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Reproduction of hydrothermal alteration textures of synthetic Basalt with sulfuric acid and CO2-bearing fluid

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Analysis of Martian surface materials by Martian probes provided various information on the composition of the Martian soil. However, the origin, process and conditions of the Martian surface soil formation are not yet fully understood.
In the present study, reproduction of the Martian soil was carried out by the alteration experiment of the iron-rich basaltic rock which is the most common volcanic rock in the Martian crust. Experimental figuration was built to preserve textures of the run products with a Teflon vessel and a PFA vial.
Experimental conditions followed Yoshizawa (2009). Alteration experiments are carried out at 100 ℃ and 150 ℃, and mass ratio of the starting material to the pH1.0 sulfuric acid solution is 1:50. Run durations are 1, 2, 4 or 8 weeks. Appropriate mass of dry ice was sealed in the experimental vessels to expel atmospheric oxygen with CO_2.
In the run products, characteristic iron mineral particles are formed for 100℃ and 150℃ concordant with Yoshizawa (2009). These iron minerals distributed not only inside the starting material powder but also on the surface of the reaction vessel and vial in the reactive solution. The surface of the reaction vessel shows orange and reddish color on 100℃ and 150℃ run products, respectively. By SEM observation, dissolution of melt and olivine particles were observed, and iron mineral particles substituted partly.
Diameters of the iron mineral particles are submicron to several micron meters at 100℃, and slowly increase with run durations and temperatures. The occurrence of the iron mineral in the run products of this study suggests that characteristic iron mineral fine particles including hematite and goethite were formed by acidic hydrothermal alteration of iron-rich basaltic rock even at remote region from the source materials.

Keywords: Martian soil, Hydrothermal alteration, iron mineral, hematite, goethite