

The Concurrent Emergence and Causes of Double Volcanic Hotspot Tracks on the Pacific Plate

T. D. JONES¹, D. R. DAVIES¹, I.H CAMPBELL¹, G. IAFFALDANO²,
G. YAXLEY¹, S. C. KRAMER³ AND C. R. WILSON⁴

¹ Research School of Earth Sciences, The Australian National University, Canberra, Australia

² Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark

³ Department of Earth Science and Engineering, Imperial College, London, UK

⁴ Department of Terrestrial Magnetism, Carnegie Institution of Washington, USA

Mantle plumes are buoyant upwellings of hot rock that transport heat from Earth's core to its surface, generating anomalous regions of volcanism that are not directly associated with plate tectonic processes. The classic and best-studied example is the Hawaiian-Emperor chain. However, the emergence of double-track volcanism along this chain - namely the Loa and Kea tracks - and the systematic geochemical differences between them have remained enigmatic. Here we demonstrate that their emergence coincides with the appearance of other double volcanic tracks on the Pacific plate and a recent azimuthal change in Pacific plate-motion. We propose a three-part model that explains the evolution of Hawaiian volcanism: (i) mantle flow beneath the rapidly moving Pacific plate strongly tilts the Hawaiian plume and leads to lateral separation between high and low pressure melt source regions; (ii) the recent azimuthal change in Pacific plate-motion exposes high and low pressure melt products as geographically distinct volcanoes, explaining the simultaneous emergence of double-track volcanism across the Pacific; and (iii) secondary pyroxenite, formed as eclogite melt reacts with peridotite, dominates the low pressure melt region beneath Loa-track volcanism, yielding the systematic geochemical differences observed between Loa- and Kea-type lavas. Our results imply that the formation of double-track volcanism is transitory and can be used to identify and place temporal bounds on past plate-motion changes.