

Nascent continental crust in oceanic island arcs: insights from the Virgin Islands batholith, British Virgin Islands

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Mid-crustal exposures of oceanic island arcs have been found to contain a significant component of granitic material that is not typically associated with subduction at oceanic island arcs. The Virgin Islands batholith is a large ($\sim 250 \text{ km}^2$) suite of bimodal mafic and felsic plutonic rocks (K_2O ranges from 0.75 to 2.14% at $>62\% \text{ SiO}_2$) that represents a mid-crustal exposure of the Antilles arc. We obtained U-Pb zircon dates, major and trace element compositions, whole-rock Sr-Nd-Pb isotope ratios, and zircon O-Hf isotope ratios for samples from four plutonic suites of the Virgin Islands batholith to provide insight into the production and character of granitic magmatism in oceanic island arcs and the formation of continental crust.

Evidence from the batholith suggests that oceanic island arcs produce nascent continental crust that evolves toward average continental compositions. Zircon geochronology indicates that the batholith was intruded over ≥ 13 Ma between 43.6 and 30.6 Ma with the assembly of at least four discrete suites. Initial $^{87}\text{Sr}/^{86}\text{Sr}$, $\epsilon_{\text{Nd}(t)}$, zircon $\epsilon_{\text{Hf}(t)}$, and zircon $\delta^{18}\text{O}$ suggest that the batholith evolved from mantle-derived melts with limited incorporation of isotopically evolved crustal components. The batholith exhibits spatio-temporal and geochemical patterns. Chondrite-normalized REE patterns vary with age from old samples characterized by flat patterns interrupted by negative Eu anomalies, to young samples characterized by LREE-enrichment and no Eu anomaly. Normalized to average continental crust, the youngest samples are nearly flat but somewhat depleted. This indicates a shift in petrogenetic processes with age that produces crust similar to average continental crust. We suggest that this immature crust is a precursor to typical continental crust requiring only minimal differentiation during accretion and represents an important step in producing continental crust.