MULTIPLE TECTONIC AND VOLCANIC EVENTS: GINA CRATER AREA, VENUS

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Introduction: A current controversy in the geology of Venus centers on the age(s) of its highlands – the tesserae. One view of Venus' past is that it experienced a global resurfacing event at ~1.5 Ga, now represented mostly by volcanic plains, and that the tesserae represent earlier crust deformed in that event [1,2]. It is also argued that the resurfacing represents multiple volcanic events over long times [3,4]. The ancient age of tesserae has recently come into question [5,6]. Some tesserae include distinct morphologic units that could represent deformed plains material [5,6]; in other cases, it is possible that tesserae are forming today [7]. To address this question, we are mapping a tessera-plains transition around Gina Crater, near Venus' north pole.

Gina is a ~15 km diameter crater at 78.1°N, 76.3°E (Fig. 1), in the Snegurochka (V1) quadrangle [8]. Gina is on the western boundary of the Szél-anya Lineae belt (mapped mostly as tessera [8]), where it abuts a broad area of regional volcanic plains [9]. The area is complex, with evidence for multiple episodes of tectonism and volcanism and was specifically chosen to help constrain the timing of deformation events relative to those of volcanic emplacement.

Q: Could it be possible that some tesserae formed geologically recently?

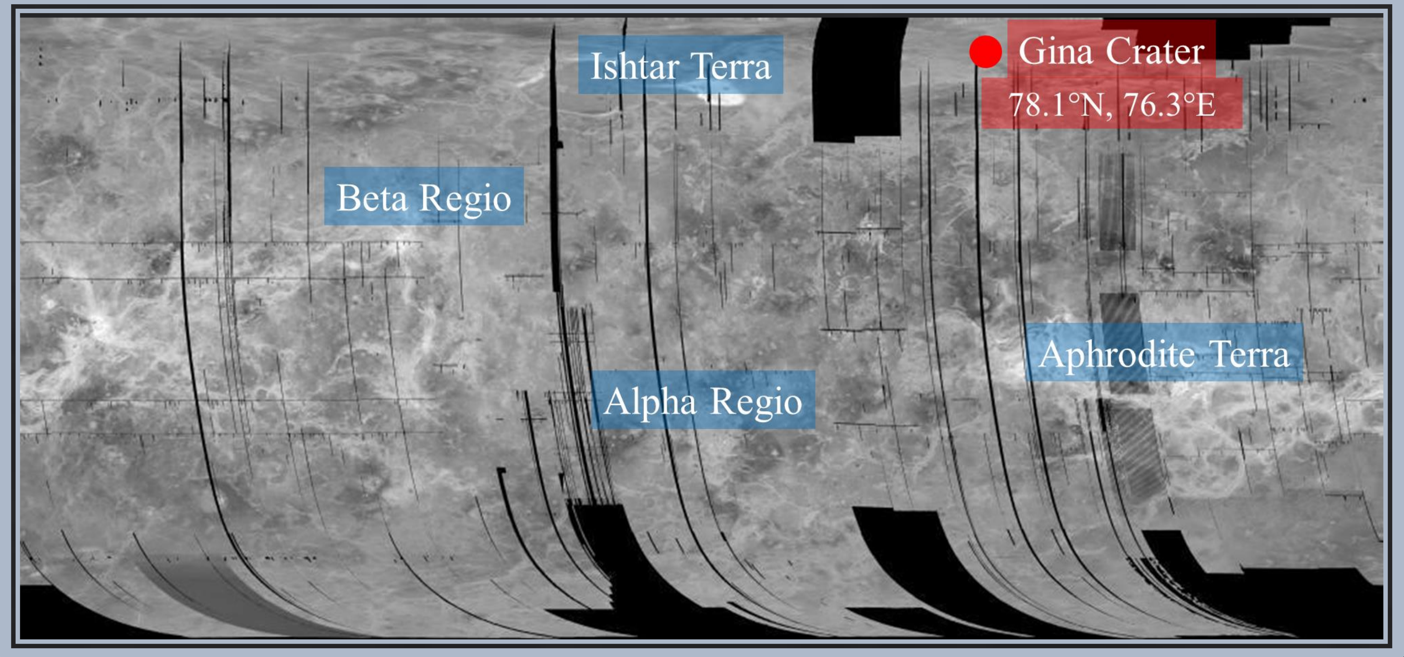
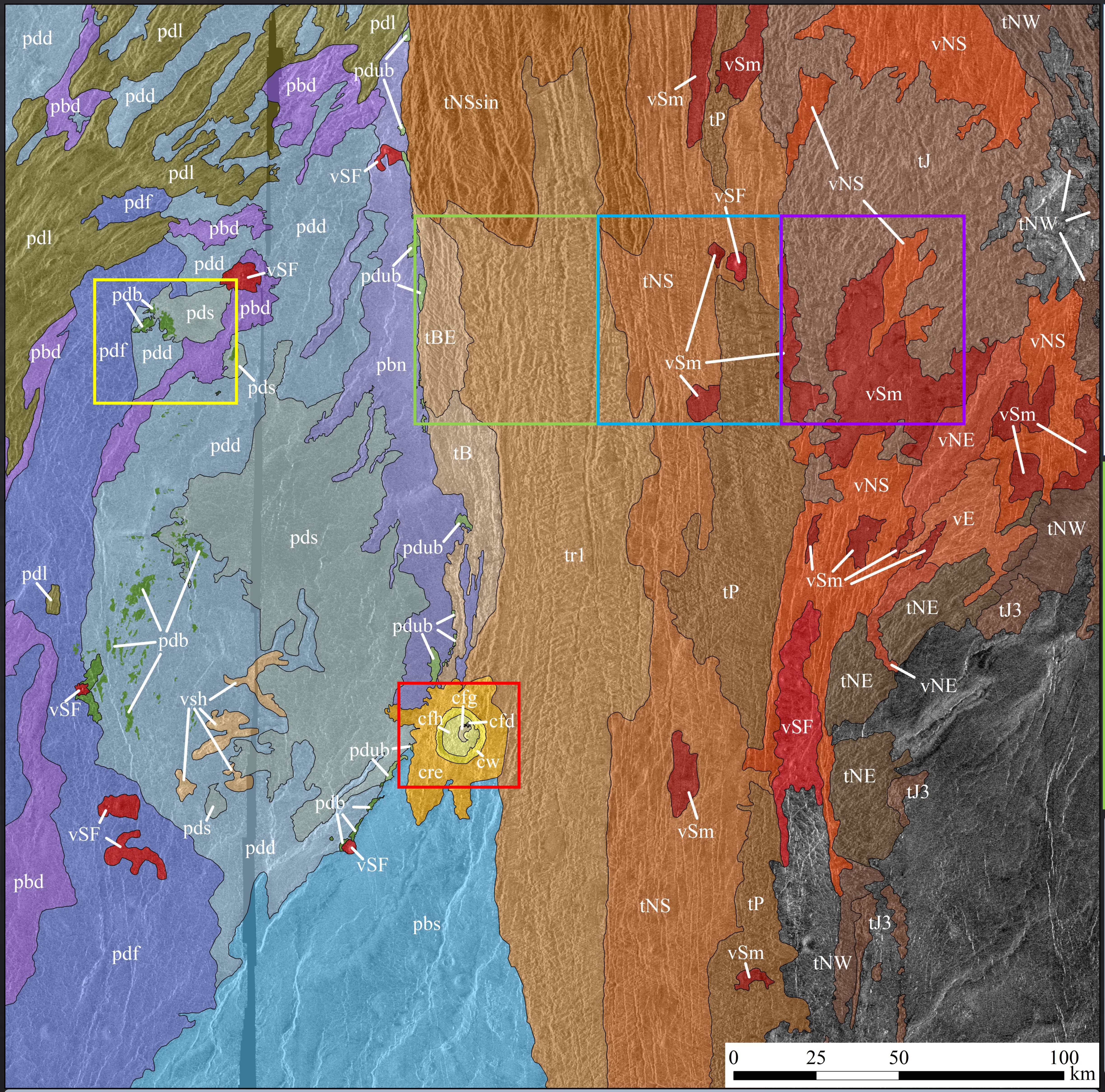


Figure 1. Location of Gina Crater at 78.1°N, 76.3°E.

Data: Magellan's SAR left-look global mosaic (~75 m/pix) was used as the basemap. ArcMap 10.6.1 was used for mapping. JMARS was used for general visualizations.

Methodology: Morphologic features are defined by shape, orientation, and SAR backscatter. Map units are defined based on differences in radar brightness, morphology, texture, and stratigraphic relations. Units are generally defined based on the radar brightness of emplaced material, but when material is obscured by deformation, the unit is instead characterized by that deformation. Contacts are defined by embayment relationships, radar brightness, deformation morphology, and the density of fractures.



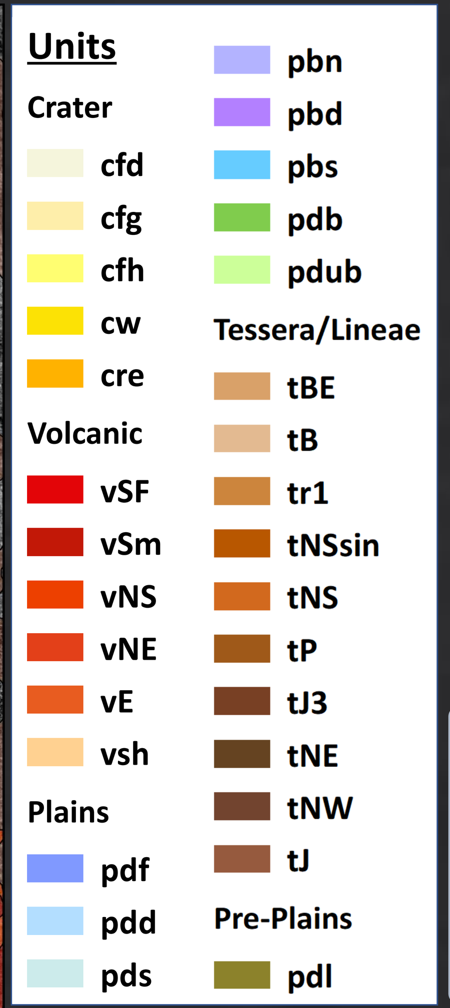


Figure 2. Geologic map of Gina Crater and its surroundings. Mercator projection centered at Gina. North is up. Colored boxes show locations of panels in figures 3 and 4.

Discussion: The fold belt (pdl) is the oldest feature, pre-dating all the plains units; it is truncated by the tessera/Lineae (tNSsin), cut by fractures of several orientations, and embayed by plains units (pdd, pdf, pbd). The tessera/Lineae record at least three distinct deformation fabrics (the dominant N-S fabric matches the Szél-anya Lineae) and has evidence for alternating episodes of volcanism and deformation (Fig. 4A-C). The plains have been deformed in multiple events (Fig. 3B) and are inferred to be basaltic, without detectable vents. Gina Crater post-dates the emplacement of the plains and pre-dates some of the E-W compression of the tessera/Lineae (Fig. 3A).

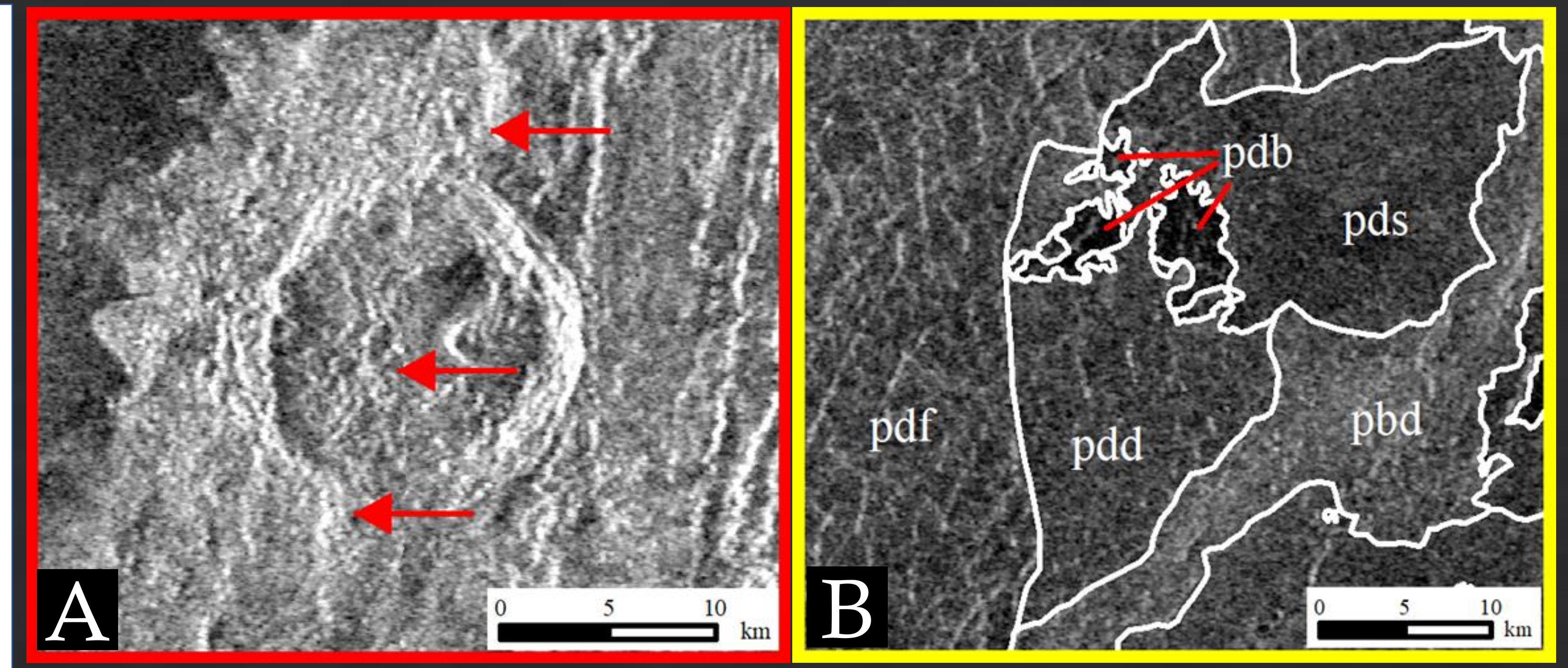


Figure 3. (A) Deformed Gina Crater with tessera/Lineae. Arrows indicate tectonic fabric trending N-S. Ejecta lobes to the east are indistinct. **(B)** Adjacent plains units exhibiting a range of radar backscatters and fracture densities indicating different degrees of deformation.

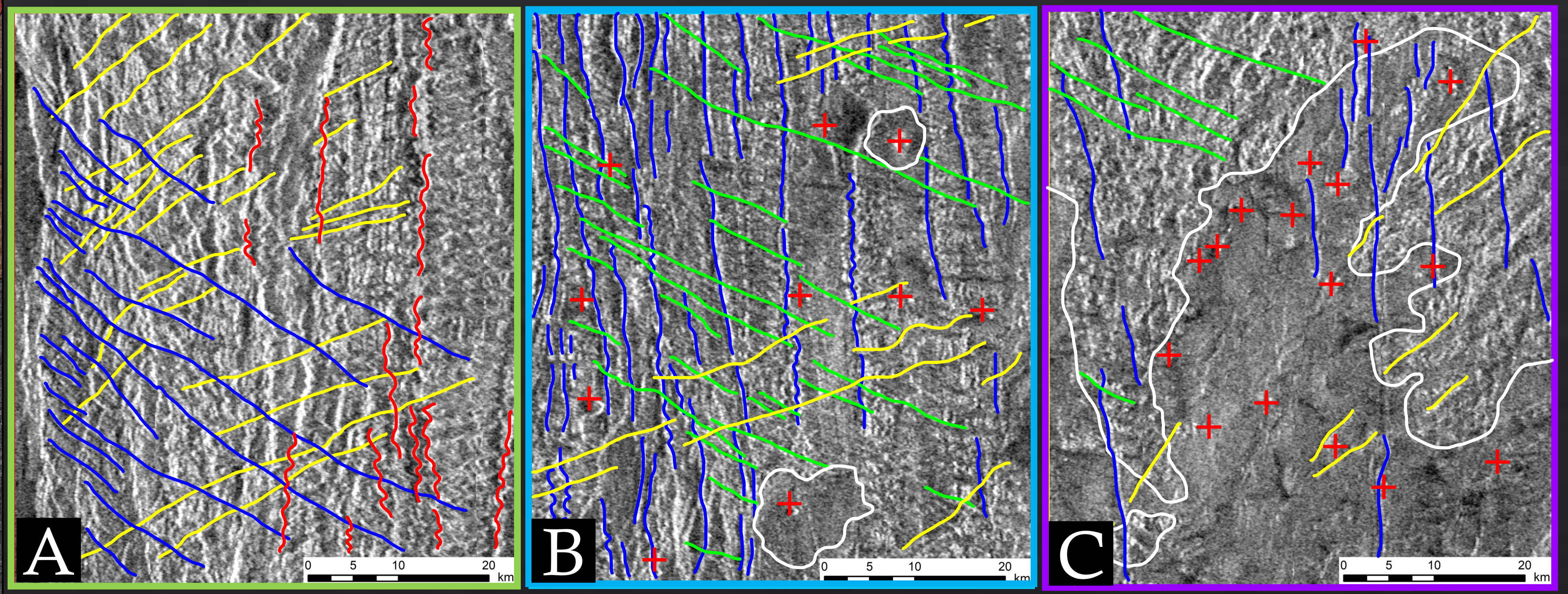


Figure 4. Transect across the tessera/Lineae units. **(A)** No definitive volcanics. Irregular (zig-zagged) N-S deformation structures. Extensional features on the western boundary trend NW-SE. Total of three deformation fabrics: N-S (dominant), NE-SW, and NW-SE. **(B)** Underlying tessera/Lineae embayed by volcanic flows with subsequent deformation. Undisturbed volcanoes/vents and flows, implying that there was volcanism, followed by stages of deformation, and volcanism again. Dominant N-S deformation fabric; others trend NE-SW and some NW-SE. **(C)** Oldest tessera unit is embayed by volcanism; volcanic vents are indicated by red crosses. The NW-SE deformation fabric is restricted to the tessera, whereas the N-S and NE-SW fabrics are also found in the lava flows.

Conclusions: The history of the plains and lineae/tessera are difficult to link but have their interaction with Gina in common. Gina post-dates emplacement of the plains but impacted into the deformed highlands and is slightly deformed itself, parallel to the fabric of the lineae. All of this suggests that the tessera formed in multiple episodes of deformation while ongoing volcanism emplaced neighboring units. This interpretation is specific for the Gina Crater area and may not be applicable to all tesserae.

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References: References are the same as the published abstract.