Non-monotonic scenarios for the Earth's thermal history

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Expected variations of heat loss out of the Earth's mantle with the cycle of aggregation and separation of supercontinents and the consequent variations of the wavelength of mantle flow are important, of the order of 20 TW on a timescale of a few hundreds million years [Grigné *et al*. 2005]. Monotonic models of planetary thermal evolution do not account for those variations and thus, may not be relevant for the Earth. The observed variations obtained in numerical models of mantle convection including continents are presented.

On a longer timescale, an event that may influence the heat loss of a terrestrial planet in a more dramatic way is the possible cessation of plate tectonics [e.g. Lenardic *et al.*, 2004, Sleep 2000]. This possibility is studied here using models of thermal convection including a temperature-dependent viscosity and plastic yielding, which leads to either a stagnant lid or a plate-like regime, depending on the chosen parameters for plastic yielding, on the vigour of convection, on the thermal state of the mantle and on the geometry of the flow. We discuss the consequences of switching between the two regimes on the thermal state of the mantle, particularly on the temperature and heat flux at the core-mantle boundary, and on the thermal evolution of terrestrial planets.

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The non-existence of the SEP noble gas component – Implications for geo- and cosmochemistry from Genesis samples

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Dust grains from the lunar regolith appear to contain a solar noble gas component istopically heavier than the solar wind that is trapped at larger depths. This component was attributed to solar particles implanted at considerably higher energies than the solar wind and dubbed "SEP" for Solar Energetic Particles. Though it has been impossible to reconcile the high apparent abundance of the "SEP" component in lunar samples with the very low flux of solar energetic particles measured in-situ in space, the "SEP" component also found wide acceptance for the interpretation of N and O data in cosmo- and geochemistry.

Ne and Ar data from a metallic glass exposed on the Genesis mission now have clarified this conundrum. The isotopic and elemental depth profiles in the glass are very similar to those predicted for a solar wind uniform in composition implanted with the velocity distribution as measured by Genesis instruments. Thus, the gases at larger depths do not represent an isotopically distinct component but are solar wind particles that got fractionated with implantation depth as a function of their mass (Grimberg *et al.*, 2006).

In this contribution we will discuss some implications of this finding for noble gas geo- and cosmochemistry. The interpretation of solar Ne in the Earth's mantle being due to accretion of grains irradiated by an early solar corpuscular radiation (Trieloff *et al.*, 2000) may be maintained, except that the observed Ne composition in this case would not be a result of large contributions of "SEP"-Ne but rather has to be implantation-fractionated SW-Ne. Similarly, the inferred isotopic composition of solar O in lunar dust reported by Hashizume and Chaussidon (2005) with a $\Delta^{17}O$ value less than -20‰ needs not to be revised, though the O measured by these authors has now to be viewed as fractionated SW-O rather than as "SEP"-O. On the other hand, the proposed inverse trend between the isotopic composition of Ne and N from SW to "SEP" (Mathew *et al.*, 1998) needs to be reinterpreted in the light of our results.

References

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