Small-scale sublithospheric convection reconciles geochemistry and geochronology of intraplate volcanoes in the W- and S-Pacific

M.D. Ballmer[1]*, G. Ito[2], J. van Hunen[3], T.A. Bianco[2] and P.J. Tackley[1]

[1]Institute of Geophysics, ETH Zurich, Switzerland (*correspondence: ballmer@tomo.ig.erdw.ethz.ch)
[2]SOEST, University of Hawaii at Manoa, USA
[3]Dep. of Earth Sciences, University of Durham, UK

Seamounts in the W- and S-Pacific (i.e., Gilberts, Wake seamounts, Marshall and Cook-Austral Islands) display distinct geochemical trends, of which signatures are stable through geological time (>100 Myrs) and depend on the absolute location of volcanic activity relative to the underlying Superplume [1]. This has been interpreted in terms of magmas to originate from short-lived plumelets (~30 Myrs) that rise from the top of the Superplume. However, sample ages along the individual seamount trails violate the predictions of plume theory in terms of geographic age-progressions. Furthermore, stability of proximal geochemical anomalies in the Superplume over >100 Myrs seems unlikely. Small-scale sublithospheric convection (SSC) as triggered by a low-viscosity Superplume may instead account for enigmatic age patterns and geographic geochemical systematics altogether.

We perform 3D numerical thermo-chemical models of SSC and of related melting. The melt source consists of pyroxenite veins and enriched peridotite blobs in a matrix of depleted peridotite [2]. SSC-melting emerges in elongated features parallel to plate motion ('cigars'). Magmas are predominantly derived from pyroxenite melting (~70%) with the remainder from enriched peridotite melting. Depleted peridotite (with 0.0075 wt-% water) does not cross the solidus, since excess temperatures as associated with SSC-upwellings are low (<100°C). The fraction of pyroxenite derived melts decreases with increasing age of the overlying seafloor. This behaviour reconciles geographic trends of geochemical observables without presuming large-scale source heterogeneity [1, 2]. Moreover, geometries of SSC-melting ('cigars') reconcile sample ages. Given that alkalic ocean island basalts (OIB) are considered to originate from pyroxenite melting without simultaneous large-volume peridodite melting [3], SSC may be a viable mechanism to produce many OIBs.

[1] Konter *et al.* (2008) *EPSL* **275**, 285-295. [2] Ito & Mahoney (2005) *EPSL* **230**, 29-46. [3] Kogiso *et al.* (2003) *EPSL* **216**, 603-617.

Integration of petrological-geochemical constraints and local seismic tomography – Implications for magmatic processes within continental arc crust of S-Alaska

S. Ballmer*, E. Kissling, P. Ulmer, and T. van Stiphout

Department of Earth Sciences, ETH Zurich, 8092 Zurich, Switzerland (*correspondence: silke7@web.de)

We explore the potential of integrating petrological-geochemical constraints and local seismic tomography for the investigation of arc magmatism-induced evolutionary processes within the overriding continental crust. Petrological-geochemical predictions alone (as well as interpretation of seismic anomalies alone) are ambiguous, something that calls for integration of these approaches. We draw qualitative predictions on seismic wave velocities from geochemical data of Cook Inlet arc volcanics (Augustine, Redoubt and Spurr, S-Alaska) and theoretical petrological constraints to be compared with an independently calculated high-quality minimum 1D seismic velocity model. Thereby, the integration of both v_p and v_s is essential to deal with water and melt in the system. Comparison of two minimum 1D models from two spatially distinct datasets as well as the finding of increased v_p/v_s-ratio throughout the area covered by rays contribute physical evidence to the petrological-geochemically predicted crustal evolution throughout different stages of magmatic modification. Although along-arc variations indicated by geochemistry remain unconfirmed by the minimum 1D model due to inherent geometrical limitations of our approach, they further support the high potential of our method especially in view of extension towards three dimensions (i.e. 3D-tomography) and towards quantitative petrological-geochemical predictions on seismic wave velocities.