Permeability structure of rhyolite body inferred from hydrothermal garnet at Wada-touge, Central Japan

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Surface structure of silicic lava domes has been considered as an important factor to control magma degassing process. Hydrothermal minerals in cavities and lithophysae may record otherwise unrevealed information on degassing pathways in the rhyolitic lavas. For this purpose, I have studied the chemical and isotopic characteristics of the garnets that occur in cavities of rhyolite lava at Wada-touge, central Japan. The garnet crystals occur in the cavities aligned along the flow foliation, and include alpha quartz. The host rhyolite which bears garnet is crystalline and forms a layer (thinner than 1m) next to the outermost obsidian shell. The inner part of the lava flow is composed of compact crystalline rhyolite. The garnets are spessartine-almandine solid solution of YMn=55.0 (YMn=Mn/Mg+Fe2++Mn*100 in mol%). The occurrence and chemical composition indicate that the garnet is not phenocrystic but has hydrothermal origin, as shown by the previous studies. I performed O-isotope analysis of coexisting garnet and quartz inclusion with laser-ablated fluorination technique, and estimated the crystallization temperature of the garnet at 590C using the fractionation factor between quartz and pyrope. The delta 18O value of source gas is estimated at +6 permil, which is slightly lower than the high temperature volcanic gas (HTVG). The relatively high temperature (close to the hydrous rhyolite solidus) and magmatic signature of the source gas indicate that the garnet-bearing cavitated rhyolite was an effective degassing pathway at late stage crystallization. Since garnet-bearing layer is concordant with flow banding and lava surface, it is inferred that internal permeability structure formed by flow, cooling and resulting vesiculation of rhyolitic magma may be an important factor to control the degassing efficiency.