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Modeling the formation of large-scale volcanoes on Venus

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The surface of Venus is characterized by a large number of volcanic features, indicating that volcanic activity played an important role in the planet's thermal and tectonic evolution. This volcanic activity is driven by a superheated interior and is likely to be related to either plumes coming from the deep interior or extension of the surface. The largest volcanoes have a diameter of more than 500 km, a height exceeding 3 km, and are associated with significant gravity anomalies. In order to better understand the formation of the large volcanoes on Venus and their gravity signatures, we investigate the rise and subsequent relaxation of a large-scale volcanic edifice by performing a series of 2D and 3D numerical simulations of the heat and mass transfer in Venus' upper mantle. The numerical modeling is conducted with the finite-element code ASPECT (https://aspect.geodynamics.org/) which has been modified to include different types of fractional melting parameterization and driving mechanisms (extension, plumes of different widths and temperature, etc.). The topography and the gravity signal are computed assuming that the lithosphere behaves as a Maxwell viscoelastic solid and the results are compared with the topography and gravity around selected prominent volcanic features.