

***Rivers flow not past, but
through: a fluvial perspective
on Earth's carbon cycle***

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Abstract

Maintaining habitability on Earth has required a careful, ~4.5 billion-year-long balancing act. Averaged over a million years, the rates at which CO₂ is added and removed from the atmosphere must be kept nearly equal lest the oceans freeze or boil away. As CO₂ supply from deep within the Earth is (relatively) insensitive to surficial conditions, balance must be maintained by adjustments in the rate at which the chemical breakdown (weathering) of silicate minerals converts gaseous CO₂ into solid metal carbonates. A fundamental link between weathering rates and climate may serve as negative feedback that regulates habitability. Yet, open questions remain regarding the nature of the climate-weathering feedback (is it dominantly through variations in temperature or runoff?), the role of tectonics in modulating the strength of the feedback (are mountains sinks or sources of CO₂?), and the competing effects of other biogeochemical cycles (are there roles for the sulfur and organic carbon cycles in planetary habitability?). Here, these topics are explored using spatial and temporal variations in the chemical composition of modern river waters as an integrated measure of weathering and the factors that affect its role in planetary habitability.

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