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Hydrothermal alteration process preserved in hydrothermally altered rocks in volcanic products of Tokachidake volcano, central Hokkaido, Japan

Takumi Imura[1], Tsukasa Ohba[1], Yusuke Minami[1], and Mitsuhiro Nakagawa[1]

[1]Akita University, Hokkaido University

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Hydrothermally altered volcanic products of the 4.7ka, 3.3ka, and 1926AD eruptions from Tokachidake were mineralogically observed to interpret interaction between magma and subvolcanic hydrothermal system. We collected samples from the 4.7 ka pyroclastic flow deposit (Gfl-0), lower and upper units of the 3.3 ka pyroclastic flow deposit (Gfl-1 and Gfl-2), and the 1926AD eruption deposits consisting of the lower debris avalanche deposit (Unit A), the middle hydrothermal surge deposit (Unit B), and the upper debris avalanche deposit (Unit C). Each product contains unaltered ash grains consisting of primary igneous minerals and volcanic glass, weakly altered ash grains in which unaltered part coexists with altered minerals, and intensely altered ash grains consisting only of altered minerals. Individual ash grains have one of three types of altered mineral assemblages: silica (sil), silica mineral-alunite±kaolin (sil-al±kl), and silica mineral-kaolin (sil-kl). Most ash gains in Gfl-0 have undergone alteration that produces sil-alu±kl assemblage. Gfl-1 contains abundant sil-kl ash, subordinate sil-alu±kl ash, and minor unaltered ash grains. Alteration types in Gfl-2 are similar to Gfl-1 but unaltered ash grains are more abundant. Most ash grains in the 1926 ejecta are altered, and major alteration mineral assemblages are sil and sil-al±kl. These alteration mineral assemblages imply acidic hydrothermal alteration at 150-250 °C, except for the sil assemblage that could be produced at a higher temperature condition. The occurrence of weakly altered ash, consisting of unaltered part and altered part, indicates incomplete, brief reaction between volcanic rocks and a low-T acidic fluid. It is suggested that an acid hydrothermal system develops to form alteration zone under the crater when a magma intrudes, but it dissipates quickly as the magma cools and solidifies.