

The Case for Catastrophic Global Resurfacing of Venus

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The Magellan images of Venus began to provide evidence for a major puzzle after only a small part of the globe had been mapped. Previous images from Soviet Venera 15/16 and Arecibo appeared to show a broad range of crater ejecta characteristics, interpreted as a range of ages. After only about 10% into the Magellan mapping it appeared that nearly all the crater ejecta fields were unmodified except for a few that were clearly embayed by volcanic flows or in zones of faults and fractures. An early speculation was that if the entire planet had craters similar to those on the first small mapped area, modifying geologic processes must be extremely slow, or we were seeing a relatively young population. Further, no relative ages could be readily deduced based on crater morphology or other radar properties. After complete mapping, not only was the first sample of craters seen to be representative of the rest, but all the craters appeared to be randomly distributed. Other key observations include the fact that we see no "ghost" craters on the Venusian plains, as we do on the plains of the Moon and Mars. The so-called tessera, or highlands of Venus, do not have a demonstrably different crater population than do the plains. Nearly all modified craters are found near volcanic regions of different style than the background plains - shields and well defined flow fields, or they are in relatively recent zones of intense fracturing. Finally, certain characteristics of the plains suggest that they were, at least regionally, emplaced over short periods of time and had uniform characteristics over regions thousands of km in extent, much more extensive than equilibrium models require to account for the few flooded craters.

The simplest explanation for these observations, not necessarily the only one, is that global resurfacing occurred, ending approximately 500 my ago. Resurfacing was accomplished by extensive and pervasive tectonism with a terminal phase of vast outpouring of lavas that formed the plains. Volcanism and tectonic activity diminished. Post-catastrophe volcanism was of a different style consisting of edifices and localized outpourings that constitute approximately 5% of the background plains.

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