosciences Union 2005



Solidification temperature for iron and iron-rich melt at pressures in the Earth's core

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The Landau model, well-established as a quantitative description of first order phase transitions, is applied to the liquid–solid phase transition inside the Earth. The general expression obtained for the transition temperature as a function of pressure and depth is first scaled to correspond to pure iron using the zero pressure melting temperature T_m together with T_m at 105 GPa, as measured by Ma & al. (2004). This gives the iron melting temperature at all pressures inside the Earth which agrees very well with experiments by Shen & al. (1998), Nguyen & Holmes (2004) and Brown & McQueen (1986) and rather well with calculations by Alfè & al. (2004). Next, the same expression for the solidification temperature is scaled for iron-rich melt with impurities; the calibration to the temperature at the centre has been approximated using the pure iron result. This expression is used to predict the solidification temperature of the melt at core pressures, and thus the temperature at the Earth's inner core boundary.