viscosity of 10^{19} Pa s. Zero stress boundary conditions are applied to all sides of the model region, while no motion perpendicular to region boundaries are allowed except at the top.

Results: Figure 1 shows a typical result of the computations modeling the density changes. Density contours (0.1 g/cm^3 spacing) clearly delineate the slab and its crustal layer. In this case (10°C/km geotherm, 25 km crust, subduction rate of 5 km/m.y.) the net slab densities in the region above the basalt-eclogite phase transition are lower than their mantle surroundings (the phase change is set for the density analysis at 110 km depth). Above the 110-km depth densities in the crustal portion of the slab are lower than in the mantle outside the slab. This causes the net slab density to be less than that in the surrounding mantle. Below the basalt-eclogite phase change, net slab densities exceed those in the neighboring mantle. Net slab buoyancy remains positive until the slab has lengthened to about 275 km. Thereafter, slabs become negatively buoyant.

Initial finite element results indicate that the positively buoyant slabs will rise through the mantle at a rate of 5 to 10 km/m.y. This analysis considers only the instantaneous velocity of the slab and does not incorporate the full results of the density modeling or the dynamics of slab subductive descent.

Discussion: Qualitatively, subduction is likely to be enhanced by negatively buoyant slabs or hindered by slabs that are positively buoyant. Positive net buoyancy is found above the basalt-eclogite phase change, tending to oppose subduction. Negative net slab buoyancy for the full-length slab was found for all conditions, while neutral buoyancy was achieved for slabs at a length of about 275 km. Thus, the slab must penetrate deeply into the mantle before negative buoyancy can help drive subduction. The rate of the slab's buoyant rise through the mantle is then important in determining whether the slab may descend deeply enough to become negatively buoyant.

Preliminary results of finite element modeling indicate the slab may rise at rates between 5 and 10 km/m.y. Thus, subducting slabs will tend to rise into an underthrusting position if their subduction rate is slow. However, it may be that moderate to high rates of subduction will overwhelm the buoyant rise of a slab. This could lead to slabs being forced through the basalt-eclogite phase transition and to great enough depths to become negatively buoyant, thus possibly producing a self-sustaining subduction system.

These initial results must be considered in light of the presumption of subduction made in undertaking the analysis. Some process still must be found that would carry the slab downward despite its initial positive buoyancy. Further work will model more closely the dynamics of the subductive motion of the slab and the effects of the slab density evolution on slab buoyancy, its rate of rise through the mantle, and the continuance of subduction.

These results indicate that for all cases of assumed Venus geotherm a lithospheric slab whose subduction has been initiated will instead be forced to underthrust the overriding lithosphere if the subduction rate is slow. This could then lead to crustal thickening, melting, and volcanism, and possibly provide one model to explain the association of compressional mountain belts and blocks of high-standing tessera, with apparent flexural rises and foredeeps, and with large volumes of volcanic deposits.

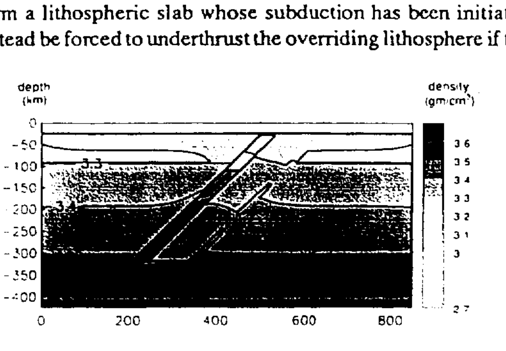

Fig. 1. Final density distribution for 10°C/km geotherm, 25 km crust, and 5 km/m.y. subduction rate. Contours have a 0.1 g/cm^3 spacing.

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EROSION VS. CONSTRUCTION: THE ORIGIN OF VENUSIAN CHANNELS. D. B. J. Bussey and J. E. Guest, University of London Observatory, University College London, London NW7 2QS, UK.

Lava channels are a common feature in the volcanic regions of the Moon, and have now been observed on Venus [1]. There has been much debate about the origin of lunar channels: Are they the result of erosional (either thermal or mechanical) or constructional processes? It is necessary to determine the criteria to distinguish between the different types of channels. The clearest evidence is that the presence of levees indicates that the channel experienced a constructional phase for a period.

Greeley [2] has proposed that Hadley Rille, on the Moon, was formed as a leveed channel and lava tube system. Evidence for this is its location along the crest of a ridge. In addition, Hadley Rille and other lunar mare sinuous rilles are discontinuous, suggesting that their origin was, in part, a lava tube that has subsequently undergone partial roof collapse. Carr [3] and Head and Wilson [4] have argued that these rilles were produced by lava erosion. For lunar highland channels, which tend to be larger than their mare counterparts, mechanical erosion of the megaregolith is a possible process.

Channels of several different types have been observed on the surface of Venus [1]. They are probably formed by more than one process. They range in size from a few kilometers to over 6800 km [1]. The relatively short ("tadpolelike") channels [5] (e.g., 24 S 347) appear similar to lunar mare sinuous rilles in morphology. They are so like certain constructional terrestrial channels (e.g., Kalaupapa, Hawaii [6]) that it appears reasonable to say that they too are constructional channels or collapsed lava tube systems.

However, the long sinuous channels referred to by Baker et al. [1] as "canali" pose a different problem in the understanding of their formation. One example of a channel of this type in the southeast region of Aphrodite Terra appears to show both erosional and constructional characteristics. This channel is represented in Fig. 1. It is approximately 700 km long with an average width of about 1 km. It drops a distance of 700 m from beginning to end, which means that the average slope is 0.06°. Its source may have been a graben situated at the northwest end of the channel. It appears to have different origins along its length.

The lack of levees near the source suggests that the channel is erosional in this region. An inferred profile is shown as AA' in Fig. 1.

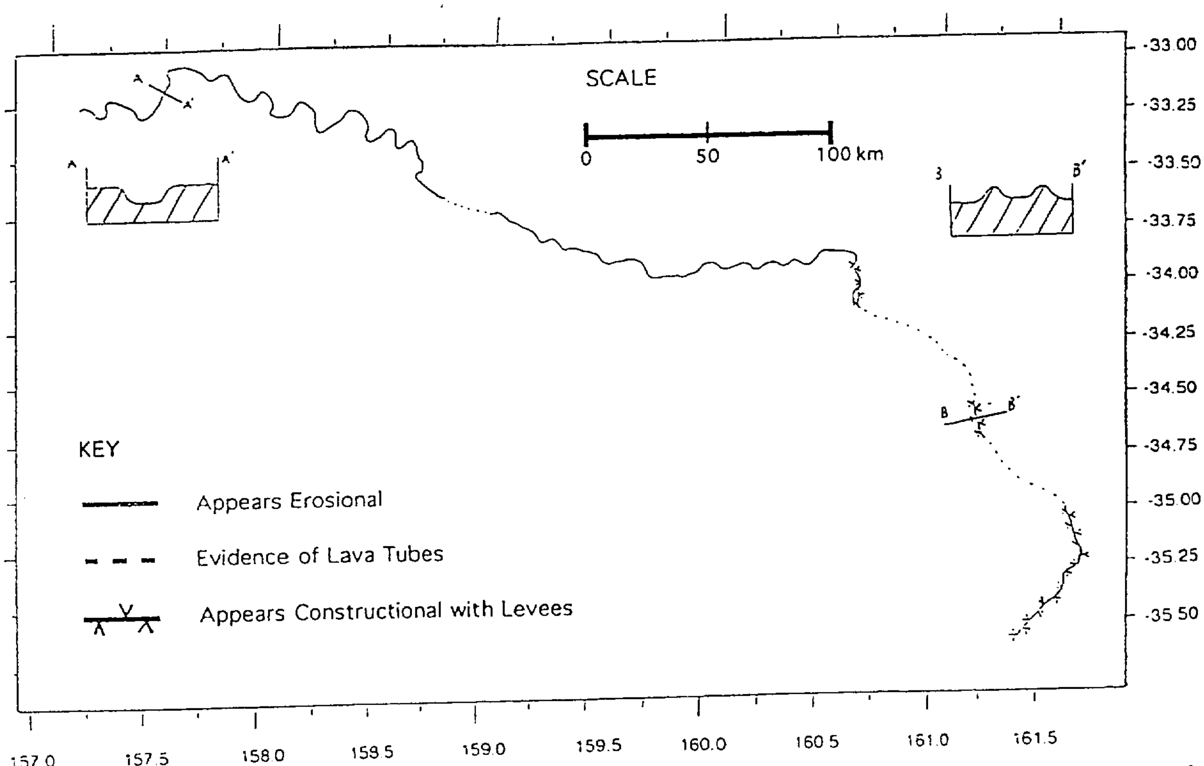

Fig. 1. A channel in southeast Aphrodite Terra. Evidence for erosion or construction obtained by analysis of north-south sections of the channel.

The presence of levees indicates that a constructional phase has occurred. These are formed by lava repeatedly splashing over the channel sides and solidifying. Evidence of levees is seen further away from the source. A possible profile is shown in BB' in Fig. 1. However, the presence of levees does not mean that the lava was not also eroding and deepening the channel. BB' could just as credibly be redrawn with the level of the channel floor below the level of the surrounding terrain.

Thus, in conclusion, our example channel is very sinuous and there is evidence of erosion. There may also have been overflow here. In its middle reaches it roofs over and has the characteristics of a lava tube. In the lower reaches there is strong evidence for the presence of levees indicating construction.

On Earth, limited amounts of erosion may occur in basaltic lava channels [7], although not nearly on the same scale as on the planets just mentioned. For lava erosion on Earth to occur to a comparable extent, excessive eruption times are required. However, low-viscosity komatiite lava may erode to a larger extent and there is direct evidence that carbonatite lava erodes when the underlying strata is also carbonatite [8].

Previously it has always been assumed that for thermal erosion to occur the flow must be turbulent [9]. Recent findings [8] indicate that this may be a false assumption and that laminar flow may be effective in eroding the substrate.

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POLARIZATION PROPERTIES AND EARTH-BASED RADAR MEASUREMENTS OF VENUS IN THE POST-MAGELLAN ERA. D. B. Campbell, Department of Astronomy, Cornell University, Ithaca NY 14853, USA.

Studies of the polarization properties of reflected radar signals provide information about wavelength-scale surface and subsurface irregularities and can place constraints on the scattering models used to explain anomalously high backscatter cross sections, such as those measured for the surfaces of the icy Galilean satellites. The JPL aircraft-mounted synthetic aperture radars (SAR) provide cross-section and polarization information for terrestrial terrain types. Comparison of these measurements with results from the Magellan mission is helping to relate volcanic flow types on Venus to terrestrial equivalents [1]. Unfortunately, the Magellan SAR transmits and receives a single linear polarization so that information concerning the polarization properties is dependent on past and future observations from the Earth, primarily with the 12.6-cm wavelength (the same as Magellan) radar system on the Arecibo telescope.

Early radar observations of Venus discovered several areas on the planet that had both high backscatter cross sections and high circular polarization ratios (i.e., the ratio of the received power in the same sense as that transmitted to that in the opposite sense). Most prominent among these were Alpha and Beta Regiones and