Mantle-to-surface magma dynamics at Mauna Loa and Kīlauea, Hawai'i

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In 2002 Mauna Loa Volcano, Hawai'i, began a nearly decade long period of inflation. Almost simultaneously, inflation and heightened activity occurred at neighboring Kīlauea Volcano. We address the question if and how both volcanoes are dynamically linked.

We model asthenospheric and crustal magma flow and pressure using a numerical model that integrates kinematic models of volcano deformation with a lumped parameter flow model. The model is constrainted by continuous global position system (GPS) measurements of deformation at both volcanoes. The past decade of summit deformation at Kīlauea and at Mauna Loa can both be explained by coupling crustal magma flow and storage to a common permeable asthenospheric melt zone beneth both volcanoes. Each volcano's shallow crustal magma system is connected to the asthenospheric melt zone by a lithospheric magma plumbing system through which changes in magma pressure can be transmitted. Consequently, pore pressure diffusion within the porous zone produces a dynamical linkage between both volcanoes and increased activity at one volcano may or may not be correlated with activity at its neighbor, depending on the interplay between deep and shallow magmatic processes.

A characteristic pore pressure diffusion time between both volcanoes of approximately ½ year explains the time-delayed onset of inflation at Mauna Loa relative to Kīlauea during 2002. Moreover, magma flow paths within the asthenospheric melt zone capture compositionally distinct magma from different parts of the asthenospheric melt source over long periods of time, consistent with geochemical observations. Because the time required for melt flow within the porous layer between both volcanoes is about three orders of magnitude slower than pore pressure diffusion. Consequently, significant redistribution of melt by porous flow requires time scales of 100s to 1,000s of years, so that decadal changes in surface activity are unlikely to affect long-term trends in magma geochemistry.

Oxidation of Fe(II) in natural waters at high nutrient concentration

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The Fe(II) oxidation kinetic was studied in seawater enriched with nutrients as a function of pH (7.2-8.2), temperature (5-35ºC) and salinity (10-36.72) and compared with seawater media. The effect of nitrate ($0-1.77 \cdot 10^{-3}$ M), phosphate ($0-5.80 \cdot 10^{-5}$ M) and silicate ($0-2.84 \cdot 10^{-4}$ M) was studied at pH 8.0 and 25ºC. The Fe(II) oxidation is faster when a high nutrient concentration is present, decreasing the $t_{1/2}$ and compromising the permanence of Fe(II) in nutrient rich waters. The most important nutrient affecting the oxidation rate is silicate. A kinetic model was applied to the experimental results in order to follow the speciation of each Fe(II) species and to compute the fractional contribution to the overall rate constant as a function of pH. The speciation was controlled by Fe^{2+} from pH 6 to 7.9 and $FeCl^+$ from pH 6 to 7.6. $FeH_3SiO_4^+$ was the most important species for pH higher than 7.6, when the concentration of total silicate was 1.41×10^{-4} M. The $Fe(OH)^+$ controlled the kinetic process at pH lower than 8.1, while the $Fe(OH)_2$ began to control the oxidation rate constant at higher pH values.