This document includes captions for visualizations of geochronological data used to generate U-Pb ages (Figs. SM1-SM4) and a sensitivity test of the carbon isotope box model discussed in Chapter 4 and Appendix 3 visualized in Fig. SM5.

**Figure SM1.** Visualization (ranked-age and concordia diagrams) of geochronological analyses used to generate ages for the following samples from El Capitan: A) EAGC2010 (LA-ICPMS and TIMS), B) EAGC2011 (LA-ICPMS and TIMS), C) EAGC2012 (LA-ICPMS and TIMS), D) EAGC2001 (LA-ICPMS), E) EAGC2002 (LA-ICPMS), F) EAGC2003 (LA-ICPMS and TIMS MDA), G) EAGC2006 (LA-ICPMS and TIMS), H) EAGC2008 (LA-ICPMS and TIMS), I)F1917-33.7 (TIMS), J) F1917-13.4 (LA-ICPMS and TIMS MDA), K) F1917-8.2 (LA-ICPMS and TIMS), L) F1917-0.7 (LA-ICPMS and TIMS), M) M1801-0.73 (LA-ICPMS), N) EAGC2009 (LA-ICPMS MDA).

**Figure SM2.** Visualization (ranked-age and concordia diagrams) of geochronological analyses used to generate ages for the following samples from Naples Beach: A) EA1902-16.6 (LA-ICPMS and TIMS), B) EA1902-12.34 (LA-ICPMS and TIMS MDA), C) EA1902-12.0 (LA-ICPMS), D) EA1902-11.73 (LA-ICPMS and TIMS, E) EA1902-11.55 (LA-ICPMS), F) EA1902-9.2 (LA-ICPMS), G) F1916-24.9 (LA-ICPMS), H) M1806 (LA-ICPMS), I) M1805 (LA-ICPMS), J) M1804\_6.5 (LA-ICPMS), K) M1808 (LA-ICPMS).

**Figure SM3.** Visualization (ranked-age and concordia diagrams) of geochronological analyses used to generate ages for the following samples from Tajiguas Beach: A) EAGC2016 (LA-ICPMS), B) EAGC2013 (LA-ICPMS), C) EAGC2014 (LA-ICPMS), D) EAGC2107 (LA-ICPMS), E) EAGC2103 (LA-ICPMS and TIMS MDA).

**Figure SM4.** Visualization (ranked-age and concordia diagrams) of geochronological analyses used to generate ages for the following samples from Tajiguas Beach: A) F1914-3.6 (LA-ICPMS and TIMS), B) F1915-7.2 (LA-ICPMS and TIMS MDA).

**Figure SM5.** Sensitivity test of the carbon isotope box model defined in Chapter 4. A) forg calculated for pre-Monterey Event conditions ( 𝛿13Ccarb of ~0.5‰), given a range of 𝛿13Cin and 𝛿13Corg values and a global carbon burial flux of ~0.6GtC/yr. B) forg calculated for syn-Monterey Event conditions ( 𝛿13Ccarb of ~1.5‰), given a range of 𝛿13Cin and 𝛿13Corg values and a global carbon burial flux of ~0.6GtC/yr. C) change in forg (Δ forg) required to drive a shift in 𝛿13Ccarb from ~0.5‰ to ~1.5‰ for a given combination of 𝛿13Cin and 𝛿13Corg values. D) Sustained organic carbon mass accumulation rates (OCMARs) in circum-Pacific basins (total area of 600,000km2) required to explain a shift in 𝛿13Ccarb from ~0.5‰ to ~1.5‰ through organic carbon burial in the Monterey Formation and equivalent strata for a given combination of 𝛿13Cin and 𝛿13Corg values. In all panels, the red triangle indicates the model output for the assumed 𝛿13Cin and 𝛿13Corg compositions (-6‰ and -23‰, respectively) discussed in the main text.

\* \* \*