



## **Interannual and interdecadal variability of pH in the seas of Russia**

Peter Makkaveev and Peter Zavialov

Shirshov Institute of Oceanology, Physical Oceanography, Moscow, Russian Federation (peter@ocean.ru)

Regional data sets have been assembled at Shirshov Institute of Oceanology, encompassing the principal chemical indicators for the seas of Russia, more specifically, the White Sea, the Kara Sea, and the Caspian Sea. These data sets include the original data obtained in several expeditions of SIO RAS, as well as other historical data. Basing on these records, we analyze the long-term (seasonal and interannual to interdecadal) variability of pH and alkalinity in these seas.

The data on the Caspian Sea were collected since the 1930s. The pH values in the upper layer were increasing continuously until the 1970s, and then started to decrease and, by the 2010s, returned to the values of the 1930s. Such a pattern of variability follows the changes of the sea surface level, which was decreasing until the 1980s, and recovering thereafter. The correlation between pH and other chemical indicators and the sea surface level was high. However, there is no direct correlation between the level and alkalinity. This is because of terrigenous organic matter that was received by the Sea in the 1990s and 2000s, when the former dry bottom areas in the Northern Caspian were covered again by the water. If the alkalinity associated with organic acids is subtracted from the total alkalinity, the "residual" alkalinity exhibits good correlation with the sea level.

The data on the White Sea were collected since 1897 and encompass the total of 19,734 individual stations. Based on these data, we described the seasonal variability of pH (maximum in summer, minimum in spring) and pCO<sub>2</sub>, and also investigated the interdecadal variability of these parameters. At the long-term scale, pH in the White Sea has actually increased.

The data on the Kara Sea were obtained during 2 research cruises to the area, one in September of 1993, and the other one in September of 2007. We evaluate the interdecadal changes of pH in the southwestern and the southeastern parts of the Sea. The pH profiles have increased in the western part of the Sea and remained essentially unchanged in the eastern part.

In summary, it can be said that the available data suggest that in the inland and marginal seas of Russia, the long-term variability of pH followed a complex pattern rather than reflected any distinct general trend.