

## Investigating submarine eruptions using H<sub>2</sub>O contents of volcanic glasses: application of a new FTIR spectroscopy method

\*Iona McIntosh<sup>1</sup>, Alex Nichols<sup>2</sup>, Kenichiro Tani<sup>3</sup>, Ed Llewellyn<sup>4</sup>

1. Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan, 2. University of Canterbury, Christchurch, New Zealand, 3. National Museum of Nature and Science, Tsukuba, Japan, 4. Durham University, Durham, United Kingdom

Volatile degassing during magma ascent plays a fundamental role in determining eruption style and pyroclast formation, and the analysis of the dissolved volatile contents preserved in volcanic glasses (both melt inclusions and matrix glasses) is therefore an important tool for investigating eruption processes. Given its strong control on parameters such as melt viscosity, H<sub>2</sub>O is one of the most important magmatic volatiles, especially for felsic magmas where it is often the most volumetrically abundant volatile. In addition, the well-constrained pressure-dependence of H<sub>2</sub>O solubility means that the H<sub>2</sub>O contents of pyroclast glasses can provide a record of the pressure at which pyroclasts quenched. For submarine eruptions, where vent depth and pyroclast formation are rarely observed directly, this is particularly valuable information. Unfortunately, silicate glasses are vulnerable to secondary hydration (i.e. the addition of H<sub>2</sub>O from the surrounding environment at low temperature in the time following deposition), and thus volcanic glasses deposited in the submarine environment are often hydrated. To obtain meaningful H<sub>2</sub>O data from these hydrated glasses it is therefore necessary to distinguish between the original final dissolved H<sub>2</sub>O content and the H<sub>2</sub>O added subsequently during hydration. Since H<sub>2</sub>O added during hydration is added as molecular H<sub>2</sub>O (H<sub>2</sub>O<sub>m</sub>), and the species interconversion between H<sub>2</sub>O<sub>m</sub> and hydroxyl (OH) species is negligible at ambient temperature, the final OH content of the glass remains unaltered during hydration. By using H<sub>2</sub>O speciation models to find the original H<sub>2</sub>O<sub>m</sub> content that would correspond to the measured OH content of the glass, the original total H<sub>2</sub>O (H<sub>2</sub>O<sub>t</sub>) content of the glass prior to hydration can be reconstructed. These H<sub>2</sub>O speciation data are obtained using Fourier Transform Infra-red (FTIR) spectroscopy. In many cases OH cannot be measured directly and instead is calculated indirectly as  $OH = H_2O_t - H_2O_m$ . Here we demonstrate the importance of using a species-dependent H<sub>2</sub>O<sub>t</sub> molar absorptivity coefficient to obtain accurate H<sub>2</sub>O<sub>t</sub> and H<sub>2</sub>O speciation data and outline a methodology for calculating such a coefficient for both hydrated and unhydrated rhyolite and andesite glasses. Using this method we present reconstructed final H<sub>2</sub>O<sub>t</sub> contents of hydrated felsic pyroclasts from submarine volcanoes in the Japanese Izu-Bonin Arc and use these data to investigate submarine felsic eruptions and the processes that produce submarine pyroclasts, in order to understand their associated hazards.

Keywords: FTIR spectroscopy, hydration, submarine volcanology