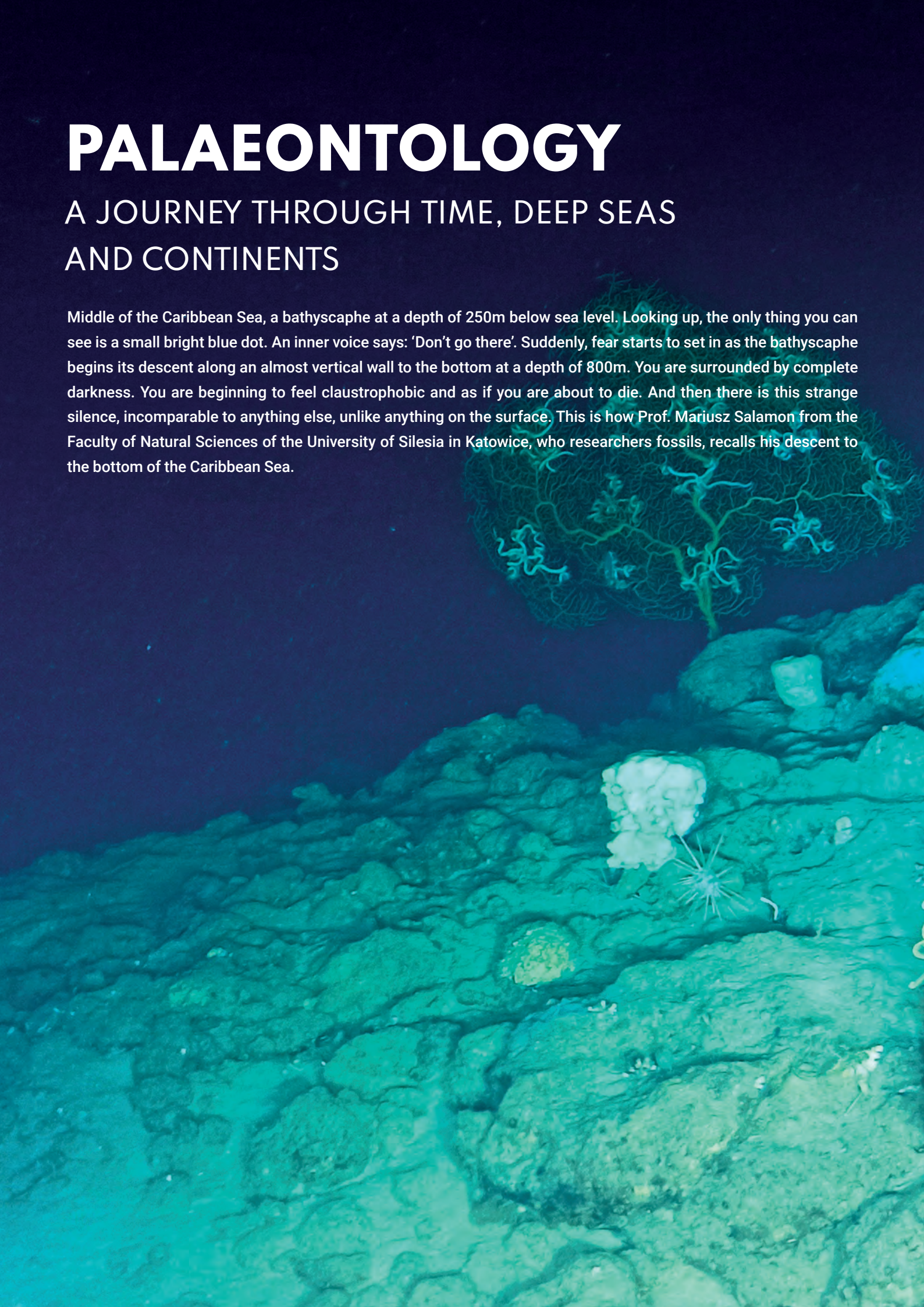
PALAEONTOLOGY

A JOURNEY THROUGH TIME, DEEP SEAS AND CONTINENTS

Middle of the Caribbean Sea, a bathyscaphe at a depth of 250m below sea level. Looking up, the only thing you can see is a small bright blue dot. An inner voice says: ‘Don’t go there’. Suddenly, fear starts to set in as the bathyscaphe begins its descent along an almost vertical wall to the bottom at a depth of 800m. You are surrounded by complete darkness. You are beginning to feel claustrophobic and as if you are about to die. And then there is this strange silence, incomparable to anything else, unlike anything on the surface. This is how Prof. Mariusz Salamon from the Faculty of Natural Sciences of the University of Silesia in Katowice, who researchers fossils, recalls his descent to the bottom of the Caribbean Sea.



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Bottom of the Caribbean Sea seen from a bathyscaphe
Photo: Mariusz Salamon

FOSSILS AS A TIME MACHINE

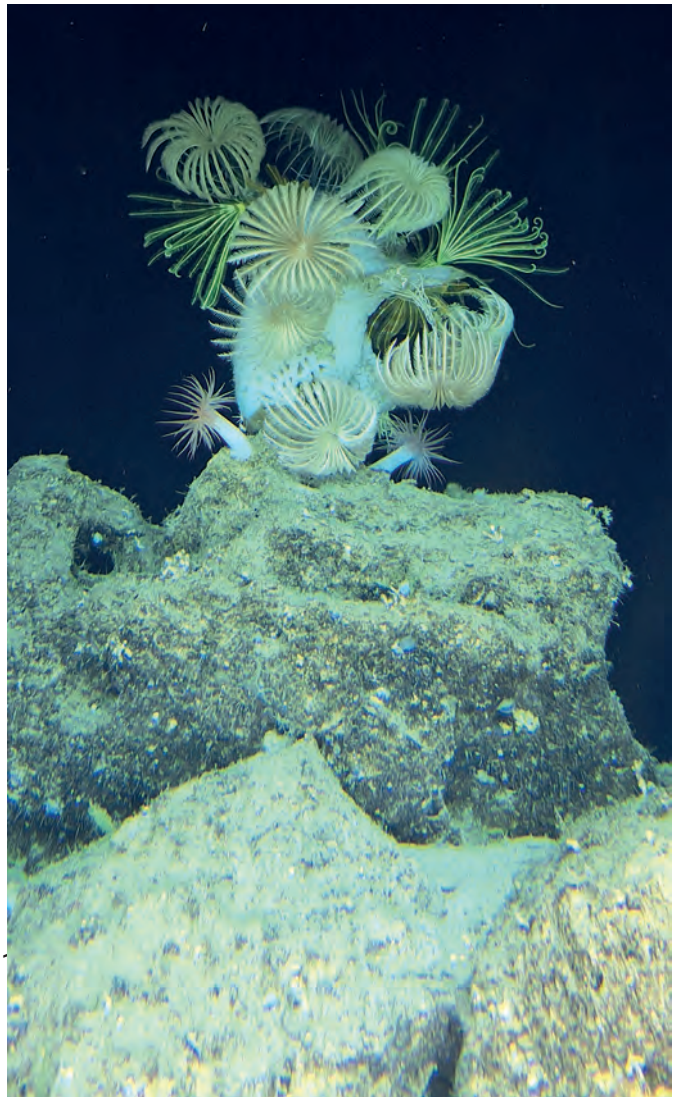
Invertebrate fossils belong to many groups – from the most primitive, including sponges and corals, through arthropods, to echinoderms, the most sophisticated in their anatomical structure. By studying them, we can learn a lot about the history of the Earth. They allow us to determine the age of rocks, and are also an excellent indicator of the palaeoenvironment. Based on various geological clues, we can determine whether their environment was a shallow or deep one.

'A specific group of organisms can help us identify certain aspects: from the age of rocks to the palaeoenvironment and temperature preferences. Fossil invertebrates are worth learning about', says the scientist from the University of Silesia.

Some ammonites are easy to identify, such as *Perisphinctes*, characteristic of the Jurassic period. Crinoids prove to be more troublesome. At the beginning of the Cretaceous period, they still lived in relatively shallow (up to 100–150m below sea level), extremely clear, food-rich, and usually very warm marine environments. These stenohaline organisms tolerate only a narrow range of salinity in water – from 31 to 33‰.

'We know that crinoids require very specific conditions to live. If any of these parameters – temperature, salinity, or water clarity – change even slightly, crinoids die. So, when we find a fossilised crinoid, we know that the place was either shallow or deep, very warm or cold, and that the water was perfectly clean', says Prof. Mariusz Salamon.

Sponge-crinoid association at the bottom of the Caribbean Sea | Photo: Mariusz Salamon



Bottom of the Caribbean Sea (Honduras) | Photo: Mariusz Salamon

FOSSIL PAPERWORK

Palaeontologists partly rely on observations of museum specimens. They contact the curator in advance, who then prepares the collection so that the scientists can take proper measurements, photograph the specimens, and e.g. determine the condition of the crinoids. The researcher admits that working in a museum is quite tedious and he definitely prefers fieldwork. The scientists usually rely on the services of a guide who explain the local geology to them, as was the case in Algeria, Morocco, and Chile.

'In the field, you just have to lie down and examine the ground centimeter by centimeter to see whether there are any fossils. Unfortunately, usually we do not find anything and are forced to move on. In Morocco, we found a lot of crinoid fossils, which often were visible enough that we didn't have to put our faces against the rocks. Then we'd take a brush and a hammer, chip everything out, pack it into bags, and describe it in detail', says the researcher.

Scientists are not always able to transport the fossils they find to Poland. Depending on the country, the process can be more or less complicated. Currently, Prof. Salomon is waiting for crinoid specimens from Mexico; in this case, obtaining the necessary permits requires ministerial approval. However, specimens found in Chile cannot be transported to Poland at all – scientists have to make do with photographs taken during their research.

'I am building a huge database, and while in many cases photographs are sufficient, for some projects specimens are essential. This was the case, for example, with a project on North Africa. A monograph was then published on crinoids of the southern shelf of the Tethys where the famous prehistoric ocean was located. Reviewers and editors of the leading journals believe that if specimens were found in, e.g. Algeria or Egypt, they should be returned there. I always send specimens back to their countries of origin', says the researcher.

SCIENCE VERIFIES ITSELF

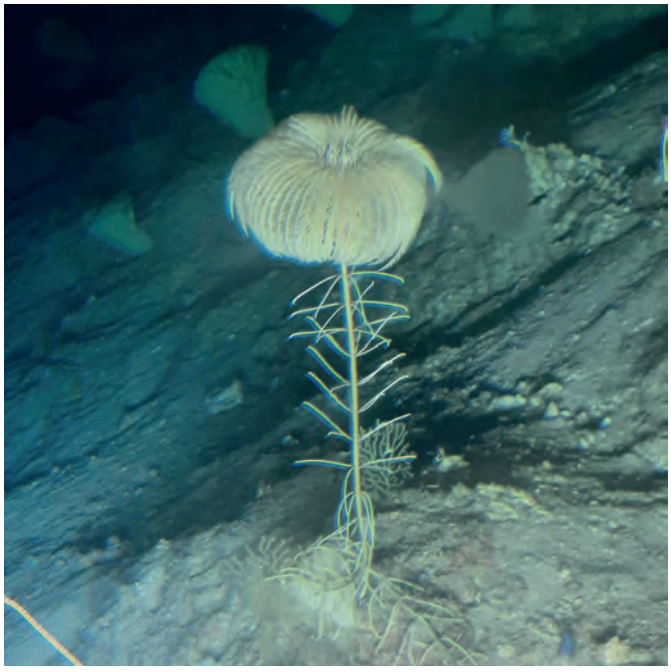
Prof. Mariusz Salamon has conducted research in many parts of the world. He has searched for crinoids in Chile, Mexico, Romania, and at the bottom of the Caribbean Sea. It was in the latter place that several of his scientific dogmas, guiding him thus far, collapsed. The scientist emphasises that in palaeontological research, uniformitarianism is of utmost importance. The first dogma concerned the photic zone, i.e. the place reachable by sunlight. Descending to the bottom in a bathyscaphe allowed him to see that this depth in the Caribbean Sea is much greater than the standard 250m below sea level. The second dogma concerned stemless crinoids.

'Based on data from the 1980s and 1990s, I always claimed that they were an indicator of extremely shallow environments. However, while 800m underwater, I saw a rock occupied exclusively by stemless crinoids. But that's not all. When we began to surface and were at a depth of 300–150m, stalked crinoids, known as cyrtocrinids, appeared. In this case, previous scientific research suggested that they were an indicator of extremely deep marine environments. It turned out to be completely the opposite', admits the palaeontologist.

Crinoids changed their habitats in an attempt to protect themselves from predators, and their biggest predators were not fish but their sister group.

'Sea urchins, which belong to the Echinodermata, have five teeth with which they can grab the crinoid's side appendage and suck it in like spaghetti', explains the scientist.

Scientists discovered a fossil in a flat area – a dozen or so stem crinoids surrounded by several dozen sea urchins approaching them. In order to defend themselves against predators, the crinoids slowly began to descend to greater depths. In the Triassic period, they lived relatively close to the surface, but by the beginning of the Mesozoic era, they had already moved deeper down. Today, they live completely outside the photic zone. In this way, crinoids changed their living environment.



Bottom of the Caribbean Sea (Honduras) | Photo: Mariusz Salamon

Fossil of a stemless crinoid from the Cretaceous period (Australia) | Photo: Mariusz Salamon

SCIENTIFIC ADVENTURE IN THE FIELD

The researcher recalls that at the beginning of his scientific work, he was happy with every little thing that he could find in Poland, but now he searches for specimens all over the world. He has studied fossils from Slovakia, the Czech Republic, Germany, France, Italy, India, Madagascar, Ethiopia, Kenya, Chile, and Australia, among other places. He has participated in many scientific expeditions. Crinoids are often found in mountain ranges, quarries, and mines. One such place is Atacama, the highest desert on Earth, located in Chile.

'Our research station was quite close, but the conditions were difficult due to the altitude, even despite acclimatisation. It was an incredible amount of effort that showed me how important acclimatisation camps are for those who want to conquer the Seven Summits. There, we found a well-preserved crinoid. During the expedition, we were caught in a storm at an altitude of almost 5,000m above sea level, and I also saw the highest geysers in the southern hemisphere. The Valley of the Moon made a big impression on me – its red rocks are reminiscent of the surface of Mars. Nights in Atacama are incredible, you can see the stars and planets with perfect clarity. No photos can capture the view in its full glory. There is no hard surface, only gravel and llamas all around – they approach the cars unconcerned by the presence of humans', says Prof. Mariusz Salamon.

The scientist has more ideas for research. Among other things, he is preparing a project on crinoids from the Permian-Triassic period. It was a moment in history when one of the five great mass extinctions occurred. It was the largest in terms of scale – 95% of marine species became extinct. Crinoids were decimated and underwent a complete transformation. For a long time, people believed that, following the extinction, only one group of crinoids remained. It wasn't until much later that Prof. Mariusz Salamon stumbled upon materials from Spitsbergen, Montenegro, and Slovenia which proved that other groups of crinoids from the period survived as well.

The palaeontologist emphasises that each expedition is different and unique. He is currently studying fossils from Romania and Mexico, and planning a field trip to Japan. His biggest dream is to visit Tasmania, because of its Permian rocks, and the North Island of New Zealand.

'I would like to visit the sites that show great promise in terms of a huge number of crinoids, and New Zealand is basically a tabula rasa that I hope to discover', concludes Prof. Mariusz Salamon.