Dehydration melting of amphibole bearing gneiss and its implication for the high conductivity anomalies in the mid-lower crust of Tibet Plateau

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Abstract

Magnetotelluric (MT) surveys in the past decades have revealed that high-conductivity layers (0.1-1 S/m) widely exist in the mid-lower crust of Tibet plateau (Wei et al., 2001). In addition, a number of geophysical data sets indicate that these regions are usually characterized by the feature of low velocity (Unsworth et al., 2005). It is of significance to interpret the origin of these low-velocity-high-conductivity zones (LV-HCZs) in the Tibetan crust. Nevertheless, the possible origin is a long-standing and controversial issue.
In this study we investigate the electrical conductivity of amphibolite with different volume fraction of garnet (3 vol% and 18 vol%) at 1.8 GPa and 500-1525 K using an 1260 impedance spectroscopy analyzer. Fast decrease of the sample's resistance from 1250 K indicated that dehydration melting occured at 1250 K. The activation enthalpies before and after dehydration melting are 0.66 eV and 1.56 eV, respectively. When we cooled the sample after dehydration melting to temperatures lower than 1250 K, the activation enthalpy decreased to 0.55 eV. Post-experimental EPMA analysis showed that the melt is adakitic and hydrous. Except for adakitic melt, the other reaction products include garnet and pyroxene.

Dehydration melting of amplibole bearing sample can explain the high conductivity anomaly of 0.1 S/m at temperatures higher than 1250 K. However, the explanation of 1 S/m requires temperatures higher than 1350 K. Our results suggest that the dehydration melting of meta-mafic rocks to explain the high conductivity anomalies of 1 S/m requires high crustal temperature.

References:

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