Magnetotelluric Survey to Delineate the Deep Resistivity Structure of Mae Tha Fault Zone

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Abstract

Mae Tha fault zone (MTFZ) has been known to be one of the major active fault zones in northern Thailand. Following the recent earthquake occurrences in Chaing Mai province and the nearby areas, many seismological investigations have been undertaken. However, no deep imaging techniques have been conducted. To understand the mechanism and the deep geological structures related to the earthquake occurrence in this area, the magnetotelluric survey was therefore conducted. Electric (*E*) and magnetic (*H*) fields in horizontal directions, i.e., x-northing and y-easting, are measured at the earth surface to obtain the impedance tensor (*Z*) as the MT data where **E=ZH**. The off-diagonal components of **Z**, Z_{xy} and Z_{yx} are then used in 3D MT inversion to produce the deep 3D resistivity model beneath the investigation area.

In the area covering MTFZ, more than 20 broadband MT stations were installed during 2019-2022. The additional high-frequency (HF) MT stations of more than 15 stations were later installed in 2023 covering the small earthquake swarms in Chiang Mai province to get the detail of the shallow structure related to the occurrence of the swarms. All the data from the acquisition ranging from 3000-0.001 Hz were then processed and applied with a 3D MT inversion code, WSINV3DMT, in the high-performance computers to get the overall deep structure up to a depth of more than 20 km covering MTFZ and Chiang Mai Basin (CMB). The additional smaller resistivity models around the earthquake swarms were later obtained by a sequential 3D inversion using the finer grid with the data from HF MT stations. The preliminary results indicate good agreement between the resistivity models and surface geology. The inverted models also reconstruct the conceptual model of the MTFZ and CMB. The large north-south oriented resistive structures in west and east borders of CMB delineate the mountain range, where the shallow conductive structure in between reveals the structure of CMB. The resistivity contrast along the MTFZ could be used to estimate the dip angle of the fault. Some resistivity structures show prominent relation with the earthquake swarm and will be further investigated with other geophysical data.

Keywords: magnetotelluric, active fault, resistivity model, Mae Tha fault