The Yellowstone magmatic system from the mantle plume to the upper crust

Hsin-Hua Huang, Fan-Chi Lin, Brandon Schmandt, Jamie Farrell, Robert B. Smith, and Victor C. Tsai

Abstract

The Yellowstone supervolcano is one of the largest active continental silicic volcanic fields in the world. An understanding of its properties is key to enhancing our knowledge of volcanic mechanisms and corresponding risk. Using a joint local and teleseismic earthquake *P*-wave seismic inversion, we unveil a basaltic lower-crustal magma body that provides a magmatic link between the Yellowstone mantle plume and the previously imaged upper-crustal magma reservoir. This lower-crustal magma body has a volume of 46,000 km^3, ~4.5 times larger than the upper-crustal magma reservoir, and contains a melt fraction of ~2%. These estimates are critical to understanding the evolution of bimodal basaltic-rhyolitic volcanism, explaining the magnitude of CO_2 discharge, and constraining dynamic models of the magmatic system for volcanic hazard assessment.

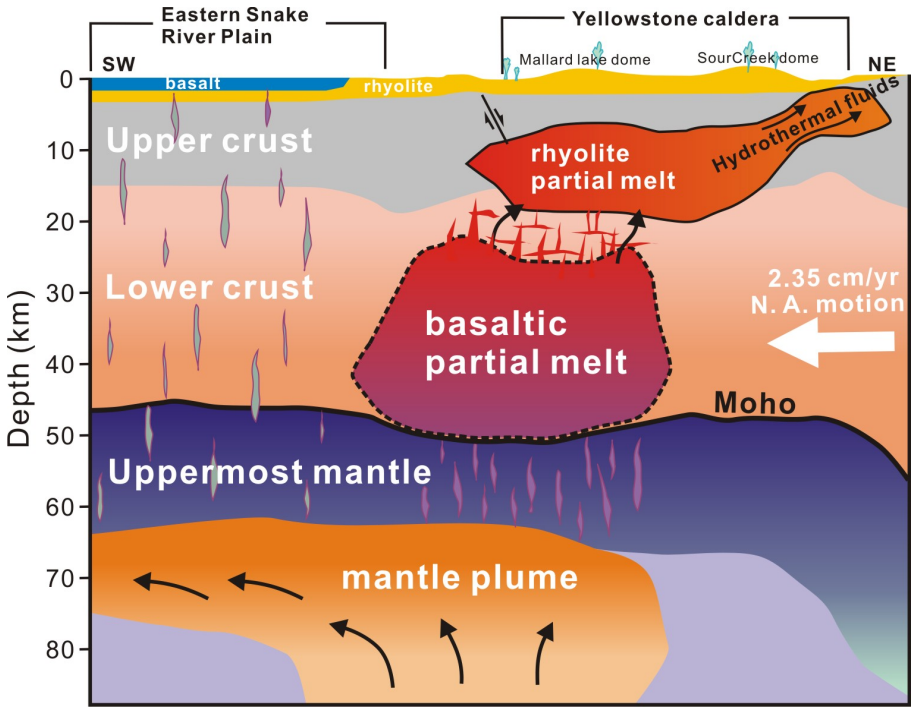

Fig. 1 Schematic model for the Yellowstone crust-to-upper mantle magmatic system. The geometry of the upper and lower crustal magma reservoirs are based on the contour of 5% V_P reduction in the tomographic model. The white arrow indicates the North American plate motion of 2.35 cm/yr.