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Two primary magmas derived from Samoan mantle plume: less-degassed tholeiitic and EM2-type alkalic magmas

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Alkali basalts from Tutuila Island, American Samoa are interpreted as products of binary mixing of magmas derived from isotopically distinct source components (Farley et al., 1992): PHEM (primitive helium mantle, {sup}3{/sup}He/{sup}4{/sup}He >24 R{sub}A{/sub})-type and EM2-type. Our new data show that the isotopic ratios in these lavas correlate with trace element ratios, clinopyroxene compositions, and phenocryst assemblage. PHEM-type basalts have lower Nb/Zr, LREE/HREE, and {sup}87{/sup}Sr/{sup}86{/sup}Sr and higher {sup}143{/sup}Nd/{sup}144{/sup}Nd and {sup}176{/sup}Hf/{sup}177{/sup}Hf ratios than EM2-type basalts. PHEM-type basalts include augite and orthopyroxene, while EM2-type basalts contain diopside together with olivine and/or plagioclase. The presence or absence of othopyroxene and the difference in Ca-Ti-Na contents in clinopyroxenes suggest that the PHEM- and EM2-type end-member magmas are of tholeiitic and alkalic compositions, respectively. The reaction rims around the orthopyroxene phenocrysts indicates that PHEM-type tholeiitic end-member magmas mixed with EM2-type alkaline magmas before they were erupted. These results suggest that formation of tholeiitic basalts associated with the Samoan mantle plume can be detected by phenocryst assemblage and mineral compositions. Lack of systematic correlation between isotopic ratios and stratigraphy suggests that the end-member magmas were generated in the same period. The coexistence of tholeiites and alkaline magmas places important constraints for melting conditions and source materials for the Tutuila basalts.

Keywords: OIB, Samoa, primary magma