Recognition of a HIMU-like reservoir beneath northwest Ethiopia

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The initiation of Cenozoic magmatism throughout East Africa has been attributed to mantle plume activity; however the number and composition of these plumes has remained controversial. The recognition of the 'C' mantle reservoir in Afar magmatism and a radiogenic Pb isotope signature in Kenya basalts have been interpreted as manifestations of the African superplume. A radiogenic Pb isotope signature is also commonly observed in magmas erupted on the African and Arabian plates, highlighting the importance of spatial and temporal isotopic studies in developing an understanding of the interaction of the African superplume with the continental lithosphere. Distinguishing between these reservoirs has proven difficult using traditional Sr, Nd and Pb analyses, though the increasing quantity of Hf isotope analyses has highlighted some differences. We present new Sr, Nd, Pb and Hf isotopic data on a Miocene series of silica under saturated (10-16% normative nepheline) mafic (6-8% MgO) flows from the northwestern Ethiopian Plateau. These samples are particularly enriched in the most incompatible trace elements (e.g. 120 ppm Nb, 100 ppm La) and display some of the most elevated TiO_2 values (4.1-5.2%) in the region. Measured $^{206}Pb/^{204}Pb$ values extend to ~20 and are coupled with unradiogenic εHf (~0.8-1.8). These magmas exhibit linear mixing arrays that reflect assimilation of the continental lithosphere by a magma with a radiogenic Pb isotopic signature. The position of these samples well below the εNd-εHf mantle array and towards the St. Helena HIMU field, precludes a significant role for either the 'C' mantle reservoir or the radiogenic Pb component evident in the Arabian lithosphere in the generation of these magmas. These data show conclusively that a HIMU-like component is present in the Ethiopian mantle and that it can be distinguished from other reservoirs using Hf isotopes, though its location remains poorly constrained. The major and trace element characteristics of these Miocene Ethiopian magmas are comparable to those interpreted as partial melts of a metasomatized lithospheric mantle (Getra Kele - S. Ethiopia; Kajong – N. Kenya). Whether this HIMU-like signature is an inherent component in the lithospheric mantle or the result of plume-lithosphere interaction is the subject of ongoing study.

Coupled arsenic and sulfur speciation in semi-arid mine tailings

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Arsenic is a potential airborne hazard when populations are exposed to fine-aerosolized particles. Dust from a high As (>5000 mg kg^{-1}) tailings pile blows into residential areas flanking the Iron King mine, a federal Superfund site, in semi-arid central Arizona, USA. Phytostabilization of the historic tailings pile is being implemented to reduce surface wind velocity and runoff to limit dispersion of respirable particulates and decrease contaminant transport. The tailings are acidic (pH = 1.9-2.2), and generally homogenous; a redox gradient has developed from surface oxidation of the sulfidic tailings that were initially deposited. Core samples were collected from the top meter to examine the As-S-Fe system speciation with X-ray absorption spectroscopy (XAS), and investigate the mobility of As in the tailings. In the top 0-25 cm, As XANES shows a single peak at 11875 eV, indicating As (V) dominates in the upper 25 cm of the tailings; sulfur NEXAFS shows sulfate as the dominant sulfur species, fit as gypsum and jarosite, with residual pyrite present (Fig.1). A change in speciation, reflected concurrently in As and S, occurs at 25 cm. At 25-55 cm, two distinct As peaks at 11869 and 11875 are observed, indicating As (V) and As-sulfide species, with the noted absence of As (III). The S NEXAFS at 25-55 cm show pyrite as the dominant S species. Weathering of the tailings, indicated by sulfur speciation, controls the mobility and speciation of contaminants, such as arsenic, in the tailings and has important implications for the health risks to nearby communities.

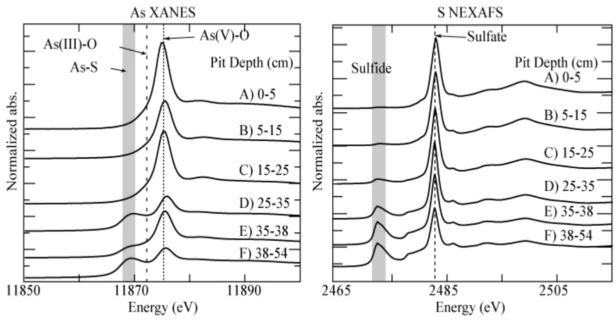

Figure 1: Arsenic XANES and sulfur NEXAFS as a function of depth in the tailings pile.