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Oxygen isotope composition of olivine phenocrysts from Koolau Scientific Drilling Project (KSDP)

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Subaerial Koolau lavas are an end-member of Hawaiian geochemical diversity and thus, are of special interest for understanding sources of Hawaiian volcanism.

We analysed oxygen isotope ratios of olivines from 22 tholeiitic lavas from the Koolau Scientific Drilling Project (KSDP), taken from between 304 and 511 meters below sea level (mbsl). All measurements were made using the laser fluorination method, and our results are compared to previous measurements of subaerial Koolau lavas. Olivines from 11 deeper KSDP basalts (381-511 mbsl) have $\delta^{18}O$ values (5.39±0.1 per mil) slightly higher than typical upper mantle peridotites (5.20±0.2 per mil) and Mauna Loa lavas (5.17±0.11, *n=28*, [1]). In contrast, olivines from 11 upper KSDP basalts (304-359 mbsl) have higher $\delta^{18}O$ values (5.56±0.05 per mil), similar to olivines from plagioclase-spinel peridotite xenoliths collected on Oahu (5.51±0.05, *n=2*, [2]) and approaching exceptionally high values previously reported for subaerial (Makapu`u) Koolau lavas (5.89±0.12, n=7; [1]). Our results are consistent with the suggestion from [3] and [4], based on major and trace element geochemistry, that KSDP lavas record a geochemical transition toward Mauna Loa-like compositions at depth.

Values of $\delta^{18}O$ for Koolau olivines correlate positively with their whole rocks La/Nb and Sr/Nb ratios. These trends are consistent with previous interpretations that the extreme Koolau-like geochemical signature is derived from recycled upper oceanic crust in the Hawaiian plume [1, 5]. Moreover, this trend constrains the properties and mixing proportions of that component. Thus, the contribution of recycled crust to Koolau lavas increased near the end of shield-building volcanism. However, an analogous trend in the oxygen isotope geochemistry of Mauna Kea volcano has been interpreted to reflect progressive rift zone contamination. We will discuss this process in relation to the oxygen isotope geochemistry of Koolau volcano.

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Earliest stages of formation of oceanic lithosphere in the central Atlantic Ocean: The oceanic plate beneath the Canary Islands

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The Canary Islands form a roughly east-west trending chain normal to the coast of Africa. The base of the continental slope lies only 30-40 km east of the coast of the easternmost island, Fuerteventura. The oceanic lithosphere beneath the Canary Islands formed about 180-150 Ma ago during the earliest stages of opening of the central Atlantic Ocean. The Canary Islands hotspot has been active during the last 60-70 million years. Through point analyses of trace elements and $^{87}Sr/^{86}Sr$ isotopic ratios in minerals in deep crustal and upper mantle xenoliths, one can "see behind" the effects of the Canarian magmatic event, to the original composition of the underlying oceanic plate. This is best preserved in the REE concentrations in the most refractory olivine and orthopyroxene porphyroclasts, which are strongly depleted in MREE relative to HREE. LAM-MC-ICPMS Sr isotope analyses of clinopyroxenes in mildly metasomatised spinel harzburgite xenoliths give $^{87}Sr/^{86}Sr$ ratios of 0.7027-0.7028, within the range of N-MORB and significantly below the range of Canarian magmatic rocks. Modeling based on major and trace elements suggests that the oceanic lithospheric mantle beneath the Canary Islands represents the residue after about 25% depletion relative to the Primordial Mantle. The lower crust consists of highly refractory tholeiitic gabbros that have reacted with Canarian alkaline magmas to different degrees. The lowest degree of metasomatism is found in gabbro xenoliths from Fuerteventura. Estimates based on the REE compositions of clinopyroxenes in these rocks suggest formation from melts with $(La/Sm)_N$=0.16 and $(Sm/Yb)_N$=0.52. These ratios are among the lowest ones recorded for MORB magmas and suggest by partial melting of a mantle source that had already undergone at least 12-15% depletion relative to Primordial Mantle. Composition of the lithospheric mantle beneath the Canary Islands is thus in agreement with an origin as the residue after formation of the oceanic crust in the area. We have found no east-west changes in mantle composition. The continent-ocean transition in the area of the Canary Islands appears to be quite sharp, unlike the wide continent-ocean transition zones found in the Iberia Abyssal Plain and in the Red Sea.