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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Calibration of non-ideal thermal conductivity sensors" *by* N. I. Kömle et al.

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Response to Referee 2 (M. Siegler): General Remarks: Please note that this paper is considered as an add-on to the previous paper by Hütter and Kömle (2012), which is also cited here. In this paper modelling results using finite element computations have been extensively presented and discussed. We did not want to repeat this here. We admit that by now we have only experimentally tested the calibration curve between the ideal and the non-ideal sensors in the range 0.2 – 2 W/m/K. It is a necessary (and planned) task for the future to do the same type of comparisons also for powders under vacuum in order to extend the calibration curve towards lower conductivities. However this was beyond the scope of the present paper. Nevertheless we have included this aspect in the conclusions section of the revised version.

P2/ line 8 and 14: Typo was corrected. Concerning the second statement I a not quite

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sure what is meant here. I have left the text unchanged. A reference to the TECP instrument is made in the introduction.

P6/ line 18: The text in Section 3 was re-written, in particular the part concerning the Agar and the Agar-ice. I hope this is now clearer. In our tests we have used both agar at room temperature ("solidifed water") and in other tests the same agar samples were frozen and kept inside a -20°C environment long enough that a homogeneous constant temperature was established before any thermal conductivity measurement was performed. Also, the sensors were frozen in while inserted in the Agar sample and there was always a firm contact between the sample and the surrounding Agar-ice.

P7: The temperature rise due to sensor heating was never more than a few degrees. So it was made sure that no phase change (melting) has taken place during a measurement, since the initial temperature of the Agar-ice samples was -22°C. It is true that for the short thick sensors (LNP-A and LNP-B) the axial heat loss (via the wires) plays a significant role and is probably the main reason why the measured THC values are different for the two types of sensors used. This has also been demonstrated by the modelling results shown in Hütter and Kömle (2012) and seems to be confirmed by our calibration measurements. Figure 5 demonstrates the suitability of a linear fit at least for the investigated THC range. Of course, as mentioned above further tests to extend this range will be necessary.

P9: We cannot give a firm answer to the questions posed right now. This demands further work as indicated in the "General remarks" section. But I can refer to the investigation in the previous paper by Hütter and Kömle (2012), where an FE-model of these sensors was presented and the influence of various parameters was studied. It seems that the main reason that the thicker sensors give apparently lower values of thermal conductivity is that the influence of axial heat flux via electrical and mechanical connections is stronger than in the reference sensors. If axial heat flux along the sensor axis is significant it means that the heating of the sensor is slower than otherwise. This is equivalent to the statement that the derived thermal conductivity is higher. This

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is a plausible explanation but it is by no means self-evident that the correction factor to be applied is a constant. Therefore we think that the the mere presentation of this experimental result may be worth to be reported as a case study. It does not mean that the value of the factor cannot change when a different geometry is used. We have extended the discussion in the conclusions section to take the referee's remarks into account.

Figures: Figure 5 was revised to include error bars and a single regression line for the linear fit, which makes representation more clear. Concerning typos with capitalised "l" I could not identify any error like this in the figures. An additional figure (Fig. 6) was added, which shows the deviation of the true data from the linear fit (corresponding to a constant calibration factor). The figure is discussed in the Results section, which has been somewhat extended to discuss the results in more detail and give an outlook to further work to be done.

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 2, 685, 2012.

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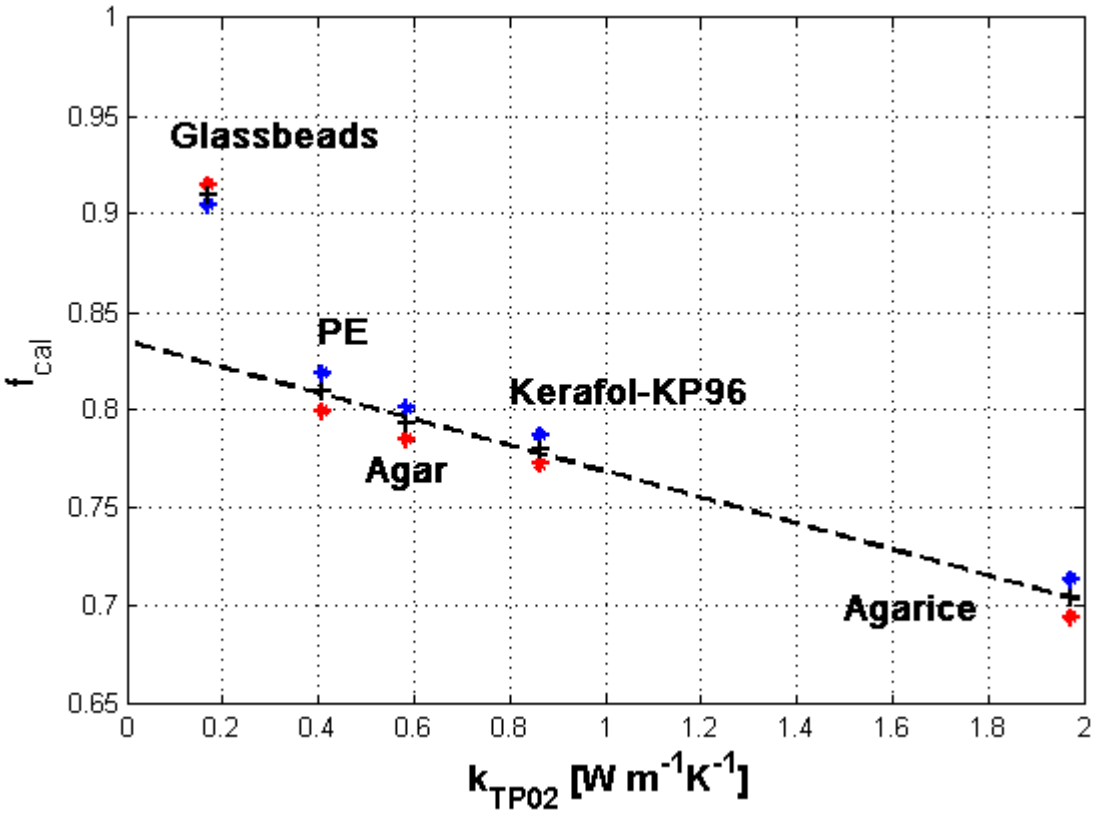

Fig. 1. Added Figure 6

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