SALAR GRANDE AS AN ANALOG FOR SALT FLATS ON MARS. Nikhila Rao Lakku[1], Marc Gagné[1], Daria Nikitina[1], and Thomas R. Watters[2]. West Chester University[1] Department of Earth and Space Sciences, 750 S. Church St., West Chester, PA, 19383. (lakkunikhilarao@gmail.com). Udvar-Hazy Center[2], National Air and Space Museum, 901 7th Street NW, 4th Floor, Washington, DC 20001, USA.

Introduction: There is ample evidence that Mars contains geomorphic features, like those found on Earth, suggesting that surface water once flowed on Mars [1,2,3,4,5,6,7,8,9,10,11]. Terrestrial analog sites can help untangle the complex geological history of Mars. Martian landforms and their mineralogy have revealed geomorphological similarities with terrestrial fluvial channels, sedimentary basins, deltas, and salt flats [12,13]. Salar Grande in the Atacama Desert is a dry saline lake formed in the closed basin in which water had ponded before the Miocene period [14,15]. Tectonic activity and changes in climatic conditions have resulted in extreme aridity lasting for at least 10 million years, forming large salt-encrusted playas. Minimal precipitation (0.5-12 mm per year) characterizes the Atacama climate as arid to hyper-arid [16]. Its unique environment, very slow erosion rates, and accumulation of salt deposits make it an ideal analog for salt flats containing chloride deposits on the southern highlands of Mars [17,18]. Depositional environments conducive to chloride salt formation on Earth are usually associated with evaporating surfaces of lakes fed by runoff or upwelling of groundwater or hydrothermal brines. The occurrence of chlorides on Earth provides evidence of persistent low water activity following salt precipitation [18].

Results: Using MRO CTX and HiRISE imagery in Terra Sirenum, we identify alluvial fans and polygonal features associated with the basin containing chloride deposits [17,18]. Using Earth Observing Satellite imagery, we identify similar features in the evaporitic basins of the Salar Grande. The distinctive geomorphological features observed on the salt flats on Mars are similar to those found on Salar Grande in terms of appearance and texture, including irregular ridges that resemble shorelines [12], fractured surfaces with polygons, and eroded surfaces. They also appear to be structurally controlled by faults and ridges with a system of fluvial channels draining directly into a local basin formed at the topographic lows. Features such as inverted channels and fan-like structures near the juncture of the salt flat indicate the possibility of fluvial activity on Mars. The fractures at the location mapped at 21.14°S, 69.92°W show a striking similarity to the features seen in the Mars study area (-33.68°N, 205.4°E) with long linear fractured polygons with orthogonal orientation.

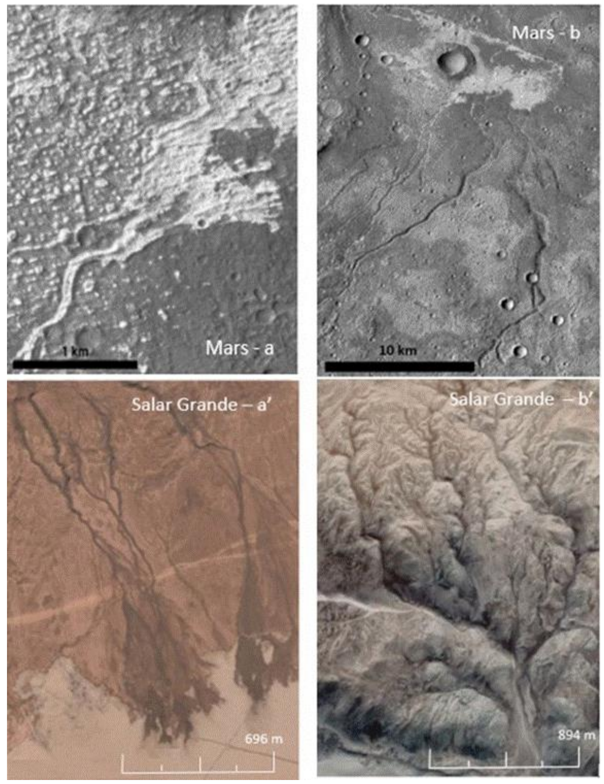

Fig-1: (a) Alluvial fans in Terra Sirenum CTX image P21 009318 1463 XI 33S154W (image center: -33.39°N, 205.49°E). (a') Alluvial fans in Salar Grande (image center: 20.92°S,70.04°W). (b) Dendritic drainage patterns in Terra Sirenum. (b') Dendritic drainage patterns in Salar Grande (image center: 21.05°S,69.93°W).

Discussion: Geomorphologic evidence of fluvial features present in an aqueous evaporitic basin like Salar Grande on Earth was found in the Terra Sirenum region on Mars. Relict channels debouching into the Salar Grande and the hypothesized fluvial channels near the salt flats on Mars show a similar dendritic pattern. On Salar Grande, a system of faults influenced the basin geometry and the drainage system of the channels that resulted from a series of tectonic faulting events associated with the Salar Grande fault system. By analogy, the surface surrounding the salt flats on Mars has also been altered by the compressional deformation relating to the evolution of Tharsis with the formation of wrinkle ridges [19] and the fault system of Sirenum Fossae that could have influenced the drainage system like routing of fluvial channels and deposition.

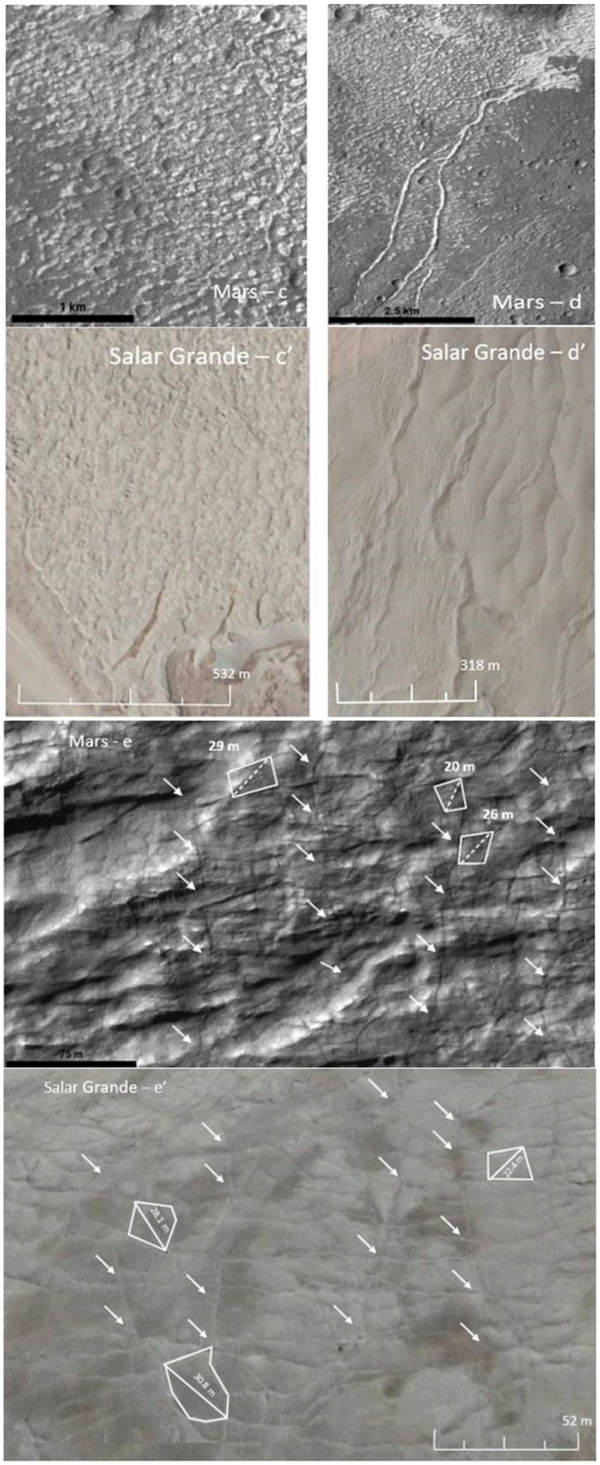

Fig-1: (c) Erosional surfaces in Terra Sirenum. CTX image P21 009318 1463 XI 33S154W (image center: -33.38°N, 205.39°E). (c') Erosional surfaces in Salar Grande (image center: 21.20°S, 69.91°W). (d) Inverted channels in Terra Sirenum. (d') Inverted channels in Salar Grande (image center: 21.18°S, 69.91°W). (e) Polygonal fractures in Terra Sirenum HiRISE image PSP 009318 1465. (e') Polygonal fractures in Salar Grande (image center: 21.14°S, 69.92°W).

The changes in the Martian terrain through tectonic activity and the evidence of evaporation of water from the basin, point to a transition from a volcanically and tectonically active planet favoring surface water, to the extremely dry and arid conditions on present-day Mars [12,20]. The inverted channels on Mars closely resemble the ones observed on Salar Grande, which also developed near the salt flat. In both cases, the surfaces around the inverted channels are highly eroded, with a knobby-rough texture. The bedrock lithology of both areas is valuable for investigating the inverted channels because it greatly influences channel dissection and preservation of the drainage channel pattern [21]. Alluvial fans in the study area on Mars closely match the morphology of the alluvial fans mapped on Salar Grande and therefore suggest a fluvial origin. Water sources that supported fluvial activity on Mars remain uncertain. Alluvial fans and polygonal fractures observed in the study area on Mars could play an important role in understanding the stream power, stream orders, and duration of fluvial activity.

Future Work: Salar Grande could be an ideal terrestrial analog to study the surface processes when water flowed on the surface of Mars and also the role of tectonic activity in changing the climatic conditions leading to present-day conditions on Mars.

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