BGS Postgraduate Conference Attendance Grant: The sinuous ridge and channel network within Rahway Vallis and the wider contextual study of the surrounding Rahway basin, Mars.

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Summary

The postgraduate conference attendance grant provided the funding for me to be able to attend the week-long European Geosciences Union General Assembly in April 2014. The meeting provided an exciting selection of up-to-date research presentations from the Geoscience community. With almost 5000 oral, 10,000 poster, and 500 PICO presentations there was a large multi-disciplinary audience of around 12,000 scientists to which ideas could be presented. This conference allowed me to present my work on the geomorphology of Rahway Vallis, Mars to a wider audience including geomorphologists working on terrestrial analogues.

Rahway Vallis

Rahway Vallis is shallow basin located in the Cerberus Plains of Mars which are thought to be composed of late Amazonian lavas (Berman and Hartmann, 2002; Jaeger et al., 2010; Page, 2010; Plescia, 2003; Tanaka et al., 2005), although there have been other interpretations involving once ice-rich basaltic sediments (Brakenridge, 1993; Murray et al., 2005; Page, 2007). The Cerberus Fossae, extensional en-echelon fracture systems, have been identified as a possible source of both lava and water outbursts onto the Cerberus Plains (Balme et al., 2010; Berman and Hartmann, 2002; Burr et al., 2002a, 2002b; Head and Kreslavsky, 2001; Jaeger et al., 2010; Page, 2010; Plescia, 2003; Thomas, 2013).

Rahway Vallis contains a branching network of channels converging on the basin floor (Fig.1) with both the channels and valley descending and deepening consistently from west to east. The morphology and topology of this channel system is consistent with formation by contributory fluid flow, generated from a continuous source or many distributed sources. The transition between the older heavily cratered highland terrain and the floor of the Rahway basin is bounded by near-horizontal continuous topographic terraces. Plotting the elevation of the terraces shows that they conform to a plane. We calculate that the volume of material needed to fill the topography up to the level of the plane best fit by the terraces is ~1500 km^3. Bordering the channels are sinuous ridges, typically several kilometres long, 20 m across, with heights on the order of 10 m. They sometimes form branching networks leading into the channels, but also occur individually and parallel to the

channels. The multiple tilted terraces, the channel/valley network with many fluvial-like characteristics, and the distributed source regions, suggest that the landforms within the Rahway basin are unlikely to have formed through purely volcanic processes. Rather, the channels within the Rahway basin are consistent with a genesis requiring the flow of liquid water, and the sinuous ridges with surficial melting of a non-glacial ice body that occupied the basin.

We suggest a hypothesis of rapid basin filling by fluvial flooding, followed by lake drainage. Drainage could have occurred as a consequence of an ice or debris-dam failure within (or during the formation of) the large, nearby fluvial flood channel Marte Vallis. If the lake was partly or largely frozen prior to drainage, this offers a possible explanation for the sinuous ridge systems. Hence, although the sinuous ridges provide some of the most compelling morphological analogues of terrestrial eskers yet observed, we conclude that the contextual evidence for this interpretation in Rahway Vallis is not strong, and instead they are better explained in the context of a frozen or partially frozen lake or cryolacustrine model.

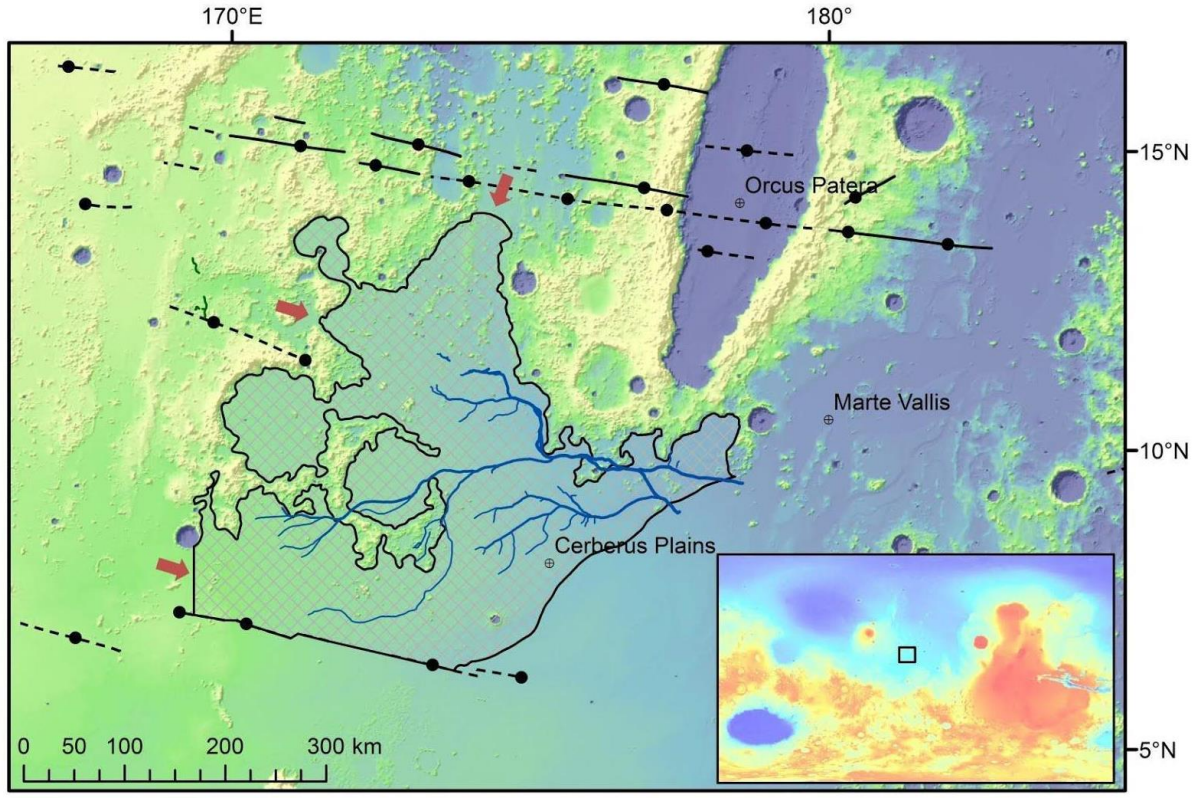

Fig 1. Regional context map of Rahway Vallis, Rahway basin and Marte Vallis with MOLA colour coded elevation in the background (blue ≈ -3000 m; yellow ≈ -2000 m). The solid black line filled with light-grey hatching represents the approximate boundary of the Rahway basin. Blue lines show the locations of the channels within Rahway Vallis identified in this study with increased thickness representing higher stream orders. The Cerberus Fossae are marked by noded lines with solid black lines where fresh and dashed black lines where subdued. The red arrows mark possible inlets for the Rahway basin. Insert: Near global MOLA elevation map (blue ≈ -5000 m; red ≈ 16000 m) showing the location of the study area; the blue crater to the south-west is Hellas. (North is up in this figure and all following figures unless otherwise stated).

Outcomes

The results of this work and discussions developed at the EGU GA form the basis of a paper recently submitted to Icarus.

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