Interactions between regional transient shearing, rifting, & mantle flow on Venus - radar & gravity interpretations & Earth analogues

Venus shows no evidence for plate tectonics.
- No evidence for "modern," single-sided subduction.
- No active volcanoes/extension.
Venus is dominated by mantle plumes formed within a stagnant lid convection regime.

Plains (such as Lakshmi Planum in Ishtar Terra) are elevated areas resembling continents on Earth.

**Bouguer gravity & crustal thickness**

Bouguer lows = craton-like blocks with deep keels
Bouguer highs = rifts
Offset &/or deflection of "wavy" & anomalies = regional transient shear zones

**Fold & thrust / transpositional belts = areas of thick crust**

Mantle plumes form an elongate wall of slightly thicker crust flanked by thin crust - rifts

**Venus - an analogue for an Archaean Earth without plate tectonics**

- Gravity & radar images show that transient shear zones on Venus (a planet without plate tectonics) are of far greater extent than previously mapped.
- Plate-like horizontal displacements of several hundred kilometres on Venus occurred without the stresses created by "ridge push," slab pull, & "french suction" associated with plate tectonics on Earth.
- Lateral displacement of "craton-like" plains on Venus result from mantle tractions at their base & plume push within a stagnant lid to transitional convection regime.
- Broad fold & thrust belts & regional transient shear zones on Venus illustrate that "modern" plate tectonics is not required to form similar structures in Archaean terrains, previously attributed to subduction-related collision & arc accretion.
- Studies of Venus support a cratonic mobilism model for the Archaean Earth where cratons are displaced due to mantle flow acting upon their deep lithospheric keels.

**Mantle tectonics drive displacement of planes on Venus**

Plume push on Venus has produced an identical geometry of structures to the Himalayan-Indochina indentation & lateral escape system on Earth, BUT which were formed without plate tectonics.
Plume push on Earth adds to plate tectonic induced forces of ridge-push, slab pull, & trench suction.

**Extension at broad rifts is accommodated by folding, thrusting, & transient shearing.**

Venus plumes & Archaean proto-cratons are displaced due to mantle flow against their deep keels.

**Mantle tectonics drive rapid early & ongoing, post-collisional displacement of India**

India plate motions are driven by the interaction of lateral & mantle flow in addition to plate boundary forces.
The Arabian plate hotspot is a major driving force for modern events between ca. 70 & 44 My.
Continued northward displacement of India is due to the flow of mantle plumes across its continental crust.

**References**

**3D seismic tomographic surfaces portray merging of upwelling plumes (warm colours) accompanying the Red Sea & Gulf of Aden rifts, & downsinking plumes (cold colours). A similar relationship is proposed for Venus.**