

# *Venus: Craters, Coronae, and Chasmata*



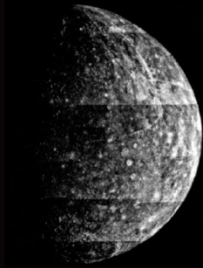
*Donna M. Jurdy*

*Northwestern University*

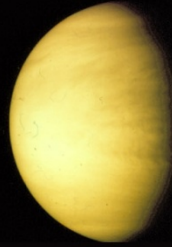
# Early View of Venus



Mercury



Venus



Earth



Moon



Mars



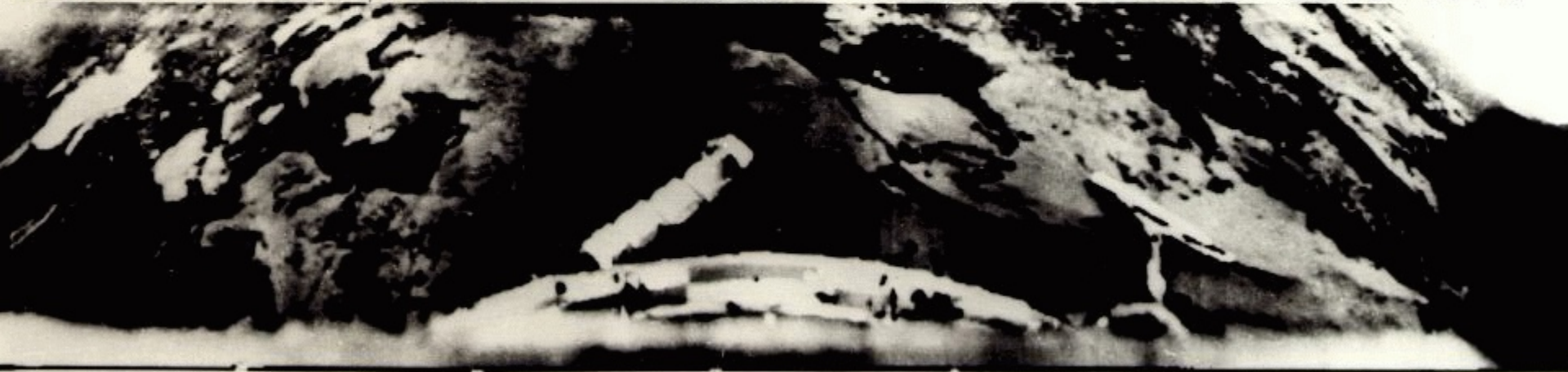
Radius (km)	2439	6052	6378	1738	3398
Mass (kg)	$3.30 \times 10^{23}$	$4.87 \times 10^{24}$	$5.98 \times 10^{24}$	$7.35 \times 10^{22}$	$6.42 \times 10^{23}$
Density (kg/m <sup>3</sup> )	5420	5250	5520	3340	3940
Distance from the Sun (A.U)	0.387	0.723	1.000	---	1.524
Mean Surface Pressure (bars)	---	92	1	---	0.006
Mean Surface Temp (K)	452	726	281	250	230
Atmosphere	---	CO <sub>2</sub>	N <sub>2</sub> , O <sub>2</sub>	---	CO <sub>2</sub>

# Venus, as seen by Veneras 9 and 10



ВЕНЕРА-9 22.10.1975

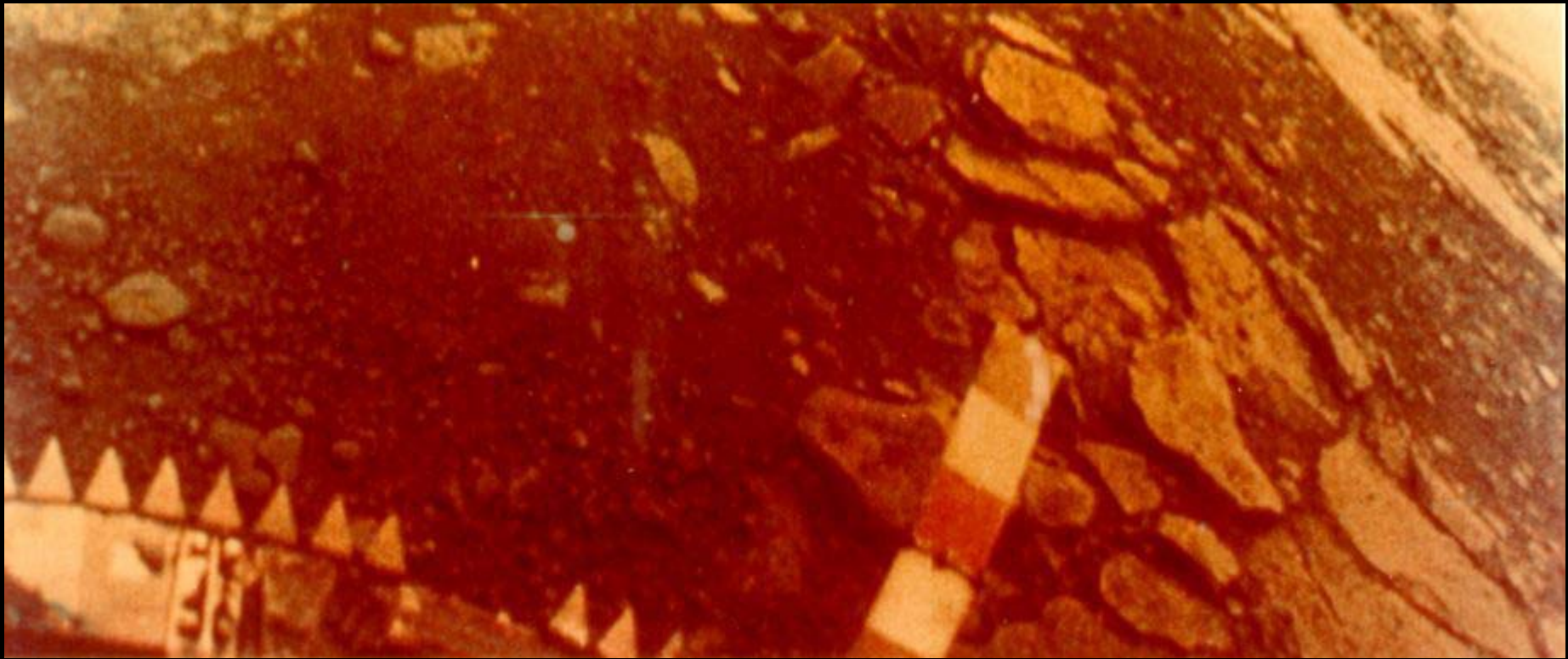
ОБРАБОТКА ИППИ АН СССР 28.2.1976



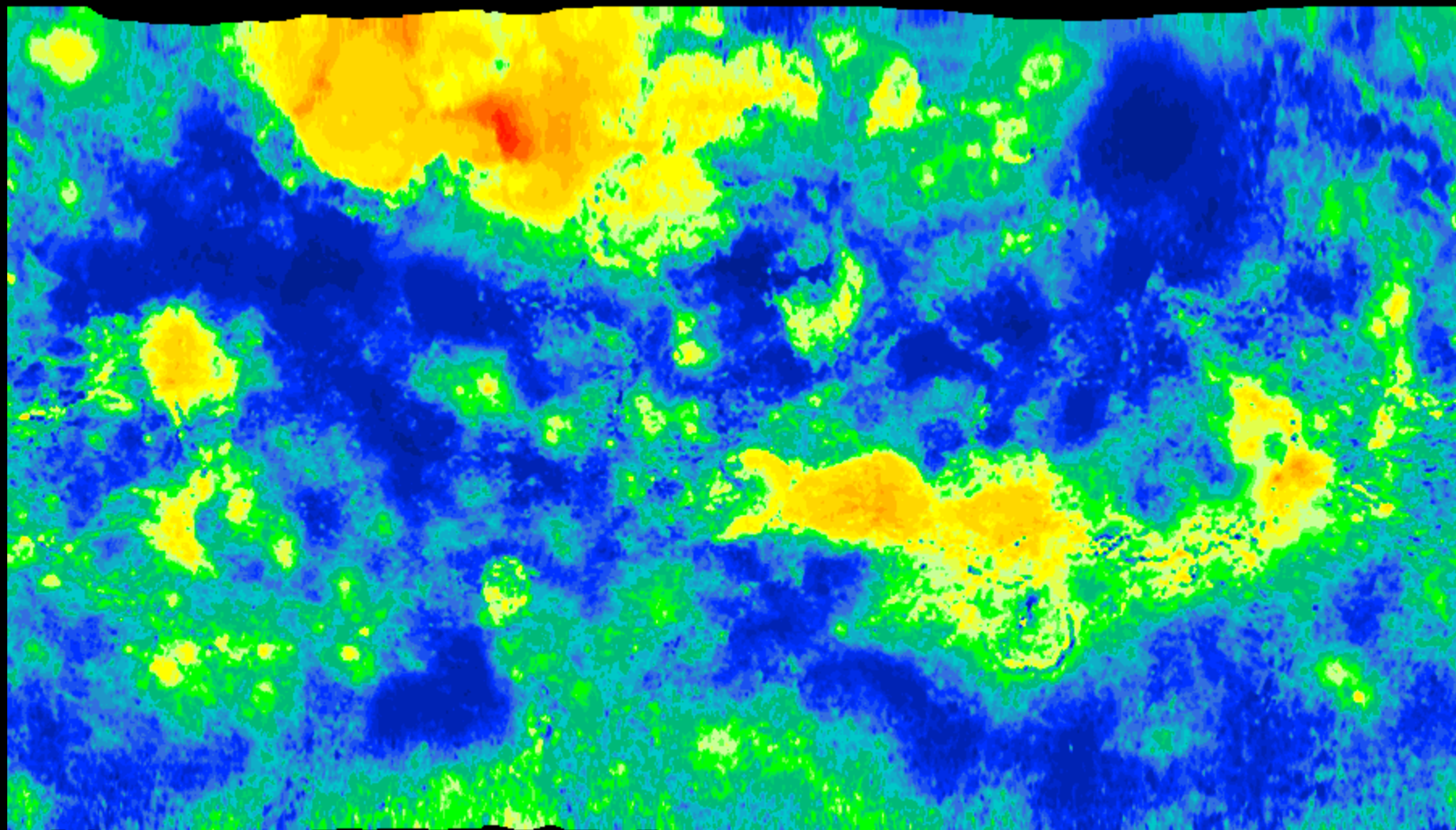
ВЕНЕРА-10 25.10.1975

ОБРАБОТКА ИППИ АН СССР 28.2.1976

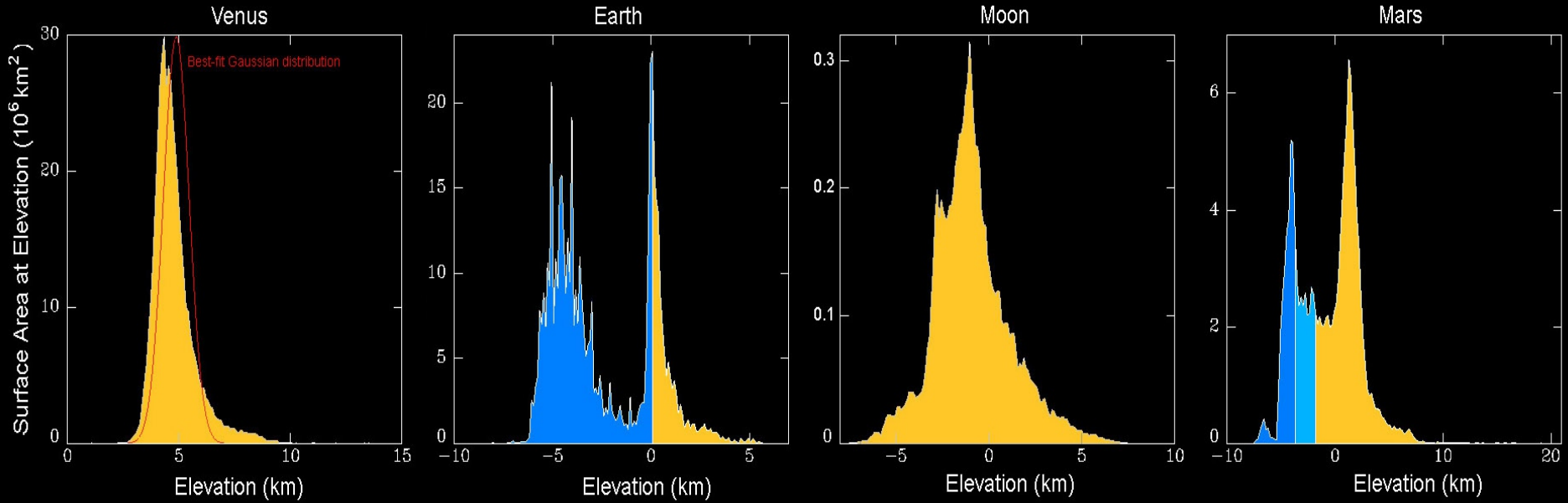
# Venus as seen by Venera 13 (1-Mar-1982)



# Pioneer Venus Topography



# Inner Solar System Hypsographic Comparisons

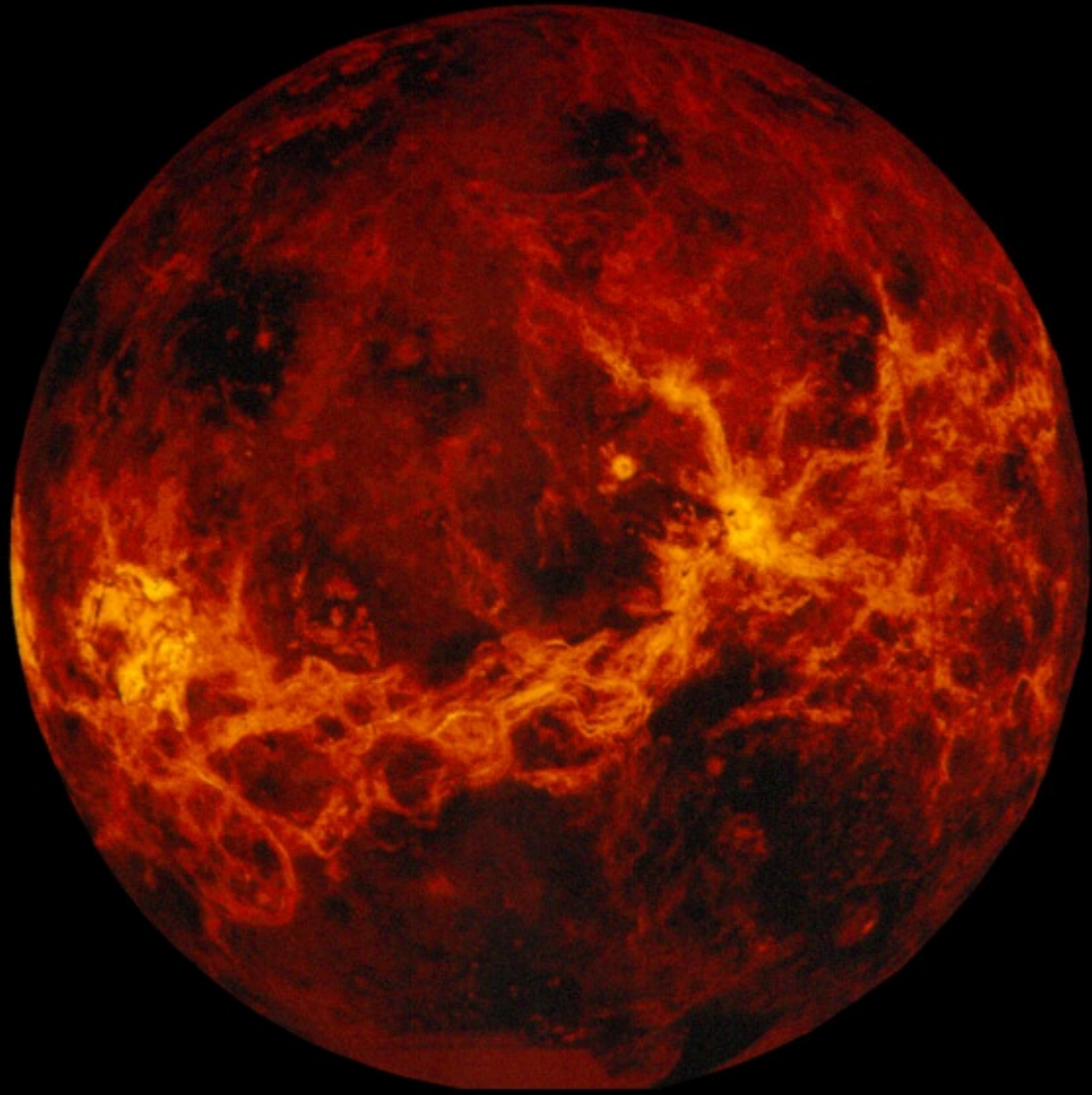


# Magellan Deployment



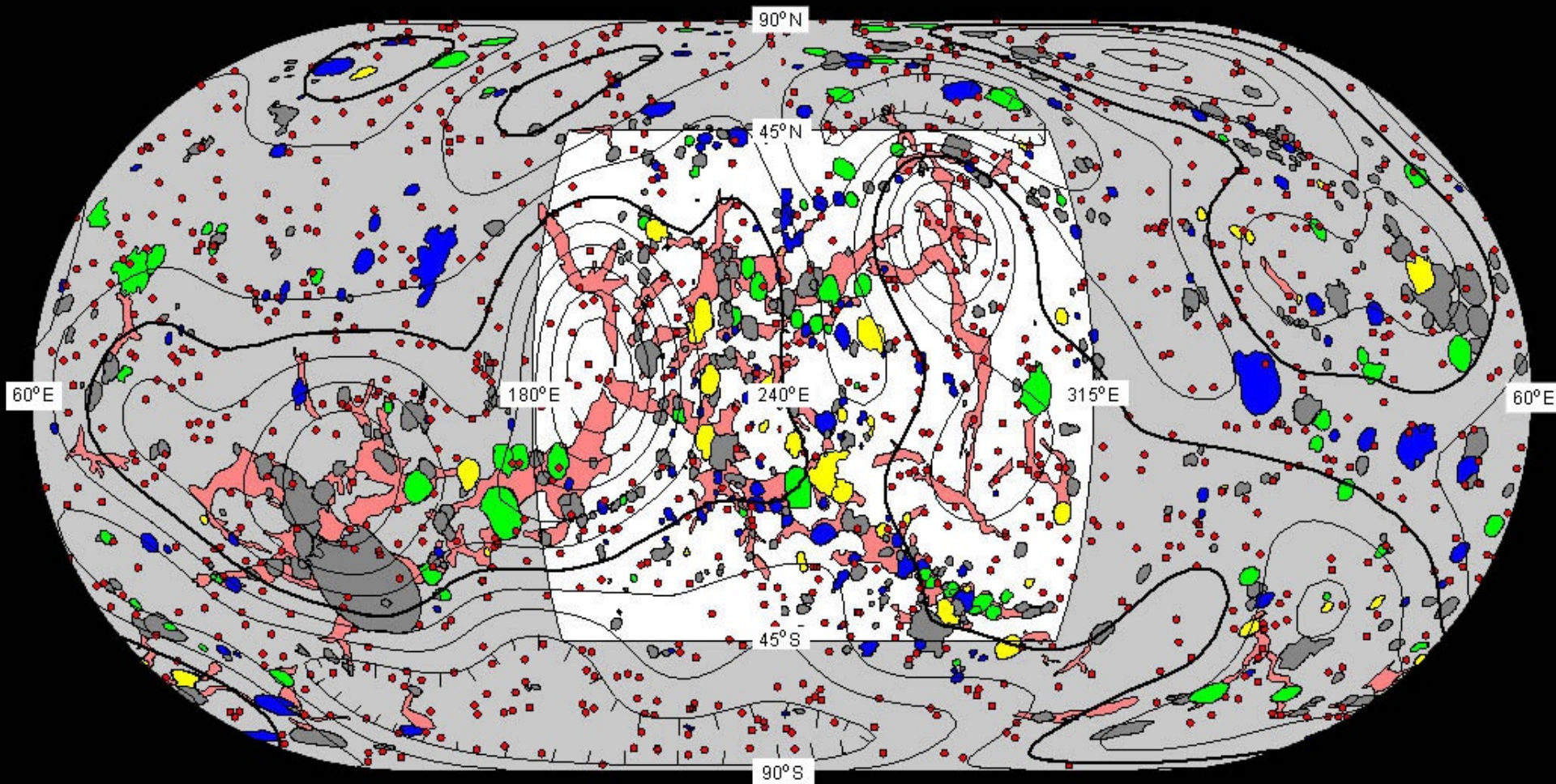




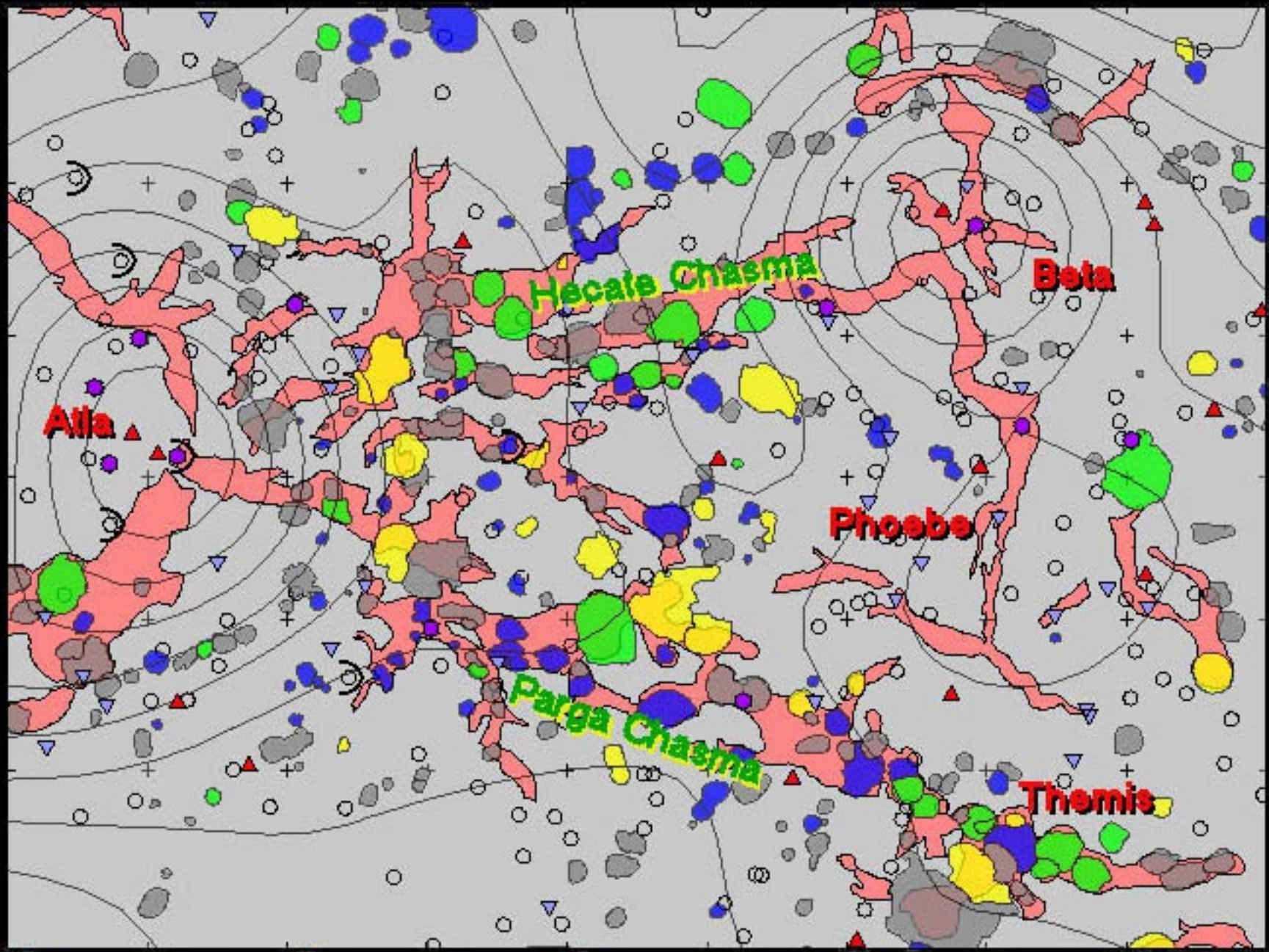


# Venus Chasmata, Coronae, Craters, and Geoid

(Eckert IV projection)

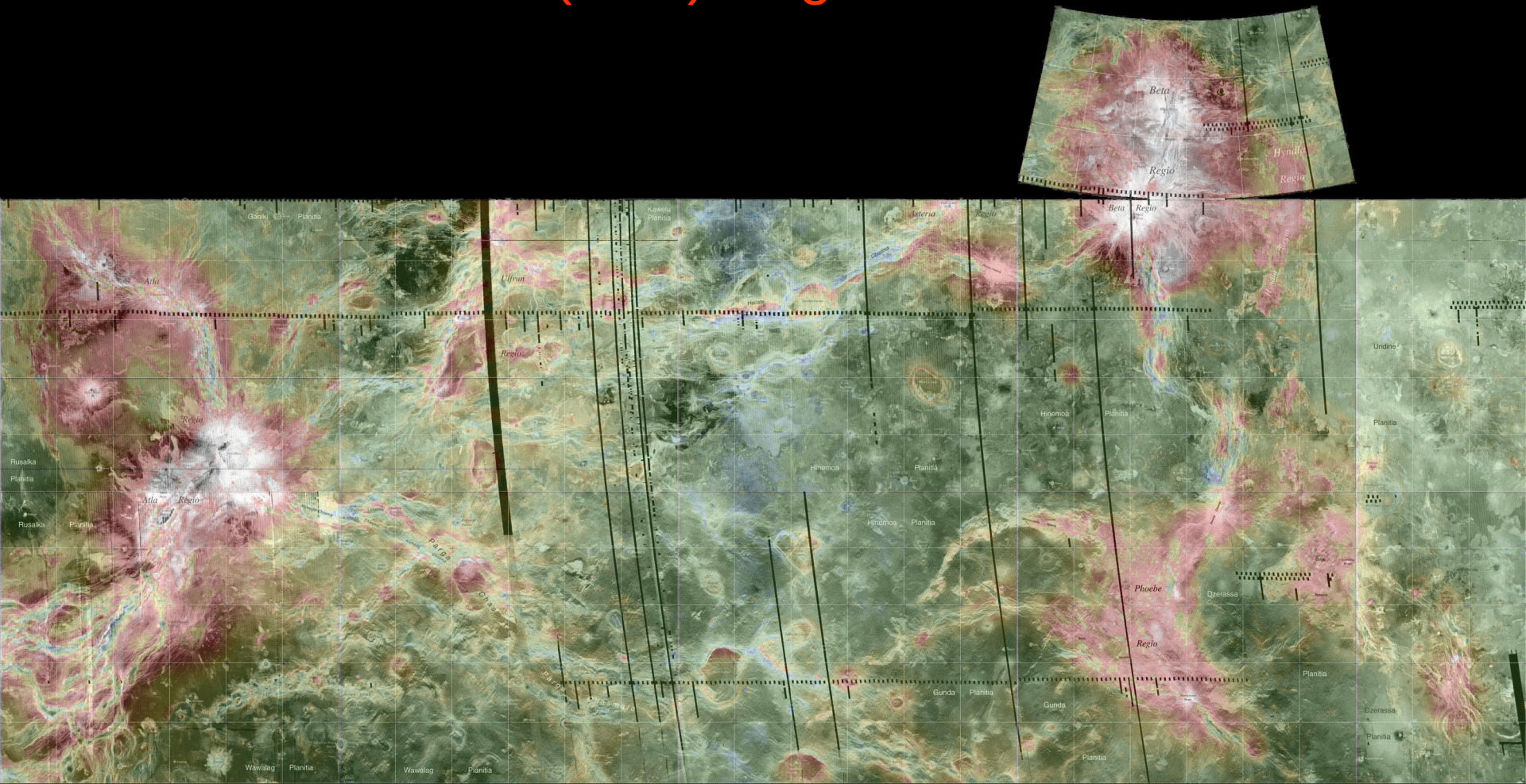


45°N  
30°N  
15°N  
0°N  
15°S  
30°S  
45°S



180°E 210°E 240°E 270°E 300°E

# Beta-Atla-Themis (BAT) Region



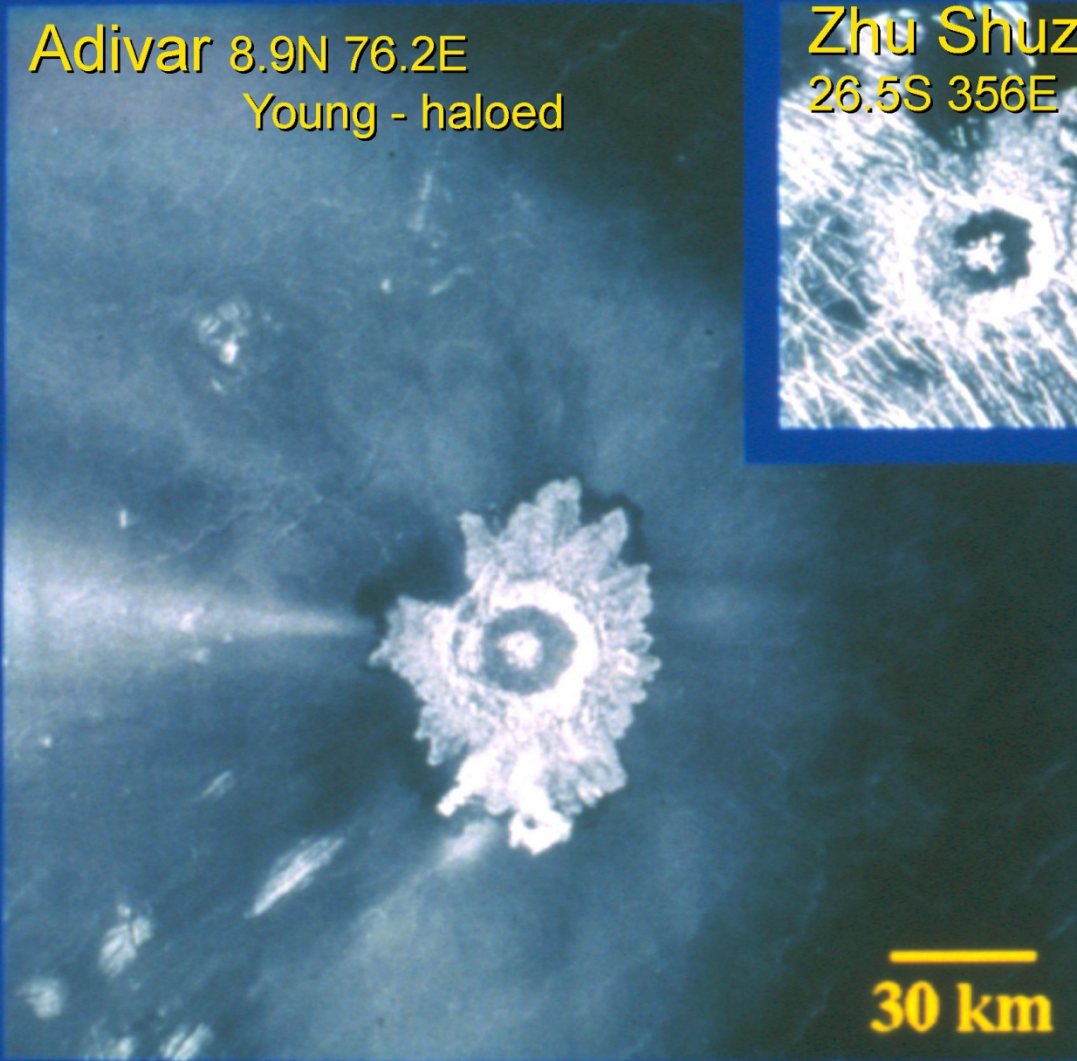
# Craters

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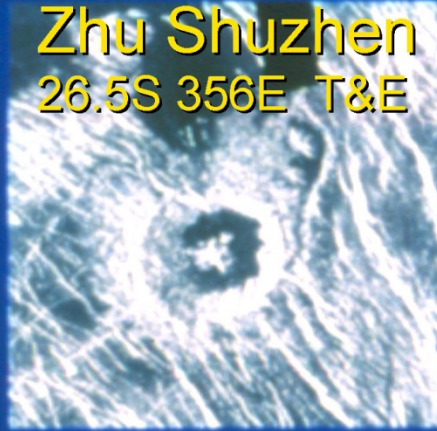
- About 1000 globally
- Apparent random distribution
- Most pristine, some modified
  - Tectonization
  - Embayed
  - West-opening Haloes (very young craters)

# Craters on Venus

Adivar 8.9N 76.2E  
Young - haloed



Zhu Shuzhen 26.5S 356E T&E



Bashkirtseff 14.7N 94.1E  
Embayed



Balch 29.9N 282.9E  
Rifted

# Chasmata

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- Probable analog to Earth rifts
- Total length of Venus chasmata system similar (when adjusted for planetary radius) to that of Earth's rift system (within ~95%)



# Venus Chasmata Example

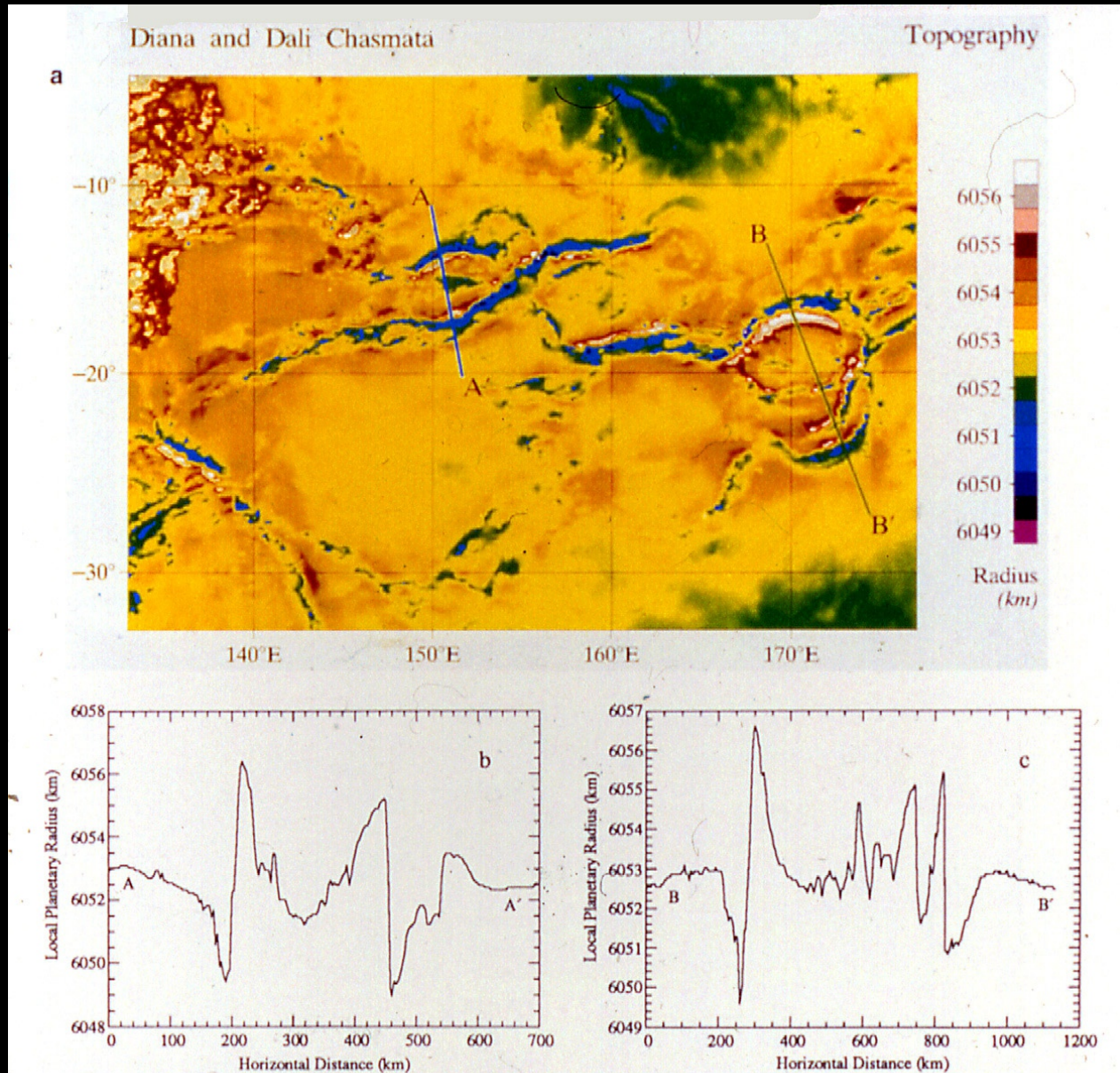
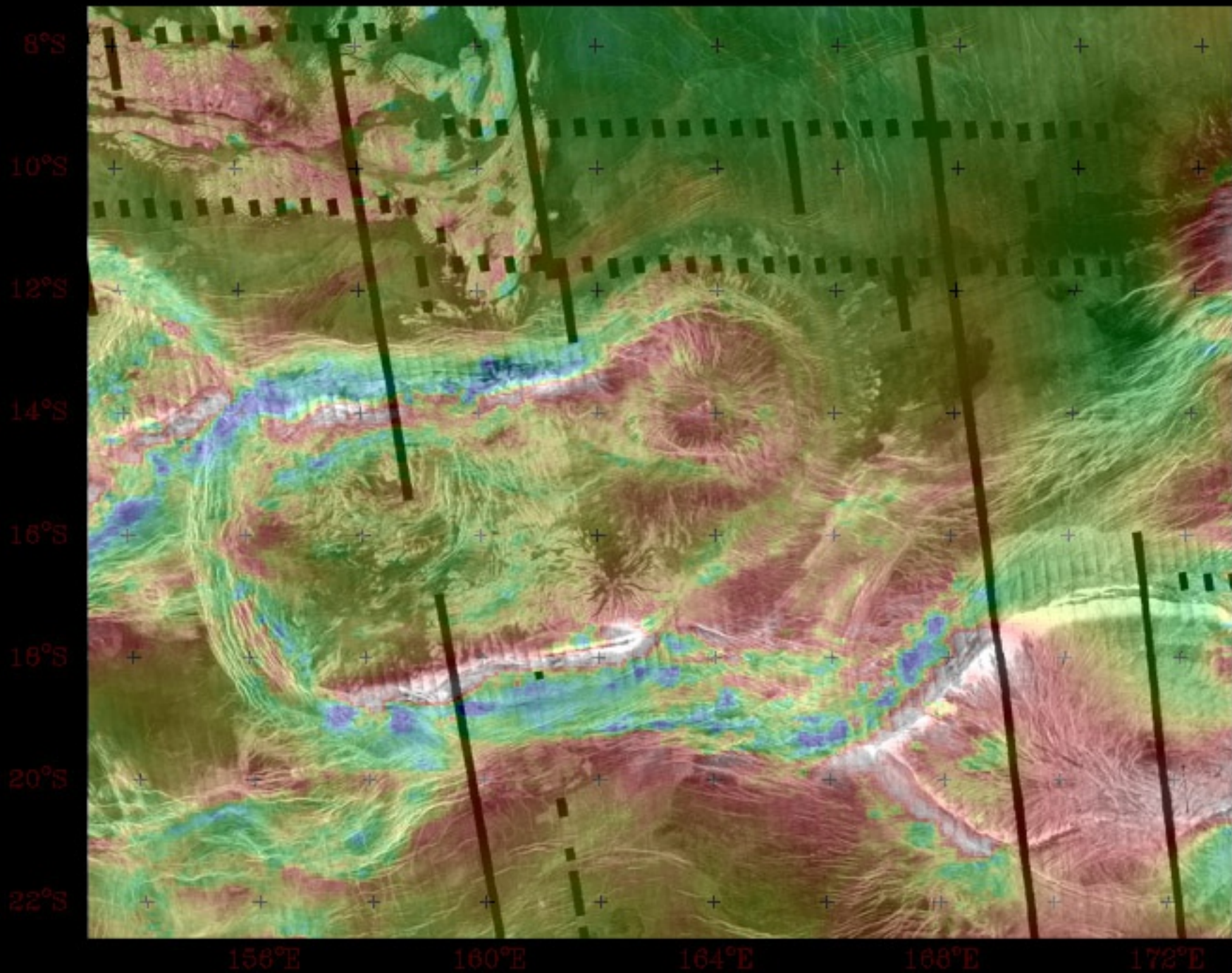


Plate 4. (a) Relief over Diana and Dali chasmata; (b) topographic profile along A-A'; (c) topographic profile along B-B'.



# Coronae

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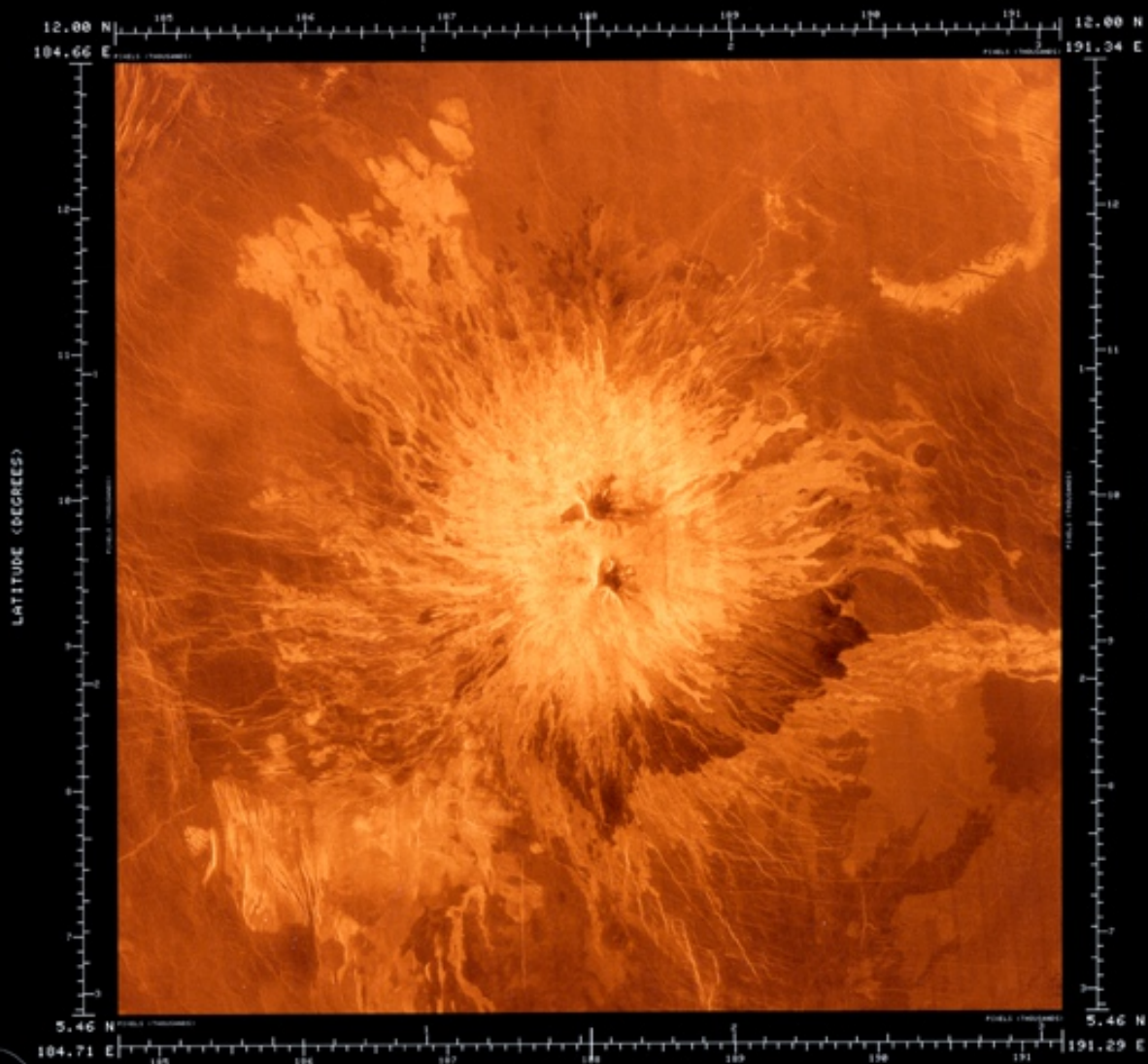
- Large volcanic features, marked by central topographic high or low, surrounded by annulus
- About 670 identified
- Not randomly distributed – concentrations near chasmata and in the B-A-T region
- Possible evolution scheme determined...

# Venus Volcanoes

MRF0 110  
MRF0 01 00 14 11.00 N1 0000 N1 0000 PNT 000 00  
D 100 1110 198701 JOB 000 0104  
Original MRF0 1 0010 Paper Note Colored with NASA Graphics



C1-MIDRP.09N188



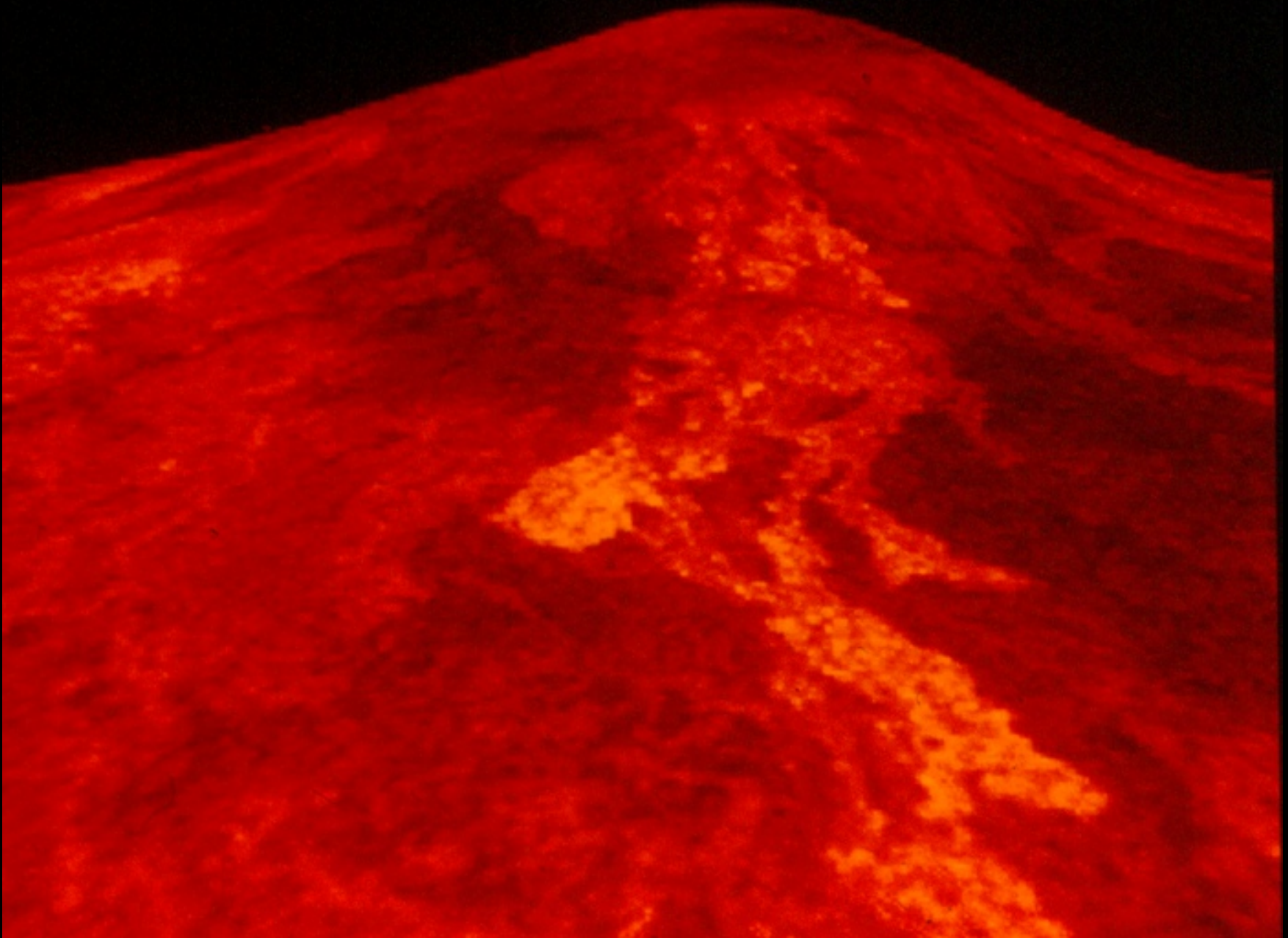
PROJECTION LONGITUDE: 188.00 DEGREES EAST



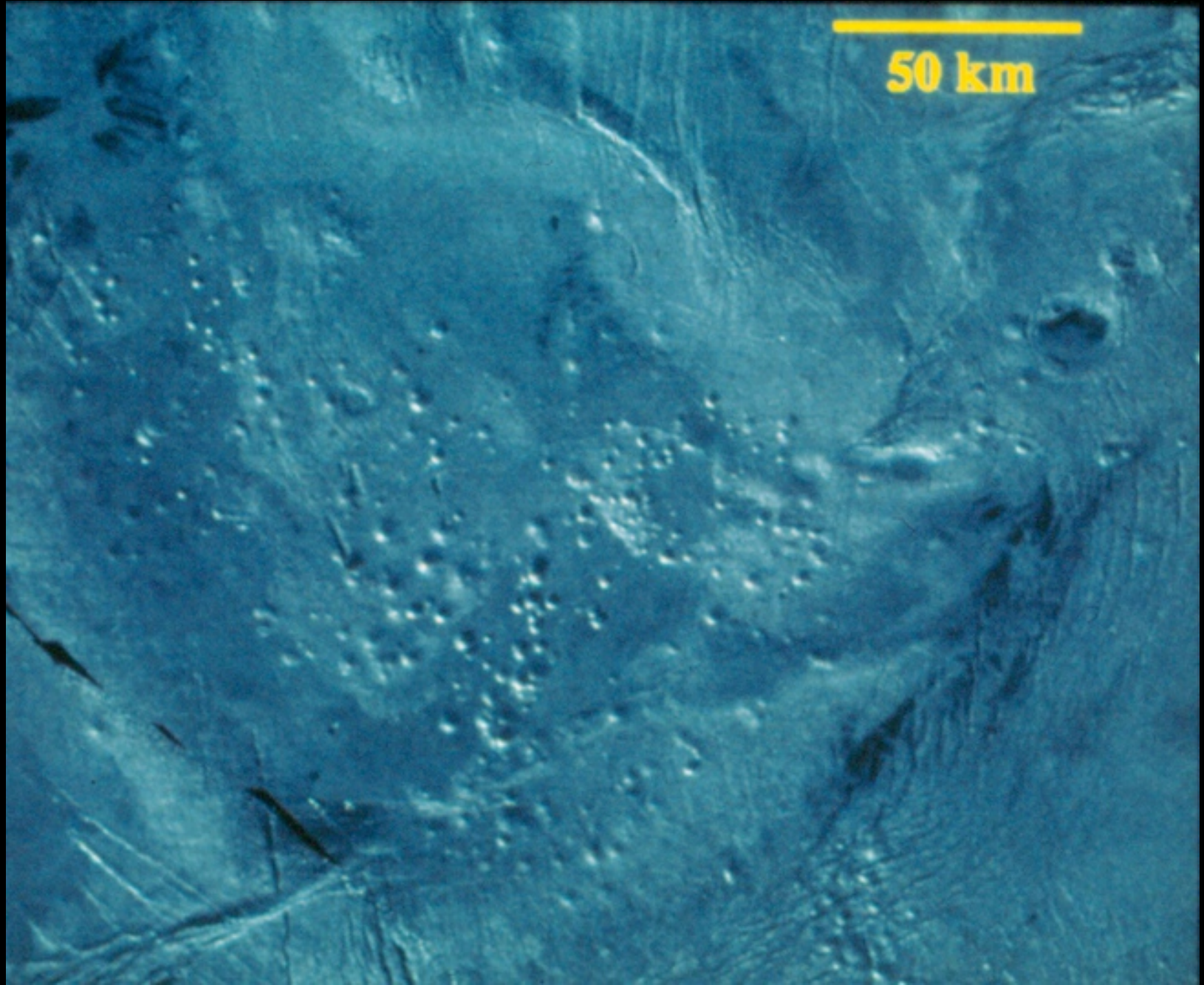
PIXEL SPACING: 225 METERS/PIXEL SINUSOIDAL PROJECTION



# Sif Mons

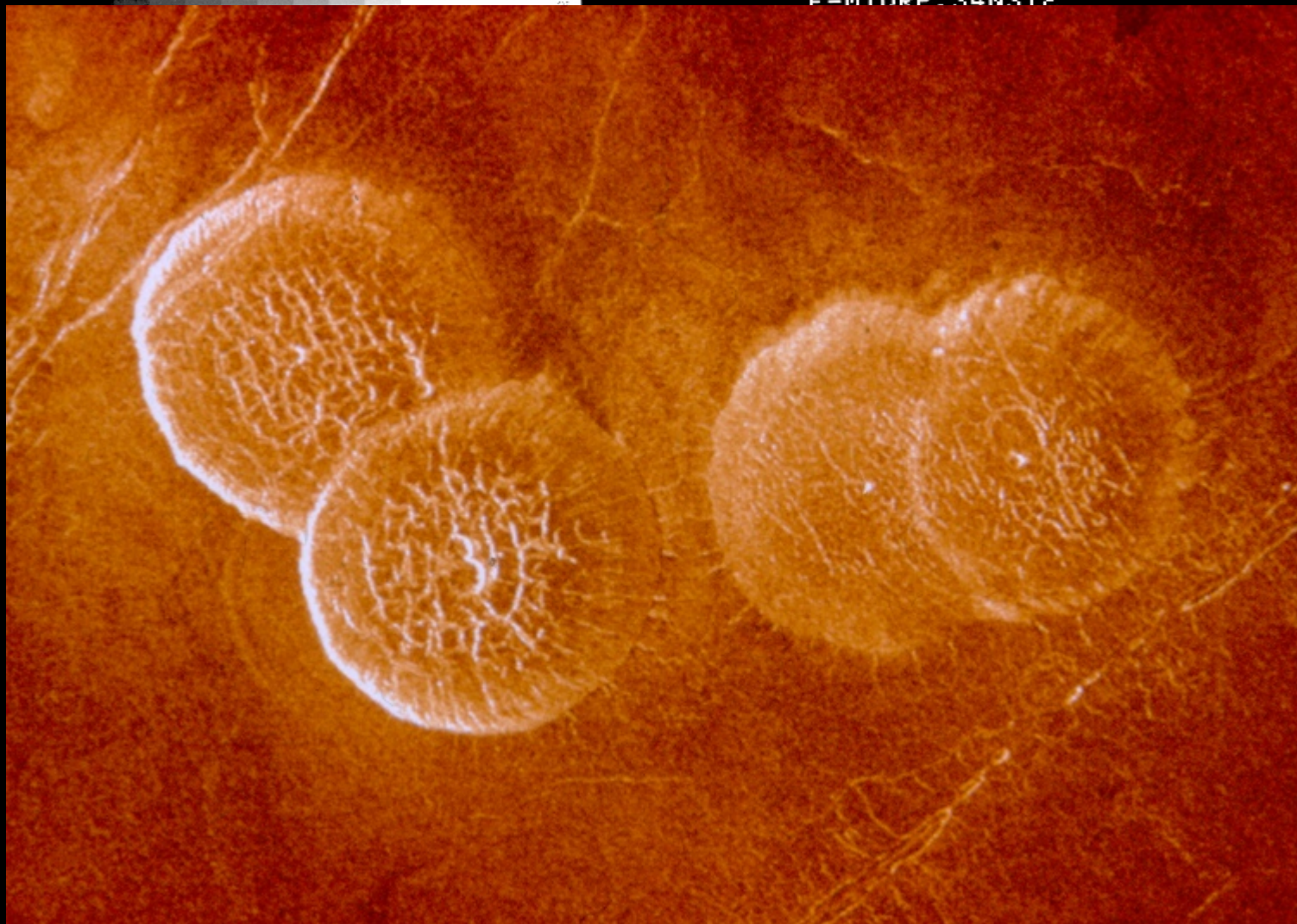


# Shield Field



# Pancake Domes

E-MIDRP\_34N312



30.00 N  
310.52 E | 311 | 312 | 312.72 E

PROJECTION LONGITUDE: 311.62 DEGREES EAST

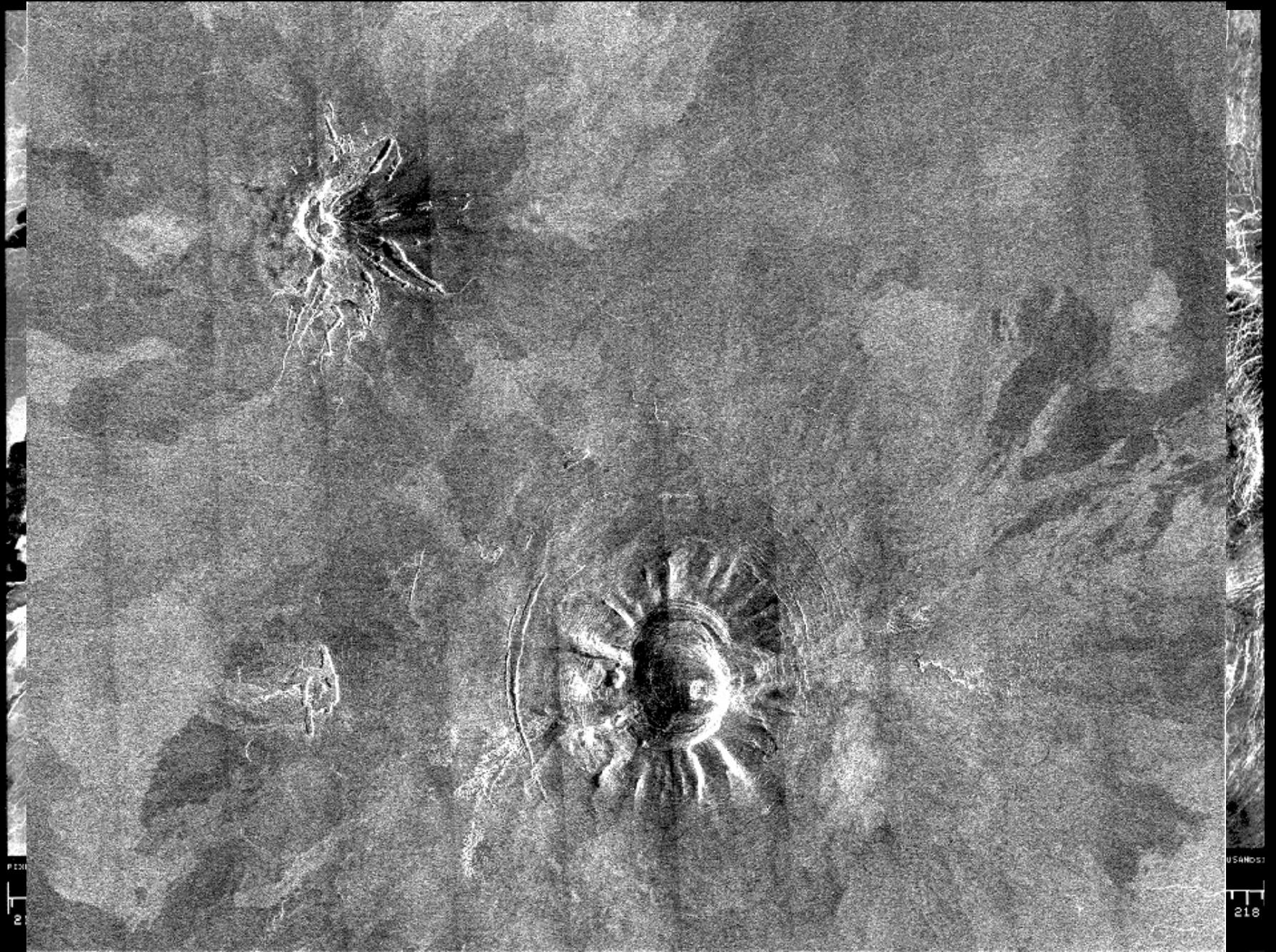
0 10 20 30 40  
KILOMETERS

PIXEL SPACING: 75 METERS/PIXEL

SINUSOIDAL PROJECTION

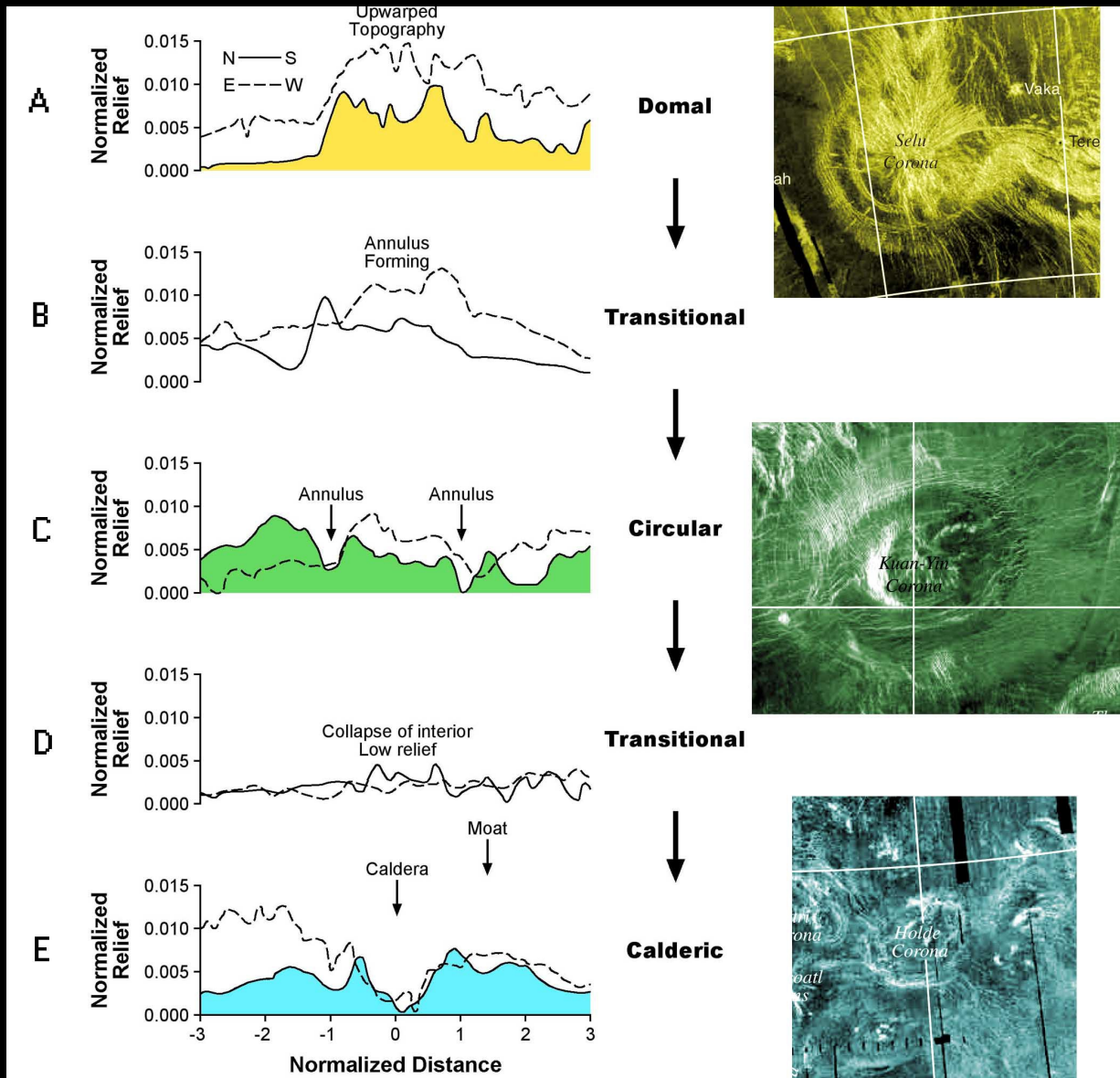


# Coronae

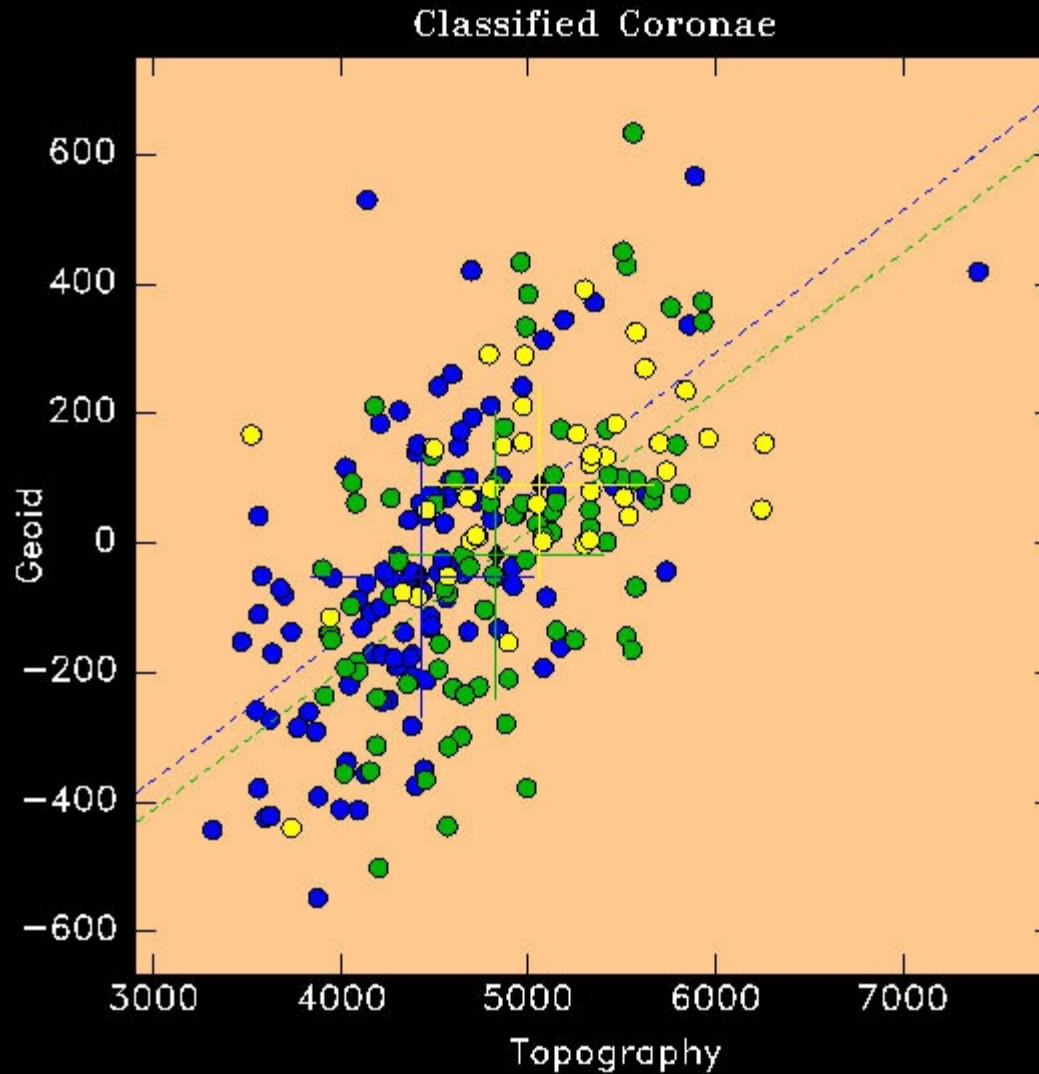




# Corona Evolution



# Sample Comparison of Coronae, by Type



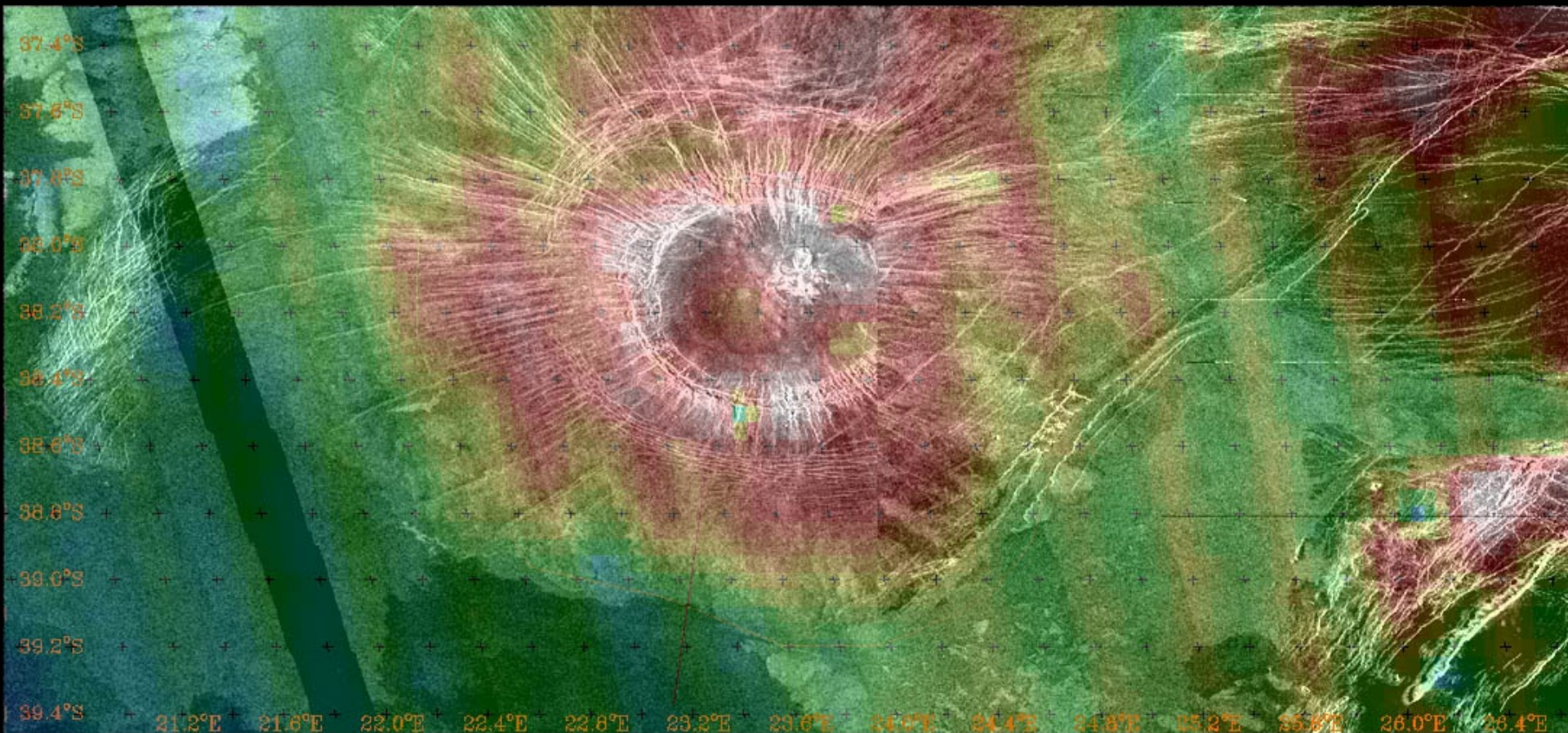
# Craters vs. Coronae

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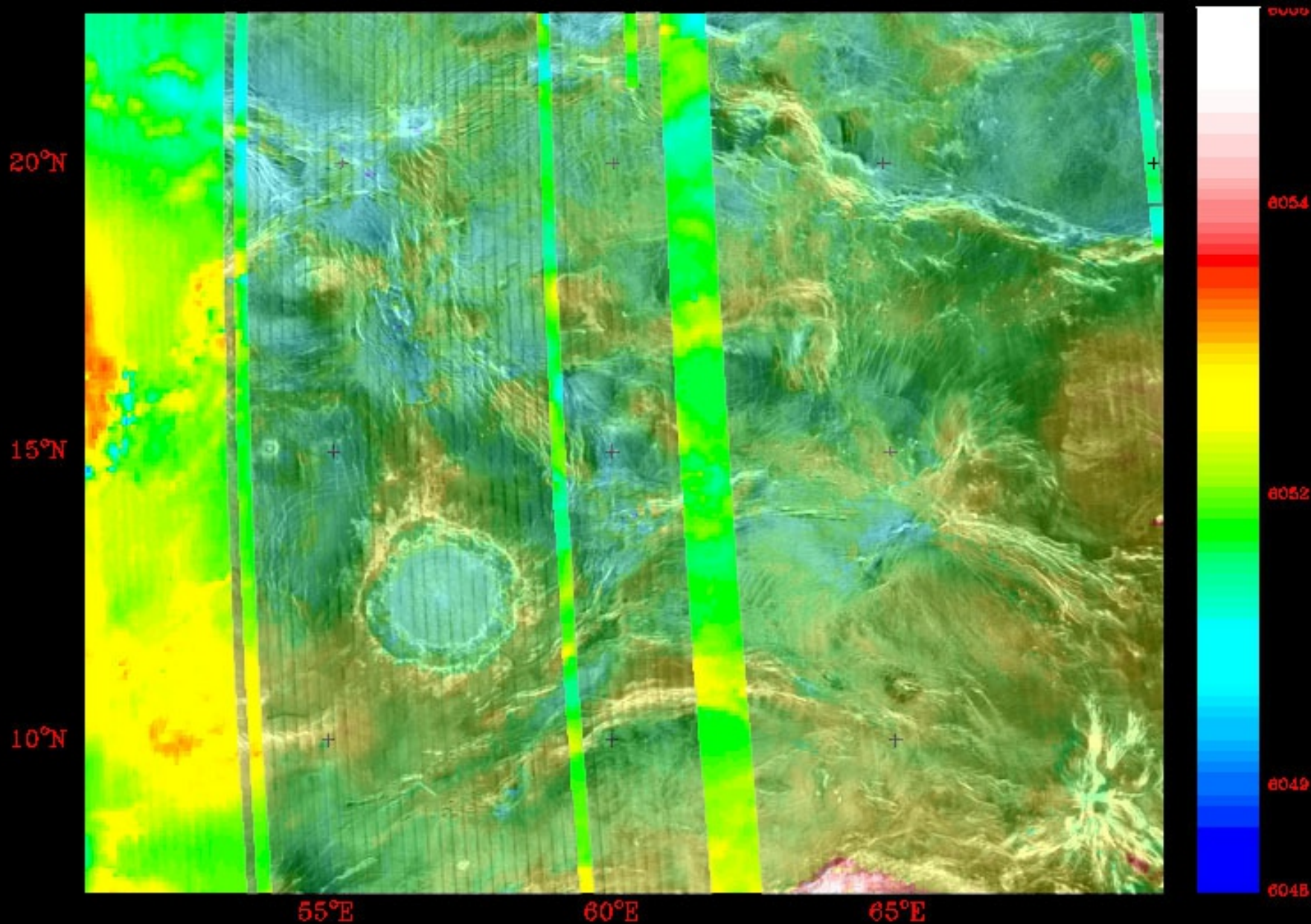
Recently, several researchers (Hamilton, Vita-Finzi, e.g.) have suggested that coronae are actually craters.

Comparison of topography may help assess this hypothesis.

# Ninhursag – Corona or Crater?

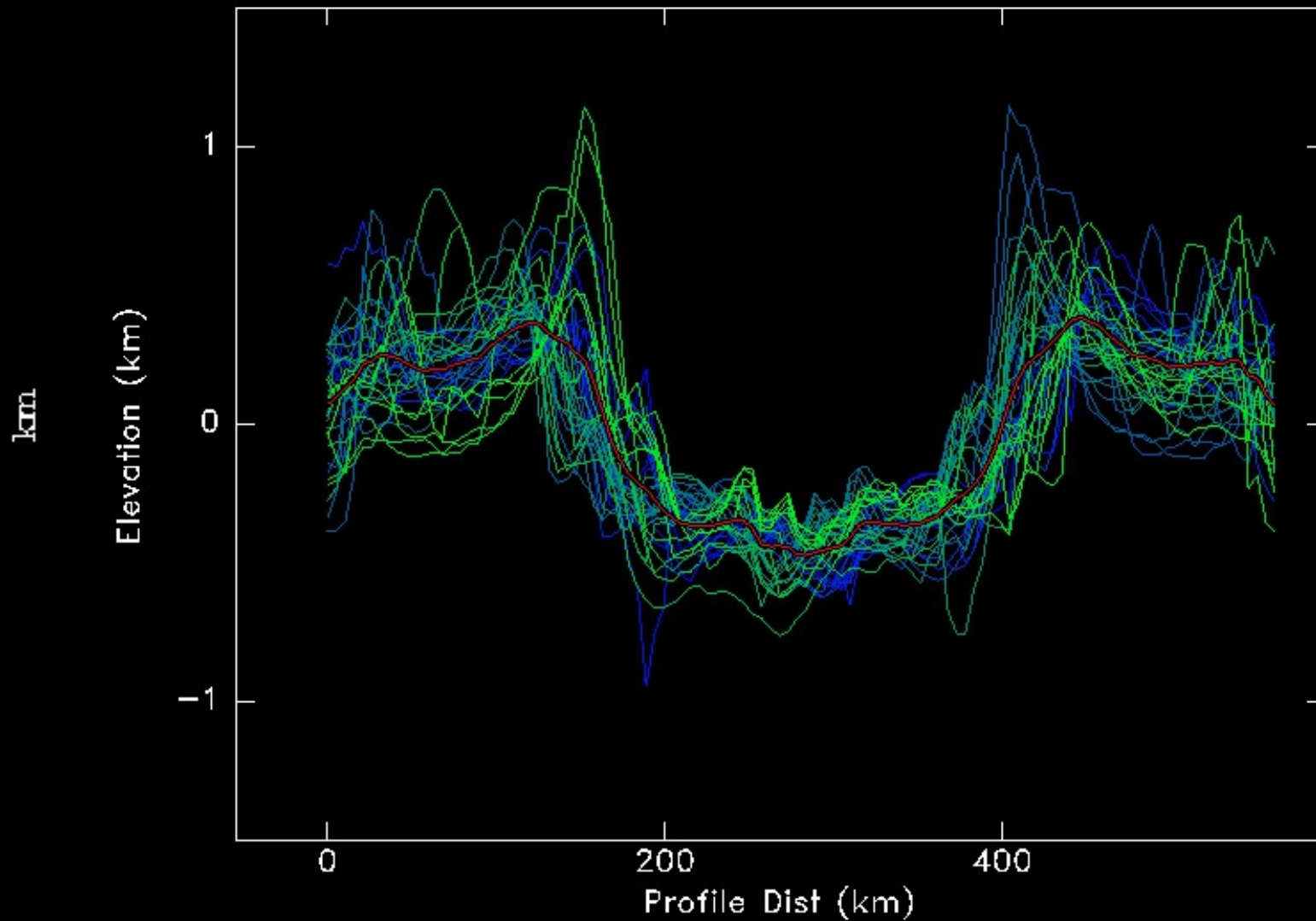


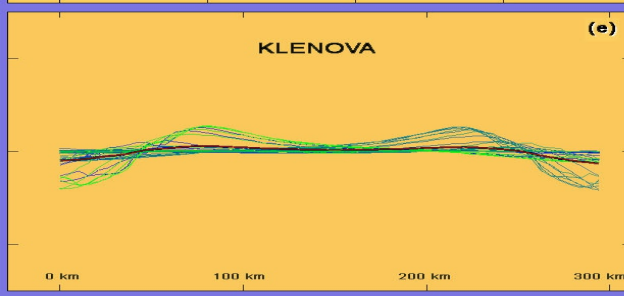
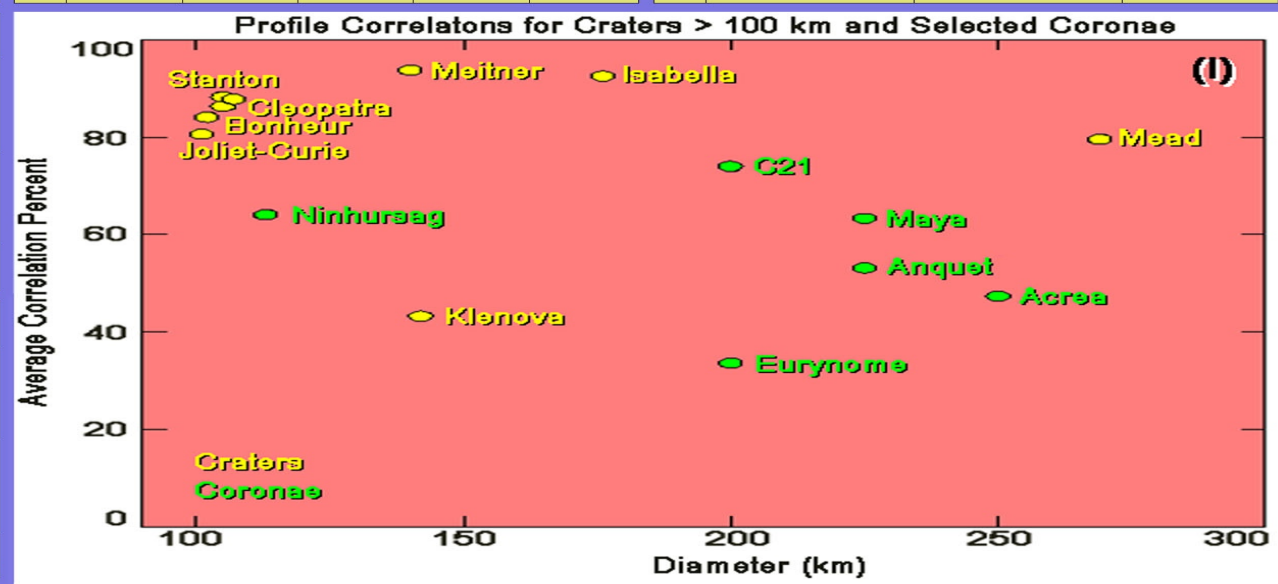
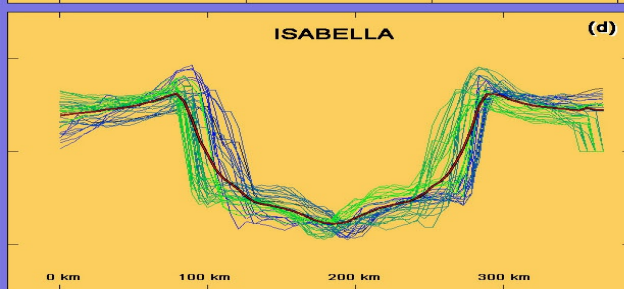
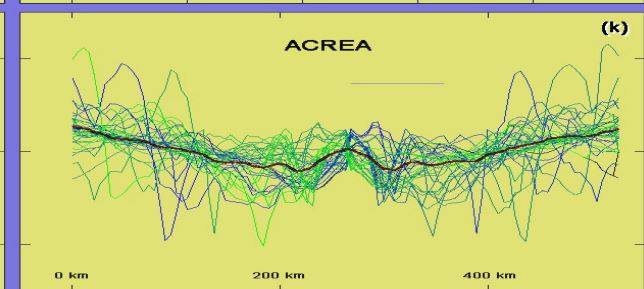
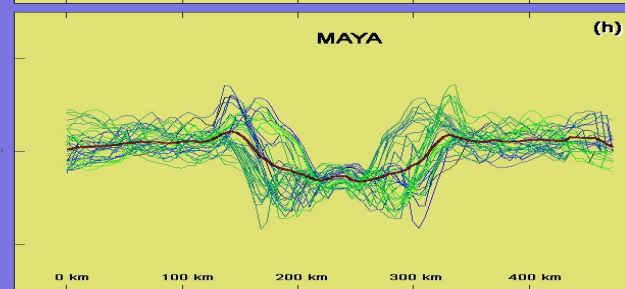
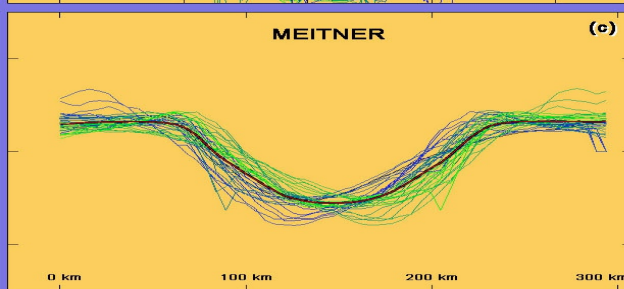
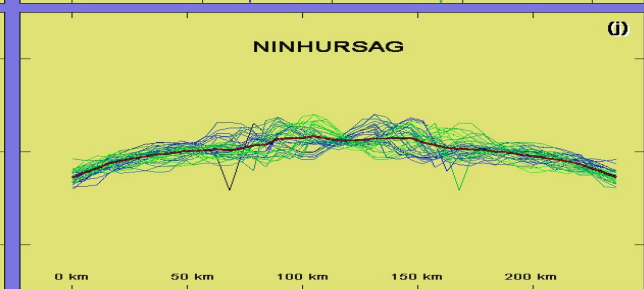
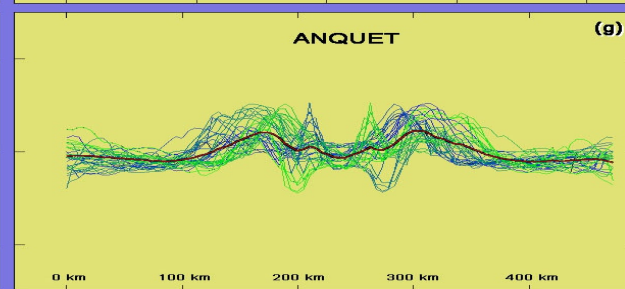
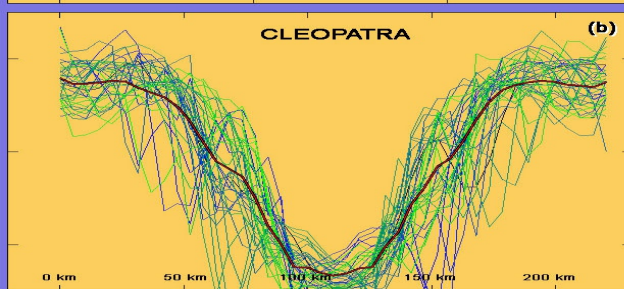
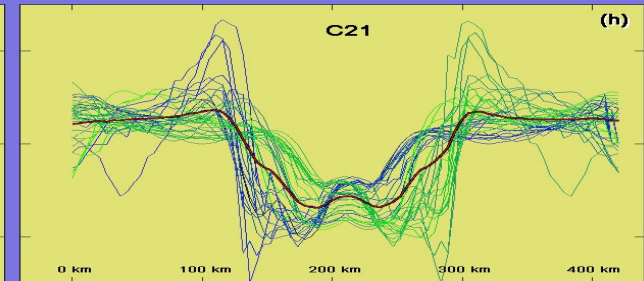
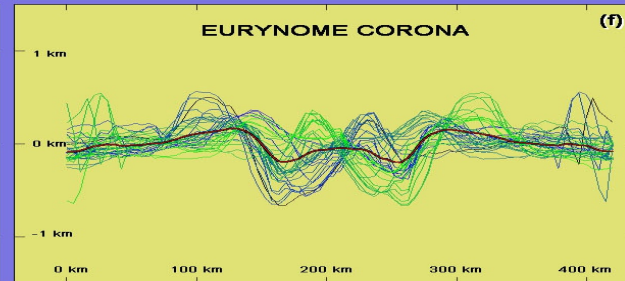
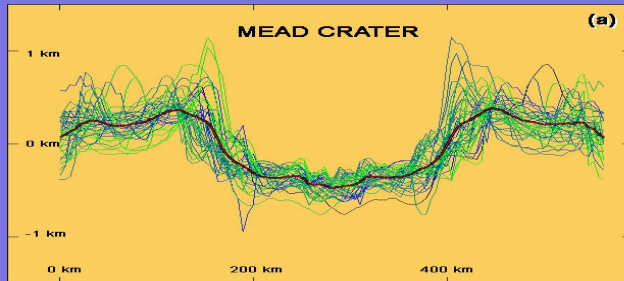
# Mead Crater – Radar and Topography



# Cross-Correlation Example

Mead

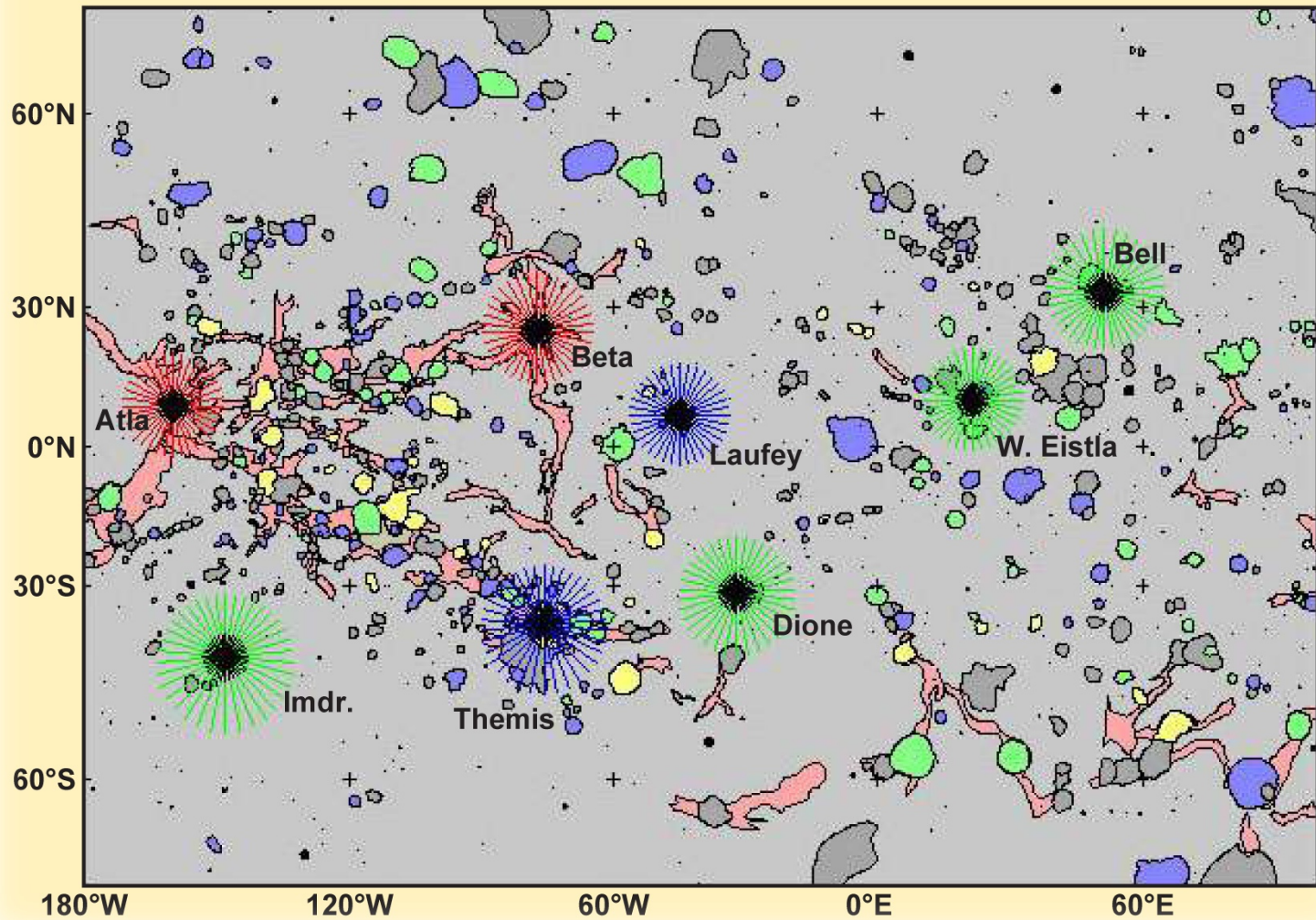






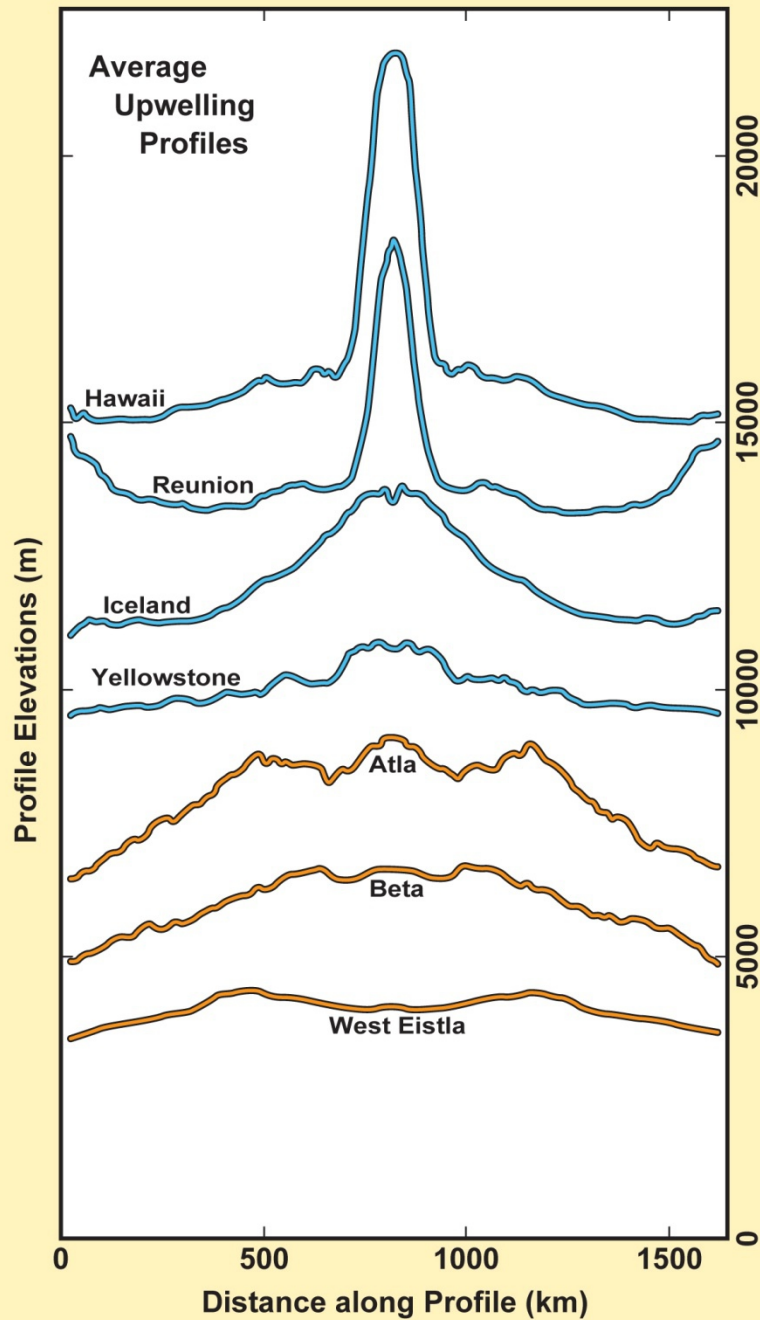


# Venus Profiles

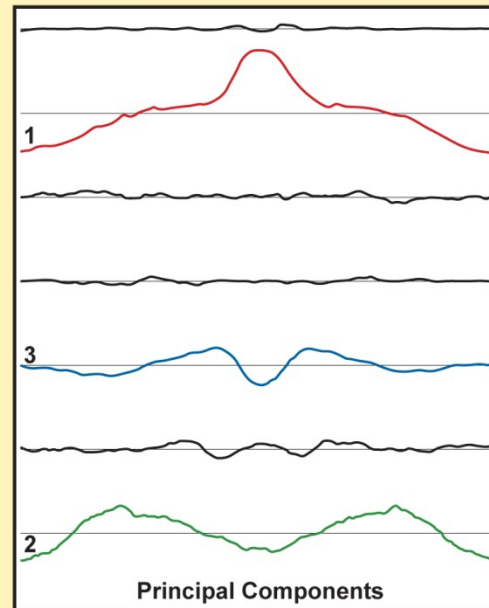
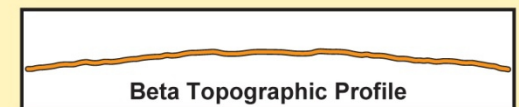
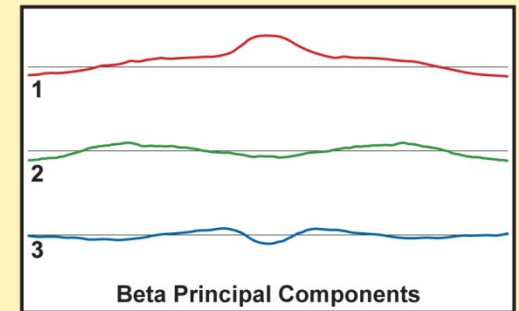
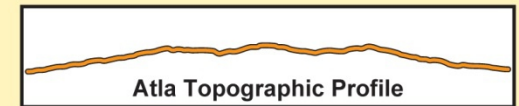
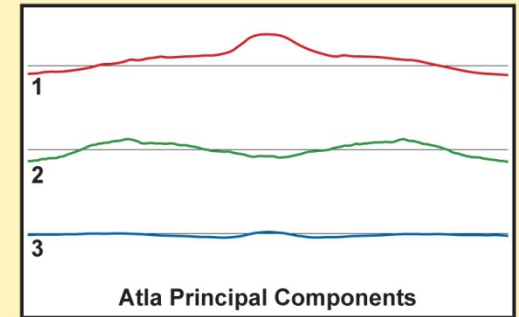
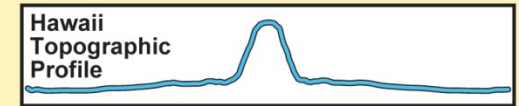
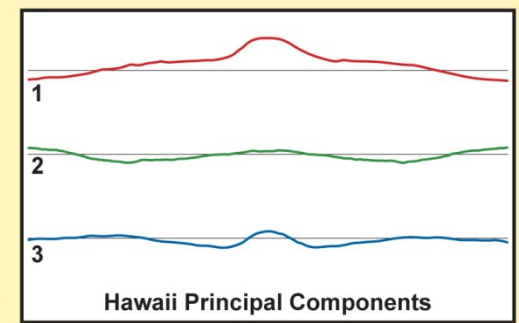


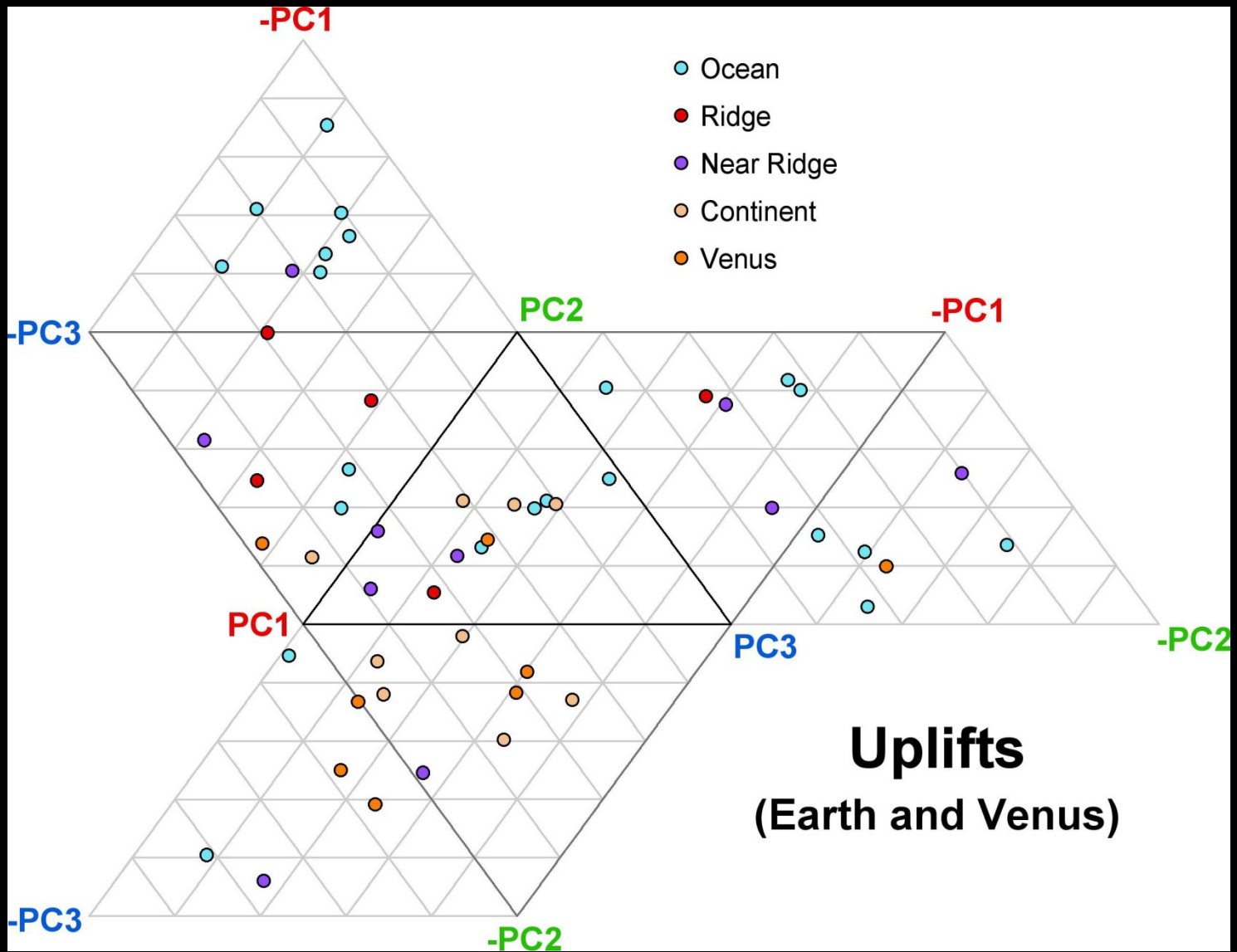
Venus profile lines for regions. For each uplift feature, 36 radial profiles are taken through

	Hawaii	Reunion	Iceland	Y'stone	Atla	Beta	W. Eistla
Hawaii	100	85	62	68	32	29	17
Reunion	85	100	39	41	9	11	25
Iceland	62	39	100	94	52	65	14
Yellowstone	68	41	94	100	60	66	15
Atla	26	7	43	49	100	89	77
Beta	24	9	53	54	89	100	63
W. Eistla	13	20	11	11	77	63	100
Principal Component Strength	<b>398.5</b>	<b>168.5</b>	4.8	16.78	10.52	<b>100.4</b>	0.53
Normalized PC	<b>0.57</b>	<b>0.241</b>	0.007	0.024	0.015	<b>0.143</b>	0.0008
Hawaii	<b>0.37</b>	<b>0.46</b>	0.46	0.54	0.16	<b>0.22</b>	0.28
Reunion	<b>0.27</b>	<b>0.49</b>	0.36	0.36	0.14	<b>0.53</b>	0.37
Iceland	<b>0.43</b>	<b>0.17</b>	0.49	0.45	0.35	<b>0.42</b>	0.23
Yellowstone	<b>0.44</b>	<b>0.16</b>	0.63	0.12	0.23	<b>0.38</b>	0.4
Atla	<b>0.41</b>	<b>0.42</b>	0.1	0.5	0.13	<b>0.04</b>	0.62
Beta	<b>0.42</b>	<b>0.36</b>	0.04	0.25	0.77	<b>0.13</b>	0.14
W. Eistla	<b>0.28</b>	<b>0.44</b>	0.1	0.22	0.41	<b>0.58</b>	0.41

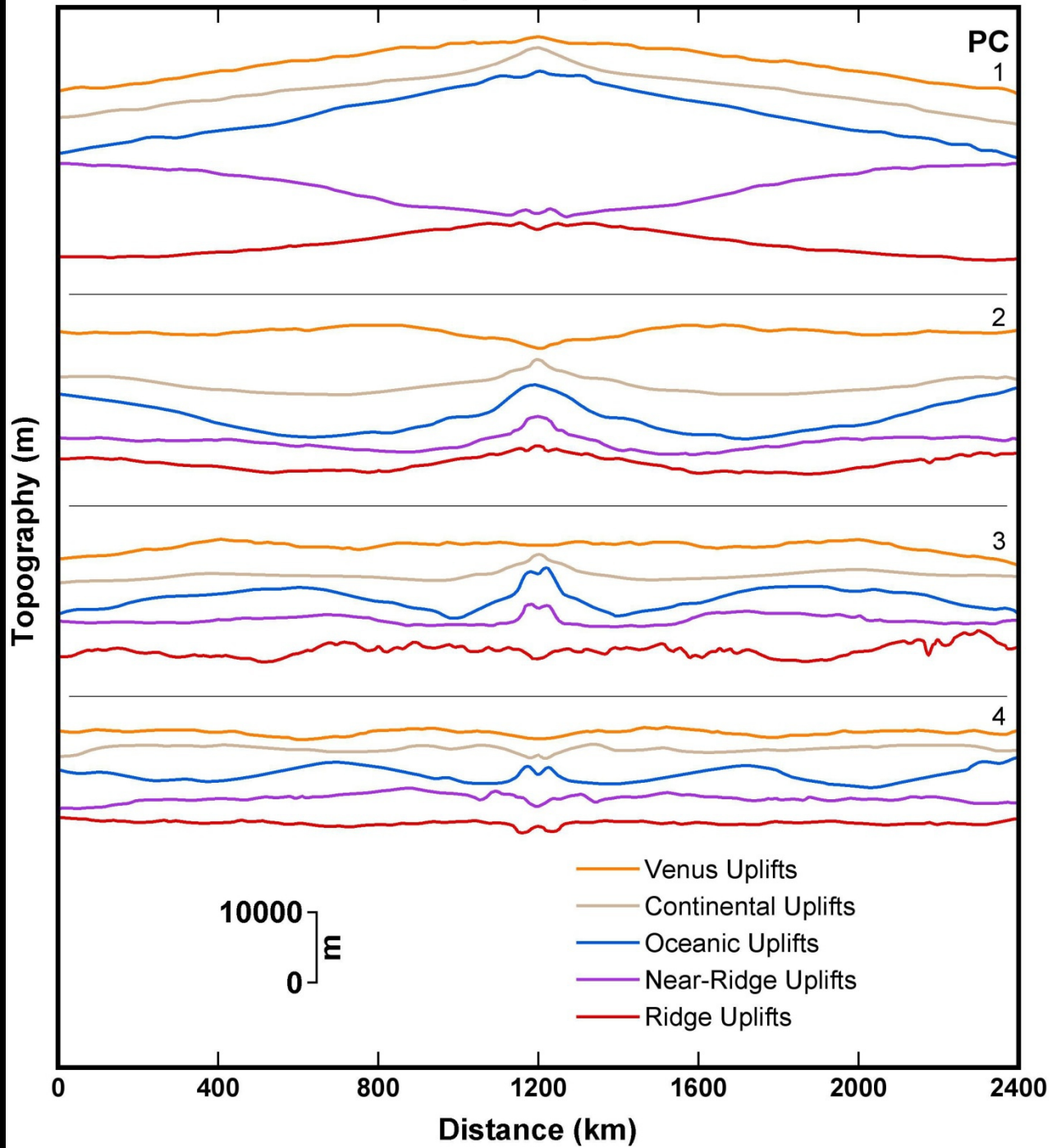


**EXAMPLE:** At left are shown profiles for 4 Earth hotspots: Hawaii, Reunion, Iceland and Yellowstone and 3 Venus regiones: Atla, Beta, and W. Eistla. The seven principal components derived from the covariance matrix are shown. Principal components are shown as representative traces, the sum of which, appropriately weighted, will reproduce the original profile. Summing the top 3 components (the second, seventh and fifth respectively, labeled 1, 2, and 3) accounts for 95% of the shape of the profiles in this example.





# Principal Components



# Conclusions

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- While Venus closely resembles Earth on a global scale, there are very significant differences between the two:
  - Atmospheric composition, density, and temperature
  - Tectonic style
  - Volcanic style
  - Crater distribution

# Conclusions

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- Venus may have been totally resurfaced in a very short time frame (~100 Ma?) between 300 Ma and 1 Ga.
- This history will have to be rewritten if features classified as coronae are actually craters
- Preliminary analysis indicates that classification must be done carefully, on a feature-by-feature basis

# Conclusions

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- Venus Remains Enigmatic
- Venus Remains Mysterious
- Venus Remains a Riddle