

Origin of the Hahajima seamount- a double transform cooking model -

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The Hahajima Seamount is located in the landward slope at the junction between Izu-Bonin and Mariana trenches. The seamount was discovered in 1980 by Ishii and others and was thought to be an eroded seamount called Hahajima paleo-land. The topographic feature of the Hahajima Seamount was made clear during the KH03-3 cruise in 2003 together with gravity and magnetic survey. This time dredge and seismic profile survey were also carried out. We intend to compare the various features of the Hahajima Island with the other serpentine seamount of the Izu-Bonin-Mariana arc and made a possible model for its origin.

The Hahajima Seamount shows ubiquitous morphology. It is perfect rectangle shape with 35 km x 68 km. The size of the seamount is several times larger than those of serpentine seamounts. The rectangle shape is especially notable in the 1400 m water depth contour line and the topography shallower than 1400 m water depth forms rather flat surface with two notable peaks at NW and SE corner. The elongated direction of rectangle is NW-SE and NE-SW. The shadow map of the seamount represents notable deformed lineaments along NW-SE direction. The topographic cross section shows steep cliff at the western and southern walls.

In 1980, 1982 and 2003 dredge hauls were carried out with R/V Hakuho-Maru to obtain various types of rocks: they are harzburgite, dunite, gabbro, basalt, andesite, boninite, troctrite, siltstone, amphibolite, tuff breccia and serpentine breccia as well as gabbro breccia. Of these rocks ultramafic rocks including serpentine breccia distribute along the NW-SE trending faults.

Two dominant directions of faults are clearly seen; they are NE-SW and NW-SE, respectively. The former faults are parallel to the transform faults in the Parece Vela basin and the latter is to the transform faults in the old Pacific plate at the western Pacific region.

Two dives were conducted with submersible Shinkai 2000 at the Hahajima Seamount, #632 and #686, respectively. The former covered the summit area and the latter the eastern wall to the seamount. During the #632 dive two major faults, trending NW-SE were encountered and they correspond to the NW-SE trending lineaments. The dive #686 discovered many serpentine flows with round peridotite blocks like serpentine mud volcanoes in the Mariana Forearc.

Multi-channel seismic profile and gravity measurements were carried out across the Hahajima Seamount. The seismic structure under the seamount was chaotic with no layer that means the strata under the seamount consist mostly of soft sediments and/or highly brecciated rocks. Results of the gravity measurement to be isostatic suggest that the materials of the seamount are not dense but light. Taking into account the dredged materials the seamount yields much of soft and light serpentine mud.

Compilation of all the data available for the Hahajima Seamount we depict a possible model for the origin of the seamount in terms of double transform cooking rectangle block. The Hahajima Seamount was an extension of the Chichijima and Hahajima Islands and consisted of andesites, boninites and tuff breccias similar with the present Bonin Islands. The transform movements when the Parece Vela Rift cut the proto-Hahajima block NE-SW direction. The blocks slide down as to the trench axis before the transform fault on the Pacific Plate reached the present position. The transform fault on the Pacific Plate reached to the Izu-Bonin trench axis then subducted under the Izu-Bonin arc. The soft and buoyant materials consisting of serpentine mud with basalts, gabbros and peridotites, which were yielded at the paleo-transform fault squeezed out to the upper part that is the Hahajima seamount forming a chaotic rock assemblage, like an ophiolite suite.

This model well explains the mixture of rocks, direction of faults and other features on the Hahajima Seamount.