Improving Measurement of Nitrogen, Argon, and Oxygen in the Ocean Using Gas Chromatography

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The concentrations of argon, nitrogen, oxygen, and other gases in the ocean can be used as tracers for physical and biological processes, such as gas exchange, primary production, and denitrification, and changes in concentration over time have implications for ocean circulation. A new gas chromatographic technique using a 5A molecular sieve column at 0°C and a TCD detector was developed to measure nitrogen, argon, and oxygen in gas samples extracted from seawater. At room temperature, oxygen and argon have very similar retention times on a 5A molecular sieve column, resulting in overlapping peaks, meaning that the instrument cannot accurately measure the concentration of either element under these temperature conditions. Nitrogen, argon, and oxygen concentrations from samples taken on research cruises, such as the Transient Tracers in the Ocean program in the 1980s, were previously measured using gas chromatography. However, these measurements did not achieve a clean separation of oxygen and argon in their chromatogram and results, which led to measured argon concentrations that were inconsistent with the expected values. By lowering the temperature of the column in the gas chromatograph, our study was able to achieve a separation of oxygen and argon, leading to more accurate argon and oxygen measurements and hence a more accurate ratio of nitrogen to argon, which is a useful tracer of denitrification. The accuracy of the nitrogen measurements was essentially the same for both methods. Nitrogen concentrations agree with expected values, while oxygen and argon concentrations fall slightly below expected equilibrium values. This slight discrepancy may be due to fractionation during extraction at sea or processes at the sea surface.