Are carbon cycle theories and predicted time scales consistent with the geologic record?

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Questions such as “What is the response of ocean chemistry to carbon input?” or “Does carbonate precipitation/burial lower atmospheric CO2?” can lead to opposing answers, depending on the time scale considered. Our current understanding of the global carbon cycle is partly based on theories and models, which are difficult to validate based on modern observations, which span at most a few centuries. This presentation will introduce the fundamental controls on carbon cycling and associated time scales. The predictions of carbon cycle theories and models will be tested against records of key geologic eras and events, including long-term changes during the Cenozoic, the Eocene hyperthermals, and more. Observational records will include reconstructions of changes in atmospheric CO2, stable carbon isotopes, ocean chemistry, and the calcite compensation depth (CCD). I will also comment on the apparent paradox of a deepening Cenozoic CCD, despite a decreasing atmospheric CO2 trend over the same time scale, which should have led to reduced weathering and CCD shoaling. Finally, I will touch on some new developments in the reconstruction of volcanic degassing, a critical parameter for long-term carbon cycle models.