EVIDENCE FOR COLLISIONAL TECTONICS AT TELLUS REGIO TESSERA, VENUS;
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The ongoing study of Venus utilizing Magellan data has served to stress the importance of
tessera terrain in the history of the planet. Mapping analyses have show that in the vast majority of
cases tesserae are stratigraphically older than the widespread volcanic plains, however the
distribution of craters on tesserae yield a surface age that is statistically indistinguishable from the
average age of the planet of approximately 300 Ma [1,2,3]. Students of Venus are forced to
reconcile these observations that seem to require a Venus that went from a planet capable of
producing the heavily deformed tessera highlands to a planet that erupted volcanic plains over the
majority (>80%) of her surface within a time that is short relative to the cratering rate. Thus the
structures in the tesserae and their relationship to adjoining plains are the most detailed record
available of the events that took place during this era of global resurfacing. Additionally, although
the morphology of the terrains from the first 80-90% of the lifetime of Venus was destroyed in this
300 Ma global resurfacing event, rocks from these terrains are certainly included in the tesserae
[4,5]. Detailed study of the tesserae is required to address the many unanswered questions about
the formation, evolution and distribution of tesserae and their role in the geologic evolution of
Venus.

Previous studies of tessera terrain have shown there to be similarities in the types and
stratigraphy of structures within individual plateaus. Tessera comprise early compressional
features in the form of ridges and troughs (Phase I deformation) that are superposed by one or
more episodes of extensional (Phase II) deformation, which is in many cases pervasive [5-10].
Intratessera plains generally postdate, but may be contemporaneous with, Phase II deformation
broad (10-20 km width) ridges and troughs that are parallel to the margin, often cut orthogonally
by sets of troughs or graben. This marginal ridge and trough terrain corresponds to the highest
elevations in Alpha [12] and Tellus [10]. Interior to such margins are the more irregular structures
dubbed as interior block [8], or disrupted terrain [12] characterized by raised blocks 15-75 km
across separated by curvilinear troughs. There is qualitative morphological evidence that addition
of sets of extensional structures can convert ridge and trough terrain to disrupted terrain [5,9], an
observation that has been cited in Ovda as evidence of episodic construction of the plateau by
accretion of peripheral fold and thrust belts onto an older interior plateau core [13]. It is unclear
from these studies how to differentiate between a scenario where tessera are formed in one event
producing trough and ridge terrain that is modified from the interior, and one where different
tessera regions represent accreted terrains separated in space and time. To address this problem,
we have looked for evidence of collisional tectonics at another plateau highland: Tellus Regio.

We have undertaken preliminary analysis of the southwest border of Tellus Regio, where we
have identified an indenter (Fig. 1, outlined in dots) of tessera terrain approximately 1000 km² in
extent. The boundary between this indenter and the interior of Tellus is marked by a ridge belt
(Fig. 1,black arrows), where the orientations of the ridges mimic the edge of the indenter. The
presence of these ridges indicates compression, where the indenter and the interior of Tellus moved
closer relative to one another along a NE-SW azimuth. What is striking about this tectonic
configuration is that structures within the interior of Tellus are affected by the presence of the
indenter. Where the indenter and the interior make the closest contact (Fig. 1, boxed area), the
trend of the intervening ridges is 300°. The ridges and troughs of the tessera interior have an
average azimuth of 282+50° from the boundary for r ≈ 1000 km [10]. With increasing
distance from the boundary, interior structure orientation deviates from 300°. A set of graben (Fig.
1, white arrows) trending normal to the indenter border emanates from near the indenter, across
the ridge belt and into the tessera interior and is perhaps the last strain indicator associated with this
collisional event as the graben predate only intratessera volcanism.

We assume that the tessera terrain was formed during a compressive event, from downwelling
of the mantle. We cannot distinguish the absolute positions of the indenter and the Tellus interior,
we can only say that they were relatively further apart at one time. However, the ridges and
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troughs of the interior trending $= 300^\circ$ suggest that the interior of Tellus responded in a ductile manner to the stresses of a collisional event with a rigid indenter, where the primary evidence that the indenter behaved as a rigid block is that its compressional structures do not conform to the indenter-interior margin. The compressional deformation that formed the structures of the indenter occurred prior to the collision of the indenter into Tellus' interior and at the time of collision, the indenter was cool enough to behave rigidly. While there is no coherence in the structural trends from the indenter to the interior, we cannot distinguish whether the indenter and the interior were part of a contiguous piece of tessera that was shortened during a compressive event or pieces of tessera separated in space and time that were accreted.

**Figure 1.** Magellan SAR image (Cycle 1) of SW portion of Tellus Regio centered $= 320^\circ N, 78^\circ E$. Image is $= 750$ km across; north is at the top of the image. Symbols described in text.