Mantle controls on the geochemistry of Kīlauea lavas erupted over the last millennium

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Lavas from Kīlauea Volcano display rapid geochemical variations on a time scale of decades to centuries. The wall of Kīlauea Caldera at Uwekahuna Bluff exposes a 135-m thick sequence of recent prehistoric lavas (erupted mostly between AD 900-1400) and tephra from an explosive eruptive sequence at the volcano's summit (the Uwekahuna Ash). This stratigraphic section allows us to re-create a detailed temporal record of the mantle controls on the geochemical evolution of Kilauea lavas erupted over the last millennium. Previously [1], we analyzed the Pb, Sr, and Nd isotope ratios and major-element abundances of a series of 24 successive lava flows from the upper portion of Uwekahuna Bluff. The $^{206}Pb/^{204}Pb$ and $^{87}Sr/^{86}Sr$ ratios of these lavas were found to converge with prehistroic Mauna Loa lavas of the same age. This observation was attributed to the rapid passage of a small-scale compositional heterogeneity through the melting regions of both volcanoes. Here we present a detailed geochemical study (major- and trace-element abundances, and Pb, Sr, and Nd isotope ratios) of four glass separates from the Uwekahuna Ash and the remaining 38 lavas exposed lower in the Uwekahuna Bluff, along with trace-element abundances for the upper 24 lava flows from Uwekahuna Bluff. These prehistoric lavas and glasses display a small, but systematic, temporal variation in ratios of highly over moderately incompatible trace elements (e.g. La/Yb) that correlates with fluctuations in the Pb and Sr isotope ratios. These correlations suggests that the lithology of the mantle source controls the degree of partial melting at Kīlauea. The origin of these differences in source lithology will be explored using the major- and trace-element abundances of the lavas.

[1] Marske *et al*. (2007) *EPSL* **259,** 34-50.

Mechanisms of deep crustal subduction and exhumation: Insights from numerical modelling

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The dynamic processes leading to syn-convergent crustal subduction and consequent exhumation of high pressure low and high temperature rocks in continental collision zones remain poorly understood. Using results of thermo-mechanical thermodynamically coupled numerical models, we here discuss different possible mechanisms of crustal subduction and exhumation. To reach that goal, oceanic subduction-continental subduction and collision is modelled using a forward viscous-elastic-plastic thermo-mechanical models and synthetic petrology models allowing to trace P-T-t paths, generated out of numerical simulations, and compare them with natural P-T-t paths. Different collision scenarios, as function of the convergence rate and thermo-rheological profile are also discussed. It is shown that crustal subduction may occur only at very specific conditions in terms of crustal rheology, structure, subduction rate and thermal regime. It is also noteworthy that the models predict strong variations in the exhumation rates during the subduction-collision stage, and indicate that UHP rocks are likely to be exhumed at the earlier stages of continental subduction. Several additional mechanisms related to strain localization due to strain softening, metamorphic reactions, heat dissipation and fluids are also discussed. A particular attention is paid to the role of surface processes, sedimentary content and inherited structures. The experiments also show that the dynamic pressure in the subduction channel is unlikely to deviate by more than ± 10% from the lithostatic approximation. The models are applied to a number of regions such as the Alpes, Zagros and Hymalaya showing each time a significant difference in the mechanisms of subduction and exhumation.