



# What Lies Beneath: Carbon in wetland and buried soils

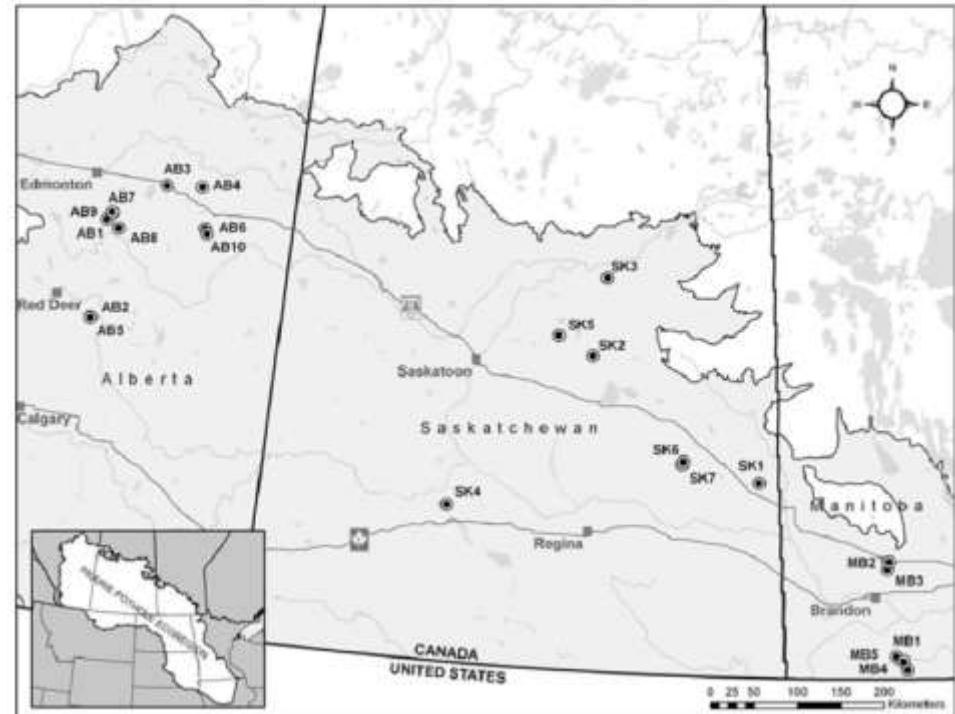
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# Introduction

- Prairie Pothole Region spans 800,000 km<sup>2</sup> and encompasses millions of freshwater mineral soil wetlands
- Landscape has been dramatically altered by agriculture:
  - Drainage
  - Tillage redistribution



Badiou et al. 2011. *Wetlands Ecol Manage* 19: 237-256

# C in wetland soils: why?

- In North America, freshwater mineral soil wetlands have been estimated to account for 40 Gt of C
- Despite the potential importance of wetland soils for accurate inventory of soil C stocks, they often fall between the cracks: too wet for soil scientists and too dry for wetland scientists
- Over the past decade, much more recognition of their significance, but still room for improvement!

# C in wetland soils: how?

- Touch on three studies:
  - Quantifying C in cultivated wetland soils of the Black soil zone with different drainage histories: never drained, recently drained ( $\leq 15$  yr), medium-term drained (15-35 yr), and long-term drained ( $\geq 35$  yr)
  - Quantifying C in wetland soils of the Dark Brown soil zone with different management histories: native (never-tilled), uncultivated (tilled in the past, but not currently), and cultivated (annual cropping)
  - Quantifying C in restored wetland soils across the Prairie provinces: recently ( $< 5$  yr) vs. long-term restored ( $\geq 5$  yr)

# C in wetland soils: cultivation

Wetland type	n	Soil organic carbon SOC <sub>eqm</sub> to 30 cm (Mg ha <sup>-1</sup> )
Cultivated	7	87.2 (21.7)
Uncultivated	7	168.6 (21.5)
Native	12	175.1 (52.8)

Uncultivated wetlands occupy only 11% of site area but contain 23% of SOC stores!

# C in wetland soils: restoration

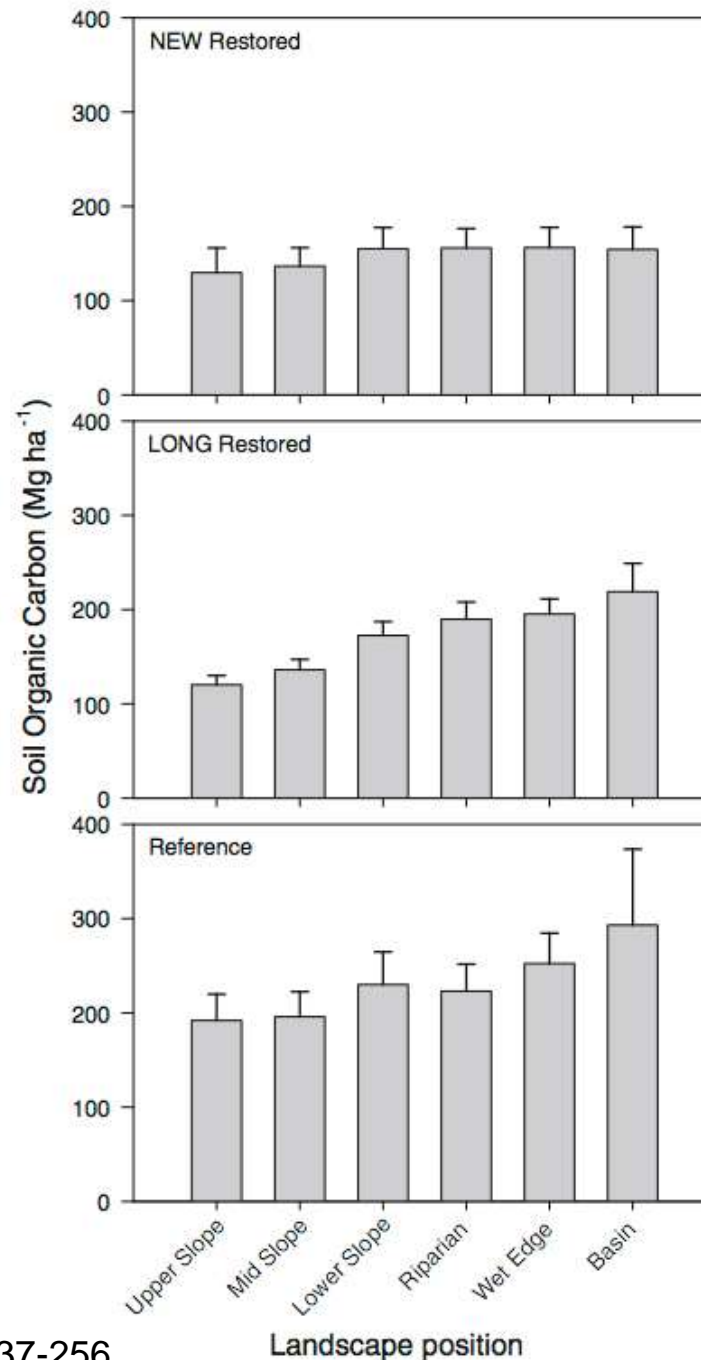
Estimated a mean annual  
sequestration rate for  
restored wetlands (33 y):

2.7 Mg C ha<sup>-1</sup> year<sup>-1</sup> *or*

9.9 Mg CO<sub>2</sub> eq. ha<sup>-1</sup> year<sup>-1</sup>

Even after accounting for  
increased CH<sub>4</sub>:

3.3 Mg CO<sub>2</sub> eq. ha<sup>-1</sup> year<sup>-1</sup>



# C in buried soils: why?

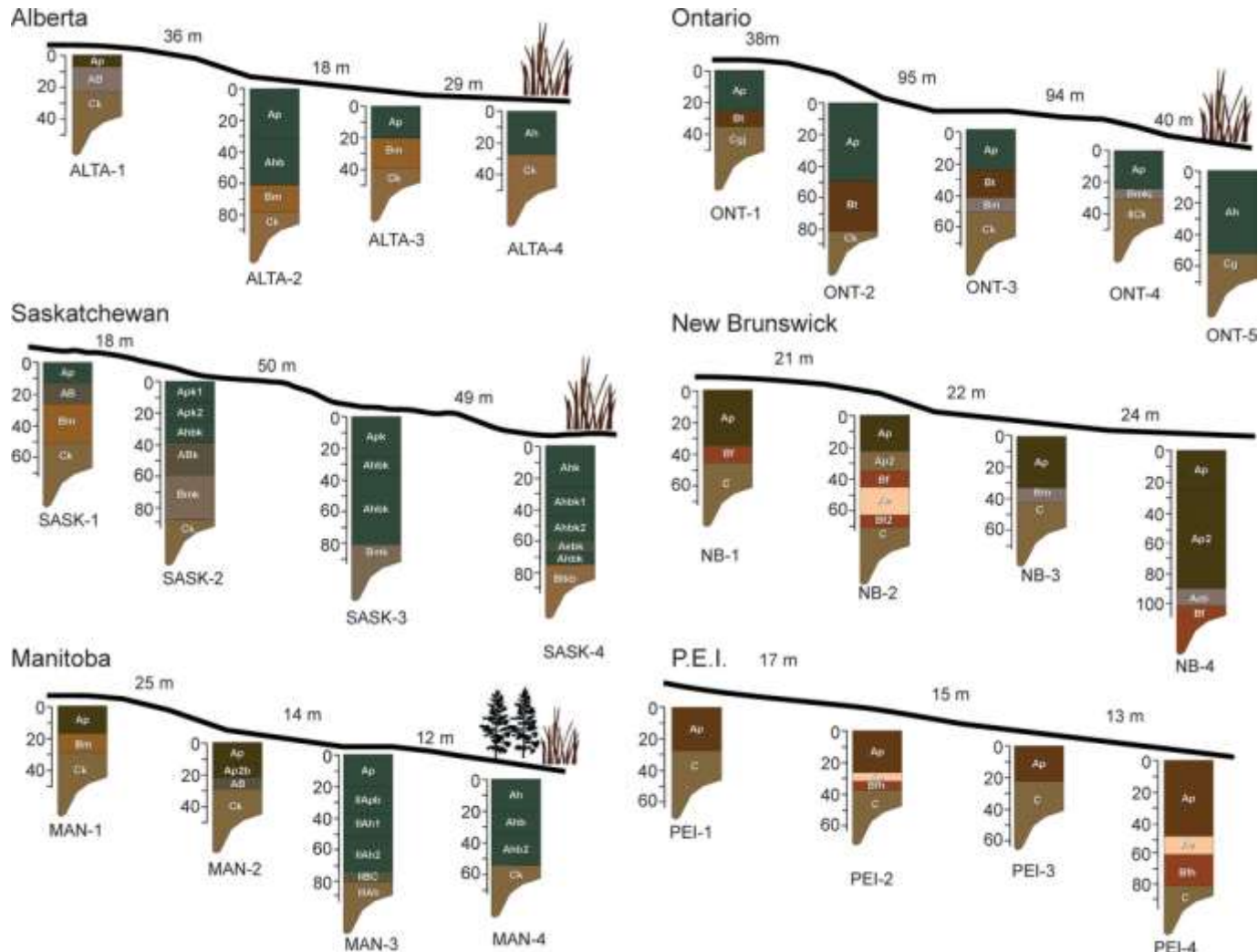
- Redistribution of soil across the landscape changes lateral and vertical distribution of SOC
- Where redistribution has resulted in inverted profiles, may underestimate SOC stocks
- Buried A horizons are potential C sinks
- Eroded knolls also potential sinks: dynamic replacement, especially when restored to grassland

# C in buried soils: how?

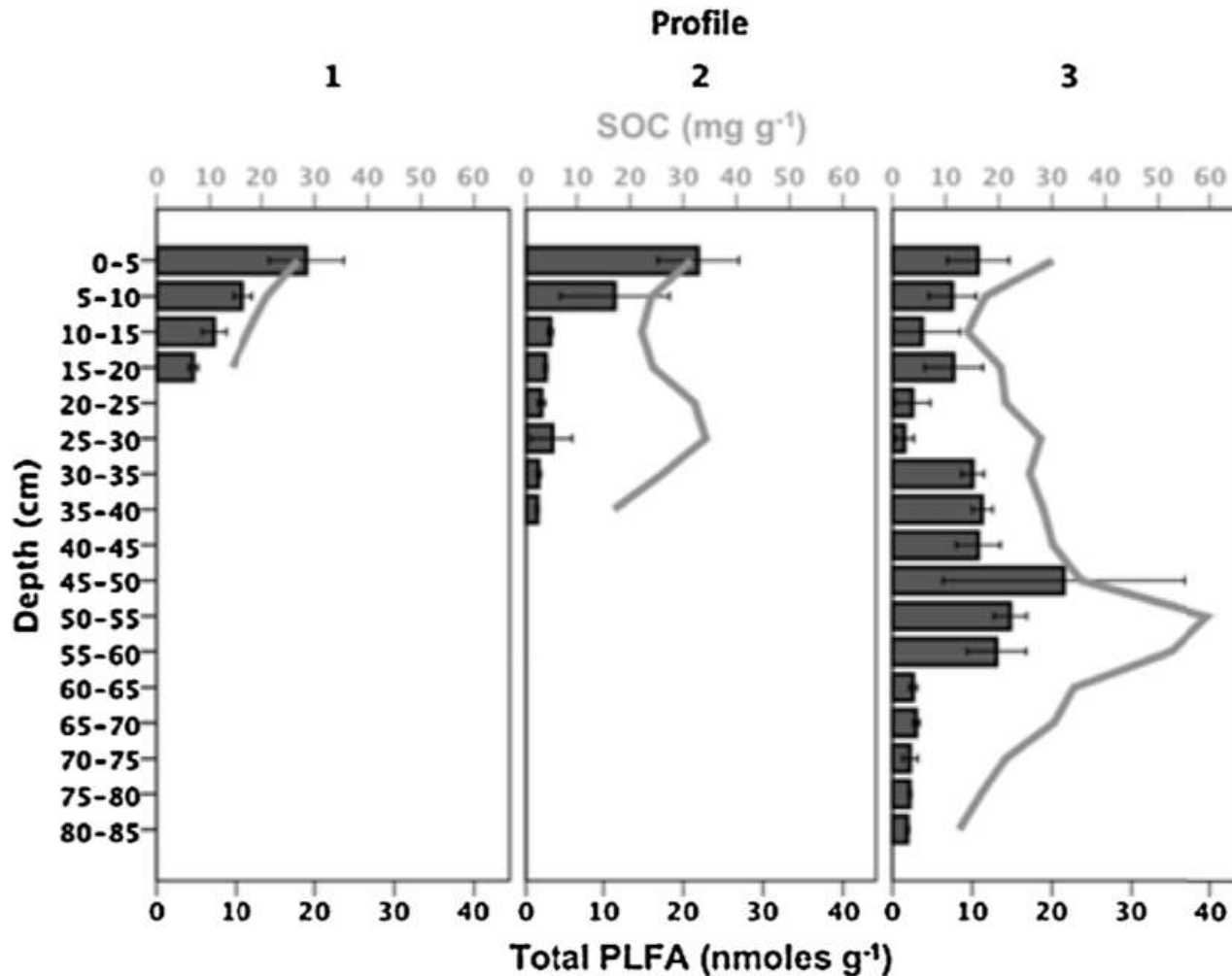
- VandenBygaart et al. examined SOC concentrations/stocks with depths at six sites across Canada
  - Also used  $^{137}\text{Cs}$  and A horizon thickness to evaluate amount and timescale of C redistribution over past 50 years
- Helgason et al. considered microbial activity in buried profiles at one of VandenBygaart's sites
  - Looked at microbial abundance and C mineralization
- Other studies have observed buried profiles with potentially much longer redistribution histories



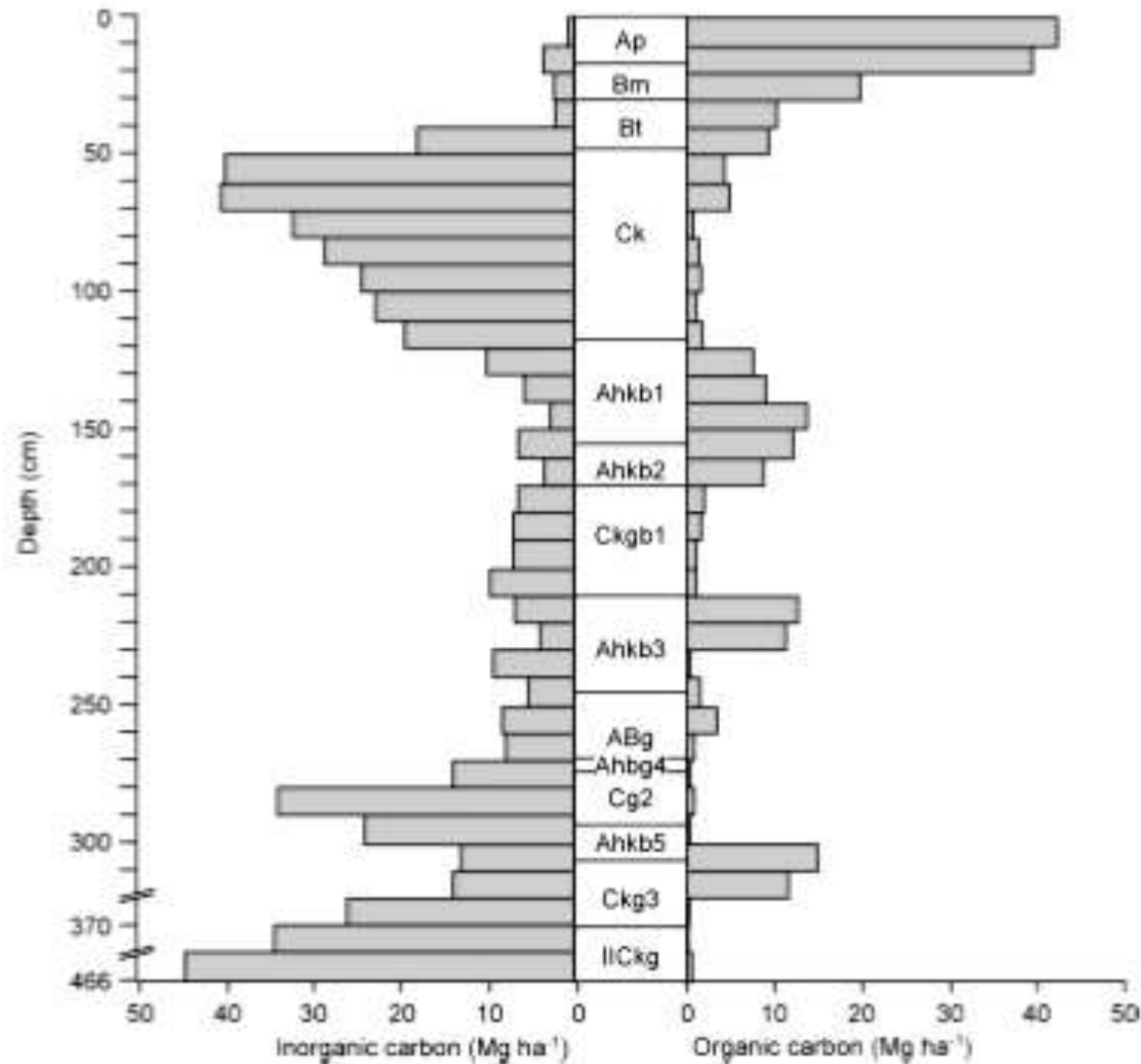
# C in buried soils: tillage redistribution



# C in buried soils: still living C



# C in buried soils: old C



# C in wetland and buried soils: implications

- Depressions, wetland soils, and concave backslopes hold relatively high proportion of grassland soil C – especially if we look beyond the surface!
- Given their potential to serve as sinks, wetland soils should be targeted for restoration to grassland
- Watch for unusually low surface C in depositional positions – may be sign of inverted profile
- When quantifying C in grassland environments, need to look deeper and maybe even get your feet wet!

# Acknowledgments

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