Role of the oxygen-deficient zone in transfer of organic carbon to the deep ocean

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ABSTRACT: Benthic carbon oxidation rates and carbon burial rates have been determined for two contrasting continental margins and their sum has been used as an estimate of carbon rain rate to the sediments. On the Washington State margin, where the water column is oxic, rain rates at 100 m were about 15 to 20 mmoles C m^{-2} d^{-1} and they decreased with increasing water depth to values of near 3 mmoles C m^{-2} d^{-1} at 1,000 m. The rain rate estimates, CR, were described by a power function, $C_z = C_{z=100m}(z/100)^{-\alpha}$, with an attenuation coefficient, α, of 0.93 ($C_{z=100m}$ = 16.2, r^2 = 0.89). This attenuation rate is similar to numerous others previously reported for various oceanic areas. In contrast, off northwest Mexico, where the water column is oxygen deficient between 180 and 700 m, rain rates at 100 m were considerably less, about 7.5 mmoles C m^{-2} d^{-1}, but rain rates at 1,000 m were similar to those off Washington. Thus, the attenuation coefficient for the Mexican margin was significantly lower, α = 0.36 ($C_{z=100m}$ = 7.4, r^2 = 0.77). Off Mexico, the rain rates estimated from sedimentary parameters were corroborated by values determined directly from sediment-trap deployments. The generally smaller rain rates off Mexico are probably due to the lower primary production, hence lower initial supply. The lower attenuation rate, however, is hypothesized to result from a decreased oxidation rate of the sinking flux within the oxygen-deficient zone relative to a more typical oxic water column.

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