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Mercurian megaregolith layer and surface heat flows constraints

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Mercury is covered by a thermally insulating megaregolith layer. Despite the fact that it is known that this poor conducting layer has important influences on surface heat flows, most thermal modeling studies have overlooked it. Mercurian megaregolith is not very well known, but data provided by MESSENGER suggest that mercurian megaregolith is less insulating than its lunar counterpart. This information together with brittle-ductile transition (BDT) depths, estimated from the analysis of fault geometries associated with lobate scarps, allow us to constrain the surface heat flow on Mercury at the time of scarps formation.

In this work, we have solved the heat conduction equation in order to constrain surface heat flows. Firstly, we obtain an upper limit in surface heat flows by using published values of the BDT depth and by neglecting the megaregolith layer. Then, we calculate a lower limit by including in the heat equation a top layer with thermal properties representative of the lunar megaregolith. In our calculations we have taken into account volumetric heat production rates obtained from the surface abundances of radioactive elements provided by MESSENGER. Heat equation solutions constrain surface heat flows to a range of 6 – 29 mWm^{-2}. These results suggest the possibility that surface heat flows could be lower than those calculated in previous works, which is in agreement with the small amount of radial contraction detected on Mercury. Furthermore, the procedure followed in this article can be easily applied to other planets and satellites, which will improve our knowledge about the thermal evolution of these bodies.