#7

Upwelling velocities inferred from helium isotope disequilibrium

REINER STEINFELDT, J. Sültenfuß, M. Dengler, T. Fischer, M. Rhein

In the framework of the German project SOPRAN, three upelling regimes have been investigated, two eastern boundary upwelling systems (Mauritania, Peru) and the equatorial eastern Atlantic. The upwelled water typically exhibits high concentrations of climate relevant gases such as CO_2, N_2O and halogenated compounds. The oceanic upwelling velocities, however, are too small (in the order of 10^{-5} m/s) to be measured directly. Here we use oceanic measurements of the helium-3/helium-4 isotopic ratio as an indirect means to infer these velocities. The water that upwells into the oceanic mixed layer from below is typically enriched in the lighter isotope helium-3. This excess of helium-3 originates from venting of primordial helium through hydrothermal activity. The supply of helium-3 into the mixed layer from diapycnal mixing is also considered. Helium data have been collected on four cruises within the coastal upwelling regions off Mauritania and Peru and on six cruises in the equatorial Atlantic. It is investigated, in how far the helium derived vertical velocities can be derived from the wind stress. Therefore, away from the equator, the Ekman theory, and near the equator, a shallow water model with Rayleigh friction on a beta-plane are applied. Both advective and turbulent (derived from microstructure measurements) fluxes of nutrients into the mixed layer are determined. In upwelling regions, these fluxes play a key role in fostering ocean primary productivity.