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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Influence of probe geometry on measurement results of non-ideal thermal conductivity sensors" *by* P. Tiefenbacher et al.

Anonymous Referee #3

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The overall technical quality of the paper is very good. However the article is written more like a report rather than a research paper. The paper lacks a clear description of the motivation for the work and lacks a proper assessment of the results. Therefore it is recommended that the paper be 'repackaged' to promote the thesis of the work better. Suggestions on how this can be achieved will follow. In addition the structure of the paper, as it is, makes it difficult to digest the information presented and needs to be reorganised. Suggestions on how to address this will also follow. First the outline of the paper is described to highlight the contents as they appear to the reviewer.

Brief outline of the paper as it appears to the reviewer:

The authors report on a way to measure the thermal properties of a regolith using a

strengthened version of an established design used for terrestrial measurements. It is suggested this customised sensor could possibly be deployed from a landed spacecraft. In section 1 the authors introduce some previous in situ measurements by landed spacecraft and recount a brief history and importance of the needle probe. In section 2 the mathematical theory of the needle probe is comprehensively covered which is appropriate for this journal. In section 3 the authors introduce their instruments. In section 4 describe their method, sample properties and results. In section 5 the calibration of the sensors are described and in section 6 the two customised sensors used by authors are compared.

Suggestions for making the motivation clearer:

The paper mentions the need for more thermal property measurements as a consequence of a small amount of previous in situ measurements made by spacecraft. It does not automatically follow that there is a need for thermal property measurements because there have not been many in the past. The reason why there have not been so many measurements in the past needs to be examined more fully. Is it difficult to obtain precise measurements with previous techniques? What are the advantages and disadvantages of the techniques used previously?

Also does your instrument allow multiple sampling at different sites? What kind of forces can it tolerate during deployment? If this is not known will there be some tests in the future to determine what kind of materials it can be deployed in without breaking? Could it be deployed in an icy regolith?

It is noted the authors miss out some more recent work on the measurement of thermal properties of planetary bodies by landed spacecraft. It would be a good idea to mention these as they would aid the authors when examining the advantages and disadvantages of the different techniques that are available for making thermal property measurements of the surface and shallow subsurface.

Martinez et al., 2014, Surface energy budget and thermal inertia at Gale Crater: Cal-

culations from ground-based measurements, 2014, Journal of Geophysical Research: Planets, 119, 10.1002/2014JE004618

Spohn et al., 2015, Thermal and mechanical properties of the near-surface layers of comet 67P/Churyumov-Gerasimenko, Science, 349, 10.1126/science.aab0464

Paton et al., 2016, Thermal and microstructural properties of fine-grained material at the Viking Lander 1 site, Icarus, 271, 10.1016/j.icarus.2016.02.012

There is also no mention of remote sensing techniques and how the authors' instrument would fit in with measurements made by orbiting spacecraft. It is important that the authors' mention the possible application for lunar exploration which they have done. It would however be more useful, for promoting the instrument's relevance, if information regarding the context of the scientific measurements could be described briefly.

In summary the introduction could be expanded by adding a paragraph or two's worth of extra text outlining the motivation for the work more fully. To start with I suggest splitting the second paragraph of the introduction and then expanding the two blocks of text.

Suggestion for assessing the results:

There appears to be no assessment of the results in a wider context. This could be achieved by comparing the precision to other techniques and the expected precision in the lunar regolith. This would be best placed at the end of the results section, if the text is not too expansive, otherwise it might be worth creating a discussion section after the results.

Improving the structure of the paper:

The results section (section 4) contains a description of the method and the properties of the samples. It is recommended this material be relocated to the previous section (section 3) so all the material related to the experimental set-up is in the same place.

Also some motivation regarding the choice of the materials, in terms of testing the instrument and its relevance to planetary regoliths if any, needs to accompany the description of the materials.

Section 5 and 6 need to be placed at the end of section 3 too as that is part of the experimental set-up. It is suggested table 11 and 12 be reduced in size by deleting the long columns of numbers used to calculate the means.

Technical comments:

The meaning and relevance of the sensor labels used in the paper, i.e. TP02, LNP03 and LNP04, take some time to be understood. It is suggested that a sentence or two is added in the introduction to expand the meaning of the acronyms. Additionally it might be a good idea to refer to LNP03 and LNP04 as 'our customised sensor LNP03' instead of just writing 'the LNP03 sensor' a few times in the text to remind the reader the relevance of the labels.

Are the TP02, LNP03 and LNP04 sensors really sensors or instruments? This needs to be made clearer.

Table 1 is not required and can be deleted.

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