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The thermo-chemical evolution of asteroid 21 Lutetia

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The early thermal evolution of the asteroid Lutetia has been studied using new data obtained by the Rosetta flyby[1]. We have used the thermal evolution model by [2], which includes accretion, sintering due to hot pressing, related changes of material properties, melting, advective heat transport and differentiation by porous flow. We obtain a number of structures consistent with the observations. The most probable macroporosities for a Lutetia-like body with the bulk density of 3400 kg m^{-3} are $\varphi_m \geq 0.04$. Depending on the value of φ_m, formation times range from the formation of the CAIs for $\varphi_m = 0.04$ to 7 Ma after the CAIs for $\varphi_m = 0.25$. We find a differentiated interior only for a rather narrow interval between $0.04 \leq \varphi_m < 0.06$ with the formation times between 0 Ma and 1.8 Ma after the CAIs. The core size is ≤25 km and the mantle thickness amounts to a similar value. No melt extrusion at the surface is likely, which is consistent with the lack of basalt at the surface of Lutetia. For higher values of φ_m an iron-silicate differentiation is not possible but the interior is substantially compacted.

[1] Vernazza, P. et al. (2011) Icarus 216, 650-659. [2] Neumann, W. et al. (2012) A&A 543, A141.

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