CANALI ARE LAVA, NOT RIVER, CHANNELS. R. C. Ghail, S. Rolfe, and L. Watt Department of Earth Science and Engineering, Imperial College London, South Kensington Campus, London, SW7 2AZ, United Kingdom. R.Ghail@imperial.ac.uk

Introduction: Canali are erosional channels that were first identified in the lowland plains of Venus from Magellan data and studied by [1]. They share many features with terrestrial rivers such as meanders, oxbow lakes and braiding, although with lower sinuosity [2], but their sources are frequently never seen or hard to identify. Thermal erosion was ruled out as a possible formation mechanism by [2] on the basis of the great length of some flows (up to 6800 km) and alkali carbonatite was proposed as the most likely fluid causing the mechanical erosion of the channels. Recently [3] has proposed that the flows were aqueous and formed at a time when Venus had oceans. We have identified the source of several flows as a volcano in Aphrodite and have studied the morphology of two flows using stereo dems. Our research supports the conclusion of [2] that canali were eroded by volcanically-derived carbonatites at a time when its surface temperature was ~100 K hotter than now. The interesting observation is that Venus once supported carbonatite lakes.

Background: We identified a region of canali on Venus located at 12˚N 067˚E (fig. 1) in a lowland area ~1000 km north of Ovda Regio. The area has good stereo coverage and so was suitable for generating dems. The main feature of the area is a large volcano in the northwest corner with multiple flows originating from it. There are numerous small-scale compressional ridges, fractures and small shield volcanoes. The first canali studied originates from one of the small shields flanks of the large volcano and runs in a southeast direction towards the lower plains. The source of the second canali was not identified but may be another small shield nearby. This flow cuts through several ridges and disappears into a large fractured plain. Both flows are large enough to be studied using high-resolution (~150 m horizontal, ~15 m vertical) digital elevation models (dems) generated using the Magellan Stereo Toolkit.

Observations: The first canali is 330 km long with a sinuosity of 1·1, middle of the range for terrestrial rivers. It is, on average, 300 m wide and 55 m deep, but both width and depth increase away from source. The average gradient along its length is 0·34 degrees which we believe is close to the original value, despite dem errors and possible later ground movements. Its profile is consistently V-shaped (so far as can be determined) with levees and occasional terraces. The distal portion of the flow is covered by later lava flows and so a second canali was studied to its farthest extent. This canali is also 300 m wide for most of its length but widens and shallows considerably as it approaches a large, fractured, plain into which it disappears. Its average gradient cannot be measurement because of later ground movement associated with developing ridges. However, it does flow around several ridges and was clearly syntectonic, thus providing a unique insight into fault/drainage development on Venus. Its sinuosity is only a little higher at 1·2. Assuming an alkali carbonatite flow, and taking the average dimensions and gradient of the first canali and values appropriate for Venus, we have calculated that the flow was turbulent and the average flow rate was ~6 m s^{-1} for a flow 30 m deep (i.e., in flood), corresponding to a modest discharge (eruption) rate of ~4 x 10^4 m^3 s^{-1}. For comparison, if the fluid were water, the discharge rate would be 50 m s^{-1}. Levees and overbank deposits indicate that such floods did occur but there is considerable evidence for multiple flows in the channel that suggest that much of the time the canali carried far less fluid.

Discussion: Even at the present surface temperature, the flow could have travelled more than the length of this channel (in fact, up to 560 km), however, it has been proposed that the surface temperature of Venus has varied considerably over time [4] and may have been above the melting point of the lava (~830 K). The second canali crosses two sets of ridges and, after the latter, widens onto a broad plain before disappearing in an expanse of lava flows that are apparently derived from it. A number of other canali have been identified in this area, emanating from a number of small volcanoes in the area, all apparently flowing towards the plain, some with deltas at their distal ends. Though it is by no means required, if the surface temperature was higher at the time, then we can speculate that this plain was once a carbonatite lake covering as much as 1000 km^2. to a depth of at least 20 m. In any case, our calculated canali flood would have covered that area in a few days, so it is possible that much of this area was resurfaced by carbonatites, providing the necessary carbonate buffer inferred [5] from the surface pressure of CO_2 on Venus.

References: [1] Baker V. R. et al. (1992) *JGR, 97,* 13421-13444. [2] Williams-Jones G. et al. (1998)

JGR, 103, 8545-8555. [3] Jones V. R. and Pickering K. T. (2003) *J Geol Soc, 160,* 319-327. [4] Solomon S. C. et al (1999) *Science, 286,* 87-90. [5] Fegley B. et al. (1992) *Proc LPS., 22,* 3-22.

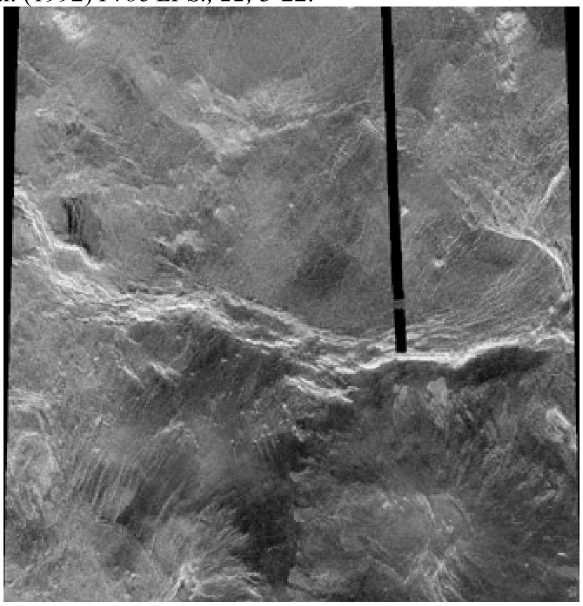

Fig 1. The study region. The image is ~500 km across, north is at the top. The main volcano with the first canali is in the lower-left. The second canali flows through the ridges to the north-west onto the the oval “lake” area.

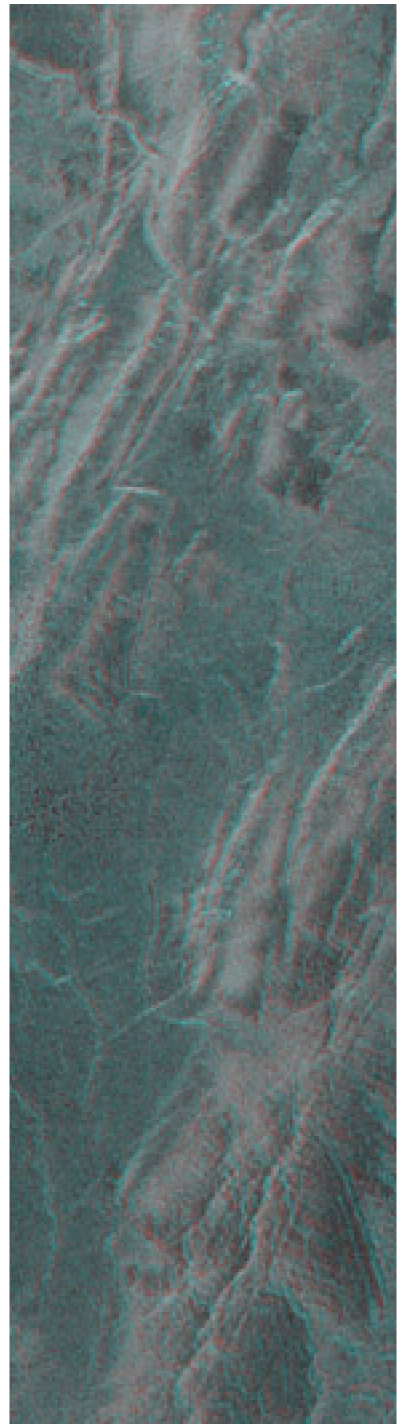

Fig 2. Stereo anaglyph of the second canali. Image is 30 km wide, north is to the right. The canali cuts through several ridges and terminates in lava flows at the bottom of the image.