gid-1-109-2011 Patton

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A penetrator for making thermal measurements in a gas-filled planetary regolith

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P112/L17 suit(e)

P112/L20 MUPUS PEN penetration depth is max. 35 cm! However the thermal sensors on the Philae anchors (MUPUS ANC-T) may be as deep as 2.5m

P113/L5ff It is mentioned twice that it is easier to thermally isolate a sensor mounted on the outside. One of this instances would be enough.

P113/L10ff No objection to the authors statement here. He is certainly right. A side comment at this place is that for technical purposes it is practically impossible to perfectly isolate the thermal sensor from the main body and thus a really thorough calibration of the whole system has to be ensured.

P114/L1ff I'm not entirely happy with the wording "thermal penetrator" which could be confused with a device thermally penetrating into the surface like e.g. a melting probe. This should rather be phrased as "penetrating thermal sensor" or suchlike.

P116/L5 dependant / dependent Might be british / american language variant. However, according to the internet dependant should be used for persons only.

P118/Eq 1 permeability is here denoted as K whereas on P117/L9 it is denoted as *k,* please us e the same variable name everywhere, especially as k is used for the thermal conductivity later on.

P119/L15ff It might be of interest to the readers context that k/(rho c) is the thermal diffusivity.

P119/L16ff The term rho*c is the volumetric heat capacity and should be named that way instead of "product of density and heat capacity".

P120/L6 The shaft of the penetrator is a glass reinforced plastic *tube* manufactured by pultrusion. However, a material like this might have anisotropic thermal properties because of the production process. This should be discussed with one or two sentences.

P127/Sect6/L13ff I am not sure if I agree to that conclusion; the temperature profile looks like the usual equilibrium curve between heat flow and heat production for this kind of probes. Is there a substantial deviation from an exponential heating curve which might substantiate the author's assumption? The temperature measurements in figure 11 seem to be within the resolution limit of the measurement system. I'm not sure the conclusion drawn is fully valid. What is the error bar on the measurements or can the authors bring more arguments for their interpretation.
The fluctuations might be due to convection inside the hollow body and along the outer surface of the body. However, I doubt that fluctuations of about 0.2-0.3 K as shown for the heater would propagate from the inner walls through the penetrator body, the glue and the highly insulating Kapton back to the heater without dissipating along the penetrator shaft in axial direction. I would rather assume the fluctuations are due to effects outside the penetrator, and/or fluctuations in the measurement setup. A 10 bit bridge ADC system and a Heater with a resistor tolerance of 10% (MINCO 5228 Datasheet) is not that accurate to go into great details of interpretation when the total difference between two measurements (different sample preparations and setup) is about 0.6-0.8% in absolute values and <0.09% for the fluctuations (in fig 11b).
Compare with figure 14 and 15 of Hütter & Kömle 2012 doi:10.5194/gid-2-23-2012 a paper which is also in the discussion phase of the GI Journal parallel to this paper!

P128/L6ff Again the accuracy of the measurements make any interpretations of temperature differences rather meaningless since the whole measurement system can not resolve it. For all practical purposes in fig 12 the temperatures are within the intrinsic resolution of the system. What has not been discussed here is the influence of the thermal resistance between heater and sample material. I would agree with the author that an impacted sample should have a higher thermal resistance but that would result in a temperature increase of the heater for impacted samples that is higher than actually measured here.

P129/ No objections now, to the spatial relocating of the thermistor positions for modelling (in fig 13 and 14). The nice fit is justifying this assumption in a more plausible way than just tweaking model parameters. However, why should a thermistor in a impacted sample move closer to the centre instead away from it? As pointed out by the author there is room for improving the accuracy of the thermistor localisation during sample preparation, as difficult this may be for large samples.

It would be nice though, to provide in fig 13 and 14 some numbers the author used for the thermal conductivity of both samples or at least the diffusivity if the th. conductivity is impractical.

P131/Sect7 I would prefer the usage of the wording "thermal probe for space applications" instead off "spacecraft penetrator" seeing in my imagination a penetrator ripping through the innards of spacecraft subsystems tearing a hole all the way through to the solar panels and shortening the mission lifetime substantially.

PT132 I agree to the general conclusions of the author concerning the diffusion-convection model. However, assuming the benefit of filling the interior of a thermal probe with foam, which is thermally conducting as well, would outweigh the inhibition of convection inside the tube is not straightforward. This will be a matter of the environment (Mars or airless object) and thorough design to purpose including thermal modelling.

P133/L24 K**ö**mle instead of Komle