

Japan Association of Mineralogical Sciences

http://jams.la.coocan.jp/e_index.html

DRIFT PUMICE FROM FUKUTOKU-OKA-NO-BA

Kenta Yoshida¹

Fukutoku-Oka-no-Ba (FOB) is a submarine volcano in the Izu-Ogasawara arc, located ~1300 km south of Tokyo and ~1300 km east of Okinawa, Japan. The 2021 FOB Plinian eruption occurred on 13 August (JST), with an eruption column reaching 16 km in height. A large volume of pumice erupted and drifted westward, arriving at the Nansei Islands after two months of drifting. The pumice further drifted westward, arriving at the Philippines and Taiwan, as well as eastward, arriving at the Kanto area of eastern Japan. Although the Plinian eruption of FOB did not cause any direct disasters, the large amount of drift pumice caused indirect volcanic disasters, such as obstructing the navigation of ships.

Pumice clasts drifted to the Nansei Islands exhibit a variety of colors and textures, providing fruitful information about the 2021 FOB eruption (Yoshida et al. 2022). Most pumice clasts are light gray, vesicular, and have a groundmass containing black enclaves, resembling "chocolatechip cookies." Rare black pumice and the main gray pumice components show similar trachytic composition (SiO₂ = 60-62 mass% and $Na_2O + K_2O = 8-10$ mass%) and similar phenocryst minerals of clinopyroxene, plagioclase, and olivine. The gray and black pumice exhibit contrasting textures: the gray pumice consists of colorless glass with elongated vesicles, while the black pumice consists of brown glass with relatively spherical (non-elongated) vesicles. Raman spectroscopy revealed that the brown color of the glass originates from nanolites of magnetite that are not visible under optical and scanning electron microscope observations. Recent experimental studies indicate that the precipitation of nanolite increases the magma viscosity and could enhance explosive eruptions.

Some black enclaves and black pumice contain magnesian olivine of Mg# (Mg/[Mg+Fe]) = 85-92, which contains mafic melt inclusions. These components strongly indicate that mafic magma was incorporated in the explosive 2021 FOB eruption, even though the composition of the primary magma reservoir remained trachytic. This cryptic mafic magma intruded into the trachytic magma reservoir and provided the heat and volatile components required for the explosive eruption.

The mafic magma temperature recovered from the magnesian olivine was ~1200 °C, while the temperature of the trachytic magma reservoir was estimated from the magnetite to be ~930 °C. Olivine diffusion modeling predicted the timescale of the cryptic magma mixing to be up to 45 days, a relatively short time scale of mafic magma injection.

The petrographical observation of the drift pumice successfully revealed the mechanism of the 2021 FOB explosive eruption, while the drifted and deposited pumice profoundly impacted people's lives in the related area. Observing pumice clasts on the beach is one of the safest geological field survey methods available. This amazing opportunity will eventually be lost as the deposited pumice clasts drift again with the tides and wind. We hope that normal daily life for those troubled by pumice will return soon, as well as for the many people who watch the pumice and feel concerned about the volcanic activities that occurred more than 1000 km away.

REFERENCES

Yoshida K and 6 coauthors (2022) Variety of the drift pumice clasts from the 2021 Fukutoku-Oka-no-Ba eruption, Japan. Island Arc 31: e12441, doi: 10.1111/iar.12441



SEM (BSE) image of the contact between G/B pumice

(A) Typical occurrence of drift pumice on a sandy beach (Amami-Oshima Island, Japan). (B) Hand specimen photos of major gray pumice (G) and minor black pumice (B). Gray pumice occasionally contains black enclaves and is referred to as "chocolate-chip cookies". (C) Thin-section observation clearly shows that the gray pumice consists of colorless glass, while the glass of the black pumice is brown-colored as a result of invisible nanolites. (D) Scanning electron microscope (SEM) backscattered electron (BSE) image showing the contrasting textures of the coexisting gray and black pumice, suggesting a viscosity contrast. However, their chemical compositions are similar.

187

¹ Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan