Radiolaria and tectonics in Japan and Thailand

by
Martial Caridroit *

* UMR 8217 Géosystèmes (CNRS Lille 1) – UFR des Sciences de la Terre
Université de Lille 1 - 59655 Villeneuve d'Ascq cedex – France *(Martial.Caridroit@univ-lille1.fr)*

Radiolarians are Protozoa belonging to the Actinopod class; they are planktonic predators and exclusively marine. They exist since the Cambrian times and are now common and widely distributed in the oceans, throughout the water column from the near surface to the bottom waters. They proliferate where their preys proliferate.

It is often believed that the presence of radiolarian skeletons in a rock is synonymous with distal and/or deep sedimentation. In fact, radiolarian remains can be found in very deep to very shallow deposits; their presence is firstly in relation with their taphonomy. Their skeletons are composed of pure amorphous silica and have a size varying from 30 µm to 2 mm (mainly from 100 to 300 µm). So, this skeleton can be, potentially, present in all marine sediments, even under the CCD. During diagenesis, the skeleton is transformed into quartz or is dissolved! So, the presence of radiolarians remains in a rock is mainly dependent on their preservation before, during and after sedimentation.

The study of Radiolaria started during the 19th century but several mistakes and the level of the technical tools for study (e.g. microscopes) gave rise to wrong conclusions: "Radiolaria are panchronic or living fossils". During the 1950th (e.g. by G. Deflandre in France), radiolarians have been rediscovered and presented as good tools for dating (rapid evolution of the skeleton).

Since the rediscovery, radiolarians appear to be excellent stratigraphic fossils and the precision given by their remains is more and more precise: for example, 13 biozones for the Eocene.

Japan is one of these Asian countries where limestone's and macrofossils are rather rare and where the geology and the tectonic could be understood only after many age datings obtained using the radiolarian biostratigraphy (and conodonts**). Before the 1980th, the geology of SW Japan was described in terms of formations, groups and series, using local names and with few ages. A succession of linear zones (more or less WSW-ENE) was defined having an age from Paleozoic to Tertiary, respectively from the Japan sea to the Pacific ocean. The structures were described in terms of geosynclines or collages. In the early 80th, Mesozoic datings (radiolarians and conodonts*) demonstrated the presence of a first tectonic window inside the Paleozoic domain (Wakasa window). The first implication has been to interpret the geology of SW Japan in terms of nappes and the geodynamic model in terms of Alpine Type Orogen (e.g. Charvet et al, 1985 ***). Recent geophysical data, such as seismic tomography, seem to show that the structure of SW Japan could be made of a pile of several accretionnary complexes (ACs), from the Paleozoic times to now.

Thailand is another country where Radiolaria have originated a revolution in the understanding of the pre-Jurassic geology. Before the 90th, the radiolarites were inserted in formations considered as Paleozoic. Since the study of the radiolarians remains, the radiolarites are known to be from Middle Devonian to Early Upper Triassic. So, the geological mapping and the division into formations have to be fundamentally reviewed. The radiolarites are also typical distal oceanic sediments and, in this case, the witness of a large and very long life oceanic domain between the Shantai and the Indochina continental blocs. The "Chiang Dao chert", mainly made of radiolarites is the longest continuous radiolarites series known in the world: from Middle Devonian to Middle Permian (at least 140 my) and probably to Triassic (altered radiolarites). This ocean must be opened before Middle Devonian and cannot be closed before the Early Upper Triassic. This result is well supported by recent paleomagnetic data. In addition, the location of the radiolarites gives a rather precise position of the suture zones such as the main one (Chiang Dao, ocean closure) or the Nan suture (back arc basin closure).

Radiolaria, after 35 years of intensive taxonomic and biostratigraphic researches, became fundamental fossils to understand the geology in Asia. Japan and Thailand are impressive examples. In China, Philippines, Taiwan, …, they are already largely used. We may believe that, in a near future, radiolarians will bring a lot of new data in countries such as Burma, Vietnam, Cambodia, Laos, …, to understand the geological history of these regions.

** *Conodonts are also good fossils to date marine deposits but they disappeared during the Late Triassic times.*

*** Charvet J., Faure M., Caridroit M. & Guidi A. (1985): Some tectonic and tectogenetic aspects of SW Japan: an Alpine type orogen in an island-arc position. *In* "The formation of active ocean margins", Nasu *et al* ed., 791-817.