For the description of critical stability of almost adiabatic or/and compositional planetary convection we use initial system of PDEs in the rapid rotation limit. We simplify this system to two first-order ODEs for pressure and vertical component of the velocity. The critical frequencies, modified Rayleigh numbers and distributions of convection are found for the different parameters suitable for the Terrestrial planets. Our results for the large Prandtl numbers can be interpreted within the frames of compositional convection which could efficiently support modern Earth’s magnetic field and possibly Mercury’s magnetic field. The corresponding critical frequencies are almost steady-state, while critical Rayleigh numbers are so large that makes compositional convection typically not so much supercritical. Moreover it does not work when the inner solid core is too small or too large that may explain absence of own magnetic fields in the modern Venus and Mars.

Thermal convection is much less effective for generation of a magnetic field that is in agreement with corresponding results of us for the small Prandtl numbers leading to high critical frequencies and relatively small critical Rayleigh numbers. Our results for various distributions of convective sources at ‘turbulent’ Prandtl number unity could be valid for the deep interiors of planets/moons with vigorous enough convection. For different but sufficiently thick fluid shells we obtain fully analytical expressions for critical Rayleigh numbers, frequencies and distributions of planetary/moons convection for all possible Prandtl numbers in the approximation of small inner to outer radius aspect ratio.