Fluid inclusions

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Although the seawater is the most important essence of surface environment on the earth, neither composition nor temperature of the ancient seawater is constrained yet. Especially, no estimate of the Archean seawater composition, especially inorganic elements, is obtained yet because of lack of fluid inclusions in halite.

At present, hydrothermal fluid actively spouted out along oceanic ridges, after seawater is intruded into ocean floor basalts and sheeted dike complex and heated by the magmatic heat source around a magma chamber. Chemical interaction between the fluid and ambient rock is operated during the circulation of hydrothermal fluids under the ocean floor. Compositional variaitons of modern hydrothermal fluid, ubiquitously collected from hydrothermal vents along oceanic ridges, are simply explained by mixing between seawater and an end-member of hydrothermal fluid. On the other hand, secondary minerals like quartz within drain cavities and amygdules in basaltic lava flows are crystallized during the hydrothermal metamorphisms. The minerals frequently contain the hydrothermal fluid as the inclusions. It is possible to estimate the compositions of seawater and hydrothermal fluids through the chemical analyses of fluid inclusions.

This work presents the compositions of the fluid inclusions within hydrothermally crystallized quartz in basalt/andesite lava flows of Ongeluk Formation in Transvaal Supergroup in South Africa. The Transvaal Supergroup comprises Ghaap and Postmasburg Groups. The Makganyene Formation of ca. 2.4 Ga tillite and the Ongeluk Formation of ca. 2.2 Ga basalt/andesite submarine lava flows belong to the Postmasburg Group. The basaltic and andesitic lava flows ubiquitously have fabrics of sheeted and pillowed lava flows, and evidence for hydrothermal circulations is pervasively present there. We carried out microthermometric investigation of the fluid incluisions within quarts of in drainage cavities to estimate the temperature and compositions of the fluids at their capture. Assuming the three component system of NaCl-CaCl2-H2O, we estimated salinity from the melting points. The fluid inclusions with high salinity have a correlation between NaCl and CaCl2 compositions, possibly due to albitization. The fact suggests that an end-member with the lowest CaCl2 content was more closely related to ancient seawater, and constrains the maximum of CaCl2 content of seawater in the Paleoproterozoic.