The piezomagnetic field produced by an ellipsoidal pressure source: A preliminary result

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Sasai (1986) formulated the piezomagnetic potential produced by a single force operative at a point, which was called the fundamental piezomagnetic potential (FPP). As an application example, he obtained the piezomagnetic field associated with a uniform circular load or the dam-magnetic effect. He also suggested that the FPP should be applicable to an ellipsoidal pressure source based on Eshelby's (1957) elastic inclusion theory. However, such an attempt has not been completed yet. Davis (1986) pointed out that the surface deformation observed at Kilauea volcano, Hawaii, could not be fully explained by the simple Mogi model and applied Eshelby's solution to find the best-fit ellipsoidal pressure source. He gave the displacement field only at the ground surface, while we need the one within the entire elastic half-space. Seo and Mura (1979) had formulated the displacement field due to the ellipsoidal inclusions with uniform dilatational eigenstrains, which was useful in some subjects in the metallography. Their model is also applicable to the magma reservoir in a shallow depth. When we consider the piezomagntic effect in the shallow crust, we must take into account the Curie point isotherm, i.e. an elastic half-space with a uniformly magnetized top layer. According to the representation theorem of the piezomagnetic field (Sasai, 1991), the potential is given by the surface integral with respect to the displacement and its normal derivatives. We discriminate three cases, i.e. Case I: the Curie surface (H) lies below the ellipsoid, Case II: H intersects the ellipsoid, and Case III: H lies above the ellipsoid. Here we obtained the solution for the simplist case (III).

Davis, P. M., 1986, J. Geophys. Res., 91, 7429-7438.
Eshelby, J. D., 1957, Proc. Roy. Soc., London, Ser. A, 376-396.
Seo, K. and T. Mura, 1979, J. Appl. Mech., 46, 568-572.
Sasai, Y., 1986, J. Geomag. Geoelectr., 38, 949-969.
Sasai, Y., 1991, Bull. Earthq. Res. Inst., Univ. Tokyo, 66, 585-722.

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