How deep and persistent are the influences of aboveground disturbance on soil microbial activities at the Calhoun CZO?

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The idea

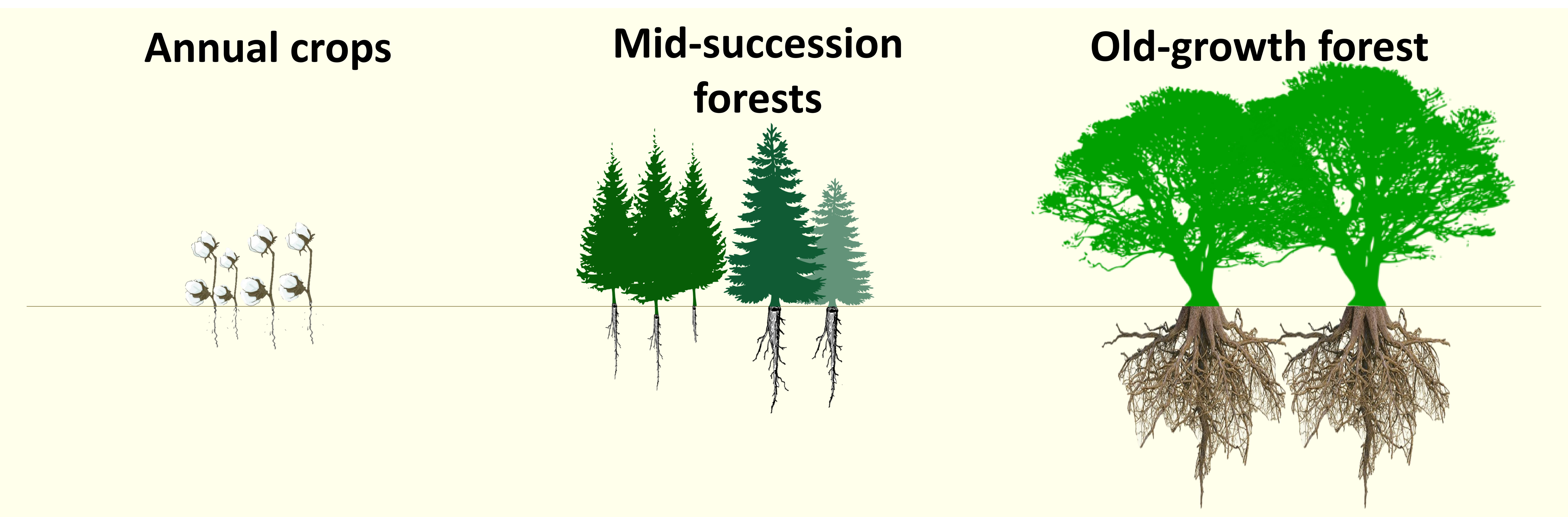
Disturbance of terrestrial ecosystems may drive soil changes that extend far deeper into regolith and persist far longer than is currently appreciated. Typically, the influences of disturbances are studied aboveground and in surface soils, but many of the likely-affected processes govern regolith production deep in soil profiles.

If so, large-scale disturbances may serve an unappreciated role as drivers of change in the type and rate of processes responsible for generating soil, the very material upon which terrestrial ecosystems grow. However, few investigators have integrated the probable responses of deep-soil biogeochemistry to aboveground disturbances into a testable hypothesis.

Why might this be true?

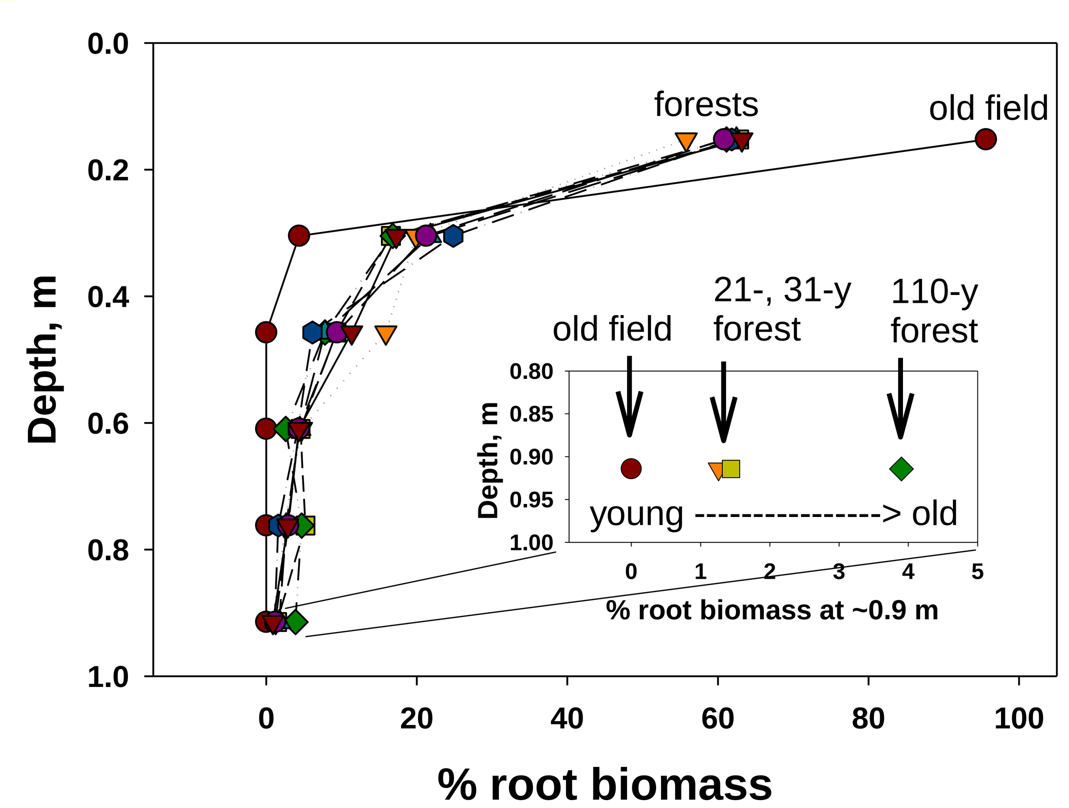
Three well-accepted phenomena provide a logical basis for this idea.

1) Roots and the microbes dependent on them serve as an observable, acid-generating weathering front that advances through soil volumes across ecosystem time.



2) Severe disturbance aboveground halts the advancement of this weathering front, induces massive re-organization of the microbial communities dependent on root-derived resources, and curtails deep water uptake.

3) Full recovery of the rooting system's depth and density after disturbance, and hence of its microbes, requires many decades to centuries (figure to right, plotted from Billings 1938).



A formal hypothesis

Disturbance of mature ecosystems severs well-networked, deep root systems that develop over ecosystem time and serve as weathering fronts and sinks for water deep in soil profiles. Thus, the composition and activities of soil microbial communities whose C, N, and P cycling link to weathering processes vary with historic and contemporary disturbance frequency, and the extent of rooting system recovery.

Preliminary data

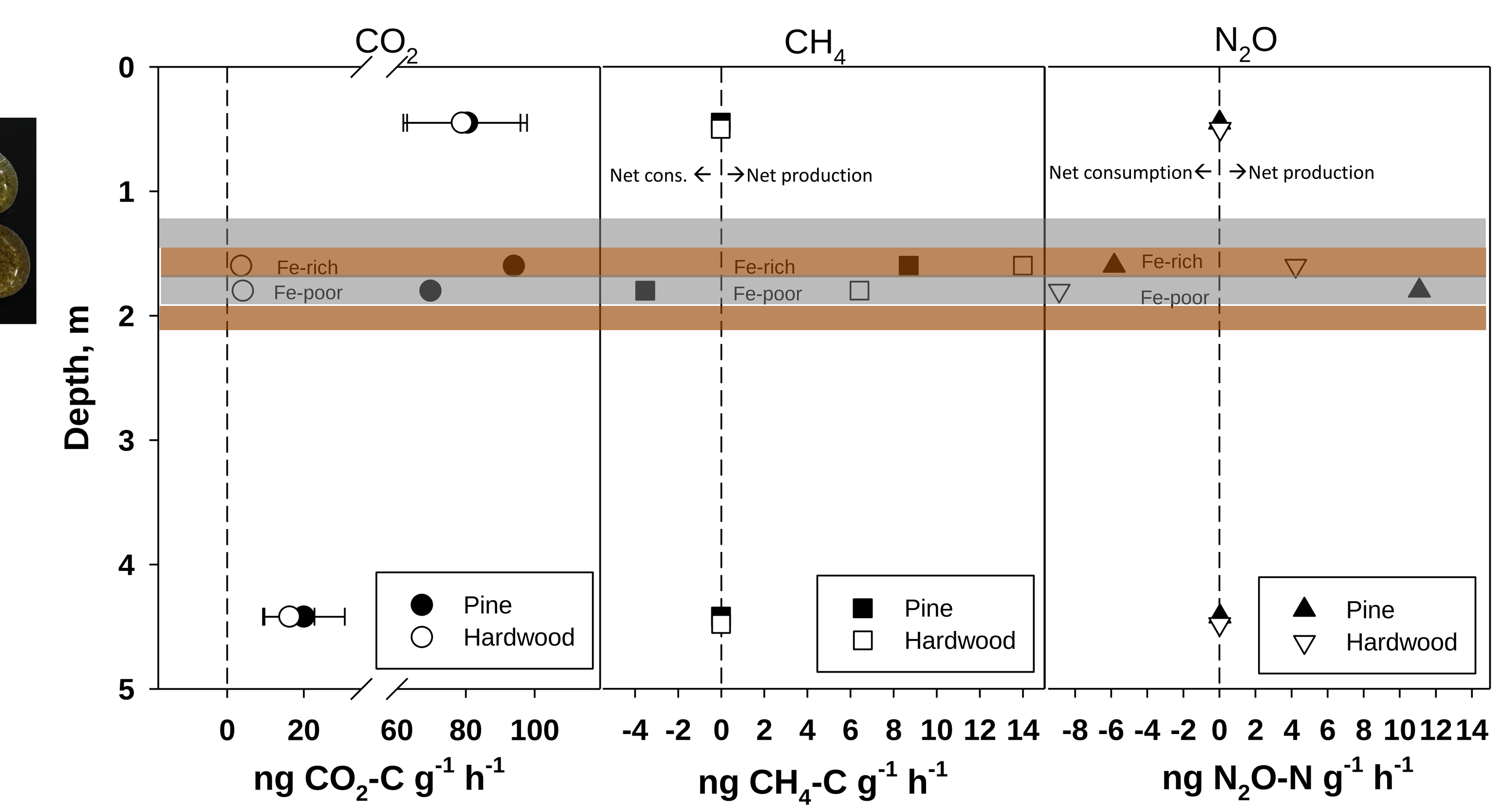
To address our hypothesis, we ask:

1) What biogeochemical evidence demonstrates microbial activity deep in the subsoil?

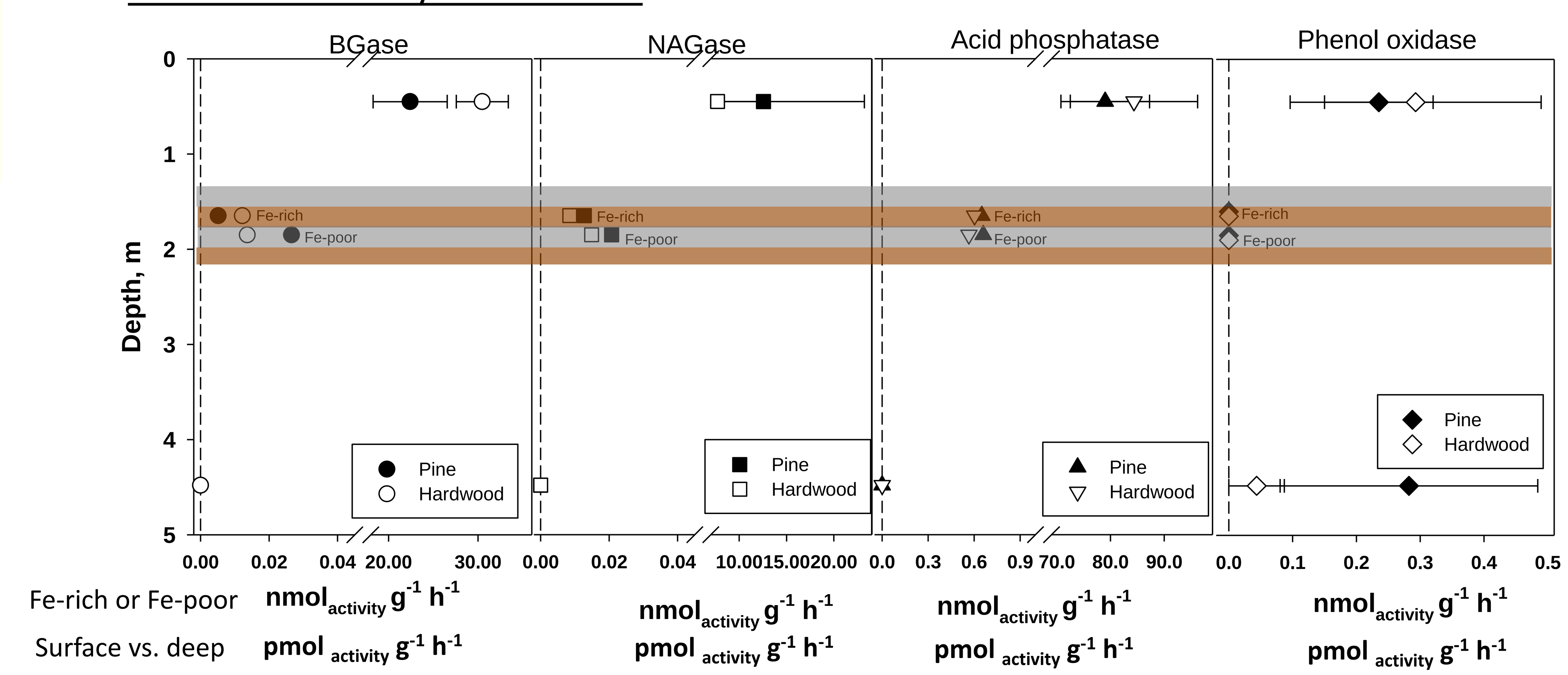
2) How do differences in these activities and their intensities among depths vary with time since disturbance?

Gas fluxes and extra-cellular enzyme activities derived from soils incubating at 70% WHC and similar temperature.

Gas fluxes



Extra-cellular enzyme activities



Soil moisture regimes will be characterized in the coming years.