

GEOLOGICAL EVOLUTION OF THE GANIKI PLANITIA QUADRANGLE (V14) ON VENUS

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Introduction: The Ganiki Planitia quadrangle (25-50°N, 180-210°E) is located north of Atla Regio, south of Vinmara Planitia, and southeast of Atalanta Planitia. The region contains a diverse array of volcanic-, tectonic- and impact-derived features, and the objectives for the ongoing mapping effort are fivefold: 1) explore the formation and evolution of radiating dike swarms within the region, 2) use the diverse array of volcanic deposits to further test the neutral buoyancy hypothesis proposed to explain the origin of reservoir-derived features, 3&4) unravel the volcanic and tectonic evolution in this area, and 5) explore the implications of 1-4 for resurfacing mechanisms. Here we summarize our ongoing analysis of the material unit stratigraphy in the quadrangle, data central to meeting the aforementioned objectives successfully.

Approach: Ongoing 1:5M-scale mapping and analysis of the geology within V14 builds upon integrated interpretation of multiple datasets. The primary mapping base is a single, 250 m/pixel (~1:1M scale), georeferenced, Lambert Conformal Conic-projected Magellan radar image, co-registered in ArcGIS 9 with topography and remote sensing (e.g., emissivity, etc.) datasets. Complementing this mapping configuration, similar resolution synthetic stereo images (10x vertical exaggeration) viewed on an adjacent screen provide powerful topographic insight into material unit boundary locations and stratigraphy. In addition, georeferenced FMAP resolution (75 m/pixel) radar data are employed, sinusoidally projected to a central meridian of 195°E and then digitally mosaicked within ArcGIS; all units defined during mapping on the lower resolution Lambert base can be reprojected “on the fly” in ArcGIS to co-register with the sinusoidally projected FMAP images, yielding a quick and efficient way to use high resolution data to refine problematic unit boundaries and stratigraphic relationships. Finally, existing geomorphological units defined using backscatter and topography data are being studied statistically using the available raster datasets (with backscatter corrected for latitude) to test quantitatively the degree to which the units remain characterized by unique and internally self-consistent physical properties [1,2].

Summary of Material Unit Stratigraphy: The stratigraphy within the quadrangle unfortunately cannot be organized into a single comprehensive sequence due to the presence and extent of (1) a morphologically and temporally diverse “garbage bag” plains unit *prb* that cuts several broad swaths across the quadrangle, and (2) a few extensive, crater-related, radar-dark

deposits—most notably from the crater Yablochkina—which obscure stratigraphic details within the affected areas. Several local sequences can be defined, however, covering in sum roughly half of the quadrangle.

Each stratigraphic sub-region is characterized by a common sequence of transitions from one predominant style of geological activity to another. This could suggest that each local region records a similar sequence of transitions occurring at different times and/or rates, or that some/all of the local regions endured a general sequence of geologic events at about the same time and rate. In the text that follows we present the general stratigraphic sequence characteristics observed, and note that there are no compelling data suitable for testing if/how the localized stratigraphies are related.

Tessera. Tessera *t* is consistently the oldest material unit where it is observed as part of a local stratigraphic sequence. Tessera blocks are embayed or crosscut by all surrounding units, and in no location do we observe tessera forming at the expense of other units, though some deformation affecting tessera blocks also affects the surrounding units. We have not yet analyzed in detail whether all tessera preserve similar histories.

Transition 1. A complex era of intermingled plains emplacement and deformation dominated for some interval following tessera formation. This era yielded three distinct units which locally are older than everything but the tessera; however, they do not occur in a consistent sequence relative to one another, exhibiting variable temporal relationships in different areas of the quadrangle. In some cases deformed belts *bl*—either elevated and clearly constructed from a distinct material unit or so heavily deformed that the precursor unit failed to survive—are locally the oldest unit preserved. In other areas, plains characterized by pervasive extensional deformation (i.e., *pl*, *pla*, *plb*, *pLla,b*) and preserved as elevated kipukas are locally the oldest unit. Finally, in many areas the “garbage bag” plains *prb* are, at least locally, the oldest feature other than tessera. These plains have, relative to other plains units in the quadrangle, an intermediate radar backscatter and a highly blotchy appearance. They are distinctive yet defy further subdivision, displaying stratigraphically variable contact relationships which are often ambiguous locally but, viewed collectively, indicate the unit has undergone a prolonged history of spatially and temporally patchy emplacement and modification.

Transition 2. The next interval is characterized predominantly by extensive plains volcanism, *prc*. These plains have a darker backscatter than other plains units

observed, and embayment of other material units as well as the superposition locally on different lineament sets both suggest a fairly thin deposit. Emplacement of this unit appears to have occurred over a prolonged interval, and though younger than *prb* in most places in a few the two are clearly contemporaneous. The dark plains *prc* are never older than the lineated plains or deformed belts, but locally they predate all other units with which they are in contact.

Transition 3. The final distinct phase is characterized predominantly by edifice-related volcanism *fe* and emplacement of a final regional plains unit *pra* with a distinctly brighter radar backscatter than the other plains in the quadrangle. The majority of the *pra* plains occur as a single continuous and spatially extensive unit with no evident source. Onlap relationships reveal the unit is thicker in the middle and thin at the edges, and unlike the older *prb* and *prc* plains it appears to define a stratigraphically brief (single?) emplacement event. Other small patches of *pra* generally have identifiable local sources (a volcano, etc.) but all are similar in stratigraphic position. Complementing the bright plains, several large (>100 km diameter) edifices formed and the lobate surface flows from these constructs are everywhere superimposed on the surrounding materials, including the major bright plains unit. Similarly, there are several extensive plains units *pe* characterized by overlapping small shield deposits. The duration of time over which the small shields were emplaced is almost by definition unconstrained, but like *fe* the *pe* units they are everywhere younger than the materials against which they abut; in no location are *pe* and a major volcanic edifice in stratigraphic contact.

Other Selected Observations. There are four other brief observations we choose to note here. (1) Continued mapping of three giant radiating dike swarms (part of unit *fe*) reveals that these complex magmatic centers have prolonged emplacement histories that clearly postdate formation of the lineated plains units [3]. (2) Corona in V14, mostly in a relict state (highly modified remnants shown as dashed rings in Figure 1 are all that remain) appear to have formed predominantly prior to the era(s) characterized by extensive regional plains emplacement. Lineated plains units and *prb* occur upon the elevated rims which have been preserved, and the rims are embayed by *prc* and younger deposits. (3) Continued study of a potential pyroclastic deposit has revealed that the combination of remote sensing, backscatter and morphological characteristics is inconsistent with an eolian or lava flow origin, but consistent with pyroclastic emplacement [4]. Study of this enigmatic deposit continues. (4) One major impact crater in V14 is older than surrounding units, but deposits from most are clearly younger than their sur-

roundings. There are insufficient craters to date the existing surface.

Major Work Remaining: We are in the process of assessing the deformation histories preserved within the tessera units, of studying the evolution of individual volcanic features, and, of completing our analysis of the tectonic history of V14 [5]. Once these stages are concluded, we will begin to assess the implications for the overall formation and evolution of the quadrangle and how/if this history is related to the development of nearby physiographic features.

References: [1] Long, S.M. and E.B. Grosfils, this volume, *LPSC XXXVI*, 2005. [2] Richards *et al.*, this volume, *LPSC XXXVI*, 2005. [3] Grosfils, E.B. and R.E. Ernst, Abstract #1808, *LPSC XXXIV*, 2003. [4] Long, S.M. and E.B. Grosfils, Abstract #1194, *LPSC XXXV*, 2004. [5] Venechuk *et al.*, this volume, *LPSC XXXVI*, 2005.

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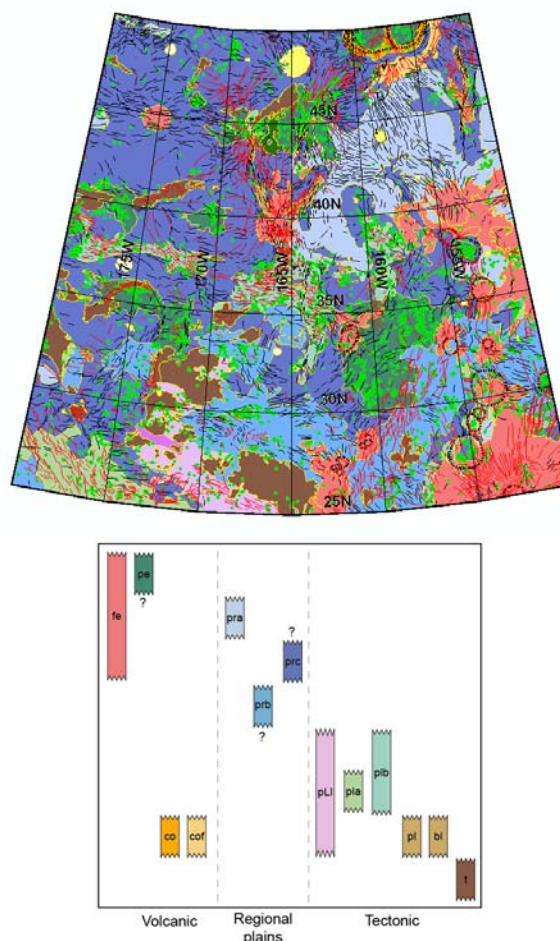


Figure 1. *Top:* Geological map of V14, ~3000 km across. Extensional lineaments are shown in red, compressional in black, major annuli as dashed rings, and small shields as green dots. *Bottom:* general stratigraphic sequence preserved in different temporally unrelatable areas of the quadrangle; colors correspond to the map units depicted above.