tribution of isolated, ragged scarps/massifs west of the basin may represent the predicted separation of lithospheric blocks along concentric faults. East of the basin, the Hellas knobby terrains display disruption and rectilinear faulting on a broader scale but are confined to a roughly circular region. This concentration of observed disruption and its circular outline may reflect a localized extension of the region of enhanced deformation into lithosphere overlying a pre–Hellas impact basin. The local reduction in asthenospheric viscosity from residual impact heating and mantle uplift would allow greater response to the hydrostatic gradient into the Hellas cavity, which would enhance the surface deformation.

The absence of distant concentric canyons around Isidis is now attributed to the smaller size of the impact. The Isidis basin is just small enough that the region of plastic flow need not extend past the basin scarp. If we assume that the Isidis basin scarp marks the outer limit of plastic deformation, the inversion of a 5:1 cavity aspect ratio with a 100–km thick lithosphere (equivalent to the inversion for Hellas) requires a transient cavity radius of ~350 km (Figure 17). Since the massif ring radius of Isidis is just over two–thirds that of the Hellas massif ring, this is consistent with the derived Hellas transient cavity of about 550 km radius and the same aspect ratio. Alternatively, for a cavity aspect ratio of 20:1, the maximum transient cavity depth is only 60 km. In this case, canyon formation is precluded around Isidis because this depth is of the order of the predicted lithospheric thicknesses. In either case, formation of large canyon systems outside the Isidis basin scarp is unlikely. Deformation should be more intense, however, inside the basin scarp in the case of a 5:1 transient cavity aspect ratio.

Basin Volcanism and the Rim Plana

Although lithospheric flexure or impact equilibration mechanisms can account for the massif ring graben, the distant Hellas–concentric canyon system, and the radial troughs, these processes do not completely account for the observed basin volcanism. In particular, the offset of both rim plana to the basin edge is inconsistent with the axial symmetry implicit in the mechanisms described thus far. Further, tectonic processes cannot directly produce the offset heat sources needed for extended volcanism.

The most striking feature of the observed basin volcanism in Isidis and Hellas is the correlation in age of the youngest volcanic units in both basins. In Isidis, all the dated volcanism falls into a narrow age span that correlates with the surface age of SMP. In Hellas, although MP and Tyrrhena Patera have older ages, Hadriaca Patera and the intercrater plains west of MP also possess ages similar to SMP (Figure 9). Since the most recent volcanic events are partly represented by volcanic units of low volume like the volcanic cones north of Isidis and small intercrater plains units, a brief pulse of volcanism in both basins appears to coincide with final volcanism in SMP. This common pulse of volcanism, combined with the absence of later basin tectonism, is suggestive of a global change in thermal or stress conditions, possibly related to planetary expansion/contraction as has been proposed for the Moon [*Solomon and Head*, 1979; 1980]. The common age of the basin massif ring graben at a slightly earlier time than final planum surfacing also supports such an interpretation.

Basin volcanism on Mars, therefore, has a finite lifetime restricted to the earliest phase of planetary history and, in this respect, resembles the basin sequences of mare volcanism on the Moon. Moreover, since MP and SMP represent the majority of volcanism observed in their respective basins, the difference in their ages indicates an earlier decline of volcanism in Hellas than Isidis, possibly related to the difference in basin ages. Nevertheless, despite an additional similarity in size and thickness to the lunar mare units, the rim plana differ strongly in structure and regional setting from the volcanic sequences observed on the Moon. While the lunar mare are largely contained within their respective basins [*Wilhelms*, 1987], the rim plana are offset to one side of the basin with surface elevations 4–5 km above the present basin floor. While mare units are primarily interpreted as the result of fissure eruptions [*Basaltic Volcanism Study Project*, 1981], the rim plana appear to be low–relief volcanic constructs with central caldera structures [*Schaber*, 1982]. Finally, while the lunar mare appear to have several source vents distributed along the basin edge [*Guest and Murray*, 1976; *Boyce and Johnson*, 1978], the rim plana seem to be concentrated about a single source region on the basin periphery.

The temporal and spatial association of the rim plana with the massif ring graben indicates that flexure in response to central basin filling probably influenced the radial distance of planum volcanism from the basin center. Some other mechanism, however, appears to control the location of rim planum formation: The rim plana of both Isidis and Hellas are located west of their respective basins at the south end of the observable massif ring graben.

There are several mechanisms that could account for a concentration of volcanism on the basin periphery. First, the superposition of impact heating and lithospheric fracture associated with two overlapping basin impacts could create a region, offset from the center of the younger basin, more susceptible to volcanism than other areas around the basin rim. Second, *Schultz* [1984] proposed that volcanism is concentrated in regions where the basin–concentric and basin–radial deformation trends associated with different basins reinforce each other. Finally, volcanism outside the massif ring could result from movement of an impact–induced thermal anomaly beneath the lithosphere during the global reorientation following basin formation [*Wichman and Schultz*, 1988*a*]. The details and constraints of these different mechanisms relative to rim planum formation will be explored in a separate contribution, but several brief comments should be