Mesozoic drift and rotation of the Pacific plate

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Continents have complex geologic histories and are constructed largely through the processes associated with the convergence of continental lithosphere and subducting oceanic plates. Thus, we may infer that observed geological features on Pacific Rim continental margins are related to the relative motions of these continents and those of a growing, and subducting, Pacific Plate. But understanding the motion of only the continental plates gives an incomplete picture, a situation analogous to reconstructing an automobile accident after one of the vehicles has been towed away. Our knowledge of the construction of the Western U.S. and the rest of the Pacific Rim is, therefore, greatly enhanced by an understanding of Pacific Plate development and motion through time.

Paleomagnetism provides a way of reconstructing the development of the Pacific plate, and ocean drilling provides one of the few tools available to obtain the appropriate needed samples. Direct paleomagnetic measurement of drilled samples is a straightforward process in which samples are "cleansed" of spurious magnetizations. Once cleaned, a measurable vector may be recognized as representing a characteristic direction related to Earth's paleomagnetic field at the time the rock formed. The magnetic inclination may then be used to tell the latitude of formation of the rock.

Sediment core samples at Sites 800, 801, and 802 (ODP Leg 129), DSDP samples from Sites 585, 306, and basalt sample from Site 462 provide a unique record of latitudinal motion of the Pacific Plate during its earliest history. The accompanying figure illustrates the initial northward drift of the plate during the Middle and Late Jurassic followed by 19° of southward drift during the Late Jurassic and Early Cretaceous. Finally, during the Early Cretaceous, the plate began 39° of northward drift that continues today. In addition to these latitudinal results, a select suite of structurally-tilted samples recovered from the Middle Jurassic sediments of Site 801 indicate 41° of net counterclockwise rotation of the Pacific Plate during its history. Based on current results, increased rates of convergence with North America would be expected during the Middle Jurassic (period of northward drift) while decreased rates and associated relative tectonic quiescence would be expected during the period of southward drift. Future drilling efforts should concentrate not only on testing and refining the current plate motion hypothesis by continued sampling in the oldest portions of the Pacific Plate but also on constraining the timing of the inferred rotational events.