COMMON LANDFORMS ON VENUS, MARS AND IO; Philip J. Stooke, Department of Geography, University of Western Ontario, London, Ontario N6A 5C2 (bitnet: STOOKE@VAXR.SSCL.UWO.CA).

INTRODUCTION: Several classes of landform identified on Venus in Venera 15/16 images are often described as unique to that planet (e.g. 1, p. 87), particularly coronae and tesserae. Comparison of these landforms with those of Mars and Io suggests greater similarity than is usually acknowledged, with implications for the geology of each world. This study is based on the Viking 1:2,000,000 controlled mosaics, Voyager images of Io, all Venera 15/16 subquadrangle images and the first Magellan F-MIDR strip along longitudes 330-340.

VENUS: Tesserae are uplands cut by orthogonal, oblique or multiple fracture sets. Several distinctive patterns have been described (2), though it is not certain that the differences are more than superficial. Coronae are roughly circular volcanotectonic structures from 150 to 1000 km in diameter. Similar but smaller features (arachnoids, ref. 3) and larger ring structures (Heng-O, Artemis, ref. 4,5,6) probably represent, with coronae, a continuum of volcanic complexes. Western Ishtar Terra may be the largest corona-like structure on the planet (7). Its rim includes arcs of tesserae and mountain belts surrounding the Lakshmi volcanic province. Some large shield volcanoes are surrounded by troughs (e.g. Tepev Mons) and others by possible concentric graben systems (e.g. Melia Mons, Mokoshu Mons) which may be related to coronae, either at very early stages of development or too small to evolve further. Domed uplands like Beta Regio appear to be tectonic uplifts with a veneer of basalt, with or without shield volcanoes and medial rifts (8). Figure 1 shows a representative region of Venus for comparison with Figures 2 and 3.

MARS: Alba Patera and its annulus of grabens would undoubtedly be called a corona if situated on Venus. Early Magellan images show a corona at lat. -59, long. 348 which resembles Alba. There are several other large ring structures in the Tharsis region which resemble degraded or less fully developed coronae. The best developed are Acheron Fossae just north of Olympus Mons and that surrounding Syria Planum (9), where a ring of grabens and associated flows is now partly obscured by Noctis Labrynthus. Others, less developed or more obscured, are Halex Fossae (lat. 28, long. 128), Fortuna Fossae (lat. 5, long. 93) and two partial rings of graben (one with a central volcanic construct) in Tempe Terra. Elysium and Arsia Montes are also surrounded by arcuate graben and may represent proto-coronae preserved at a very early stage of development by crustal thickening or mantle cooling, or too small to fully evolve. The Tharsis dome itself is an obvious analog of Beta or Metis Regiones, complete with its vast array of medial rifts from Memnonia to Tempe Fossae. The Alba corona occupies the summit of a second such dome and is also characterized by medial rifts including Ceraunius Fossae. The Olympus Mons aureole (Lycus Sulci) is indistinguishable in scale and form from tesserae on Venus, and for consistency should probably be renamed as tesserae, leaving the term 'sulci' for Ganymede-like groove sets. Olympus Mons itself is surrounded by a trough like that of Tepev Mons on Venus, now largely filled with lava (10). These features are illustrated in Figure 2 at the same scale as Figure 1.

IO: Voyager images of Io reveal a volcanic terrain similar to that of Venus in some respects, with extensive plains, numerous shields and rugged uplands, though ridge belts are not recognized. The mountains of ref. 11 have the same tectonic texture and scale as Manzan-Gurme Tesserae and other isolated tessera blocks on Venus, seen at similar resolution. A linear belt of corona-like features occurs along longitude 270 from the equator to the south pole. They are developed in layered plains and are characterized by incomplete raised arcs of layered material associated with roughly concentric lineaments or graben, calderas (e.g. Babbar and Svarog Paterae) and mountain (tessera) blocks. Note that Nightingale Corona on Venus has a block of tessera-like material within its southern rim and that Clotho or Itzpapalotl Tesserae form part of the rim of the postulated Lakshmi mega-corona (7). At lat. -53, long. 273 is a kidney-shaped ring structure 160 x 220 km across with a partial annulus of concentric lineaments to the southeast at a radius of 200 km. Nemea Planum, an arcuate fractured upland with tessera-like texture at its eastern end, may be another example of a mega-corona 1600 km across. These features are illustrated in Figure 3 at the same scale as Figures 1 and 2. Another example, poorly imaged by Voyager 1, is at lat. 49, long. 298, immediately south-east of Dazhbog Patera. Large domal uplifts up to 3000 km in diameter and 2 km high have been identified (12) but were not imaged at high resolution by Voyager 1. They may be comparable to Beta Regio and Tharsis. Only about 30% of Io was imaged at sufficient resolution to identify such features, but Galileo should extend coverage and allow better characterization of such features.

IMPLICATIONS: Three planets have similar landforms, including broad domes, coronae and tesserae. The similarities between Io and Venus in volcanic style and pervasiveness are striking, though tectonically different. Mars closely resembles Venus in its most volcanically and tectonically active provinces, Tharsis and Elysium. The implication for Venus is that the volcanic and particularly tectonic styles resemble Mars rather than Earth. Mars cooled while Venus remained active, but the style of both is that of a horizontally static, not mobile, crust. Thus, plate tectonics is not indicated for Venus (cf. 13, 14). The implication for Mars is that water need not be invoked to explain the Olympus Mons aureole (e.g. 15) or the theatre-headed valleys around Hellas, Elysium Mons and elsewhere (e.g. 16) which resemble 'Gumby' on Venus. Water may modify or help lubricate the processes responsible for these features on Mars but need not be considered essential. For Io this study predicts that Galileo may observe Beta Regio-style medial rifting in the large domed uplands of ref. 12 and that coronae and tesserae may be widespread on Io.

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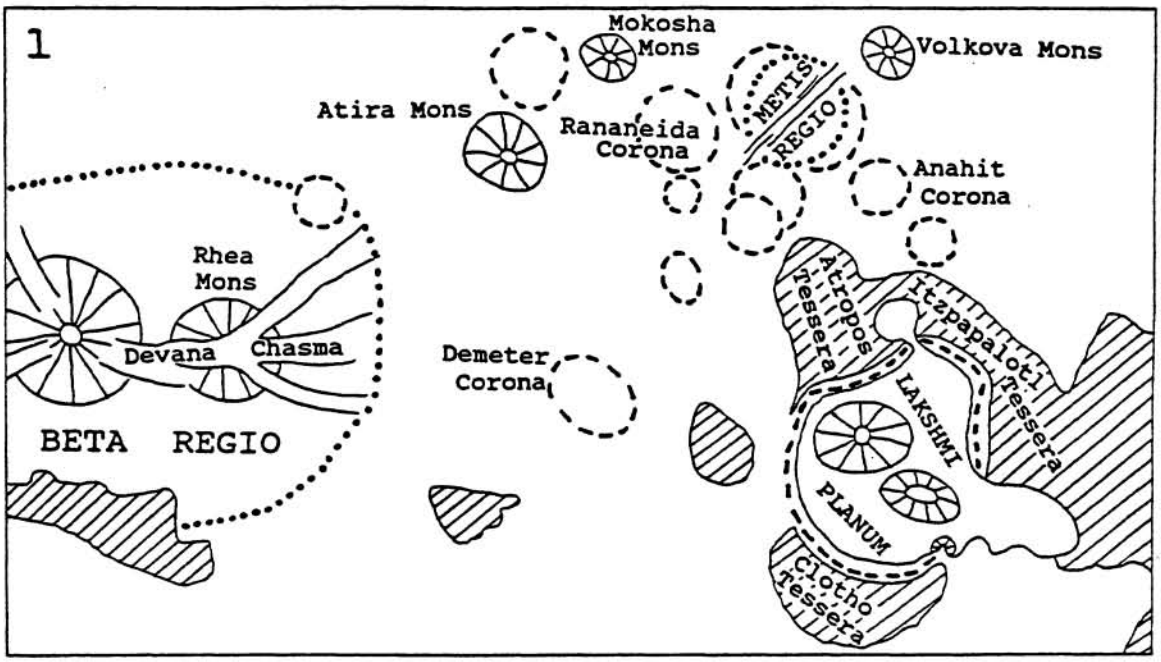
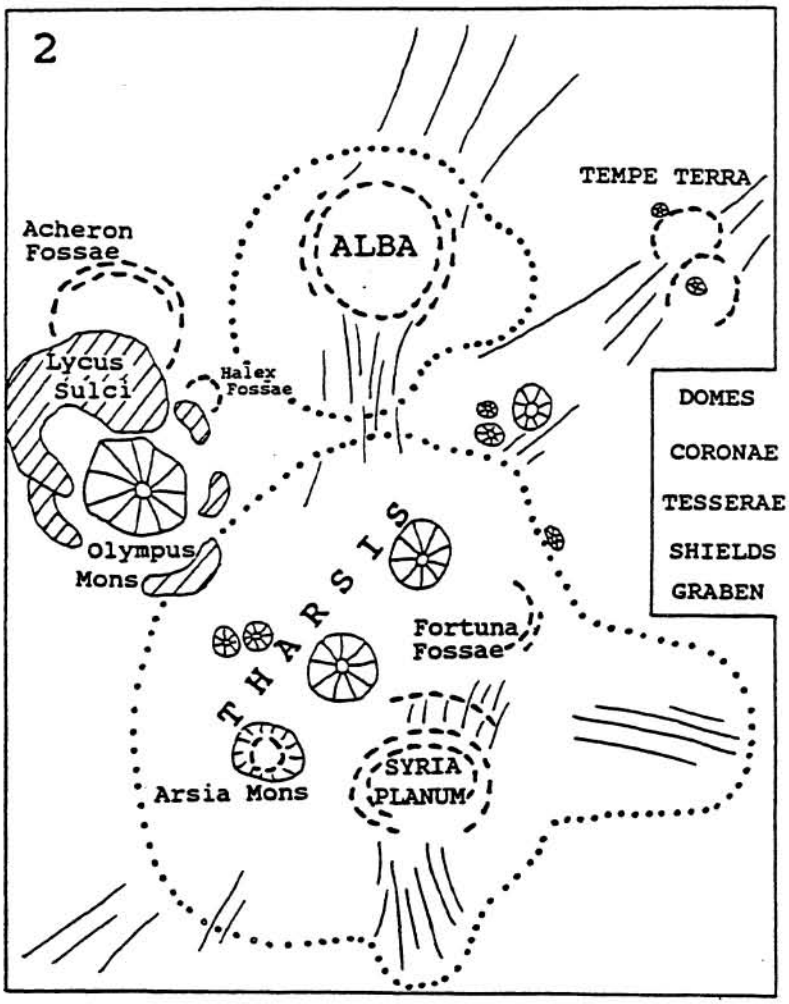
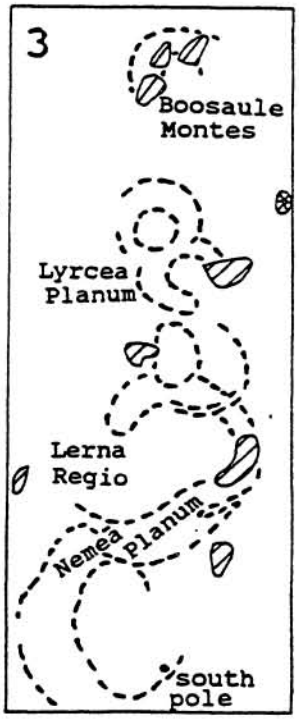
VENUS, MARS, IO COMPARISON; Stooke, P.J.







0 2000

Common Scale (km)

Fig. 1: Venus

Fig. 2: Mars

Fig. 3: Io