VALLEYS-OCEAN BOUNDARY ON MARS: IMPLICATION FOR GLOBAL CLIMATE CHANGE.

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Introduction: This work investigates relationship between morphology and elevation of Martian valleys termini and hypothetical Martian ocean, as well as their implication for global climate change.

Valley networks: Valley network systems on Mars remain the most unequivocal evidence that water carved the surface of the planet in the distant past and that the climate was different than today [1]. Observations suggest that valley network formation was long-lived process that competed with other geologic processes in the history of Mars, such as impact cratering and volcanic resurfacing [2]. Recent analyses of MGS data show that valley network morphology is much more Earth-like than was previously thought, in terms of stream order and density [3]. Computationally extracted drainage densities of Martian drainage basins (using MOLA data) also resulted in much higher values than found before [4].

The ocean hypothesis: Outflow channels and features related to the evolution of standing bodies of water (polygons, lobate impact craters) [5], fluvial valley formation [6], glaciers, fluvial channels and gullies [7], and catastrophic flooding from system of gigantic valleys northwest of Tharsis [8], were additionally proposed as arguments supporting ocean hypothesis [9]. Recently, possible application of the Mathematical Theory of Stochastic Processes (MTSP) in the Lunar and Planetary Science (LPS) domain was presented [10]. First results of the approach, the Topography Profile Diagrams (TPDs) [11, 12, 13], clearly outline the correlation between crater density and elevation on lower altitudes which is, as all indicates, caused by an ocean that was constantly drying out [14] starting from elevation near Contact 0 [15].

Channels termini: Valleys increase in size the further we are from the source and they generally flow into some larger valley, lake, sea or ocean. Whatever flows in simply has to flow out, since only small amount of fluid can dry out or sink into the ground. Otherwise, we wouldn't have the growth of valley's size the further we go from the source, as we do on Mars as well as on Earth. At the valley termini, all that flawed that far can hardly just vaporize or sink into the ground, and can not continue to flow without leaving any trace, unless it flows into ocean that was there before river dried up. In Fig. 1 (large background image) Kasei Valles termini was shown for ocean level that corresponds to Contact 1, strongly supporting the above case. The image was generated using 1/64° MOLA data and algorithm published in [16], with modifications regarding shadowing only, where in Eq. 3 and 5 from [16] was omitted "x2". Using the same approach, termini of other valleys were examined as well. While previous research shows that the highly distinctive morphology of six large channels that empty into Chryse Planitia disappears near Contact 2 [17], this one additionally confirms that the same goes for all other channels that empty into northern lowlands, where the elevation when all those channels start to loose their shape approximately corresponds to Contact 1.

Conclusion: The above indicates that valleys dried up while the proposed ocean was between Contact 1 (Fig. 1. top-right) and Contact 2 (Fig. 1. middle-left). This additionally suggests that global climate change also occurred while ocean was between those two elevations, from warm and wet to cold and dry conditions. While topographic map of the intersection of Tiu and Ares Valles (Fig. 1. top-left) shows that this transition took same time, close elevation of Contact 1 and 2 implies that this transition did not take a long time. Future work should prove that correlation noticed by TPDs was caused by an ocean. Hopefully, Mars Exploration Rovers will also prove that running-water shaped Martian valleys, and so that water was main compound of the ocean as well.

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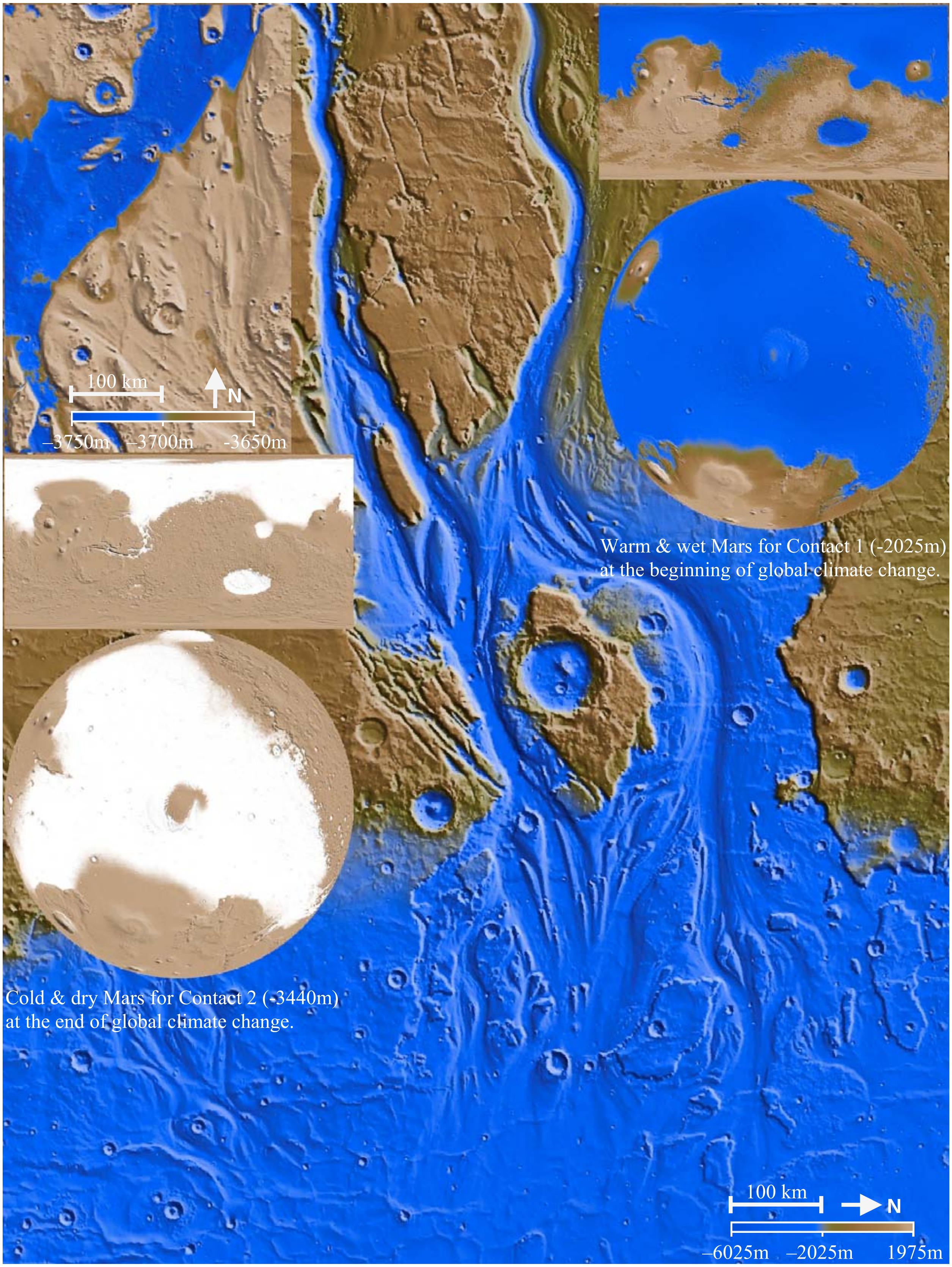

Figure 1: Intersection of Tiu and Ares Valles (top-left), global topography for Contact 1 and Contact 2 (right-top and middle-left), with Kasei Valles for ocean at elevation of Contact 1 as background.