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Piezomagnetic fields arising from the propagation of teleseismic waves in magnetized crust with finite conductivity

Ken'ichi Yamazaki[1*]

[1]DPRI, Kyoto Univ.

To determine whether the piezomagnetic effect is a plausible mechanism in explaining variations in the magnetic field that occur synchronously with the propagation of teleseismic waves, a set of solutions are derived for the electromagnetic field. The situation is considered in which the Earth's conductivity has a stratified structure and seismic waves are expressed as a plane wave. The piezomagnetic field in this situation is expressed by an analytically closed form. Using the obtained solution, quantitative aspects of the piezomagnetic field that accompanies seismic Rayleigh waves with an amplitude of 1 cm are discussed. It is shown that the finite conductivity of the Earth's crust sometimes acts as an enhancer of the magnitude of the piezomagnetic field. However, the expected piezomagnetic field is substantially small. Even in the case that the initial magnetization around the observation site is as large as 5 $Am^{?1}$, the expected amplitudes in the piezomagnetic field are at most 0.1 nT. This result means that the piezomagnetic effect is not a reasonable mechanism to sufficiently explain variations in magnetic fields that occur synchronously with ground motions, if the initial magnetization is horizontally uniform.

Keywords: Rayleigh wave, piezomagnetic effect, electrical conductivity, electromagnetic field, enhancement