What built Shatsky Rise, a mantle plume or ridge tectonics?

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ABSTRACT
Shatsky Rise is an oceanic plateau that formed at the Pacific-Farallon-Izanagi triple junction during the Late Jurassic to Early Cretaceous. Its origin is unclear, but volcanism from a mantle plume or plume head is accepted as an explanation because many observations from the plateau are consistent with the plume head model. Initial eruptions were massive and rapid, with emplacement rates estimated at 1.2–4.6 km^3/yr, similar to continental flood basalts. The plateau exhibits an age progression, with igneous output waning over time, possibly representing the transition from plume head to plume tail. Shallow water fossils imply that the rise top was subaerial and that thermal and dynamic uplift was significant. Furthermore, the age progression and trends of Shatsky and Hess rises are mimicked by the Mid-Pacific Mountains, to be expected if these features formed by the drift of the plate over mantle plumes. In contrast, several observations do not fit the plume head model. The initial eruption was coincident with a reorientation of the Pacific-Izanagi ridge and an 800-km jump of the triple junction, a low probability occurrence if plume heads behave independently of plate motions. Moreover, this same type of event may have occurred repeatedly, as other western Pacific plateaus occur near the trace of this triple junction (Hess Rise) and the Pacific-Farallon-Phoenix triple junction (Magellan Rise, Manihiki Plateau, Mid-Pacific Mountains). If these other plateaus formed from plumes, either there were many plumes or the plumes defining the triple junction paths exhibited large relative motion. Moreover, rocks recovered from the main Shatsky Rise edifices have mid-ocean ridge basalt (MORB) geochemistry and isotopic signatures, whereas most plume head models imply that lower mantle material, with a different signature, will be carried to the surface. A simpler hypothesis is that Shatsky Rise and other near-triple-junction plateaus were formed as a result of ridge tectonics. One possibility is that decompression melting occurred near the triple junctions during the Mesozoic because the northwest Pacific was located over a region of anomalous asthenosphere that was susceptible to melting given only small perturbations in lithospheric stress. A pitfall for this argument is that changes in the thin, fast-spreading Pacific lithosphere must result in massive volcanism. Although both plume and ridge tectonics hypotheses explain some observations from Shatsky Rise, uncertainties make it premature to conclude which, if either, is correct. Resolution awaits future investigations, which must reveal missing pieces to this puzzle.