

IMPACT BASINS IN SOUTHERN DAEDALIA, MARS: EVIDENCE FOR CLUSTERED IMPACTORS? Herbert Frey¹ and James H. Roark², ¹Laboratory for Terrestrial Physics, Goddard Space Flight Center, Greenbelt MD 20771, 301-286-5450, ²Science Systems and Applications, Inc., Lanham, MD 20706.

The distribution of ancient massifs and old cratered terrain in the southern Daedalia region indicate the presence of at least two and probably three impact basins of large size. One of these is located near where Craddock et al. [1] placed their center for a Daedalia Basin, but has very different ring diameters. These basins have rings exceeding 1000 km diameter and overlap significantly with centers separated by 500 to 600 km at nearly identical latitudes of -26 to -29°. The smaller westernmost basin appears slightly better preserved, but there is little evidence for obvious superposition that might imply a temporal sequence. Recognizing the improbability of random impacts producing aligned, nearly contemporaneous features, we suggest these basins may have resulted from clustered impactors.

Introduction

Both Craddock et al. [1] and Schultz and Frey [2] suggested a major impact basin in the Daedalia Planum region. Craddock et al. [1] used orientations of grooved units, interpreted as impact materials, to locate a center at -26.0°, 125.0°, and suggested ring diameters of 1100, 1500, 2200, 3200, 4500 (main ring) and 6400 km. Schultz and Frey [2] looked to a broader distribution of a variety of mapped geologic units to infer a basin at -14.5°, 127.0° with ring diameters 1475, 2540 (main ring) and 3960 km, but acknowledged Craddock et al.'s fit was more consistent for many Noachian age features south of Daedalia Planum. We suggest neither of the proposed basins is a very good fit to the observed structures. Detailed study of not just the distribution but also the structure and orientation of features used to define basin rings suggests that at least two and more likely three impact basins of significant size exist in this area.

Evidence for Several Daedalia Basins

The sharply delineated scarp of *Nplh* material at 139°W between -22 and -30° is one of several large structures which suggest impact basin rings. Craddock et al.'s [1] second (1500 km) ring passes through this feature (Figure 1a), but fails to capture its true curvature: a smaller circle (diameter 850 km) centered at -26°, 131°W is a better fit to this feature and to outcrops of similar material farther south (SW Basin, Figure 1c). This smaller circle also lies along a textural boundary northeast of the scarp and passes through outcrops of *Nb* material near -30°, 125°W, features not explained by earlier proposed basins. Two additional rings (1180 and 1570 km) are well defined by similar outcrops of old material. Less but still intriguing evidence exists for two outer rings with diameters 1880 and 2375 km.

Outcrops of *Nb* material form a well-defined circle of diameter 420 km (SE Basin, Figure 1b), centered at -29.3°, 119.8°W, 500 km east of SW Basin described above. *Nb*, *Nplh* and *Npl1* units define a second and third ring with diameters 740 and 1015 km, and a major arcuate scarp-like structure of *Nplh* marks a fourth 1290 km diameter ring. Three or four additional outer rings may also exist, but are not so well marked by discrete outcrops of old material.

West of the SW Basin lies a complex uplifted region through which pass the three major rings of SW Basin (and possible outer rings of SE Basin?). Detailed study of this region suggests several large, overlapping craters or perhaps small (2-3 ring) basins (Figure 1d), one at -27.5°, 141.8°W with a diameter of 335 km and possible outer rings ($d = 690$ and 1125 km) passing through arcuate *Nplh* outcrops to the west, east and south. A 275 km impact crater overlaps this feature to the south, at -30.0°, 141.3°W.

Basin Spatial and Temporal Overlap

The combination of three basins explains the existing Noachian outcrops and many large, channel-like deposits of Hesperian-age plains-forming materials which lie between major rings. The ancient materials appear highstanding and well-preserved where positive re-reinforcement

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between two basins occurs (basin rings nearly tangent to one-another). Where rings cross at high angles, less survives in the overlap regions.

The basins show no obvious superposition relations that might indicate a temporal sequence in their formation. Many of the same structures are attributed to two different basins. Within the limits of the observational data, the two largest basins are of comparable age. The inner ring of the smaller W Basin is somewhat more complete, but the outer rings are best preserved where tangent to the overlapping SW Basin. If W Basin were significantly younger, better preservation of its outer rings on the eastern (Daedalia Planum) side might be expected.

The probability of random impacts producing three contemporaneous, aligned basins (two of similar large size) is very small. If all three basins really exist, the possibility they are genetically related should be considered. This might imply a nearly simultaneous impact by a closely spaced (recently disrupted?) group of objects. If the separation of the basins were due only to the rotation of Mars, the impacts would be separated in time by about 35 minutes.

REFERENCES: [1] Craddock, R.A. et al., JGR 95, 10,729-10,741, 1990. [2] Schultz, R.A. and H.V. Frey, JGR 95, 14,175-14,189, 1990.

FIGURE 1. Proposed impact basin rings superimposed on a simplified geologic map of the Daedalia region of Mars. (1a) Daedalia Basin as proposed by Craddock et al. [1]. (1b) SE Daedalia Basin. (1c) SW Daedalia Basin. (1d) Western large craters or small basins.

