

On the Significance of Venusian Canali: Landing Site Selection

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Venus Canali: What?

Arcuate to sinuous troughs

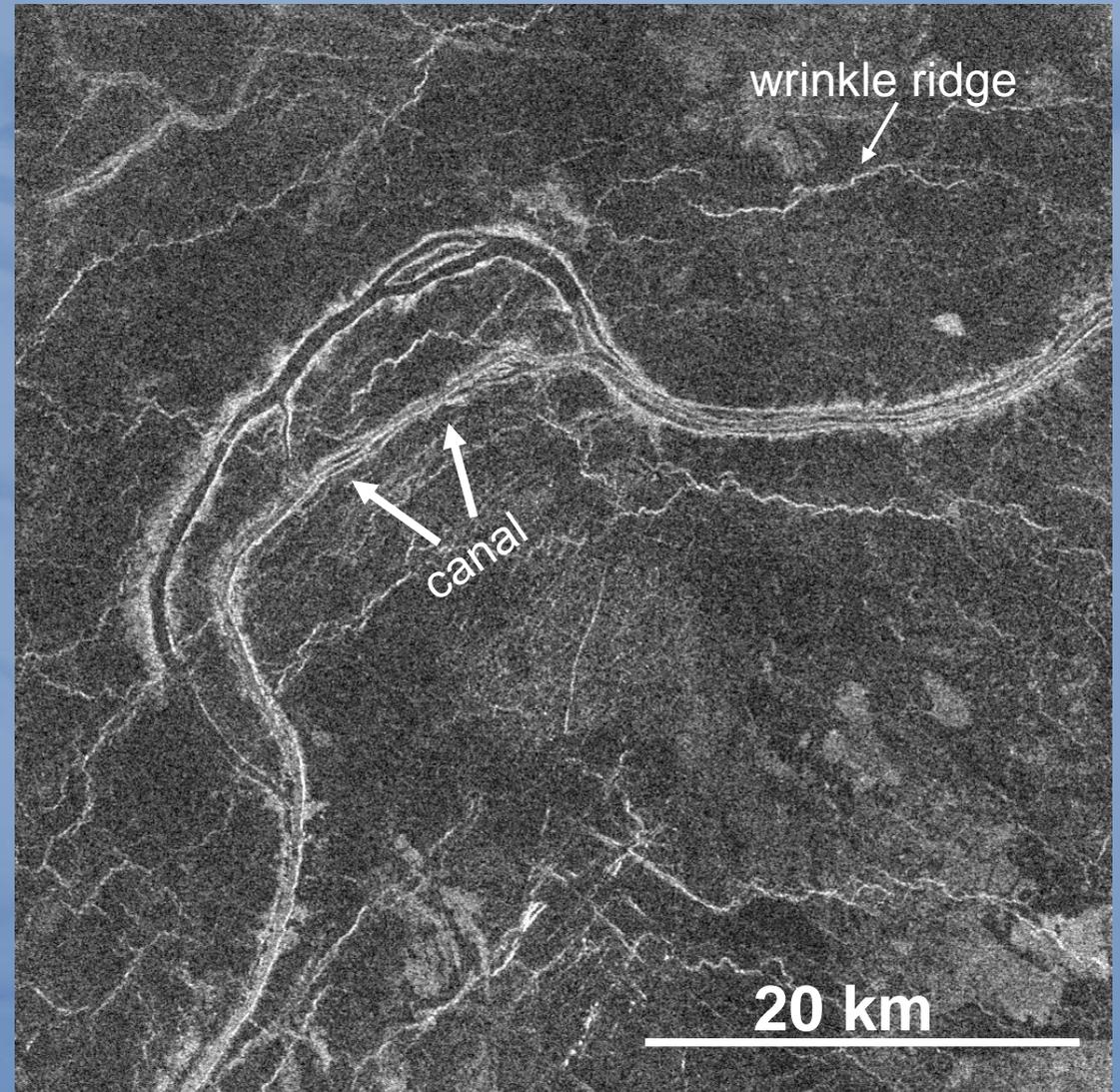
$10^1 - 10^3$ km long

Longest channel = Baltis Vallis,
>6800 km long

Almost constant widths (1 - 5 km)
along lengths

Limited branching (tributaries and
distributaries rare)

Similar to lunar sinuous rilles

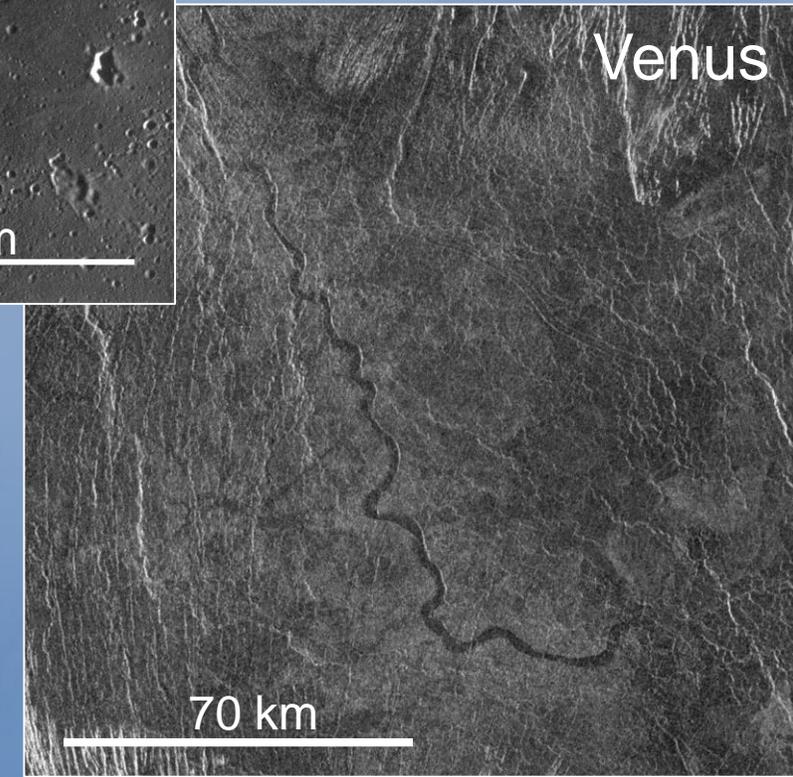
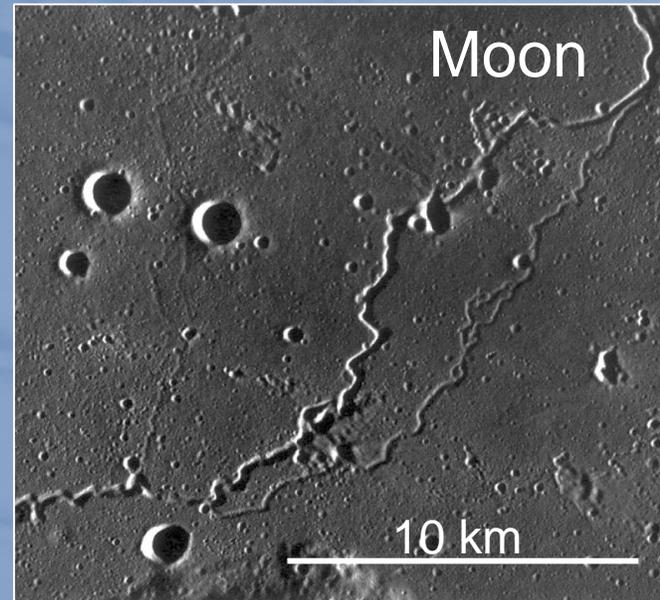


Venus Canali: Feeding the plains

Significance: similar to lunar sinuous rilles, likely contain the lava that created the Venusian plains

Rille lavas = Venusian plains

VEGA & Venera Landers = composition of Venusian plains



Venus Canali: How?

Requires liquid to form
Lava

Basalt?

Something more exotic?

carbonatite

komatiite

sulfur

Kilauea, Hawaii



drained lava channels

Venus Canali: How?

Lava erosion vs. lava construction

Erosion: thermal, mechanical, or both?

Construction: collapsed lava tubes, drained lava channels?



Venus Canali: Construction

Collapsed lava tubes
Drained lava channels
Mafic lavas
basalt
komatiite



Venus Canali: Erosion (mechanical)

Requires exotic lava
compositions

Lavas with low (<730 K)
solidification temperatures

carbonatite

sulfur

(Kargel et al., 1994)

Natrocronatite



Venus Canali: Erosion (thermal)

- Fully turbulent lava flows? (*Wilson and Head, 1981*)

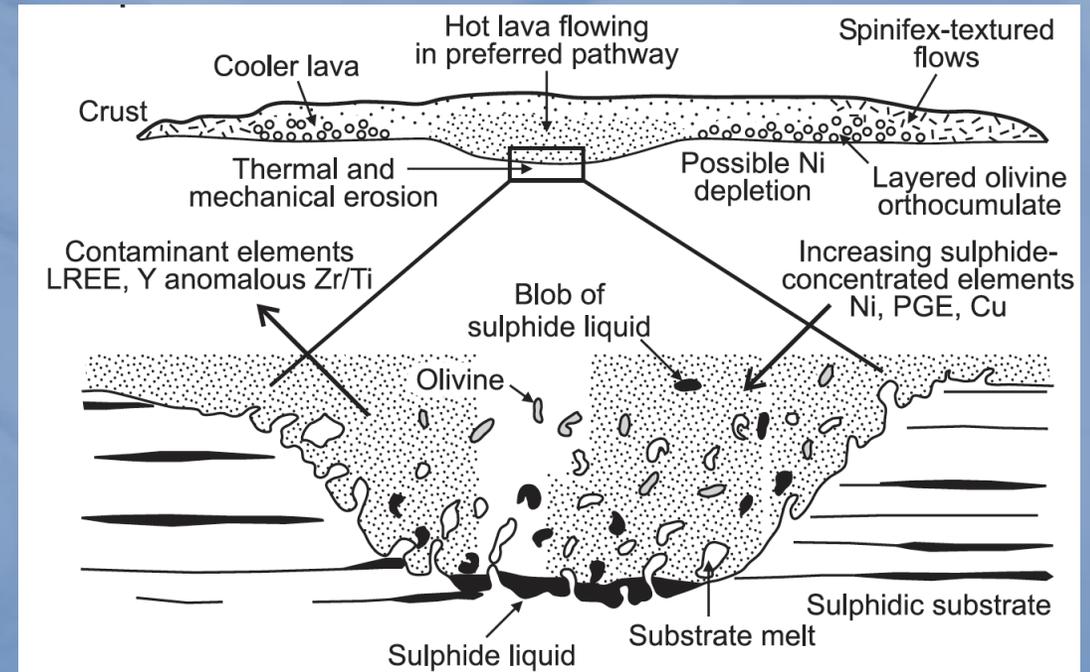
- high effusion rates
- low-viscosity lavas
- efficient heat transfer
- short eruption duration

- Laminar lava flows?

- low, steady effusion rates
- long eruption durations
- thermal conduction

downcutting

Thermal erosion in terrestrial komatiites



McQueen (2005)

Erosion vs. construction: Significance

Turbulent lava erosion:

- requires conditions not observed on Earth today
- requires violently high effusion rates for entire eruption

Laminar (thermal diffusion) lava erosion on Earth ~10 cm/day downcutting: no exotic lavas required



Venus canali: Parameter space example

Input:

Basalt lava (*Barsukov, 1992*)

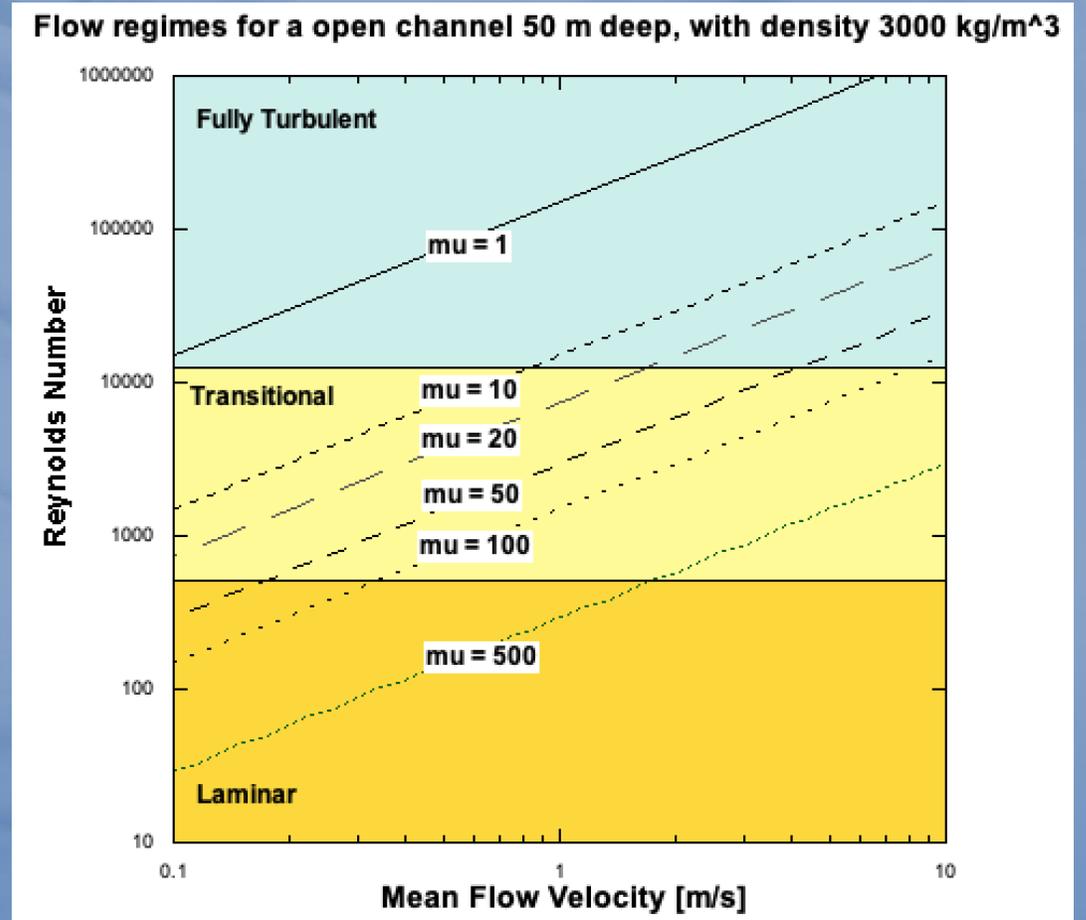
ρ = density = 3000 kg/m³

μ = viscosity = 1 - 500 Pa s

open-channel flow

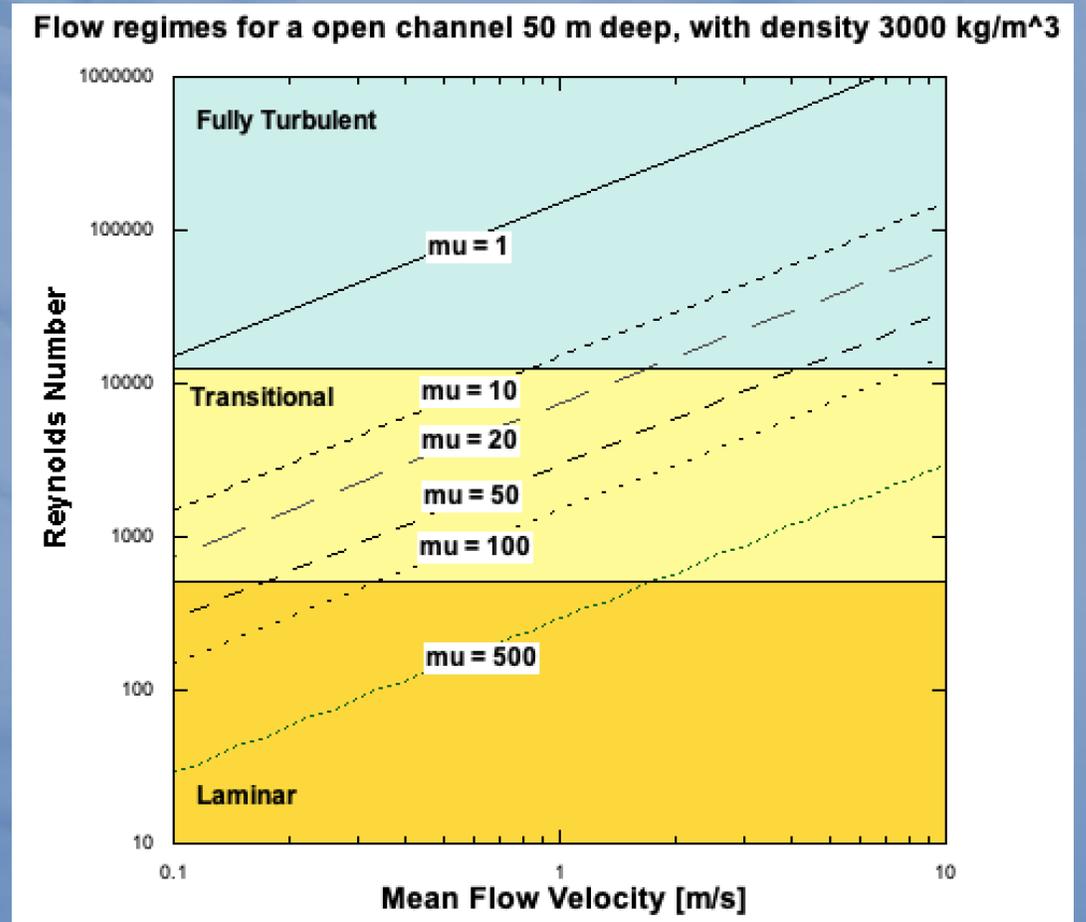
lava depth = 50 m

channel width = 5 km



Venus canali: Parameter space example

Fully turbulent (mechanical erosion) requires exotic lavas (carbonatites, sulfur)
 Transitional, laminar regimes can be basalt
(Sakimoto and Gregg, 2001)



Venus landing sites: Land near canale (as safely as possible)

- Canali-fed plains lavas: what are they?
- Look for constructional levees
 - Levees higher than surrounding plains
 - Spatter ramparts
 - Spillovers
 - Bingham fluid behavior
- Look for layers exposed in canali walls (cf. Hadley Rille)
 - Thick? Thin? Similar to Moon? Earth?
 - Accurate canali dimensions



References

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Venus Canali: Probably Basalt

Venera / VEGA landers
consistent with basaltic
plains (Barsukov, 1992)

Morphology

Analogy with lunar sinuous
rilles