

Aerobic methane emission from grey poplar (*Populus x canescens*)

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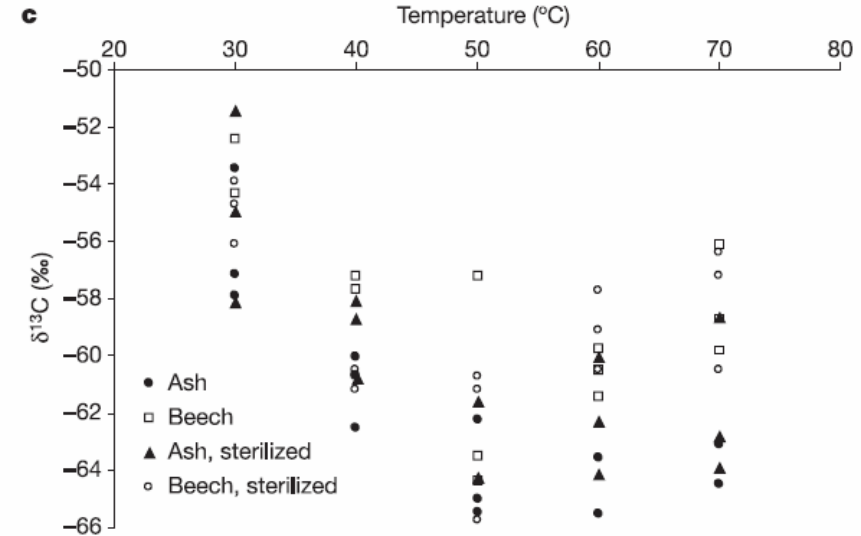
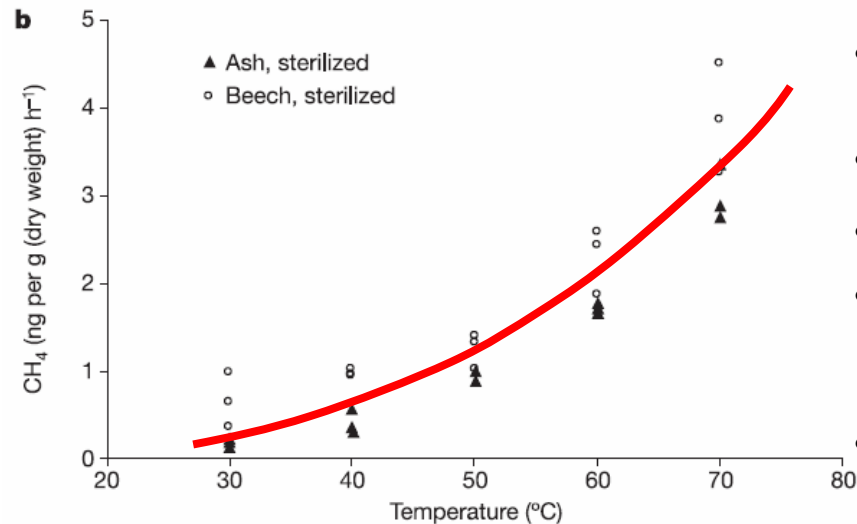
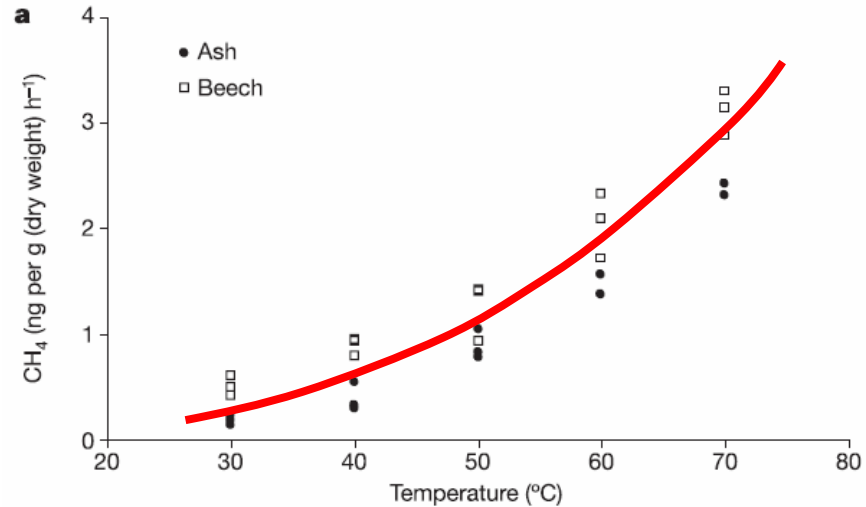
Carbon isotope anomaly in the major plant C₁ pool and its global biogeochemical implications

F. Keppler^{1,2}, R. M. Kalin², D. B. Harper¹, W. C. McRoberts^{1,3}, and J. T. G. Hamilton^{1,3}

Plant common name (<i>species</i>)	Chloromethane (CM) ($\delta^{13}\text{C}$)	Biomass (B) ($\delta^{13}\text{C}$)	Pectin methoxyl (PM) ($\delta^{13}\text{C}$)
C₃-leaf²			
European ash (<i>Fraxinus excelsior</i>)		-27.9±0.2	-73.7±1.0
40°C	-147.0		
50°C	-142.6		
60°C	-129.0		
Wych elm (<i>Ulmus glabra</i>)		-30.8±0.1	-69.2±0.3
40°C	-138.9		
50°C	-130.4		
60°C	-126.9		
Cocksfoot (<i>Dactylis glomerata</i>)		-29.3±0.2	-50.7±0.2
40°C	-119.2		
50°C	-113.5		
60°C	-110.3		

Methane emissions from terrestrial plants under aerobic conditions

Frank Keppler¹, John T. G. Hamilton², Marc Braß^{1,3} & Thomas Röckmann^{1,3}



- CH₄ emission from intact plant material 1–2 orders of magnitude higher than from detached plant material
- CH₄ emission in sun light 3–5 times higher than in dark
- CH₄ unusually depleted in ¹³C
- CH₄ source strength of 62–236 Tg yr⁻¹ for living plants and 1–7 Tg yr⁻¹ for plant litter, i.e. 10–30% of the global annual CH₄ emissions
- However, most measurements performed in CH₄-free air

Reactions of the international research community

www.publish.csiro.au/journals/fpb

Functional Plant Biology, 2006, 33, 613–615

Rapid communication:

**A comment on scaling methane emissions from vegetation
and grazing ruminants in New Zealand**

www.publish.csiro.au/journals/fpb

Functional Plant Biology, 2006, 33, 521–530

Rapid communication:

A comment on *Rapid report*

Miko U
Graham

No evidence for substantial aerobic
methane emission by terrestrial plants:
a ^{13}C -labelling approach

New Phytologist (2007) 175: 29–35

as a
comment,
and

Global Change Biology (2008) 14, 1821–1826, doi: 10.1111/j.1365-2486.2008.01607.x

Missing methane emissions from leaves of terrestrial plants

DAVID J. BEERLING*, TOM GARDINER†, GRAHAM LEGGETT‡, ANDY MCLEOD‡ and
W. PAUL QUICK*

Methodology of follow-up experiments

Dueck et al. (2007)

- basil, sage, wheat, maize grown under $^{13}\text{CO}_2$ atmosphere from seeds
- potential $^{13}\text{CH}_4$ emission measured with photoacoustic instrument
- observed no significant methane emission

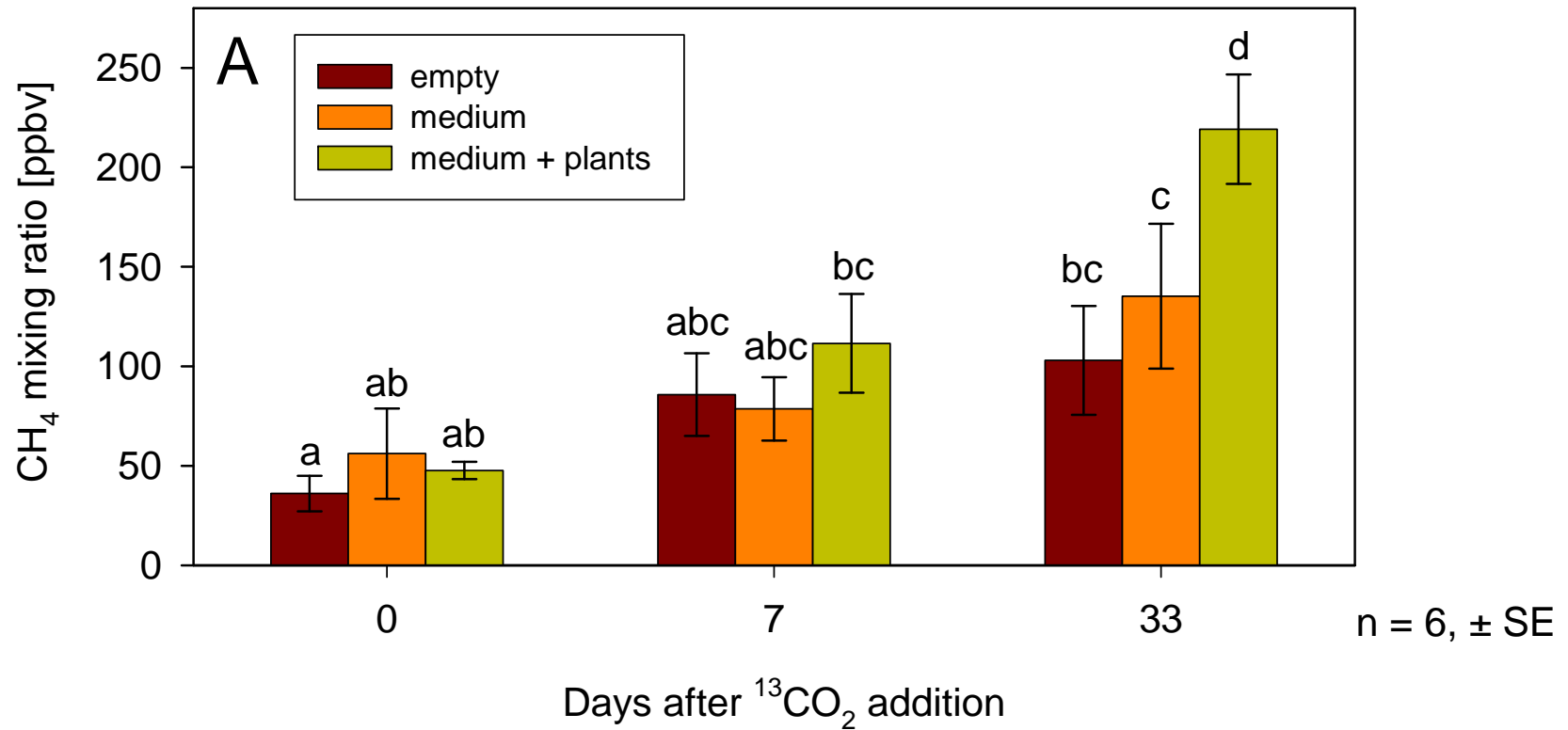
Beerling et al. (2008)

- maize and tobacco, grown under normal CO_2 in a greenhouse
- potential $^{13}\text{CH}_4$ emission measured with FID and leaf cuvettes
- observed no significant methane emission

Our experimental design

- Plant species: grey poplar (*Populus x canescens*, syn. *Populus tremula x P. alba*), derived from cell cultures under sterile conditions
- Plants on sterile medium in gas-tight flasks in CH₄-free air
- Headspace was exchanged with synthetic air containing 20% of oxygen and 385 ppm ¹³CO₂ (99 at% ¹³C)
- Flasks were kept in glove box filled with pure N₂ for 33 days under a 16/8 h light/dark regime

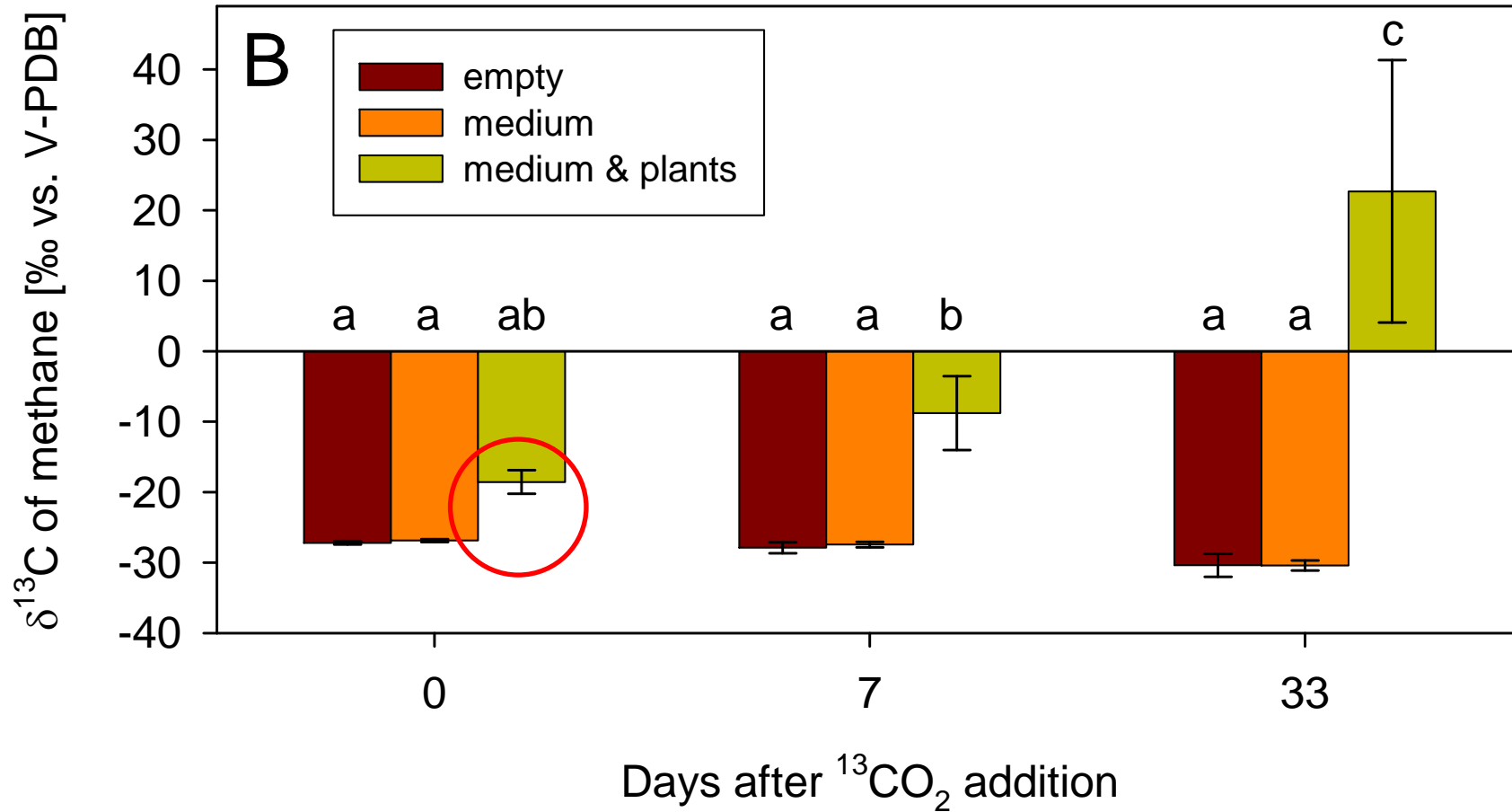
CH₄ formation



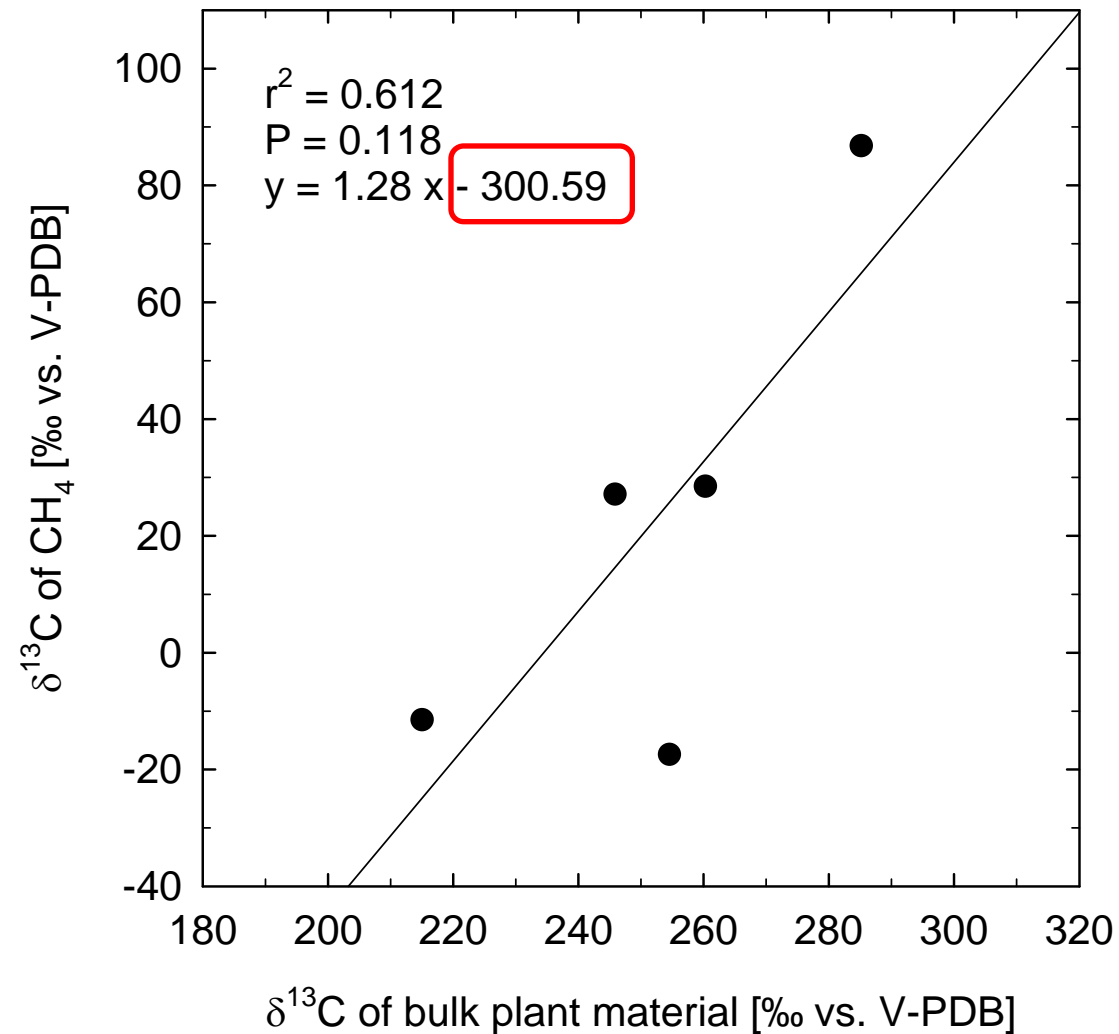
CH₄ release rate from plants (mean, ± SE)

0-7 days: 0.55±0.39 ng g⁻¹ dw h⁻¹
7-33 days: 0.21±0.11 ng g⁻¹ dw h⁻¹
0-33 days: 0.25±0.07 ng g⁻¹ dw h⁻¹

$\delta^{13}\text{C}$ of CH_4



Relationship between $\delta^{13}\text{C-CH}_4$ and $\delta^{13}\text{C}$ of bulk plant material



Summary

- Keppler et al. (2006) reported on substantial aerobic CH₄ emission from plants and calculated a contribution of 10-30% of this new source to the global methane budget
- So far, other research groups failed to detect aerobic methane emission from plants significantly different from zero
- We have observed CH₄ release from poplar significantly different from zero and isotopically labelled
- However, the observed emission was 3 orders of magnitude lower as reported by Keppler et al. (2006)
- Possible other reasons for high atmospheric methane concentrations in the tropics: anaerobic methane formation in the soil, transport of CH₄ via the transpiration stream and release through the leaves