EFFECTS DUE TO OVERLAPPING LARGE IMPACT BASINS ON MARS

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Many ancient highly degraded large impact basins exist on Mars [1,2,3]. In many cases these basins overlap or are overlapped by more easily observed, presumeably younger, impact basins. While impact basin overlap is becoming more recognized, the effects of such overlap have only occassionally been described. Such effects will depend on a variety of factors, including the absolute and relative size of the basins, the degree of overlap, the state of the lithosphere and its thermal gradient at the time of impact, and the time between impacts. There now exists enough evidence for overlapping basins of different sizes that some of these can be discussed. This paper highlights some examples of obvious effects of basin overlap.

Figure 1 shows several of the many examples now recognized on Mars. The Chryse-Acidalia Basins discussed in this volume [4] are shown in Figure 1a. Figure 1b shows the overlapping Utopia [5], Elysium [6] and Arcadia [3] Basins, and the overlapping Isidis, Scopolus [3] and Hellas Basins. We previously discussed the south polar region [7,8], where South Polar Basin is overlapped by Malea B and South Polar B as well as by the outer ring of Hellas.

Small impact basins affect only the upper structure of the lithosphere, so small basins overlapping the rim or edge of large impact basins have obvious and limited effects. There are several examples of such overlap, including Isidis-Utopia (Figure 1b). In such cases, the major effect is alteration of the surface structure, e.g. disruption of the larger basin rim. A second and larger example of this is the overlap of Acidalia with Chryse [4], which appears to have destroyed the northern portions of the Chryse rings (Figure 1a).

There are many cases where overlapping impact basins appear to control the extent of plains-forming units. Isidis-Utopia (Figure 1b) is one such example. Another may be the two larger basins in Daedalia, discussed elsewhere in this volume [9], where most of the (especially Hesperian age) plains in southern Daedalia lie within the overlap of two comparably sized basins. In the south polar region, the 40% overlap of South Polar and South Polar B, which are both of order 1000 km across but for which the area of deformation appears to be twice the main diameter, seems to control the off-axis deposition of polar deposits *Apl*.

A more complicated example of how basin overlap appears to control the distribution of plains-forming units is the Chryse-Acidalia pair. Topographic barriers associated with rings from the overlap of the comparably sized Acidalia Basin may have blocked the flow of volcanic and sedimentary materials draining northward from south of Chryse, causing ponding and subsidence in the southern portion of the Chryse Basin [4]. The distribution of Amazonian and Hesperian age plains units within Chryse-Acidalia also appears related to the location of Acidalia rings where they overlap the central portion of the Chryse Basin (Figure 1a). In particular the Amazonian units in central Chryse lie southward of the second Acidalia ring, and most of the Hesperian-age units lie within this ring.

In eastern Mars, most of the northern lowlands are confined within two very large (> 4000 km) Utopia [5] and Elysium Basins [6] (Figure 1b), the main rims of which form the crustal dichotomy boundary zone in this part of Mars [10,11] The extension of Amazonian plains units into Utopia appears controlled by the topography in the overlap regions of the two basins, especially for the northwest trending *Ael3* unit. We have also suggested the combined deep-seated effects of two such large basins may have concentrated prolonged volcanic activity which gave rise to the Elysium tectono-volcanic complex [10] centered in the overlap region of the two basins. The central Elysium volcanoes are located close to the intersection of Utopia rings with inner Elysium rings, as given by [6].

Smaller examples of concentration of volcanic effects exist elsewhere. The Meroe and Nili Paterae lie along an outer Isidis ring where it paasses through the center of the Scopolus Basin, and Hadriaca and Tyrrhena Patera may be associated with intersecting rings of a smaller Hesperia Basin and Hellas.

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Structural effects also occur when distant rings of large basins cross inner rings of a another basin. The outer ring of Hellas (d ~ 4200 km) may have influenced South Polar Basin, whose main ring is broken into segments at about the location of the Hellas ring. Perhaps gentle uplift along this zone raised this portion of the South Polar Basin rim and prevented its burial beneath polar deposits.

Near tangency of basin rings may provide positive reinforcement that elevates and helps preserve ancient terrains. Examples appear in the Daedalia region, discussed elsewhere in this volume [9] as well as in Chryse-Acidalia [4] where a lone outcrop of Noachian terrain in the northern lowlying plains appears to coincide with the one place where inner rings from the two basins are tangent (Figure 1a).

There are also many examples among the basin pairs where channel flow direction has been altered by overlapping rings of basins. Channel flow often widens between rings, running concentrically along what are presumed to be topographic lows, but may break through a ring or change direction abruptly where a ring from an overlapping basin crosses through. Examples in Chryse-Acidalia [4] and in western Daedalia [9] are discussed in this volume.

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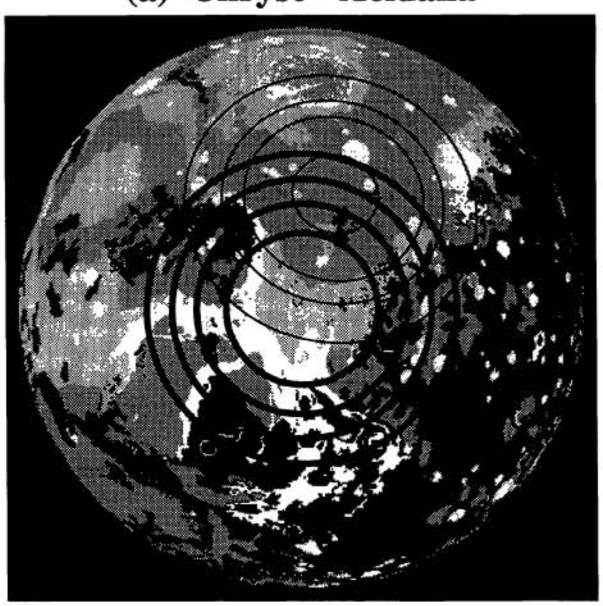
FIGURE 1: Examples of overlapping impact basins. (1a) The Chryse-Acidalia pair, discussed elsewhere in this volume [4]. (1b) Eastern Mars. Major basins [3] include Elysium, Arcadia, Utopia, Isidis, Scopolus and Hellas. See text for details.

(a) Chryse - Acidalia



(b) Utopia and Other Basins