

Geothermal exploration via magnetotelluric surveys in non-volcanic geothermal fields in northern Thailand

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SUMMARY

Thailand's geothermal fields are non-volcanic and mostly located in northern part of the country where there are relatively high tectonic activities. Government agencies had conducted the geothermal potential assessment projects for electricity generation in 4 geothermal fields distributed around Chiang Mai, Chiang Rai, and Mae Hon Son provinces. Magnetotelluric (MT) surveys were then proposed and conducted in the mentioned provinces. More than 150 MT stations were deployed during 2013 – 2018, mainly to locate shallow geothermal reservoir and delineate the geothermal system in each area. The 3D resistivity models with the investigation depth of up to 2,000 meters were then obtained from the off-diagonal components of the impedance tensor within the frequency ranging from 3,000 – 0.003 Hz. The resistivity feature in all areas share the similar manner relating to the non-volcanic geothermal system: (1) the conductive geothermal reservoir (2) the conductive hydrothermal alteration zone (3) fluid pathway in term of fault and fracture, and (4) resistive granite heat source. To assess the potential in electricity generation, the testing boreholes were then proposed using the model derived from MT surveys. Several drillings were success in producing the hot water from the shallow reservoirs. In addition, the borehole results help confirming the reliability of the 3D resistivity models and reveal an important relation between resistivity structure and the geological targets.

The case study from the Mae Chan hot spring (MCH) in Chiang Rai province and the Fang hot spring (FGH) in Chiang Mai province also demonstrate the development made in the past ten years since the 3D MT survey was introduced to the local agencies in the early of 2010s. MT surveys of the first phase in those fields started with a very sparse clusters of MT stations to get the big picture of the geothermal system. The detailed MT surveys with denser MT stations (up to 50 meters) were then conducted in the focusing area pinpointed by the previous phase of the survey. The drilling results mostly agreed with resistivity model of both MCH and FGH which will be used as a guidance in future developing production and re-injection wells. The strategy and procedures used in these geothermal explorations can be shared with other non-volcanic geothermal exploration in Thailand and worldwide.

Keywords: geothermal exploration, magnetotelluric survey, northern Thailand
