TIME-DEPENDENT MODELLING OF THE ELECTRIC AND MAGNETIC FIELDS CAUSED BY FLUID FLOW IN VULCANO, ITALY

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The surface manifestation of the electric and magnetic fields on volcanoes have long been thought to originate in the convective flow of hydrothermal fluids that are driven by the proximity of the hot magma body. The modelling of this scenario, even in two dimensions, is difficult because it requires the contemporaneous solution of three sets of mutually dependent partial differential equations, which describe (1) the behaviour of the time-dependent heat transport, (2) the time-dependent flow of fluids, and (3) the behaviour of time-dependent electro-magnetic fields within the volcano. For example, while fluid flow is affected by the temperature field via its effect on the density of the fluid, the fluid also transports heat. Furthermore, the fluid flow itself produces an electro-magnetic field by the electro-kinetic phenomenon. If the modelling is likely to be any use for understanding the development of a volcano or prediction of eruptions, the modelling must also be time-dependent. We show initial modelling results for the solution of this time-dependent problem along a two dimensional transect through the volcano Vulcano. Initial results indicate that both the electric and magnetic fields measured at the surface are highly sensitive to the movement of magma in the volcano. Movement of the magma body deep in the volcano expresses itself as changes to the electric and magnetic fields at the surface sufficiently to allow the possibility of using these changes to provide timely warning of future volcanic activity at the surface.

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9. NONE