Ancient yet tasty – ^{14}C-free sedimentary organic matter is a significant substrate for microorganisms

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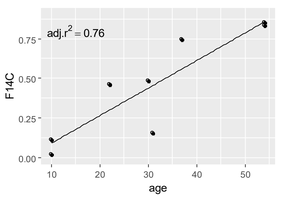
1. Introduction

Fossil organic matter (OM) is surprisingly often present in modern environments, either being excavated by anthropogenic activities like construction and mining, or introduced by weathering of sedimentary rocks and erosion.



Overburden remaining after coal mining contains ^{14}C-free aliphatic kerogen and aromatic coal at a post-mining area in the western part of the Czech Republic. During ecosystem restoration of spoil heaps, plant derived soil organic matter increases with time since heaping and thus the proportion of fossil OM decreases.

RECLAMATION



SUCCESSION

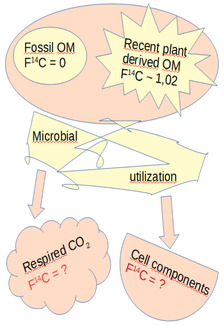
time

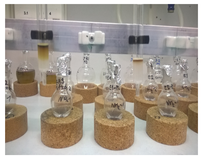
2. Hypothesis

Soil microorganisms utilize fossil OM and they do so more at less developed sites where recent plant derived OM is present in lower amounts than the fossil OM.

3. Methods

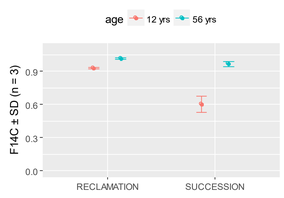
We sampled topsoils (0–10 cm) from three 1 m^2 plots at two 12-year and two 56-year-old sites. We sieved the soil, adjusted WHC to 60 % and carried out incubations. Then, we measured ^{14}C content of respired CO_2. We also extracted PLFA for a more direct measure of ^{14}C content in microbial cells. In addition, several samples of vegetation of different functional types (n= 23) were sampled and its ^{14}C content determined to give a ^{14}C measure of contemporary plant inputs. Fossil C uptake was calculated as $f = 1 - F^{14}C_{PLFA}/F^{14}C_{plants}$.

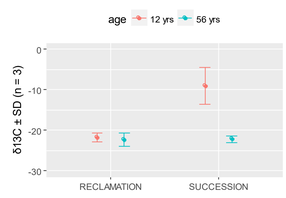




4.A Results

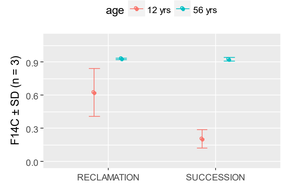
We found out that soil microorganisms at the 12-year-old sites respired more ^{14}C depleted CO_2 compared to the 56-year-old sites. However, the respired ^{14}C-free CO_2 may have originated also from carbonate weathering at one site as shown by its enriched δ^{13}C value.





4.B Results

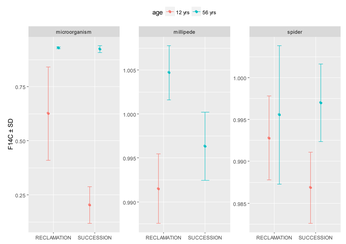
Microbial PLFA at the 12-year-old sites were more ^{14}C depleted compared to the 56-year-old sites. The fossil carbon (C) uptake by soil microorganisms is 14–89 % at less developed/younger sites compared to 8–11 % at more developed/older sites. The spontaneous succession is less regrown than the reclaimed plantation after 12 years of ecosystem development and thus fossil C uptake by soil microorganisms is even higher at the former.



site	fossil C uptake (%)
Reclamation-12-yrs	14–53
Reclamation-56-yrs	8–9
Succession-12-yrs	73–89
Succession-56-yrs	8–11

5. Conclusions

Although formerly fossil OM was considered recalcitrant, we show that it is readily utilized by soil microorganisms. This effect is larger at younger sites that have a smaller proportion of recent plant C inputs. It corroborates our previous findings that soil macrofauna were ^{14}C depleted at young sites relative to old sites. Overall, our results demonstrate that fossil OM sustains heterotrophic microorganisms and enters the decomposer food web.



6. Acknowledgements

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