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Limits to Chemical Weathering and the Climate Stabilizing Feedback

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Feedback between chemical weathering and Earth's long-term climate is thought to be responsible for maintaining equable surface conditions over geologic time. This relationship represents one of the longest-frequency, critically life-sustaining teleconnections in the Earth surface system. Yet the way this feedback operates, and the way it is perturbed by other surface processes such as tectonic activity, have remained contentious. This talk will summarize a quantitative model for the relationship between chemical weathering and its main controlling parameters, temperature, runoff, and physical erosion. When the supply of fresh rock material through erosion is rapid, weathering rates are kinetically limited and controlled by climate. However at low physical erosion rates, chemical weathering becomes limited by material supply and is no longer climatically dependent. This reconciles apparent inconsistencies in previous conceptualizations of this problem and provides the basis for assessing the role of the climate-weathering feedback over Earth's recent history. The talk will consider the potential importance of supply limits for the operation of this feedback as a climate stabilizing mechanism, both in the past and potentially in the future.