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TI: Timing of extreme magmatic differentiation at Hualalai and Mauna Kea volcanoes from ^{238}U-^{230}Th and U-Pb dating of zircons from plutonic xenoliths
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AB: Leucocratic plutonic xenoliths erupted in alkali basalt lavas and tephra cones along the summits of Hualalai and Mauna Kea volcanoes, Hawaii, are probes of subvolcanic differentiation and reflect extreme fractionation of mafic magmas. To determine the timing of differentiation recorded by these plutonic xenoliths and assess the temporal relation between differentiation and effusion of evolved magmas at Hawaiian volcanoes, we performed in situ ^{238}U-^{230}Th and U-Pb dating of single zircons from Hualalai and Mauna Kea xenoliths by ion microprobe. Xenolith zircons are euhedral to anhedral, with U concentrations ranging from 30 to 3000 ppm and U/Th varying from 0.3 to 2. Single zircons contain up to a 2-fold variation in U/Th, yet yield core and rim ages that are within analytical error of each other. Zircons from Hualalai syenitic and dioritic xenoliths yield crystallization ages that define two populations: one at ca. 30 ka and the other at ca. 250 ka. Zircons from Mauna Kea dioritic xenoliths yield ages of ca. 60 ka. The zircon ages indicate that syenitic and dioritic xenoliths from Hualalai record the crystallization of highly evolved alkalic magmas in episodes that are tens of thousands of years older and younger than the single brief episode of trachyte volcanism at ca. 100 ka, and suggest that extreme differentiation is not necessarily followed by eruption of highly evolved magma. The older population of Hualalai xenoliths records generation of differentiated alkalic magma at least 100 thousand years prior to the tholeiitic shield to post-shield alkalic stage transition inferred from lava stratigraphy, which, in turn, suggests protracted transition between these stages and/or simultaneous evolution of chemically distinct magma reservoirs at different depths. In contrast, crystallization of dioritic xenoliths from Mauna Kea is synchronous with the eruptive episode of evolved Laupahoehoe Group lavas.
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