宇宙風化作用における硫化鉄の効果
Effect of iron sulfide on the space weathering of asteroids

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The space weathering alters surface optical properties on airless bodies such and asteroids, the Moon and Mercury. As for silicate bodies containing iron silicate, the space weathering (characterized by optical reddening, darkening and attenuation of Fe-related absorption) is caused by nanophase metallic iron (npFe^0) particles within vapor-deposited amorphous rim by micrometeorite impacts or within amorphous rim by solar wind implantation.
However nanophase iron sulfide (npFeS) was found in Itokawa particle's space weathered rim (Noguchi et al., 2011) and was observed more frequently than npFe^0 in regolith breccia meteorites (Noble et al., 2011). Therefore we performed experiments of pulse laser irradiation to olivine and FeS mixture samples to explain the effect of FeS on space weathering. The samples which 5, 10, 20 weight % FeS mixed to olivine of particle size 45-75 micron was made and irradiated at 10 mJ once or twice. Some of laser irradiated samples were also conducted additional thermal fatigue experiments. After laser irradiation and/or thermal fatigue experiments, reflectance spectra of samples were measured, and some of laser irradiation samples were observed by microscopes; FE-SEM, HRM, TEM and SEM-EDS.
The results show FeS promote vapor deposition type space weathering, especially overall darkening. The spectra of samples including FeS showed more reddening and also overall darkening, and also fine FeS particles are highly effective. Thermal fatigue experiments after laser irradiation show that darkening was back to standard but reddening remained. This results show that spectral change especially darkening is not stable against heating simulating asteroidal surface. Our HRM, TEM and SEM-EDS observation suggest npFeS particles exist but have not been exactly identified in this study.
Therefore, addition of FeS particles promote reddening by formatting npFe^0 on the surface of olivine particles. The cause of darkening is not micro-scale particles but macro-scale sulfur deposition by HRM, TEM and SEM-EDS observation. Thermal fatigue experiments in this study show sulfur can easily vaporize from surface, which suggests sulfur on asteroids is less than in meteorites.

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