Study of the temperature evolution of a heated cylinder with mantle and consequences for spaceborne thermal conductivity sensors

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The temperature evolution of a heated cylinder of infinite length, composed of a core and an adjacent concentric mantle, is analysed. Thermal resistive boundaries between core and mantle, and between mantle and surrounding medium, are considered. A similar problem, namely the non-heated case of the same geometry, has been treated by previous authors in the context of the heat flow experiments on the lunar surface, performed by the Apollo 15 and 17 missions in 1971 and 1972. Our analysis shows how a constant heating of the core and/or mantle of the cylinder can be taken into account, giving exact solutions to this problem. The resulting temperature evolution of core, mantle and surrounding medium is expressed in terms of integrals over the positive real axis. Numerical evaluation of the integrals is performed to study various examples, with particular emphasis on spaceborne thermal conductivity sensors.