

# Response to Referee Comments

The authors would like to thank the anonymous reviewers for the helpful comments and suggestions. We will consider these points in the revised manuscript, and would like to respond to the specific questions below.

## **1. Comments of Anonymous Referee #1, RC C6189, 29.10.2013**

*“Fig. S2: Change the title of Fig. S2 to “Multi-level sampler (MLS)”.”*

*“ Figs. S2 and S4: Reference Nauer et al. (2013) at the end of the captions.”*

The changes have been implemented in the supplementary material as suggested.

## **2. Comments of Anonymous Referee #2, RC C7209, 05.12.13**

*“First, is there any way to examine the particles that could potentially contain the methane to test whether or not they really are of subglacial origin?”*

We are planning to directly investigate the released methane. The presence or absence of other hydrocarbons (i.e. gas wetness) could indicate either thermogenic or biogenic origin, whereas the  $^{14}\text{C}$  age can provide information about recent or fossil origin. A  $^{14}\text{C}$  age of centuries to millennia would be a clear indication of subglacial origin. Furthermore, we will investigate different particle fractions of the soils for their methane release. This could hint towards certain forms of entrapment, e.g. if the gas is contained in the bedrock itself, or if it is entrapped in secondary carbonate precipitates of likely subglacial origin.

*“Second, the differences in bedrock, and consequently in pH and nutrient concentrations, must have an effect on the microbial community in the sediment/soil. Have any differences been found in the abundance and/or diversity of methanogens (as sources of methane) and/or methanotrophs (as sinks) between the siliceous and the calcareous sediments? This may affect methane concentrations assuming that the methane is biogenic, of course).*

We are currently preparing a publication with data on community composition of methanotrophic bacteria in the Damma and Griessfirn glacier forefield soils. While the

methanotrophic community appears to be different, the *pmoA*-gene abundance and methane sink strength in the two forefields seem to be similar. In some preliminary tests we did not detect any methanogens in shallow soil samples; however, this does not exclude their presence in deeper soil layers. Nevertheless, we believe that methanogenesis is unlikely to occur in measurable amounts in the forefield soils, as there is very little organic matter available, and the soils are fully aerated down to 1 m depth. It would be interesting to test for the presence of methanogens in fresh subglacial samples; however, so far we were not able to access such sites.

*Specific comments:*

*“Page 818 line 2: Glacier forefields are created by glacial melt, not just affected.”*

The manuscript has been changed accordingly.

*“P818, l4: “organisms are forced to adapt” is a bit misleading. The subglacial/proglacial transition definitely creates a strong selection pressure, but some organisms simply die out rather than adapt.”*

We agree with the referee, and for further clarification changed the sentence in the manuscript to the following:

*“..., organisms already present either adapt or disappear, while new organisms start to colonize the substrate.”*

*“P818, l8: : : little is known of CH<sub>4</sub>: : :”*

The manuscript has been changed accordingly.

*“P821, l9: what is quasi-undisturbed?”*

Here the word “quasi” was referring to the circumstance that truly undisturbed core sampling was impossible due to the rather small diameter of the tube to collect the cores (it was smaller than many stones present in the soil). However, as all cores were sampled in a similar fashion we believe this is of minor importance.

For clarification, we omitted the term “quasi-undisturbed” in the respective sentence of the revised manuscript and directly refer to the compaction of the cores:

*“...core length inside the tube. Compacted cores were discarded on the spot, while cores with negligible compaction were immediately transferred...”*

*“P824, l23: correct to ‘sonication’”*

The manuscript has been changed accordingly.

### ***3. Additional Modifications***

To improve clarity we modified the following sentence on p 14825, l 7-9:

*“Similar CH<sub>4</sub> concentrations in the headspace of the vial containing the core and in the vials containing the excess gas volume showed that CH<sub>4</sub> was released together with CO<sub>2</sub> during acidification only.”*

Revised sentence:

“Similar CH<sub>4</sub> concentrations in the headspace of the vial containing the soil core and in the vials containing the excess gas volume showed that CH<sub>4</sub> release from the core ceased once the added acid was buffered.”