# Markov Chain Monte Carlo Inversion of Mantle Temperature and Composition Beneath Iceland

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Basaltic magmatism is a fundamental consequence of convection within the earth's interior. Basalts are generated by adiabatic decompression melting of the upper mantle, and thus provide spatial and temporal records of the thermal, compositional, and dynamical conditions of their source regions. Uniquely constraining these factors through the lens of melting is challenging, however, given that primary basalts are variable mixtures of melts derived from compositionally heterogeneous mantle sources consisting of a range of lithologies with different melting behaviors (e.g. peridotite vs. pyroxenite). To overcome these challenges, we have combined the Metropolis-Hastings Markov chain Monte Carlo sampling method with the forward melting model REEBOX PRO [1], which simulates adiabatic decompression melting of lithologically heterogeneous sources containing peridotite and pyroxenite. This coupling allows us to invert for key mantle source parameters (and their uncertainties), including mantle potential temperature ($T_P$), lithologic abundances and their initial trace element and isotopic compositions, by identifying optimal models that produce the best fits to the observations. We have applied this combined methodology to magmatism along Reykjanes Peninsula in Iceland, exploring melting of depleted peridotite and an enriched peridotite/pyroxenite lithology (either KG1 peridotite or G2 pyroxenite). Best-fit model sources have ~92% depleted peridotite and ~8% pyroxenite with $T_P$ ~148 ± 4 °C above ambient mantle. The enriched lithology has an EMORB-like trace element composition but was not likely produced by melting at a mid-ocean ridge. The depleted peridotite lithology is similar to DMM [2] in terms of its trace element and Nd isotopic compositions. We discuss these results with regard to existing Iceland source models and reconcile our results with arguments against the depleted Iceland source being derived from DMM [3].

[1] Brown & Lesher (2016); G^3, v. 17, p. 3929-3968
[2] Workman & Hart (2005); EPSL, v. 231, p. 53-72
[3] Thirlwall (1995); J. of the Geol. Soc., v. 152, p. 991-996