

Regional-Scale Lithospheric Recycling on Venus via Peel-Back Delamination. A. C. Adams¹, D. R. Stegman¹, S. E. Smrekar², and P. J. Tackley³, ¹Institute of Geophysics and Planetary Physics, Scripps Institution of Oceanography, University of California, San Diego, CA, USA, ²Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA, ³Institute of Geophysics, Department of Earth Sciences, ETH Zürich, Zürich, Switzerland.

Abstract: We currently have a limited understanding of the tectonic framework that governs Venus. Schubert and Sandwell (1995) identified over 10,000 km of possible subduction sites at both coronae and chasmata rift zones [1]. Previous numerical and experimental studies have shown the viability of regional-scale lithospheric recycling via plume-lithosphere interactions at coronae, yet little work has been done to study the possibility of resurfacing initiated at Venusian rift zones. We created 2D numerical models to test if and how regional-scale resurfacing could be initiated at a lateral lithospheric discontinuity. We observed several instances of peel-back delamination - a form of lithospheric recycling in which the dense lithospheric mantle decouples and peels away from the weak, initially 30 km-thick crust, leaving behind a hot, thinned layer of crust at the surface (Figure 1). Delamination initiation is driven by the negative buoyancy of the lithospheric mantle and is resisted by the coupling of the plate across the Moho, the significant positive buoyancy of the crust arising from a range of crustal densities, and the viscous strength of the plate. Initial plate bending promotes yielding and weakening in the crust, which is crucial to allow decoupling of the crust and lithospheric mantle. When there is sufficient excess negative buoyancy in the lithospheric mantle, both positively and negatively buoyant plates may undergo delamination. Following a delamination event, the emplacement of hot, buoyant asthenosphere beneath the crust may have consequences for regional-scale volcanism and local tectonic deformation on Venus within the context of the regional equilibrium resurfacing hypothesis.

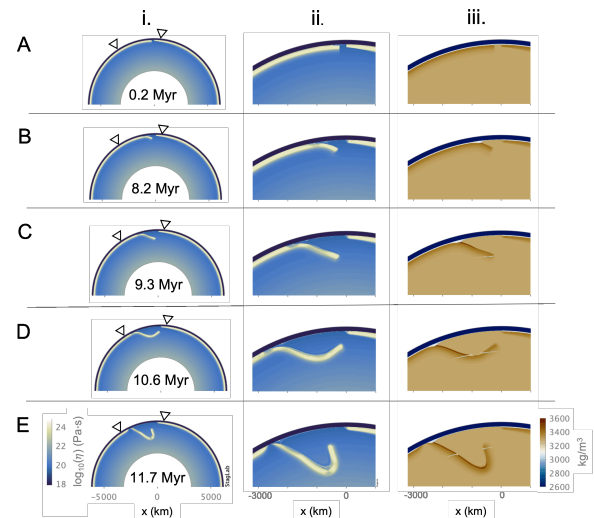


Figure 1: Typical evolution of a peel-back delamination event shown in the (i) full-scale viscosity field, (ii) local viscosity field, and (iii) local density field of reference model. (A) A 250 km-wide gap separates the thicker plate edge on the left from the 100 km plate edge to the right of the gap. (B) The edge of the thicker plate is bent downward due to the negative buoyancy of the lithospheric mantle. A layer of eclogite is formed in the thin layer of crust still attached to the down-going plate. (C) The lithospheric mantle continues to peel-back from the surface and thicker layers of crust are recycled due to eclogitization of the growing crustal root over the delamination hinge. The slab tip encounters the phase transitions near 710 km depth and (D) is deflected upward. (E) The plate necks and thins at the delamination hinge prior to slab break-off at the surface.

References:

- [1] Schubert, G. and Sandwell D. (1995) *Icarus*, 117, 173–196.