Roger Larson (1943–2006): Cretaceous Magnetic Reversals, Super-plumes, and the Tectonic Reconstruction of the Pacific

by James H. Natland

From the start, Roger Larson and scientific ocean drilling ran on parallel tracks. While he was still a graduate student at the Scripps Institution of Oceanography, the Deep Sea Drilling Project (DSDP) was launched from Scripps. Close to four decades later, Roger's passing this last May at age 63 cut short an eminent career in geosciences and exploration of the ocean floor.

Roger the graduate student was mainly a practicing geoacoustician and magnetician. His thesis parsed out for the first time the details of the opening of the Gulf of California and the magnetic character of young ocean crust. However, his attention soon turned to the mapping and calibration of the Mesozoic (M-Series) magnetic lineations in the central and western Pacific. One of the consequences of this work followed from the revelation that the M-Series anomalies and adjacent Cretaceous magnetic "quiet zone", about 37 million years of no magnetic field reversals, reveal a period of unusually high spreading rate wherever those anomalies exist (Larson and Chase, 1972). Larson and Pitman (1972) argued that the rapid emplacement of a large volume of young, warm lithosphere beneath spreading ridges displaced sea water, thus providing a cause of sea level rise and formation of epicontinental seas, extensive arc volcanism, and large-volume batholith emplacement during those non-glacial times.

Discovery of the M-Series lineations in the Pacific led Roger to be selected as one of the co-chief scientist of DSDP Leg 32 that drilled and dated Mesozoic plateaus and magnetic lineations in the northwest Pacific. Then, when subsequent integration of magnetic studies showed that the oldest part of the Pacific plate began existence as a Jurassic microplate that was surrounded by M-Series lineations spreading away

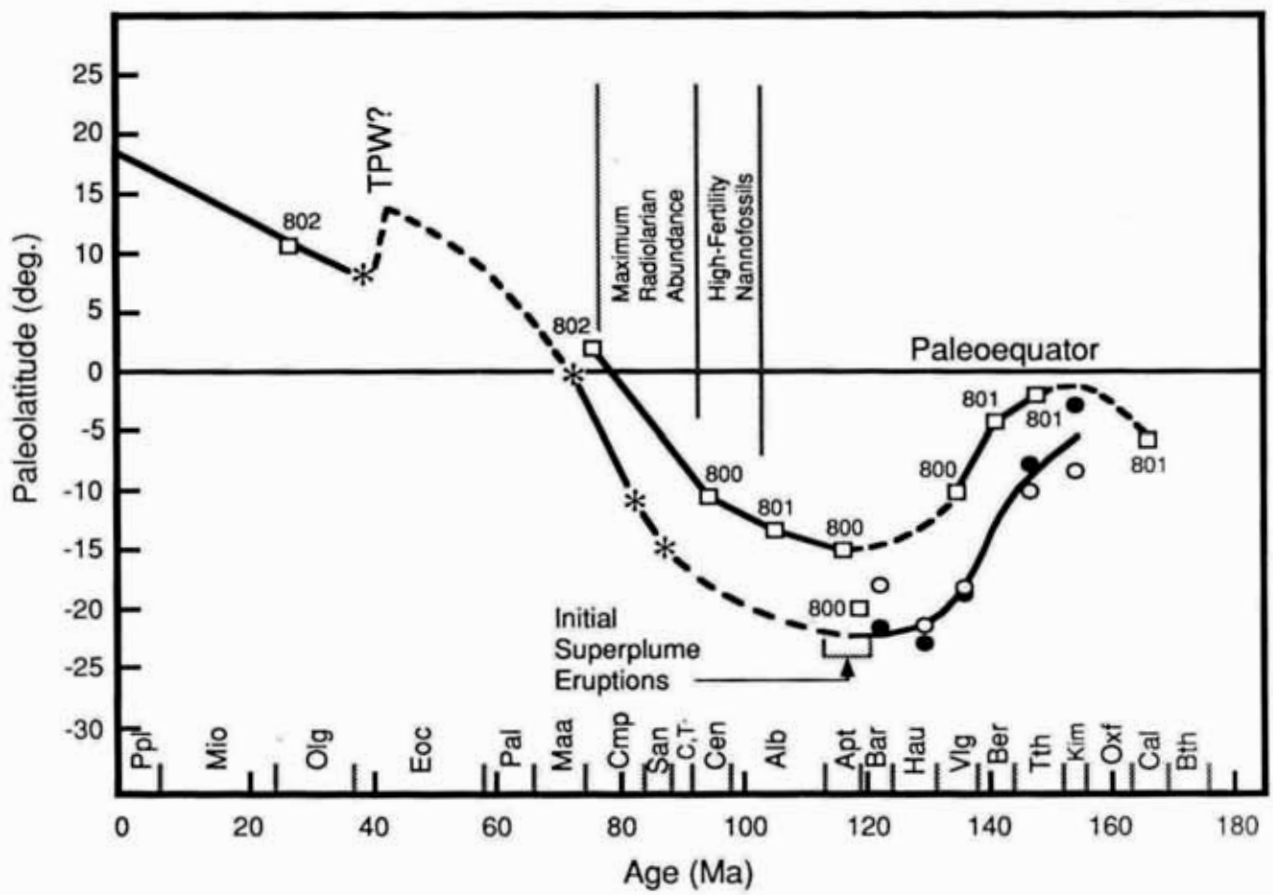

Figure 1. Possible paleolatitude history for ODP Site 801, published by Larson et al. (1992) in *Scientific Results* Volume 129 of *Proceedings of the Ocean Drilling Program.*

in all directions, Roger was selected as co-chief scientist to drill said Jurassic basement in the Nauru Basin during DSDP Leg 61. The great surprise was that the ancient basement is thickly carapaced by much younger basalt in the apparent form of a Cretaceous basin-filling outlier of the Ontong-Java Plateau. Emplacement of these lavas was evidently so rapid that it did not erase the magnetic signal of underlying Jurassic crust.

Two legacy papers published in *Geology* (1991a, 1991b) integrated the drilling results in the Pacific and set the agenda for decades of global research and scientific discussions. The first paper proposed a mid-Cretaceous mantle superplume centered on the Ontong-Java Plateau. Roger argued that only a superplume could ring the bell of the core-mantle boundary sufficiently to 'freeze' the magnetic field direction for tens of millions of years and trigger large-scale plateau volcanism and high spreading rates worldwide. The second paper explored the consequences of this cataclysmic event on sea level, global magmatism, emission of greenhouse gases, anoxic events, formation of black shales, and global warming.

During Ocean drilling Program Leg 129, with Roger as one of the co-chief scientists, Site 801 eventually reached Jurassic basalt formed at a spreading ridge. Larson et al (1992) published a splendid synthesis of the history of the Pacific Plate from the Mesozoic into modern times in the proceedings from that expedition (Fig. 1).

Roger Larson's activities extended beyond the drilling and the labs and included service in numerous community committees, including being chair of the of the Steering Committee for the first Conference on Scientific Ocean Drilling (COSOD I, 1982), chair Planning Committee of the Ocean Drilling Program (1984–1985), and chair of the U.S. Science Advisory Committee (USSAC) for the Ocean Drilling Program (1995–1997). During the initial run-up to IODP in 1996, Roger advocated Moho drilling as one of the big challenges for this new program. A decade later, IODP is sponsoring an international workshop to define a roadmap for a successful mission to Moho. In this and in many other ways, IODP will sorely miss Roger's unique ability to look over the horizon and identify global scientific problems that only this program can solve.

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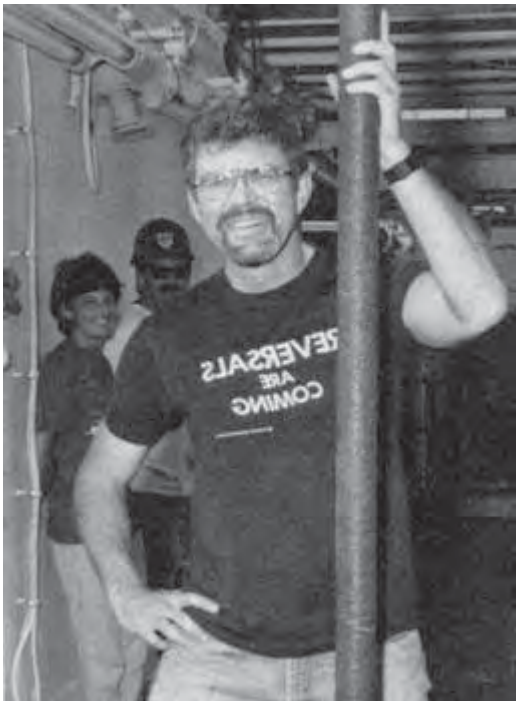

Roger and a 2-m long piece of Jurassic basalt recovered during ODP Leg 129 from Hole 801C in Pigafeta Basin, western Pacific. Shirt, in reverse print, says, "Reversals are coming". Photo provided by John Beck of Integrated Ocean Drilling Program.

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Author

James H. Natland, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Fla. 33149, U.S.A., e-mail: jnatland@rsmas.miami.edu