Geophysical Research Abstracts
Vol. 16, EGU2014-13341, 2014
EGU General Assembly 2014

Synthetic enstatite for the comparison with ground-based and VIRTIS-M/ROSETTA reflectance spectra of asteroid 2867 Šteins in the VIS and IR

Kathrin Markus (1), Gabriele Arnold (2), Harald Hiesinger (3), Arno Rohrbach (4), Fabrizio Capaccioni (5), Gianrico Filacchione (5), Federico Tosi (5), Maria Cristina De Sanctis (5), Maria Teresa Capria (5), Eleonora Ammannito (5), and Stephane Erard (6)

(1) DLR, Institute of Planetary Research, Berlin, Germany & Institut für Planetologie, Westfälische Wilhelms-Universität Münster, Germany (kathrin.markus@dlr.de), (2) DLR, Institute of Planetary Research, Berlin, Germany, (3) Institut für Planetologie, Westfälische Wilhelms-Universität Münster, Germany, (4) Institut für Mineralogie, Westfälische Wilhelms-Universität Münster, Germany, (5) INAF, Istituto di Astrofisica e Planetologia Spaziali, Rome, Italy, (6) LESIA, Observatoire de Paris, France

Asteroid 2867 Šteins was observed by the Rosetta spacecraft on September 5, 2008. During this close encounter, the VIRTIS spectrometer (Visible and Infrared Thermal Imaging Spectrometer) aboard Rosetta acquired spectra of Šteins in the wavelength range from 0.2 μm to 5 μm [1]. We compare ground-based VIS and NIR reflectance spectra of Šteins [2-7] with reflectance spectra obtained by OSIRIS (Optical, Spectrocopic and Infrared Remote Imaging System) [8] and VIRTIS-M during the fly-by and with laboratory reflectance spectra of enstatite chondrites (aubrites) and minerals (enstatite, oldhamite, albite).

Ground-based and fly-by observations show an overall flat spectrum with the typical E[II]-type absorptions bands at 0.49 μm and $\sim$0.9 μm. E-type asteroids have been associated to aubrites due to their high reflectance and overall featureless spectrum. The lack of absorption bands at 1 μm and 2 μm indicates that Šteins' surface has no Fe-bearing pyroxenes or olivines.

It is well known that even small amount of Fe in enstatite lead to prominent absorption features in the IR at 1 μm and 2 μm. Terrestrial samples of enstatite usually contain several mol% of FeO and therefore exhibit the absorption features. Pure enstatite is extremely rare. A sample of enstatite with 2.5 mol% of FeO already shows distinct absorptions features at 1 μm and 2 μm [9]. To have available sufficient amounts of pure enstatite for our spectral studies, we developed a technique for synthesis of enstatite.

Enstatite has 3 stable polymorphs with clinoenstatite, orthoenstatite, and protoenstatite being stable at low (<700°C), intermediate (>600°C), and high (>1000°C) temperatures [10]. Orthoenstatite and protoenstatite are orthorhombic, while clinoenstatite is monoclinic. Orthoenstatite is abundant in terrestrial rocks and in meteorites. Clinoenstatite is known from meteorites [10, 11]. Shear deformation and quenching of orthoenstatite or protoenstatite induces inversion to clinoenstatite [10]. Clinoenstatite in enstatite chondrites and aubrites formed presumably by crystallization from a melt and subsequent quenching and mechanical deformation (brecciation) [11].

We synthesized powders of orthoenstatite and clinoenstatite. Following the synthesis we used XRPD to discriminate between the polymorphs. The grain sizes of the samples were determined using SEM pictures of the samples and are comparable to the <25 μm sieving fractions of our terrestrial samples with some additional larger grains. The orthoenstatite sample is slightly coarser than the clinoenstatite sample. We collected reflectance spectra of both enstatite samples and mixtures of orthoenstatite and synthetic oldhamite and some mixtures with additional terrestrial albite. Our spectral measurements of our enstatite samples show no absorptions features at 1 μm and 2 μm. The spectra are flat and featureless in the VIS and IR. We compare the spectra of our orthoenstatite and clinoenstatite to spectra of a synthetic enstatite by Klima et al. (2007), terrestrial enstatite, the aubrite Peña Blanca Spring, and spectra of Šteins.

[1] Coradini et al. (2007) *Space Science Reviews, 128*, 529-559. [2] Barucci et al. (2005) *A&A, 430*, 313-317. [3] Dotto et al. (2009) *A&A, 494*, L29-L32. [4] Fornasier et al. (2007) *A&A, 474*, L29-L32. [5] Fornasier et al. (2008) *Icarus, 196*, 119-134. [6] Nedelcu et al. (2007) *A&A, 473*, L33-L36. [7] Weissman et al. (2008) *Met. Planet. Sci., 43*, 905-914. [8] Keller et al. (2010) *Science, 327*, 190-193. [9] Klima et al. (2007) *Met. Planet. Sci., 42*, 235-253. [10] Lee and Heuer (1987) *J. Am. Ceram. Soc., 70*, 349-360. [11] Mason (1968) *Lithos, 1*, 1-11.