THARSIS/ELYSIUM CORRIDOR: A MARKER FOR AN INTERNALLY ACTIVE MARS?:

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Introduction: The small size of Mars (<50% Earth's diameter) and other geophysical constraints have led to the theory that Mars experienced an early rapid loss of internal heat energy with subsequent steady-state decline [1,2]. This is consistent with the enduring paradigm of an ancient warm, wet, and dynamically active planet, which transitioned into a cold, dry, and internally dead world [e.g.,3]. However, this paradigm is contradicted by published Viking-, Mars Global Surveyor (MGS)-, Mars Odyssey-, and Mars Express-based geologic information from global to local scales that indicate a water-enriched, geologically-recent active planet, both hydrologically and tectonically, as recently as the Late Amazonian epoch [e.g., 4-6], and perhaps even to present [6-14].

MGS-, Odyssey-, and Mars Express-based information in the Tharsis and Elysium provinces, and the region that straddles both volcanic provinces (referred to here as the Tharsis/Elysium corridor; **Fig. 1**), collectively supports a potentially active Mars. This information includes: (1) pristine lava flows of Tharsis Montes with few if any superposed impact craters [15-18], (2) structurally-controlled releases of water and other possible volatiles from Cerberus Fossae [e.g., 19-20], as well as structurally-controlled channels that dissect Amazonian lavas of Tharsis Montes and Medussae Fossae Formation materials [9, 21-25], (3) the occurrence of dark slope streaks in the Mangala Valles and northwestern slope valleys region (NSVs), a region of which has recorded magmatic, tectonic, and hydrologic activity since the Noachian Period [7,9, 23-24,26], (4) tectonic features such as fractures, faults, graben, and structurally-controlled pit crater chains that cut stratigraphically young rock materials, including the flanks and aureole deposits of Tharsis Montes shield volcanoes, plains-forming materials in the region that straddles Tharsis and Elysium, and Elysium rise-forming materials [6, 11-13], (5) geologic terrains that display few if any superposed impact craters [13,15,17], such as recorded in the Ceberus Fossae region where impact crater counts of the fluvially dissected plains adjacent to Cerberus Fossae range from 10 to 100 Myr [19-20,27]], although error bars could indicate either an almost contemporary age or a much older age, ranging from 144 to 1700 Myr [28], (6) Mars Odyssey Gamma Ray Spectrometer (GRS)-based elevated hydrogen and chlorine in NSVs region and other regions along the highland-lowland boundary (**Fig 2**)[29-30] that contain materials of the Medusae Fossae Formation [4,5,31], located west of Tharsis Montes shield volcanoes, possibly indicating magmatic-driven hydrothermal activity [24,32], although other explanations are also viable [33], and (7) and elevated atmospheric methane revealed through the Planetary Fourier Spectrometer instrument on Mars Express [34] and Earth-based observations [35]; magmatism, hydrothermal activity, and biological release are few of several possible explanations for the presence of methane [34, 36-37].

Collectively, the above information supports the hypothesis of an internally active planet distinctly expressed in the Tharsis/Elysium corridor (**Fig. 1**). More specifically, the corridor is a primary locale where the internal heat of the planet still may be emitted through magmatism (including volcanism), tectonism, and hydrologic/hydrogeologic activity.

Implications: An internally active Mars has tremendous implications, including: (1) a potential for magmatic-driven activity well into the future, including volcanism, tectonism, hydrothermal activity, and related climatic response; (2) regions of elevated heat flow that may include near-surface groundwater; and (3) possible near-surface life. In order to optimally unfold the potential information that awaits discovery on Mars, international science-driven robotic (as described in [38]) and piloted missions to such locations as the NSVs prime site within the Tharsis/Elysium corridor will be necessary.

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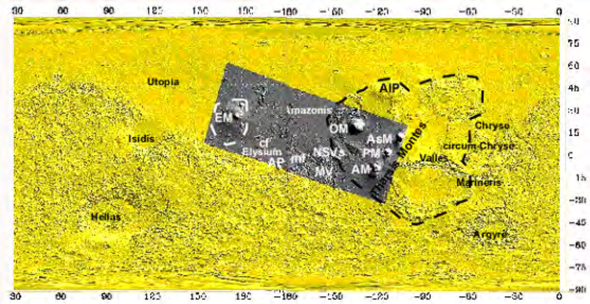

Fig. 1. MOLA map highlighting (gray tone) Tharsis/Elysium corridor region, which includes parts of Tharsis and Elysium volcanic provinces (dashed line shows their approximate boundaries), and the region that straddles their boundaries, and more specifically the Tharsis Montes shield volcanoes, Arsia Mons (AM), Pavonis Mons (PM), and Ascraeus Mons (AsM), and Olympus Mons (OM), Northwestern Slope Valleys (NSVs), Mangala Valles (MV), Amazonis and Elysium basins, Cerebus Fossae (cf), Apollinaris Patera (AP), and Elysium Mons (EM). Importantly, the boundary is only roughly defined and schematically shown here. The boundary will be mapped more accurately in the future through continued exploration to Mars. For example, Alba Patera and other parts of Tharsis might be added to the corridor region, as possibly indicated by the pit crater chains that mark the martian surface to the near the southeast margin of the shield volcano [also see 11-12].

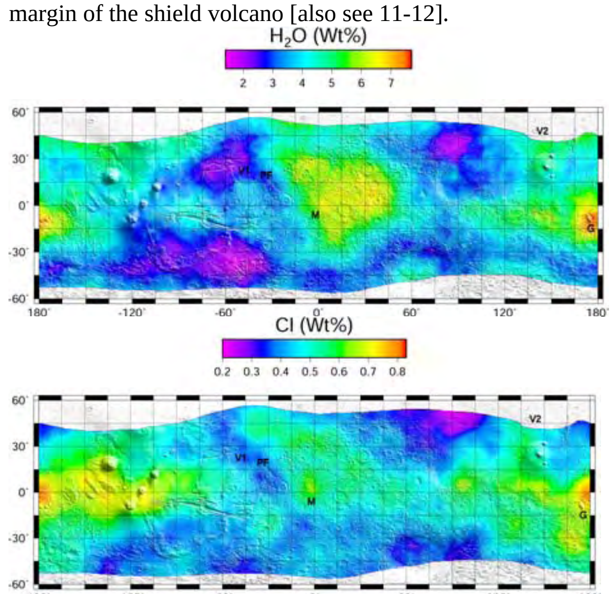

Fig.2. Anomalous elevated H_2O (top) and Cl (bottom) concentrations in the Tharsis/Elysium corridor region [e.g., 29-30] may indicate possible aqueous activity related to the interactions of magma with water/water-ice and fluvial activity, as well as other contributors such as acid fog [*33*].