ABSTRACT FINAL ID: T43K-05;

TITLE: Weak Intraplate Volcanism Caused by Shear-Driven Upwelling *(Invited)*

SESSION TYPE: Oral

SESSION TITLE: T43K. The Origin of Intraplate Volcanism: Hotspots, Nonhotspots, and Large Igneous Provinces I

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ABSTRACT BODY: Statistical analysis shows that there is an unusually high incidence of recent (<10 Ma), intraplate volcanism over asthenosphere that is predicted to be rapidly shearing. This result is heavily influenced by the large number of small seamounts west of the Eastern Pacific Rise, and small-volume basaltic volcanism throughout the Western United States. Here we explore one relationship that may explain why small-volume volcanism preferentially occurs above rapidly-shearing asthenosphere. Numerical models show that asthenospheric shear can be deflected upward by lateral viscosity variations within the asthenosphere, producing “shear-driven upwelling” (SDU). To constrain the rate, duration, and surface expression of intraplate volcanism caused by SDU, we simulated 2D flow and peridotite melting in the upper 200 km of the mantle. Asthenospheric shear is driven by lithospheric plates with different thicknesses moving at 3 to 9 cm/yr, and the initial low-viscosity region is a rectangular–shaped pocket with an imposed viscosity that is two orders of magnitude smaller than the surrounding asthenosphere. Melting decreases as the pocket deforms, and reaches steady state after 3 to 12 Myr. The age progression of surface volcanism is nearly stationary in the reference frame of the plate, which distinguishes SDU from hotspot volcanism. Similar steady-state behavior occurs if the viscosity heterogeneity is induced by variations in the water content of mantle peridotite. If the pocket’s low viscosity is caused by excess temperature, buoyant upwelling of the entire pocket dominates volcanism, which decreases exponentially with time. Differences in the time dependence of volcanism associated with damp and warm pockets may help identify which type of mantle heterogeneity and associated dynamic process best explains weak, intermittent, intraplate volcanism with no obvious age progression. We suggest that asthenospheric shear induced by plate motions and global mantle flow, by exciting SDU, drives some of the non-hotspot small-scale volcanism that occurs away from plate boundaries.

KEYWORDS: [8178] TECTONOPHYSICS / Tectonics and magmatism, [8120] TECTONOPHYSICS / Dynamics of lithosphere and mantle: general, [8415] VOLCANOLOGY / Intra-plate processes.

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Additional Details

Previously Presented Material: The work presented will discussed results published in a Nature Geoscience paper and a paper under review at the Journal of Geophysical Research-Solid Earth.

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