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Quasi-static electromagnetic induction in spherical Earth: Vector potential formulation.

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We deal with the electromagnetic induction in a spherical conductor with 3-D distribution of electric conductivity in quasi-static approximation with the focus on theoretical aspects related to the solvability and posedness of this problem. We formulate the initial, boundary-value problem of electromagnetic induction in terms of a magnetic vector potential only, first in differential and then in integral forms. After cumbersome mathematical considerations, we prove that the problem of electromagnetic induction with 3-D distribution of electric conductivity, formulated only in terms of magnetic vector potential, is well posed in Hadamard's sense. This means that a solution exists, is unique and continuously depends on boundary data, that is, a solution is stable. An important feature of the formulation is that no electric scalar potential is employed in the formulation and no gauge condition is imposed on the magnetic vector potential. The three attributes, that is the well posedness, only magnetic vector potential is employed and no gauge condition is imposed on a solution, make the formulation attractive for numerical implementation.