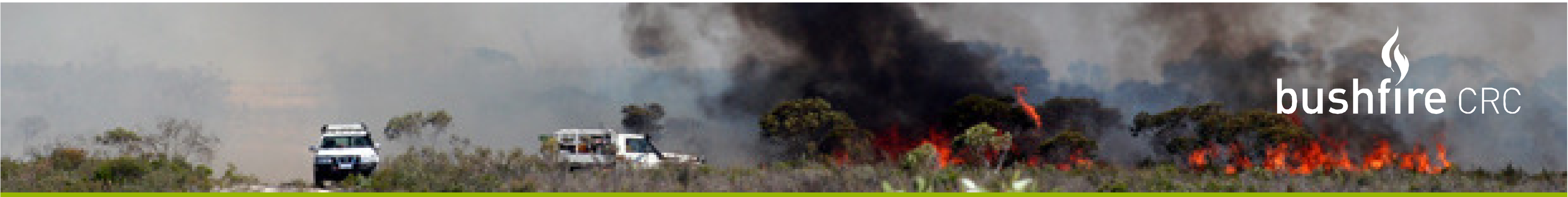

PROGRAM B B6 The Highfire Project: High country fuels and ecosystem functions

Untangling the effects of soil properties on methane oxidation

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1. Fire rapidly changes soil properties

Although the effects of fire on soil properties is well known, less is understood about the effects of these changed soil properties on soil processes. One such important process is methane (CH_4) oxidation, particularly with aerobic forest soils being important sinks of atmospheric CH_4. Before understanding the effects of fire on CH_4 oxidation, a better understanding of the effects of individual soil properties on CH_4 oxidation is needed.

Methods

Soils cores were incubated in specially modified fowlers jars. Changes in headspace CH_4 was measured using a gas chromatograph.

Sites

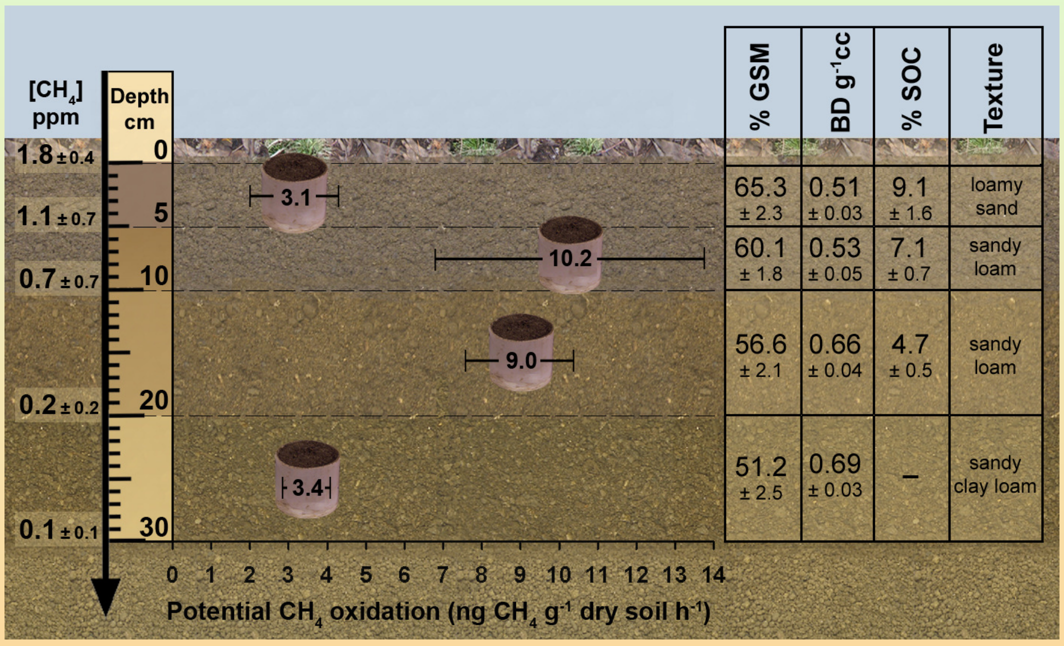
Soil was collected from Alpine ash (*Eucalyptus delegatensis*) forest, Bogong High Plains, Victoria. Wildfires in 2003 and 2006 caused crown death of dominant trees in some areas and removal of the understorey vegetation in others.

2. Potential methane oxidation varies in the soil profile

Differences in CH_4 oxidation rates within the soil profile could not be explained purely by the differences in individual soil properties (Figure 1).

Differences in net CH_4 oxidation rates may be explained by:

- differences in methanotroph composition and abundance,
- limitation of methanotroph growth and activity by low CH_4 concentration,
- differences in soil properties with depth (i.e. inhibition by inorganic N),
- competition for resources with other soil bacteria.



% GSM	BD g⁻¹cc	% SOC	Texture
65.3 ± 2.3	0.51 ± 0.03	9.1 ± 1.6	loamy sand
60.1 ± 1.8	0.53 ± 0.05	7.1 ± 0.7	sandy loam
56.6 ± 2.1	0.66 ± 0.04	4.7 ± 0.5	sandy loam
51.2 ± 2.5	0.69 ± 0.03	–	sandy clay loam

Figure 1: Potential methane oxidation from soils collected at different depths, determined from laboratory incubations of 2 mm sieved soils packed to the same bulk density (BD). The table shows field BD. Values are means ± se, n = 10 (except n = 5 for %SOC). %SOC = soil organic carbon (Walkley Black). GSM = gravimetric soil moisture (% by weight of water to dry soil).

3. Soil surface area and bulk density affects CH_4 oxidation

Intact soil cores of 0-10 cm showed less CH_4 oxidation than the sum of cores from 0-5 and 5-10 cm (Figure 2), suggesting that increased surface area to volume ratio allows more CH_4 to diffuse into the soil.

Although intact soil better represents field conditions, sieved soil can be more accurately manipulated. No significant difference was detected between CH_4 oxidation of intact and sieved soil from the same depth (Figure 2) suggesting that sieved soil can be used in laboratory incubations to determine factors controlling oxidation.

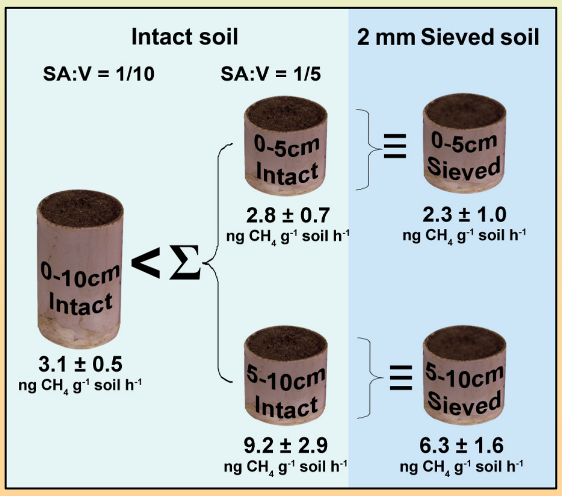


Figure 2: Differences in methane oxidation between intact soil (of different SA:V) and sieved soil. Values are means ± se, n = 10. SA:V = surface area to volume ratio. Intact soil was collected from the field with minimal disturbance. Gravimetric soil moisture differences were within 8%.

4. Effects of soil moisture on methane oxidation

Soil samples adjusted to 30 and 45% WHC showed the greatest CH_4 oxidation suggesting this is the optimal range for both methanotroph activity and CH_4 diffusion (Figure 3). Oxidation was reduced by moisture-limited methanotroph activity or water-limited diffusion of CH_4.

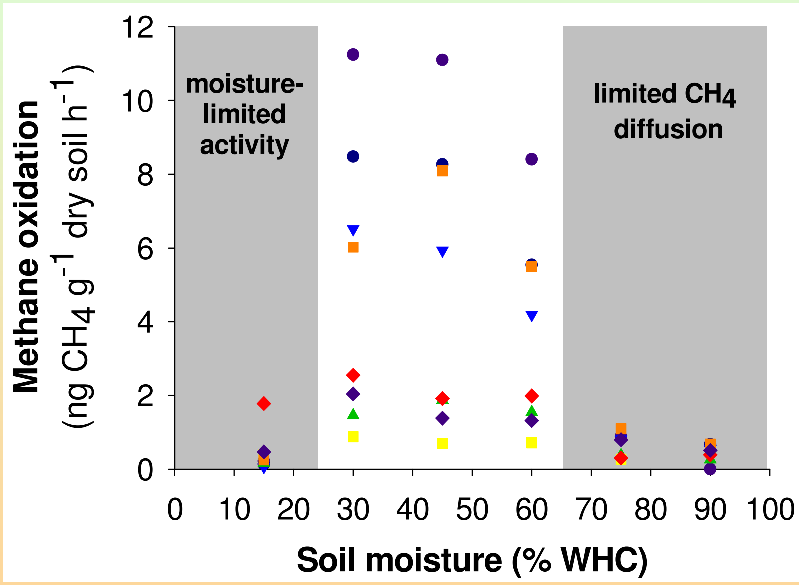


Figure 3: Variation in methane oxidation with soil moisture (soil adjusted to % of water holding capacity; WHC). Each point is the mean of three replicates of the same soil sample.

5. Conclusions and future work

Methane oxidation rates are controlled by methanotroph composition, abundance and activity, which are influenced by soil properties.

Further research is needed to build a model to predict the effects of fire and climate change on CH_4 oxidation rates. This project aims to explore CH_4 oxidation kinetics, temperature and inorganic nitrogen effects, field CH_4 rates (e.g. manipulation of field soil properties) and the composition of the methanotroph populations (using molecular studies, T-RFLP).

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