

Sponges, one of the most primitive animals, are also one of the first and oldest Metazoa on the Earth. For this reason they are crucial in understanding early evolution of animals. These exclusively aquatic sessile organisms occur in various environments from shallow water zones of tropical seas to cold and deep waters of oceanic trenches, and even fresh water bodies. Many sponge species produce internal skeleton composed of spicules. Those, in most cases, siliceous elements that are from micrometers to (exceptionally) meters in size, serve as to stiffen otherwise soft sponge body.

The spicules are formed in the process of biomineralization and are not purely mineral structures but rather biocomposites of silica and organics. During the process of siliceous skeleton formation, sponges incorporate in their spicules different stable silica isotopes in proportions that are different than those in the surrounding sea water. This process is called fractionation. The ratio of various silica isotopes in spicules is correlated with the concentration of silica in the sea water. It was proven that such fractionation depends only on concentration of dissolved silica in the sea water, but does not on other environmental parameters such as, for example, temperature. Having well preserved fossil sponge spicules in which ratios of silica isotopes can be measured, and basing on information about fractionation in living sponges, it is possible to reconstruct the concentration of dissolved silica in ancient oceans.

First, however, we need to calibrate the process of fractionation in Recent sponges, to find out how concentration of silicic acid in the sea water is correlated with silica isotopes ratio in spicules. For this purpose we will use spicules of living sponges where the concentration of silicic acid in sea water is known. Next, based on these observations and measured silica isotopes ratio in fossil spicules of various age (from the Jurassic to the Miocene) we will try to reconstruct the level of dissolved silica in those ancient oceans.

It is generally accepted that in the geological past the dissolved silica level was changing and was much higher in some geological epoch than is today. Former studies of this problem were based, however, on secondary evidence such as frequency of chert in rocks of various ages, or frequency of occurrence of silicified originally carbonate fossils, and thus were of qualitative character only. There are some earlier attempts to measure the ratio of silica isotopes in Paleogene spicules, and to reconstruct silicic acid concentration in Paleogene sea, but this technique was never used to older, Mesozoic spicules. Such investigations require very well preserved fossil spicules, and our team has such spicules of the Jurassic to the Miocene age. Due to the fact that our team is interdisciplinary and consists of experts in biology and palaeontology of sponges as well as geological history (Institute of Paleobiology), techniques of isotope studies (Polish Geological Institute), as well as silica structure on the atomic level (Laboratoire de Chimie de la Matière Condensée de Paris, France), proposed here investigations will have a complex character. Considering the fact that we will use the most modern analytical techniques such as SHRIMP (Sensitive High Resolution Ion Microprobe) and SsNMR (Solid State Nuclear Magnetic Resonance), and the fact that nobody has tried to use these methods to Mesozoic spicules, our studies will be unique and original. Moreover, for the first time, the expected results will not be of qualitative, but of a quantitative character.

Considering the fact that the concentration of silica in the sea water is linked with several geological processes such as weathering, volcanism, plate tectonics, and carbon cycle in nature, knowing this concentration in the geological past will help to understand all these processes, as well as changes of global climate. On the other hand, from the biological point of view, results of our studies will allow to better understand evolutionary processes/events concerning organisms bearing siliceous skeletons.