Lithospheric Thermal Profiles Constrained by Entropy Production Principle

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Lithospheric thermal profiles can be obtained by extrapolating the surface heat flow and heat generation data using classical heat conduction theory, using equilibrium thermodynamical data on melts and metamorphic rocks, inferences from relationship between temperature and seismic velocity and electrical conductivity obtained from seismological and geomagnetic investigations. Entropy production principle has been used to infer thermal profiles in the case of planetary atmospheres. It has been shown that a system which is in the state of self-organized criticality (SOC) will have extremum production of entropy. Lithosphere has been shown to have such a state based on structure of solidified melt products in various tectonic environments. SOC has also been shown in earthquake occurrences and hydro-seismicity. Thus, there is good case to apply this entropy production principle to estimate thermal profiles of the lithosphere. We have used this principle to obtain temperature distribution for lithosphere using fixed temperature boundary conditions and exponential distribution of radiogenic heat sources. Results depend upon the nature of the constitutive relationship between heat flux and temperature gradient, such as the Fourier law, used in the formalism. We shall discuss the implications of other forms of constitutive relationship. Profiles obtained by entropy production principle are compared with profiles obtained by the classical heat conduction equation.