GEOMORPHIC EVOLUTION OF PLEISTOCENE LAKE BONNEVILLE: TEMPORAL IMPLICATIONS FOR SURFACE PROCESSES ON MARS. Marjorie A. Chan[1], Kathleen Nicoll[2], Paul W. Jewell[1], Timothy J. Parker[3], Bruce G. Bills[3], Chris H. Okubo[4], and Goro Komatsu[5]. [1]University of Utah, Department of Geology and Geophysics, 115 S. 1460 E. Rm. 383 FASB, Salt Lake City, UT 84112-0102, marjorie.chan@utah.edu, [2]University of Utah, Department of Geography, Salt Lake City, UT 84112, [3]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, [4]U.S. Geological Survey, Flagstaff, AZ 86001, [5]International Research School of Planetary Sciences, Università d'Annunzio, Viale Pindaro 42, 65127 Pescara, Italy.

Introduction: Pleistocene Lake Bonneville of the Great Basin offers unparalleled insight into temporal constraints for understanding the development of similar analog environments and processes on Mars. The extensive and well preserved lake system exhibits many intact features that include: prominent shorelines, spits, bay mouth barriers, deltas, gullies, outburst channels, and playa lake features, including patterned grounds and downwind aeolian systems. Although water is recognized as a geomorphic agent on Mars, remotely sensed datasets by themselves have limited utility for inferring how long it took for the formation of specific features. With the Lake Bonneville analog, we can address how long standing water might be geomorphically effective, and infer the rate of development for specific landforms (e.g., coastlines, wave-cut terraces, outflow channels, rills).

A wealth of recent data collected by instruments such as Mars Odyssey's THEMIS (Thermal Emission Imaging System), Mars Reconnaissance Orbiter's CTX (Context Camera), CRISM (Compact Reconnaissance Imaging Spectrometer for Mars), and HiRISE (High Resolution Imaging Science Experiment), and the Mars Exploration Rovers' Athena payload, allow new outcrop-scale analyses that were not previously possible. Terrestrial analogs provide ground-truth to aid in interpretation of these Mars datasets [1].

Background: Two decades ago, Lake Bonneville was proposed as an analogue for understanding putative lakes on Mars because it was a better comparison than Earth's tidal oceans, given the anticipated lack of tides on Mars. [2,3,4]. Current Mars datasets can greatly improve these past interpretations. Correspondingly, we also have enhanced our knowledge of Lake Bonneville history, the subtleties of superimposed landforms, its stratigraphy and sedimentology, and surface water dynamics.

Justification: There are many easily accessible sites in close proximity within the Bonneville basin (~50,000 sq km), where the lack of vegetative cover is an advantage for remote imaging at various scales by satellite or robotic instruments. The dry, desert climate and modern wind processes of the Bonneville basin are comparable to Mars and its current surface.

Most importantly, Lake Bonneville is an ideal analogue for describing standing water as a geomorphic agent on Mars because of the following reasons.

(1) Its oscillating water levels left an extensive record of erosional and aggradational sedimentary features that developed over different timescales, ranging from gradual (e.g., wave-cut shoreline terraces, lobate fan deltas) to the sudden or catastrophic (e.g., outburst channels, boulder-strewn plains). The wide range of landforms, some showing cross-cutting relationships, is similar to Mars (gullies, channels, deltas, fans, shorelines).

(2) Evaporates in the lowstand, remnant Great Salt Lake have similar mineralogies to the Burns Formation on Mars, with the potential for understanding life (astrobiology) in extreme environments.

(3) Lake Bonneville persisted at highstand around the Last Glacial Maximum (~20 ka BP in C-14 years) until a catastrophic outburst flood event ~14.5 ka BP. The warming climate produced rapid drying. We know the time constraints on outbursts as well as drying cycles.

(4) The extensional tectonic setting produced steep margin sides similar to the morphologies of Martian craters that held ancient lakes.

(5) Changing water loads of Lake Bonneville produced isostatic adjustments reflected in the shorelines; this can have important implications for understanding crustal properties on Mars.

Summary: Our inventory of sedimentary and landscape features from Pleistocene Lake Bonneville is valuable for interpreting new imagery from Mars missions. The temporal constraints from the Bonneville analog have critical implications for understanding the rate of geomorphic processes and the evolution on Mars.

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Acknowledgements: Funding provided by NASA Mars Fundamental Research (NNG06GI10G) for Chan, NASA Mars Data Analysis NNX06AE01G for Okubo, and a grant from the Italian Space Agency for Komatsu.