MicrOmega detections of C-rich phases in Ryugu returned samples within the Hayabusa2 JAXA Extraterrestrial Curation Center

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The Ryugu samples brought back by the Hayabusa2 spacecraft in December 2020 have been delivered to the JAXA Extraterrestrial Curation Center [1, 2]. Bulk samples and then individual grains have been deposited onto sapphire dishes, weighted, and analyzed with optical microscopy, FTIR spectroscopy, and MicrOmega hyperspectral imaging [3] for initial description [2]. The MicrOmega instrument used in the JAXA Extraterrestrial Curation Center is a NIR hyperspectral microscope. It images samples ~ 5 mm x 5 mm large, with 250x256 pixels of ~22 µm in size. Its spectral capability covers the range from 0.98 µm to ~3.6 µm, which gives access to primary and secondary minerals and organic matter, in particular through their OH, CO_3, and CH features [4, 5].

As presented in the Yada et al. and Pilorget et al. talks (this conference), the averaged spectra of Ryugu returned samples present two major features, centered around 2.7 and 3.4 µm, attributed to OH-rich and CH-rich compounds respectively. Thanks to the MicrOmega capability to characterize the spectral signatures of returned grains down to the few tens of µm scale, a variety of C-rich compositions do show up, through the following features:

- variability in the central position and shape of the 3.4 µm dominant absorption, with a minimum varying from 3.35 µm to 3.45 µm, and the occasional presence of several local minima with varying spectral band areas. These observations suggest organic matter of varying composition and structure is present over the entire samples;
- the presence of coupled spectral features such as at around 2.85 µm, 3.1 µm or 3.55 µm, with their associated band ratios. Additional spectral structures < 2.7 µm are in some cases observed and correlate with them. These bands collectively suggest organic carbon is at times bound to non-C groups or intimately mixed with specific minerals.
- the ratio between the 2.7 µm and 3.4 µm band depths spans a very wide range of values, with some grains highly depleted in either OH-rich or CH-rich phases.

These spectral features are diagnostic of specific C-rich compositions and of their spatial heterogeneity in the collected samples at the scale of few tens to few hundred microns. We shall present a preliminary review of the observed diversity, and discuss it in terms of the composition and origin of the potential carriers.

References

[1] Tachibana S. et al. (2021) LPS, XXXXXII, Abstract #1289. [2] Yada T. et al. (2021) LPS, XXXXXII, Abstract #2008. [3] Bibring J.-P. et al (2017) Space Sci. Rev. 208, 401-412. [4] Pilorget C. and Bibring J.-P. (2014) PSS 99, 7-18. [5] Pilorget C. et al. (2021) this conference.