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Piezomagnetic fields due to inclined rectangular faults in a viscoelastic half-space

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We investigated time dependent piezomagnetic fields due to inclined rectangular fault embedded in a viscoelastic, homogeneous half-space. In volcanic areas, rocks near magmatic sources are considerably heated and weakened beyond the brittle-ductile transition expected in a temperature range of 300-500 °C. Above these temperatures, rocks no longer behave in a purely elastic manner, but permanently deform because the viscosity is significantly lowered. In such a case, viscoelastic rheology is more appropriate to characterize the crust around the magmatic source, and can greatly influence the piezomagnetic field, making the elastic approximation inappropriate. We applied the Correspondence Principle to the analytical elastic solutions for dislocation sources in order to determine the time dependent piezomagnetic fields in a viscoelastic medium. Among all the possible rheological models, we investigated three cases in which the bulk modulus is purely elastic and the shear modulus relaxes as: (i) a Maxwell solid, (ii) a standard linear solid (SLS), and (iii) a Kelvin solid. The piezomagnetic field completely vanishes after the relaxation process for a Maxwell rheology, whereas it is found to decrease over time and reach some finite offset value for SLS and Kelvin rheologies. A real case study concerning the magnetic anomalies observed during the 2002-2003 Mt. Etna eruption is also investigated.