

Seasonal faunal change of living radiolarians in surface-subsurface waters of the Japan Sea off Sado Island, central Japan

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The seasonal change of living radiolarian faunas from winter to summer is documented from surface-subsurface waters of 2005-2008 years in the Japan Sea, off Tassha, Sado City, Sado Island, Niigata Prefecture, central Japan.

The sea water temperature shallower than 100 m depth in late winter (March 10, 2008) at the sampling site (6 km west of Tassha, Aikawa) is almost constant around 9.6-9.7 degrees, which probably represents the lowest water temperature throughout the year round. This homogeneous temperature water is considered to be formed by the development of a surface mixed layer disturbed by the strong northwesterly winter monsoon in the Japan Sea side. The faunal composition is characterized by the dominance of cold-water spumellarians (*C. reticulata* and *L. buetschlii*) and spicule-type nassellarians (*N. distephanus* and *P. cremastoplegma*) with minor amounts of a warm-water dweller (*D. t. tetrathalamus*).

The water properties on June 6, 2005 (Kurihara et al., 2006) indicate that the water mass is in the intermediate condition between the winter and summer seasons. The radiolarian faunal composition can be summarized as follows: (1) the fauna collected from ca. 90-63 m depth is characterized by the abundant occurrences of *C. reticulata* and plagiacanthid and lophophaenid nassellarians, associated with *T. octacantha*, *D. t. tetrathalamus*, and *L. buetschlii*, (2) the faunas collected from waters shallower than 63 m depth are similar to those of the deeper fauna but their compositions are quite different; *T. octacantha* and *D. t. tetrathalamus* are relatively abundant instead of *C. reticulata*.

The water properties and vertical distribution of radiolarian faunas in late summer (September 28, 2005) have been reported by Kurihara et al. (2007). The features of the water mass structure shallower than 100 m depth are distinguished by gentle gradients of temperature (ca. 14.4-24.0 degrees, 0.9-1.6 degrees/10 m) and salinity (34.629-32.993 psu) in waters between 100 m and 20 m depth and a homogeneous temperature and salinity (ca. 24.0 degrees, 32.9 psu) in waters shallower than 20 m. The species composition of the deeper fauna (ca. 77-54 m) is characterized by the abundant occurrence of *A. circopora*, *P. octostylus*, *Lophospyris* sp., and *Acanthodesmia* sp. It is also noteworthy that each species in the deeper water fauna does not exceed 20%. In the shallower fauna (ca. 35-0 m), *S. streptacantha*, *P. obeliscus*, and *P. octostylus* comprise 87.5% of the fauna.

Based on cumulative knowledge on the radiolarian ecology of living species off Sado Island, the faunal characteristics in winter can be explained as resulting from low water temperature which cold-water species preferred, opportunistic appearances of spicule-type nassellarians, and weak inflow of the Tsushima Warm Current (TWC) during winter. For *C. reticulata* and *L. buetschlii* in early summer, there is a close correlation between lowering temperature in the vertical profile and increasing numbers of individuals. This may be caused by their temperature tolerance ranges. Considering the characteristics of vertical water properties in late summer, high standing stocks of *S. streptacantha* and *Pseudocubus* species are likely caused by their temperature preferences and adaptive strategies for a summer environment in the Japan Sea. In addition, *S. streptacantha* is considered a typical inflowing species transported by the TWC (Kurihara et al., 2008). Taken the temperature profiles and faunal data together, we conclude that the seasonal faunal change of the Japan Sea off Sado Island is mediated by the influx of warm water dwellers of the Tsushima Warm Current into the surface layer of the water column during spring to summer.