

Introduction

Tertiary System of the northern part of Ibaraki Prefecture is well developed in the area between the Yamizo and Abukuma Mountains, and also along the Pacific coast. Many different kinds of depositional facies are recognized in these areas and also in the southern extension of the Tanakura Tectonic Line.

While, studies of the Japanese Neogene echinoid fossils began by Yoshiwara (1899), and then it was succeeded to mainly by Nisiyama (1934-1986) and Morishita (1949-1983). Studies of echinoid fossils from the Tertiary System in Ibaraki Prefecture first begun by Yoshiwara (1899), who reported the occurrence of *Echinus* sp. from the Pliocene Hatsuzaki Sandstone Member of the Hitachi Formation.

However, the reports of echinoid fossils from the Tertiary System in Ibaraki Prefecture are very few. The following echinoid records and fossil studies have been carried out in the present studied area.

- 1) *Linthia nipponica* Yoshiwara (probably from the Pliocene Hatsuzaki Sandstone Member of the Hitachi Formation) by Yoshiwara (1899).
- 2) *Linthia nipponica* Yoshiwara and *Echinarachnius mirabilis* A. Agassiz from Hitachi area (probably from the Pliocene

- Hatsuzaki Sandstone Member of the Hitachi Formation) by Tokunaga (1903).
- 3) *Astriclypeus manni ambigenus* Nisiyama from probably the early middle Miocene Asakawa Formation in Omiya area by Omori (1958).
 - 4) *Linthia nipponica* Yoshiwara from the Pliocene Kume Formation in Kanasago area by Ishii et al. (1974).
 - 5) *Pourtalesia* sp. from the middle Miocene Tatsukuroiso Mudstone Member of the Higashikanasayama Formation in Suifu area by Kikuchi and Nikaido (1985).
 - 6) *Linthia tokunagai* Lambert from the Pliocene Kume Formation of the Hitachiota area by Kikuchi and Nikaido (1987).

In addition, some systematic and biogeographic significances of echinoid fossils were discussed by Kikuchi and Nikaido (1985, 1987).

Based on these previous paleontological and stratigraphical studies, the Neogene strata, widely distributed in the northern part of Ibaraki Prefecture, can be considered to an important area understanding the Neogene echinoids faunal changes of the Japanese Islands.

The present study focuses on paleontological and stratigraphical studies of the echinoid fossils in aim to understanding the historical changes of the echinoids fauna in the northern part of Ibaraki Prefecture. Indeed, origin and

migration of echinoid family or genus was examined based not only on fossils from the northern part of Ibaraki Prefecture but also fossil records in southwestern Japan.

On the other hand, geological studies of the Tertiary System of the present study were first done by Yamada (1888), and followed by many works, such as Omori (1958), Otsuki (1975), Saito et al., (1992) and Yoshioka et al., (2001).

However, stratigraphy of some area such as Naka, Tokai and southern part of Hitachi areas were first studied in the present study. Therefore, stratigraphy and depositional environments of the Tertiary strata of the northern part of Ibaraki Prefecture were systematically studied in the present work.