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SYSTEMATIC VARIATIONS IN COMPOSITION WITH ERUPTIVE SEQUENCE IN HOLOCENE CONTINENTAL THOLEIITES

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The Holocene Ice Springs volcanic field of west-central Utah consists of 0.53 km^3 of tholeiite basalt erupted as a sequence of nested cinder cones and associated lava flows. Whole rock analyses of ninety-six samples of known relative age document statistically significant inter- and intra-eruption chemical variations. The initial products of eruption were enriched in felsic components. Elemental trends include increases in Ti, Fe, Ca, P, and Sr, and decreases in Si, K, Rb, Ni, Cr, and Zr with decreasing age, consistent with previously observed systematic variations in strontium isotopic ratios. Microprobe analyses demonstrate that minerals from different eruptive events are nearly identical in composition. Lavas and pyroclastic deposits contain silicic xenoliths, orthopyroxene megacrysts, and plagioclase xenocrysts. Excess argon in cinder (30.0×10^{-12} moles/gm) and in distal lava flows (8.3×10^{-12} moles/gm) yields apparent ages of 16 and 4.3 m.y., respectively for basalts less than 1000 years old. The major element, trace element, isotopic, and thermophysical properties of the lavas and cinders are compatible with a model involving crystal fractionation, crustal assimilation, and magma mixing. Olivine fractionation at depth caused initial modification of melts. The overall inter-eruption chemical trends are explained by a combination of fractionation (plagioclase, 6%; olivine, 0.2%; magnetite 0.5%, assimilation of silicic basement rocks (< 1%), and interaction of compositionally similar magma pulses. The intra-eruption chemical variations follow the long-term trends, and a similar combination of processes on a smaller scale accounts for these short-term variations.