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Geochemical constraints on bimodal magmatism in Okinawa Trough, Japan

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The Okinawa Trough (OT) is an incipient continental back-arc basin that extends ~1200 km south from Kyushu to Taiwan, and can be split in to three segments, the Northern (NOT), Middle (MOT), and Southern (SOT).

We present petrological descriptions, major and trace element, and Sr–Nd isotopic data for a bimodal sample suite of lavas and pumice collected from various seafloor knolls and ridges in the Io and Iheya grabens in the MOT, and from a volcanic ridge in the Yaeyama graben and an isolated knoll in the SOT. Samples were dredged during the R/V Sonne HYDROMIN1 and 2 cruises in 1988 and 1990, respectively.

The mafic end member ranges from ~50 to 56 wt% SiO_2 and records a subduction signature, with MORB normalised multi-element plots showing enrichment of incompatible elements and depletion of Nb and Ta. Both tholeiitic and calc-alkaline trends are recorded with basalts from Yaeyama graben and a single mafic enclave from Iheya graben showing tholeiitic affinities, while basalts erupted in Iheya graben and three mafic enclaves from Io graben are calc-alkaline. Major and trace element data also suggest at least two groups of basalt in Iheya Graben, defined by the relative depletion in incompatible elements, and enrichment in MgO, Co, Sr of one group vs the other.

The silica end member ranges from ~71 to 77 wt% SiO_2, with all samples recording the same subduction signature present in the mafic end member. However, there is significant diversity in the incompatible elements of the silicic end member defining at least four identifiable groups. Each group contains at least one dense lava suggesting the chemical diversity is a primary feature of magmatism in the Okinawa Trough. Age dating of Zircons from a glassy rhyolite from Iheya graben give Triassic ages suggesting incorporation of older continental material in the silicic magma.

Using petrological descriptions and sample chemistry along with MELTS modelling we will evaluate the conditions and processes of magma formation and evolution. In doing so we hope to provide a model to explain magma chemistry in the MOT and SOT.