GEOLOGY OF THE LACHESIS TESSERA QUADRANGLE (V-18), VENUS. D. L. Buczkowski[1], E. M. McGowan[2], L. R. Ostrach[3], and G. E. McGill[2] [1]Johns Hopkins Applied Physics Laboratory, Laurel, MD 20723, debra.buczkowski@jhuapl.edu; [2]University of Massachusetts, Amherst, MA; [3]USGS Astrogeology, Flagstaff, AZ.

Introduction: The Lachesis Tessera quadrangle (V-18) lies between 25º and 50ºN, 300º and 330ºE. We present a first draft of a geologic map of the quadrangle and the associated tectonic analysis started by George McGill before his death.

Methods: Mapping was based on a 250 m/pxl Magellan cycle 1 synthetic aperture radar (SAR) mosaic prepared by the U.S. Geological Survey (USGS) planetary team. Most of the mapping was carried out using 75m/pxl FMAPS provided by the USGS in digital format. During the mission, data for the Lachesis Tessera quadrangle were collected in left-looking mode at incidence angles ranging between 43.73º-32.85º. The final base map is a 1:5M-scale controlled mosaic of SAR data. Topographic information was derived from digital elevation models and from gridded elevation data; the altimetry data were combined with the SAR data by the USGS to create synthetic stereoscopic images.

Geology: The Lachesis Tessera quadrangle includes parts of Sedna and Guinevere Planitiae; regional plains [1] cover approximately 80% of the quadrangle. In addition, the quadrangle includes two deformation belts and embayed fragments of one or two possible additional belts, 3 large central volcanoes, abundant small shield volcanoes and associated flow materials, 13 impact craters, 3 named coronae, and a number of coronae-like features [2].

Plains: The most areally extensive materials are regional plains. These are mapped as two units, based on radar backscatter. The brighter unit appears to be younger than the darker unit, based on the common presence within the lighter unit of circular or nearly circular inliers of material with radar backscatter characteristic of the darker unit. The circular inliers are most likely low shield volcanoes, which are commonly present on the darker unit, that were only partially covered by the brighter unit. Clear cut examples of wrinkle ridges and fractures superposed on the darker unit but truncated by the brighter unit have not been found to date. These relationships indicate that the brighter unit is superposed on the darker unit, but that the difference in age between them is very small. Because they are so widespread, the regional plains are a convenient relative age time “marker”. The number of impact craters superposed on these plains is too small to measure age differences [3], and thus we cannot estimate how much time elapsed between the emplacement of the darker and brighter regional plains units. More local plains units are defined by significantly lower radar backscatter or by a texture that is mottled at scores to hundreds of kilometers scale. A plains-like unit with a homogenous, bright diffuse backscatter is present as scattered exposures in the eastern part of the quadrangle. These exposures have been mapped as “bright material”, but it is not clear at present if this is a valid unit or if it is part of the brighter regional plains unit.

Tessera: Tessera is primarily found along the western border of the quadrangle, where Lachesis Tessera refers to southern exposures, and Zirka Tessera refers to northern. A second tessera unit appears to be deformed by the requisite 2 sets of closely spaced structures, but is so extensively flooded by regional plains materials that the structural fabric is partially obscured.

Deformation belts: Ridge and fracture belts are both present, but not as extensive as is the case in other quadrangles [e.g. 4, 5]. As is commonly the case, it is difficult to determine if the materials of these belts are older or younger than regional plains. A recent study using radar properties [6] demonstrated that at least most ridge belts appear to be older than regional plains. The materials of fracture belts probably are also older than regional plains, but the fractures themselves can be both older and younger than regional plains [e,g., 4].

Coronae: Three named coronae are present, but only Zemira Corona has significant associated flows. An interesting nearly linear structure extends from the fracture belt Breksta Linea in the western part of the quadrangle east-southeastward through Zemira Corona to Pasu-Ava Corona. The tectonic significance of this composite structure is unclear at present. A feature named Jaszai Patera is very likely another corona.

Volcanoes and shield flows: Volcanic materials and landforms are abundant in the Lachesis Tessera quadrangle. Small domes and shields are abundant and widespread. In places, small shields are not only exceptionally abundant, but are associated with mappable materials, and thus define a “shield flows” unit. Isolated flows are common, and where areally large enough they have been mapped as undifferentiated flows. Other volcanic features include two relatively large shield volcanoes, both with complete calderas and with flows extensive enough to map. A number of pancake domes occur in the Lachesis Tessera quadrangle.

Impact craters: The 13 impact craters in the Lachesis Tessera quadrangle range in diameter from 2.4-40 km. Four of these are doublet craters, while five have associated radar-dark halos or parabolas. Only 2 of the 13 are significantly degraded. All 13 craters are superposed on either regional plains or on flows that are, in turn, superposed on regional plains.

Tectonic Analysis: Important individual structural features identified within the Lachesis Tessera quadrangle include radar-bright lineaments, graben, and wrinkle ridges, all of which are abundant and pervasive. The individual features commonly occur in poorly defined belts that do not include associated mappable materials. These belts vary widely in trend with respect to each other, and some also exhibit significant variations in trend within individual belts. In addition, there are broader ridges scattered around the quadrangle that may be isolated inliers within younger regional plains or else local folds involving regional plains – these alternatives commonly are not easy to separate [6].

Wrinkle ridges are locally abundant, and range in length from a few to scores of kilometers, but are generally less that one kilometer in width. The general interpretation is that these ridges formed approximately normal to compressive stresses in the shallow crust [e.g. *7*; 8; 9]. The greatest abundance occurs in the northern and eastern parts of the quadrangle, particularly the portion that lies within Sedna Planitia, where the wrinkle ridges define a wavy east-west trend. This is similar to the wrinkle ridge trends in many quadrangles in the northern hemisphere [e.g. *7*; 8; 9]. To the south and west, within Guinevere Planitia, wrinkle ridges are much less abundant. This distribution of wrinkle ridge abundances coincides approximately with local topography, expressed as RMS slopes.

The Lachesis Tessera quadrangle includes abundant, radar-bright, straight to arcuate linear features. Most of these are too narrow to define their geometries, but locally are wide enough to be resolved as graben. Thus most are inferred to be small faults or fractures of extensional origin. Individual linear and arcuate features range in length from the limit of detection (1-2 km) to hundreds of kilometers. In places, there are 2 trends of straight linear features at high angle to each other, defining a "grid" pattern. Where wrinkle ridges cross plains with gridded lineaments it is clear that the wrinkle ridges are younger than the grid pattern.

Shishimora Dorsa is a ridge belt centered at 39°N, 302°E that trends northeast and is somewhat elevated relative to adjacent regional plains. Although dominated by ridges, the belt also includes radar-bright lineaments, possibly fractures, that have two distinct azimuths which define a pattern of parallelograms. The age of Shishimora Dorsa relative to adjacent plains materials is ambiguous.

Breksta Linea, centered at 34°N, 306°E, is a belt of closely spaced fractures and graben, most of which trend with about the same azimuth as the belt itself. The fractures appear to be younger than and also elevated relative to the adjacent regional plains.

Arguably the most interesting structural feature within the Lachesis Tessera quadrangle is a linear grouping of a prominent structural belt, coronae, and coronae-like structures oriented NW to SE in the southern half of the quadrangle. This belt links Breksta Linea, Zemire and Pasu-Ava coronae, several small deformed coronae-like features, pancake domes and a putative corona. The highest elevation of the linear group is in the west, adjacent to a fracture belt in the Beta Regio quadrangle [10].

Discussion: The fragmented record of tessera and some deformation belts suggests that flooding by regional plains materials has had a significant effect on the distribution of materials older than the regional plains. This, in turn, indicates that regional plains must be relatively thin in the Lachesis Tessera quadrangle, or else the tessera and deformation belts exhibit less relief than generally is the case.

References: [1] McGill G.E. (2000) V-20 quad [2] McGowan E.M. & McGill G.E. (2011) *LPSC XLII*, abs.1300 [3] Campbell B.A. (1999) *JGR 104*, 21,951 [4] Rosenberg E. & McGill G.E. (2001) V-5 quad [5] Ivanov M.A. & Head J.W. III (2001) V-55 quad [6] McGill G.E. & Campbell B.A. (2006) *JGR* doi: 10,1029/2006JE002705 [7] McGill G.E. (1993) *GRL* doi:10.1029/93GL02635 [8] Kreslavsky M.A. & Basilevsky A.T. (1998) *JGR* doi:10.1029/98JE00360 [9] Bilotti F. & Suppe J. (1999), *Icarus* doi:10.1006/icar. 1999.6092 [10] Basilevsky, A.T. (2008) V-17 quad.

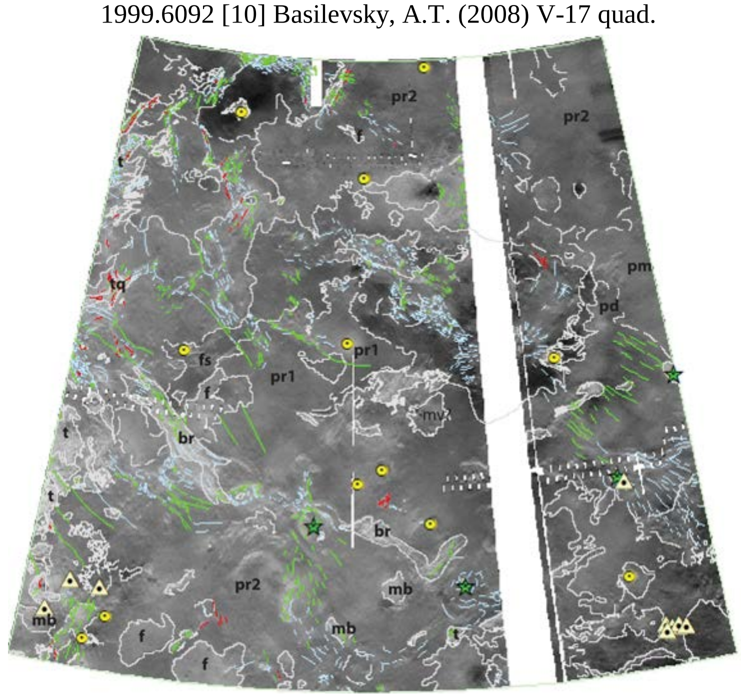

Figure 1. First draft of the geologic map of the V-18 quadrangle by George McGill. White lines are geologic contacts, green lines are graben, blue lines are lineaments, red lines are ridges, yellow triangles are shield volcanoes, green stars are coronae, and yellow circles are impact craters. Preliminary assignment of material units was partially completed