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The role of geology and climate in soil nutrient variability - potential drivers for large ungulate migrations in the Serengeti ecosystem (Tanzania)

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Aims of the project

What are the long-term drivers of animal migrations in dynamic ecosystems?

→ Interplay of climate and geology, but mainly geological processes provide important controls on long-term ecosystem dynamics.

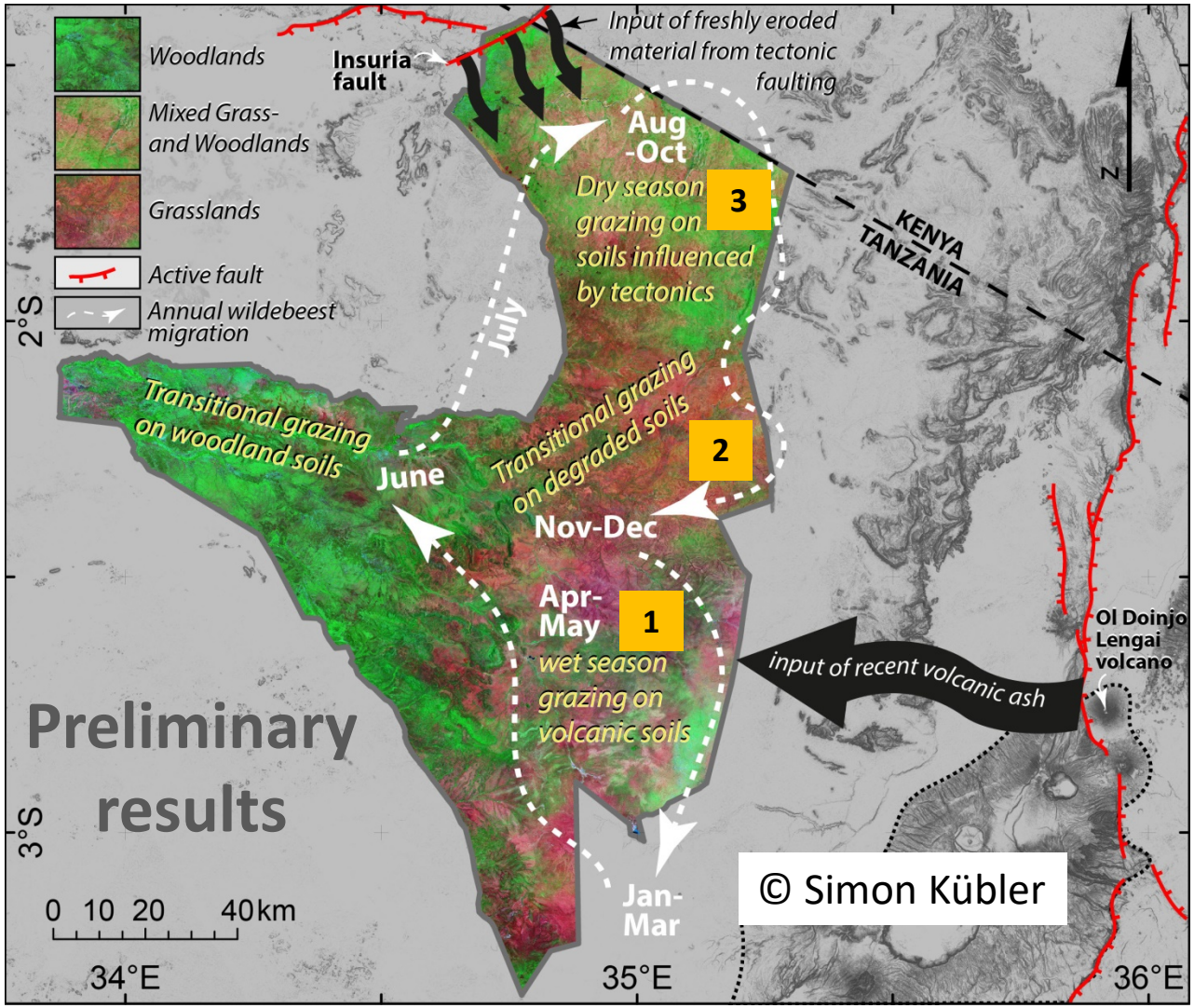
How does geology steer the provision and distribution of essential nutrients?

→ The composition (mineralogy and chemistry) and degree of weathering of the different rocks and sediments influence the amounts of plant-available nutrients in soils, which therefore control the grazing patterns of herbivores.

Further research questions of our project are:

(1) How does the interplay between climate and geology controls the avilability of plant-available elements in soils? How can we quantify the influence on vegetation pattern? How large is the influence of recent dust and ash input?
(2) Does the heterogeneous distribution of soil nutrients impact the seasonal wildebeest migration pathways?
(3) What are negative factors, what is reducing soil fertility?

Migration pathways and differences in geology



(1) Volcanic ash from recent eruptions of the Ol Doinjo Lengai carbonatite volcano.

(2) Archean basement rocks including granitic gneisses, phyllites and banded iron formations.

(3) Patchwork of Archean basement rocks and basaltic lavas, thick fluvial deposits. North of Mara river, the Insuria fault creates a wide sedimentary basin dominated by basaltic sediments.

→ Analyses on the way …

Preliminary conclusions and outlook

- Geochemical variations together with continuous (syngenetic) pedogenesis through active volcanism or tectonic faulting and related fault scarp erosion created a patchwork of soils of different edaphic nature.
- Soil characteristics are overprinted by climatic effects (precipitation changes) and land-use effects (overgrazing and subsequent erosion) which can reduce the amount of plant-nutrients and even biomass available as fodder.

- Our working hypothesis is based on results from the Kenya-Rift project, which focused on understanding early hominin landscape inhabitance and animal migrations related to the distributions soil nutrients in this region:

Kübler, S., Owenga, P., Reynolds, S.C., Rucina, S.M. & King, G.C. (2015): Animal movements in the Kenya Rift and evidence for the earliest ambush hunting by hominins. Scientific reports 5, 14011.

Kübler, S., Rucina, S.M., Reynolds, S.C., Owenga, P., Bailey, G. & King, G.C. (2016): Edaphic and topographic constraints on exploitation of the Central Kenya Rift by large mammals and early hominins. Open Quaternary 2, 1-18.

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