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The VIRTIS observations of 2867 Steins during the Rosetta fly-by

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On the September 5th 2008, VIRTIS, on board of the Rosetta Spacecraft, collected VIS-NIR hyperspectral images of the surface of the E-type asteroid 2867 Steins. Steins fly-by is the first scientific objective of the Rosetta mission on its way to the Comet 67P/Churyumov-Gerasimenko.

VIRTIS is an high performance instrument since it combines VIS-IR imaging and spectrometry, through a slit spectrometer, named VIRTIS-M (M is for "mapper"); a separate channel, named VIRTIS-H, provide high resolution spectroscopy. The -M mapper channel operates in the 0.25-5 micron range, with spatial resolution of 250 microrad (IFOV) and Field of View (FOV) of 3.6˚x3.6˚. Steins was observed in two consecutive phases: when the distance from the asteroid was between 223000 km and 20700 km, the spectrophotometric lightcurve was acquired; inthe second phase, when the S/C asteroid distance was between 2800 km and 1100 km, passing through the closest approach, high spatial resolution hyperspectral images were collected. During these observations, the solar phase angle changed, passing through the zero phase condition.

The observations of Steins are a real "premiere" since for the first time a rare compositional type asteroid, potentially differentiated, is observed with great detail. In fact Steins, based on telescopic observations, has been classified as an E-type asteroid. This population of objects is considered as possible residuals of a complex differentiation of a larger melted parent body. However, the telescopic observations are insufficient to completely confirm this theory. Therefore the VIRTIS observations are extremely valuable.

Despite the intrinsic difficulties for an imaging spectrometer to operate during a fast (8.6 km/s) and close (800km) flyby, VIRTIS-M was able to acquire high signal/noise hyperspectral data of different regions of Steins. The average spatial resolution was of the order of 300 m/pix

Using this data set we have investigated the spectral behavior of the asteroid's surface , which appears to have a red slope in the visible range. The high spectral resolution joined with the spatial information has allowed to map the distribution of different compositional units on the surface. The last bands of the infrared channel has allowed to characterize the thermal behavior of the asteroid. Moreover, the variation of the solar phase angle during the fly by, will help to understand the surface regolith properties.

By reconstructing the Steins spectrum from Visual to Thermal IR we have verified that the Steins classification seems to be confirmed and that the asteroid exhibits an average spectrum compatible with enstatite achondrite material.

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