FORMATION AND MODIFICATION AGES OF SOME STEEP-SIDED DOMES ON VENUS; Nathan T. Bridges and George E. McGill, Department of Geosciences, University of Massachusetts, Amherst, MA 01003.

Large, steep-sided domes are among the most enigmatic features on Venus. Their origin is controversial, and numerous models considering both emplacement mechanisms and compositions have been proposed (1-9). An understanding of their stratigraphic positions relative to other geologic units and structures is critical. Age relationships between domes and surrounding plains materials and structures are commonly complex. However, we find that most of the steep-sided domes examined in this study formed before or during structural modification of the surrounding plains.

Geologic mapping of the Sappho Patera (V20) and Kaiwan Fluctus (V44) quadrangles on Venus was undertaken in part to better understand the origin and evolution of steep-sided domes. Both regions are well suited for this analysis. Two of the domes in Carmenta Farra in V20 are the largest on the planet. V44 has more domes than any other quadrangle, seven of which form the classic assemblage Seoritsu Farra.

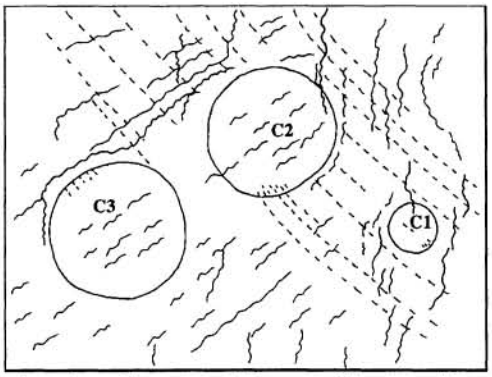

Fig. 1: Carmenta Farra. Sinuous lines wrinkle ridges; dashed lines linears concentric to Nehalennia Corona.

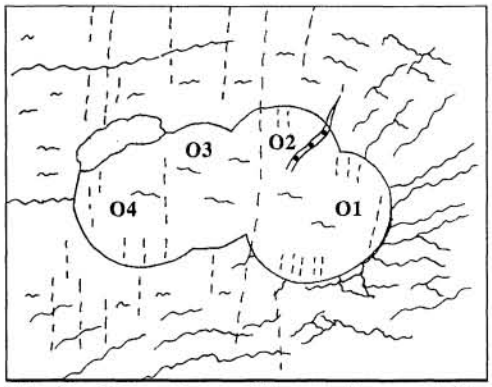

Fig. 2: Oshun Farra. Sinuous lines wrinkle ridges; dashed lines linears related to coronae Belet-ili and Gaia; line pair with balls a graben; landslide deposit stippled.

V20: Carmenta Farra consists of three domes, labeled here C1 (12.1° N, 9° E; 20.6 km diameter), C2 (12.5° N, 8.4° E; 58 km), and C3 (12.1° N, 7.5° E; 62 km) (Fig. 1). Two intersecting sets of wrinkle ridges are present in the region. A NE-SW set is circumferential to the young volcanic constructs of Sungmo and Irnini Montes to the east of Carmenta Farra, and thus inferred to be associated with the early stages of shield development (10). Wrinkle ridges on the tops of C2 and C3 are parallel to this set, and at least one wrinkle ridge appears to extend from the plains onto the SW flank of C2. A N-S set of wrinkle ridges occurs in the eastern part of the area in Fig. 1, and members of this set appear to extend from the plains onto the northern flanks of C1 and C2.

All three domes show peripheral lineations and pit chains parallel to a set of linears concentric to the corona Nehalennia, NE of Carmenta Farra. The wrinkle-ridge sets and the linears concentric to Nehalennia are truncated by the youngest lava flows derived from the shields Sungmo and Irnini Montes. Therefore, the domes of Carmenta Farra appear to be older than the young shield volcanoes and also older than at least some corona-related structures. This suggests that they formed during or shortly after the emplacement of the global regional plains here represented by the ridged plains surrounding the domes.

Oshun Farra consists of four overlapping domes centered at 4.2° N, 19° E. The domes are labeled O1-O4 from east to west (Fig. 2). The cluster has a total length of 85 km. Several sets of wrinkle ridges deform the adjacent plains. The regionally oldest (10) ~E-W trending set appears to be deflected by O1. In addition, linears that are both radial to the corona Belet-ili to the north and concentric to the corona Gaia to the east cut the domes, and one long linear clearly extends from the plains through dome O2 (Fig. 2). These relationships indicate that Oshun Farra formed prior to the earliest wrinkle ridges and prior to at least some structures related to the adjacent coronae.

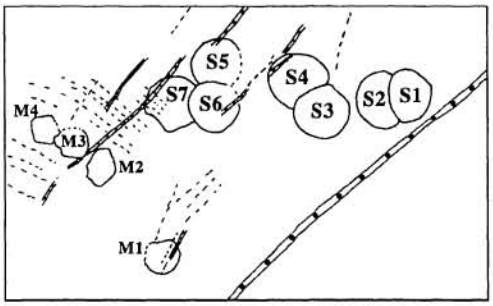

Fig. 3: Seoritsu Farra and modified domes. Dashed lines linears; line pairs with balls grabens. Dome boundaries dotted where uncertain.

V44: Seoritsu Farra consists of seven domes (S1-S7 from east to west) centered at 29.7° S, 11.9° E (Fig. 3). Diameters range from 22.5 to 25.3 km. The domes are arranged in three overlapping sets: S1-S2, S3-S4, and S5-S6-S7. NE-SW trending grabens cross-cut the plains and S5-7. A graben atop S4 is confined to the dome but has the same orientation as the plains grabens, indicating that it may have formed in the same stress regime. Four, ~ 15 km diameter, modified domes or dome-like structures lie to the west of Seoritsu. They are here labeled M1-M4 from SE to NW. M3 and M4 overlap. The modified domes truncate some NE-SW grabens; M3 truncates the one that cuts S7. Thus M3, although extensively modified, is younger than S7 and perhaps all of Seoritsu Farra. M1, however, is cut by a graben of the same orientation. Thus, Seoritsu Farra formed before and the modified domes formed during or after regional NW-SE extension.

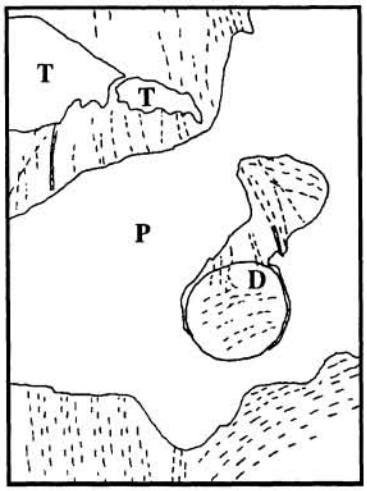

Fig. 4: Dome and adjacent lobe SE of Alpha Regio. Dashed lines linears; line pairs grabens.

Approximately 200 km south of the modified domes, at 32.0° S, 10.5° E, is a 36 km diameter dome (D, Fig. 4). It is 80 km SSE of Alpha Regio tessera (T). The dome's northern edge abuts a lobate, radar-bright, surface. Structures on the dome and lobe are truncated by adjacent radar-dark plains (P). Approximately N-S trending linears and grabens on the northern textured plains adjacent to the tessera and on the lobe indicate these may have been continuous before being embayed by the radar-dark plains. Some linears on the lobe extend onto the dome, indicating that both underwent the same deformation as the northern textured plains. An ENE-WSW set of linears on the dome and southern textured plains suggest that the dome existed prior to this deformational episode as well. Thus the sequence here is: 1) formation of the radar-bright plains and the dome, 2) deformation, and 3) embayment by radar-dark lavas.

Conclusions: The observations reported here show that most steep-sided domes were modified at the same time as adjacent or nearby plains. In some cases, domes are embayed by local flows. Thus, most domes appear to be relatively old. However, a few domes may be younger than structures cutting the surrounding plains, indicating more than one episode of dome formation. Preliminary examination of other areas on Venus indicates that this also is true elsewhere. Thus most domes are related to plains emplacement rather than the extrusion of young volcanics, an observation that should be considered when developing genetic models.

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