**THE STRUCTURAL CONTROL OF VENUSIAN IMPACT CRATER FORMATION – TECTONIC CASE STUDIES.** S. Kukkonen[1], M. Aittola[2,3], and T. Öhman[3], [1]Astronomy, Department of Physics, P.O. Box 3000, FI-90014 University of Oulu, Finland (soile.kukkonen@oulu.fi); [2]Oulu Southern Institute, University of Oulu, Pajatie 5, FI-85500 Nivala, Finland (marko.aittola@oulu.fi); [3]Arctic Planetary Science Institute, Karhuntie 19 C 24, FI-96500 Rovaniemi, Finland (teemusp.ohman@gmail.com).

**Introduction:** Impact craters on Venus sometimes display a polygonal rather than circular plan view [1–2]. As on other terrestrial planets, the formation of such polygonal impact craters (PICs) is controlled by pre-existing tectonic structures, such as faults and fractures, although their exact formation mechanisms are still debated [3–5]. In our previous studies [1–2] we established the presence of 121 PICs in the Venusian impact crater population >12 km in diameter. The orientations of the straight crater rim segments are non-random, and were instead shown to have statistically significant positive correlations with the orientations of different tectonic structures [2]. In particular, the straight PIC rim segment orientations match the orientations of rift zones and the concentric, but to a lesser extent also the radial component of volcano-tectonic features, as well as the structural orientations measured from the underlying tessera terrain [2].

Much of our earlier work, while unraveling how different tectonic structures have different effects (or no morphologically observable effects at all) on subsequently forming impact craters, addressed the problematics of PICs and the pre-existing target structures mostly from the point of view of impact cratering mechanics [4–5]. In our on-going study, we are taking a more detailed look on the types of tectonic structures affecting polygonal crater formation, and how the effects vary with the type, size, and location of the tectonic structure. As PICs can reveal tectonic features hidden below the surface, these new observations and detailed case studies will, hopefully, provide further insight into the tectonic history of Venus, as well as the formation mechanisms of PICs.

**Preliminary results and discussion:** Our study was carried out by using the Magellan SAR (Synthetic Aperture Radar) images, which cover 98% of the surface [6], with additional insight provided by Magellan topographic data. Previously we showed that the orientations of the straight rim segments of the impact craters match especially the concentric component of volcano-tectonic features, usually coronae [2]. 75% of PICs which are located less than two crater diameters from a corona show at least one straight rim segment parallel to the corona annulus, and still 43% of those PICs situated 2–10 crater diameters from the corona have the same characteristic [2]. This correlation can also be seen in the case of the radial component of coronae and PICs – although the correlation is not that strong (39% and 24% respectively – still higher than randomness would predict [2]).

In many of the studied cases the volcano-tectonic feature (mostly corona) related to a PIC is rather large in diameter. In addition, it is relatively common that the annulus of the accompanied corona is clearly visible in topography, which can be seen as a prominent sign of uplift caused by a mantle diapir that rises close to the surface, and emphasize the possible concentric deformation and stresses caused by corona formation.

The size of the corona along with the raised annulus may give us indications on how far the crustal deformation of the corona extends, and how large the corona should be to create a dominating pattern of crustal planes of weakness that affect the formation of crater rims. Based on the currently limited number of case studies, it appears possible that only coronae larger than some threshold diameter can create crustal stress and strain high enough to induce the formation of PICs.

The studied sample shows that if one rim segment of the PIC matches the concentric or radial component of the nearby corona, the PIC rims very rarely show any correlation with other tectonic structures except young rift zones. This is natural, because many of the studied coronae are situated on the rift zones and actually in some cases part of the corona annulus is deformed or even formed by the rift zone. This observation may indicate that these tectonic structures form the dominant fracture pattern in the area, later “utilized” by the formation of polygonal craters. This observation also emphasizes the results of our earlier work [2] which showed that orientations of straight crater rims most commonly match the concentric components of the coronae and the orientations of young rift zones.

Along with the relatively large diameter and the raised annulus, many of the studied “PIC-related” coronae show indications of rather complex and long-lasting evolutionary processes. In such a long geologic evolution, the tectonic patterns inside and around the volcano-tectonic features can be highly variable, depending on the evolutionary stage of the feature and the presence or absence of an additional regional stress field (for discussion and references, see, e.g., [7–8]). This observation may, therefore, suggest that the long evolutionary process of a corona has a vital role in creating favorable circumstances for PIC formation. The details of this question, however, remain to be studied in the future.

**Conclusions and future work:** Our previous study [2] showed that the orientations of the straight rim segments of polygonal impact craters match especially the concentric component of volcano-tectonic features, usually coronae, indicating that something in the environment of the corona enhances straight rim segment formation of the crater. Our current, very preliminary studies show that there seem to be some systematics in those "PIC-related" coronae. The studied coronae, which have either a parallel radial or concentric component with a PIC straight rim segment, are mostly rather large in diameter, and their annuli are clearly visible in topography. Moreover, many of them show signs of rather complex formation process, which may, therefore, suggest that the long evolutionary process of a corona has a vital role in creating favorable circumstances for PIC formation. This preliminary study also corroborates our earlier work [2] indicating that young rift zones and the concentric components of coronae form the dominant fracture pattern in the area, later "utilized" by the formation of polygonal craters. More detailed structural analysis and additional case studies form the basis of our future work on the interplay of Venusian tectonics and impact cratering.

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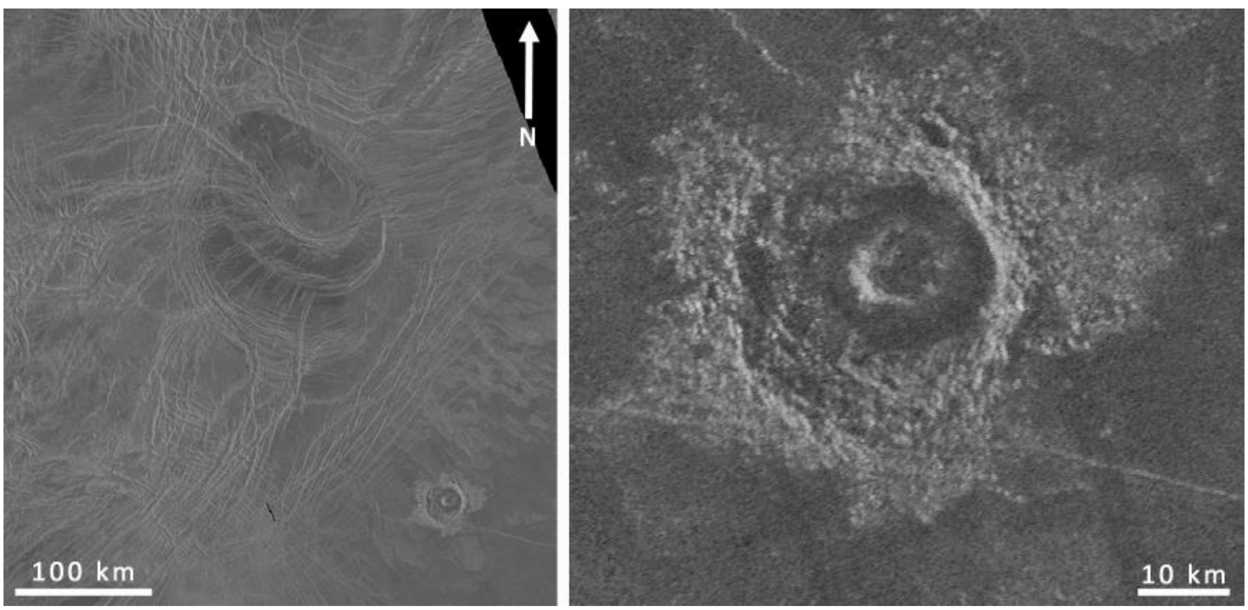


**Figure 1.** The image pair shows an example of a Venusian PIC (Juanita crater, D=19.4 km, 62.8°S, 90.0°E) with four straight rim segments. In the left image, crater's close proximity and structural relation to the large Dunne-Musun corona (60.0°S, 85.0°E, only partially seen in the image) and a smaller corona (upper center of the image) southeast of Dunne–Musun (indicating later activity on the Dunne–Musun annulus) is easily seen. Magellan left-looking SAR images in Mercator projection.