GLOBAL RELATIONSHIPS BETWEEN VOLCANIC VENTS AND FRACTURES RADIAL TO LARGE IMPACT BASINS ON MARS.

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The relation of volcanic vents on Mars to impact basins has been studied previously (1,2,3,4,5,6). It has been asserted that the concentric fractures around impact basins extend into the crust and might localize some features, including volcanoes (e.g. 4). In this study, we assess the possibility of radial fractures inferred to be associated with impact basins as an additional control on the location of volcanoes on Mars. Geologic mapping at 1:2 million scale enabled 250 central vents and fissure vents to be identified. Patterns of vent distribution (fig. 1) superimposed on a globe show that most are located on three distinct circles. The first is a great circle which passes through Arsia Mons, Pavonus Mons , Ascreaus Mons, and Tempe Fossae, along Protonilus Mensae (an area of fractured terrain), through Syrtis Major, Hadriaca Patera, and a series of fissure vents southwest of Tharsis. A similar great circle trends SW to NE from the Hellas basin, through Hadriaca Patera, Tyrhenna Patera, Elysium, Alba Patera (which is approximately antipodal to the Hellas basin), southern Tempe Fossae, the eastern Valles Marineris chaotic region, and the Amphitrites Patera vents on the southwest rim of the Hellas basin. The third series of vents is on a small circle ~4800 km in diameter centered at ~ 104°W, 2°N. This site is near the center of the Tharsis gravity anomaly (7) and the loci of associated tensile stresses (8). Most fissure vents not located on the Tharsis trend of volcanics are on this small circle, as are Alba Patera and other central vents.

There are two more possible great circles which may be superimposed onto the martian globe. The first can be traced along the escarpment dividing the northern lowlands from the southern highlands, across Isidis Planitia (the site of a possible impact basin at ~ (273°W, 13°N), fractured terrain in Solus Planum (a possible fissure vent source area), and through Juventae Chasma. This circle may reflect the role of inferred radial fractures in modifying the surface without associated volcanism. The second possible great circle passes through the Hellas impact basin, some large unnamed central vent volcanoes (at ~ 205°W, 48°S) , Apollonaris Patera, the escarpment north of Alba Patera and the Tempe Fossae region, and into Acidalia Planitia. Acidalia Planitia is also along the trend of the Tharsis chain of volcanoes and may indicate an impact site centered near 30°W, 60°N.

VOLCANIC VENTS AND FRACTURES RADIAL TO IMPACT BASINS

Schneid,B.D. and Greeley,R.

Although concentric fractures of smaller impact basins may influence local vent sites, the global setting appears to be governed by radial fractures associated with major impact basins. This is supported by the association of one or perhaps two great circles with the Hellas impact basin, and possible great circles associated with the Isidis basin and Acidalia Planitia. The distribution also suggests that larger impacts produce larger fractures and can, therefore, accommodate more
volcanic vents. Isidis, Argyre, Procellarum, and Hellas basins in that order, have an increasing number of vents inferred to be associated with them.

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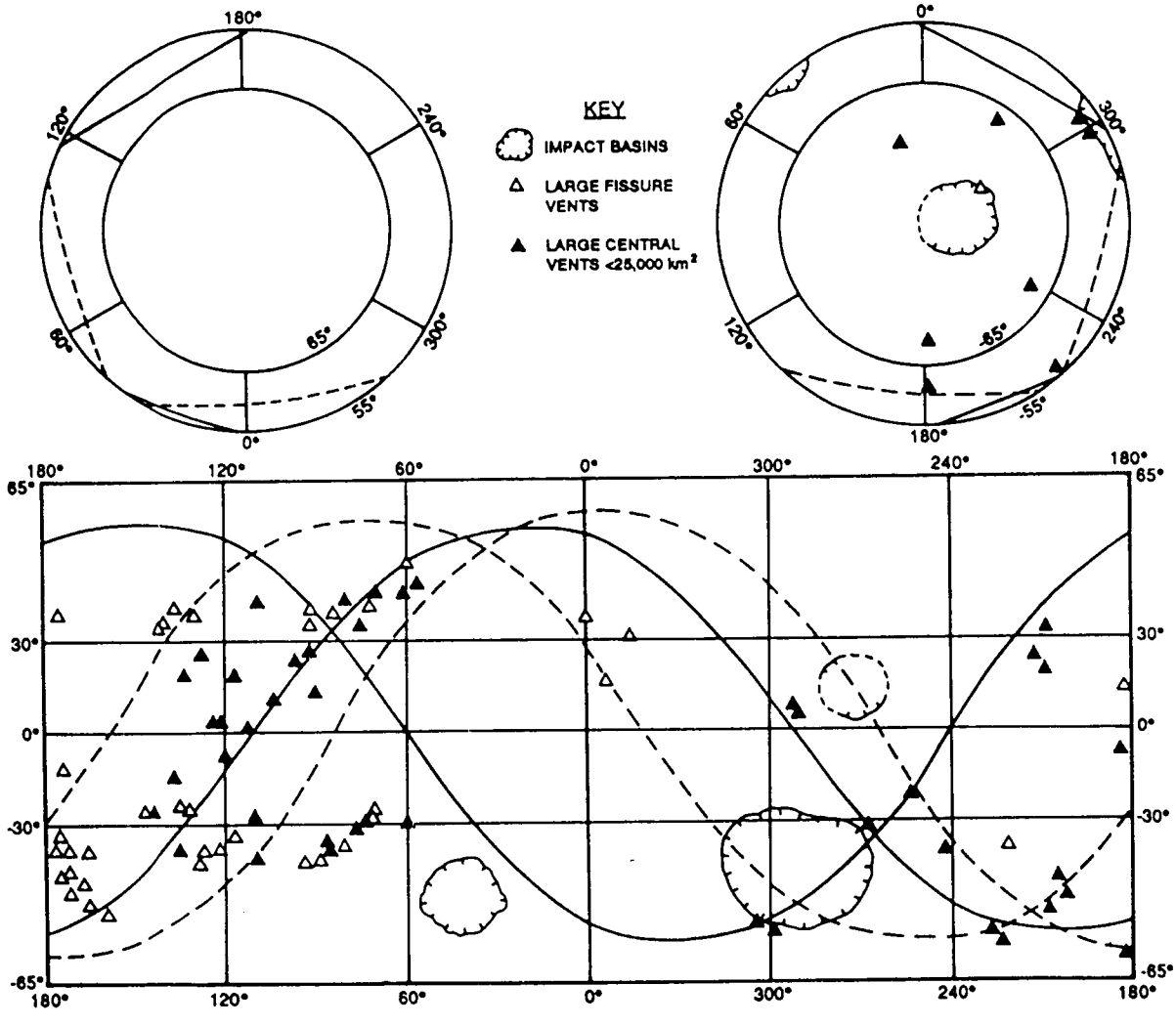

Diagram illustrating mercator projection of great circles and selected volcanic vents on Mars.