The relationships between the peaks of mantle convection energy, surface heat flow, and crust-mantle differentiation

U. WALZER[1*] AND R. HENDEL[1]

[1]F.-Schiller-Universität, Humboldtstr. 11, 07743 Jena, Germany

We present a numerical study on the chemical and thermal evolution of a 3-D spherical-shell mantle based on radial distributions of viscosity, Grüneisen and other parameters. We discuss latest geochemical proposals but arrive at a chondritic mantle. Assuming this, we conclude: The mode of early mantle convection is not necessarily bound to plate tectonics. Bulk convection is energetically dominating. Not the whole mantle is depleted but only half. Below lithosphere-asthenosphere boundary there is no distinct chemical layering but a marble-cake structure. Upper mantle is more depleted than lower mantle. Best agreement between observed and computed total *continental-crust* [CC] size is found for $r_n=0.5$ (this is a Rayleigh number 10^8) and for thermal conductivity, $k=5.0W/(m\cdot K)$. Kinetic convection energy, E_{kin}, and surface heat flow, *qob*, slowly decreases but show also augmented-activity and *thermal peaks*. Calculated near-present *qob* approximate measurements. We vary r_n, k, viscoplastic yield stress ($=\sigma_y$) and melting-criterion parameter ($= f_3$). For a restricted (r_n, σ_y, k, f_3)-space, we find *simultaneous* agreement with all observations. For $r_n=0.5$, $\sigma_y=120$ *MPa*, and optimal (k, f_3) space, the time lag between *qob*-peak and corresponding *crust-mantle-differentiation peak* is 50 to 75Ma, time lag between maximum mantle-convection intensity and subsequent differentiation peak is 80 to 100Ma. For 4490 Ma to presence, average temperature drop is 210K. Observations reveal, in late Archean 50 to 70% CC existed. Our model predicts 60.4 to 75.7%. We find *crustal growth episodicity*. Please go to www.geodyn.uni-jena.de