

Observations of internal structures of the Chengjiang macrofossils with a synchrotron-CT technique at SPring-8

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Earth is a unique planet, which is filled with a large variety and number of life. Recent active planetary expeditions and telescopic observations of extrasolar planets allow us to expect possibility of life in other planets. But, presence of metazoan distinguishes biosphere of the earth from others. Conventional idea suggests that Metazoa suddenly appeared and drastically evolved in early Cambrian around 530 Ma, so-called Cambrian explosion. But, recent paleontological investigations in the Neoproterozoic showed some metazoans of sponges and cnidarians already appeared in the Ediacaran, and support cryptic emergence and early evolution of Metazoa in the Ediacaran. But, fossiliferous sections such as the Chengjiang Lagerstätten provide well-preserved various fossils, and constrain the timing and rate of biological evolution.

The Chengjiang fauna comprises sponges, arthropods, cnidarian, echinoderms, molluscs, chordates and others, and is a key milestone to study early evolution of Metazoa. Some fossils still preserve biological tissue including eyes, gats, gills, notochords and others (e.g. Shu, 2008, Gondwana Research). But, most Chengjiang fossils are severely compressed so that their thickness is less than millimeters. In addition, key fossils are too few to observe internal cutting planes of the fossils. As a result, the internal structures are still obscure.

Recent X-ray micro-CT analyses of the microfossils yielded new methods to observe the internal structures (e.g. Donoghue et al., 2006, Nature). Compared with microscopic and SEM observations, this technique has two advantages of nondestructive analyses on any cross-sections of internal structures. We obtained preliminary observations of three-dimensional structures of the Chengjiang fossils including an echinoderm, a fish, arthropods with/without eggs, a mollusk, and a brachiopod with a Synchrotron X-ray micro-CT at SPring-8 (beam line: BL20B2). The fossils range from 5 mm to 3 cm across in their sizes, whereas the host rocks range from ca. 5mm to 1.5 cm thick. The fossils are exposed on the surface of pale-brownish shales. Their synchrotron CT observations show it is possible to identify the fossils on the rocks possibly because the fossils have higher density than the host rocks. The thickness of the fossils is less than millimeters. It is easier to observe the fossils on thinner rocks compared with their sizes. Although preliminary, the three dimensional observation of the echinoderm, which possesses gill-like structures, shows a relict of internal cavity. Because the thickness of host rocks is thin, we could observe the structures of the arthropod, named as Isoxys, and the brachiopod, too. The synchrotron micro-CT technique provides a convenient and effective observations of internal structures for even completely compressed fossils.

Keywords: Chengjiang fossils, Cambrian explosion, SPring-8, micro-CT