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Modelling the early Cretaceous tholeiitic suite of picrite-to-rhyolite dykes from the Spitzkoppe region of Namibia (Thompson et al., 2007), was the original motivation for adding isenthalpic assimilation and fractional crystallization to the alphaMELTS software (then called Adiabat_1ph; Smith & Asimow, 2005). For most measured major oxides and trace elements (Al2O3 being an exception), observed data from the dyke swarm fell between trends modelled with (p)MELTS for (a) closed-system fractional crystallization, dominated by conductive heat loss, and (b) heat-balanced assimilation and fractional crystallization, with local granitic crust as the contaminant. alphaMELTS 2 is a complete rewrite of the alphaMELTS software built on the latest rhyolite-MELTS / pMELTS code, including an improved algorithm for detection of phase saturation (Ghiorso, 2014). Routines for assimilation, reverse frationation, and fitting the liquid line of descent (LLD) for fractional crystallization have recently been added to alphaMELTS 2, and are used here to revist the evolution of Spitzkoppe dykes. A MATLAB/Python version of the software can be automated to map the effects of oxygen fugactity and volatile content on modelled LLDs and has the flexibilty to explore the model space between the two end-member scenarios.

Unlike the original MELTS liquid calibration (Ghiorso & Sack, 1995), the rhyolite-MELTS and H_2O-CO_2 mixed fluid model (Gualda et al. 2012; Ghiorso & Gualda 2015) successfully predicts the major element compositions of the more evolved Spitzkoppe dykes. Fractional crystallization models (without assimilation) that match the trend in Al_2O_3 slightly overestimate total Fe as Fe_2O_3 at low MgO, and vice versa, but the overall fit to the major elements is significantly improved compared to Thompson et al. (2007). By alternating heat-balanced assimilation steps and closed-system (except for oxygen) fractionation a family of thermodynamic models is generated that simultaneously explains major and trace element trends, and isotopic signatures of the Spitzkoppe suite. The alphaMELTS 2 models are compared to ones constructed using the Magma Chamber Simulator (Bohrson et al. 2014) and will be included in the Database of AlphaMELTS@CIT Examples (DACITE; part of an upcoming alphaMELTS 2 website: alphamelts.caltech.edu).