Vesiculation experiments of rhyolitic glasses in permeable cells

Shumpei Yoshimura[1]; Michihiko Nakamura[1]

[1] Inst. Mineral. Petrol. Econ. Geol., Tohoku Univ.

[Introduction]

Open system degassing in volcanic conduit has been considered to play a central role in non-explosive rhyolitic eruptions. As a working hypothesis for degassing, the permeable foam model has been proposed, in which bubble coalescence and permeable flow of the gas are assumed (Eichelberger et al., 1986). However, little is known about the elementary processes of the permeable foam model such as mechanism and time scale of bubble coalescence, and relationship between permeable degassing and foam compression,. In this study, we have performed a series of vesiculation experiments of hydrous glasses in permeable bolt/nut cells in order to investigate how degassing proceeds in the open system.

[Experimental procedure]

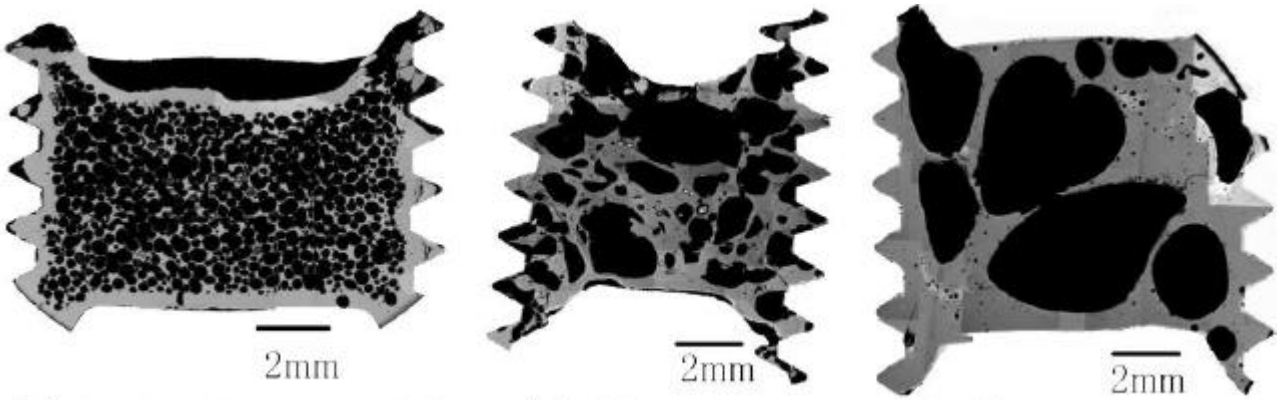
Cylindrical cores of natural rhyolitic obsidian with ca. 1.0wt% initial water content were put in iron nuts, then held by bolts from the both sides. These bolt/nut cells were heated in a muffle furnace at 1000 deg.C for 0.5-96 hours. After the run, the cells were quenched at the room temperature and then cut and observed by BSE images. Water content in the glass of run products was measured with FT-IR.

[Results]

The water content degassed outside of the system calculated from the difference in water content in the glass before and after the run was at least 1.5 times as large as that expected only from diffusive degassing. This indicates that permeable degassing must have occurred. The bubbles were nucleated mostly within 0.5 hour and show coalescence into larger bubbles. Radius of the largest bubble reached up to 3 mm at 72 hours. The bubble number density decreased after the coalescence rate had exceeded the nucleation rate. In some of the run products, interconnected bubble networks throughout the capsule were observed, suggesting permeable degassing has occurred. However, in most of the runs, bubble-free rim was observed all around the quenched foam. The rim thickness is fairly constant and the outline of central foam is almost parallel to the cell inner wall. In this case, degassing from the whole system is rate-limited by diffusive flux through bubble-free impermeable rim.

[Discussion]

If the bubble-free rim was formed throughout the heating duration, permeable degassing cannot have effectively occurred, which is contradictory to the mass-balance calculation of water. Therefore, two different microstructures were supposed to be formed alternately during the run; one is the impermeable foam with bubble-free rim and the other is a permeable foam without rim.



(a) Heating duration = 24h (b) 48h (c) 72h