GOBI DESERT DELTAS AS AN ANALOGUE ENVIRONMENT FOR JEZERO DELTA MARS:
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Introduction: Mission science goals for the 2020 Mars rover required a landing site hosting characteristics for in situ investigations including astrobiologically relevant ancient environments with biosignature preservation potential [1]. On Earth, deltas contain diverse sub environments that both support and preserve microorganisms. Rapid burial potential makes deltaic deposits an ideal environment for organic material sequestration and potential biosignature preservation. For this reason, the large delta in Jezero Crater was selected as the landing site for the Mars 2020 Perseverance rover.

Few large deltas in environmentally similar areas on Earth are available for use as Jezero delta analogues. Wax Lake delta (WLD-Louisiana, USA) and the New Rhine Lake Constance delta (RLC- Austria) have been used to test formation timing for the Jezero delta [2]. Both are classic river-dominated deltas with well-documented formation histories, and detailed study of their sedimentological and surficial geomorphic characteristics [3]. However, neither is located in a cold-desert arid environment currently dominated by aeolian processes, and thus they may not be adequate analogues for understanding Jezero delta processes.

Northeast China Gobi Desert study area: The Gobi, a region characterized by sand dunes and weathered gravels, experiences long, cold winters and hot summers with continual high winds. A number of endorheic (interior drainage) basins are found throughout the Gobi Desert in northeastern China, ~500 km NW of Beijing (Fig. 1). During the last interglacial, these basins formed an interconnected body of water when it reached ~1030 meters in elevation. During high stands, runoff formed a number of deltaic deposits (Figs. 2 & 3) with classic lobate forms. Since vegetation cover is sparse, there is substantial dust emission that affects regional and global climate.

Fig. 1. A. Gobi Desert study area. B. Distribution of deltas within the Southwest Basin (SWB). Sample numbers refer to cross-sections documented. Additional deltas (Fig. 2) are found within the North (NB) and South (SB) basins. Red dot in A is location of delta shown in Fig. 3. Yellow dot in B is location of cross-section shown in Fig. 4. Red box shows large delta north of this site.

Fig. 2 Deltaic forms within the study area. North to top of each sub image. Scale varies.
Gobi Desert deltas as analogues for Martian river-dominated deltas:
The areal extent and river-dominated forms of the mapped Gobi deltas area are comparable to the Jezero delta. The Gobi North delta (Fig. 3a) is ~130 square km in size and likely similar to the Jezero delta before its front was eroded, as hypothesized based on the preservation of distal remnants [2]. The slope angle of upper surfaces of deltas in the Gobi study area range between ~0.5° and 0.08°, while the average slope of the Jezero delta is ~0.15°. The slope of the delta shown in Fig. 3a is ~0.177°.

Fig. 3 a. Delta in the North Gobi Basin of similar size and form as the target site delta in Jezero Crater. The 995-meter contour line for this North Basin delta is shown in black and represents the outer edge of the delta. b. Jezero delta. Remnants of the eroded delta are visible to the left of the lower center of the image. Both deltas exhibit lobate forms.

Basaltic drainage area:
Approximately 25% of the drainage area for this Gobi North Basin delta drains a portion of the Abaga-Dalinour volcanic field [3, 4]. This field, one of the largest Cenozoic volcanic fields in eastern Asia, consists of a lava plateau of alkali basalt and tholeiite with a significant olivine component. Deltas that drain basaltic areas, while common on Mars, are rare among deltas on Earth. Thermal infrared analyses [5, 6] suggest a dominance of basaltic compositions in the Jezero drainage system.

Depositional sedimentary features: A cross-section of one of these deposits (Fig. 4) shows classic cross bedding features associated with a foreshore/nearshore depositional environment. Distal sections of these deltaic deposits preserve organics and as such may serve as an analogue for depositional environments at Jezero.

Fig. 4 Section stratigraphy for SWB delta HL119A from the foreshore/shoreface zone showing trough cross bedding that underlies a mix of mud and cobbles and which is capped by aeolian sand/silt.

Conclusions: Much like the Jezero delta, the deltas of the Gobi Desert exhibit classic river-dominated lobe features. Data on the geometry and morphometrics of the lobes of these deposits, channel-size distributions, and the bifurcation rates and distributary numbers of these deltas (as well as analysis of cross-section stratigraphy) may provide high quality analogues for Jezero and other river-dominated deltas on Mars. The drainage area of the North Basin delta (Fig. 3) adds an additional characteristic of interest since it likely is one of the few Jezero delta analogues on Earth that drains a significant area of basaltic rock.