Detection of new olivine-rich locations on Vesta

E. Palomba[1], A. Longobardo[1], M. De Sanctis[1], F. Tosi[1], M. Capria[1], F. Capaccioni[1], E. Ammannito[1], C. Raymond[2], and C. Russell[3]

[1]INAF-IAPS, via del Fosso del Cavaliere 100, Rome, Italy
[2]California Institute Technology JPL, Pasadena, CA, USA
[3]UCLA, Los Angeles, CA, USA

The recent discovery of olivines on Vesta by the VIR imaging spectrometer onboard the Dawn space mission changed dramatically the vision about the Vestan petrogenetic models [1]. Before that, olivines were expected to be present in the Vesta interior: in the mantle of a vertically layered body as invoked by the magma ocean models [2] or at the base of (or within) the mantle-crust boundary as claimed by fractionation models [3]. Olivines were detected by VIR-Dawn in two wide areas near the Arruntia and Bellicia regions. These are located in the northern hemisphere and not in the south, where the Rheasilvia and the more ancient Veneneia huge basins should have excavated the crust down to reach the mantle.

In this work, we present our attempts to retrieve other undetected olivine-rich areas on Vesta by using spectral parameters sensitive to olivine such as the Band Area Ratio (BAR) and other specific parameters created for the detection of olivines on Mars (forsterite, fayalite, and a generic olivine index [4,5]). As a preliminary step, we calibrated these parameters by means of VIS-IR spectra of different HED meteorite samples: their behaviors as a function of sample grain size and albedo were retrieved and discussed. We selected the BAR and the forsterite index as the best parameters that can be used on Vesta and applied two independent methods to detect olivine signatures on the VIR hyperspectral cubes: a cross-correlation and an anti-correlation analysis between the BAR and one of the olivine parameters. In agreement with the recent discovery, Arruntia and Bellicia were the most olivine rich areas. In addition, we detected 6 new regions, all but one located in Vesta's northern hemisphere. This result confirms again that the old petrogenetic models cannot be applied, in a straightforward way, to Vesta and should be reshaped in the view of these new detections. An alternative and very recent option can be represented by the model described in [4], in which surface "eruption" of material from the mantle, including olivine, can reach the surface of Vesta.

References: [1] Ammannito, E. et al., 2013, Nature, 504, 122. [2] Righter, K., & Drake, M. J., 1997, MAPS, 32, 929. [3] Barrat, J.-A et al. 2010, Geo. et Cosmo. Acta, 74, 6218. [4] Poulet F. et al., JGR, 2007, 112, E08S02. [5] Carrozzo G. et al., JGR, 2012, 117, E00J17. [6] Mandler, B.E. & Elkins-Tanton L.T., 2013, MAPS, 48, 2333–2349.