New computer-developed map shows more extensive valley network on Mars

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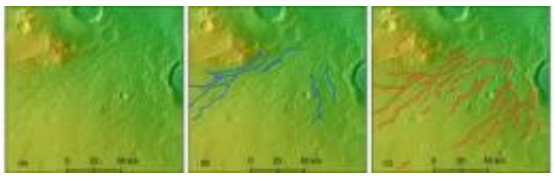


A zoomed-in area comparing the old map of valley networks and the new one. (Left) A satellite image, with color indicating elevation; (center) the old map of valley networks; (right) the new map of valley networks. Credit: Wei Luo, Northern Illinois University

(PhysOrg.com) -- New research adds to the growing body of evidence suggesting the Red Planet once had an ocean.

In a new study, scientists from Northern Illinois University and the Lunar and Planetary Institute in Houston used an innovative computer program to produce a new and more detailed global map of the valley networks on Mars. The findings indicate the networks are more than twice as extensive (2.3 times longer in total length) as had been previously depicted in the only other planet-wide map of the valleys.

Further, regions that are most densely dissected by the valley networks roughly form a belt around the planet between the equator and mid-southern latitudes, consistent with a past climate scenario that included precipitation and the presence of an ocean covering a large portion of

Mars' northern hemisphere.

Scientists have previously hypothesized that a single ocean existed on ancient Mars, but the issue has been hotly debated.

"All the evidence gathered by analyzing the valley network on the new map points to a particular climate scenario on early Mars," NIU Geography Professor Wei Luo said. "It would have included rainfall and the existence of an ocean covering most of the northern hemisphere, or about one-third of the planet's surface."

Luo and Tomasz Stepinski, a staff scientist at the Lunar and Planetary Institute, publish their findings in the current issue of the *Journal of Geophysical Research — Planets*.

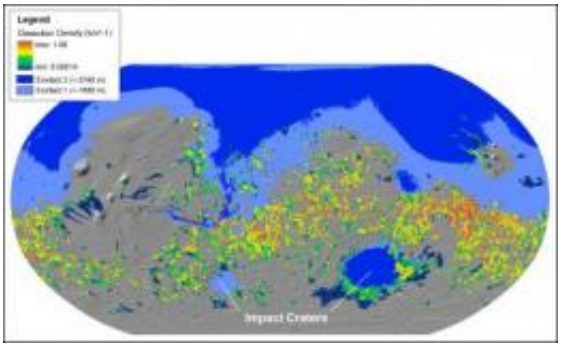
"The presence of more valleys indicates that it most likely rained on ancient Mars, while the global pattern showing this belt of valleys could be explained if there was a big northern ocean," Stepinski said.

Valley networks on Mars exhibit some resemblance to river systems on Earth, suggesting the Red Planet was once warmer and wetter than present.

But, since the networks were discovered in 1971 by the Mariner 9 spacecraft, scientists have debated whether they were created by erosion from surface water, which would point to a climate with rainfall, or through a process of erosion known as groundwater sapping. Groundwater sapping can occur in cold, dry conditions.

The large disparity between river-network densities on Mars and Earth had provided a major argument against the idea that runoff erosion formed the valley networks. But the new mapping study reduces the disparity, indicating some regions of Mars had valley network densities

more comparable to those found on Earth.



This is a global map depicting the dissection density of valley networks on Mars, in relation to the hypothesized northern ocean. Two candidate sea levels are shown: contact 1 with mean elevation at -1,680 meters and contact 2 with mean elevation of -3,760 meters. Credit: Wei Luo, Northern Illinois University

"It is now difficult to argue against runoff erosion as the major mechanism of Martian valley network formation," Luo said.

"When you look at the entire planet, the density of valley dissection on Mars is significantly lower than on Earth," he said. "However, the most densely dissected regions of Mars have densities comparable to terrestrial values.

"The relatively high values over extended regions indicate the valleys originated by means of precipitation-fed runoff erosion—the same process that is responsible for formation of the bulk of valleys on our planet," he added.

The researchers created an updated planet-wide map of the valley networks by using a computer algorithm that parses topographic data from NASA satellites and recognizes valleys by their U-shaped

topographic signature. The computer-generated map was visually inspected and edited with help from NIU graduate students Yi Qi and Bartosz Grudzinski to produce the final updated map.

"The only other global map of the valley networks was produced in the 1990s by looking at images and drawing on top of them, so it was fairly incomplete and it was not correctly registered with current datum," Stepinski said. "Our map was created semi-automatically, with the computer algorithm working from topographical data to extract the valley networks. It is more complete, and shows many more valley networks."

Stepinski developed the algorithms used in the mapping.

"The basic idea behind our method is to flag landforms having a U-shaped structure that is characteristic of the valleys," Stepinski added. "The valleys are mapped only where they are seen by the algorithm."

The Martian surface is characterized by lowlands located mostly in the northern hemisphere and highlands located mostly in the southern hemisphere. Given this topography, water would accumulate in the northern hemisphere, where surface elevations are lower than the rest of the planet, thus forming an ocean, the researchers said.

"Such a single-ocean planet would have an arid continental-type climate over most of its land surfaces," Luo said.

The northern-ocean scenario meshes with a number of other characteristics of the valley networks.

"A single ocean in the northern hemisphere would explain why there is a southern limit to the presence of valley networks," Luo added. "The southernmost regions of Mars, located farthest from the water reservoir,

would get little rainfall and would develop no valleys. This would also explain why the valleys become shallower as you go from north to south, which is the case.

"Rain would be mostly restricted to the area over the ocean and to the land surfaces in the immediate vicinity, which correlates with the belt-like pattern of valley dissection seen in our new map," Luo said.

Source: Northern Illinois University