TECTONIZED AND EMBAYED IMPACT CRATERS IN THE BETA-ATLA-THEMIS REGION OF VENUS. A. Matias and D. M. Jurdy, Dept. of Geological Sciences, Northwestern University, Evanston, IL 60208, amatias@earth.northwestern.edu, donna@earth.northwestern.edu

Introduction: The distribution and density of craters is used to study the resurfacing history and tectonic activity of planets such as Venus [1, 2]. Impact crater morphology depends on the impact energy, properties of the target, and gravity [3]. Thus, the high level of preservation of impact craters on Venus may reveal details about the geologic processes on the planet.

To assess the nature of deformation in the Beta-Atla-Themis Region, we used the morphological characteristics of craters and their orientation relative to the chasmata. Of particular interest are those that have been both tectonized and embayed by lava. As part of our analysis, we looked for correlation between the interior and exterior orientation and/or tilting of the craters with that of the chasmata area. In addition, construction of basic photogeologic maps of the craters' structures (i.e. ejecta blanket, central peak) provides information about the degradation and possible conditions at formation. Fortunately, one of the craters used in this research shows a unique and distinctive dark parabola facing to the west. The presence of craters with associated parabolas gives the age of the area. Basilevsky [4] concluded that the paraboloidal craters are contemporaneous with the late stages of rifting at about 50 Ma, the most recent activity on Venus.

Region: The Beta and Atla Regiones are dominated by rifts and large volcanic edifices, with Atla containing some of the largest volcanoes in the planet (i.e. Maat Mons) and Dali, Paga, Hecate and Ganis Chasmata [5]. Theia Mons, a major volcano on Venus, overlies on the Devana Chasma at the Beta Regio.

The Beta-Atla-Themis (BAT) region (±30°N, 180°-300°E) comprising 1/6 of the total surface area of Venus, encloses the location of the highest geoid values on the planet (order=+25) [6]. It is also the location of three rift zones defined in the global map of Venus [1]. These three rift arcs extend through: a) Aphrodite-beta zone from 25°S, 150°E to 25°N, 280°E; b) Themis-Atla from 25°N, 180°E to 40°S, 320°; and, c) Beta-Phoebe from 40°N, 285°E to 20°S, 285°E, [6].

Of 900+ impact craters cataloged by Phillips et al. [7], 158 have been tectonized, 55 embayed, of which 18 are unambiguously both tectonized and embayed. Of these 18 craters eleven out (61%) are located within the BAT region. Furthermore, a significant concentration, 5 of the 11 craters (45%), cluster near geoid maximums.

Crater Examples: Photogeologic mapping of the morphological characteristics of the 11 tectonized and embayed craters in the BAT region was undertaken. Two craters are of particular interest because of their coverage of Magellan images from two cycles (Cycles 1 and 2), which will allow stereo imaging correlation. These craters and their characteristics are shown below.

Crater Uvayasi. This crater located near the Themis-Atla rift zone also lies near the center of the geoid "bulls-eye" high. Additionally, it features the distinctive paraboloidal structure unique to Venus. Only 30-40 craters have associated a paraboloidal structure and thought to be among the youngest 10% craters on the planet [8, 4]. The west-opening may be composed of fine-grained ejecta, emplaced high into the atmosphere where they were transported and deposited by the west zonal winds [8,9]. Magellan images for the 38.9 km crater reveal a central peak, wall terracing and interior landslides (Fig. 1). Uvayasi is located on the Pl2 unit, defined as "plains with distinct flow morphology preserved" [10]. A break in the crater rim, the nearly indiscernible eject blanket, and the presence of volcano northeast of Uvayasi, all suggest embayment by lava. The rupture on the northeastern side of the rim crest could have provided a breach trough where the lava flows could pour from the exterior to the interior of the crater. Stereo imaging correlation may yield more detail of the morphological characteristics of the westward-facing dark parabola associated with this crater.

Crater Piscopia. This well-preserved crater, also located on the Pl2 unit, display a central peak, continuous ejecta blanket and flat floor. Wall terraces on this 24.8 km diameter are nearly non-existent on Magellan images (Fig. 1). In addition, several fractures are present surrounding the north side of the dark-flat crater floor. Southwest of the crater a bright material blend into the ejecta material. This slightly higher than surrounding backscattered material has been found in several craters in Venus and has been called "ejecta flows" or "outflows" [11]. The extension of the ejecta blanket as estimated from Magellan images ranges from approximately 0.1-1.0 crater radius, in the south and north respectively; the outflow extends further, about 1.5 radii to the south. Several rounded dome-like features with high reflectivity can be found north of the crater, perhaps ejecta remnants or small volcanic constructions.

Conclusions: We focused our study on craters that have been tectonized and embayed by lava on the Beta-Atla-Themis (BAT) region. This region is characterized by the high concentration of chasmata and volcanoes that dominate all surrounding structures. Both craters discussed here display tilt similar to the region external to them; stereo imaging will refine their orientation. Thus, detailed assessment of impact crater modification at various localities can give insights into the nature and timing of tectonic activity on Venus.

Impact craters that have suffered from tectonism and embayment by lava are strongly concentrated close to chasmata. The coincidence that the BAT region has a deficit in craters but contains the majority (61%) of the both tectonized and embayed craters, documents the primary obliteration of impact craters in this area. Furthermore, if the parabola-associated craters were indeed formed in the last 50 m.y., then the embayment and tectonization of crater Uvayasi establishes that activity in the BAT region is very recent.

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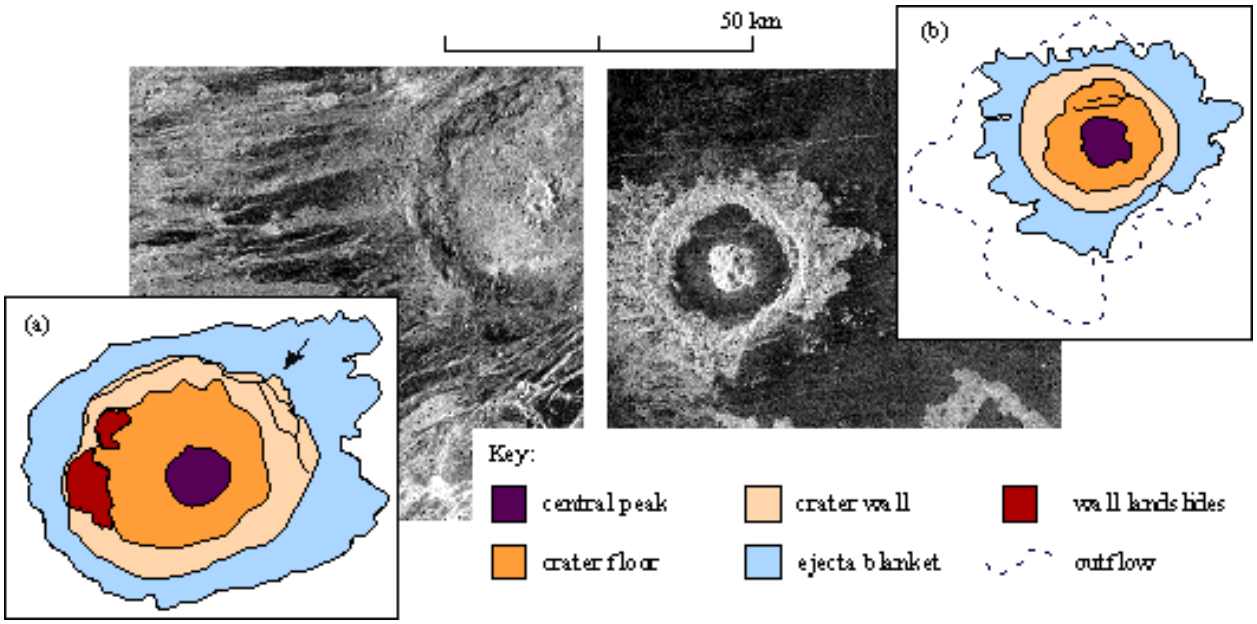

Figure 1. Magellan images (75 m/pixel; cycle 1, illumination from the left) and sketch maps, showing morphological characteristics for: (a) Crater Uvayasi (2.3N, 198.2E, D=38.0 km) Arrow indicates notched rim crest area that could have provided a breach for embayment. (b) Crater Piscopia (1.5N, 190.9E, D=24.8 km) Fractures are present in the northern area of the crater floor.