First Results and Potential of ^{39}Ar by Argon Trap Trace Analysis in the Tropical and Subpolar North Atlantic

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With a half-life of 269 years, ^{39}Ar is the ideal dating tracer to study deep ocean circulation. However, due to its very low isotopic abundance in the order of 10^{-15} sample sizes of up to 1000 liters of water were required for analysis with low-level counting, rendering the application of ^{39}Ar for ocean studies not feasible. With the development of the laser-based atom counting method Argon Trap Trace Analysis (ArTTA) the sample size requirement could be reduced drastically to about 5 litres of water. This allows for integration of the argon sampling into the standard sampling routine with hydrographic casts during ocean cruises.

In May 2015, three depth profiles were taken in the Eastern Tropical North Atlantic and the water was analysed for ^{39}Ar in the Heidelberg ArTTA laboratory. ^{39}Ar values as low as 40 percent modern argon were found in depths of around 3000 meters. By combining the measured ^{39}Ar with CFC-12 results, transit-time distributions were constrained and new insights into the ventilation regime of Labrador Sea Water was gained. An additional cruise is planned in May 2019 along the 47°N transect between Ireland and Newfoundland. Based on existing CFC-12 and SF_6 data 5 stations will be selected to take about 40 samples to study the time scales of the spreading of North Atlantic Deep Water.

The talk will briefly present the current status of the Heidelberg ArTTA apparatus and then focus on the results of the two ocean studies conducted in May 2015 in cooperation with the GEOMAR in Kiel, Germany and in May 2019 in cooperation with the Institute for Environmental Physics in Bremen, Germany.