A geochemical window into the magmatic architecture of the Taney Seamounts, northeast Pacific Ocean

Jason P Coumans[1], David A Clague[2], Willaim Minarik[1], Nobumichi Shimizu[3], John Stix[1]

[1]McGill University, Canada, [2]Monterey Bay Aquarium Research Institute, USA, [3]Woods Hole Oceanographic Institute, USA

E-mail: jason.coumans@mail.mcgill.ca

The Taney Seamounts are a NW-SE trending linear, near mid-ocean ridge chain consisting of five submarine volcanoes located on the Pacific plate 300 km west of San Francisco, California. Taney Seamount-A, the largest and oldest in the chain, is defined by four well-exposed calderas which reveal previously infilled lavas. The calderas can be differentiated in time by their cross-cutting relationships, creating a relative chronology. The caldera walls and intracaldera pillow mounds were sampled systematically by a remotely operated vehicle (ROV) to obtain stratigraphically-controlled samples. Differentiating shallow and deep magmatic processes allows us to define the magmatic architecture of near-ridge seamounts. Deep magmatic processes at the Taney Seamounts are revealed by flat incompatible element ratios such as K_2O/TiO_2 and consistent LREE slopes indicating that the aggregate melts from the mantle source are geochemically similar over the formation of a single seamount. The lavas are change chemically as the seamounts become younger (Taney-A to Taney-C) from slightly enriched to transitional MORB (K_2O/TiO_2: 0.13 - 0.7). The progressive depletion in highly incompatible elements can be explained by a change in source composition, an increase in the degree of partial melting, or a combination of the two. Melts from the mantle source are entrained in anorthitic plagioclase megacrysts (An 82-88) as they are transported to the shallow magmatic reservoir. Using H_2O-CO_2 solubility relationships from melt inclusion analysis, the majority of calculated pressures, assuming vapor saturation, are approximately 300 MPa (12 km). These pressures imply entrainment at or slightly below the crust-mantle transition where a permeability barrier promotes melt pooling, homogenization and crystallization prior to ascent to the shallow system. However, if the melt inclusions are supersaturated in CO_2, then crystallization occurred in the crust and high CO_2 concentrations could drive explosive eruptions. Evidence for explosive eruptions at the Taney Seamounts includes volcaniclastic deposits on caldera rims, which may be coeval with a collapse event. Major element geochemistry of glassy basalt pillow rims indicate that lavas which infill a caldera collapse are chemically distinctive, and can be either more or less differentiated than pre-collapse lavas. The entire sequence of lavas on Taney Seamount-A represent various degrees of fractionation at shallow depths of a similar primitive source melt. This is due to the episodic formation of near-ridge seamounts where a magma pulse from the source results in reservoir formation and differentiation, effusive eruption, then catastrophic collapse of the chamber roof due to a large evacuation. Caldera collapse is followed by magmatic rejuvenation initiating a new cycle.