Hydration of rhyolitic glass -comparison between ambient temperature and above 400 degree C-

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The mechanism and rate of glass hydration during rhyolite weathering were studied and the results were compared with those at above 400 degree C.

Thin section observation of Ohsawa rhyolite from Kozushima, weathered for 26,000 years, shows an altered layer of ˜15 um along the glass surface under plain polarized light. To measure the contents of molecular H2O (H2Om), OH species (OH) and total water (H2Ot = H2Om + OH), IR spectral line profile analysis was conducted on a glass section from the surface to the interior for a length of 250 um. The H2Om content showed ˜1.7 wt% at the glass surface and decreased to ˜0.15 wt% towards the interior to a depth of ˜100 um. In contrast, the change in OH content was small (0 to 0.2 wt%). It appears therefore that the reaction rate of H2Om to OH (formation of silanol group) is very slow and water diffuses into glass predominantly as H2Om during weathering. The analysis of the concentration profiles of H2Om and H2Ot resulted in that the diffusion coefficients were D_{H2Om} = 3.1E-10 um^2/s and D_{H2Ot} = 3.2E-10 um^2/s.

There have been many reports on the water transport in rhyolitic glasses/melts at above 400 degree C (above glass transition temperature). By comparison of the diffusivity data at high temperatures and that determined in this study, it is revealed that D_{H2Om} for the rhyolite weathering is more than three orders of magnitude larger than D_{H2Om} at 20 degree C that are extrapolated from the data at high temperatures. This may suggest that different mechanism of water transport needs to be considered for at ambient weathering conditions and above 400 degree C.