The Olapa Chasma-Idunn Mons system: an opportunity for investigating the interior of Venus through the surface geochemistry of a recently active area.

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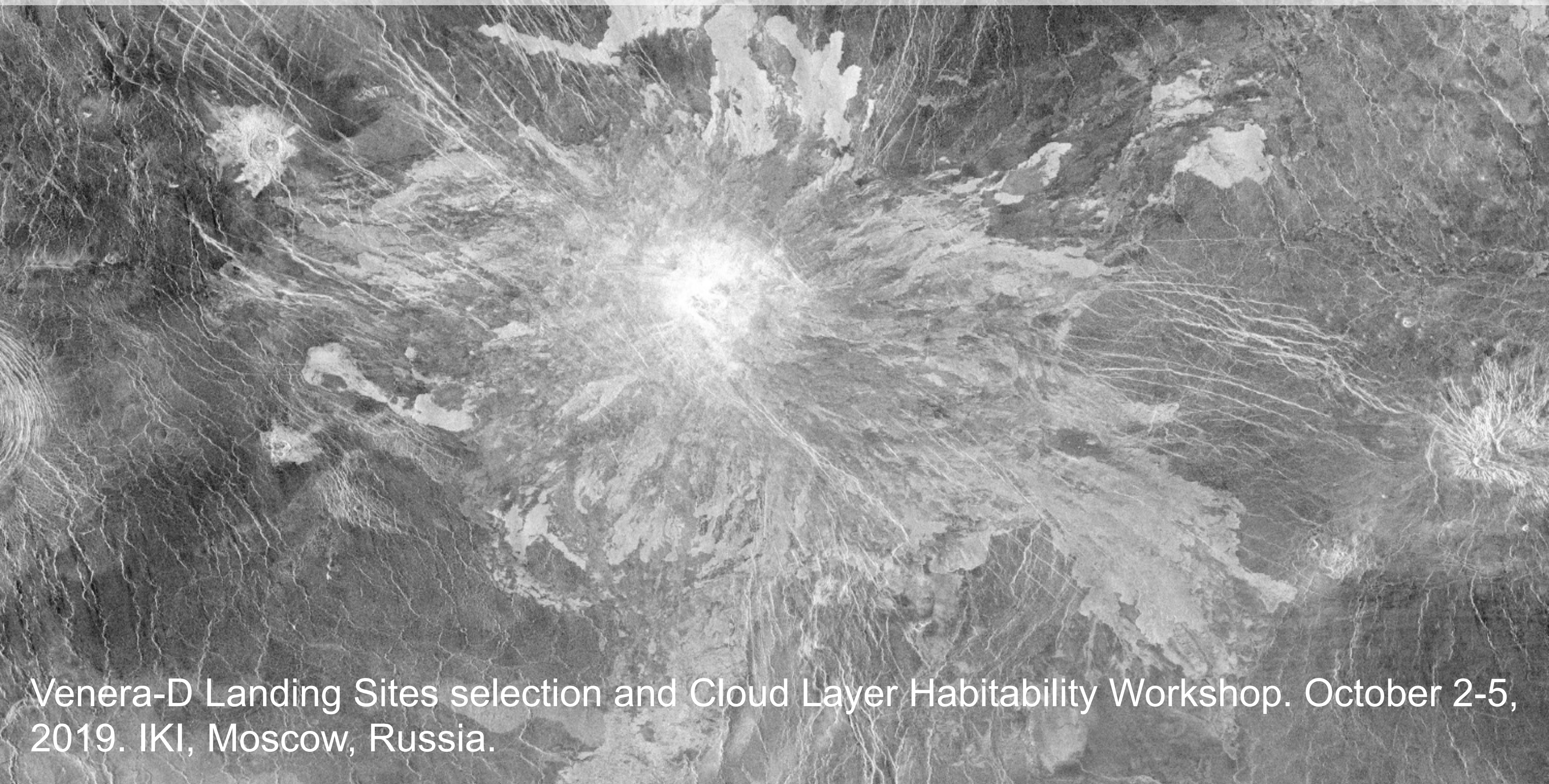


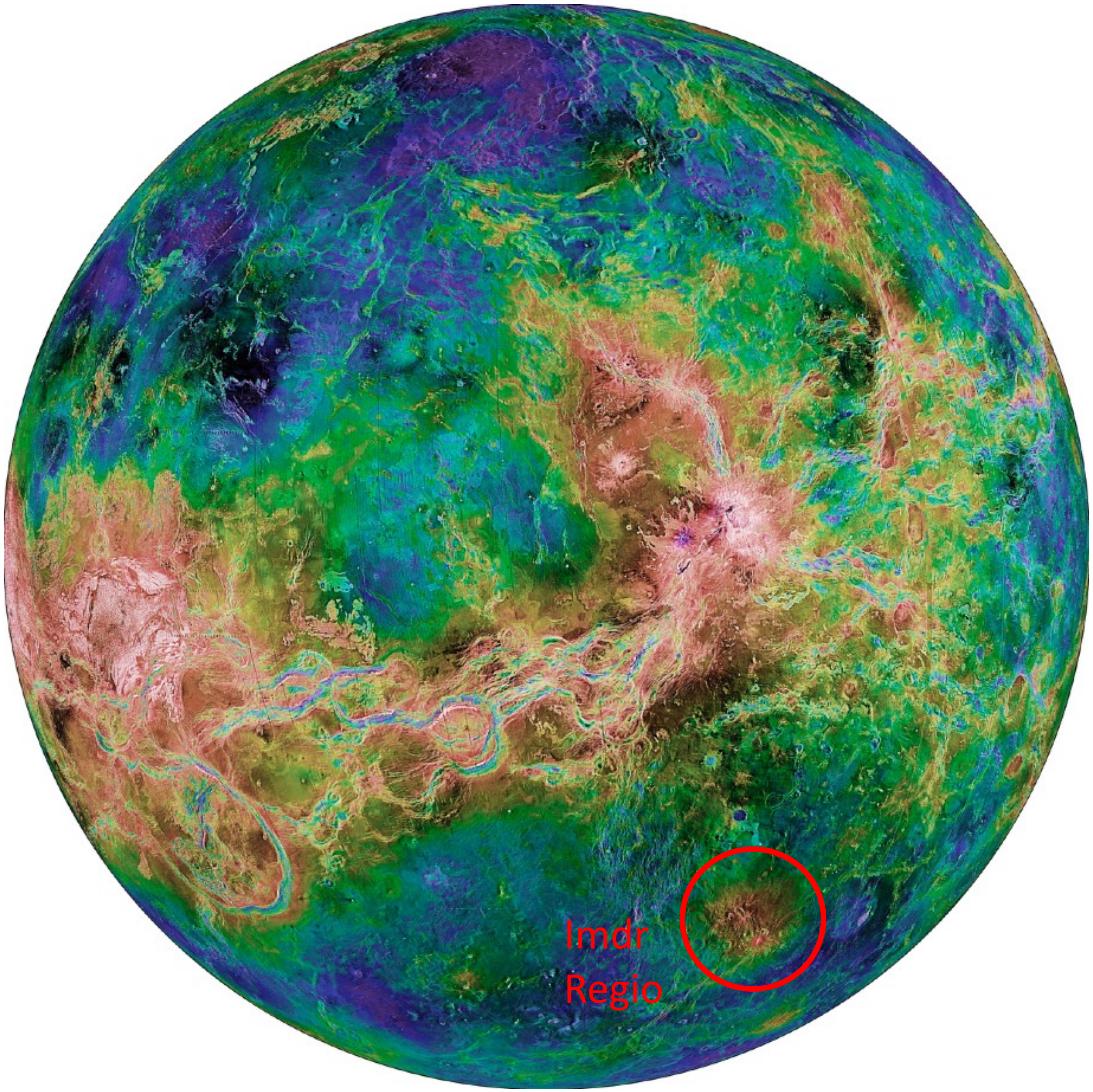
Venera-D Landing Sites selection and Cloud Layer Habitability Workshop. October 2-5, 2019. IKI, Moscow, Russia.

1 IRSPS INTERNATIONAL RESEARCH SCHOOL OF PLANETARY SCIENCES

2 Universidad Rey Juan Carlos | Escuela Superior Ciencias Experimentales y Tecnología

3 APSI Artic Planetary Science Institute

The Olapa Chasma-Idunn Mons system (OCIM).



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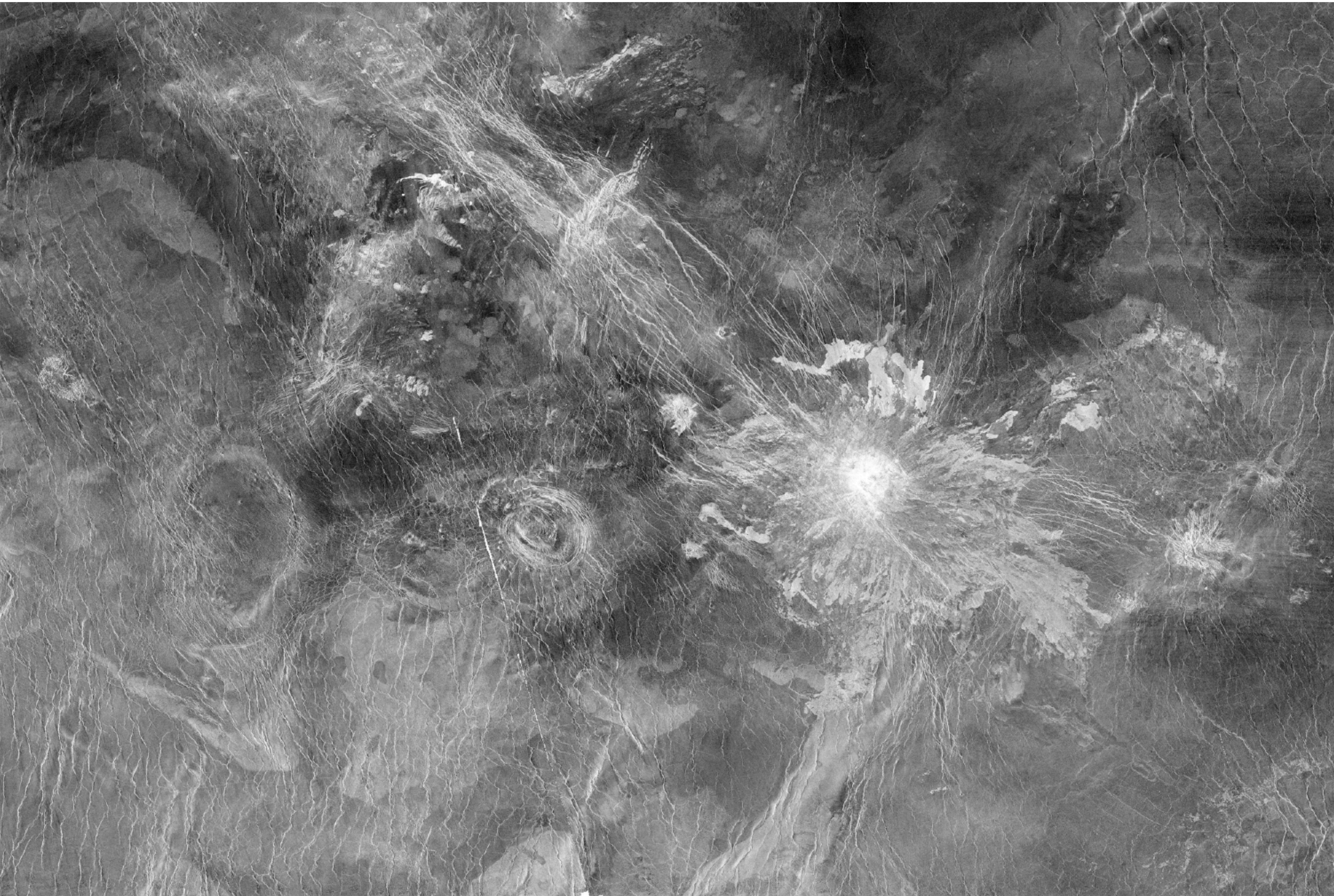
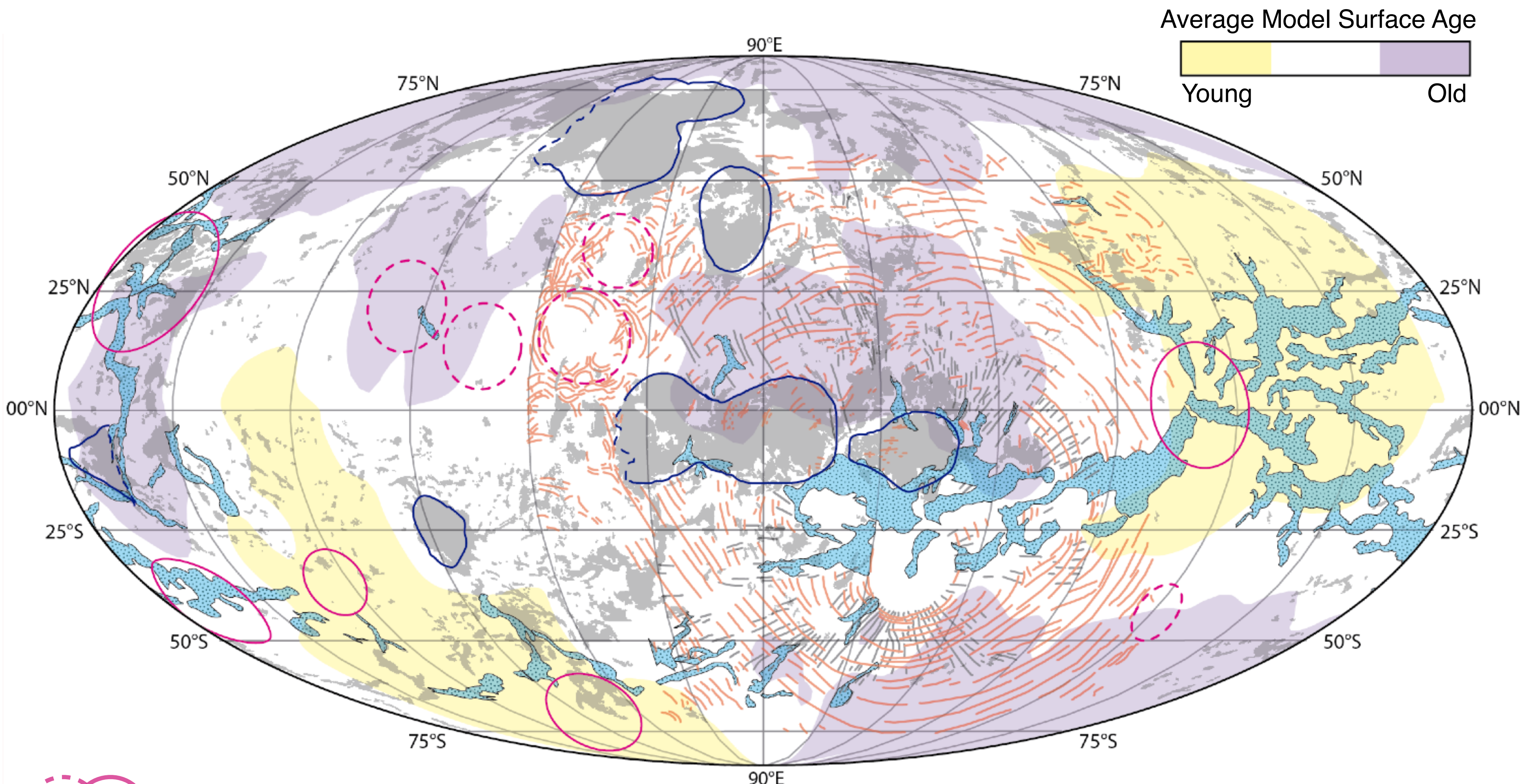


Why the OCIM?



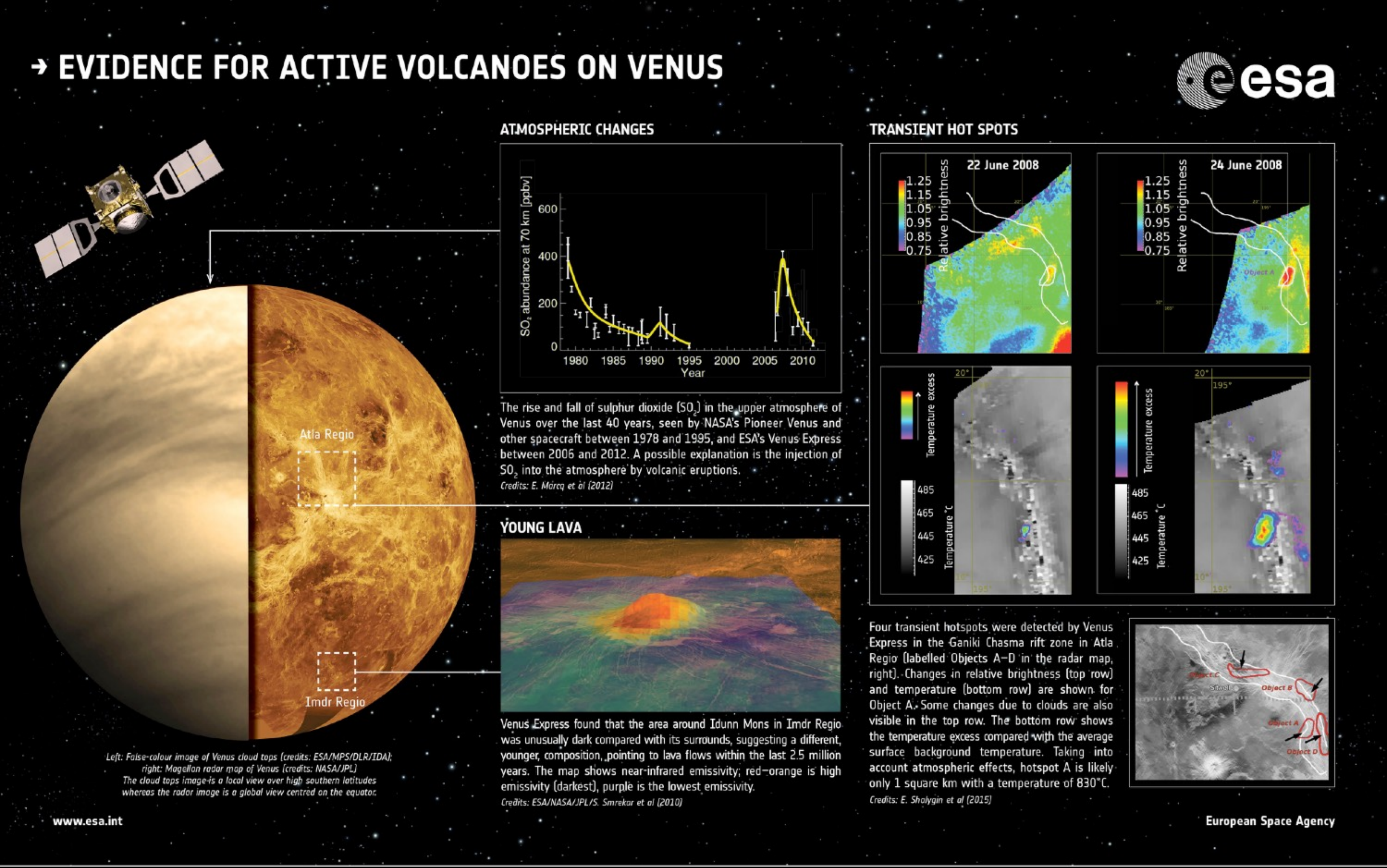
Volcanic Rises (contemporary)

Fracture zone (contemporary)

Artemis superstructure era (and formation of Ishatar Terra)

Crustal Plateaus (ancient)

Ribbon-tessera terrain (ancient)



Smrekar, et al., 2010. Recent hotspot volcanism on Venus from VIRTIS Emissivity Data. Science, 238, 605-608.

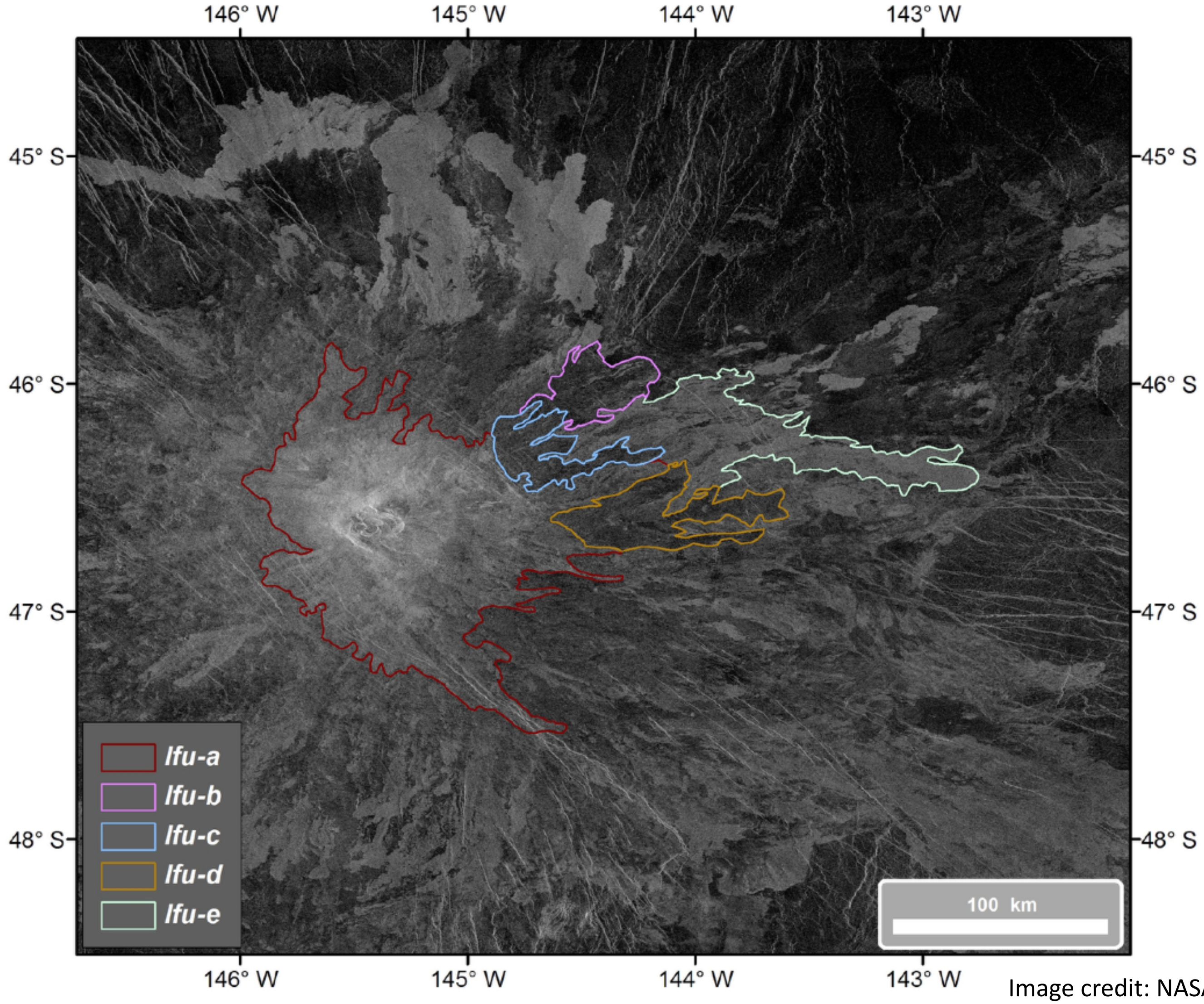
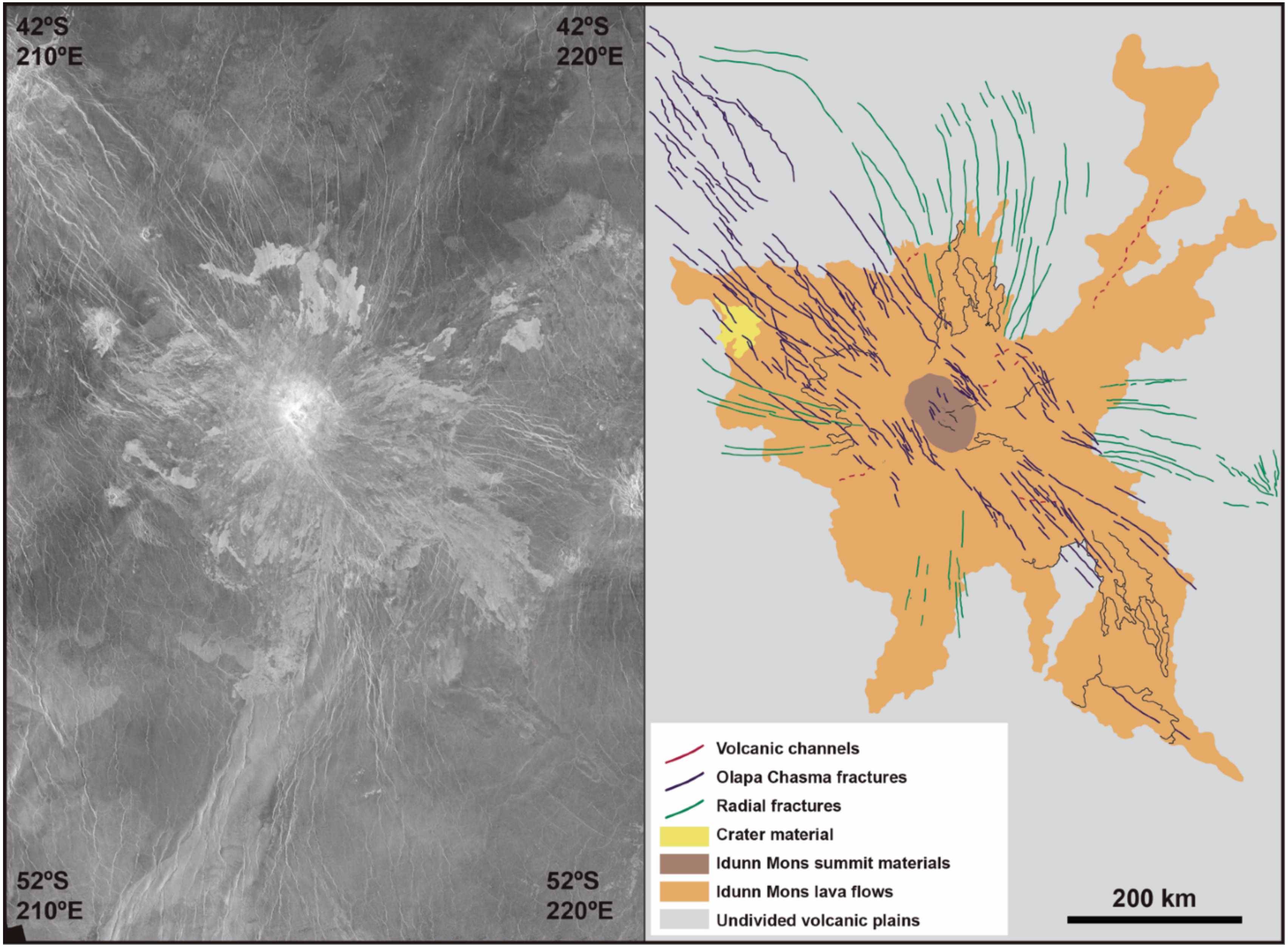


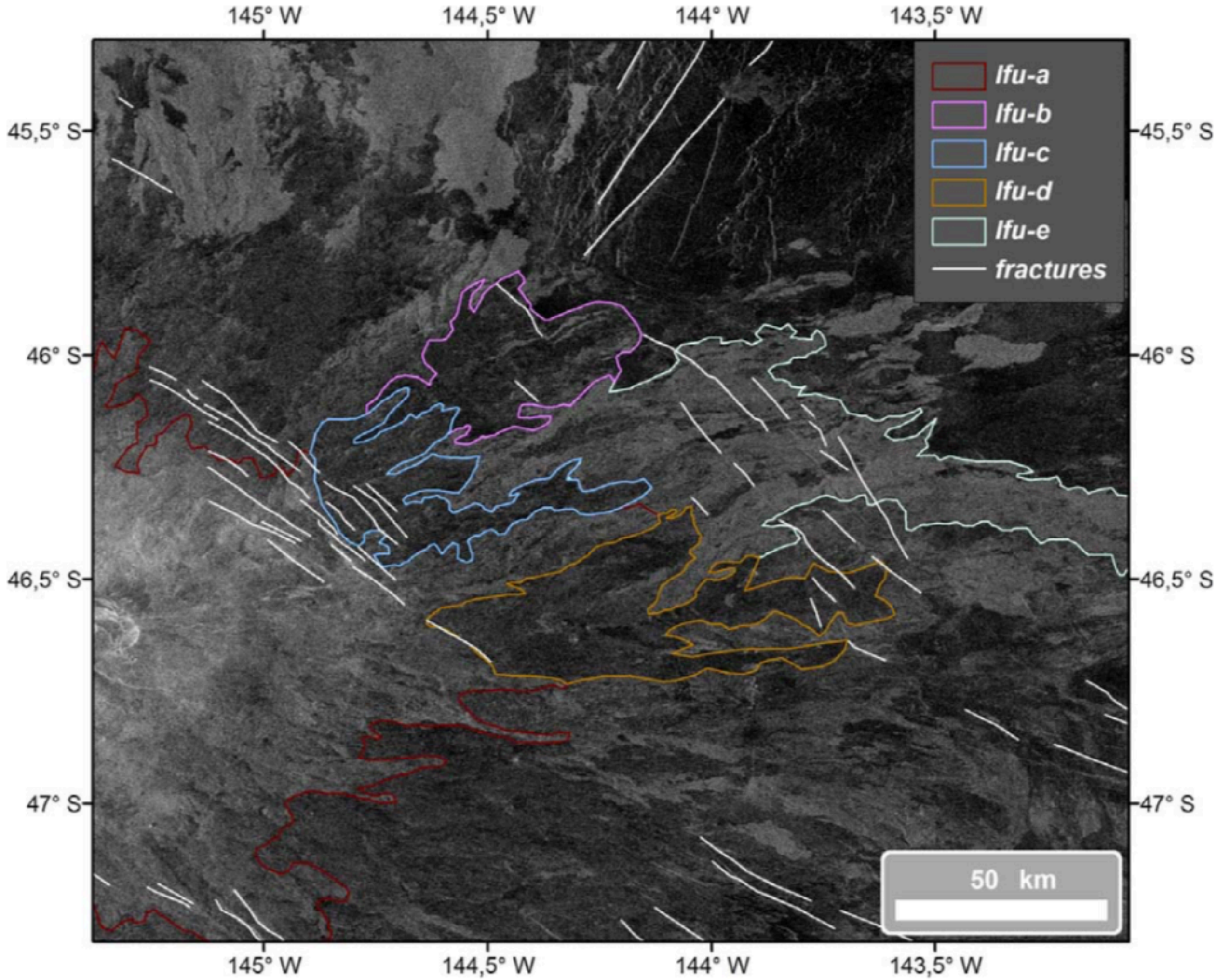
Image credit: NASA/JPL-Caltech/ESA/DLR

D´Incecco et al., 2017. Idunn Mons on Venus: Location and extent of recently active lava flows. Planetary and Space Science, 136, 25-33.

Is tectonic activity also recent at the OCIM?

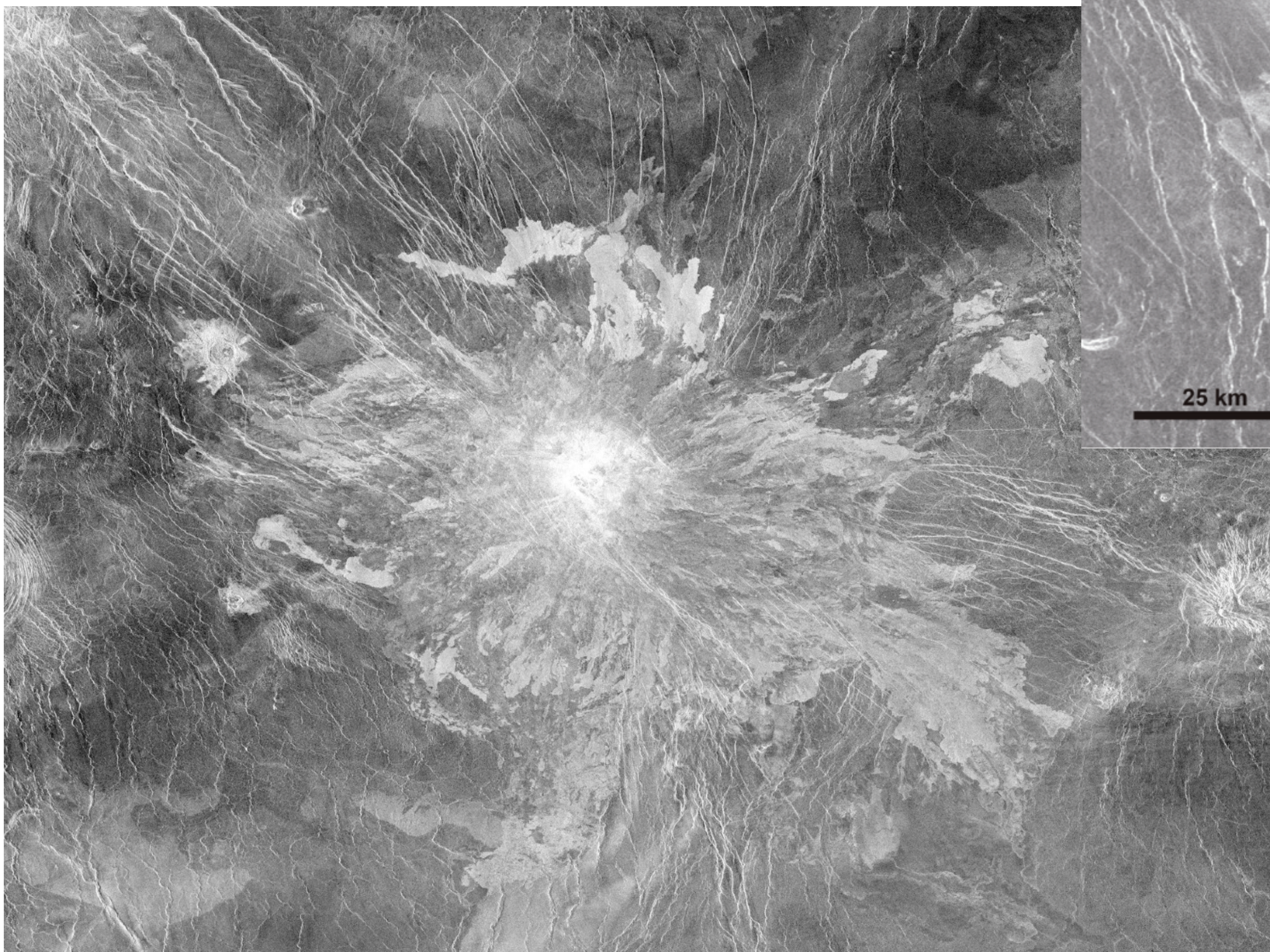


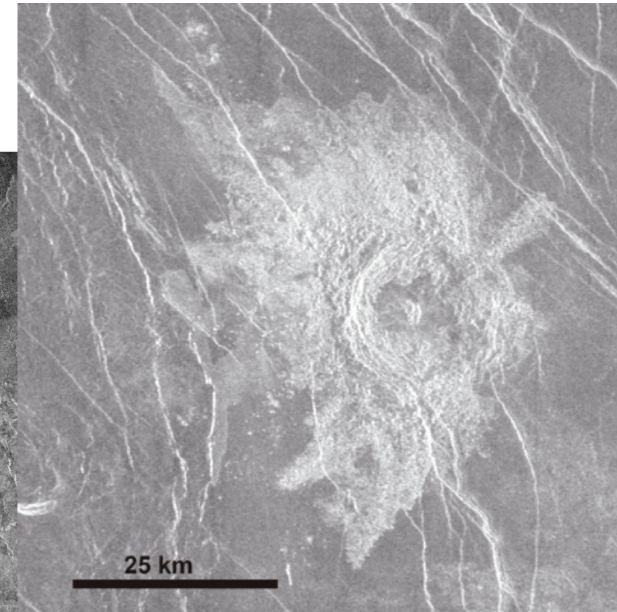
Interaction between flows and fractures.



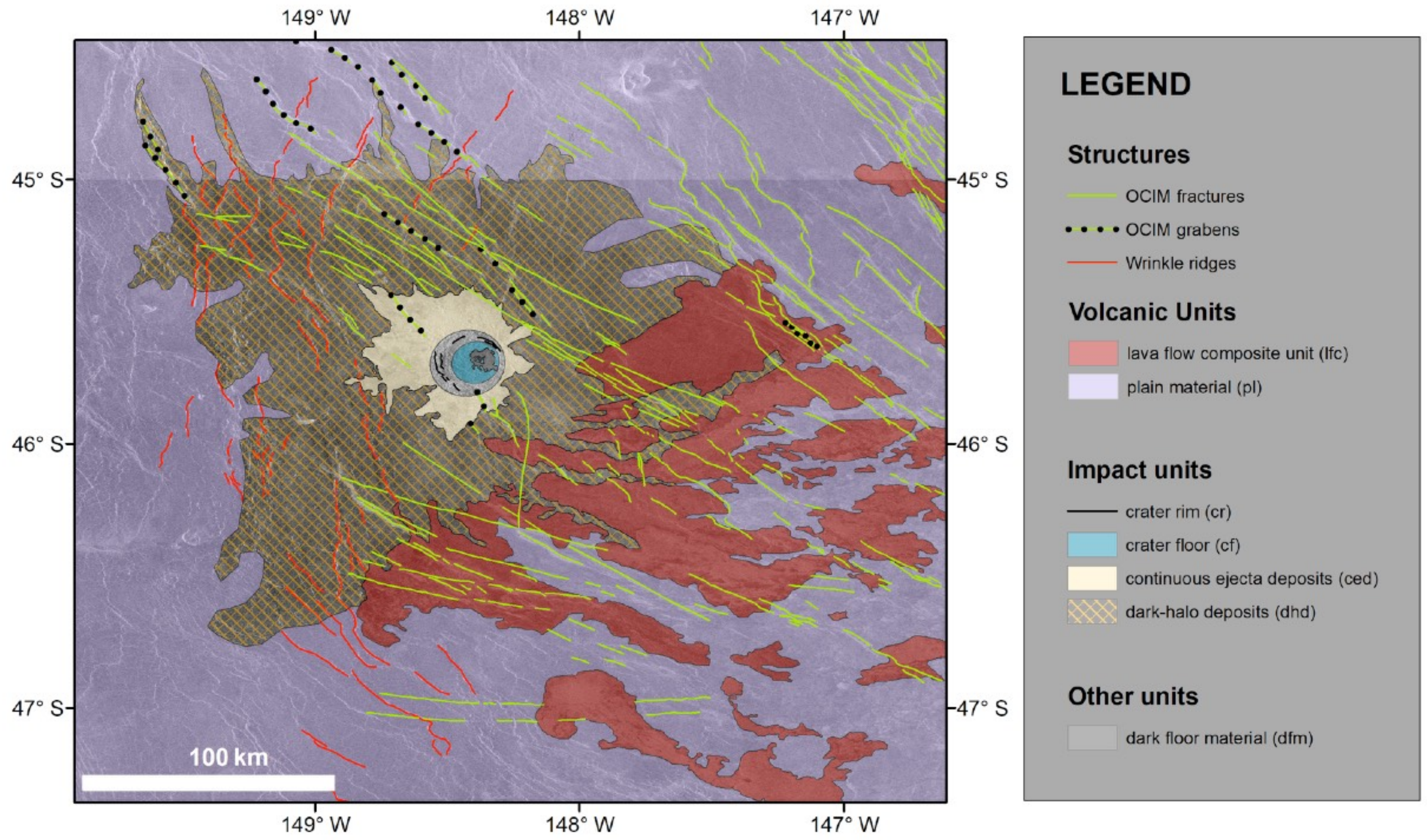
D´Incecco et al., 2017

Local stratigraphy at Sandel Crater.

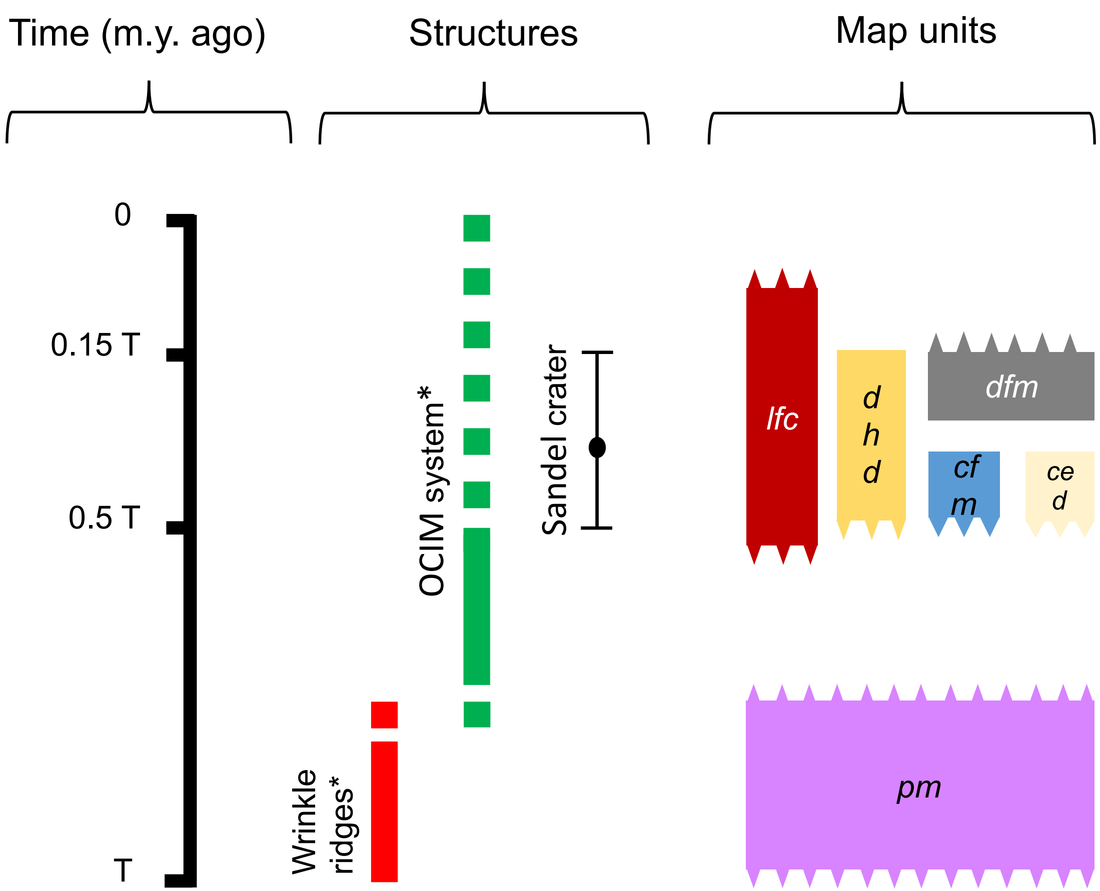




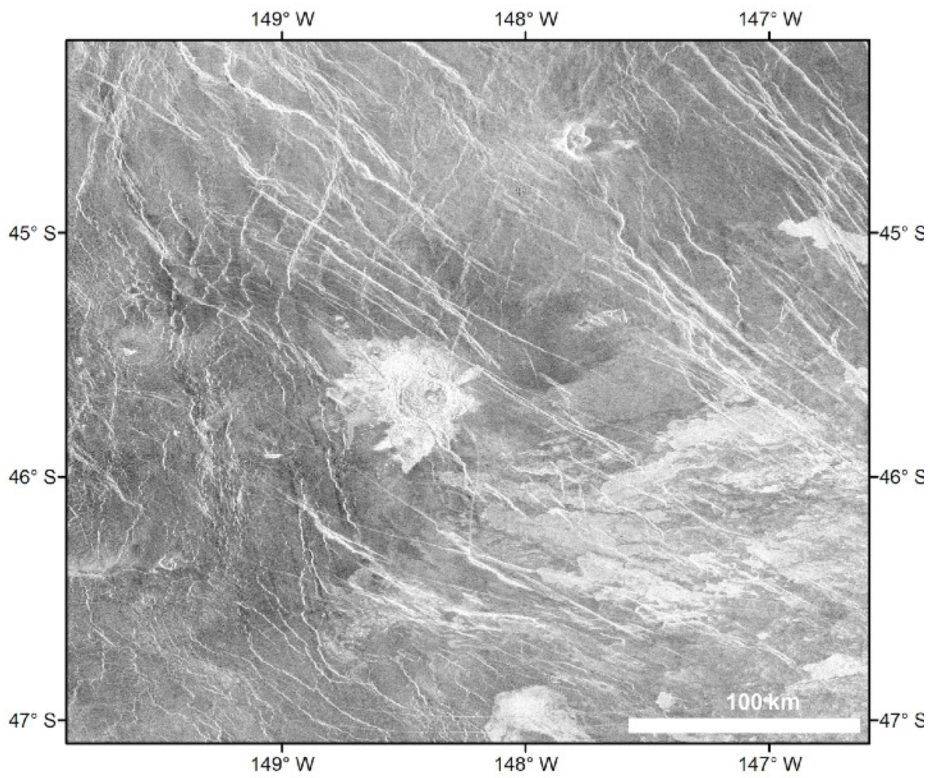
Geologic mapping of Sandel crater.

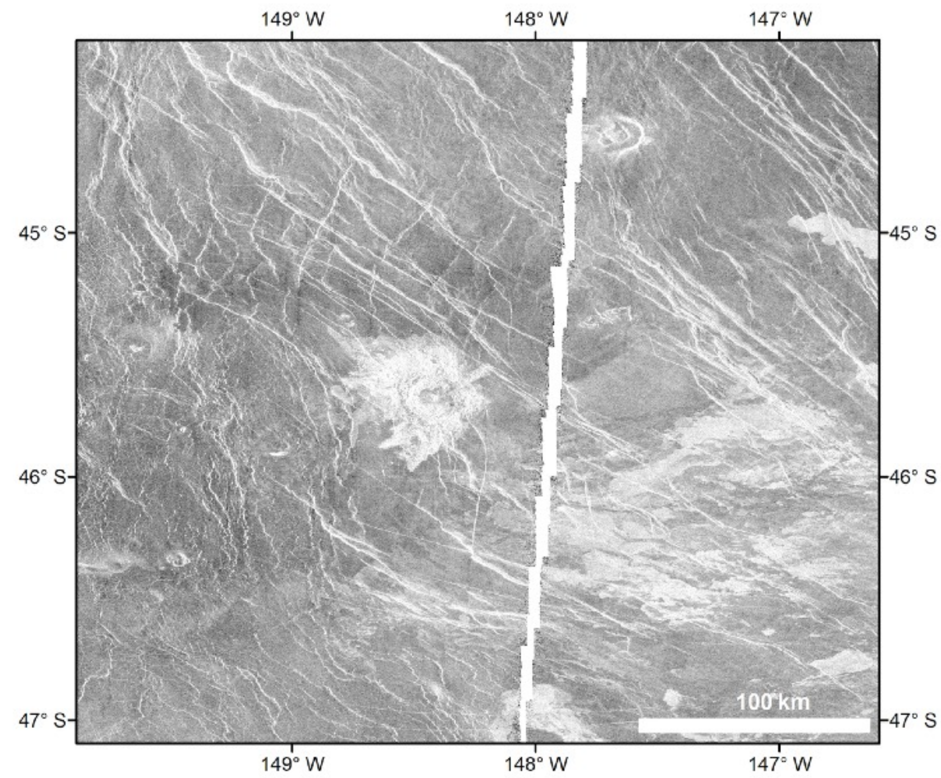


Stratigraphic sequence of materials and structures.



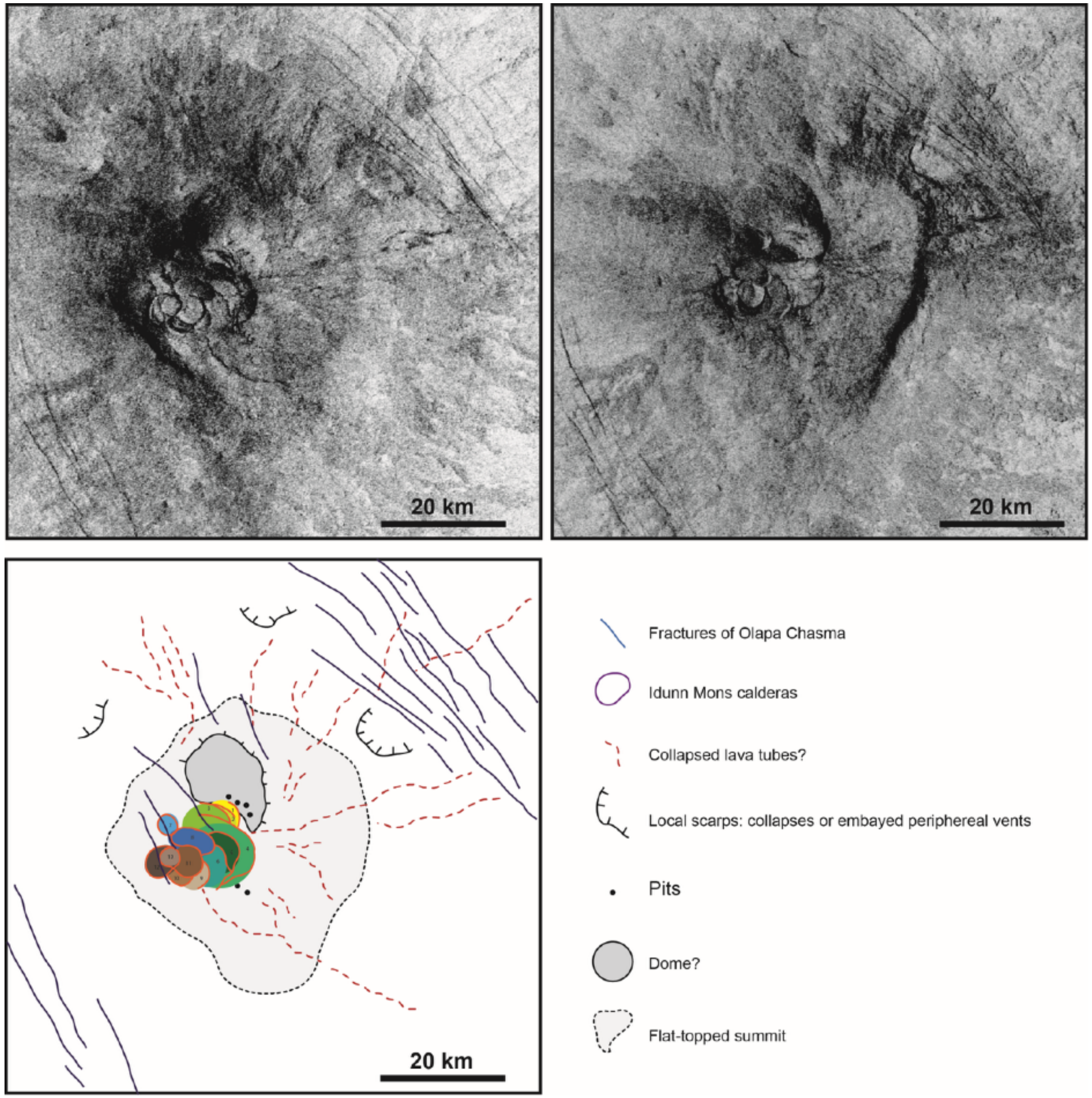
* Solid line indicates greater confidence



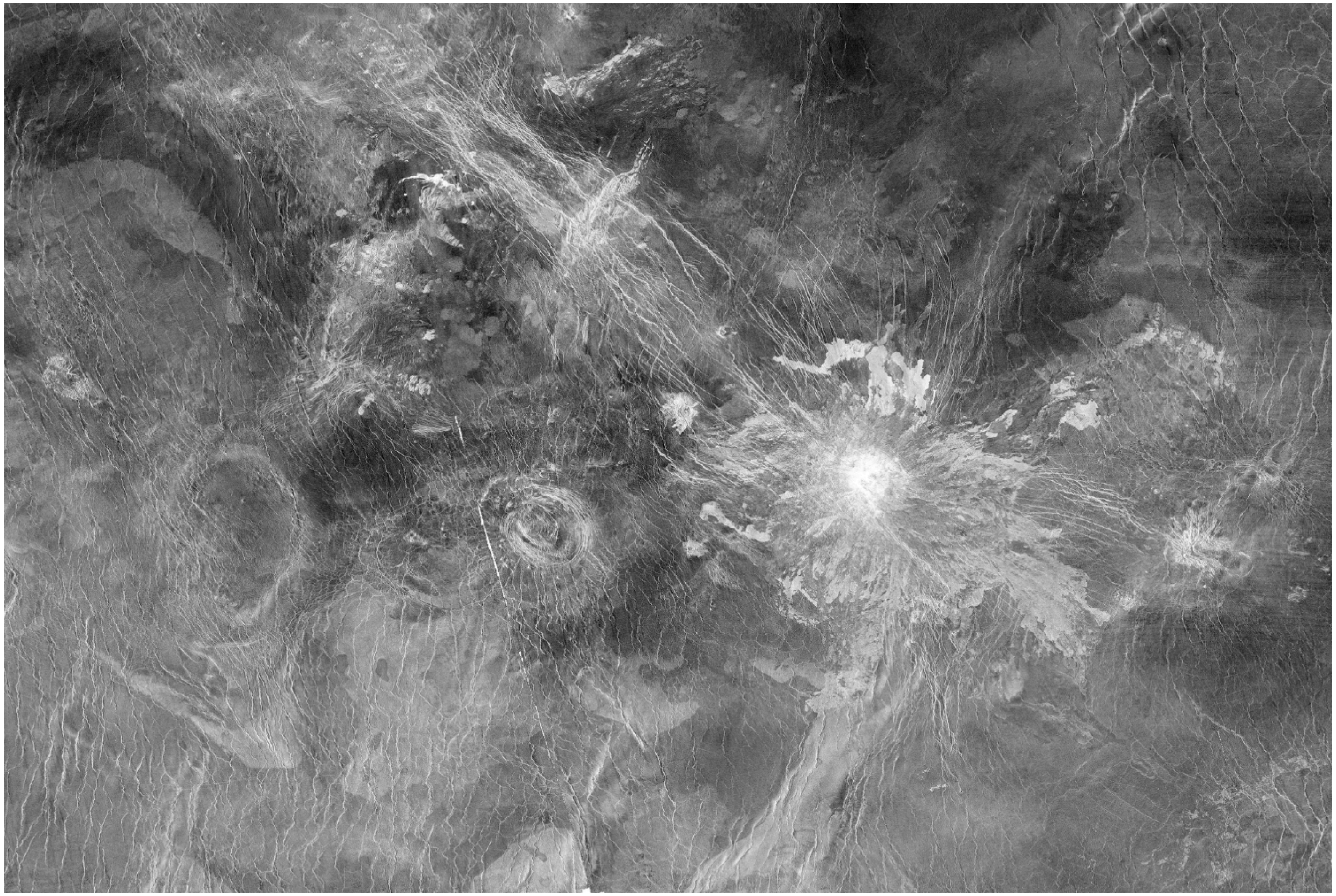


- Sandel is a crater with a partially degraded halo.
- The age of Sandel crater is estimated to be between 0,5T and 0,15T (T= average surface age).
- Ejecta postdates some distal flows of Idunn Mons but younger flows seem to postdate the halo.
- Fractures of Olapa Chasma postdate the crater ejecta deposits.

Interaction of fractures with summit structures.



In conclusion…….



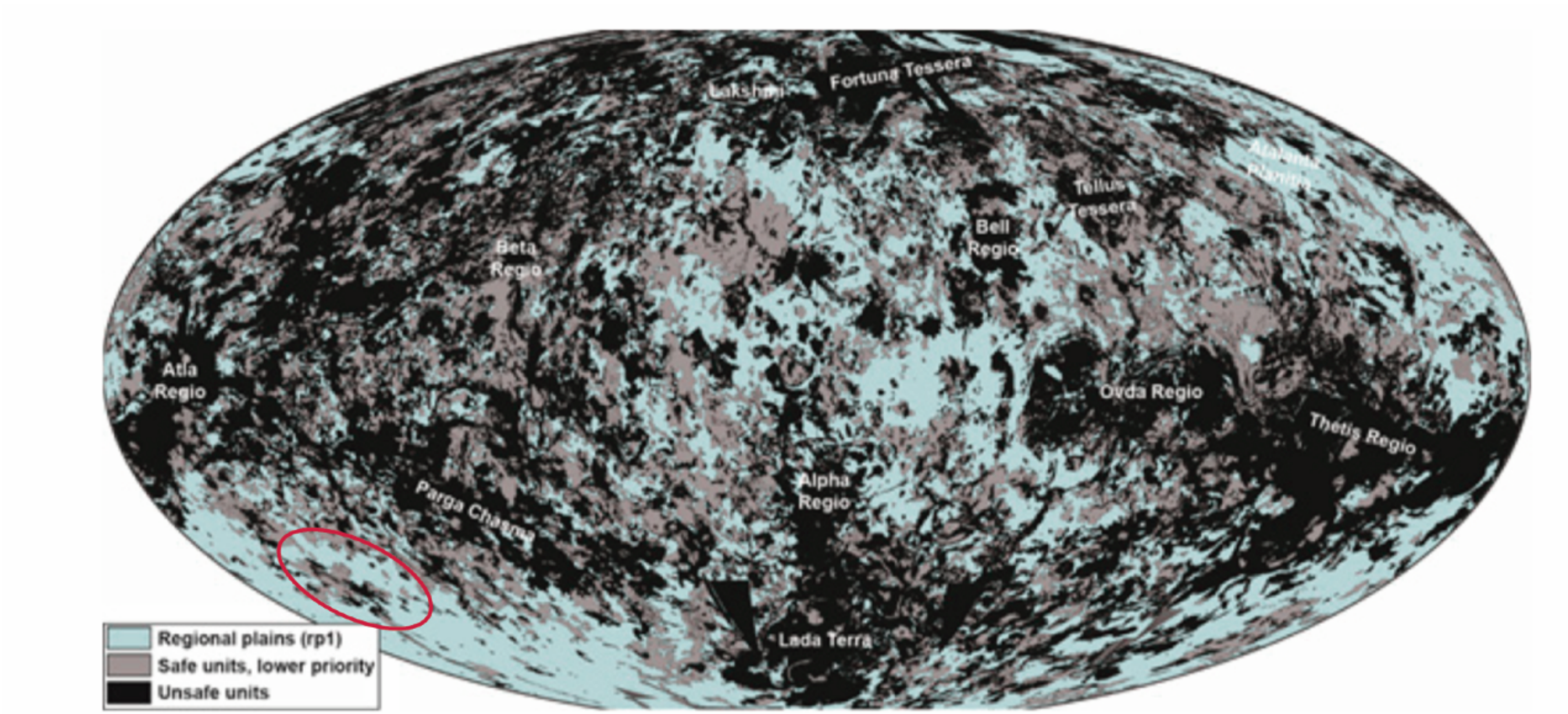
If Idunn Mons is a recent volcanic structure, the tectonic activity in Olapa Chasma is also recent.

Suitability as landing site for Venera-D.

Safety considerations.

- Only the lower and distal material of Idunn Mons are classified as Safe units but of lower priority.

- The upper part of the volcano and the fractures system are classified as unsafe.



Modified from Report of the Venera-D Joint Science Definition Team January 31, 2019

Relevance for the scientific objectives of Venera-D:

Characterization of surface geochemistry and mineralogy + Local geophysical studies.

Surface Geology and Geophysics				
L5. Surface structure and morphology	Characterize surface structure, morphology, and relief at 10 to 100 m/pixel during descent; characterize the surface at 1 m to 0.01 m/pixel at surface. Sample characterization at <0.2 mm/pixel	(1) Surface imaging during descent and measuring optical properties of the atmosphere (2) Imaging on the surface and measuring optical properties of the near surface atmosphere (3) Stereo imaging of surface (field of view (FOV) 30° to 45° and angular resolution ~0.0005 rad) starting from an altitude of several kilometers and on the surface (4) Panoramic stereo imaging of the surface. Detailed stereo imaging of surface with the spatial resolution better than 0.2 mm	Imaging system (descent imager, panoramic camera, and microscopic imager)	High
L6. Surface elemental composition	Determine the elemental composition of surface rocks with emphasis on trace elements, including the radioactive isotopes of K, U, and Th.	(1) Measure the gamma-ray spectrum of the surface induced by the flux of neutrons with energies 14 MeV (2) Spectrum of gamma radiation from natural radioactive elements of the surface. XRF spectra to determine the elemental composition (3) Chemical composition of a rocky sample (which must be delivered inside the lander)	• Active gamma-spectrometer (e.g., Active Gamma and Neutron Spectrometric Soil Analysis (AGNESSA)) • XRF mode of Mössbauer spectrometer • CAP • XRD/XRF	High
L7. Mineral phases	Identification of mineral phases, containing Fe (Fe^{2+}, Fe^{3+}, Fe^{6+}). To address atmosphere and surface evolution along with surface minerals (search for any possible bound water e.g., phyllosilicates)	Measure Mössbauer spectra of the surface rocks	Miniaturized Mössbauer spectrometer (MIMOS-2A)	High
L8a. Global and regional seismic activity	Assess global and regional tectonic activity	Measurement of planetary seismic background and self-oscillations to constrain crustal thickness over 3-hr lander lifetime	Seismometer	Low*
L8b. Venus' internal structure, heat flow, and seismic activity	Asses global tectonic activity at multiple locations	Measurement of planetary seismic background and self-oscillations to constrain crustal thickness over 120 days; measure heat flux	SAEVes	High*
L9. Electromagnetic fields	Determine electromagnetic fields, electrical activity, and conductivity of Venus' atmosphere	Measure of emissions in the range of 10 Hz to 100 kHz	Wave package (e.g., Groza-SAS2)	Low

*See Section 8.3 for SAEVe discussion. One seismometer, operating for only 3 hr, is a low priority because the anticipated data return is low. Multiple seismometers coupled with heat-flux measurements, operating over 120 days, is a high priority because of the high likelihood of meaningful data return.

- Distal parts of Idunn Mons are part of a lava flow field. This region does not have a high priority consideration as tesserae, but it has been determined to be "necessary to study at least one of these regions" (Phase II Final Report).

- The "recent" character of volcanic materials in the area makes weathering lower than in other areas (better for the chemical analysis).

- The area is part of a *hot spot* that could have been recently active. Interesting to constrain the volatile content in these materials and their implications for Venusian geodynamics.

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In a mission with SAEVes (Seismic and Atmospheric Exploration of Venus) integrated:

- If the Olapa Chasma-Idunn Mons system is an area with recent (ongoing?) tectonic activity, then is the perfect location for the deployment of this instrumentation.

- Other possible active areas (e.g. Atla Regio) represent areas with a higher risk for the landing.

Conclusions.

- There are indication of **recent volcanic activity** in Idunn Mons, and according to the initial study of the area **tectonic activity is contemporaneous with the volcanic activity or could even be younger**.

- The lower parts of this large igneous rise match with the requirements for a safe landing. Unfortunately, the upper parts of the summit where the younger flows are located are unsafe for landing.

- The **recent character of the volcanic materials** in the area could imply a **low weathering** of the materials, situation that could be **good for the characterization of surface geochemistry and mineralogy** (e.g. determination of volatile content).

- Being a **possible area with recent or ongoing tectonic activity** this area is **interesting for instruments aiming to detect seismic activity** like SAEVes.