# Filter strategy for the characterization of minerals with OSIRIS

N. Oklay, J.-B. Vincent, H. Sierks, Max-Planck-Institut für Sonnensystemforschung, Max-Planck-Strasse 2, 37191, Katlenburg-Lindau Germany (oklay@mps.mpg.de)

## NAC filters

The OSIRIS scientific imager (Keller et al. 2007) on board ESA's spacecraft Rosetta will observe comet 67P/Churyumov-Gerasimenko in the wavelength range of 250-1000 nm with a combination of 12 filters for the narrow angle camera (NAC) and 14 filters in the wavelength range of 240-720 nm for the wide angle camera (WAC). NAC filters are suitable to surface composition studies, while WAC filters are designed for gas and radical emission studies. In order to investigate the composition of the comet surface from the observed images, we need to understand how to detect different minerals and which compositional information can be derived from the NAC filters. Due to the limited spectral range of the laboratory data, Far-UV and Neutral density filters are excluded from this analysis. Considered NAC filters in this study are represented in Table 1.

Detection and separation of the minerals will not only allow us to study the surface composition but also to study observed composition changes due to the cometary activity during the mission. In order to select methods for the classification of the comet surface, we are testing several spectral parameters found in the literature.

Table 1: Selected filters of the narrow angle camera

| Name | Wavelength (nm) | Bandwidth (nm) |
|---|---|---|
| Near-UV | 360.0 | 51.1 |
| Blue | 480.7 | 74.9 |
| Green | 535.7 | 62.4 |
| Orange | 649.2 | 84.5 |
| Hydra | 701.2 | 22.1 |
| Red | 743.7 | 64.1 |
| Ortho | 805.3 | 40.5 |
| Near-IR | 882.1 | 65.9 |
| $Fe_2O_3$ | 931.9 | 34.9 |
| IR | 989.3 | 38.2 |

## Studied minerals and methodology

Minerals listed in Table 2 are selected from the list of detected components in the samples of comet 81P/Wild2 (Zolensky et al. 2006), collected during Stardust mission and the calibration materials of COSIMA and GIADA instruments on board Rosetta spacecraft (private communication). Laboratory data of those selected minerals are taken from RELAB database (`http://www.planetary.brown.edu/relabdocs/relab.htm`) and absolute spectra of the minerals observed by OSIRIS NAC filters are calculated. Fig. 1 shows one example spectrum per mineral as seen by NAC filters.

Table 2: Selected minerals

| | Minerals | | # data |
|---|---|---|---|
| Anhydrous Silicates | Olivine: | Forsterite | 20 |
| | | Fayalite | 18 |
| | Pyroxene: | Enstatite | 35 |
| | | Diopside | 27 |
| | | Fassaite | 4 |
| Hydrated Silicates | Serpentine | | 12 |

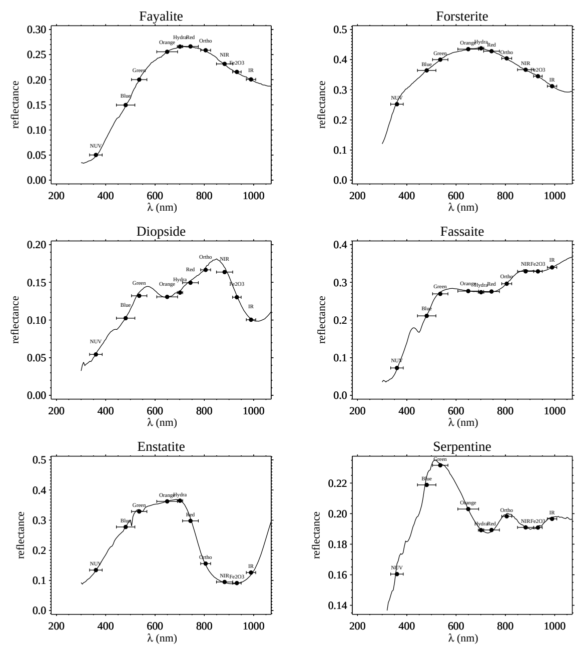


Figure 1: Absolute spectrum of selected minerals as seen by OSIRIS NAC filters listed in Table 1. Solid lines are laboratory data of corresponding mineral, while dots are sampled spectra. Bandwidths are indicated with horizontal bars.

Due to the visible/near-infrared range of the filters, we cannot observe the 1.1 micron band of olivine, and due to the low spectral resolution we cannot get the band parameters like band depth, band areas of the detected bands precisely. But we can use band minima to separate some of the species like enstatite, serpentine, diopside and fassaite. Additionally, we can use reflectance ratios, spectral slope, band tilt and band curvature methods for further identification of species.

First the most abundant minerals (forsterite and enstatite) found in Wild2 samples are investigated and separated with reflectance ratio and spectral slope techniques (See Fig. 2, first two panels from the top). The ratios in the IR range are selected to use pyroxene band as a diagnostic on the separation of these two species. In the next step we included serpentine to the analysis (See Fig. 2, $3^{rd}$ and $4^{th}$ panels from the top).

## Preliminary Results

- Detection of 0.7 micron ferric ion band, which is an indicator of altered hydration of serpentine (Vilas 1994) is possible with OSIRIS NAC filters.
- Detection of 0.65 micron band of diopside and 0.7 micron band of fassaite and 0.9 micron band of enstatite are possible with NAC observations.
- Separation of enstatite and forsterite in the observed areas can be achieved not only by filter ratios but also with spectral slopes.
- Serpentine can be separated from enstatite and forsterite both with spectral slope and reflectance ratio techniques.

## Ongoing work

In order to increase the statistics of this analysis, we are planning to collect additional data on the selected minerals and then add other silicates, as well as sulfides, carbonates, phosphates, oxides and hydroxides data to our analysis. We continue testing the techniques we presented to determine optimum reflectance ratios and spectral slopes for the determination and separation of different minerals. Meanwhile we study different detection and determination methods like band minima, band curvature, band tilts and band depths of minerals from observed spectrum.

A similar study is planned for the OSIRIS wide angle camera filters, which covers 240-720 nm wavelength range and focus on the gas properties of the coma.

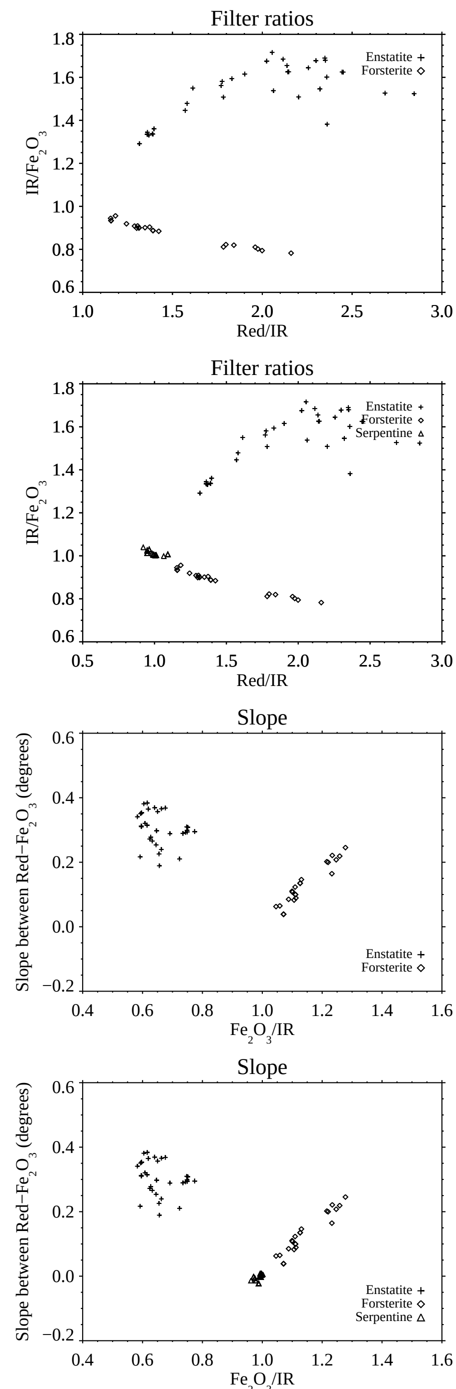


Figure 2: Separation of minerals: Filter ratios (first two panels from the top) and slopes between red and $Fe_2O_3$ filters (first two panels from the bottom).

## References

Keller, H. U., Barbieri, C., Lamy, P., et al. 2007, Space Science Reviews, 128, 433

Vilas, F. 1994, Icarus, 111, 456

Zolensky, M. E., Zega, T. J., Yano, H., et al. 2006, Science, 314, 1735