

# Paleogene molluscan biogeography of the northwestern Pacific: Relationship between the formation of the Central Japan Province and the opening of the Shikoku Basin

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Yutaka Honda (2008) Paleogene molluscan biogeography of the northwestern Pacific: Relationship between the formation of the Central Japan Province and the opening of the Shikoku Basin. *Bull. Geol. Surv. Japan*, vol. 59 (7/8), 365-368, 2 figs.

**Abstract:** The Central Japan Province, which is one of the Paleogene molluscan biogeographic provinces in the northwestern Pacific, was formed in the Oligocene between the North Japan-Western Okhotsk and Taiwan-South Japan Provinces. Besides Asagai-Poronaian mollusks of the North Japan-Western Okhotsk Province, there are many endemic species in the Central Japan Province, including *Lima sameshimai*, *Adulomya chitani*, *Saxolucina matsushitai*, *Conchocele nakazawai*, *Pitar hataii*, *P. kotoi*, *P. murotensis*, and *Emarginula tokuyamai*. Paleogene mollusks along the Pacific side of Shizuoka, the Kii Peninsula and Shikoku Island (in the Shimanto Belt) belong to the Central Japan Province. In contrast to the Nichinan Group (Oligocene to earliest early Miocene) of the Miyazaki area of southeastern Kyushu, the Shimanto Belt contains the Oligocene Ashiya fauna of northern Kyushu. The molluscan fauna of the Nichinan Group is therefore assigned to the Taiwan-South Japan Province. The boundary between the Central Japan and Taiwan-South Japan Provinces is located near to the northernmost Kyushu-Palau Ridge, on the western margin of the Shikoku Basin. This ridge has probably been the border that defines the boundary between the Central Japan and Taiwan-South Japan provinces. The formation of the Central Japan Province is closely related to the rifting and opening of the Shikoku Basin.

**Keywords:** biogeography, Izu-Bonin Arc, Kyushu-Palau Ridge, mollusks, Paleogene, Shikoku Basin

## 1. Introduction

Honda (1994) established the following Paleogene molluscan provinces for Sakhalin, Japan and Taiwan: the North Japan-Western Okhotsk, Central Japan and Taiwan-South Japan Provinces (Fig. 1). The North Japan-Western Okhotsk Province includes Sakhalin, Hokkaido and northeastern Honshu. The Central Japan Province consists of the Pacific side of Central and Southern Japan (Shizuoka, Kii Peninsula and Shikoku Island), which has been called the Shimanto Belt, the outer zone of Southwest Japan. The Taiwan-South Japan Province includes Kyushu, the Ryukyu Islands and Taiwan.

Honda (1994) noted that the Central Japan Province was formed by the southward migration of Asagai-Poronaian mollusks from the North Japan-Western Okhotsk Province (Fig. 2), in accordance with an Oligocene global climatic cooling trend and ensuing faunal provincialism. Asagai-Poronaian mollusks in the Central Japan Province include both shallow- and deep-water taxa such as *Malletia poronaica* (Yokoyama), *Portlandia watasei* (Kanehara), *Yoldia laudabilis* Yokoyama, and *Turritella tokunagai* Yokoyama. The

strata in this province yield numerous endemic shallow- and deep-water species, such as *Lima sameshimai* Oyama and Mizuno, *Adulomya chitani* Kanno, *Saxolucina matsushitai* Matsumoto, *Conchocele nakazawai* (Matsumoto), *Pitar hataii* Natori, *P. kotoi* Natori, *P. murotensis* Matsumoto and Terashima, and *Emarginula tokuyamai* Iwasaki and Ono (Honda, 1994).

In this study, I will discuss the relation between the formation of the Central Japan Province and the rifting and opening of the Shikoku Basin.

## 2. Central Japan Province and the Shikoku Basin

As noted above, Paleogene mollusks along the Pacific coast of Shizuoka, the Kii Peninsula and Shikoku in the Shimanto Belt belong to the Central Japan Province. In contrast, Kato (1985) and Saito *et al.* (1994) recorded mollusks from the Nichinan Group (Oligocene to lowermost lower Miocene) of the Shimanto Belt in the Miyazaki area of southeastern Kyushu, southern Japan. The group contains a large number of species indicative of the Oligocene (to earliest early Miocene) Ashiya fauna of northern Kyushu. These are shallow- and deep-water species, such as *Acila ashियाensis* (Nagao), *A.*

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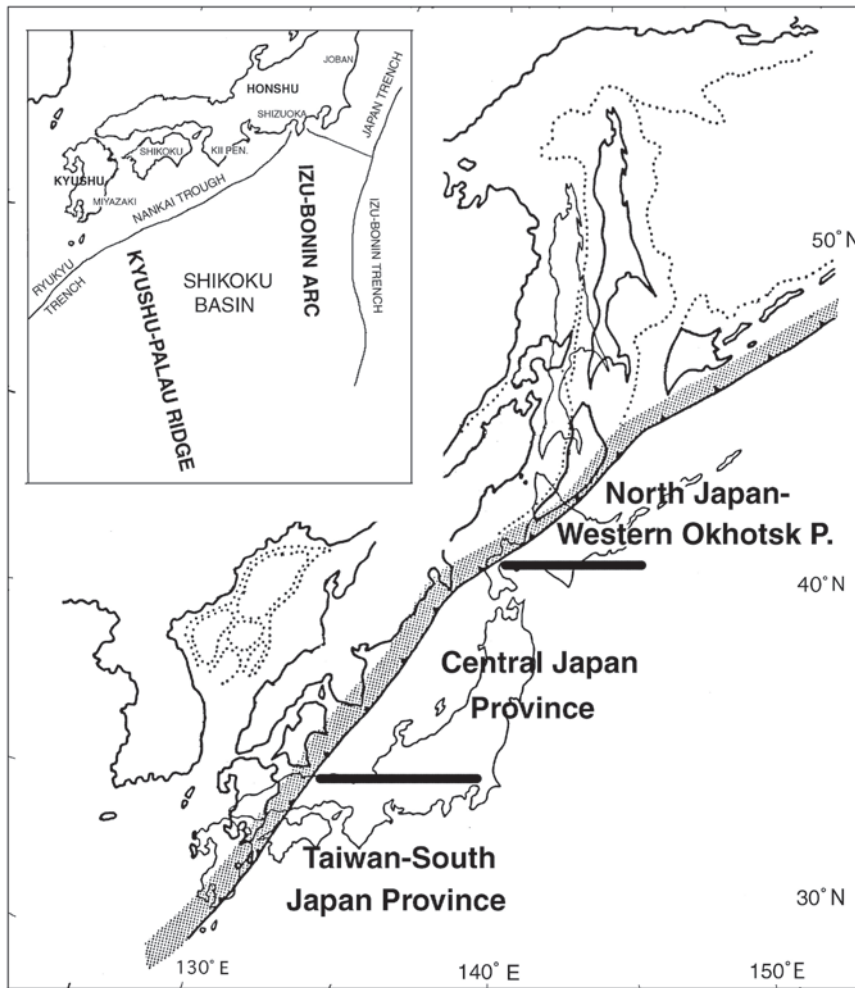


Fig. 1 Paleogeographic map before the opening of the Japan Sea (Niitsuma *et al.*, 1985), indicating the Paleogene molluscan provinces in Japan and Sakhalin, northwestern Pacific (Honda 1994). Stippled area: Shimanto and Yubetsu belts (Taira and Tashiro, 1987). Map (left upper) of Southwest Japan and the Shikoku Basin showing place and topographic names around the basin referred to in text.

*nagaoi* Oyama and Mizuno, *Y. hikosimensis* Hirayama, *Crassostrea sakitoensis* Nagao, *Glycymeris chishshuensis* Makiyama, *Cyclocardia subnipponica* (Nagao), *Venericardia yoshidai* Nagao, *Callista matsuraensis* (Nagao), *Dosinia chikuzenensis* Nagao, *Macoma nagaoi* Hirayama, *Angulus maximus* (Nagao), *Euspira ashियाensis* (Nagao), and *Fulgoraria ashियाensis* Shikama. Consequently, mollusks of the Nichinan Group, as a whole, belong to the Taiwan-South Japan Province.

On the other hand, Matsubara (2002) recorded fossil mollusks from the Paleogene Maéjima Formation in Okayama Prefecture of the Setouchi geological province, in the inner zone of Southwest Japan. He noted that this formation contains both Northern Pacific and Tethyan Indo-Pacific elements (Honda, 1991). Evidently, this fauna belongs to the transition zone between the North Japan-Western Okhotsk and Taiwan-South Japan provinces, prior to formation of the Central

Japan. More recently, Kano *et al.* (2007) observed that there was an Oligocene seaway from Sakhalin, Hokkaido, and Honshu (main island of Japan) to Kyushu along the eastern coast of the present Japan Sea. The Kyushu-Palau Ridge runs in a northerly direction from the southern part of Kyushu to the Palau Islands between the Philippine Sea and Shikoku basins. The Shikoku Basin rifted from 30 to 27 Ma and opened from 27 to 15 Ma (Okino *et al.*, 1999) and the Izu-Bonin Arc began to separate from the Kyushu-Palau Ridge at 30 Ma (Kobayashi *et al.*, 1995).

### 3. Discussion

As shown in Fig. 1, the boundary between the Central Japan and Taiwan-South Japan provinces is located near the northernmost Kyushu-Palau Ridge. The ridge was uplifted at least 2 km and it was partially emergent

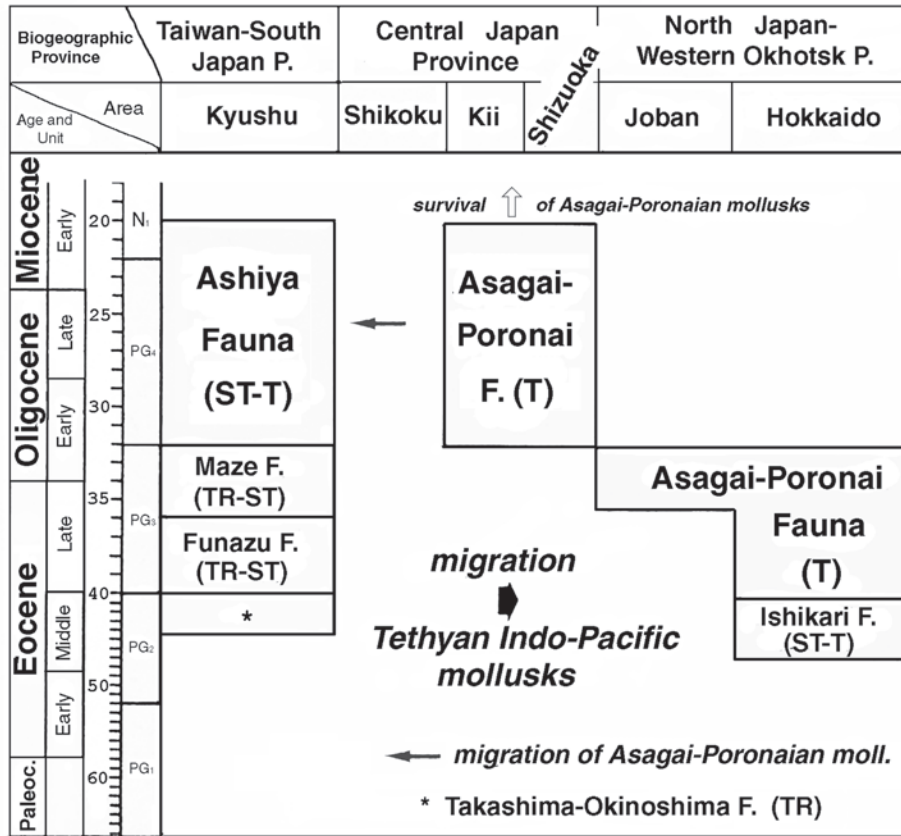


Fig. 2 Spatial and temporal distribution of the Paleogene molluscan fauna of Japan (adapted from: Honda, 1994). T = temperate, ST = subtropical, TR = tropical.

before 30 Ma, as evidenced by a hiatus between 47.5 and 30 Ma and the occurrence of shallow-marine fossils (Kobayashi *et al.*, 1995). Ujiie (1983) noted that the Kyushu-Palau Ridge was available as a biogeographic barrier during the Oligocene. Mohammad *et al.* (2000) recorded late Oligocene larger foraminifers that indicate a shallow-water environment in limestone dredged from the Kyushu-Palau Ridge, off southern Kyushu. This evidence suggests that the Kyushu-Palau Ridge has been a border that defines the boundary between the Central Japan and Taiwan-South Japan provinces.

It is possible that the Izu-Bonin Arc was a physical boundary between the Central Japan and North Japan-Western Okhotsk provinces. However, the locus of the Izu-Bonin Arc was distant from Honshu Island before the opening of the Japan Sea at 15 to 14 Ma (Niitsuma, 2007).

#### 4. Conclusion

The boundary between the Central Japan and Taiwan-South Japan provinces is located near to the northernmost Kyushu-Palau Ridge. It has been the border that defines the boundary between the Central Japan and Taiwan-South Japan provinces.

**Acknowledgements:** I would like to give thanks to Nobuaki Niitsuma (Shizuoka University) for valuable comments on the importance of the Kyushu-Palau Ridge in the formation of the Central Japan Province.

#### References

- Honda, Y. (1991) Paleogene molluscan biogeography of Japan. In Kotaka, T., Dickins, J. M., McKenzie, K. G., Mori, K., Ogasawara, K., and Stanley, G. D., Jr., eds., *Proc. Int. Symp. Shallow Tethys 3, Sendai, 20-23 September 1990* (Saito Ho-on Kai Spec. Pub., no. 3), 489-506.
- Honda, Y. (1994) History of the Paleogene molluscan fauna of Japan: a paleobiogeographic approach. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, **108**, 295-309.
- Kano, K., Uto, K. and Ohguchi, T. (2007) Stratigraphic review of Eocene to Oligocene successions along the eastern Japan Sea: Implication for early opening of the Japan Sea. *Jour. Asian Earth Sci.*, **30**, 20-32.
- Kato, T. (1985) Stratigraphy of Nichinan Group in southeastern Kyushu, Japan. *Contr. Inst. Geol. Paleont., Tohoku Univ.*, no. 87, 1-23. (in Japanese with English abstract)
- Kobayashi, K., Kasuga, S. and Okino, K. (1995)

- Shikoku Basin and its margins. In Taylor, B., ed., *Backarc Basins: Tectonics and Magmatism*, Plenum Press, New York, 381-405.
- Matsubara, T. (2002) Molluscan fauna of the "Miocene" Maéjima Formation in Maéjima Island, Okayama Prefecture, southwest Japan. *Paleont. Res.*, **6**, 127-145.
- Mohammad, M. M., Ogawa, Y. and Matsumaru, K. (2000) Late Oligocene larger foraminifera from the Komahashi-Daini Seamount, Kyushu-Palau Ridge and their tectonic significance. *Paleont. Res.*, **4**, 191-204.
- Niitsuma, N. (2007) Plate Tectonics- the new advance and Japanese Islands- Kyoritsu Shuppan, 292p. (in Japanese)
- Niitsuma, N., Taira, A. and Saito, Y. (1985) Japanese Islands before the opening of Japan Sea. *Kagaku (Science)*, **55**, 744-747. (in Japanese, title translated)
- Okino, K., Ohara, Y., Kasuga, S. and Kato, Y. (1999) The Philippine Sea: New survey results reveal the structure and the history of the marginal basins. *Geophy. Res. Lett.*, **26**, 2287-2290.
- Saito, M., Sato, Y. and Yokoyama, S. (1994) Geology of the Sueyoshi district. Geological Survey of Japan, 111p. (in Japanese with English abstract).
- Taira, A. and Tashiro, M. (1987) Late Paleozoic and Mesozoic accretion tectonics in Japan and eastern Asia. In Taira, A. and Tashiro, M. eds., *Historical Biogeography and Plate Tectonic Evolution of Japan and Eastern Asia*, Terra Scientific Publ. Co., Tokyo, 1-43.
- Ujiié, H. (1983) Micropaleontology of the Philippine Sea (DSDP Legs 58 and 59). *Marine Sciences Monthly*, **15**, 489-493. (in Japanese, title translated)
- Received July, 15, 2008  
Accepted September, 16, 2008

## 北西太平洋地域古第三紀貝類化石群の生物地理学 —中部日本区の形成と四国海盆の拡大—

本田 裕

要 旨

日本を含む北西太平洋地域では、古第三紀貝類の海洋生物地理区の一つ中部日本区が、漸新世に北日本—西オホーツク区と台湾—南日本区の間に誕生した。同区は静岡、紀伊半島及び四国の太平洋岸に面した四万十帯の地域を含み、北日本—西オホーツク区の浅貝—幌内動物群の貝類とともに、多数の固有種 (*Lima sameshimai*, *Adulomya chitani*, *Conchocele nakazawai*, *Pitar hataii*, *P. kotoi*, *P. murotensis*, 及び *Emarginula tokuyamai*) を産する。いっぽう、九州南東部 (宮崎県) の四万十帯、日南層群 (漸新統—下部中新統最下部) からは、九州北部の芦屋動物群 (漸新世) の特徴種を産することから、同地域は台湾—南日本区に含まれる。中部日本区と台湾—南日本区との境界付近には、九州—パラオ海嶺があって、古生物地理区の境界形成に九州—パラオ海嶺が何らかの関与をしていたと考えられる。四国海盆のリフティングと拡大は、中部日本区の形成と密接な関係がある。