

Transport of CO₂ and Other Combustion Products in Soils during Slash-Pile Burns

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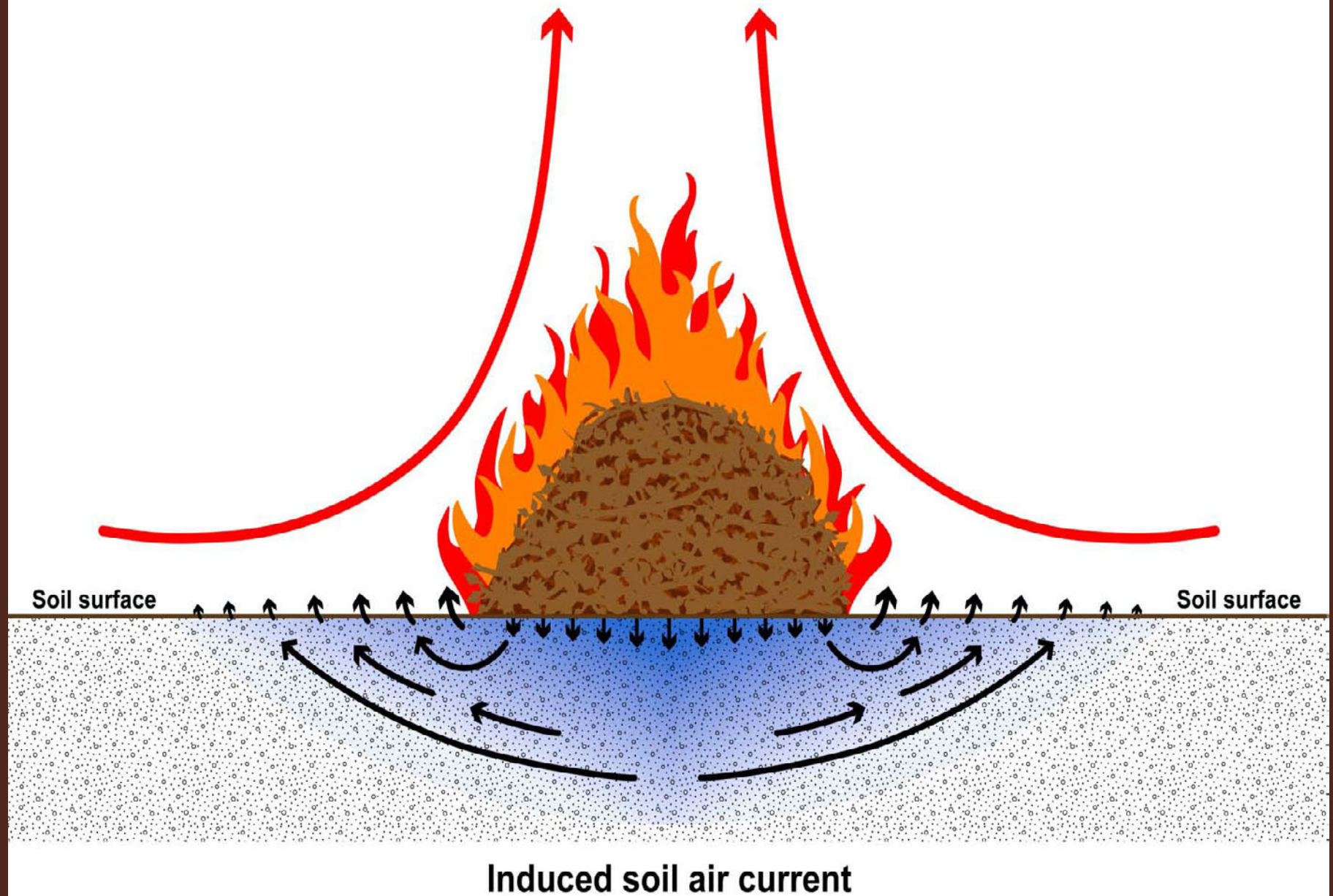
SJ Mooney, University of Nottingham

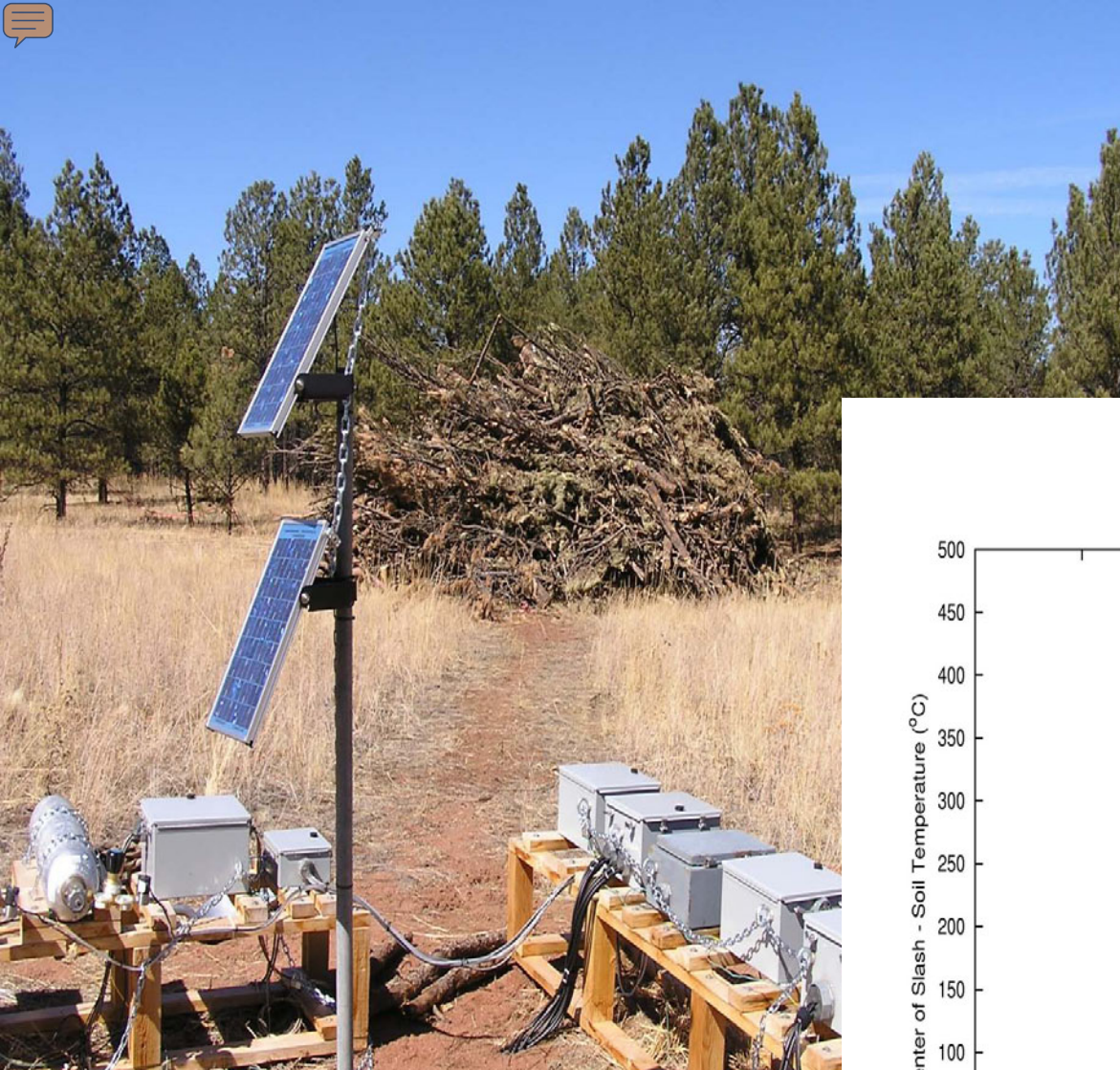
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The most obvious indication of transport of mass during a fire is flames and smoke. Furthermore it is well known that localized heating during the fire creates 3-D convective currents in the atmosphere and that these currents carry the combustion products away from the fire.

Convective currents

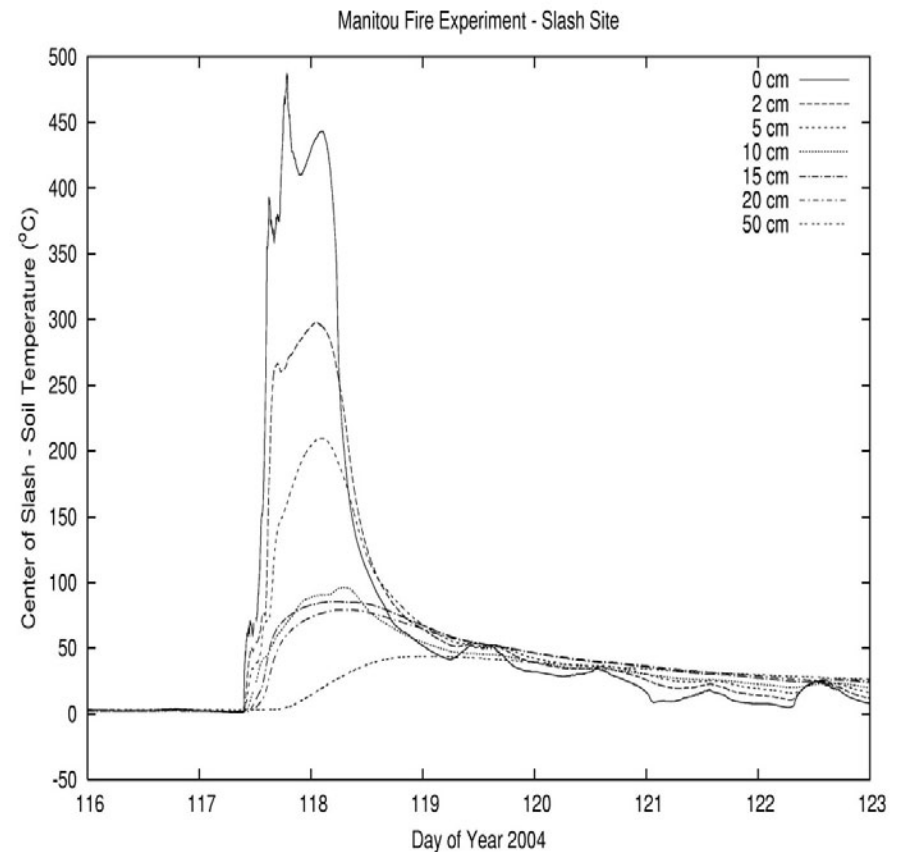




Fire initiated late morning on day 117 at Manitou Exp Forest

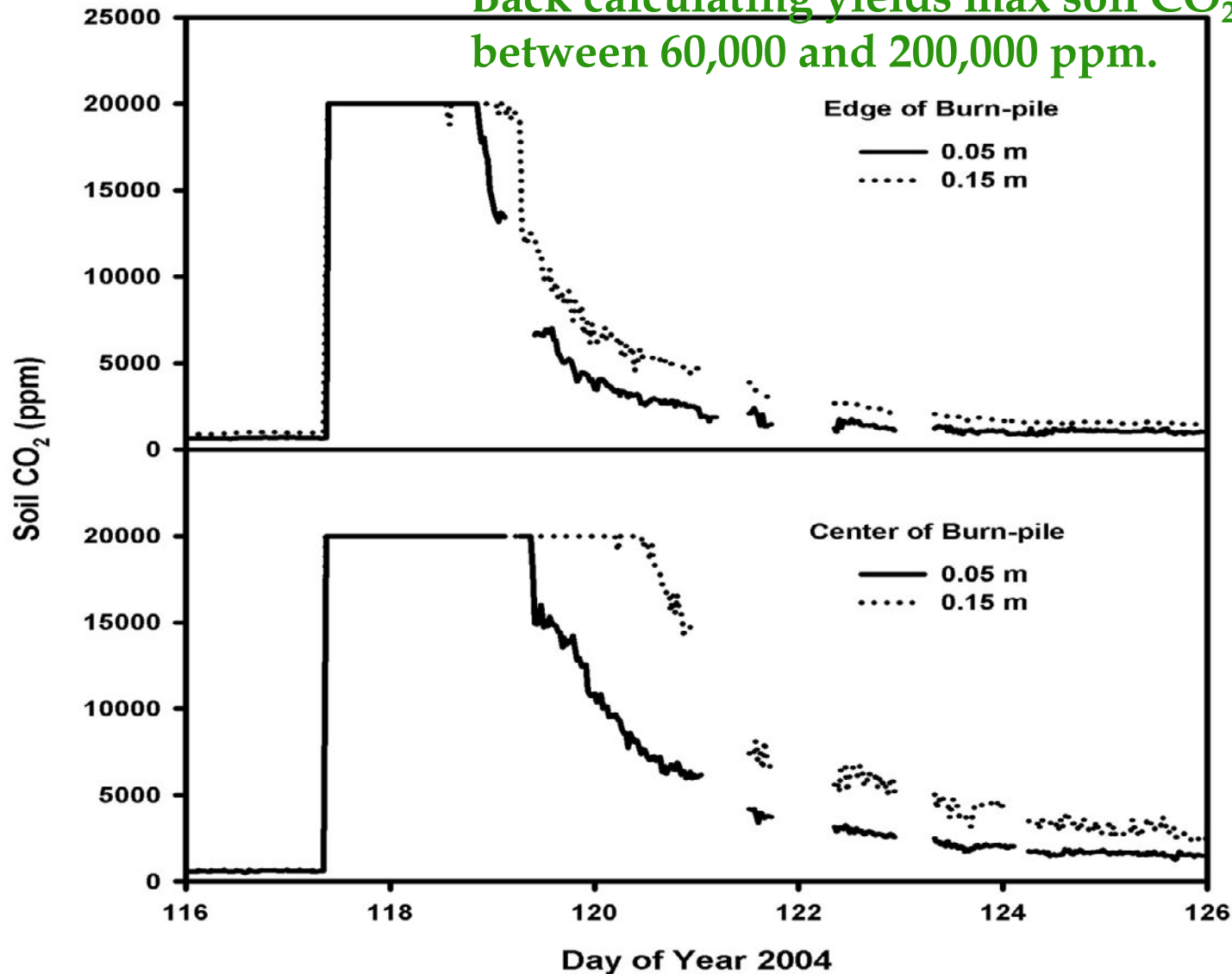
MEF Burn date April 2004

Massman et al (2008: IJWF)
Massman et al (2010: Fire Ecology)

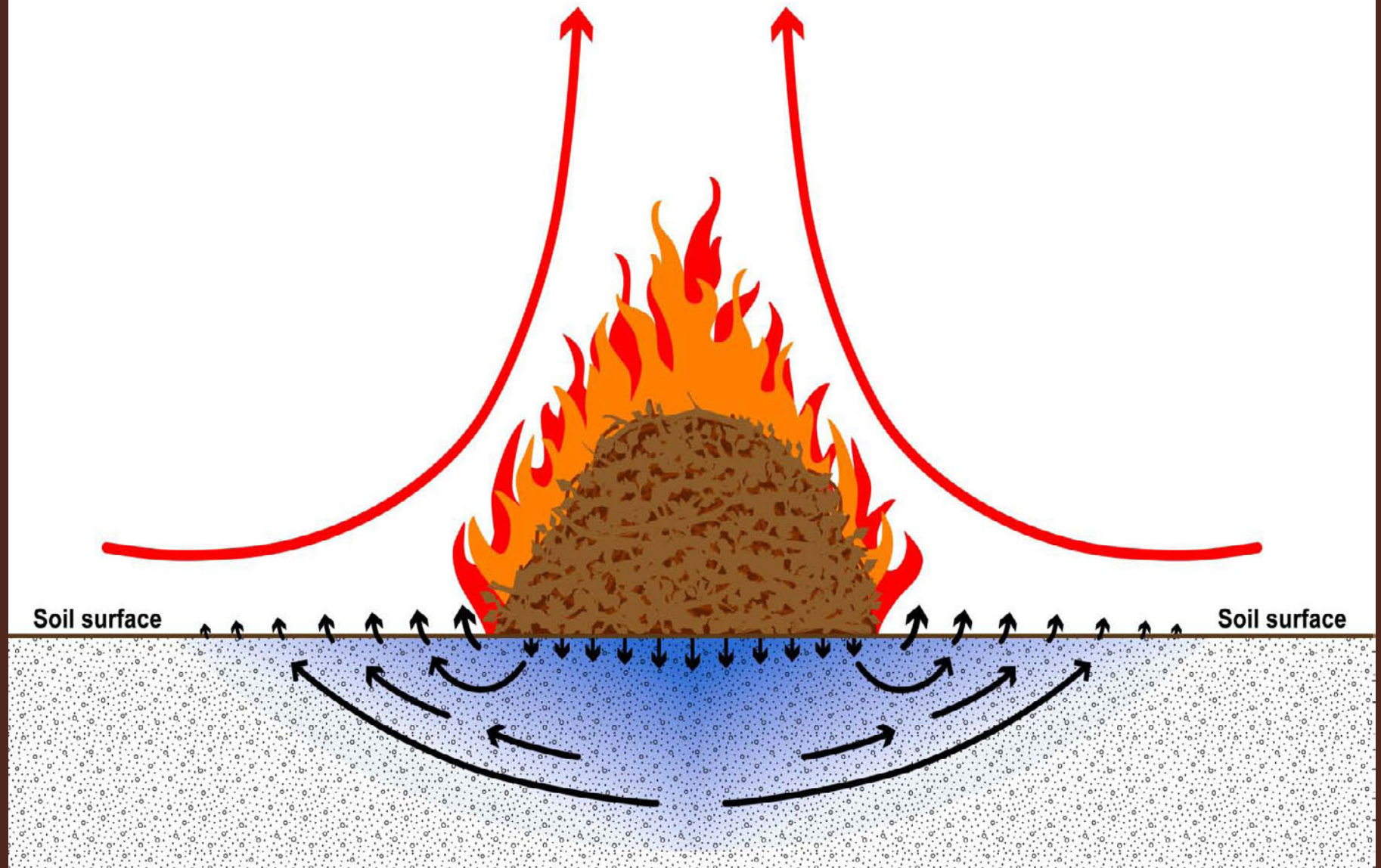


Time course of soil CO₂ before, during, and after the fire.

Back calculating yields max soil CO₂
between 60,000 and 200,000 ppm.

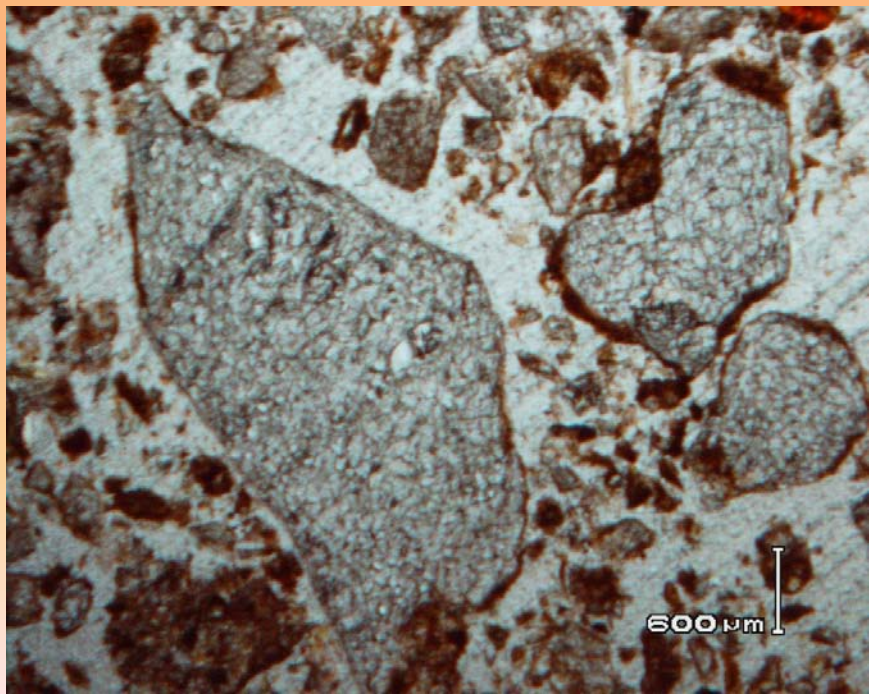
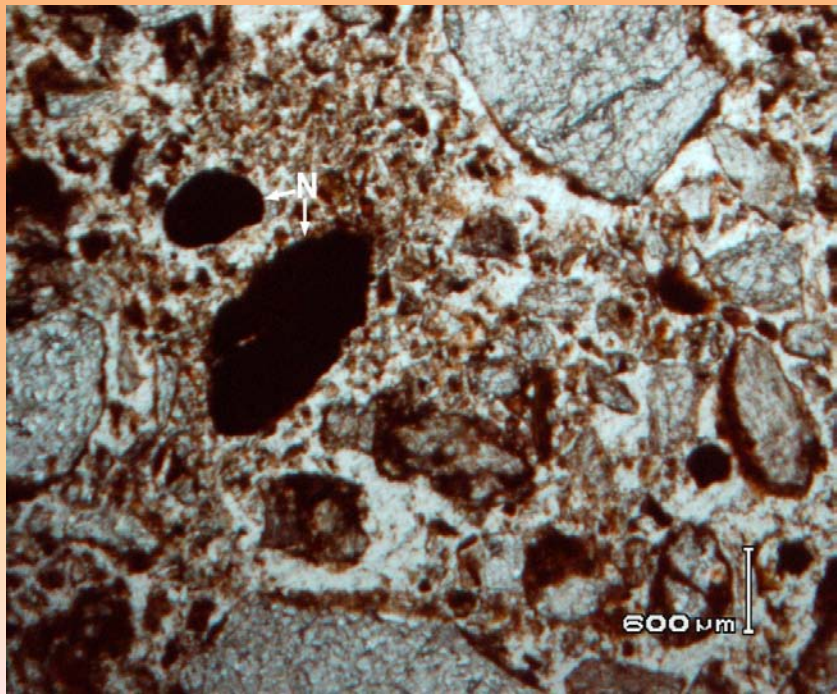
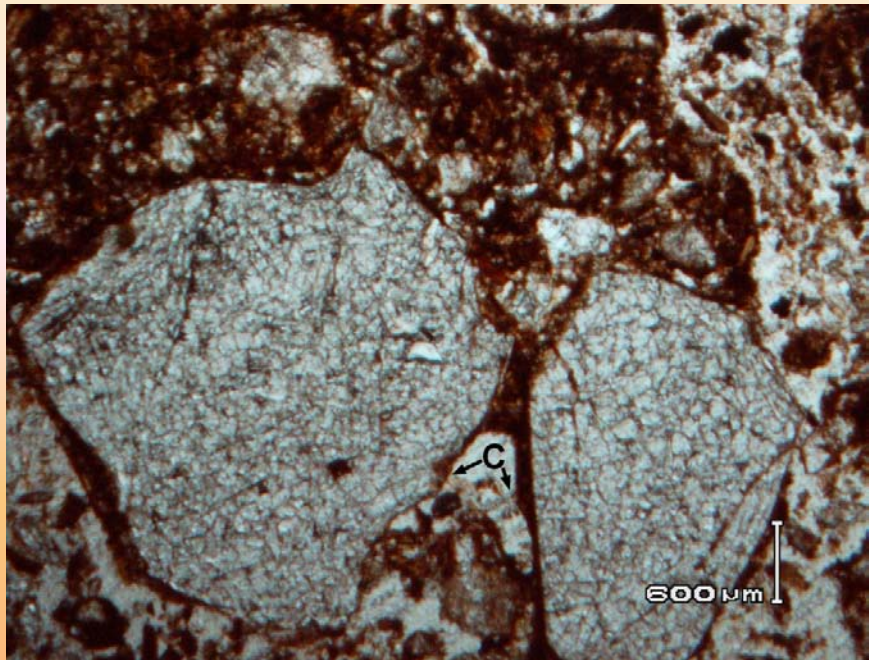
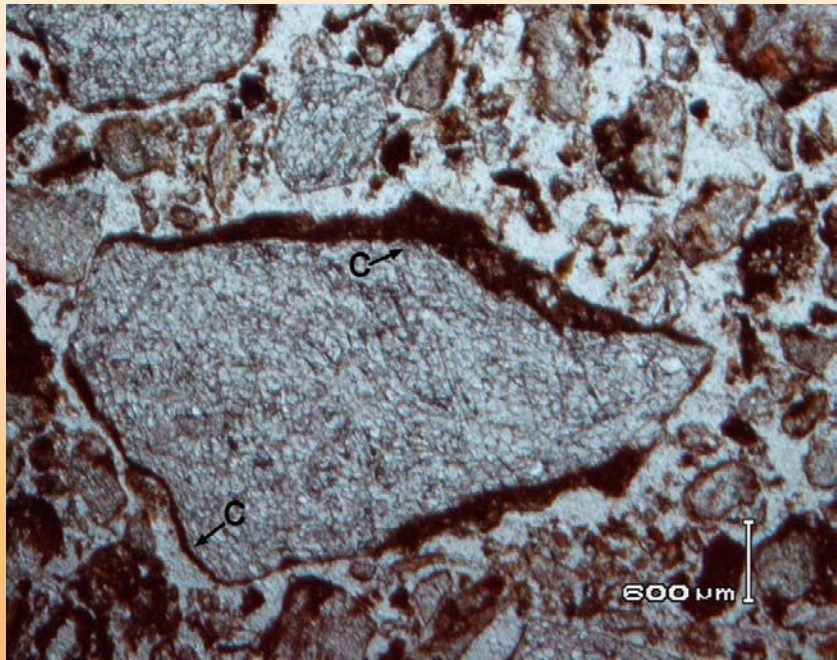


Convective currents

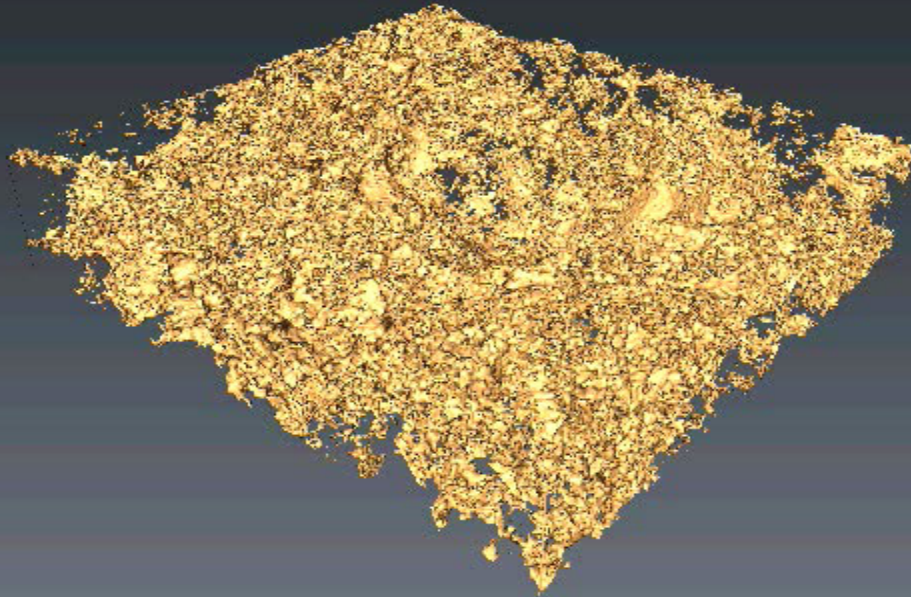


Induced soil air current

But there is no reason to assume that CO_2 is the only combustion product advected (pulled) into the soil by this induced current. In fact we should anticipate that all combustion products are “pulled into the soil”, including water vapor, volatilized organic compounds, CO, and all other oxidation products.



We hypothesize that (at least some) of these coatings and sintering materials are “mangans” or “ferri-mangans” and that they are formed during the burn after being advected into the soil by the induced soil air current and that they crystallize (or condense) onto the soil particles, where they can alter the pore structure and pore connectivity of the soil.

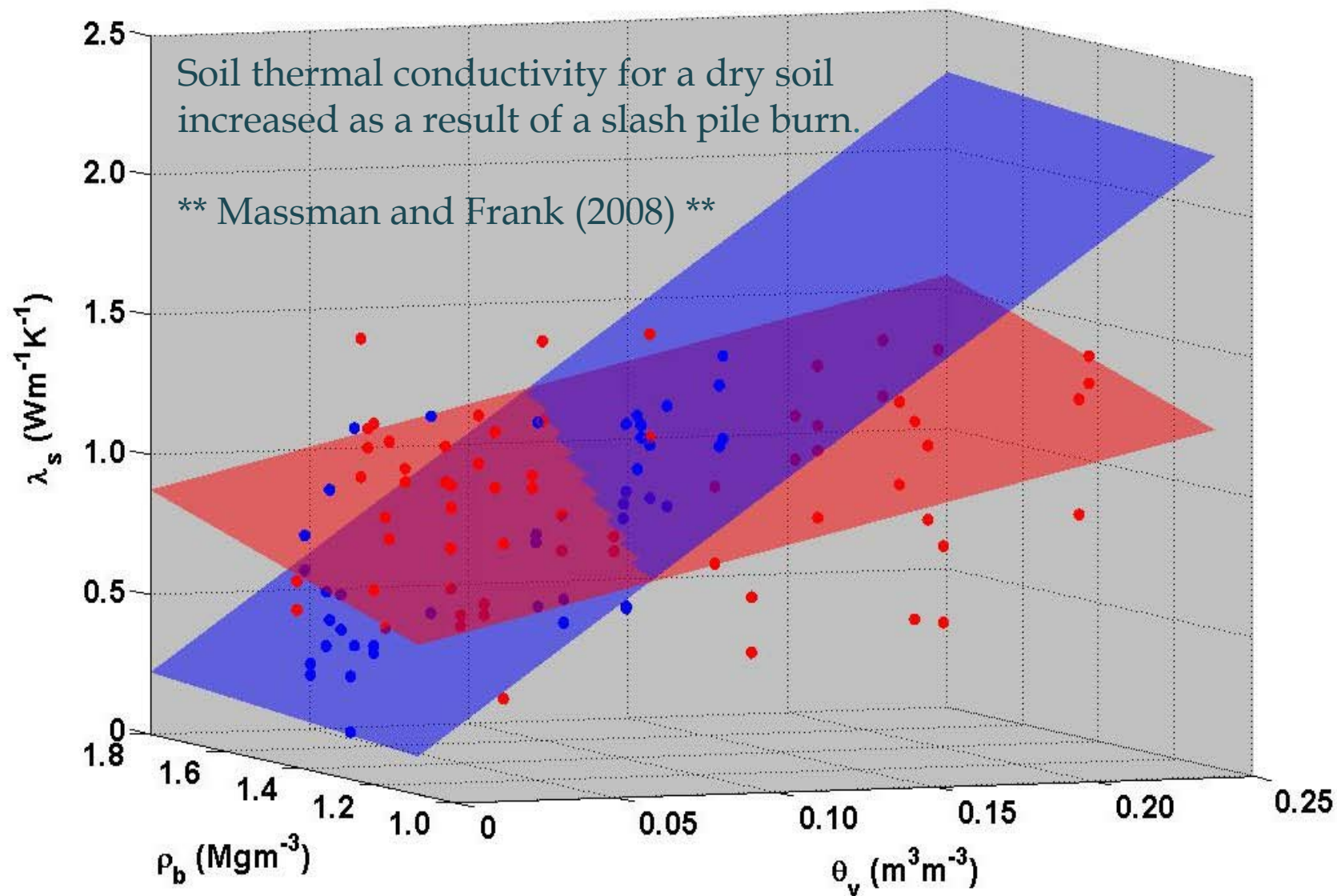


“Before”

Gold indicates
pore space

“After”





CONCLUSIONS

- (1) Slash pile burns induce advective flows in soils and transport (all) combustion products into the soil during slash pile burns.**
- (1') This may occur during (larger) wildfires as well.**
- (2) Long-term changes in soil pore structure, pore connectivity, thermal conductivity, and other soil physical properties could occur during the fire as a result of even small amounts of the combustion products (mass) imported into the soil in advance of significant soil heating.**