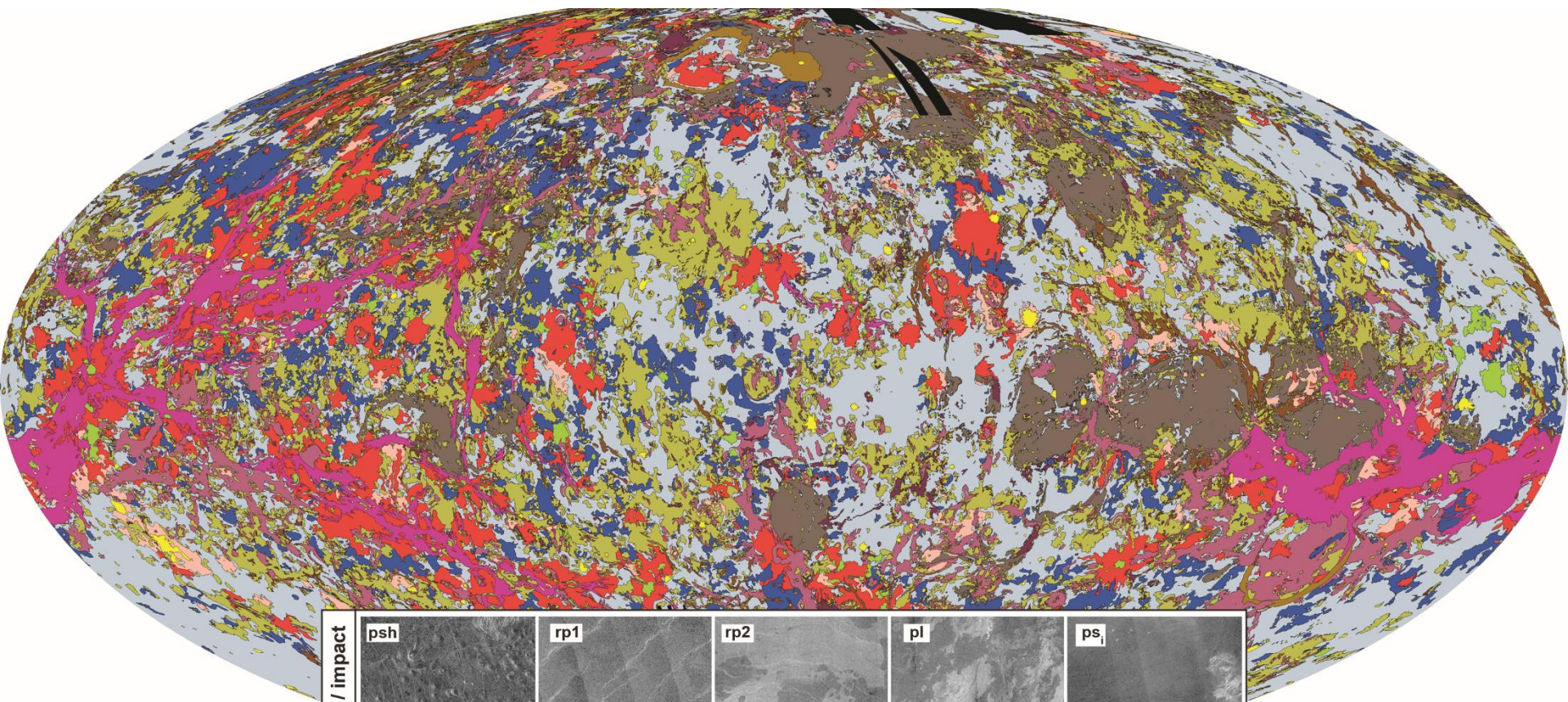# Preliminary selection of appropriate Venera-D landing sites

M.A. Ivanov, Vernadsky Institute, RAS

Safety first

No safe landing: one-leg mission

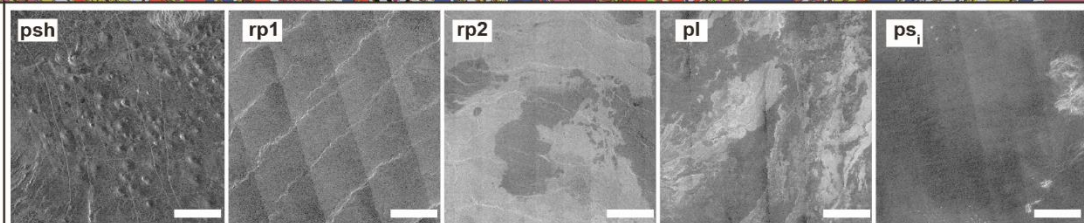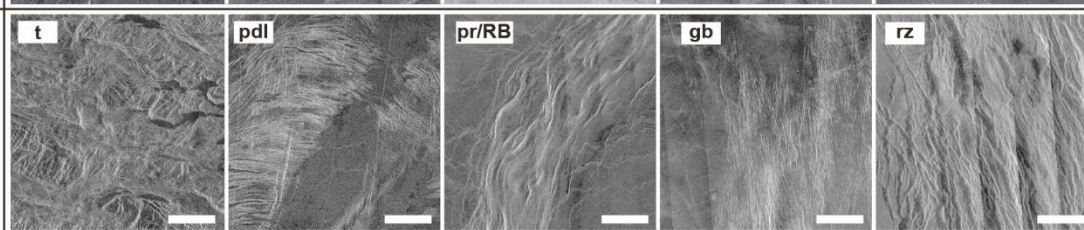# Lander safety: Variety of units

Volcanic units

- psh — Shield plains
- rp1 — Regional plains, lower unit
- rp2 — Regional plains, upper unit
- ps — Smooth plains
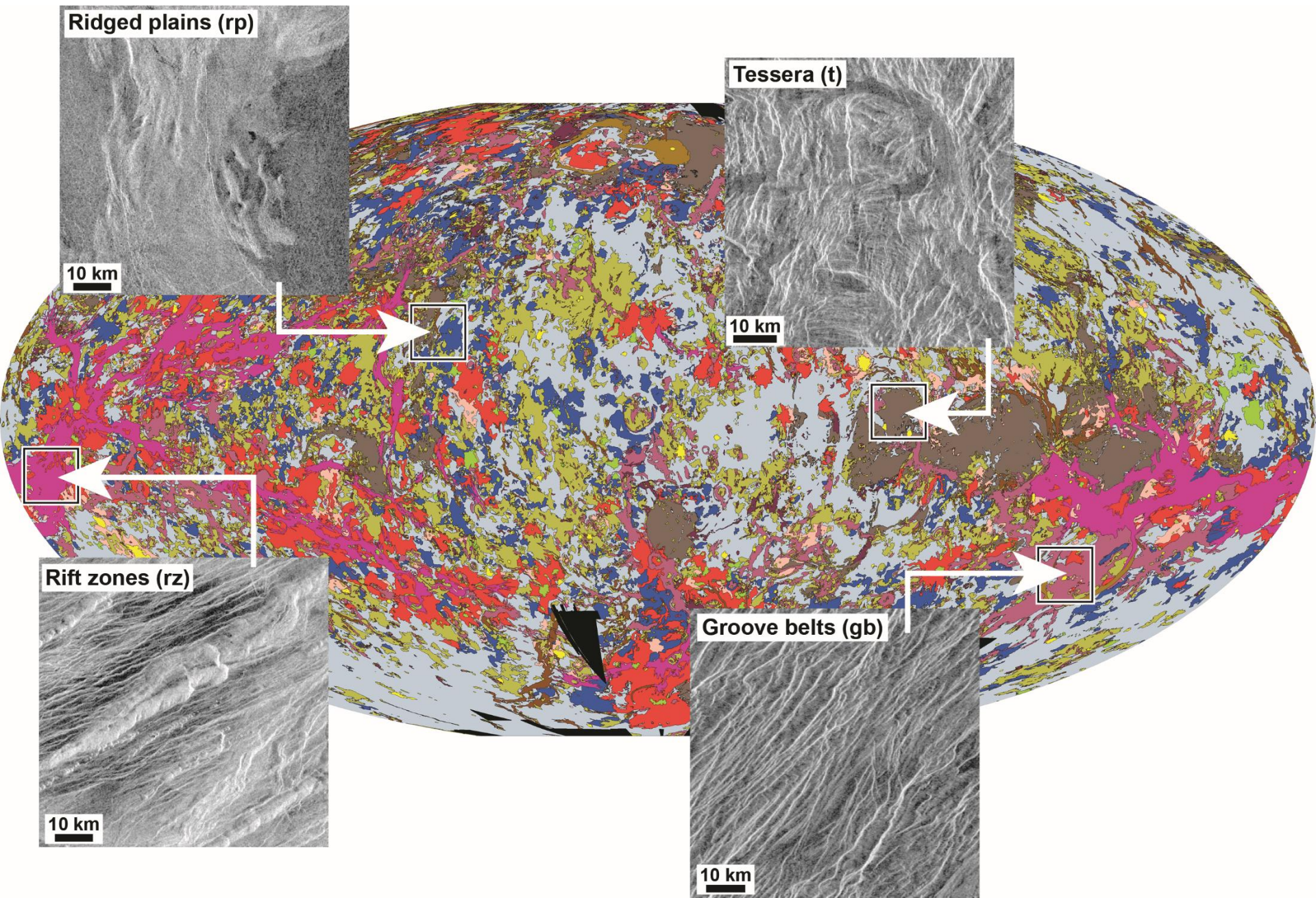- pl — Lobate plains

Tectonic units

- t — Tessera
- pdl — Densely lineated plains
- pr — Ridged plains
- gb — Groove belts
- rz — Rift zones

Volcanic / impact: psh, rp1, rp2, pl, ps$_i$

Tectonic units: t, pdl, pr/RB, gb, rz

Lander safety: Tectonic units

Ridged plains (rp)

10 km

Tessera (t)

10 km

Rift zones (rz)

10 km

Groove belts (gb)

10 km
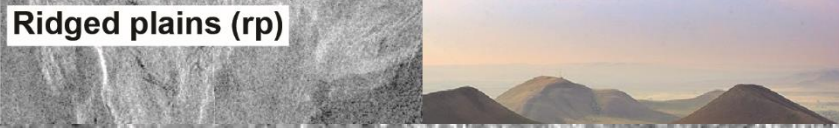
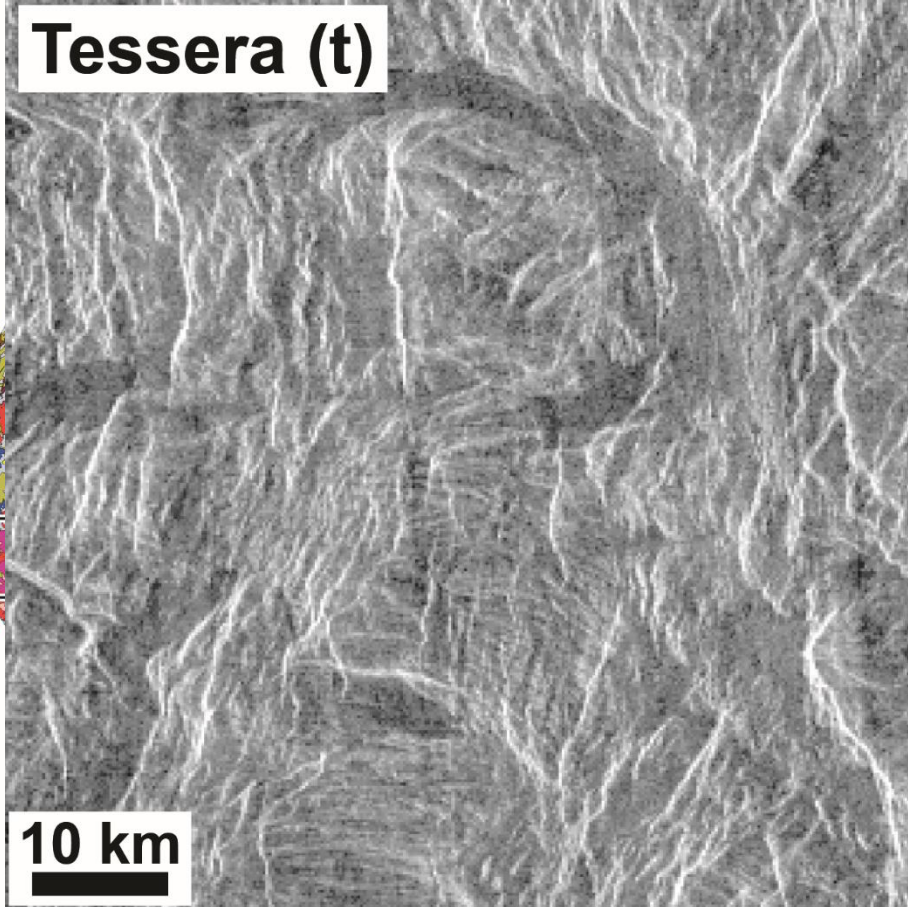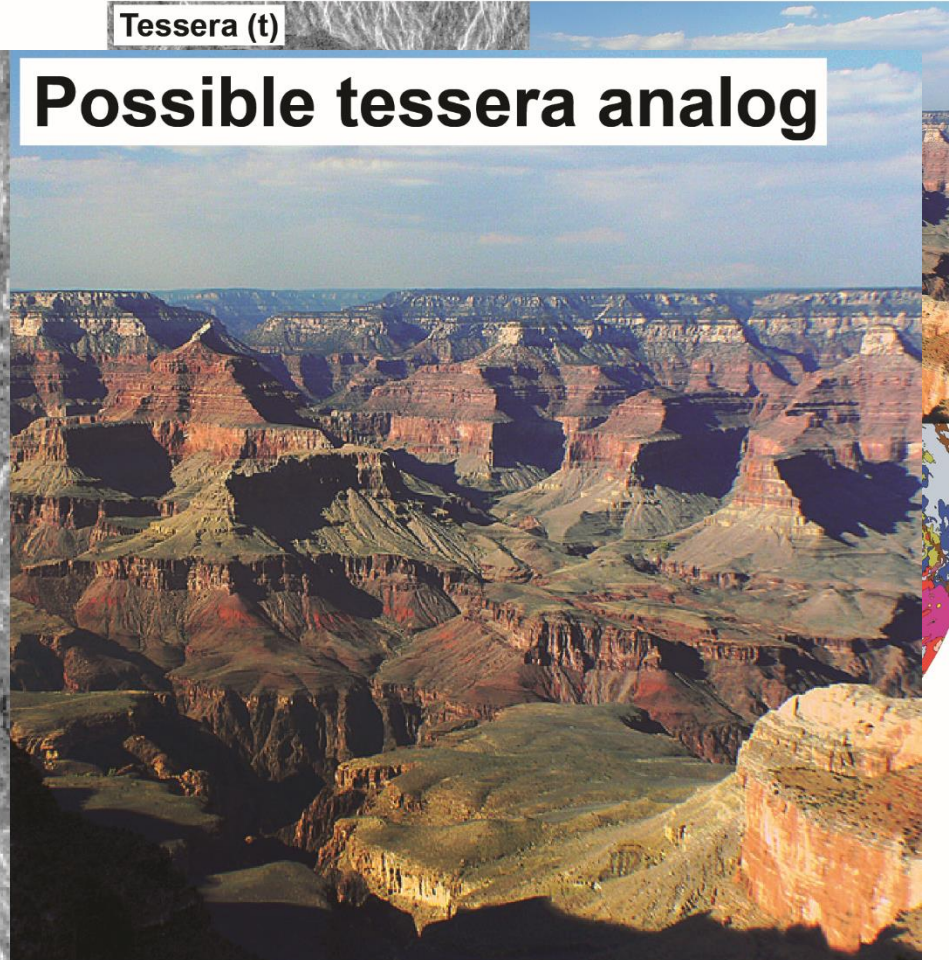# Lander safety: Tectonic units

Ridged plains (rp)

Tessera (t)

Tessera (t)

Possible tessera analog

10 km
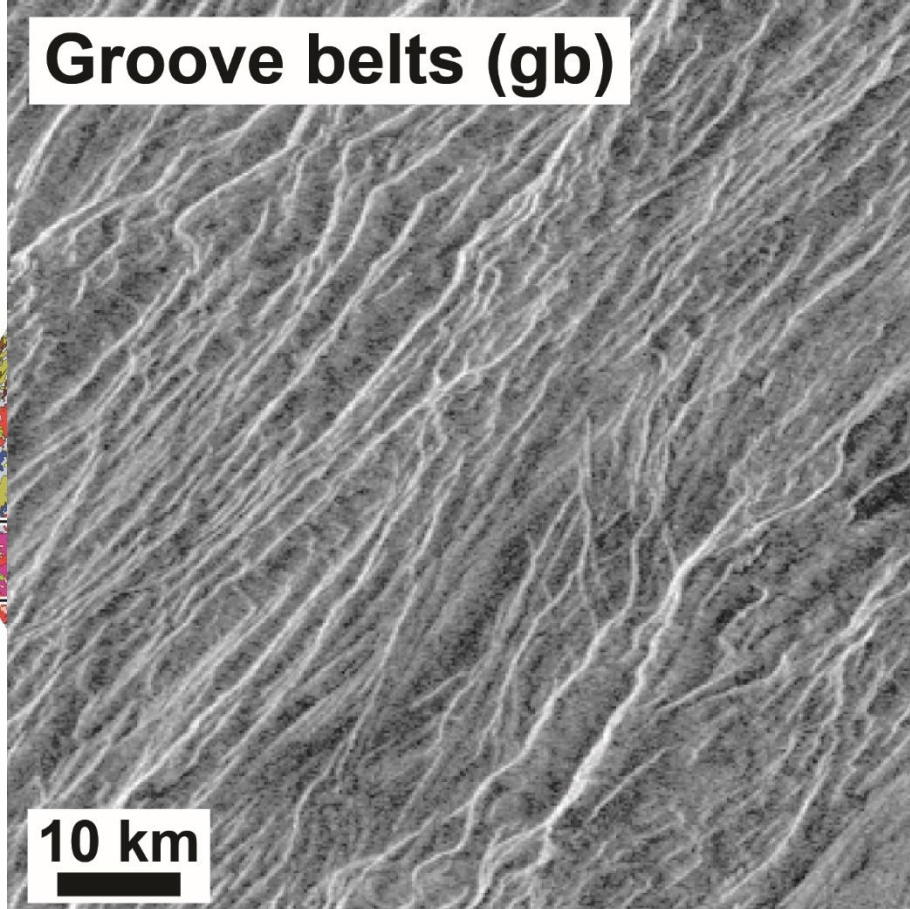
10 km

10 km

Lander safety: Tectonic units

Ridged plains (rp)
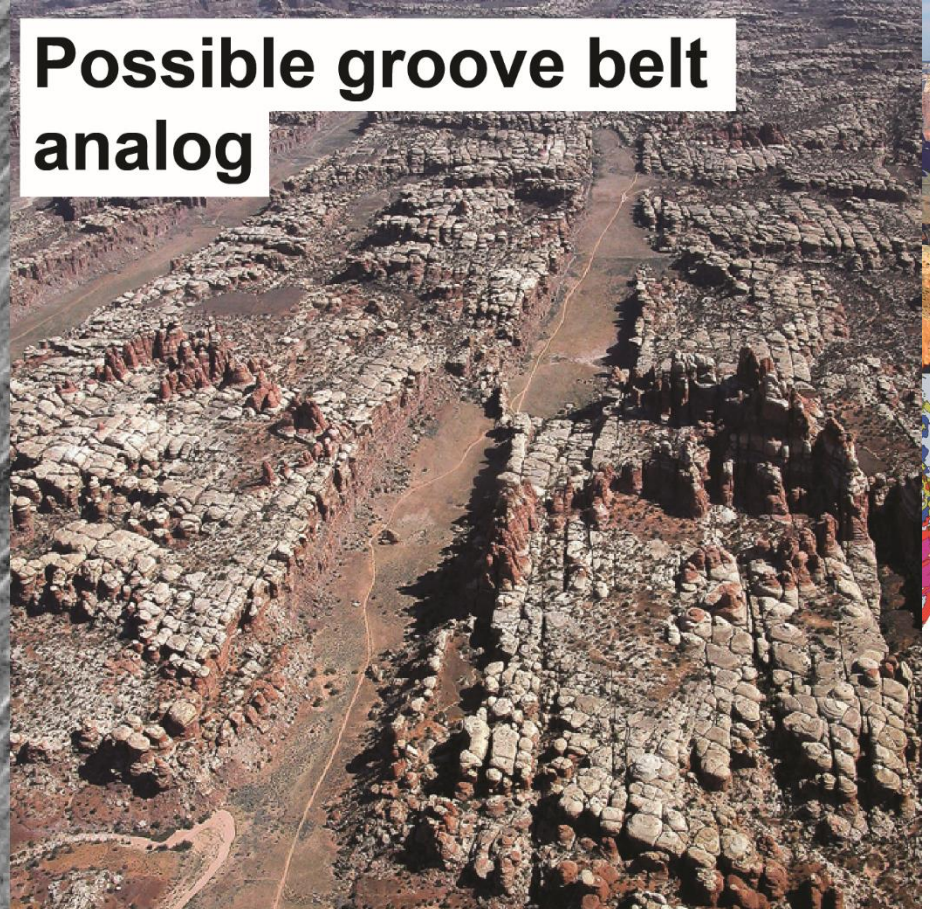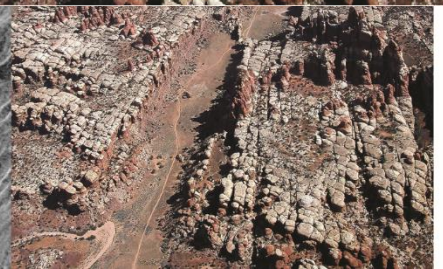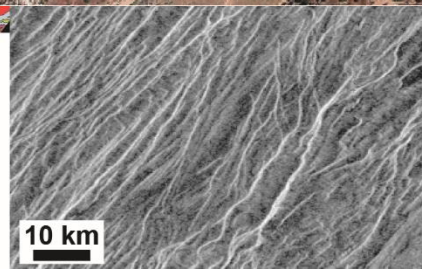
Tessera (t)

Groove belts (gb)

Possible groove belt analog

10 km

10 km

10 km

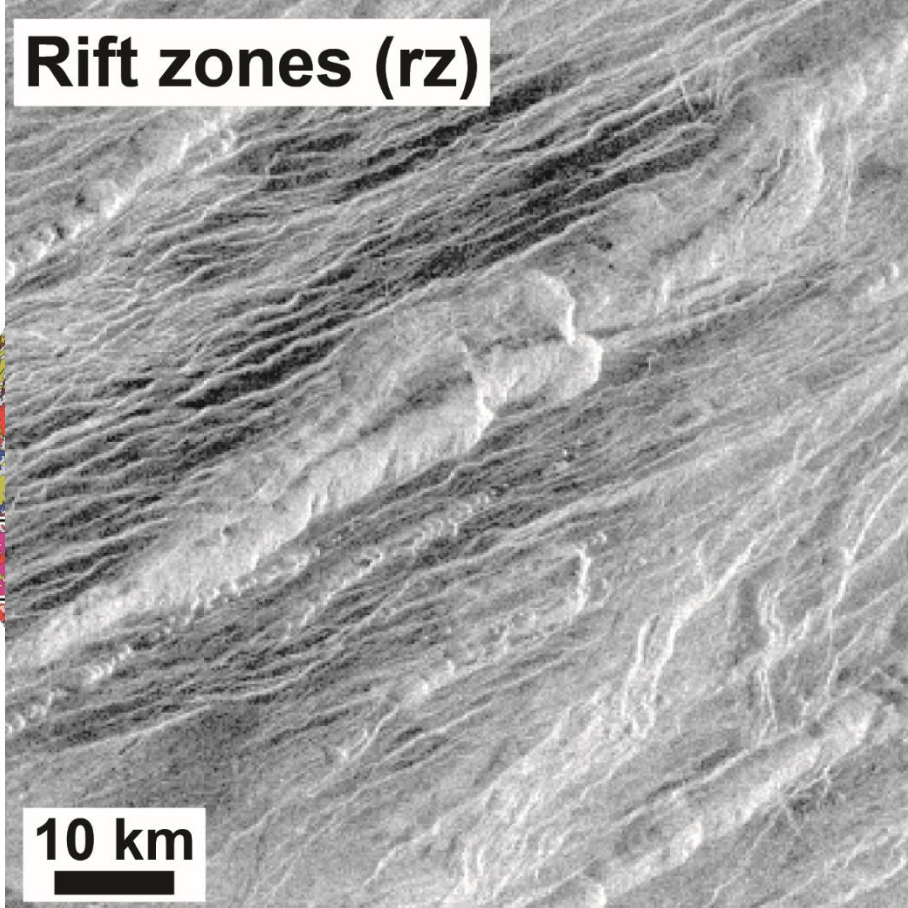# Lander safety: Tectonic units

Ridged plains (rp)

Tessera (t)

Rift zones (rz)

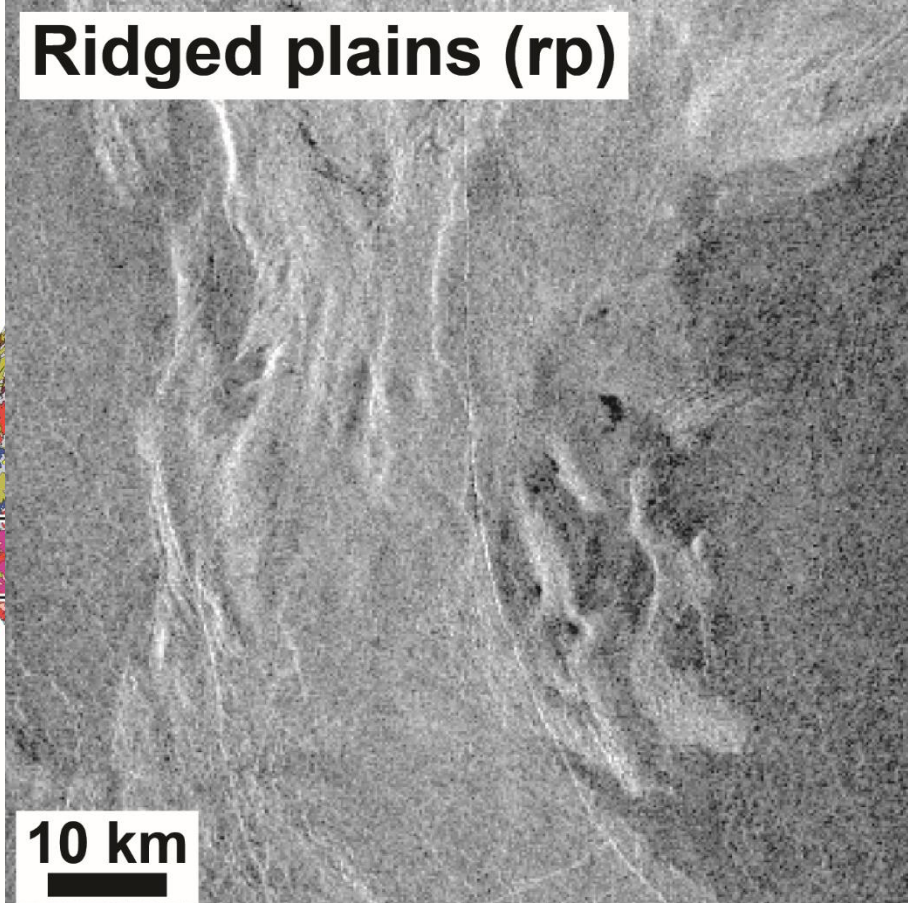Possible rift zone analog

10 km

10 km

10 km

Lander safety: Tectonic units
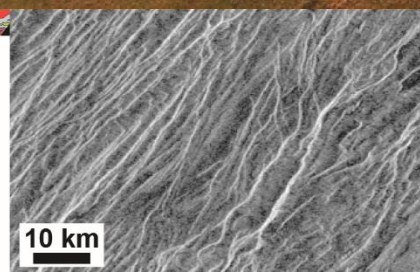

Ridged plains (rp)

Ridged plains (rp)

Tessera (t)

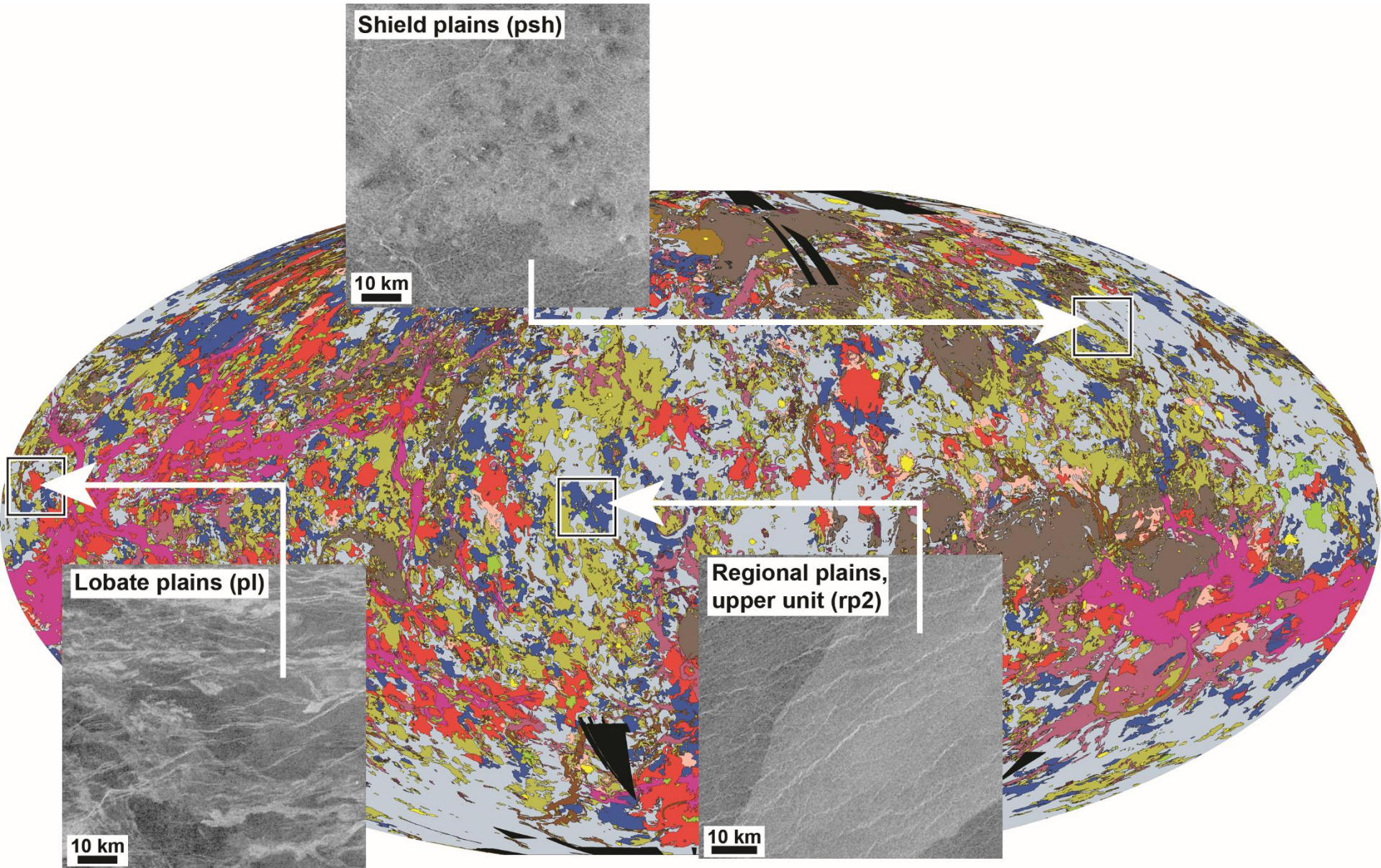Possible ridged plains analog

10 km

10 km

10 km

Lander safety: Volcanic units, unsafe

Shield plains (psh)

10 km

Lobate plains (pl)

10 km

Regional plains, upper unit (rp2)
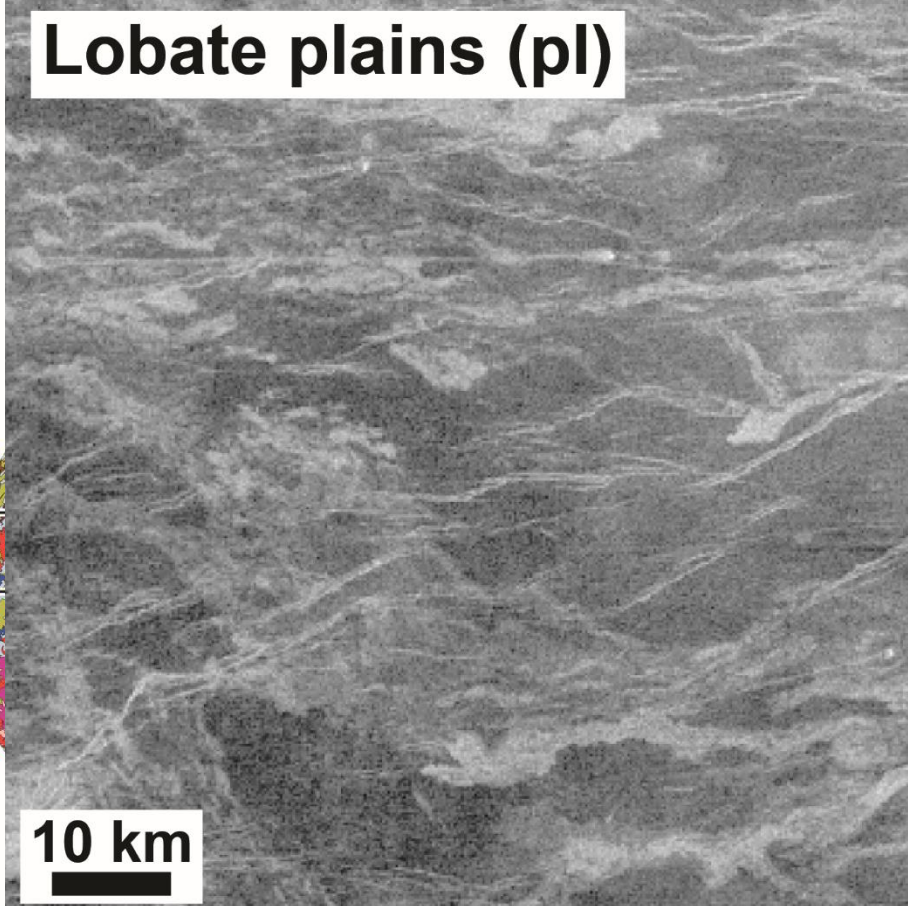
10 km

Lander safety: Volcanic units, unsafe

Shield plains (psh)

Lobate plains (pl)

10 km
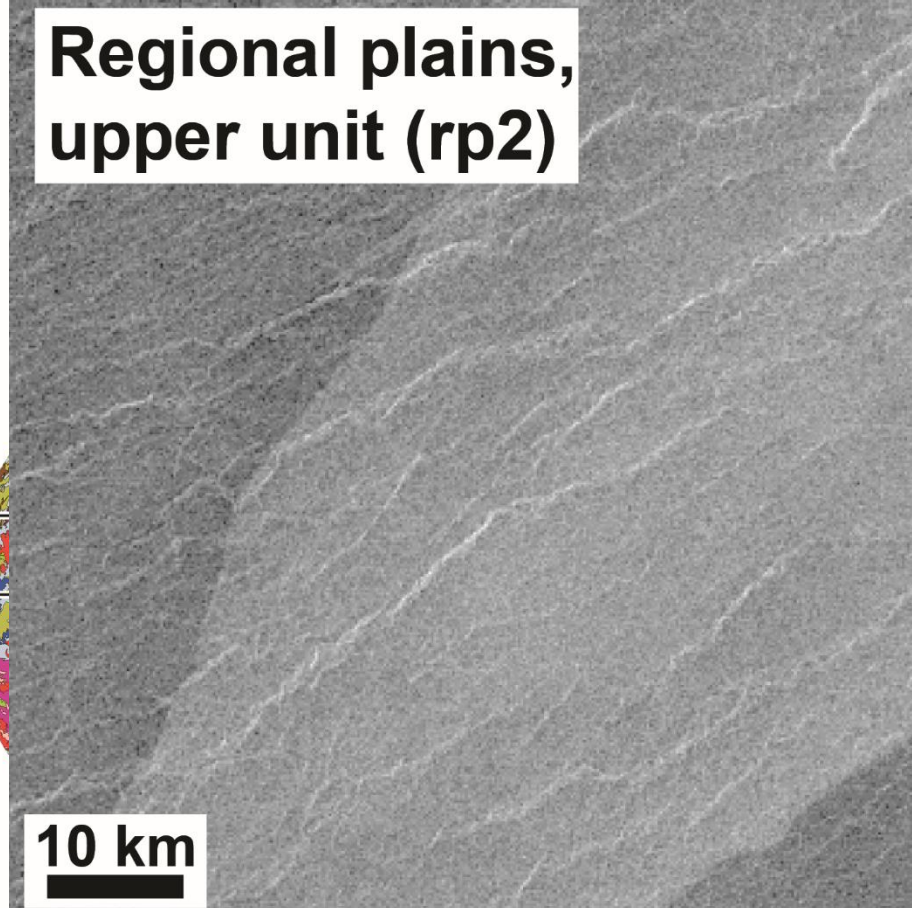
Possible lobate plains analog

10 km

10 km

Lander safety: Volcanic units, unsafe

Shield plains (psh)

Regional plains, upper unit (rp2)

Possible rp2 analog

10 km

10 km

10 km

Lander safety: Volcanic units, unsafe
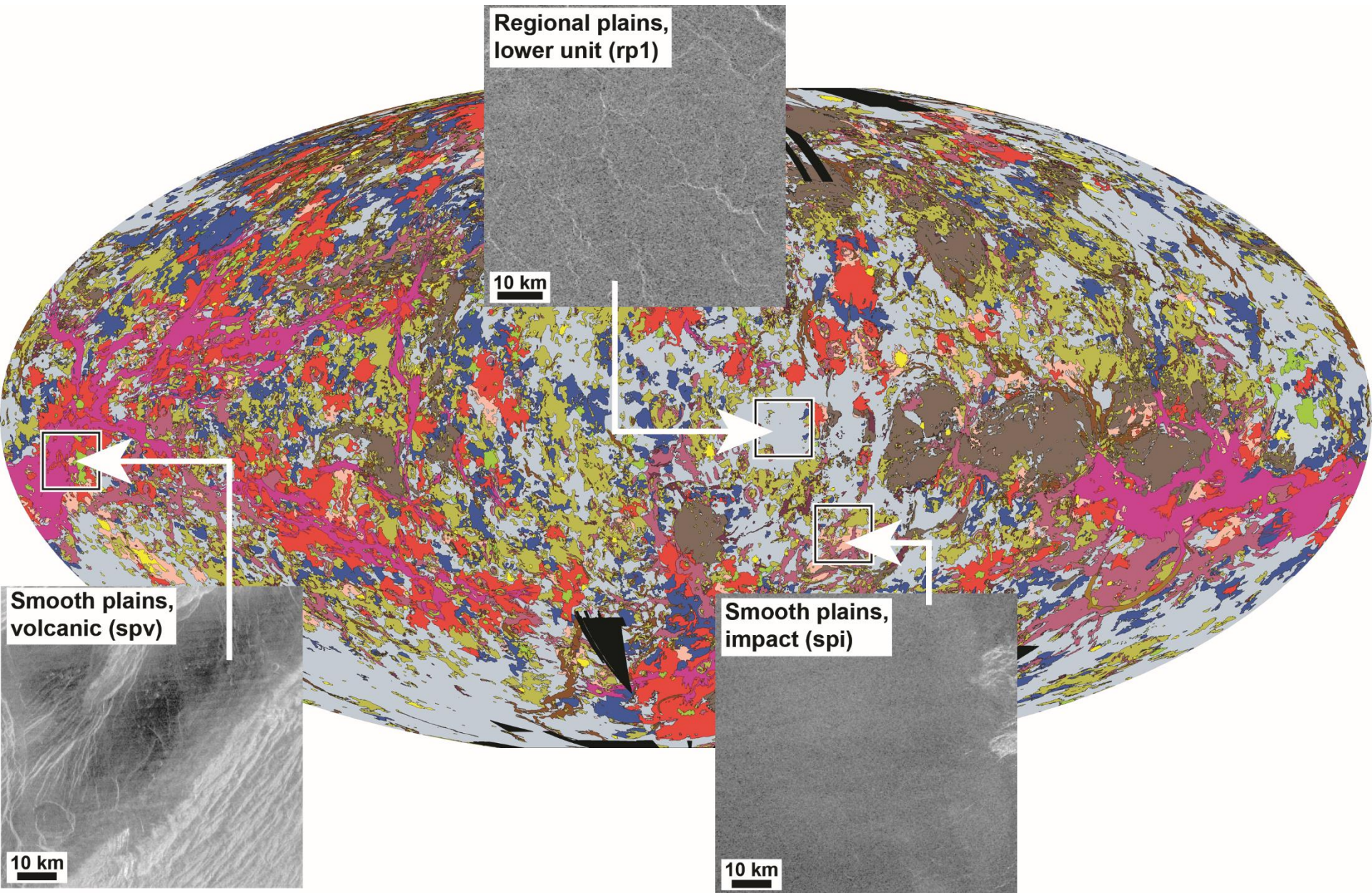

Shield plains (psh)

Shield plains (psh)

Possible psh analog

10 km

10 km

10 km

Lander safety: Volcanic units, safe

Regional plains, lower unit (rp1)

10 km

Smooth plains, volcanic (spv)

10 km

Smooth plains, impact (spi)

10 km

Lander safety: Volcanic units, safe

Regional plains, lower unit (rp1)

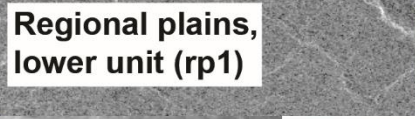Regional plains, lower unit (rp1)

Possible rp1 analog
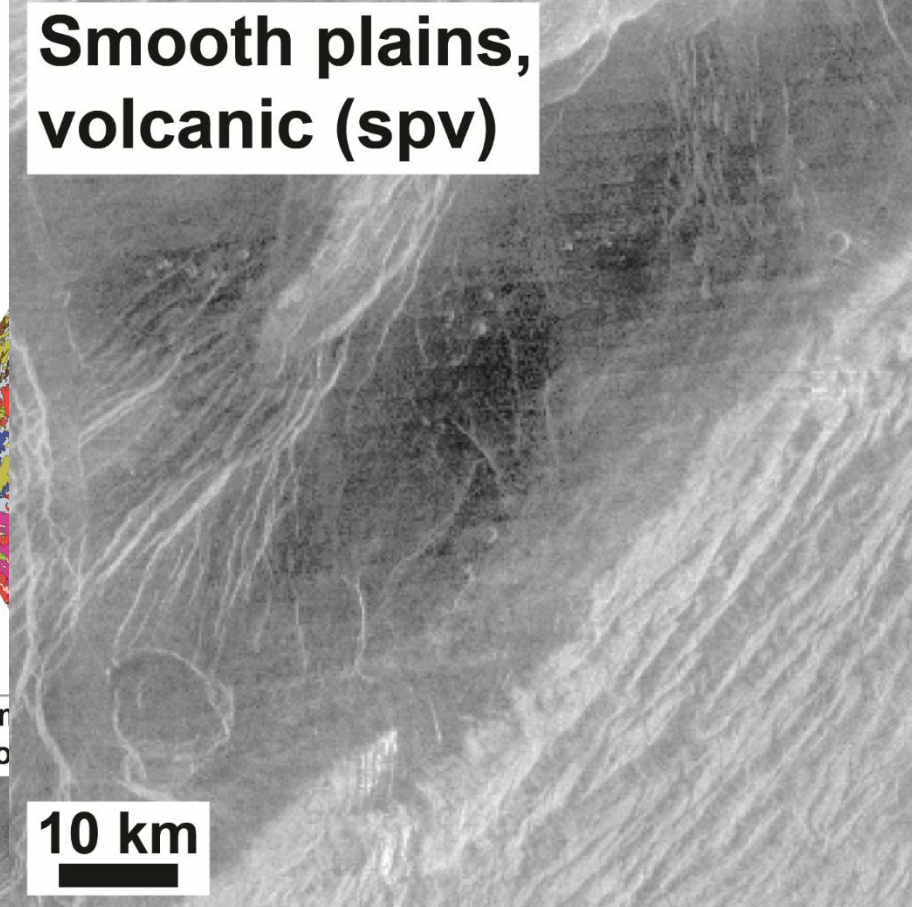
10 km

Sm vo

10 km

10 km

Lander safety: Volcanic units, safe

Regional plains, lower unit (rp1)
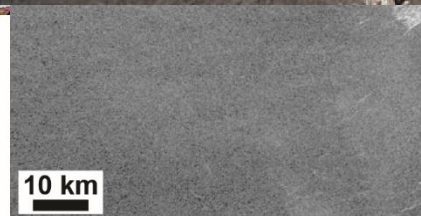
Smooth plains, volcanic (spv)

Possible spv analog

10 km

Lander safety: Volcanic units, safe

Regional plains, lower unit (rp1)

Smooth plains, impact (spi)

Possible spi analog

10 km
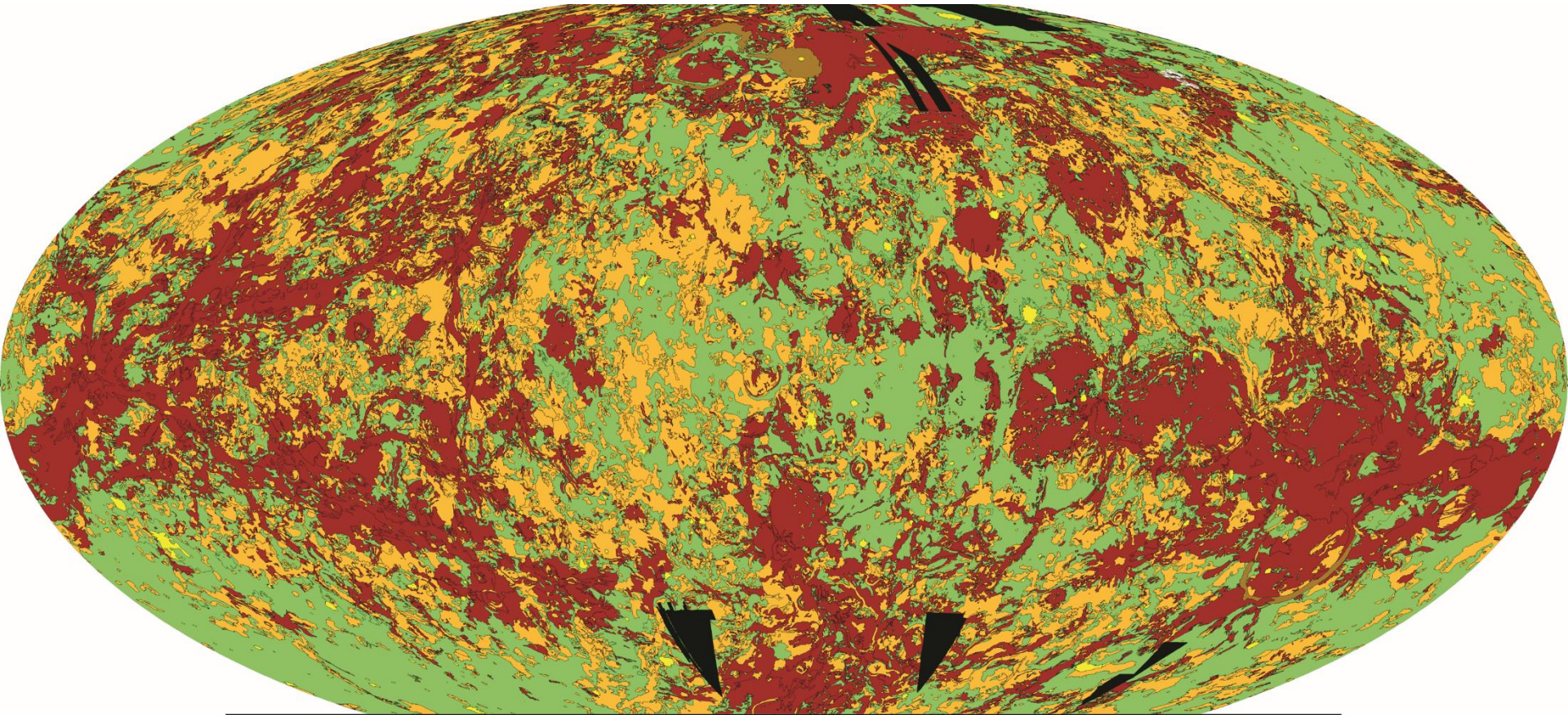
10 km

10 km

Prioritization by safety

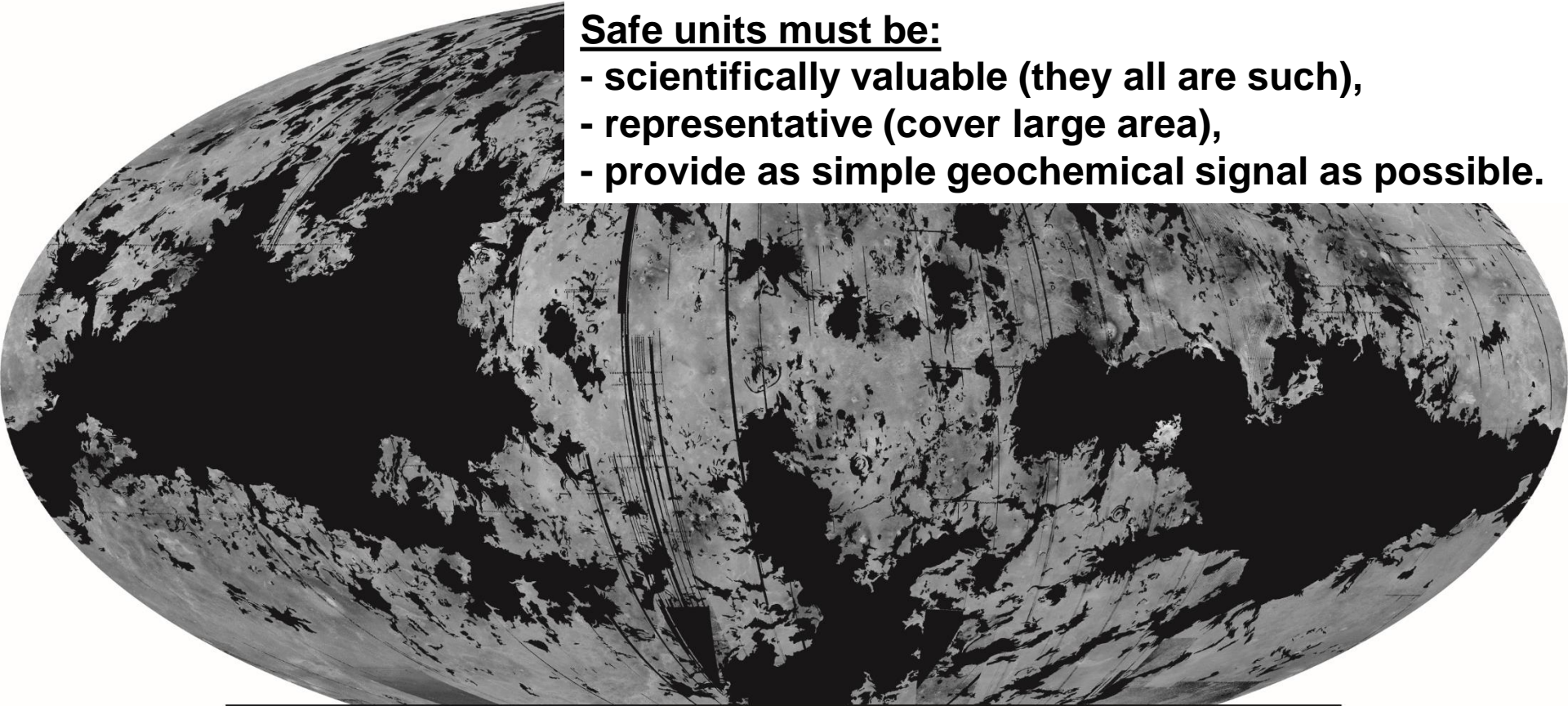| Unsafe units		Moderately safe units		Safe units
tectonic	volcanic	tectonic	volcanic	
t — Tessera	pl — Lobate plains	pr — Ridged plains	psh — Shield plains	rp1 — Regional plains, lower unit
pdl — Densely lineated plains			rp2 — Regional plains, upper unit	ps — Smooth plains
gb — Groove belts				
rz — Rift zones				

Scientific prioritization

No good data, no good mission
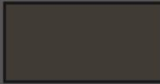
Prioritization by science

Safe units must be:
- scientifically valuable (they all are such),
- representative (cover large area),
- provide as simple geochemical signal as possible.

Unsafe units		Moderately safe units		Safe units
tectonic	volcanic	tectonic	volcanic	
t — Tessera	pl — Lobate plains	pr — Ridged plains	psh — Shield plains	rp1 — Regional plains, lower unit
pdl — Densely lineated plains			rp2 — Regional plains, upper unit	ps — Smooth plains
gb — Groove belts				
rz — Rift zones				

Prioritization by science

Ridged plains: non-representative (~2% of Venus).

Unsafe units		Moderately safe units		Safe units
tectonic	volcanic	tectonic	volcanic	
t — Tessera	pl — Lobate plains	pr — Ridged plains	psh — Shield plains	rp1 — Regional plains, lower unit
pdl — Densely lineated plains			rp2 — Regional plains, upper unit	ps — Smooth plains
gb — Groove belts				
rz — Rift zones				

Prioritization by science

Shield plains:
- representative (~19% of Venus),
- complex geochemical signal (poorly constrained interpretation).

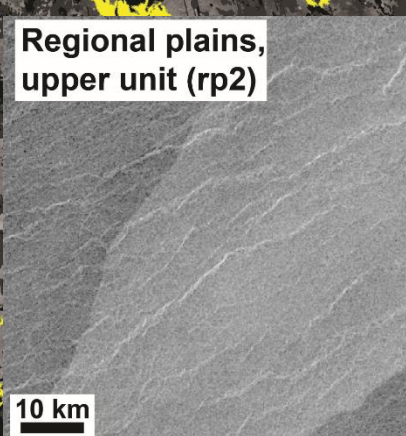| Unsafe units		Moderately safe units		Safe units
tectonic	volcanic	tectonic	volcanic	
t — Tessera	pl — Lobate plains	pr — Ridged plains	psh — Shield plains	rp1 — Regional plains, lower unit
pdl — Densely lineated plains			rp2 — Regional plains, upper unit	ps — Smooth plains
gb — Groove belts				
rz — Rift zones				

Prioritization by science

rp2

rp1

magmatic center

50 km

Regional plains 2:
- **less representative (~9% of Venus),**
- **may represent initial stages of evolution of magmatic centers,**
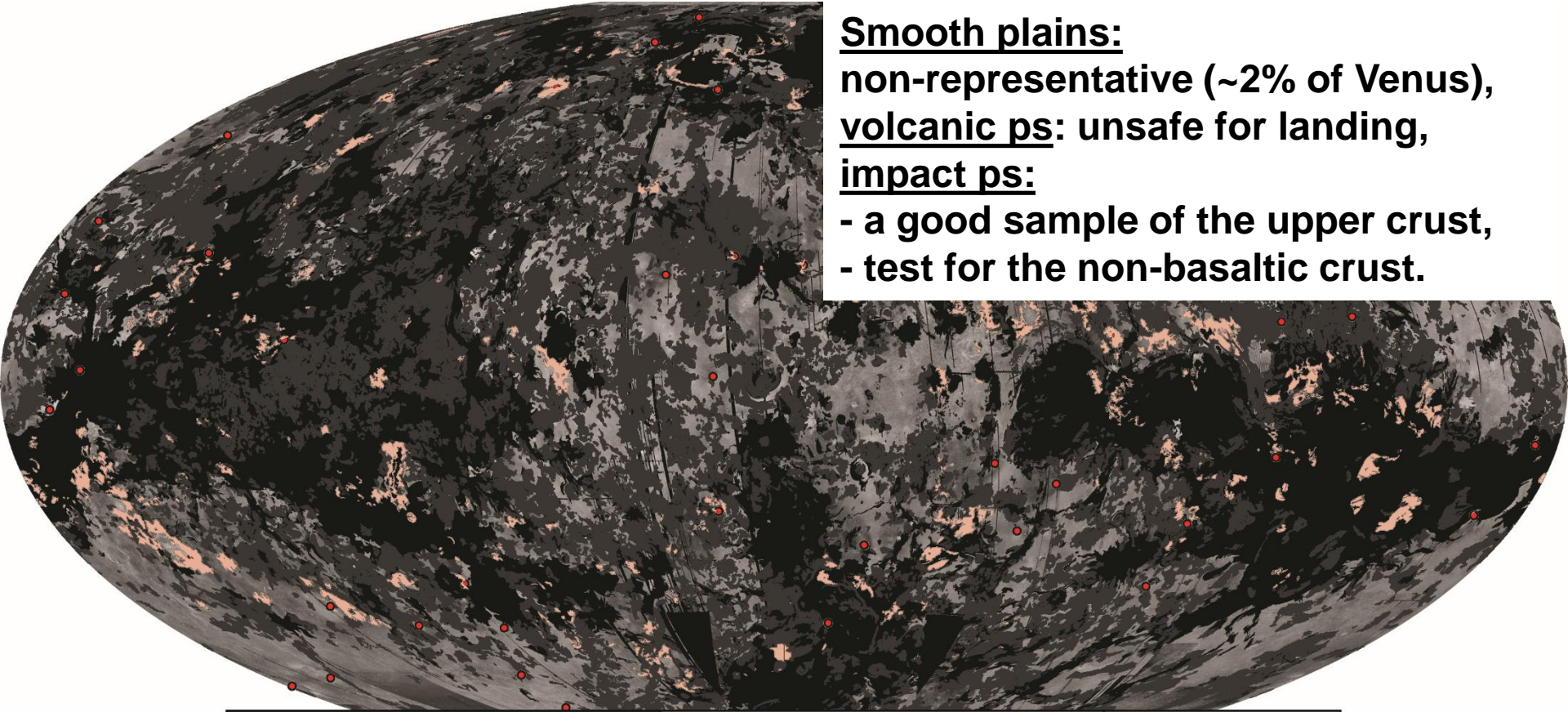- **may be unsafe for landing.**

Regional plains, upper unit (rp2)

Possible rp2 analog

10 km

Unsafe units			Moderately safe units		Safe units
tectonic	volcanic	tectonic	volcanic		
t — Tessera	pl — Lobate plains	pr — Ridged plains	psh — Shield plains	rp1 — Regional plains, lower unit	
pdl — Densely lineated plains			rp2 — Regional plains, upper unit	ps — Smooth plains	
gb — Groove belts					
rz — Rift zones					

Prioritization by science

Smooth plains:
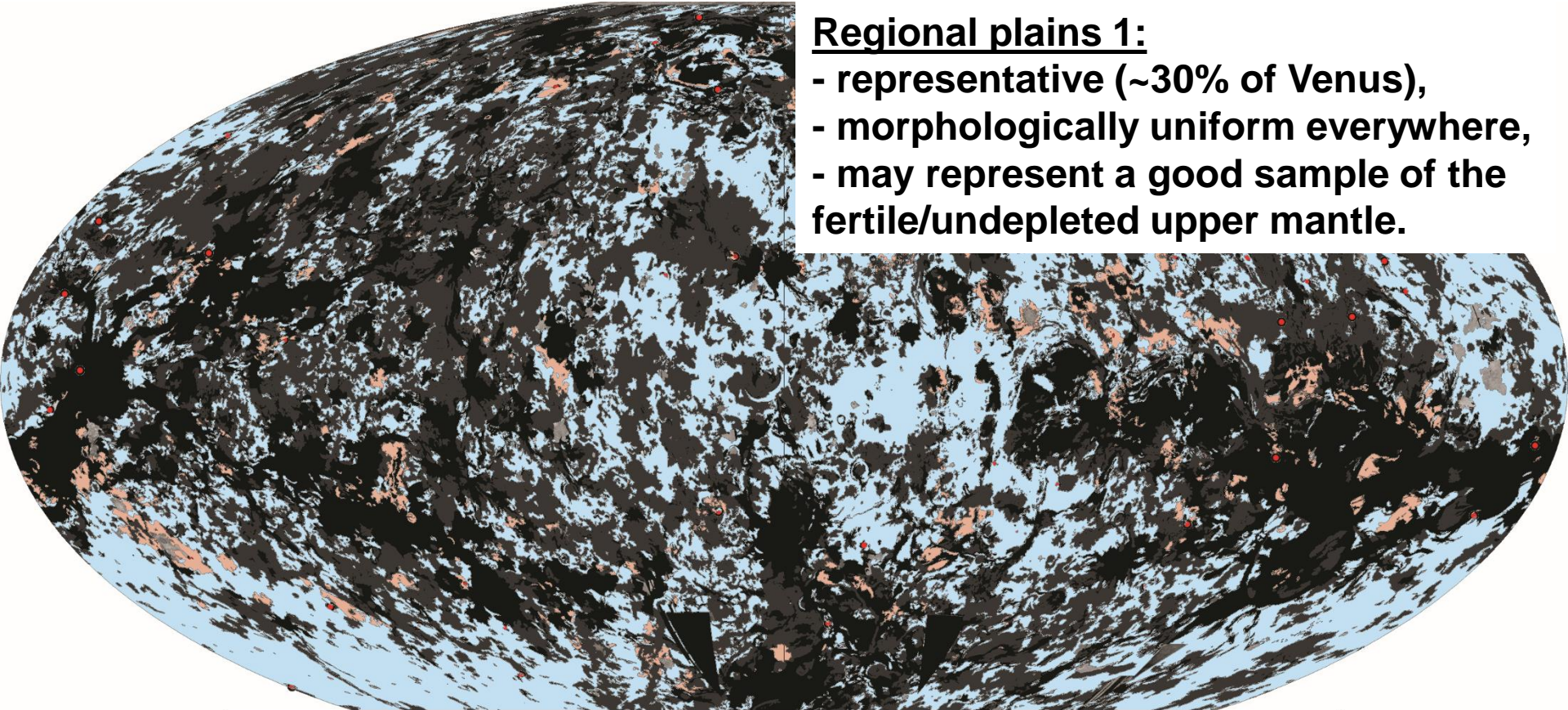non-representative (~2% of Venus),
volcanic ps: unsafe for landing,
impact ps:
- a good sample of the upper crust,
- test for the non-basaltic crust.

Unsafe units		Moderately safe units		Safe units
tectonic	volcanic	tectonic	volcanic	
t — Tessera	pl — Lobate plains	pr — Ridged plains	psh — Shield plains	rp1 — Regional plains, lower unit
pdl — Densely lineated plains			rp2 — Regional plains, upper unit	ps — Smooth plains
gb — Groove belts				
rz — Rift zones				
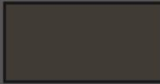
Prioritization by science

Regional plains 1:
- **representative (~30% of Venus),**
- **morphologically uniform everywhere,**
- **may represent a good sample of the fertile/undepleted upper mantle.**

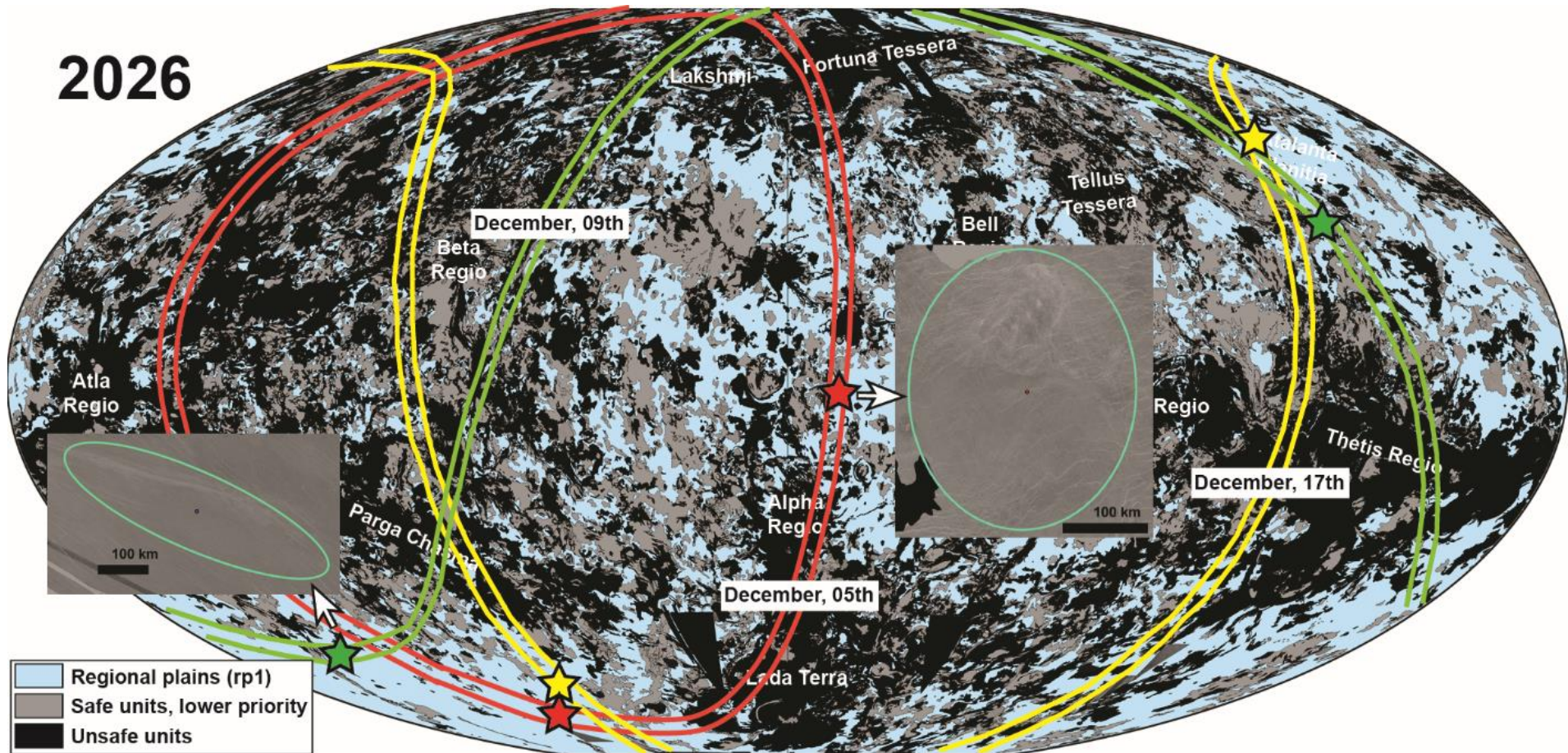| Unsafe units		Moderately safe units		Safe units
tectonic	volcanic	tectonic	volcanic	
t Tessera	**pl** Lobate plains	**pr** Ridged plains	**psh** Shield plains	**rp1** Regional plains, lower unit
pdl Densely lineated plains			**rp2** Regional plains, upper unit	**ps** Smooth plains
gb Groove belts				
rz Rift zones				

Orbital restrictions

We CANNOT land in ANY place we wish

Orbital restrictions

Position of the attainability arcs for year of 2026. Insets show examples of the uncertainty ellipses for two selected landing sites. Stars indicate the other sites.

Orbital restrictions
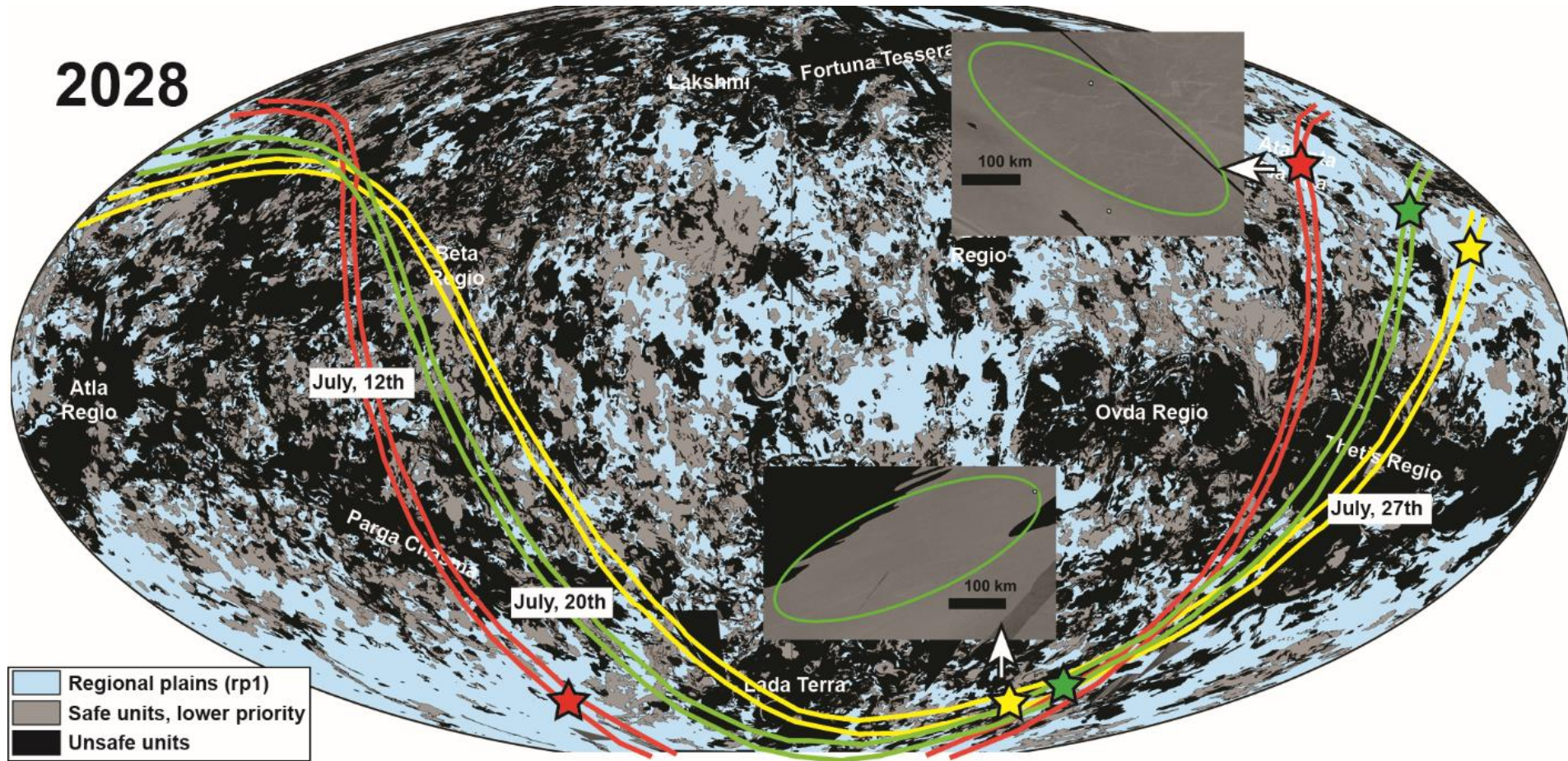

Position of the attainability arcs for year of 2028. Insets show examples of the uncertainty ellipses for two selected landing sites. Stars indicate the other sites.

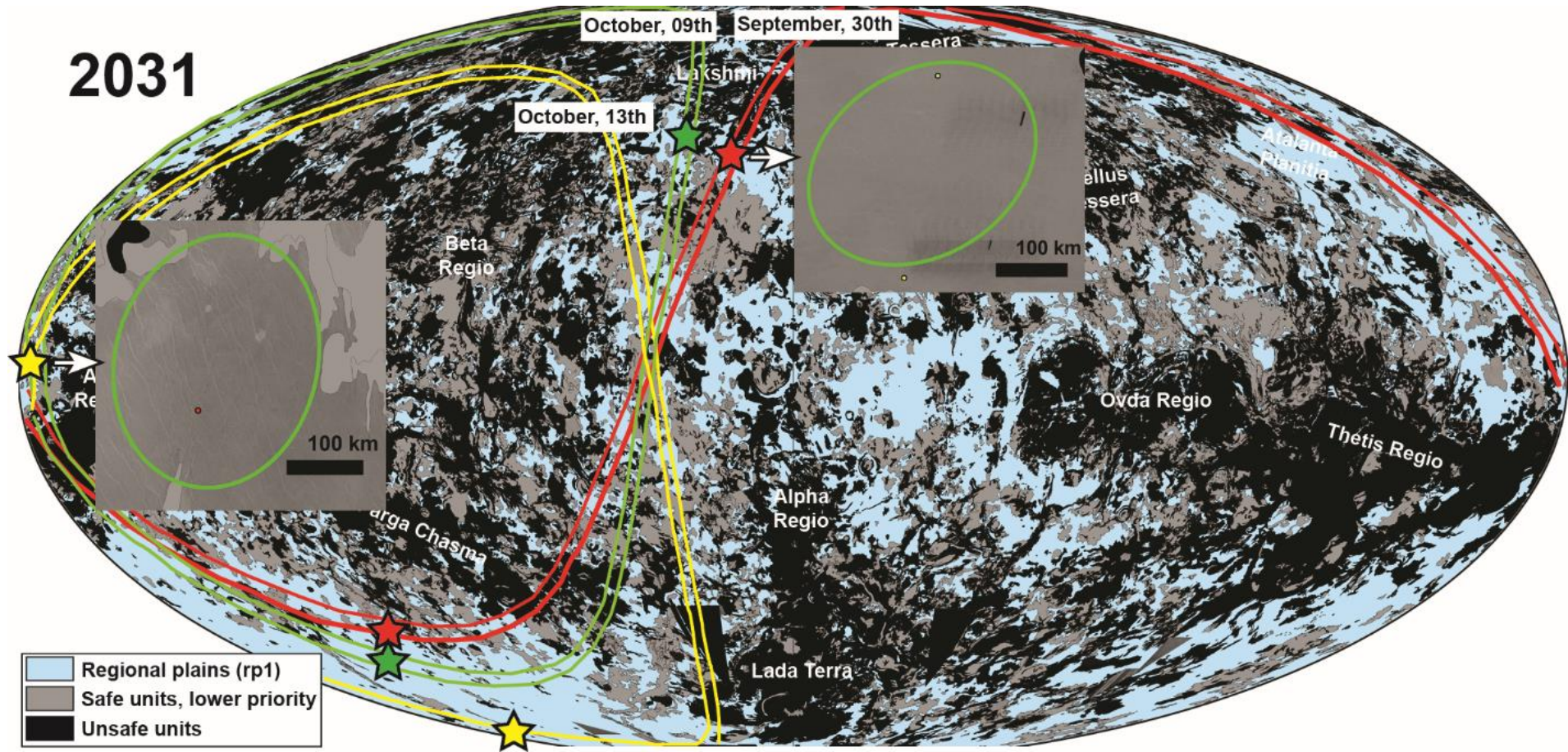# Orbital restrictions

Position of the attainability arcs for year of 2031. Insets show examples of the uncertainty ellipses for two selected landing sites. Stars indicate the other sites.