Laboratory measurement of electrical conductivity on hydrous andesitic melts

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Magnetotelluric (MT) surveys have detected many high electrical conductivity zones beneath subduction zone arc volcanoes, which may be related to the existing of active reservoirs with H_2O-bearing andesitic magma. Therefore, the laboratory determined electrical conductivity of hydrous andesitic melt is necessary to interpret the MT results and constrain the physicochemical conditions of these magma reservoirs. In this study, we report results from electrical conductivity measurement of anhydrous and hydrous haploandesitic melt with 0.01-5.9 wt% of H_2O at 1164-1573 K and 0.5-1.0 GPa in piston cylinder apparatus using sweeping-frequency impedance analyses. The measured electrical conductivity of haploandesitic melt increases with increasing temperature but decreases with pressure, following Arrhenius relationship throughout the investigated temperature range. H_2O has significant effect to enhance the electrical conductivity, which is even stronger than that for rhyolitic and dacitic melts. Using the Nernst-Einstein equation, the principal charge carrier is inferred to be Na in anhydrous melt but divalent cations in hydrous andesitic melts. The experimental data are regressed into a general electrical conductivity model for andesitic melt accounting for the *P*-*T*-H_2O dependences altogether. Modeling results show that the conductive layer at >20 km depths beneath the surface of the Uturuncu Volcano could be interpreted by the presence of less than 20 vol% of H_2O-rich andesitic melt (with 6-9 wt% H_2O).