Record of upper mantle evolution beneath Western Alaska as preserved by peridotite xenoliths in the Bering Sea Volcanic Province

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Upper mantle peridotite xenoliths from the volcanic rocks erupted at 6 Ma (Seward Peninsula), 2.5-1.6 Ma (St. George Island), and 0.70-0.15 Ma (Nunivak Island) of the eastern sector of the Bering Sea Volcanic Province (BSVP) have a broad range of major oxide concentrations (MgO = 37.4-45.1%; SiO_2 = 41.0-44.0%; Mg# = 87.0-90.8) and trace-element abundance patterns (La_N/Yb_N = 0.3-18; individual REE concentrations = 1-10 times chondrite). Some xenoliths display pronounced U-shaped patterns, and also troughs at Nb-Ta and Zr-Hf), while others exhibit depleted or highly enriched patterns. Isotopic ratios have the following ranges: $^{87}Sr/^{86}Sr$ = 0.702546 – 0.70311, $^{143}Nd/^{144}Nd$ = 0.512979 – 0.513148 (ε_{Nd0} = +6.7 to +9.9), $^{176}Hf/^{177}Hf$ = 0.283097 – 0.283364 (ε_{Hf0} = +11.5-20.3). $^{206}Pb/^{204}Pb$ = 18.36 – 20.56, $^{207}Pb/^{204}Pb$ = 15.37 – 15.92, and $^{208}Pb/^{204}Pb$ = 37.81 – 39.79. Together, the data suggest close proximity of numerous compositionally distinct mantle domains, including a primitive mantle-like end-member, refractory mantle variously depleted by melting and melt extraction, and mantle overprinted by metasomatic processes.

Two types of metasomatism have been identified based on peridotite xenolith compositions: (a) those influenced by reaction with melts migrating through fractures, and (b) those completely overprinted by a recrystallization front ascending from a fluid-laden source at deeper levels. Metasomatism by silicate melt appears to have been widespread in the BSVP, was active throughout the eruption period between ca. 6 Ma and ca. 0.70 Ma, when the crust was being extended. Xenoliths from the 0.70-0.15-Ma volcanic rocks on Nunivak Island are the only suite studied in the BSVP that exhibit evidence of both silicate melt- and fluid-induced metasomatism. This suite developed through a series of events, including extraction of some basaltic components and strongly incompatible trace elements, metasomatism by silicate melts, and then finally, overprinting with an ascending recrystallization front. Silicate liquids derived from a garnet-free, peridotite-dominated mantle beneath the BSVP, as represented by the recovered xenoliths, could account for the origin of the Late Cenozoic volcanic rocks observed in the BSVP.

Dust emission from the Sahara-Sahel region over the past 150 years

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Measurements of atmospheric mineral dust loads at Barbados indicate that dust export from the Sudano-Sahel region of Africa has increased dramatically over the past four decades [1]. The increase in dust export rates is interpreted to be related to prolonged droughts in the Sudano-Sahel region. However, in the absence of longer time records, particularly from regions close to sources of N. African dust, it is difficult to quantitatively constrain the factors responsible for the observed trends in dust export. To better understand the controls on dust generation rates and how climate change would affect dust mobilization in the future, we have reconstructed dust export rates from the Sahara-Sahel region over the past 150 years.

Previous work has shown that ^4He is an excellent tracer of mineral dust (e.g. [2]). The approach we have taken to reconstruct mineral dust emission at high-resolution (annual to sub-decadal) is to use ^4He as a tracer of dust and corals as dust archives. The ^4He-based proxy record of dust, reconstructed from the Red Sea *Porites lutea* coral, correlates well with instrumental records of 20th century precipitation in the Sahel region. Hence, variations in North African precipitation patterns in the historic past can be reconstructed from dust records. In particular, all major droughts of the 20th century, such as droughts in 1910's, 1970's, and 1980's are characterized by high ^4He fluxes. The 1950's, which is the wettest decade in the Sudano-Sahel region in the 20th century, is characterized by low ^4He fluxes.

The ^4He-based proxy record of dust suggests that dust export rates from the Sahara-Sahel region at the terminal stages of the Little Ice Age, were a factor of two higher compared to the 20th century average. Additionally, baseline values of dust export decreased from 1840's to 1900, remained constant between 1900 and 1950's, but then increased from 1960 to 1990's. We find that the high dust emission rates from the Sahel during the 1980's are not unprecedented over the past 150 years. Comparisons between our ^4He-based proxy record of dust and North African climatology over the past 150 years suggests that if current trends in climate continue, dust export rates in the Sahara-Sahel region are likely to increase during the 21st century.

[1] Prospero & Lamb (2003) *Science* **302,** 1024. [2] Patterson *et al*. (1998) *GCA* **63,** 615-625.