VENUS RESURFACING – IT'S NOT JUST ABOUT THE CRATERS. R. S. Saunders, LPI, rssaunders@earthlink.net.

Venus craters have generated a lively debate over the last twenty years since Magellan provided a global map of Venus with enough resolution to determine their distribution and morphology. Initially, the least complicated explanation for the random distribution and largely unmodified appearance was that an episode of global volcanic plains formation buried all that had come before. This was variously estimated to have occurred over a geologically short period of time sometime between 300 and 700 my ago. Subsequently, it was supposed, the observed crater population formed with little modification except by local tectonism and embayment by local volcanism.

Almost immediately an alternative hypothesis was put forward suggesting that there could be an equilibrium between crater formation and their destruction by volcanic flows, resulting in a steady state crater population, parts of which could be ancient. Variations on this theme included statistical models to explain the apparent spatial randomness as containing ancient and more recent patches [1].

Neither of these models address the actual global resurfacing event. At the same time, petrologic models of how the mantle and crust might periodically overturn were put forward [2,3,4]. And geologic observations support global tectonic resurfacing, that is, tessera formation, followed by plains emplacement, upon which the existing craters formed. This was recognized explicitly but the arguments seem to have been largely ignored [5,6].

The roughly 8% of the surface underlain by higher standing tessera are everywhere stratigraphically older than adjacent plains. Qualitatively it is evident that these older, complexly ridged terranes are not ancient relative to the plains. Gilmore at al [7] find 40% more large craters on the tessera than on the plains and calculate that there may have been 30my between cessation of much of the tessera deformation and plains formation. It may be much less or we might expect to see more buried “ghost” craters on the plains. If the tessera represent the general surface beneath the plains, then the plains did not obliterate a long history of crater formation on that surface and are not much younger than the tessera.

Given these observations, the global resurfacing event was a tectonic event that obliterated all preexisting structures. Catastrophic resurfacing was not a result of the plains emplacement, although the plains have resurfaced what lies beneath them. And plains were not emplaced in small patches over a long time. There are probably a relatively small number of plains domains. Consider the canali. Baltis, nearly 7000 km long, must have been emplaced soon after the plains formed [8]. The implication is that the region of plains around Baltis is large compared to the relatively small events postulated by an equilibrium model for crater formation and burial. There are numerous canali that represent extensive plains. And then there is the crater embayment. Clearly some amount of volcanism continued after plains emplacement, although the style changed significantly. There are craters embayed by flows from volcanic centers that are scattered and more recent than the plains. This does not argue for an equilibrium model.

In summary, complicated analyses of the plains crater population are largely irrelevant to the issue of resurfacing. Resurfacing occurred prior to plains emplacement in a global tectonic event. Plains volcanism followed soon after and isolated volcanic centers were active within the plains probably up to the present.

References. [1] Phillips, R. J. et al. (1992) JGR, 97, 15923. [2] Fowler, A. C. and O'Brien, S.B.G. (1996) JGR, 101, 4755. [3] Parmentier, E. and Hess, P. (1992) GRL 19, 2015. [4] Turcotte, D.L. (1999) Icarus, 139, 49. [5] Head, J.W. et al. (1994) Planetary and Space Science, 42, 803. [6] Collins, G.C. et al. (1999) JGR Planets, 104, 24121. [7] Gilmore, M. et al. LPSC 27. Basilevsky, A.T. And Head, J.W. (1996) GRL, 23 1497.