

EXTENT OF FLOATING ICE IN AN ANCIENT ECHUS CHASMA/KASEI VALLES VALLEY SYSTEM, MARS. Christopher Woodworth-Lynas and Jacques Yves Guigné, Guigné International Ltd. 685 St. Thomas Line, Paradise, Newfoundland, CANADA A1L 3V2 709 895 3819 chriswl@guigne.com

Introduction: From images of the Echus Chasma/Kasei Valles valley system we present further, new observations of surficial Martian features that are interpreted to be the result of interactions between the keels of flat-bottomed floating ice floes with a submerged sediment [1,2]. These features are proxy indicators of three basic environmental conditions: the former presence of a water body; the water body was seasonally, or perhaps permanently, covered by ice floes; the water area was large enough for winds, currents or both to drive the floes forward during ice/lakebed interaction. We also present an analysis of shorelines. These observations are made from analyses of Mars Global Surveyor Mars Orbiter Camera (MOC) images.

In places we have observed several, closely-spaced, terraces interpreted to be shorelines preserved at different elevations along the margins of the valley system. We use the geographic distribution of the floating ice-related features and shoreline terraces to define the limits of floating ice in the valley system. We compare the shoreline boundaries with equipotential (waterline) surfaces using Mars Orbital Laser Altimeter (MOLA) data, and estimate the volume of water and floating ice that occupied the valley system.

A narrow channel (~ 1 km wide) geographically separates very large ice floe pits that formed in a very large, long lake of the upper valley system (Echus Chasma) from much smaller ice floe pits that formed in a narrow river system of the lower valley (Kasei Valles). We interpret this difference to be in part the result of mechanical breakup of the large Echus Chasma ice floes as they entered and passed through the narrow channel, and in part because Kasei Valles, below the channel, is relatively narrow (2-5 km wide) thus not affording the same opportunities for the formation of large ice floes.

Floating ice-related features in the lower valley (Kasei Valles) are found only in the southern branch of Kasei Valles and do not extend beyond the vicinity of Sharanov crater near the mouth of the valley system

Background: There are two general types of feature preserved on the present surface of the valley system that were formed by floating ice:

1. *Networks of Parallel sided Troughs with Berms:* We interpret these troughs, typically 1 – 3 km long and 10 – 50 m wide, to be ice keel scour marks made by the deepest parts of the keels of ice floes or pressure ridges as they drifted, driven by winds and currents, across and along the valley. In places multiple, overlapping sub-parallel scour marks coalesce into wide (100 - 300 m), irregular-sided grooved and ridged surfaces. These we interpret as the proxy indicators of shear zones in the floating ice canopy. On Earth these narrow regions of shear, known as Starmukhi zones, form between stationary landfast ice and moving offshore pack ice and are regions of intense ice keel scouring.

2. *Ridge-bounded regions:* Associated with the ice keel scour marks are the imprints of grounded ice floes, the margins of which are defined by low continuous ridges. These

grounding pits range in size from 200 to 600 m, exceptionally up to 950 m, and generally occur in groups forming jigsaw-like patterns. The patterns represent the position of floes at the moment the floating ice canopy grounded in soft sediment as the water drained or evaporated away. In Echus Chasma the grounding pits tend to be of a larger scale than in Kasei Valles (in the range 0.5 to 1.0 km) and many of these appear to be imprints of several ice pans that have coalesced and frozen into composite floes. In places raised shorelines are found in association with the scour marks and grounding pits.

Based on the geographic occurrence of scour marks, grounding pits and shorelines we interpret an ancient ice-covered Echus Chasma/Kasei Valles lake and valley system as an ancient lake and valley approximately 1,500 km long and 200 – 300 km wide. (Figure 1).

Conclusion: Originally we had expected to find evidence of the former presence of floating ice preserved, at least in some places, on the ancient seafloor of an ancient north polar ocean. It is reasonable to expect that there may have been seasonal or permanent floating sea ice, and possibly icebergs, in such an ocean [e.g. 3,4,5] as is the case for the Arctic and Southern Oceans on Earth. Kreslavsky and Head [6] present a model for catastrophic submergence of the north polar basin and, geologically, rapid freezing of the entire water column to the seabed and eventual sublimation of this thick ice mass. For this scenario the conditions for creating and preserving ice keel scour marks and ice floe grounding pits are absent. To date we have found no evidence for the presence of floating ice in the north polar basin.

References:

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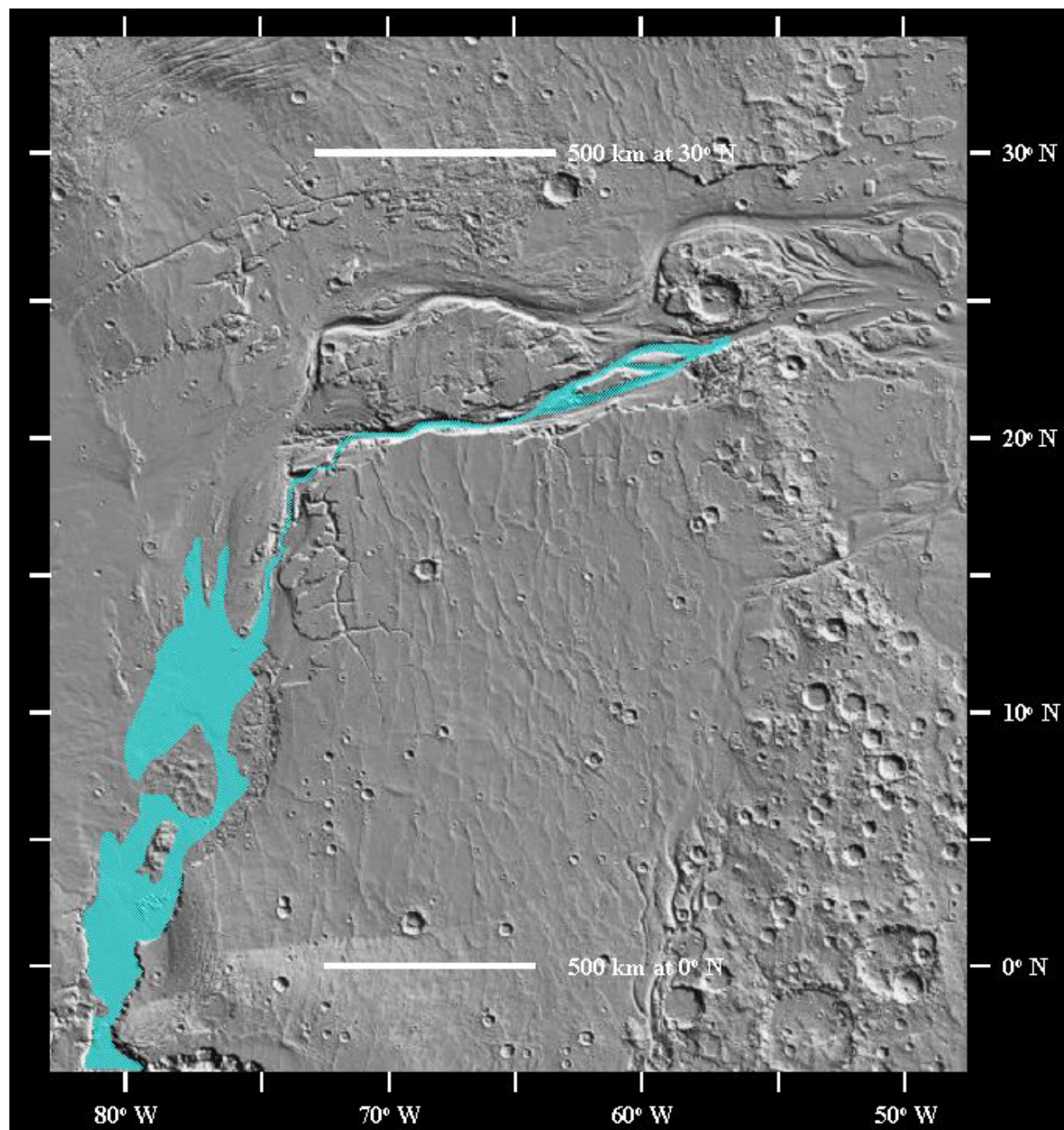


Figure 1. Relief map of Kasei Valles showing the interpreted approximate limits of an ancient ice-covered Echus Chasma/Kasei Valles lake and valley system. The system was approximately 1,500 km long and 200 – 300 km wide. The edges of the system are interpreted based on the geographic distribution of interpreted ice keel scour marks, ice floe grounding pits and shorelines. Context relief image from the Mars 2001 Odyssey THEMIS website (<http://themis-data.asu.edu/>).