Kinematics of Cretaceous to Tertiary Pacific Plate: Discussion from Ar-Ar Age and Geochemistry of Within-Plate Basalts

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A dissertation submitted to the Doctoral Program
in Geoscience, the University of Tsukuba
in partial fulfillment of the requirements
for the Degree of Doctor of Philosophy (Science)

January, 2001

ABSTRACT

Most seamounts, islands and atolls on the present Pacific Plate were formed by submarine intra-plate volcanism mainly during the Cretaceous. Such seamounts in the West Pacific Seamount Province (WPSP) indicated that some Cretaceous seamount chains are significant for hotspot trails.

In this thesis, volcanic rock samples from the Japan Trench oceanward slope, Mizunagidori Seamount in the Joban Seamount Chain, Uyeda Ridge in the Marcus Seamount Chain and Unnamed Seamount in the Magellan Seamount Chain at the Mariana Trench, were analyzed for geochemical and mineralogical compositions and Ar-Ar dating.

Alkaline pillow basalts collected from the toe of the oceanward slope of the northern Japan Trench are with a large Fo-value of olivine xenocrysts and clinopyroxene compositions suggesting a small degree of partial melting in the upper mantle. Reconstructing Pacific Plate motion based on the data of 5.95 ± 0.31 Ma ^{40}Ar-^{39}Ar age indicates that the eruption occurred off the outerswell, or forebulge of the Japan Trench in the NW Pacific and the chemistry and age, further suggest that they erupted using conduits related to fracturing or faulting of the slab just before bending prior to subduction.

In the well defined NE-SW collinear Joban Seamount Chain, disturbed age progression was identified by mid-Cretaceous Daiichi-Kashima Seamount and Late Cretaceous Mizunagidori Seamount, and this chain did not show a simple chain of hotspot origin. On the other hand, the Uyeda Ridge was known also of no hotspot origin, because the basalt samples from the Uyeda Ridge are significantly younger than the

Marcus Seamount Chain and its curious bathymetry of W-E long and narrow topography is different from normal seamount of concentric shape.

Data from the seamount in the Joban Seamount Chain, Uyeda Ridge and Japan Trench oceanward slope did not admit to utilize for the Cretaceous Pacific Plate kinematics from age progressions based on hotspot trails.

Two alkaline volcanic rock samples, one peralkaline rhyolite pillow lava and another alkali olivine basalt pillow breccia, were collected from an unnamed seamount on the oceanward slope of the Mariana Trench, and the Early Cretaceous hotspot trail was defined in the Magellan Seamount chain. The dating of the peralkaline rhyolite resulted in 127.0±5.2 Ma, which is 8-18 m.y. younger than the radiolarian age of the oldest intercalated tuffaceous radiolarian claystone, early Berriasian (approximately 140 Ma), which includes fragments of volcanic glass of Na-rich alkali-basalt (hawaiite) composition of the main shield volcanism stage. Because the peralkaline rhyolite is a very differentiated volcanic rock, and commonly erupts in the last stage of the main shield volcanic activity, it was interpreted that the activity lasted for a long period at least for 8 m.y. This long shield volcanism may be reflected by the slow spreading rate of the Pacific Plate during the Late Jurassic and Early Cretaceous. The Ealy Cretaceous absolute Pacific Plate motion extended back from this unnamed seamount may be through the Hemler Seamount and Himu Seamount among the Magellan Seamount Chain. In addition, the ^{40}Ar-^{39}Ar age of the alkali olivine basalt is 62.0±2.6 Ma, early Paleocene, that is far younger than the youngest pelagic sediment cover of the Santonian-Coniacian age (approximately 84-89 Ma). These dates suggest that the volcanism of the seamount independently occurred not only in the Late Jurassic-Early Cretaceous but also in the Paleocene as the rejuvenated volcanism by another hotspot.

The Early Cretaceous Euler pole, 140 to 120 Ma, was calculated using the Magellan Seamount Chain and the Shatsky Rise. This rotation pole is on the vertical circle against the Shatsky and Magellan Trails. In this thesis, newly accurate Euler pole from the radiometric ages was also discussed.

keyword:

Pacific Plate, seamount, hotspot, Euler pole, alkali-basalt, seamount rejuvenation, Early Cretaceous, Magellan Seamount Chain

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