Magnetotelluric survey to delineate the deep resistivity structure of active fault zones

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ABSTRACT

In the recent decade, magnetotelluric (MT) surveys have been conducted in many locations in Thailand focusing on northern Thailand to elaborate the active fault studies along with geothermal exploration. The aim of those studies is to delineate the deep structure of Earth's crust in addition to the previous shallow geological and geophysical investigations. MT employs the measurement of the natural Earth's magnetic (H) and electric (E) fields to obtain the subsurface structure in terms of the electrical resistivity model with a broader and deeper investigation, down to the boundary of crust-mantle. MT was used in many active fault studies, including the Phayao fault zone, Mae Chan fault zone, and Mae Tha fault zone along with some high-potential geothermal areas which have been supported by various organizations.

The three-dimensional resistivity models of our investigation areas were carried out by the MT inversion using MT impedance tensor (Z) as the data where $\mathbf{E} = \mathbf{ZH}$. Since rocks and geological features have specific electrical resistivity ranges, further interpretation can be made to suit academic and prospecting proposes.

The prominent example of MT investigation on active fault was the MT acquisition around the Phayao fault zone (PFZ) after the Mw 6.5 earthquake of 5 May 2014. The overall feature of the MT model agrees with surface geology and the conceptual model of the surface structures. The most interesting feature is the deep large conductive structure (DC) located at a depth of 4 km to mid-crust beneath the Mae Lao segment near the seismogenic zone which was interpreted to be a highly interconnecting aqueous fluid content playing an important role in the earthquake sequence. Other MT investigations were conducted extending to the nearby fault zones and found out about the interesting conductive features that might need further attention and investigation. In addition to the active fault studies, the shallow conductive structures in the selected geothermal explorations were found and treated to be the geothermal reservoirs where the deep hot water seeps up through the fault/fracture along the active fault zones relating to DC. We believe that MT investigation can be used as a major investigation tool to benefit further studies on geohazard, tectonic evolution, and renewable energy in the country.

Keywords: Magnetotelluric, active fault, crustal fluid, geothermal, Thailand

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