The global weathering thermostat: Fact, fiction, and computer models

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The assumed temperature (± precipitation, vegetation, pCO_2) dependence of the global rate of (calcium-magnesium) silicate rock weathering is the cornerstone of our understanding of the long-term stabalization of surface climate. Indeed, much of the basis for iconic conceptual models of the evolution of atmospheric CO_2 through the Phanerozoic, such as 'GEOCARB', relies on this relationship holding true (and at times qualitatively modified by plant evolutionary transitions and plate movements). As such, identifying geological evidence that not only explicitly supports the existence of such a mechanism, but helps to constrain its sensitivity (and by inference, elucidates the role played by e.g. organic carbon burial and low temperature sea-floor weathering), is critical.

Evidence may be sought from a variety of geological deposits and events, from carbonate preservational 'overhsoots' associated with the recovery of the Earth system from massive CO_2 release at the Paleocene-Eocene Thermal Maximum, through movements (or not, as it turns out) of the carbonate compensation depth in the ocean acorss multi Myr intervals of monotonic climate warming, to supposedly, the occurrence of anomalous 'cap carbonate' deposits in the immediate aftermath of extreme Neoproterozoic glaciation. But do any of these lend themselves to unambiguous interpretation in terms of a negative feedback on climate via enhanced silicate weathering?

In this talk I'll use an Earth system model (of course) to explore some of the proposed lines of evidence for the existence of the global weathering thermostat (of the terrestrial silicate variety). I'll illustrate to what extent silicate weathering feedback can explain geological observations, and what alternative explanations may or may not be possible or desirable.