

Estimates of geomagnetic jerks time delays from 1D mantle conductivity models: a forward approach.

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The Earth's mantle electrical conductivity has been a subject of much debate in the last few years. Induction studies agree mainly in the first 1000 km of the mantle, however in the lower mantle the conductivity is still very uncertain. Experimental studies of mineral physics simulating the conditions of the deep mantle have been performed and results disagree in 4 orders of magnitude depending, for example, on the considered geotherm. The subject is of extreme importance since electrical conductivity reflects chemical and physical properties of the planet's interior as well as place constraints on the core-mantle coupling. In addition to mineralogical and induction studies, geomagnetic jerks can also contribute for a better understanding of mantle conductivity. Geomagnetic jerks are believed to be due to motions in the fluid core and manifest at the Earth's surface as changes in the slope of the first differences of magnetic field components, dividing intervals of approximately linear secular variation. In this context, the most relevant characteristic of jerks is that they are not simultaneous at the Earth's surface. For instance, the 1969 jerk is worldwide and show an intriguing temporal-spatial pattern: a first arrival in the Northern hemisphere followed by a delayed arrival in the Southern hemisphere of about 2 years. One way to explain differential jerk delays in distinct locations is by considering the delay caused by a conducting mantle on the core geomagnetic field. Consequently, what we observe at the Earth's surface will correspond to a filtered version of the original field. In order to test this hypothesis we consider different radial mantle conductivity models acting as linear, causal and time-invariant filters. The jerk is simulated as an impulse in time at the CMB and its morphology in the core obtained by a global spherical harmonic model. The key point is that the mantle filter is different for each harmonic degree. Therefore, as the mixing of harmonics varies with location at the CMB, distinct time delays will exist in different locations at the Earth's surface, even with a simple 1D radial conducting mantle. We detected time occurrence of the 1969 and 1978 jerks by using annual means of the three components at magnetic observatories and compared with results of our conducting mantle models.