Interaction between andesite and liquid water: temporal variation of rock surfacial texture and chemical composition of water

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In order to examine the interaction between rock and water especially the development of dissolution textures, andesite samples were reacted with pure liquid water at c.a. 180 ºC with various durations (1, 2, 5, 6, 10, 20, and 50 days). An andesite sample (lava from 1914 eruption of Sakurajima volcano) of $5*5*5$ mm^3 cube with polished surface was sunk in 7ml of pure water in Teflon cell (22ml capacity) which was confined by a stainless jacket, and then heated in furnace. The initial volume ratio of water, andesite sample and vacancy is about 56: 1: 120. From calculation of water condition, the volume ratio of vapor was approximately 1% of total volume and the andesite sample completely soaked in liquid water during heating. SEM and NDIC (Nomarski Differential Interference Contrast) microscopy observation were performed to examine the temporal variation of surfacial texture of andesite sample (until 5 days). ICP-AES analysis is performed to examine the temporal variation of chemical composition of water solution (until 50 days), compared with textural variation. As a result of examination, it is confirmed that surfacial texture of andesite sample and chemical composition of water solution vary with experimental duration due to the reaction of andesite with liquid water. Many pores formed in groundmass glass and the number of the pores increases with duration. Plagioclase phenocrysts and microlites show dissolution texture, and Ca-rich particle aggregate precipitates on and around it, however, other mineral phase (pyroxene and Fe-Ti oxide) keep their original clean appearance, up to experimental duration of 5 days (120 hours). The amounts of Al, Si, Na and K in solution increase with duration. Calcium amounts increases until 5 days, and then decreases. The amounts of Fe and Mg in solution are less than other components. From textual observation and compositional analysis, we conclude that the formation of pores increases amount of K in solutions, which is included only in groundmass glass. Dissolution texture in plagioclase is consistent with increase of dissolved Na and Al in solution with time, because these are major constituent of plagioclase. Temporal variation of amount of Ca and the later precipitation of Ca-rich particle aggregates indicate that Ca is supplied into solution from rock sample till experimental duration of 5 days and then solubility of Ca in solutions decreases. Poor Mg and Fe in water solution show inactive dissolution of pyroxene and Fe-Ti oxide. We can estimate dissolved volume and dissolution rate of plagioclase from depth difference (d.d.) between plagioclase and adjacent pyroxene. The total volume of dissolved plagioclase corresponds to product of plagioclase crystallinity, surface area of rock sample (150 mm^2) and d.d., and are estimated to 0.03-0.25 mm^3 and increase with experimental duration. The dissolution rate of plagioclase are estimated to $9.0*10^{-6}$-$7.4*10^{-5}$ mm/hours and decrease with experimental duration.