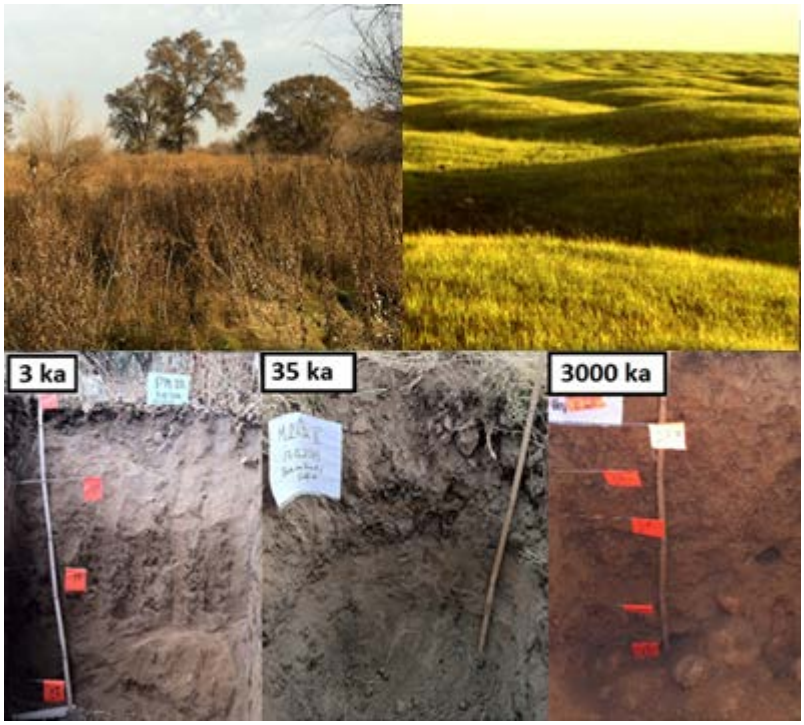

Soil weathering: The puppet master of carbon cycling?

Soils are important for carbon (C) storage and thus for possible mitigation of atmospheric CO_2 concentrations. In a recently published Nature Geoscience article, scientists took a closer look at the drivers of C storage in soils. The study along a 3-million-year old terrace sequence in the Californian central valley shows how soil weathering controls and influences crucial parts of terrestrial C cycling.

Quantifying soil C dynamics is crucial in the context of global change because soils play an important role in the exchange of CO_2 between land and atmosphere. Whether C is stored in soils store or released back to the atmosphere is usually related to climatic factors and land management, as they control plant growth and the decomposition activity of soil microorganisms. Geology, however, controls the geochemical properties and reflects the stage in which soils develop and C cycles.

An international team of researchers, with the contribution of Dr. Marco Griepentrog and Prof. Johan Six from ETH Zurich, shows why it is important to understand long-term mineral weathering when assessing short-term responses of soil C dynamics.

“Our models fail to accurately represent the influence that soil weathering (that is changes in geochemistry of soils over time) can have on present and future soil carbon dynamics” Johan Six says. The international team of researchers showed the importance of weathering processes lasting from only a couple to millions of years and how this affects plant growth, microbial communities and stabilization of soil C over time. The scientists worked along a soil chronosequence originating from the same geologic material and developed under similar climate and vegetation cover. The youngest soils along this sequence are only a few years old, whereas the oldest, and highly weathered soils are several million years old. “This difference in development stage of soil allowed us to investigate all kinds of changes that occur over time to the C cycle. For example, changes in vegetation types due to differing availability of nutrients, changes in microbial communities and their strategies to assess these nutrients, the

capacity of minerals to stabilize C in soils and the effect that warming might have on certain biological processes" Marco Griepentrog adds. The researchers demonstrate that biogeochemical alteration of the soil matrix (and not short-term warming) controls the composition of microbial communities and strategies to metabolize nutrients. More specifically, weathering first increases and then reduces nutrient availability and retention, as well as the potential of soils to stabilize C.

So how does this knowledge help us to improve predictions of the future C cycle?

"The great thing about our findings is that they show how biological processes that act on short time scales are closely tied to the long term changes in soils that come with weathering" Johan Six continues. "We hope that this understanding will encourage a better integration of weathering mechanisms into models by ecologists and biogeochemists to predict C at the global scale. If biology, that drives the C cycle, is taking place on a stage that is controlled by geochemical changes in soils, we can use much simpler approaches and larger datasets of soil properties and underlying geology to create better predictions of future developments of the C cycle" concludes Marco Griepentrog.

The article "Links among warming, carbon and microbial dynamics mediated by soil mineral weathering" is published in Nature Geoscience.

Caption to picture: *The soil sampling campaign was conducted across a sequence of soils developed on material originating from the Sierra Nevada Highlands that has been deposited over millions of years in the Californian central valley. Young, fertile soils (left side) can support vast plant life and stabilize C with minerals while old soils (right side) can only sustain a very poor and scarce vegetation due to lack of suitable minerals to sustain greater plant productivity and soil C stocks.*

Full title: Doetterl S., Berhe A.A., Arnold C., Bodé S., Fiener P., Finke P., Fuchslueger L., Griepentrog M., Harden J.W., Nadeu E., Schnecker J., Six J., Trumbore S., Van Oost K., Vogel C., Boeckx P. 2018. **Links among warming, carbon and microbial dynamics mediated by soil mineral weathering**. *Nature Geoscience, **https://doi.org/10.1038/s41561-018-0168-7.***

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