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Current Drainage Patterns on Mars from MOLA Data

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The role of water on the surface of Mars is a central issue bearing on investigations crossing a wide range of disciplines, including geomorphology, geochemistry, and biology. A basic component of the behavior of water involves the patterns of transport and accumulation on the surface. We have calculated potential drainage patterns using high-precision MOLA topographic data (combined with the latest MGS geoid) by tracing the downhill (maximum gradient) path for each point on the surface to its lowest possible destination. To the extent that the surface levels have remained unchanged, especially at the broadest scales, this exercise can illuminate the possible hydrologic patterns during the wetter eras of Martian history.

We find four major closed drainage basins. Water deposited within each of these areas will flow to its lowest point and remain confined there (unless there is enough accumulation to completely fill the depression and overflow into a lower basin). The boundaries between these basins thus are analogous to continental divides on the Earth.

The largest basin is associated with the vast, low-lying Northern Plains, for which there is some evidence for ancient oceans. The area of the planet that drains into the Northern Plains is immense, comprising over 3/4 of the surface. However, it is notable that any surface water south of about -45° (including, of course, the southern polar cap) will end up in one of the basins associated with the two largest impact structures on Mars, Hellas and Argyre. These are much smaller in area, covering 15% and 8% of Mars, respectively. The high-lying Solis basin (2% of the planet's area) has a tectonic origin, and is surrounded by a ring of mountains.

Although we do not know for certain whether widespread precipitation ever occurred on Mars, studies such as this are being used to refine our search for subtle geologic indicators for flowing water in the past and to constrain models for the evolution of Mars' surface environment.