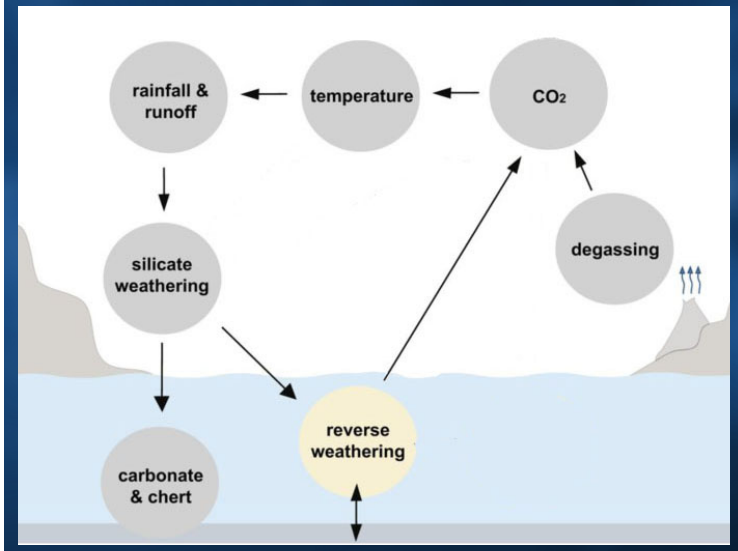
Rethinking Long-Term Controls on Planetary Climate

A process known as reverse weathering that produces carbon dioxide could explain how the early Earth stayed warm despite a fainter sun—and may provide a method for how rocky exoplanets that are otherwise too far from their host stars to sustain liquid water could remain habitable.

- Prior to about 500 million years ago, when silica-secreting eukaryotic life evolved, dissolved products of weathering could react in the ocean to form clay minerals and return CO_2 to the atmosphere (left). This process would have been more active in early oceans where higher silica fueled more rapid rates of clay formation and CO_2 production.
- This process would have also enhanced climate stability by mitigating large swings in CO_2, a critical component of Earth's thermostat during the first four billion years. The rise of siliceous organisms would decrease silica in the oceans, and lead to a more volatile climate system, including rapid icehouse-greenhouse transitions.
- Understanding how the planets like the Earth regulate climate is critical for understanding the long-term maintenance of planetary habitability, both on early Earth and Earth-like worlds beyond our solar system.



CONCEPTUAL MODEL FOR REVERSE WEATHERING. The return rate of CO_2 to the atmosphere was greater when silica content of the oceans was higher, as during the first four billion years of Earth's history.

Isson and Planavsky (2018) *Nature*