Controls and paleoceanographic significance of microbial dolomite in the Miocene Monterey Formation

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Microbial dolomite with wide-ranging $\delta^{13}C$ compositions has been reported in a number of organic carbon-rich marginal marine sequences. We consider the geochemical origin of microbial dolomites ($\delta^{13}C_{dol}$: -17 to +9‰) from a continuous core of the Miocene Monterey Formation from Santa Barbara-Ventura Basin, California. The outboard setting of this basin had exceptionally low rates of terrigenous input throughout the Monterey depositional interval, whereas siliceous productivity increased appreciably with progressive cooling following the middle Miocene climatic optimum. Persistence of finely laminated lithofacies and lack of bioturbated intervals indicates that a consistent redoxocline was maintained at or very near the sediment-water interface. The lack of highly depleted $\delta^{13}C_{dol}$ compositions indicative of methane-derived carbon (e.g., < -30‰) suggest that alkalinity was predominantly generated in association with sulfate reduction and that dolomites formed without overprinting associated with vertical migrations of the sulfate-methane transition. Several geochemical parameters ($\delta^{13}C$, Fe, Mn, Ba, P, Ce/Ce*) follow first-order basin accumulation rates despite the fact that dolomites occur as stratigraphically isolated horizons (>100). This long-term secular evolution contrasts with extreme (e.g., 40x) variations in mass accumulation rates for Monterey pelagic and hemipelagic depositional modes operating over much shorter timescales [1]. Access to sulfate diffusion, likely promoted during intervals of condensed sedimentation (e.g., eustatic high stands), was a key control regulating dolomite formation. Despite dolomites forming in anoxic porewaters their REE distributions consistently reflect oxic or suboxic seawater. Dolomite forming porewaters were thus buffered by REEs supplied from oxic hydrogenous and biogenous constituents – most likely diffusing bottom waters and planktic biomass. Interestingly, secular $\delta^{13}C_{dol}$ variation for the Monterey core is the polar opposite of Miocene open marine $\delta^{13}C$ records. This can be reconciled as most-depleted dolomites forming when rates of organic carbon sequestration were both regionally and globally high (17.5-13.5 Ma, CM 3-6) – consistent with the “Monterey Hypothesis” [2].

[1] Isaacs (1985), *Geomarine Letters* **5**, 25-30 [2] Vincent & Berger (1985), *Geophys. Monogr. Ser.* **32**, 455–468