DOES AN 'IRON-GATE' REGULATE DROUGHT EFFECTS ON PEAT DECOMPOSITION?

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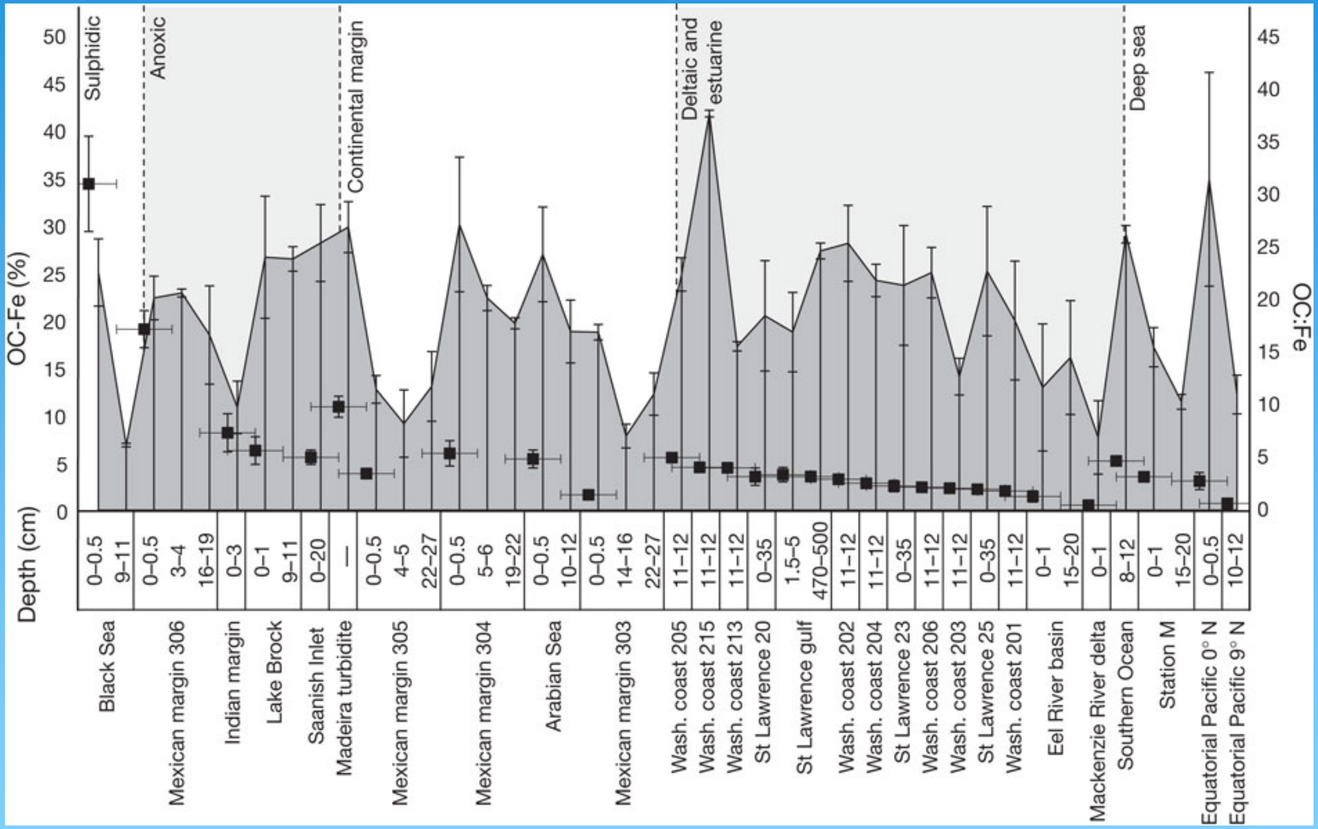
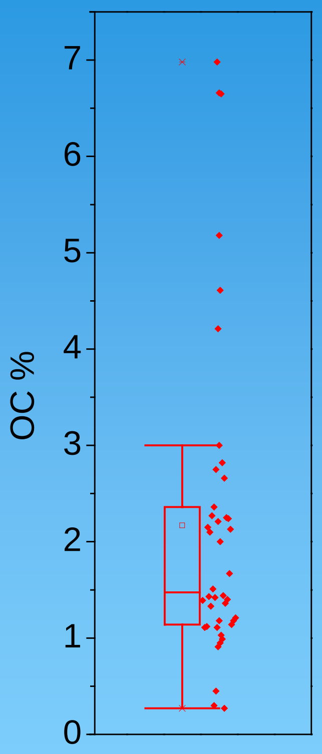
"Rusty Sink" in mineral soil





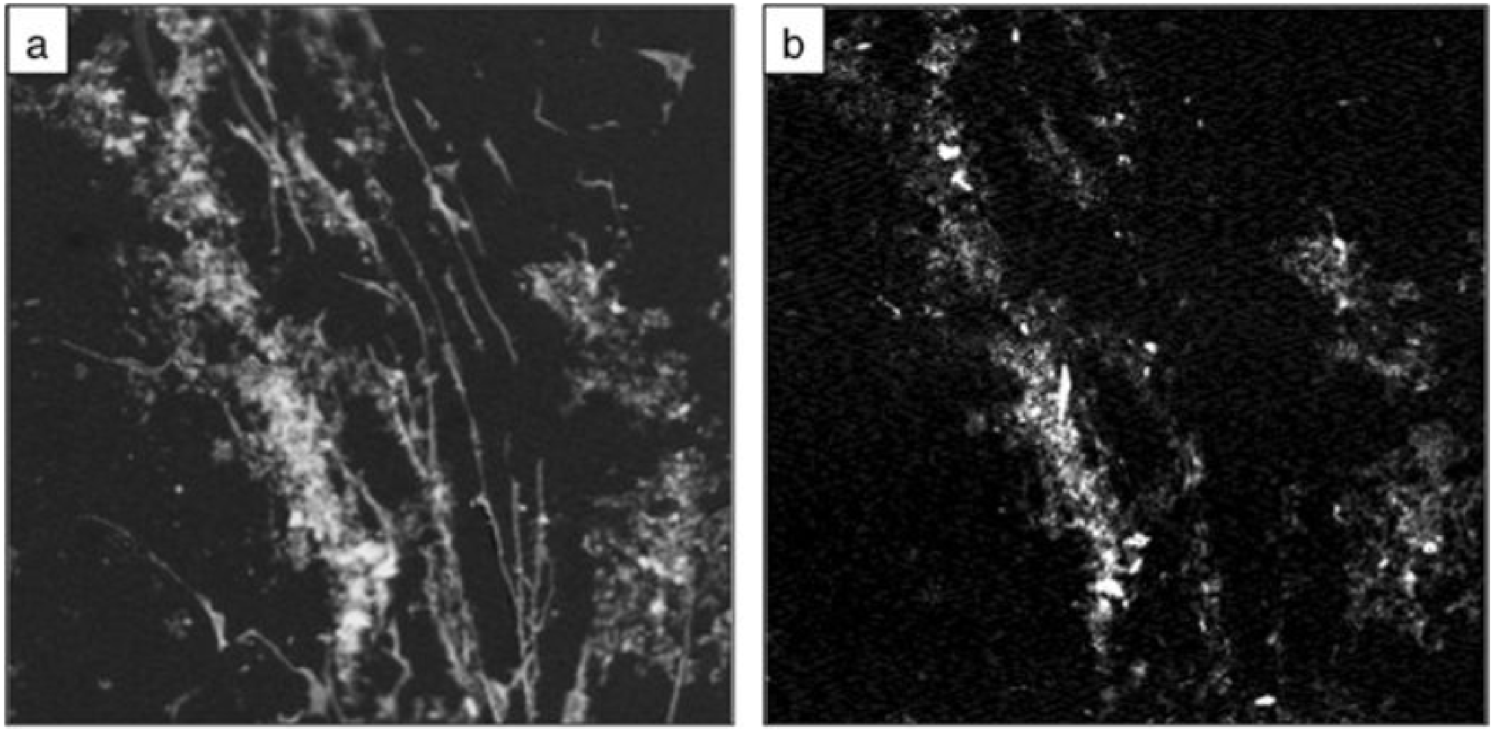
Control-corrected percentage of the total sediment organic carbon bound to reactive iron phases.

21.5% of OC bound to Fe

OC: 0.3-7%

K Lalonde *et al*. *Nature* **483**, 198-200, doi:10.1038/nature10855, 2012

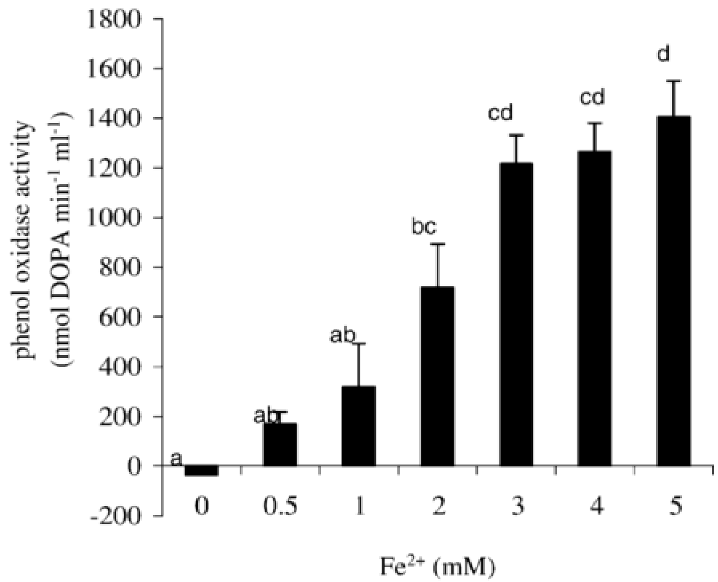
Co-localized C and Fe

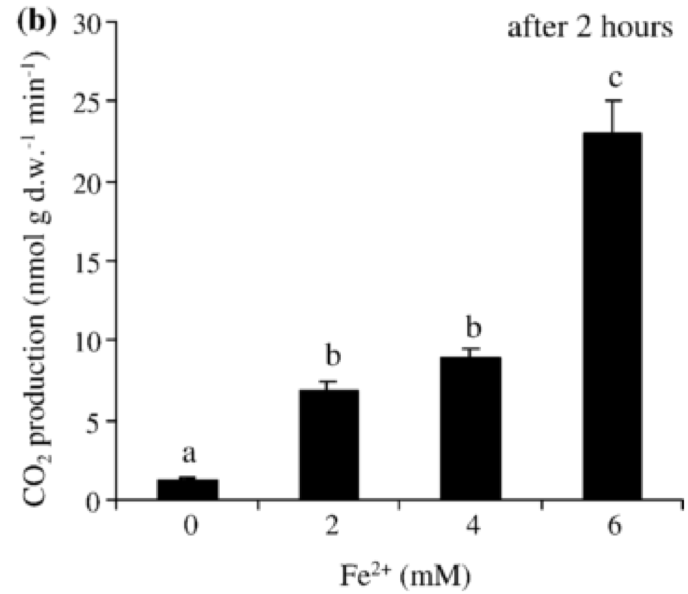


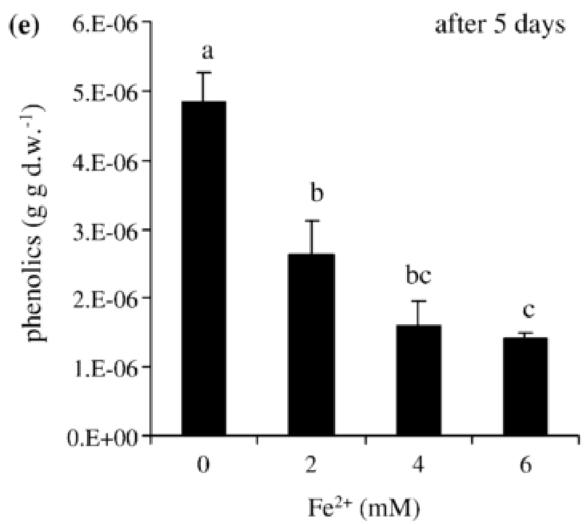
Scan Maps for carbon(a) and iron (b)

* Barber et al., Scientific Report, 7:366, DOI:10.1038/s41598-017-00494-0, 2017

Fe^{2+} stimulates phenol oxidase activity and C decomposition

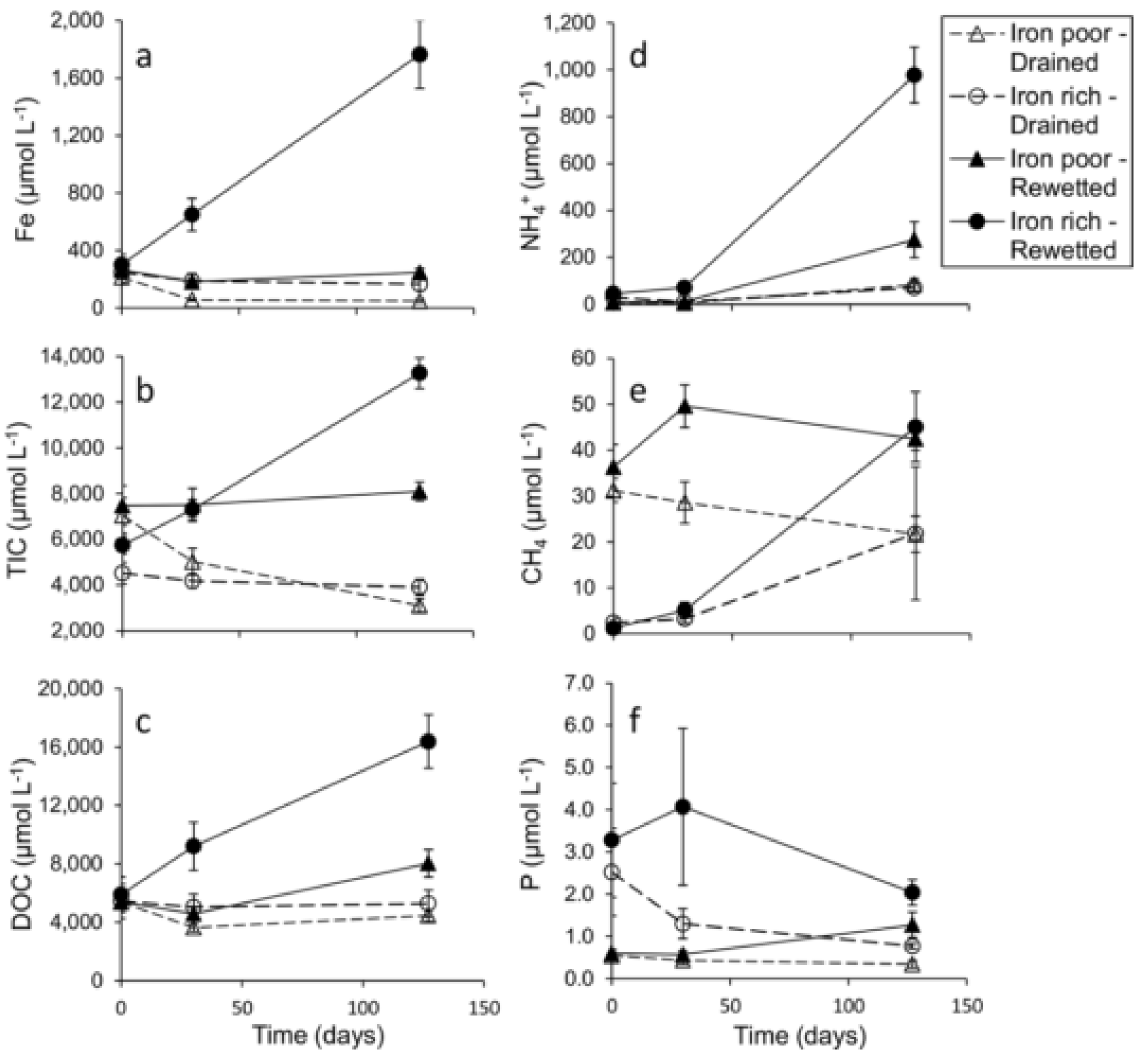






- Van Bodegom et al., Biogeochemistry 76, 69-83, 2005

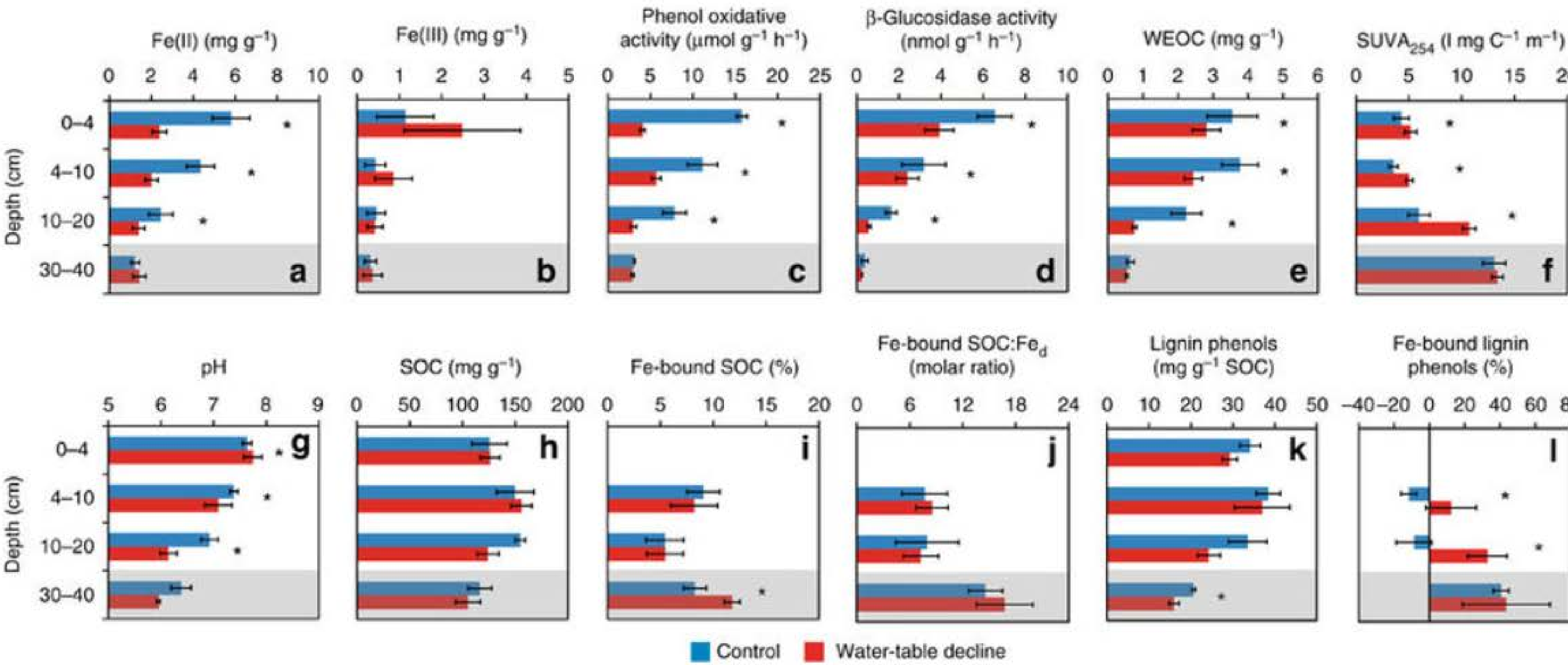
Fe stimulates C mobilization in rewetted fens



* Emsens et al., Plos One 11, DOI:10.1371/journal.pone.0153166, 2016

"Iron gate"— carbon preservation in organic-rich wetlands

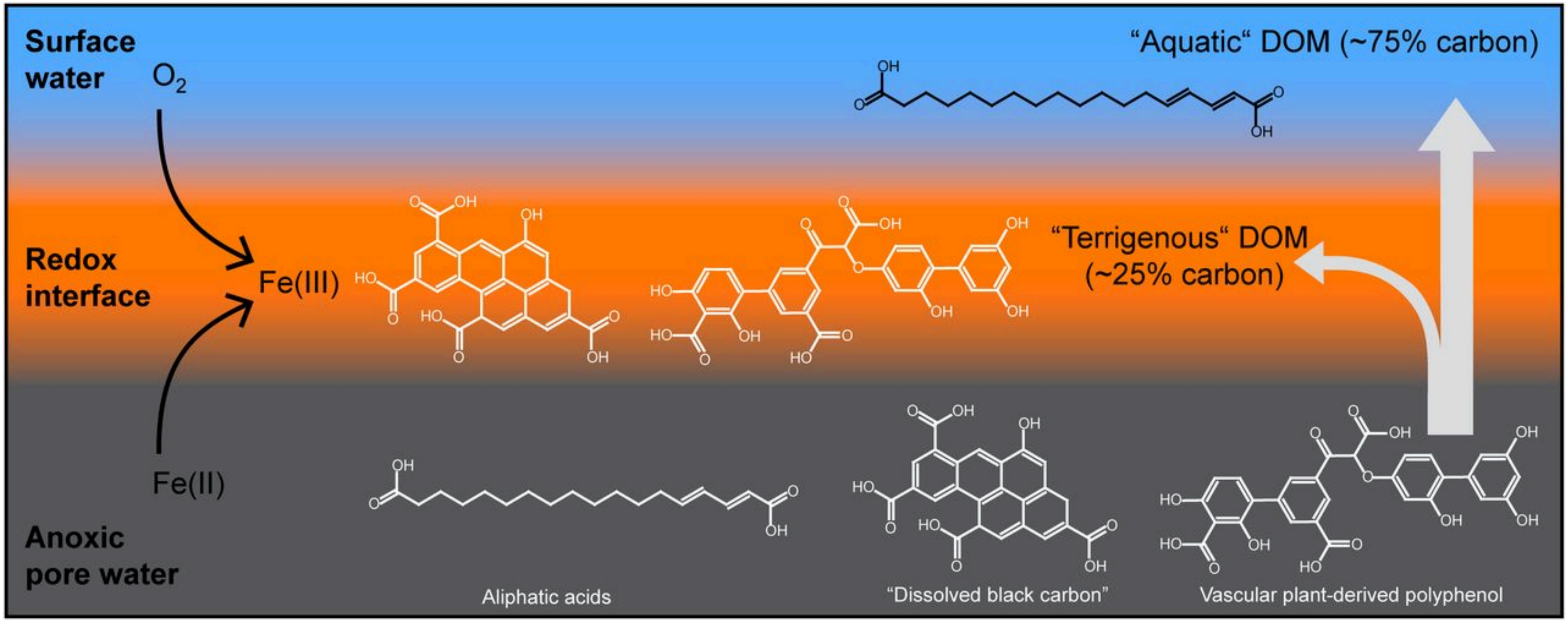
OC > 20%



"More important in mineral-rich and/or vascular plant-dominated wetlands"

* Wang et al. Nat. Commun. 8, DOI: 10.1038/ncomms15972 (2017)

Schematic diagram of the iron trap at redox interfaces depicting the export of anoxic peat pore water, oxidation of iron at the oxic surface, and coprecipitation of terrestrial DOM with Fe(III).



Thomas Riedel et al. PNAS 2013;110:25:10101-10105

Scientific questions

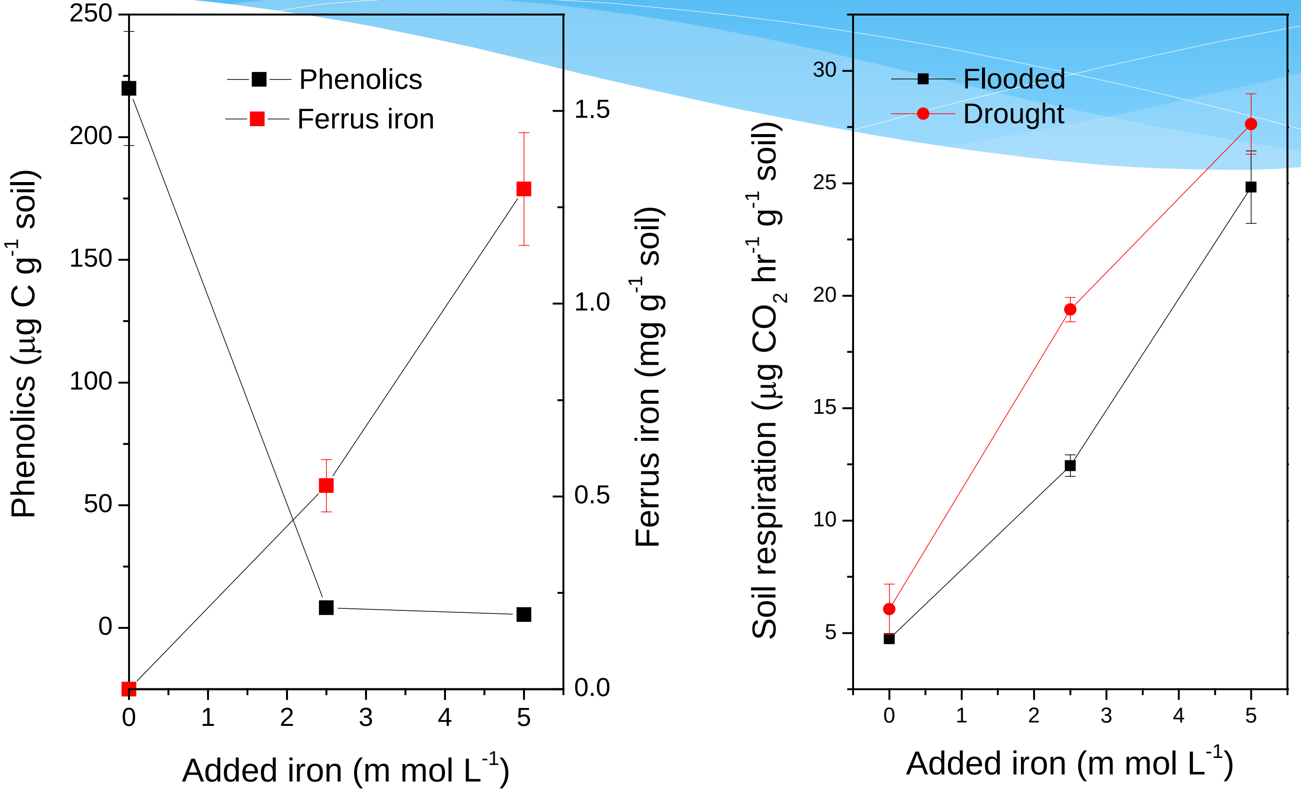
* Can iron protect carbon in organic-rich wetlands, peatlands in particular?
  * Does Fe oxidation promoted lignin derivatives sorption and decrease in phenol oxidase activity preserve carbon? A black-box experiment needed
* Does iron oxidation reduce phenolics and increase decomposition? (~100 times higher in phenolics)

Experimental test

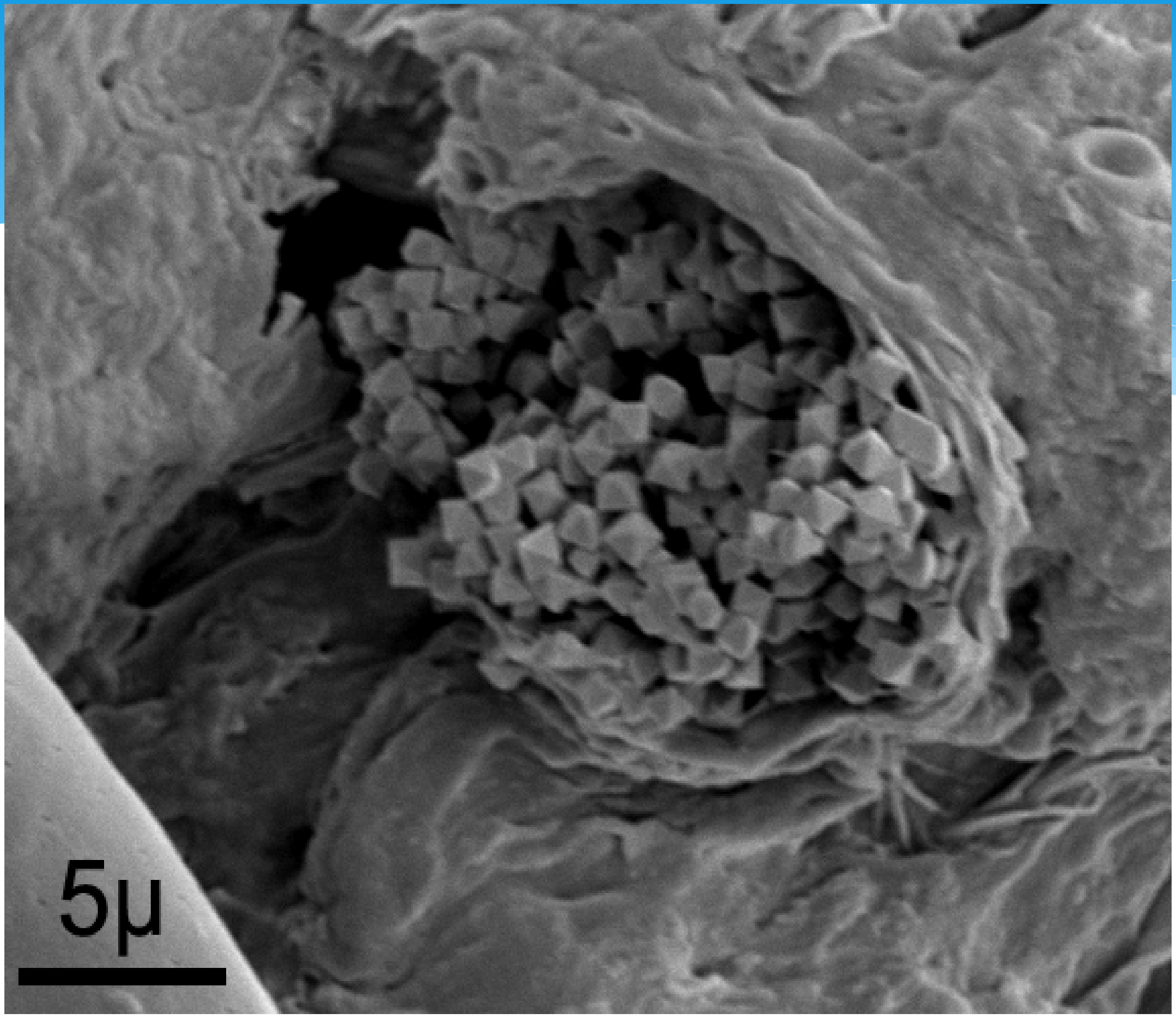
* (1) A ‘black-box’ experiment by adding $FeSO_4$or $K2SO_4$ as control (0, 2.5, and 5 mmol L-1 $FeSO_4$ or $K2SO_4$) to a high-lignin peatland soil to test how carbon decomposition responds to iron and iron oxidation,

* (2) A physical evidence test by running scanning electron microscopy (SEM) to check whether, similar to mineral sediment, iron film forms outside of carbon to protect carbon in peatlands.

An “iron key”

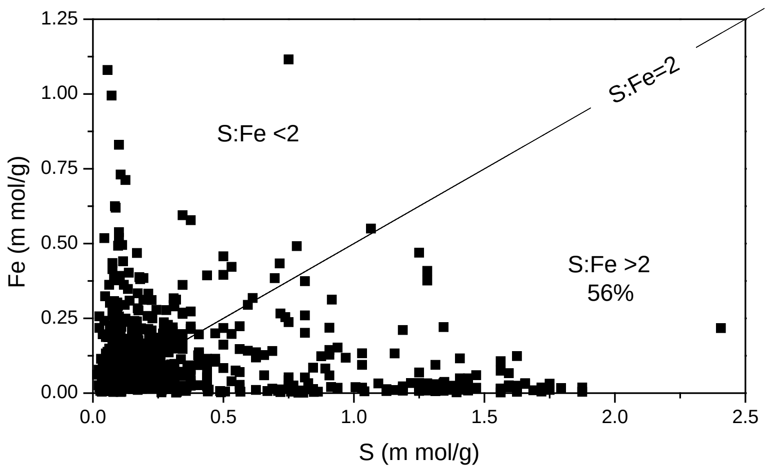


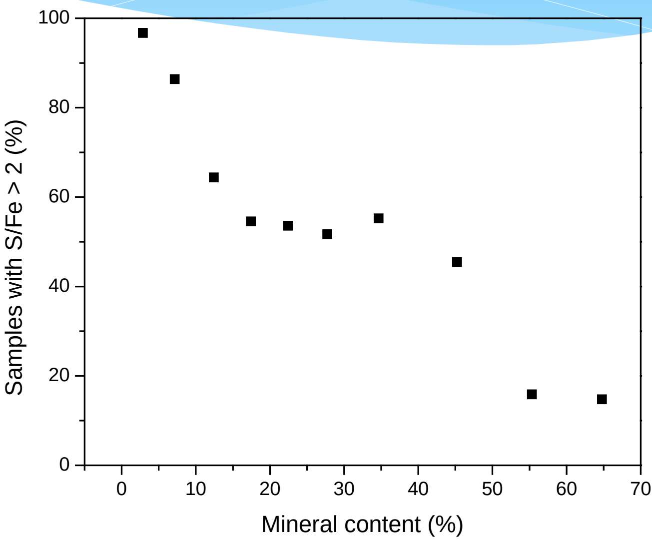
* No Fe^{2+} detected after drainage



Scanning Electron Microscope (SEM) image of framboidal pyrite (FeS_2) in a sawgrass-dominated peatland (bog) in the Florida Everglades.

Fe-Sulfur-Carbon



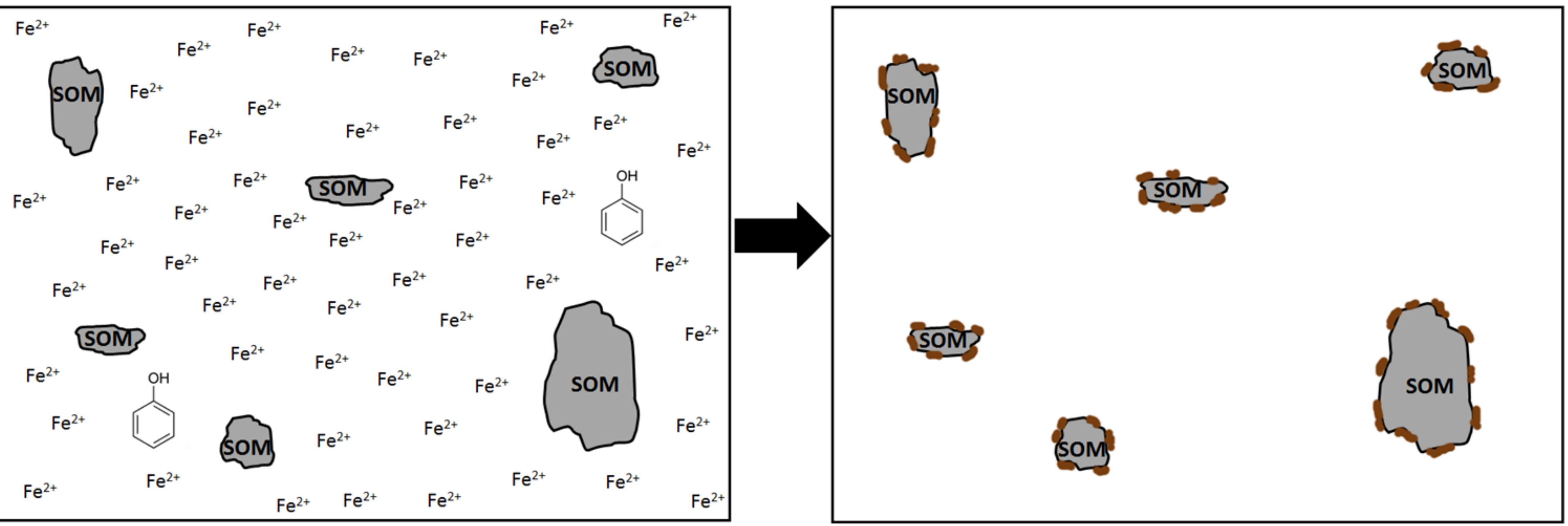


* Percentage of USGS peat samples in USA, grouped by percentage of mineral content, containing enough element sulfur to form pyrite (S/Fe>2).

Data from USGS, n=696

Summary

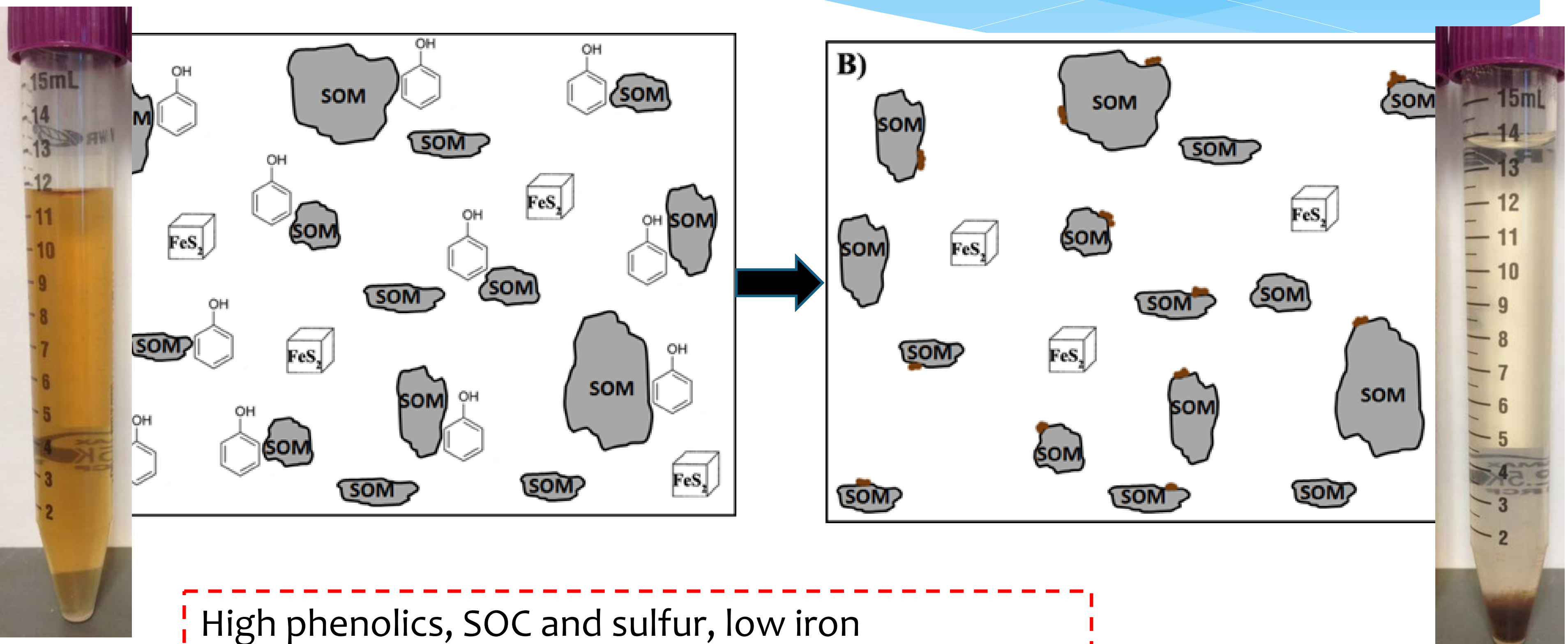
1) Rusty Sink in Mineral soil



Low phenolics, SOC and sulfur, high iron

Iron coating, chelation, co-precipitation

2) An ‘iron key’ not ‘iron gate’ in organic-rich soil



High phenolics, SOC and sulfur, low iron

Iron-phenolics co-precipitation—loss of microbial inhibitor
More carbon expose to microbes

Questions?