Radiocarbon and stable isotope signatures of sedimentary methane at a coastal California Basin

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In Santa Barbara basin sediments, sulfate reduction is driven by both anaerobic oxidation of methane and organic matter oxidation. Here, we investigate the source of substrates supporting methane production below this zone. In Santa Barbara Basin, the sulfate-methane transition (SMT) is located at ~1.3 m depth. Methane concentrations were <0.2 μM between the sediment surface and 1.2 m, and increased linearly to >10 mM below 2 m. The origin and fate of methane within and below the SMT were investigated by measuring stable- and radio-isotopes of methane ($\delta^{13}C\text{-}CH_4$ and $\Delta^{14}C\text{-}CH_4$, respectively). $\delta^{13}C\text{-}CH_4$ values were the lowest (-93‰) at the SMT, becoming more positive above and below. Below the SMT, $\Delta^{14}C\text{-}CH_4$ values ranged between -400 and -420‰ at 1.5 m and decreased to -490 ‰ at 2.5 m. $\Delta^{14}C$ values of dissolved inorganic carbon (DIC) were more positive at all depths, ranging from -384‰ at 1.5 m to -428‰ at 2.3 m, and correlated linearly with $\Delta^{14}C\text{-}CH_4$ values. $\Delta^{14}C$ values of the particulate organic carbon (POC) were also linealry correlated to $\Delta^{14}C\text{-}CH_4$ values, but clearly more positive, ranging from -280‰ to -329‰. This presentation will discuss the biogeochemical processes responsible for these changes, and focus on the role of methane.