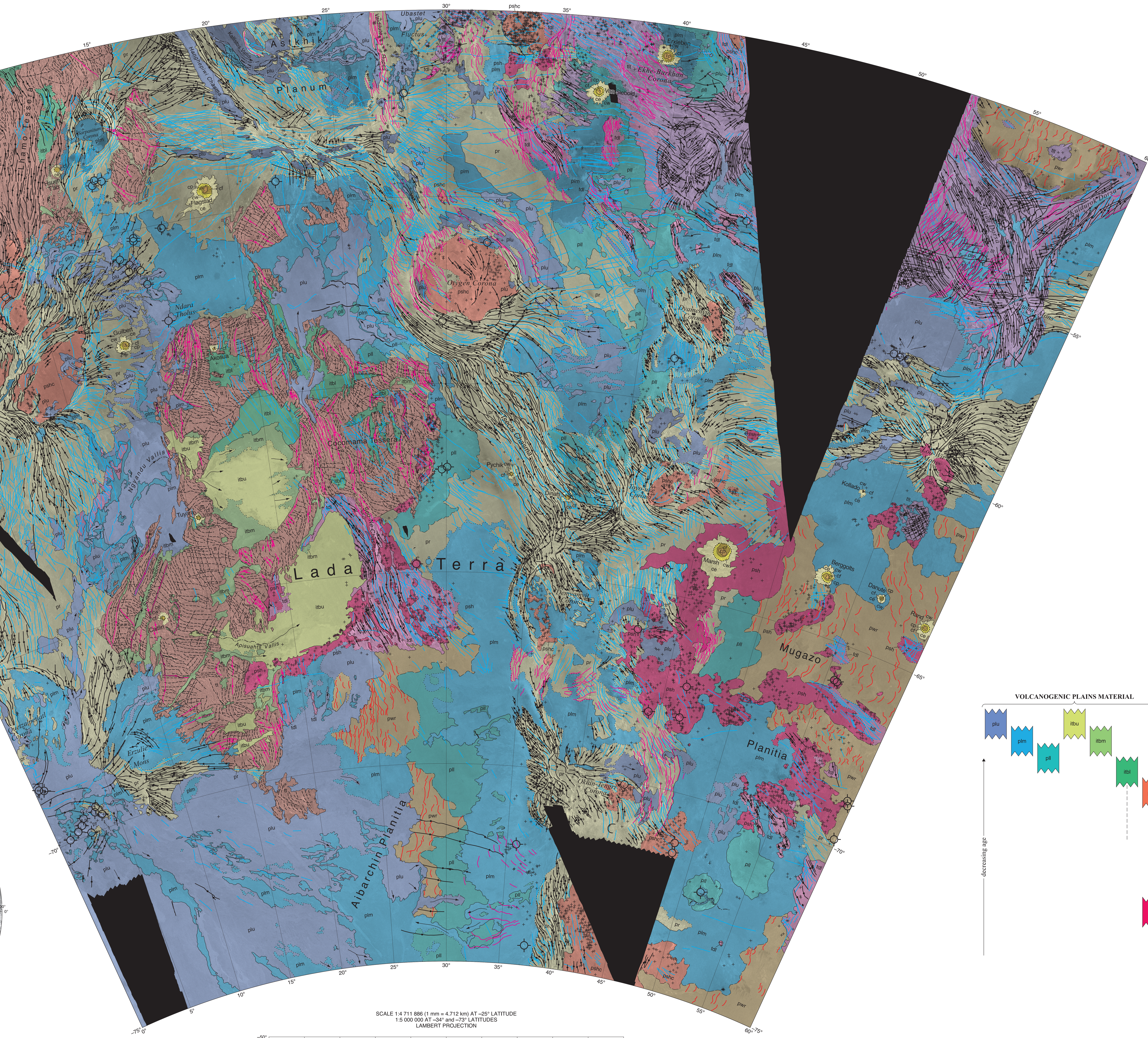
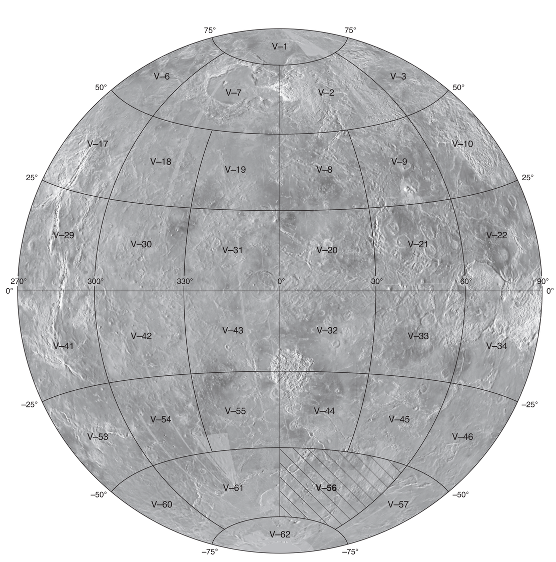
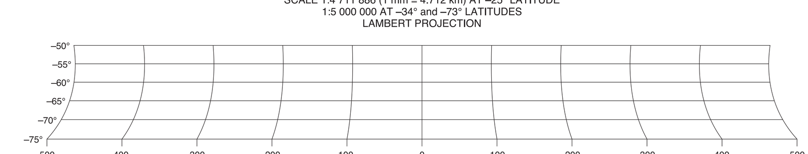




QUADRANGLE LOCATION
Photomosaic showing location of map area. An outline of 1:5,000,000-scale quadrangles is provided for reference.

SCALE 1:4 711 886 (1 mm = 4.712 km) AT –25° LATITUDE
1:5 000 000 AT –34° and –73° LATITUDES
LAMBERT PROJECTION



Descriptions of nomenclature used on map are listed at http://planetarynames.wr.usgs.gov/

Prepared on behalf of the Planetary Geology and Geophysics Program, Solar System Exploration Division, Office of Space Science, National Aeronautics and Space Administration
Edited by Jan L. Zigler
Cartography by D. Paul Mathieux
Manuscript approved for publication February 11, 2013

DESCRIPTION OF MAP UNITS

Unit label	Unit name	Characteristics	Interpretation	Type locality
	VOLCANOGENIC PLAINS MATERIAL			
	Lobate plains material			
plu	Upper unit	Dark to bright smooth surfaces on radar images, characterized by primary structures such as lobate flow fronts	Lava flows largely derived by volcanism in and around coronae and extensional belts and sometimes from large volcanoes	lat 72°54′ S., long 26°9′ E.; lat 50°44′ S., long 3°35′ E.
plm	Middle unit	Dark to bright smooth surfaces on radar images, characterized by primary structures such as lobate flow fronts	Lava flows largely derived by volcanism in and around coronae and extensional belts and sometimes from large volcanoes	lat 72°24′ S., long 32°41′ E.; lat 73°48′ S., long 24°59′ E.
pll	Lower unit	Dark to bright smooth surfaces on radar images, characterized by primary structures such as lobate flow fronts	Lava flows largely derived by volcanism in and around coronae and extensional belts and sometimes from large volcanoes	lat 69°55′ S., long 29°40′ E.; lat 61°57′ S., long 30°11′ E.
	Intra-tessera basin plains material			
itbu	Upper unit	Similar to intra-tessera basin plains materials middle unit, free from tectonic structures present in lower basin plains unit; abundant lobate structures and channels	Lava flows filling basins present inside tessera terrain materials formed by volcanism inside or outside tessera terrain	lat 62°10′ S., long 18°43′ E.; lat 65°18′ S., long 22°08′ E.
itbm	Middle unit	Similar to intra-tessera basin plains materials lower unit, but are free from tectonic structures present in lower unit; abundant lobate structures and channels. Lava flows filling basins present inside tessera terrain materials formed by volcanism inside or outside tessera terrain	Lava flows filling basins present inside tessera terrain materials formed by volcanism inside or outside tessera terrain	lat 61°09′ S., long 19°34′ E.; lat 63°35′ S., long 18°11′ E.
itbl	Lower unit	Radar smooth materials with varying degree of brightness and (or) darkness, filling isolated basins occurring inside tessera units. This unit contains substantial amount of fractures also present in tessera terrain materials	Lava flows filling basins present inside tessera terrain materials formed by volcanism inside or outside tessera terrain	lat 59°4′ S., long 14°39′ E.; lat 60°34′ S., long 19°33′ E.
	Shield plains material			
pshc	Corona	Smooth, dark, or bright plain surfaces in radar images with clusters of small shields (1–20 km in diameter) within them; similar to shield plains materials but restricted to coronae structures	Plains materials derived by volcanic eruptions from shields exclusively present in coronae structures	lat 57°4′4″ S., long 32°30′36″ E.; lat 73°59′20″ S., long 42°40′57″ E.
psh	Shield plains material	Smooth, dark, or bright plains surfaces in radar images with clusters of small shields (1–20 km in diameter) within them; shields characterized by circular volcanic features with illumination on radar-looking slopes. Summit portion of many shields contain pits. Shield plains materials derived from lava flows originated from shields	Plains materials derived by volcanic eruptions from shields	lat 66°43′ S., long 28°42′ E.; lat 68°2′ S., long 46°39′ E.
	REGIONAL PLAINS MATERIAL			
pr	Regional plains material	Extensively occurring dark to moderately bright smooth surfaces on radar image, substantially affected by later deformation due to large-scale extensional belts and coronae formation and that later deformation also affects other surrounding material units such as heavily deformed material units at some places	Material probably formed by regionally occurring volcanism	lat 59°52′ S., long 4°55′ E.; lat 52°7′ S., long 18°47′ E.
pwr	Wrinkle ridged plains material	Smooth radar dark to moderately bright radar surfaces similar to regional plains but have dense concentrations of wrinkle ridges. Wrinkle ridges in general occur only in these plains materials	Materials probably formed by volcanism and affected by compressive tectonic regime producing widely distributed wrinkle ridges	lat 52°51′ S., long 3°18′ E.; lat 71°59′ S., long 27°48′ E.
	HEAVILY DEFORMED TERRAIN MATERIAL			
tdl	Densely lineated terrain material	Radar-bright areas with moderate surface roughness, characterized by tightly spaced parallel lineaments, near-parallel arrangements of ridges, grooves, and troughs. Spatially associated with tessera and tessera-like terrain materials, except for a few isolated exposures. Lineaments that characterize this unit also present in adjoining tessera and tessera-like terrain materials	Materials of unknown origin, subsequently affected by single or multiple episodes of tectonic processes, producing somewhat parallel dense tectonic structures	lat 65°30′ S., long 26°5′ E.; lat 53°26′ S., long 34°35′ E.
ttt	Tessera-like terrain material	Radar-bright and high surface roughness areas characterized by multiple orientations of lineaments but with wider spacing between lineaments than those in tessera. They have north-northeast- to northeast-oriented ridges and troughs, cut by east-southeast- to northwest-oriented troughs; greater spacing of these structures than structures in tessera terrain materials	Materials of unknown origin subsequently affected by single or multiple episodes of tectonic processes before embayment of regional plains materials	lat 52°59′ S., long 53°47′ E.; lat 53°6′ S., long 40°41′ E.
tt	Tessera terrain material	Radar-bright and high surface roughness areas characterized by multiple orientations of lineaments. At least two sets of lineaments present: north-northwest- and east-southeast-oriented lineaments. Tightly spaced ridges and troughs generally characterize this unit	Oldest material unit of unknown origin subsequently affected by single or multiple episodes of tectonic processes before embayment by regional plains	lat 55°27′ S., long 21°5′ E.; lat 60°26′ S., long 17°13′ E.
	IMPACT CRATER MATERIAL			
cp	Impact crater peak material	Seen in complex craters; usually appears bright on radar image	Structurally uplifted target rocks	lat 54°18′23″ S., long 18°54′17″ E.; lat 63°25′28″ S., long 46°36′55″ E.
cf	Impact crater floor material	Bright or dark radar surface, depending upon surface roughness; present both in simple and complex craters	Impact melt deposits, impact breccia, and materials slumped from crater wall, as well as from central peaks of complex craters	lat 54°20′37″ S., long 19°4′15″ E.; lat 63°26′7″ S., long 46°34′51″ E.
cw	Impact crater wall material	Smooth texture with illumination on radar-looking walls; present both in simple and complex craters	Bedrock exposures, impact breccia deposits, and talus	lat 54°27′59″ S., long 18°49′24″ E.; lat 63°44′47″ S., long 46°21′28″ E.
ce	Impact crater ejecta material	Radar-bright and rough deposits associated either with simple or complex impact craters, symmetrically or asymmetrically distributed around crater rim; outflows are present for very complex craters. Some complex craters have ejecta blanket with outflow deposits	Rock fragments ejected from crater due to crater growth. Impact melt deposits may also be present. Outflow deposits are interpreted to have formed by condensation of ejecta plume	lat 54°27′26″ S., long 19°17′10″ E.; lat 63°35′48″ S., long 45°43′58″ E.

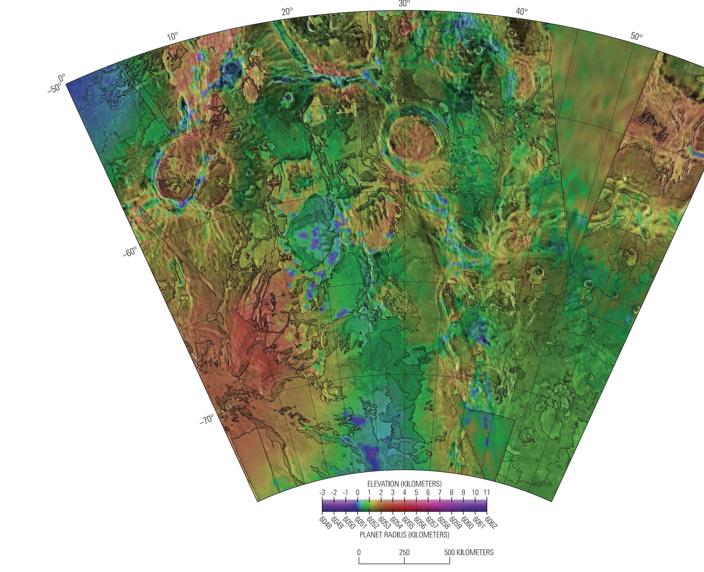


Figure 1. Topographic map of Lada Terra quadrangle (V–56), Venus, showing unit boundaries.

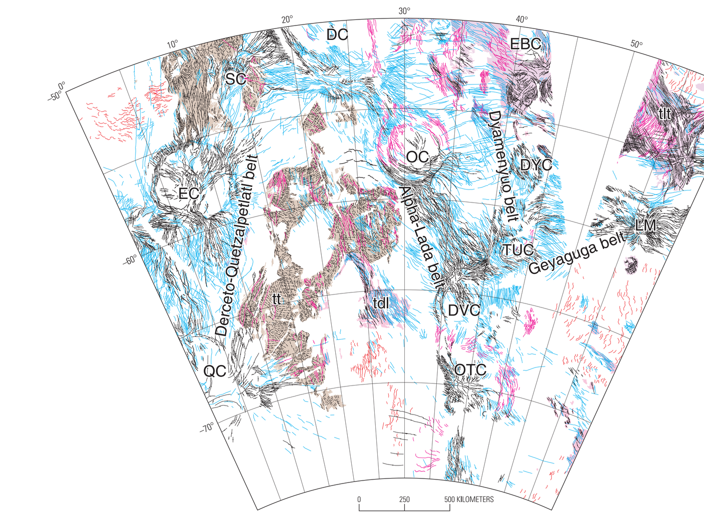
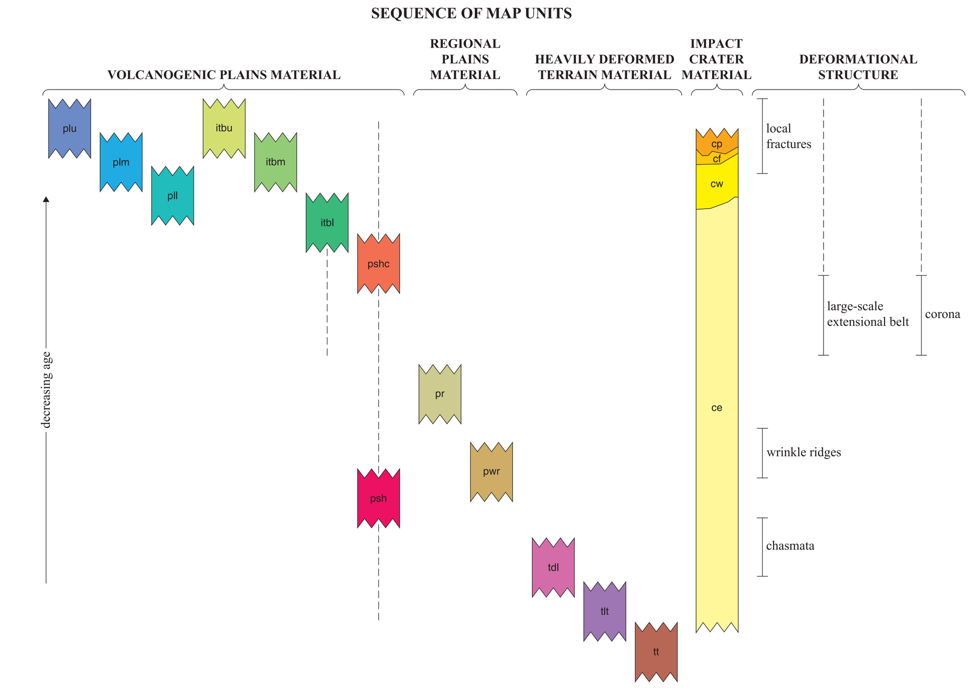


Figure 2. Distribution of large-scale extensional belts (names are labeled according to Baer and others, 1994) and coronae in Lada Terra quadrangle (V–56), Venus; coronae were emplaced along the large-scale extensional belts. Secondary structures in heavily deformed terrain materials (units tt, ttt, tdl) with unit colors in the background are also shown. Corona names: DC, Derceto Corona; DVC, Demvamvit Corona; DYC, Dyamenyuo Corona; EBC, Ekho-Burkhan Corona; EC, Eithinoha Corona; OC, Otygen Corona; OTC, Okhin-Tengri Corona; QC, Quetzalpetlatl Corona; SC, Serpanitum Corona; TUC, Toyo-uke Corona. LM, Loo-Wit Mons is an astra-like structure.

SEQUENCE OF MAP UNITS



EXPLANATION OF MAP SYMBOLS

Symbol, feature name	Characteristics	Interpretation	Type locality
Contact	Solid where certain; long-dashed where approximately located; short-dashed where gradational		
Shield (>5 km) Shield (<5 km)	Circular volcanic features with illumination on radar-looking slopes. Summit portion of many shields contain pits. Surrounded by lava flows derived from shields	Primary volcanic structures: mounds formed around volcanic vents that are made up of pyroclastic materials, ash deposits, and lava flows	>5 km: lat 57°58′ S., long 16°5′ E; lat 69°46′ S., long 2°10′ E. <5 km: lat 69°23′ S., long 54°29′ E.; lat 50°40′ S., long 33°16′ E.
Channel	Sinuous channels originated from centers of volcanism. Formed by thermal erosion of liquid lava that flow on surface of material units; sometimes formed along tectonic features such as grabens	Primary volcanic structures; formed by volcanic processes due to thermal erosion of surfaces by flowing liquid lava	lat 50°33′18″ S., long 26°10′26″ E.; lat 73°26′27″ S., long 25°59′54″ E.
Lobate flow front with flow direction	Lava flow structures mostly compound of lava flow frontal lobes showing flow direction, often associated with lava channels	Primary volcanic structures; formed by volcanic lava flows, primarily pahoehoe flows, showing direction of lava transport	lat 50°33′18″ S., long 26°10′26″ E.; lat 73°26′27″ S., long 25°59′54″ E.
Impact crater rim	Circular or elliptical edge of crater that represents uppermost tip of raised portion. In radar image, rim appears in form of circular ridge	Primary structure; formed by uplift of target rocks by an impact event	lat 54°11′30″ S., long 19°5′53″ E.; lat 63°35′22″ S., long 46°5′23″ E.
Lineament	Long, linear, radar-bright lineaments specific to tessera terrain materials	Secondary deformational structures of undefined mechanical characteristics	lat 65°24′3″ S., long 13°38′25″ E.; lat 62°27′30″ S., long 13°53′35″ E.
Fracture	Fine, sharply defined, continuous radar-bright lineaments typically observed in lowlands, largely concentrated along the large-scale extensional belts, and coronae, and tessera and in lobate plains	Secondary deformational structures, formed by brittle deformation. When associated with volcanic eruptive center, may represent surface expression of subsurface dike	lat 53°29′14″ S., long 4°28′21″ E.; lat 57°9′44″ S., long 37°17′8″ E.
Normal fault	Broad, sharply defined, continuous radar lineaments, principally singular scarps, with radar-looking scarps brightly illuminated; straight, curved, and branching shapes	Secondary deformational structures, formed by brittle deformation, mostly by extensional tectonics	lat 61°47′17″ S., long 3°8′59″ E.; lat 61°53′49″ S., long 2°25′1″ E.
Graben	Paired, parallel dark and light lineaments separated by linear troughs; mostly present along large-scale extensional belts and coronae; also present in other material units such as tessera (magenta), tessera-like terrain, and densely lineated plains. Also present as asymmetric basins similar to sigmoidal pull-apart structures in strike-slip zones	Secondary deformational structures, formed by brittle deformation formed in response to extensional tectonic processes	lat 69°17′45″ S., long 6°22′39″ E.; lat 65°12′4″ S., long 34°17′23″ E.
Linear ridge	Have linear topographic relief with oppositely dipping slopes. Radar looking slope is illuminated and brightness across crest gradually changes to darkness. Linear ridges are straight to curvilinear and are often associated with coronae, densely lineated terrains, and tessera-like terrains	Secondary deformational structures. Linear ridges are formed by brittle deformation formed in response to tectonic processes, largely during corona formation	lat 56°19′40″ S., long 33°53′21″ E.; lat 51°10′47″ S., long 27°12′50″ E.
Wrinkle ridge	Sinuous ridges, but less prominent than linear ridges. Occur widely in regional plains	Secondary deformational structures, formed by brittle deformation in response to regional compressive tectonic processes	lat 52°20′24″ S., long 4°0′59″ E.; lat 69°16′55″ S., long 23°36′43″ E.

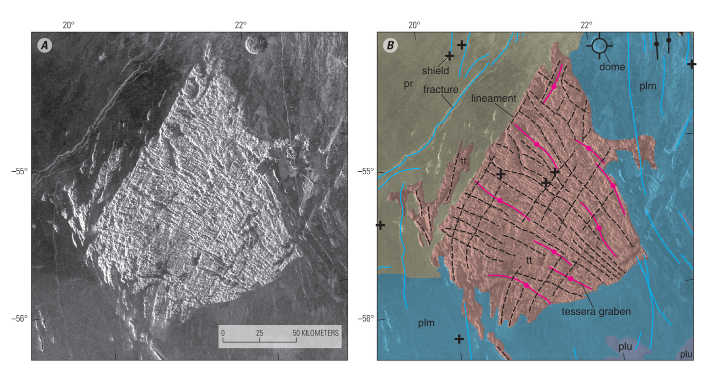


Figure 3. *A*, Right-looking Magellan SAR image; *B*, geologic map showing an island of the tessera terrain materials (unit tt), surrounded by regional plains materials (unit pr) and the lobate plains middle unit materials (unit plm). A shield and dome are also shown. Lineaments and grabens form secondary structures in unit tt.

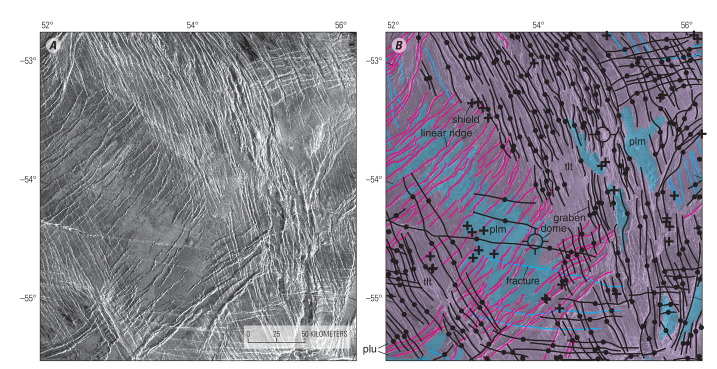


Figure 4. *A*, Left-looking Magellan SAR image; *B*, geologic map of tessera-like terrain materials (unit ttt) with younger lobate plains middle unit materials (unit plm). Shield is also shown. Tessera-like terrains materials are cut by multiple generations of grabens and ridges.

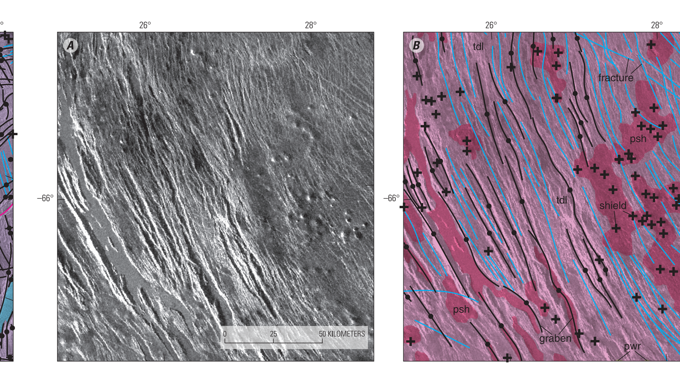


Figure 5. *A*, Right-looking Magellan SAR image; *B*, geologic map of densely lineated terrain materials (unit tdl) and younger shield plains materials (unit psh). Shields are also shown. North-northwest-oriented grabens and fractures, which are parts of Seo-Ne Chasma, cut across unit tdl. These grabens and fractures are older than large-scale extensional belts and coronae in Lada Terra.

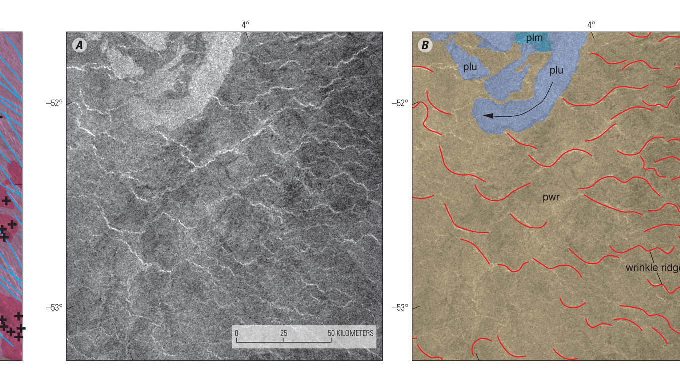


Figure 6. *A*, Right-looking Magellan SAR image; *B*, geologic map of wrinkle-ridged plains materials (unit pwr) and upper unit of lobate plains materials (plu) of Kaiwan Fluctus. Note wrinkle ridges are embayed by lobate plains materials.

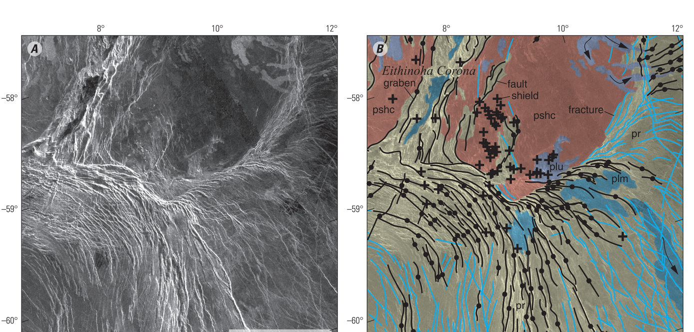


Figure 7. *A*, Right-looking Magellan SAR image; *B*, geologic map of Eithinoha Corona and surrounding regional plains materials (unit pr). Shield plains corona materials (unit pshc) and lobate plains middle (unit plm) and upper (plu) unit materials are derived from the corona. Note complex network of grabens that form corona and large-extensional belt; fractures are also abundant. Shields are also shown.

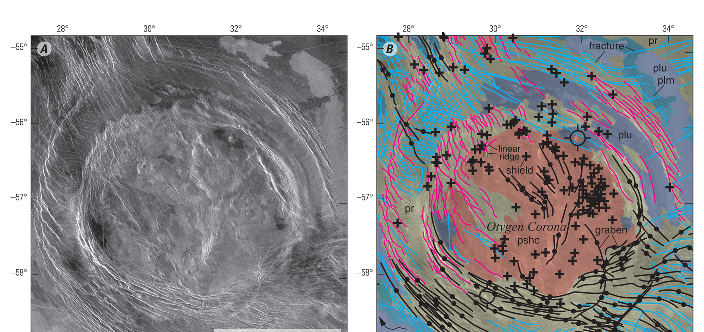


Figure 8. *A*, Right-looking Magellan SAR image; *B*, geologic map of Otygen Corona and the surrounding plains. A group of grabens, fractures, and linear ridges define the double-ringed corona structure. A suite of grabens and fractures of the large-scale extensional belt cuts across the boundary of the corona. Corona contains several centers of volcanism, generating shield plains corona materials (unit pshc) and multiple generations of lobate plains materials (units plm, plu). Regional plains materials (unit pr) constitute an older geologic unit in which Otygen Corona was emplaced.

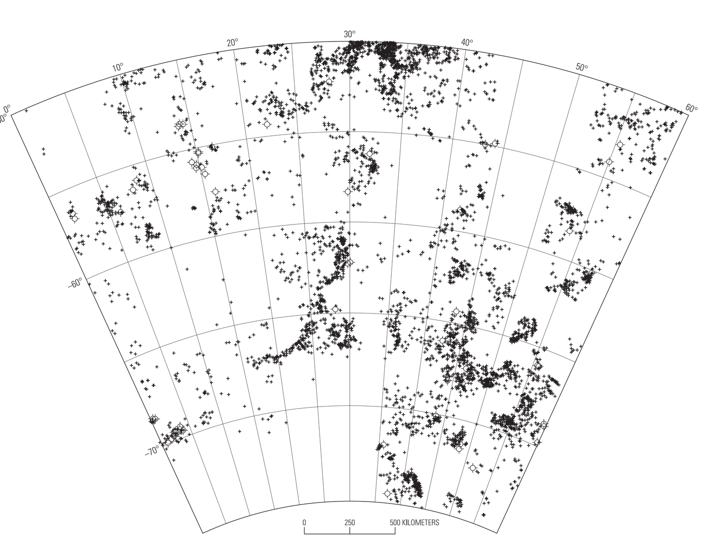


Figure 9. Distribution of shields in V–56 quadrangle. About 5,058 shields were mapped. Plus symbol (+) indicates shields with ≤5 km diameter, while hatched open circle (⌖) indicates shields with diameter >5 km diameter and domes.

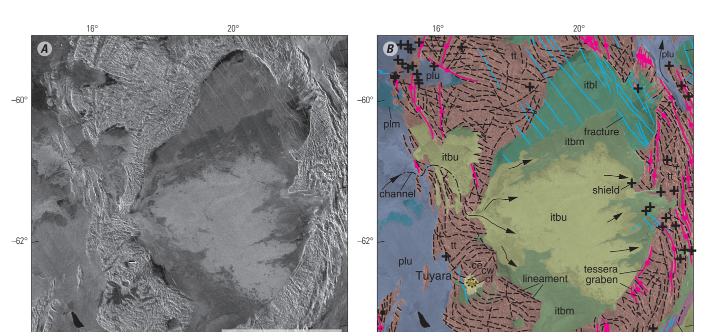


Figure 10. *A*, Right-looking Magellan SAR image; *B*, geologic map of Cocomama Tessera (unit tt) enclosing an intra-tessera basin that consists of three units of basin plains materials. Lower unit of basin plains materials (unit itbl) is cut by widely spaced fractures, whereas middle (unit itbm) and upper (itbu) units are devoid of those fractures. Lobate plains upper unit materials (unit plu) that occur outside the tessera are connected to upper unit of the intra-tessera basin plains materials (itbu) through a channel in Ngyandu Vallis. Impact crater Tuyara is also seen. Some of intra-tessera basin plains materials are related to volcanism outside of tessera. Note that fractures in unit itbl are also seen in the tessera but are completely absent in units itbm and itbu.

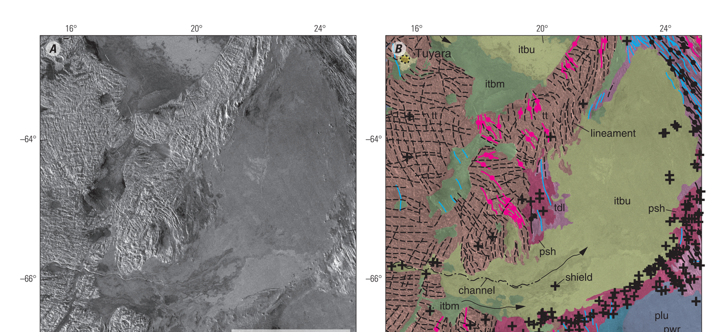


Figure 11. *A*, Right-looking Magellan SAR image; *B*, geologic map of Apisuahts Vallis, illustrating Cocomama Tessera (unit tt) and middle unit (itbm) and upper unit (itbu) of intra-tessera basin plains materials. Clearly, lobate flows of unit itbu are derived from a channel that emanates from a center of volcanism in the tessera interior. Shield plains materials (unit psh) are older than basin plains materials. Figure clearly shows that some intra-tessera basin materials are related to volcanism inside the tessera.

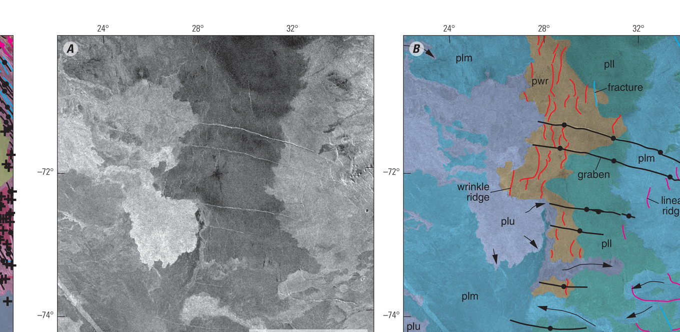


Figure 12. *A*, Right-looking Magellan SAR image; *B*, geologic map of Aibarchin Planitia. Older unit is wrinkle ridged plains materials (unit pwr), which are overlain by three generations of lobate plains materials. These lobate plains are formed by volcanism in the coronae regions. Lower unit of lobate plains materials (unit pll) embays wrinkle ridges, while upper plains unit (plu) embays a set of grabens that cut across lower and middle lobate plains units (pll and plm).

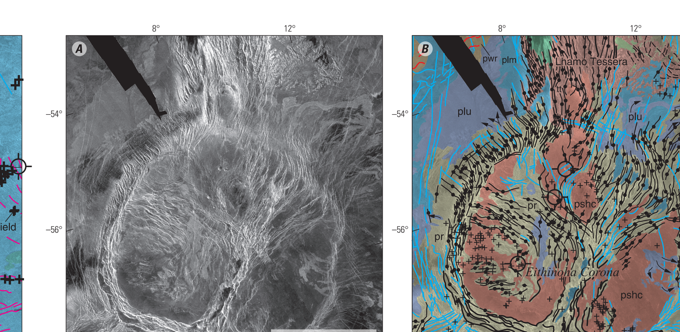


Figure 13. *A*, Right-looking Magellan SAR image; *B*, geologic map of Eithinoha Corona and surrounding regions. Concentric and radial grabens, fractures, and faults define corona structure. Grabens and fractures of large extensional belts cut across Lhamo Tessera (unit tt), as well as Eithinoha Corona. Clearly, a majority of large extensional-belt structures are younger than corona structure. However, north-northeast-oriented complex grabens that occur inside the corona appear to be a relict of an older large-scale extensional belt that could have formed prior to corona emplacement. Eithinoha Corona also witnessed a variety of volcanic processes that led to formation of shield plains corona materials (unit pshc) and younger lobate plains materials (units plm, plu). Some fractures postdate lobate plains materials, indicating the progress of corona deformation even after corona volcanism.

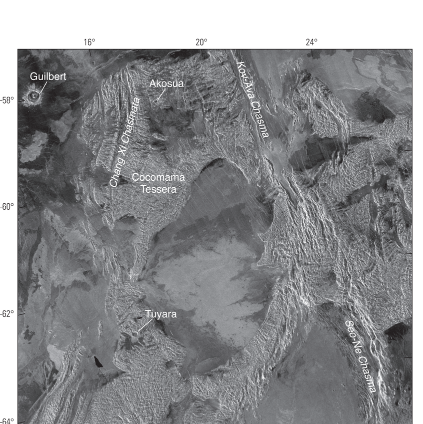


Figure 20. Right-looking Magellan SAR image showing distribution of Chang Xi, Kov-Ava, and Seo-Ne Chasma or Chasmata that are composed of complex grabens, which are older than those in large-scale extensional belts and coronae. Plains materials embay Cocomama Tessera. Impact craters, Tuyara and Akosua, postdate tessera terrain materials.

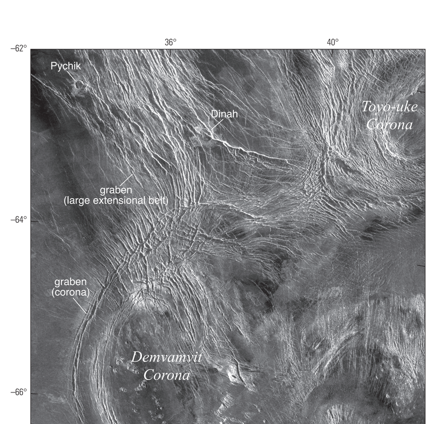


Figure 21. Right-looking Magellan SAR image of part of Demvamvit Corona and surrounding region, showing relative age relation between corona and large extensional belt. Grabens of large extensional belt postdate radial grabens in corona, suggesting corona emplacement was after extensional belts. Also note set of fractures and faults of extensional belt that cut across Dinah crater.

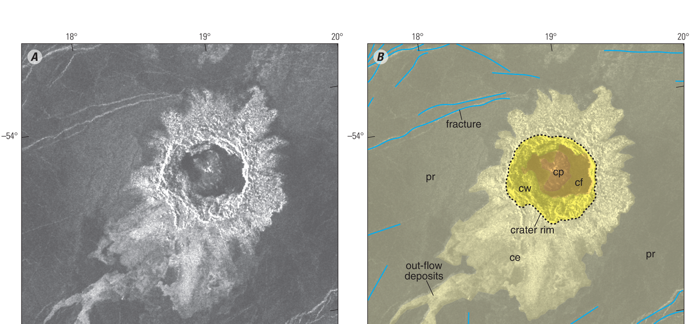


Figure 14. *A*, Right-looking Magellan SAR image; *B*, geologic map of Flagstad crater materials (ce, ejecta materials; cf, floor materials; cp, peak materials; cw, wall materials). Ejecta led to outflow deposits from southwestern part of ejecta.

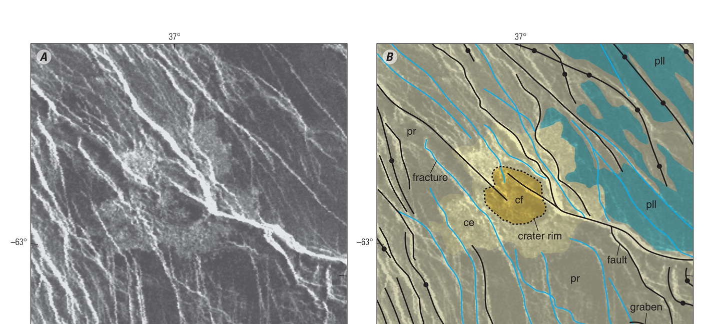


Figure 15. *A*, Right-looking Magellan SAR image; *B*, geologic map of highly degraded impact crater materials of Dinah (ce, ejecta materials; cf, floor materials). Grabens, fractures, and normal faults belonging to the large-scale extensional belt cut across crater materials.

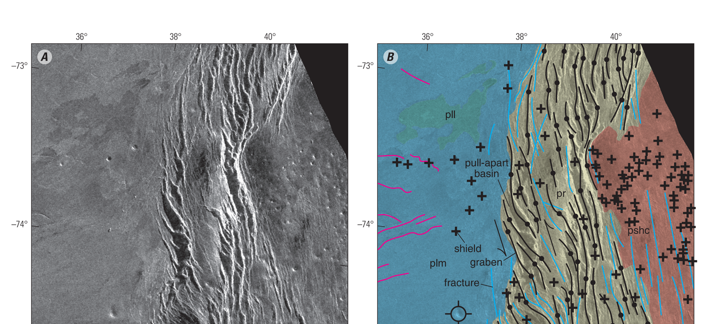


Figure 16. *A*, Right-looking Magellan SAR image; *B*, geologic map of eastern part of Aibarchin Planitia and region south of Okhin-Tengri Corona. Asymmetric structural basins (pull-apart basins) formed in extensional belt in response to left-lateral strike-slip motion and extension, which can also be termed as oblique extension. Lobate plains materials embay regional plains materials that host pull-apart basins. Shield plains corona materials (unit pshc) are also present. Also note embayment of some shields by unit plm.

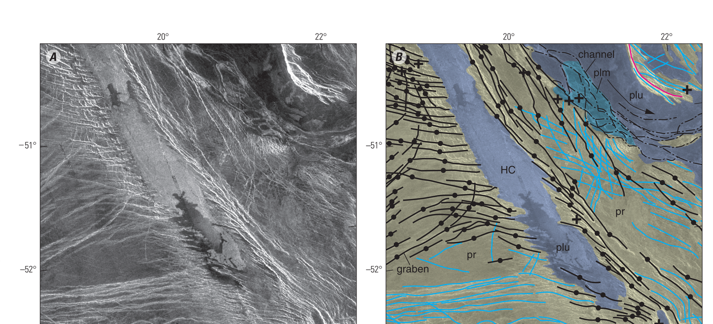


Figure 17. *A*, Right-looking Magellan SAR image; *B*, geologic map of Hanghepiwi Chasma (HC) and surrounding regional plains materials (unit pr). Unit pr west of HC is transected by two sets of obliquely oriented grabens that postdate younger lobate plains materials (units plm, plu). Some grabens east of HC are parallel to the boundary of HC.

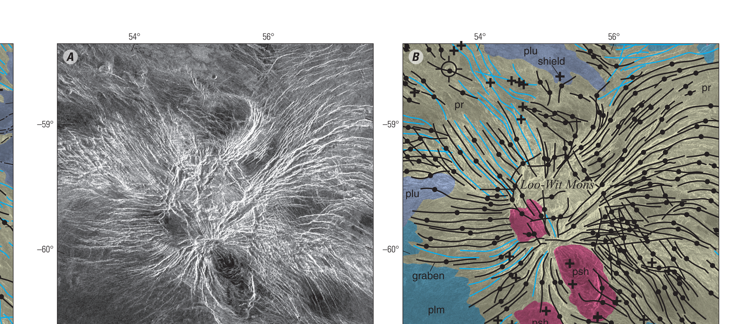


Figure 18. *A*, Left-looking Magellan SAR image; *B*, geologic map of Loo-Wit Mons and surrounding regions. Loo-Wit Mons is an astra-like structure, composed of radially arranged grabens, fractures, and faults. It also hosts shields plains material and middle and upper units of lobate plains materials (units plm, plu). Regional plains materials (unit pr) underlie astra-like structure.

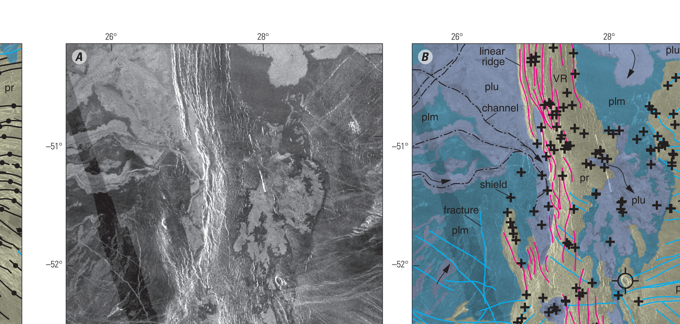


Figure 19. *A*, Right-looking Magellan SAR image; *B*, geologic map of Vaidilute Rupes (VR) and Ubastet Fluctus that are parts of Astkhik Planum. Lobate plains materials (units plm, plu) are lava flows derived from the core of Derceto Corona and flow along a set of channels that cuts across the ridge belt in VR. Lobate plains materials are underlain by regional plains materials (unit pr) with a suite of fractures predating the VR ridge belt.

Geologic Map of the Lada Terra Quadrangle (V–56), Venus

By
P. Senthil Kumar[1,2] and James W. Head[2]
2013

[1]National Geophysical Research Institute, Council of Scientific and Industrial Research
[2]Department of Geological Sciences, Brown University

ISSN 2329-1311 (print)
ISSN 2329-132X (online)
http://dx.doi.org/10.3133/sim3249

Suggested citation: Kumar, P.S., and Head, J.W., 2013, Geologic map of the Lada Terra quadrangle (V–56), Venus: U.S. Geological Survey Scientific Investigations Map 3249