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Respiration signals from the dark ocean

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Oxygen concentrations in seawater span a wide range, from supersaturated to anoxic, resulting from replenishment by the atmosphere, production by photosynthesis, and respiration by animals or microbes feeding on solid or dissolved organic and inorganic reduced substances. Globally, marine respiration mostly occurs in the photic layer. Just below the photic layer, above the basis of the mixed layer, aphotic respiration is strongest and re-supplies the photic layer with remineralized nutrients. Deeper in the dark ocean, respiration is associated with organic aggregates, multiple trophic levels, and occurs at very uncertain rates. The magnitude and spatial distribution of respiration rates in the dark ocean is uncertain and undocumented in key oceanic regions such as the Southern and Indian Oceans.

Once a parcel of seawater leaves the surface and enters the ocean interior, its oxygen amount generally decreases with time, as oxygen is used by respiring organisms. Here we use novel seawater age product and true oxygen utilization rates, accounting for air-sea disequilibrium during ventilation and ocean mixing in the presence of nonlinearity in oxygen solubility, and derive regional respiration-rate depth profiles. We compare these rates with particulate and dissolved organic carbon degradation rates to constrain the ratio of oxygen respired per organic carbon molecule degraded. The resulting O_2:C ratio compares well with estimates from the literature but has large uncertainty, which may reflect that average organic matter composition differs across oceanic regions. Our analysis suggests a respiration signal from the seafloor in the Atlantic basin.