Soviet lander and Magellan data point toward Earthlike Venus geochemistry and volcanology, with some differences, and many questions

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Key conclusions about Venus from rock geochemistry [1-3]

Confidence:	75% [4]	95% [5]
It's a silicate world	*Yes!*	*Yes!*
It has a Fe-rich core	*Yes!*	*Yes!*
It has grossly basaltic rocks	*Yes!*	*Yes!*
It has MORB-like basaltic rocks	Yes	Maybe
It has highly alkaline mafic rocks	Yes	Maybe
Alkaline mafic rocks are abundant	Yes	Maybe
It has granitic rocks	Maybe	Maybe
It has Ca-Al-Ti fractionation	Yes	Maybe
It shows a mantle role of garnet	Maybe	Maybe
It shows a mantle role of CO_2 (or H_2O)	Maybe	Maybe
It resembles Earth overall	Yes	Maybe
It resembles Mars overall	No	Maybe
It resembles eucrite parent body	No	Maybe
It resembles Earth's Moon	No	No
We have good geochemical sampling	*No!*	*No!*

(1) Surkov et al. 1984, (2) Barsukov et al. 1986, (3) Basilevsky et al. 1992; (4) Kargel et al. 1993; (5) Treiman 2007.

How similar are Venus and Earth geochemically and petrologically?

How does the Venusian plate tectonic and diapir-driven tectonic systems work in relation to igneous processes?

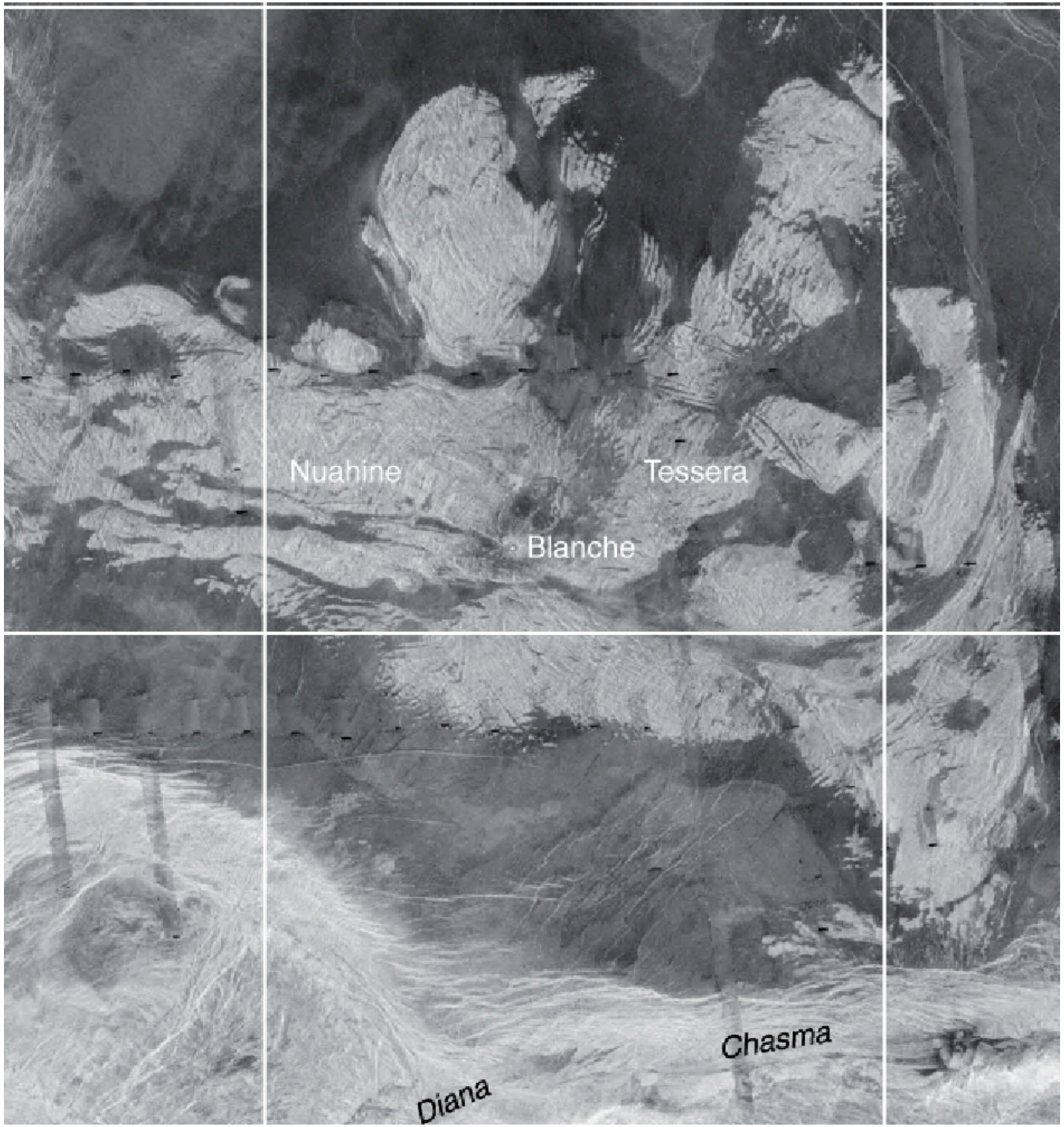
Did Venus ever have oceans, and if so, for how long? (Mark Bullock's question from VEXAG meeting yesterday)

What does the Venus greenhouse tell us about climate change? (another Bullock question)

What are the implications for the characteristic lifetimes and conditions of habitable conditions on Venus? (White paper question brought up yesterday)

In the past, how did volcanism and tectonics link with hydrogeochemistry and geologic deposits?

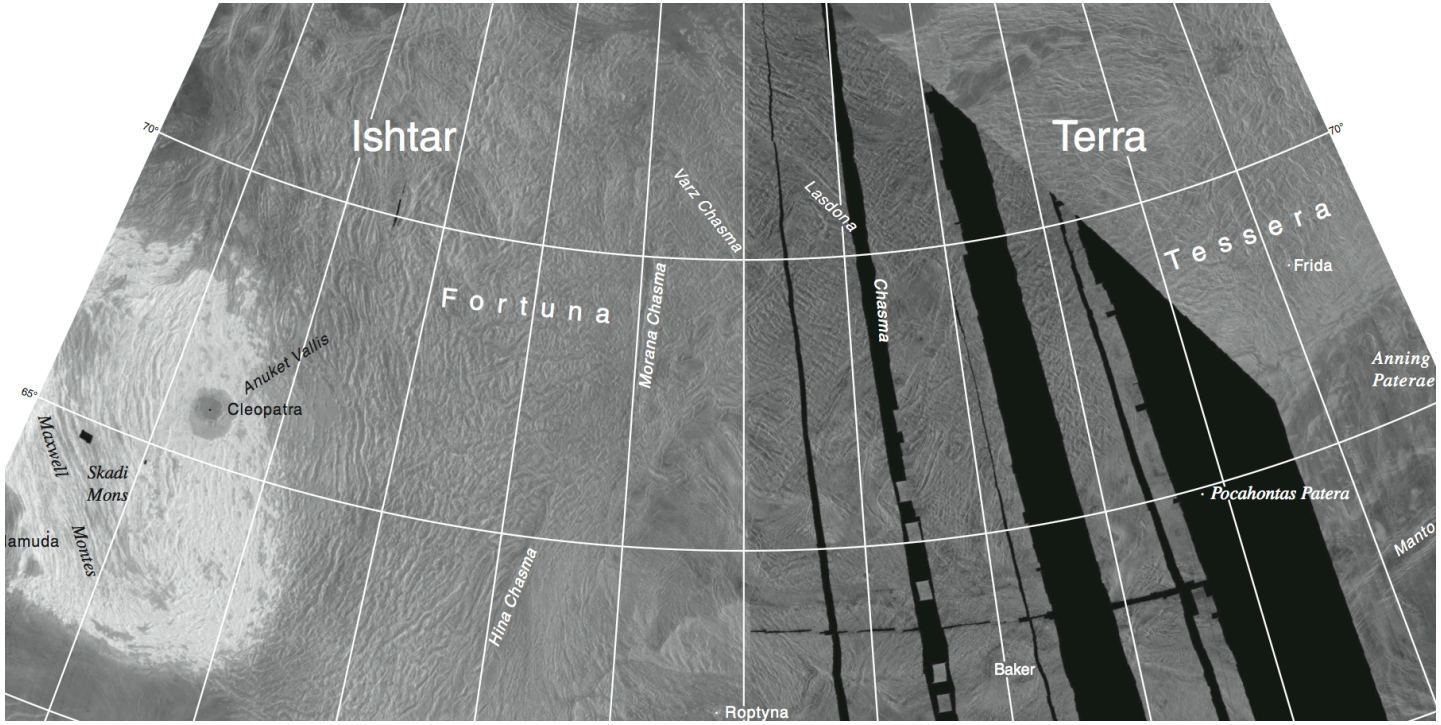
Are there any remnant geoloigic deposits or geochemical traces from a past aqueous epoch?

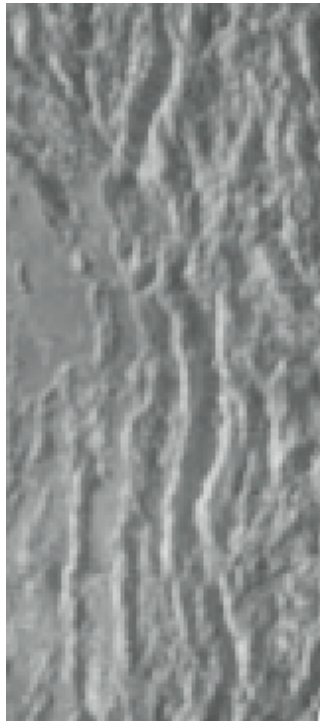


Ask Martha Gillmore: Where would we go to find whatever is preserved from the time before global resurfacing?

The tesserae*!

*tessera: Latin: a cube, a die with numbers on all six sides. Greek: four (plural tesserae): A small square piece of stone, wood,ivory or glass used for making a mosaic.





What might we find in tesserae? Folds, faults! And:

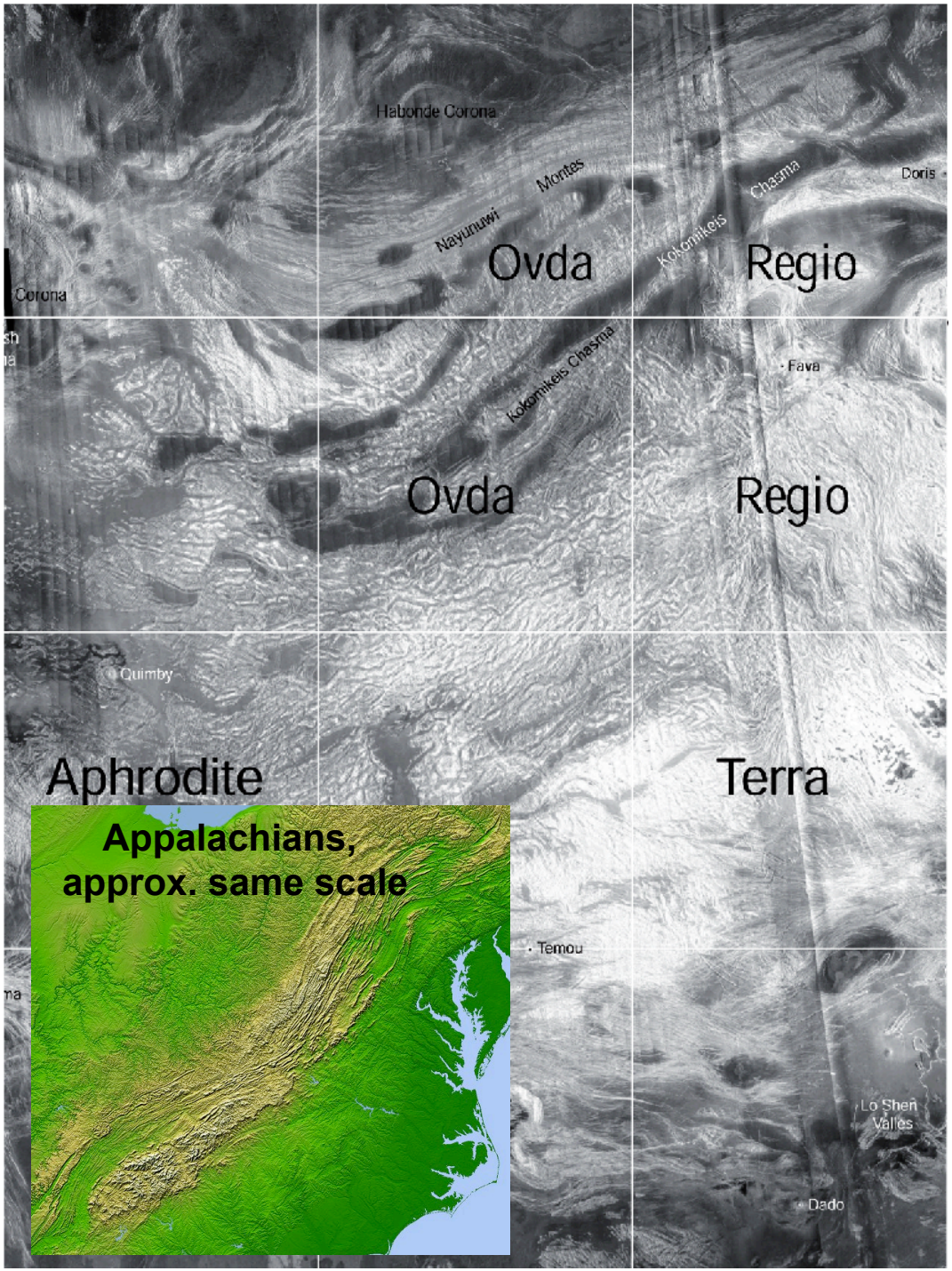
(1) Older remnants of what exists everywhere else: volcanic rocks *Consistent with folding**.

(2) Granitoid continental igneous rocks *Not the folded parts!*

(3) Earth-like relics of an aqueous past, e.g., meta-carbonate (marble), meta-pelite (gneiss), meta-conglomerate (quartzite) *Consistent with folding*

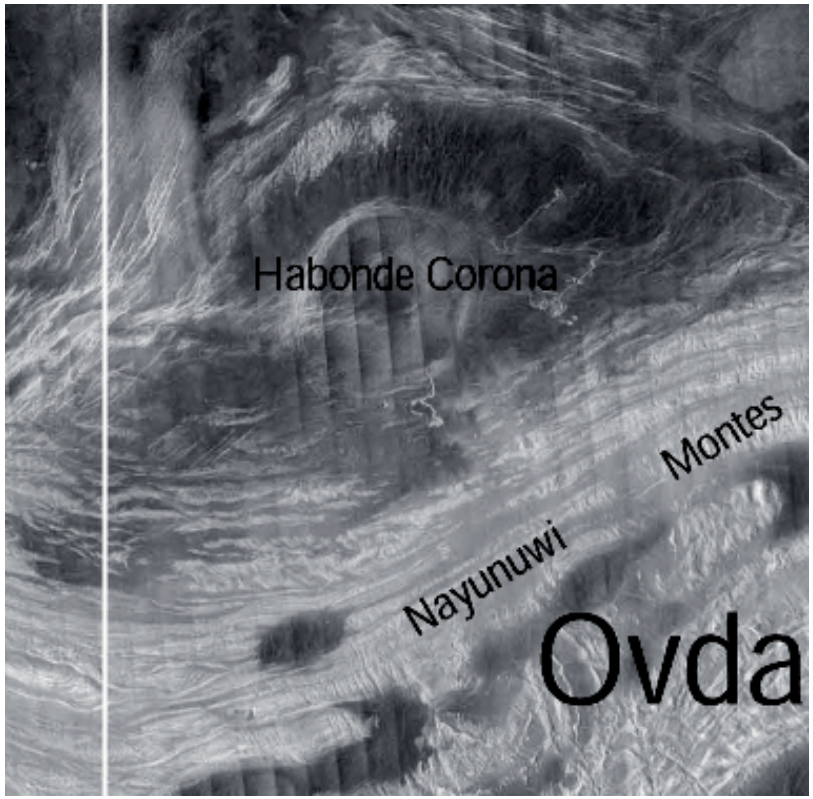
Go ye, therefore, to the *tesserae and fold belts!*

**Some tessera structural interpretations that include folds: Hansen et al. 2000, Romeo and Turcotte 2008*



Folding requires layered rocks

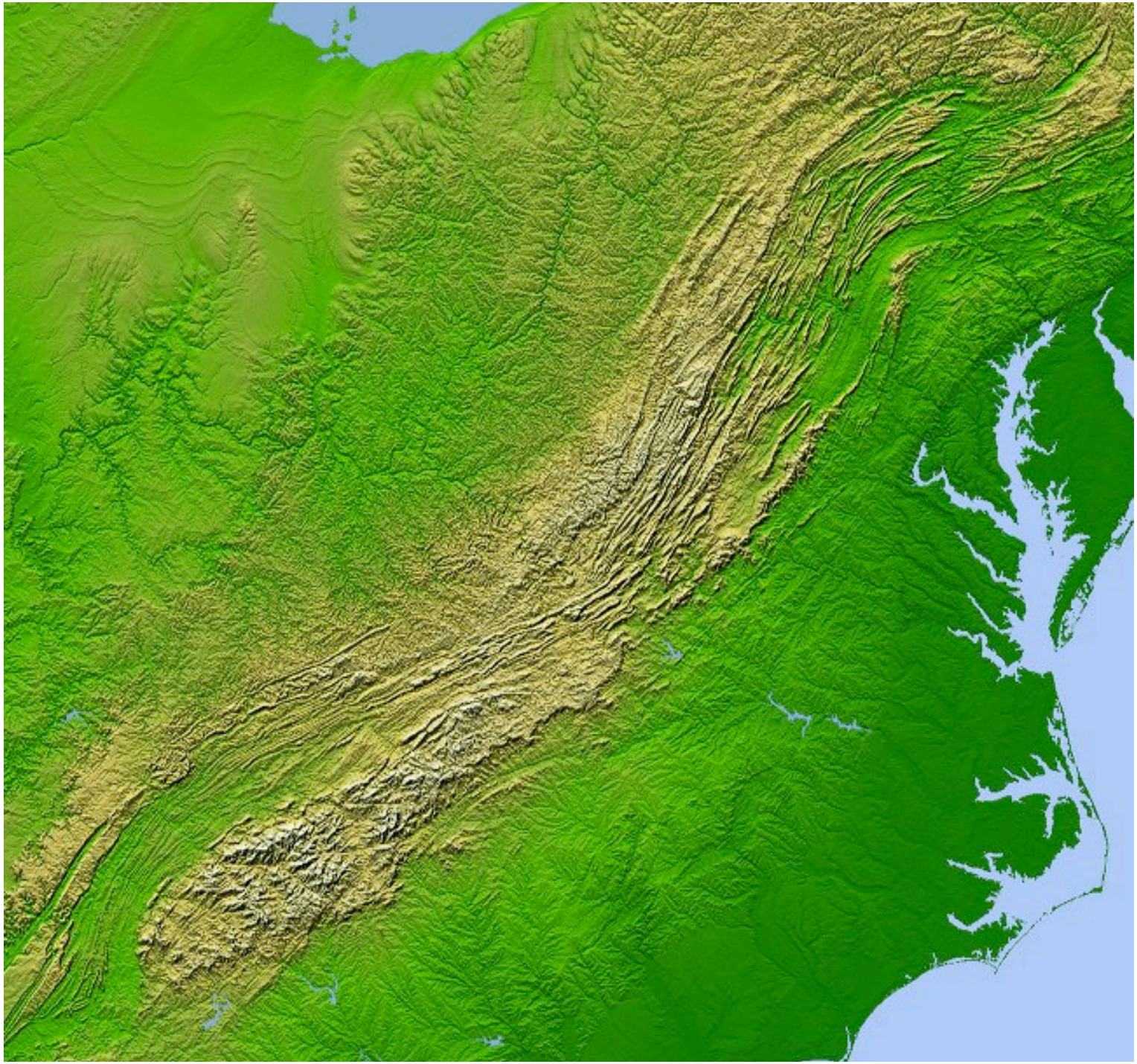
-- Volcanic
(But not massive flows)
-- Sedimentary
(But not massive layers)
-- *Not* intrusive or strongly discordant rocks



See also papers by Vicki Hansen on folding and related tectonic issues pertaining to Venus. You'll get a different and an intriguing perspective on how Venusian fold belts may have originated. See for instance:

Hansen, V. L. (2006), Geologic constraints on crustal plateau surface histories, Venus: The lava pond and bolide impact hypotheses, *J. Geophys. Res., 111, E11010, doi:10.1029/2006JE002714.*

Folded shale, siltstone, and gypsum, southern California



Folded low-grade metamorphic carbonates, siltstone, and sandstone, Appalachians (Pennsylvania)

Meta-sandstone, amphibolite grade