

The Fram Strait, the passage between Greenland and Svalbard is often called ‘the Arctic gateway’ because it forms the main connection between the Arctic Ocean and the other oceans. Warm water from the south enters across the Fram Strait into the Arctic, where it cools down releasing much of its warmth to the atmosphere and flows back across the strait, carrying sea ice and icebergs southwards. This circulation is extremely important for the heat distribution on Earth and, thus, the climate on our planet. This makes the Fram Strait a key location to study feedbacks between the ocean circulation and the climate, both in the geological past and in modern times.

Recent oceanographic studies show, however, that ocean currents flow through the Fram Strait not only north- and southwards. A crucial element is also the so-called Return Atlantic Current which crossed the strait from the east towards west. The current is particularly important as it transports warm Atlantic Water directly towards ice-sheet covered Greenland. The results of the studies show that over the last decades the current strengthened and now carries even more water. This allows it to reach the coasts of Greenland, warming them and possibly increasing the ice sheet melting rate. This, in turn, leads to the acceleration of the global sea-level rise. Its consequences become clear to all of us when we hear, for example, about the floods affecting Venice more and more often.

To better understand the changes currently taking place in the oceans, we need to learn their past. Shells of foraminifera – unicellular marine organisms found in sediments of the western Fram Strait and dated back to the early Holocene (approximately 11.7-8.2 thousand years before present) indicate a water temperature increase. The warming might suggest that the Return Atlantic Current was active already around that time. However, it remains unclear, whether the temperatures remained constantly increased or underwent natural fluctuations.

In our study, we want to reconstruct the environmental conditions in the Fram Strait from the early Holocene until the present. For this purpose, we plan to analyze a series of marine sediment cores taken across the entire width of the strait both on the continental shelves on its both sides and in its central, deep part. We want to use a set of innovative research methods (including X-ray fluorescence or the analysis of alkenones – organic compounds produced by marine plankton) that will allow us to reconstruct conditions in the Fram Strait. As a result, we will get a possibly complete image of the marine environment in this area over the last several thousand years. Our main research goal is to reconstruct the activity of the Return Atlantic Current over this period. We also want to study the feedbacks between the ocean and the ice sheets neighbouring the Fram Strait to find out how warm Atlantic Water affects the melting of the Greenland Ice Sheet and how the meltwater from the ice sheet influences the marine environment.

The study of the natural variability of the ocean environment and its interactions with the climate in an area as crucial for the global ocean circulation as the Fram Strait will provide us with knowledge about the mechanisms governing the functioning of the ocean-climate system. We will be able to better understand such phenomena as global warming, ice-sheet melting and sea-level rise. Furthermore, by helping to construct more accurate computer models, our results will contribute to more precise predictions of environmental changes that might occur in the future.