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# The role of seawater chemistry in Cenozoic carbon cycling

**LAURENCE A COOGAN**[1] AND STAN DOSSO[2]

[1]University of Victoria
[2]U. Victoria

Cooling over the Cenozoic, and the associated decreases in $pCO_2$, provides a test case for studying the geological carbon cycle. To this end we built a model of ocean chemistry and carbon cycling and used paleorecords to constrain this. The model tracks C degassing, continental silicate and carbonate weathering, high-temperature hydrothermal fluxes, seafloor weathering fluxes and sedimentation/diagenesis. The model is forced by changes in: (i) $CO_2$ degassing; (ii) continental weatherability; (iii) ocean crust accretion rate; and (iv) climate. We used a MCMC inversion, constrained by paleorecords of seawater Li, Mg, Ca, Sr and the carbon system (tracked through DIC and ALK) along with isotopic compositions for Li, C and Sr. The paleorecords can be fit by the model with a range of model parameters; i.e., the data do not fully constrain the system. However, in all acceptable models the total carbon content of the ocean atmosphere system does not change systematically over the Cenozoic despite $pCO_2$ decreasing as others have found. Instead, the decrease in $pCO_2$ reflects changing partitioning of carbon between the ocean and atmosphere (exemplified by increasing ALK/DIC). Decreased $pCO_2$ over the Cenozoic reflect a larger fraction of the total carbon in the ocean-atmosphere system being partitioned into the ocean. If the feedbacks that ensure that carbon degassing and draw-down are closely balanced depend on $pCO_2$ as generally thought, then the feedback must come through ocean chemistry changes not changes in the total carbon content of the ocean-atmosphere system. Reactions at the seafloor that moderate the major ion chemistry of the ocean and hence ALK, DIC and saturation state are likely to be central to such a feedback.