Intra-oceanic arc magma genesis: a case study from Havre volcano, Kermadec arc

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The Kermadec intra-oceanic arc comprises 33 active arc front volcanoes along its ~1200 km length, which represent key targets for studying the formation of Earth’ s crust. The discovery of numerous submarine caldera volcanoes and dacitic to rhyolitic pumice deposits from this setting has prompted new models for the genesis of intra-oceanic silicic arc magmas. A detailed investigation of the 2012 eruption of rhyolite pumice and lava at Havre volcano has provided a valuable opportunity to test these models. Moreover, the retrieval of older volcanic deposits from the edifice has given critical context for studying magma genesis throughout the lifetime of the volcano. Here we present whole-rock, mineral and glass major and trace element data for volcanic rock samples collected from Havre volcano. The samples, which span a compositional range from basalt to rhyolite, display several key features that support arguments against the derivation of silicic magmas primarily through crustal anatexis: (1) the range of sample compositions fit along coherent crystal fractionation trends; (2) low-MgO aphyric andesites fill the gap within the general bimodality of eruptive products from the Kermadec arc; and (3) there is a scarcity of tonalitic xenoliths. These features favour crystal fractionation over crustal anatexis as the dominant process for generating the compositional diversity seen at Havre volcano.

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