Investigating the formation of the Kikai submarine lava dome using matrix glass volatile contents

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The mostly submarine Kikai caldera, located on the volcanic front of the SW Japan volcanic arc, contains an unusually large (~10 km diameter; ~32 km^3) dome structure. Based on the physical characteristics and geochemistry of rhyolite rock samples recovered from this submarine dome, it is interpreted to be a vast lava dome that formed sometime after the last caldera-forming eruption of Kikai at 7.3 ka (1, 2). However, little is known about how this large dome was emplaced and its implications for understanding the Kikai volcanic system. Because the concentration of dissolved volatiles (e.g. H_2O, CO_2) in a magma/lava is strongly controlled by the ambient pressure (corresponding to, e.g., depth within a magma body or depth below sea level), matrix glass volatile contents have the potential to be a valuable record of eruption and emplacement conditions.

Here we present H_2O contents of matrix glasses and physical characteristics of samples dredged at multiple locations and water depths across the Kikai dome by R/V Shinseimaru and R/V Kairei cruises KS-19-17, KR19-11 and KR20-11. Samples were analysed using Fourier Transform Infra Red spectroscopy (FTIR), which can quantify both H_2O species that exist in hydrous magmas/glasses (i.e. molecular H_2O and OH groups). Samples are weakly to moderately vesicular with pumiceous character, requiring analysis of thin glass shards utilizing imaging FTIR analysis and a species-dependent molar absorptivity coefficient for the H_2O_t peak (3). The majority of samples exhibit excess molecular H_2O, indicating significant secondary hydration of matrix glasses since eruption. OH contents are assumed to be unaffected by low temperature secondary hydration and therefore indicative of eruption conditions. We show that almost all samples have lower OH concentrations than would be expected for an H_2O-saturated magma at their current depth below sea level. With reference to other silicic submarine volcanoes and their deposits, we explore the implications of these volatile data for understanding the eruption and emplacement conditions of the Kikai dome.

(1) Tatsumi et al (2018) Scientific Reports 8, 2753 doi: 10.1038/s41598-018-21066-w

(2) Hamada et al (2023) Journal of Volcanology and Geothermal Research 434, 107738 doi: 10.1016/j.jvolgeores.2022.107738

(3) McIntosh et al (2017) American Mineralogist 102(8), 1677-1689 doi: 10.2138/am-2017-5952CCBY

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