

**COLETTE AND SACAJAWEA: CHARACTERIZATION, COMPARISON, AND INTERPRETATION OF MAJOR CALDERA STRUCTURES ON LAKSHMI PLANUM; Kari P. Magee, James W. Head, Dept. of Geological Sciences, Brown University, Providence, R. I. 02912**

**Introduction:** Altimetry and images of Ishtar Terra have revealed the presence of two very large oval-shaped features, Colette and Sacajawea Patera, which dominate the surface of Lakshmi Planum and have been interpreted to be the calderas of giant shield volcanoes.<sup>1-4</sup> The purpose of this study is to characterize these features in detail and to assess the conditions of caldera formation and evolution on Lakshmi Planum.

**Description and Interpretation:** Colette Patera in west-central Lakshmi (323°O, 66°N) is the most distinctive of the two calderas (Fig. 1a), is elongate (130 x 180 km) in a N-S direction, has a rim that rises less than 2 km above the surrounding plain, and is estimated to be 1-3 km deep.<sup>5</sup> Colette is surrounded by an extensive radial system of lobate, radar-bright flows 100-300 km long that have an average width of 15 km. The structure of the caldera is characterized by a very complex system of semiconcentric ridges and grooves most of which we interpret to represent terraced and tilted fault scarps stepping down into the crater interior. These features define two components, an oval-shaped inner caldera (~100 x 120 km and oriented N20°W), and a triangular-shaped outer caldera (the sides of the triangle are about 200 km in length and are oriented parallel to major structural lineations in the plains and surrounding mountains). The two calderas share their western wall. The floor of the inner caldera (~40 x 80 km) appears smooth and may be slightly convex. On the southern part of the inner caldera floor is a diffuse semicircular radar-dark feature which has been interpreted to be a smooth area or one covered with loose material.<sup>3</sup> Just to the south are two volcanic domes (10-15 km in diameter) aligned parallel to a line of smaller domes (E-SE) exterior to the caldera. Numerous other small cones are scattered about the caldera floor and among the surrounding ridges.

**Sacajawea Patera** in east-central Lakshmi (336°O, 66°N) is much less distinctive in appearance than Colette, is elongated (200 x 120 km) in a NE-SW direction, and is estimated to be 1.5 km deep.<sup>3</sup> Sacajawea lacks an obviously complex caldera structure and an extensive system of radiating flow deposits. The caldera is loosely defined by a pair of semiconcentric, very diffuse bright and dark bands which may represent a degraded complex of terraced fault scarps similar to those in Colette. Concentric to the NE and SW end of the caldera are numerous faint radar-bright lineations, only some of which are easily distinguished as ridges and grooves. Adjoining Sacajawea to the SE is a system of linear fault scarps interpreted to be graben.<sup>3</sup> Within one of these graben we have identified a volcanic dome (15 km diam.) containing a central pit. The concurrence of these two features may indicate the presence of a flanking rift zone similar to those occurring in Hawaii. Scattered about the periphery of Sacajawea are numerous small cones and domes (1-30 km diam.).

**Conclusions:** 1) **Dimensions:** The very large size of Colette and Sacajawea (>100 km) make them distinctive both on Venus and on the other terrestrial planets, including the Earth.<sup>6,7</sup> There is evidence that caldera diameter may be approximately equal to the diameter of high-level magma reservoirs,<sup>8</sup> and possibly their depth.<sup>9</sup> We are presently studying the relationship of edifice volumes, caldera volumes, and type and distribution of faulting to assess whether the caldera structures represent deep or shallow magma reservoirs.<sup>7</sup> 2) **Shape and Orientation:** These features are less complex than the calderas with multiple-arcuate-scarped walls seen in Hawaii and on Mars. Their walls are also oriented parallel to major structural trends within the Planum and surrounding mountain belts. 3) **Style:** The size and characteristics of the flows surrounding Colette strongly suggest the continuous outpouring of fluid lavas at high mass flux, suggesting a basaltic composition for the lavas,<sup>7</sup> consistent with the broad low shape of the surrounding shields. The Diffuse Halo deposits mapped on the southern slopes of the Colette shield may represent pyroclastic activity<sup>10</sup> and the possibility of volatile enhancement and/or different composition magmas. 4) **Relative Age:** On the basis of the relative freshness of the caldera and surrounding deposits, and superposition relationships, Colette is interpreted to be younger than Sacajawea. 5) **Tectonic Environment and its Significance:** As described elsewhere,<sup>10</sup> these calderas occur within Lakshmi Planum which is in an environment of compressional deformation, crustal convergence, and crustal thickening. We are presently investigating models for the formation and evolution of these structures which assess the possibility that their large size is linked to melting associated with crustal thickening of several tens of km.

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**Fig. 1. a)** Venera 15/16 mosaic of Colette Patera and environment. Width of image is 520 km.  
**b)** Structural sketch map. Solid lines—ridges/scarps; dotted lines—grooves; dashed and dotted lines—unclassified lineaments.

**Fig. 2. a)** Venera 15/16 mosaic of Sacajawea Patera and environment. Width of image is 470 km.  
**b)** Structural sketch map. Solid lines—ridges; dotted lines—unclassified lineaments; dashed and dotted lines—uncertain caldera boundary; lines hachured on one side—scarps; lines hachured on both sides—grooves

