Geodynamic-petrological modelling of mantle upwellings in the Eastern Atlantic: Sources vs. porcesses

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Intraplate volcanism is a widely studied but poorly understood phenomenon. In particular, Atlantic intra-oceanic volcanism near the African continental margin displays several characteristics that do not fully conform with classical plume theory. It has been suggested that Edge-Driven Convection (EDC) plays a major role in the generation of magmas beneath *e.g.* the Canaries, Cape Verde or the Cameroon volcanic line. To explore the roles of EDC vs. plume in the generation of Atlantic volcano chains, we have conducted a series of numerical models using the code CITCOM coupled with parameterizations for melting an assemblage of peridotites and pyroxenites. Our new parameterizations have been derived from experiments and pMELTS modelling, and can predict the extent and major-element composition of peridotite/pyroxenite melting as a function of the P-T path. We study the behavior of EDC alone, as well as the possible interactions of EDC with plumes. To better understand plume-EDC interaction, we explore a wide range of model parameters, focusing specifically on the effects of plate velocity, mantle viscosity, plume temperature, and plume position relative to the edge (*i.e.*, African margin). Our results suggest that EDC alone is unable to sustain significant volcanism, unless the mantle is anomalously hydrous. In turn, plumes alone do not create the complex age progressions of *e.g.* the Canaries. However, we find that EDC can distort plume ascent and imprint characteristic properties on the related volcanism, resulting in irregular age progressions. In addition, our models predict that the chemical characteristics of primary magmas depend on mantle upwelling geometry, suggesting that the role of EDC on generating volcanism can be constrained by the geochemistry of primary magmas: for example, the pyroxenite signature decreases with decreasing plume temperature or as plume ascent becomes inhibited by EDC. Although EDC alone is not a suitable mechanism for extensive intraplate volcanism, it can have important effects on plume ascent, and thereby reconcile some previously poorly understood characteristics of eastern Atlantic volcano chains.