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Interpreting water contents of submarine pumice: insights from water speciation

MCINTOSH, Iona[1*] ; NICHOLS, Alexander[1] ; TANI, Kenichiro[2]

[1]Japan Agency for Marine-Earth Science and Technology, [2]National Museum of Nature and Science

Studies of submarine eruptions are hindered by the logistical difficulties and costs of directly observing and sampling submarine volcanic edifices, and by the difficulties of identifying the eruption source of pumice rafts that may drift for great distances. Many questions remain about the impacts of the overlying water column on eruption processes and, in particular, at what depth explosive pumice-producing eruptions can occur. H2O solubility in magma increases with increasing pressure so if the magma is saturated with respect to H2O, the dissolved H2O content of volcanic glasses provides a way to estimate the pressure at the time of quenching; hence the eruption depth. Silicic pumice however is particularly susceptible to post-eruption hydration by seawater at ambient temperature, which causes high glass H2O contents with anomalous H2O speciation. Obtaining meaningful data thus requires distinguishing between the original dissolved magmatic H2O content and the H2O subsequently added via post-eruption hydration. H2O speciation data may enable us to do so. Since H2O added during hydration is added in the form of molecular H2O (H2Om), and the species interconversion reaction between H2Om and hydroxyl (OH) species is negligible at ambient temperature, the measured OH content of hydrated pumice should remain unaltered. Using H2O speciation models, the corresponding original H2Om content can be estimated from the measured OH content, thereby allowing reconstruction of the original H2O content of the glass. By measuring H2O speciation in silicic submarine pumice by FTIR, we will examine whether this methodology provides a means to get at the magmatic H2O content, which can then be used to estimate eruption depths and help locate potential sources of rafted pumice deposits.