Spectral variegation and stratigraphy on Vesta — the Sextilia region

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The Sextilia region in Vesta's southern hemisphere (21–66°S, 90– 180°E) [1], named after the impact crater Sextilia (39°S, 146°E), is characterized by the transition from the giant impact basin Rheasilvia on Vesta's south pole to the adjacent equatorial region in the north, which is mainly covered by impact breccia ejected during the Rheasilvia impact event [2]. The Rheasilvia basin partly overlaps an older similarly large impact basin named Veneneia (52°S/170°E) [2], which dominates the northeastern part of the Sextilia region. A detailed analysis of the surface composition of this area is performed in order to derive the distribution and the compositional variations of Rheasilvia ejecta, which are globally redistributed on Vesta's surface [3]. These ejecta represent excavated crustal material from various depths and thus provide information of the compositional variations within the crustal material. Vesta is thought to exhibit an iron-nickel core, an overlying olivine-dominated mantle, a lower crust of ultramafic cumulates (diogenites) and an upper crust of basalt flows that extruded onto the surface (eucrites) [4]. Thus most of Vesta's northern region is supposed to be covered by eucrite- dominated impact breccia, the region closer to the impact basin and the basin itself is composed more and more by diogenite-like material. Global analyses of VIR data confirmed this trend [5,6].

Our analysis shows that the northern part of the Sextilia region is dominated by howardite/eucrite-rich material confirming eucrites forming Vesta's upper crust. Local spots of diogenite-like material are usually associated with ejecta of small fresh impact craters. Towards the Rheasilvia basin, an increasing amount of diogenitic material, which is highly concentrated in the Rheasilvia basin itself, can be observed. This supports a differentiated interior with diogenites formed at greater depths (lower crust). The close-up view at Matronalia Rupes shows that the whole scarp is dominated by diogenite-like material, especially, where the local slope angle of the scarp is too steep ($>40°$) that this area could be covered by regolith [7]. Furthermore, the fresh small impact crater Myia (50.5°S/106.4°E) shows eucrite-dominated ejecta but a diogenite-like material in the crater itself and slumping material extending from the crater downwards, which indicates a more extended layer of diogenite-enriched material in the subsurface. Furthermore, ejecta and steep walls of large impact craters close to and within the Rheasilvia basin like the impact crater Fonteia (53.5°S/141.6°W) are dominated by diogenite material. In contrast, the impact crater Sextilia, which is located north of Fonteia and is of similar size, shows no sign of diogenites at all. The impact crater itself and the ejecta are dominated by eucrite-like material similar to the bright ejecta of impact crater Myia [7]. Sextilia's composition corresponds with its location outside the Rheasilvia basin. It is situated in the region of the older Veneneia basin implying that not only the material emplaced by Rheasilvia but also the material of Veneneia has to be taken into account in our study. Either the ejecta of Rheasilvia were excavated asymmetrically or the local spots of diogenite-like material outside the Rheasilvia as well as the Veneneia basin represent local intrusions, which occured after the Rheasilvia impact event.

References: [1] Krohn, K.et al. (2013), EGU, Vol.15, p. 3213. [2] Jaumann, R. et al. (2012) Science, v. 336, p. 687–690. [3] Jutzi et al. (2013), Nature, v. 494, no. 7436, p. 207–210. [4] Russell et al. (2013) MPS, p. 326. [5] Ammannito, E. et al. (2013) MPS, v. 48, p. 2185–2198. [6] De Sanctis, M. C. et al. (2013) MPS, v. 48, p. 2166–2184. [7] Stephan, K. et al. (2013) JGR Planets, p. 2013JE004388.