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New Melting Parameterization for Geodynamic Modelling: Preliminary Results Applied to Plume Setting

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Melting poses a challenge in geodynamic numerical modelling: thermodynamic models are computationally expensive and they present serious restrictions as far as P-T conditions are concerned; on the other hand, simple parameterizations usually cannot address major element contents of melts, and thus physical properties. Here, we present a new polynomic parameterization based on pMELTS [Ghiorso et. al., 2002] to be used in geodynamic models. In addition, we show a first application to a geodynamic model.
Our parameterization is adapted for continuous melt fractionation under decompression. The input parameters are initial pressure of melting, pressure, critical porosity, water content and temperature. The parameterization can be further calibrated for different rock compositions. It yields as the amount of melt retained in the rock, total degree of melting plus major element compositions in the form of wt% of oxides, such as: SiO_2, MgO, FeO, CaO, Al_2O_3 and Na_2O.
The parameterization has the same limitations as the thermodynamic model on which it is based (MELTS), and somewhat bigger errors due to statistical fitting. In turn, it involves advantages in terms of computational speed, and ease of implementation. Most importantly, extrapolation of the model along this parameterization can provide statistically meaningful results. To demonstrate this, we benchmark these results with high pressure melting experiments.
Finally, we show first applications of our parameterization as it is coupled to simple thermomechanical plume models. In these models, different melt compositions are obtained when changing potential temperature, plume buoyancy flux, and plume temperature. Although the parameterization errors are probably too high for petrological ends (where MELTS and pMELTS should be used instead), it presents an efficient and suitable option for geodynamic models.