The 9th International Conference on Applied Geophysics
(GEOPHYSICS CHIANG MAI 2023)
Chiang Mai, Thailand

Crustal Thermal Structure Beneath Northern Thailand

Sorawat Siangpipop [a]*, Siriporn Chaisri [b], Niti Mankhemthong [a] and Pisanu Wongpornchai [a]

[a] Department of Geological Sciences, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[b] Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
* Corresponding author. E-mail address: sorawat_s@cmu.ac.th

Abstract

The geotherms calculation requires thermophysical parameters and the layered structure of the Earth's crust. The shear wave velocities (v_s) model of the Earth's crust beneath northern Thailand resulting from the previous study will be converted to densities (ρ) and compressional wave velocities (v_p) using selected correlation formulas. These values are used to derive the thermophysical parameters (e.g., heat generation, heat flow, and thermal conductivity) in combination with previous knowledge from observations, approximations, and laboratory experiments. From derived thermophysical parameters under thermal equilibrium and steady-state conductive conditions, the temperature-depth profiles (geotherms) are constructed to estimate thermal crustal structures beneath the Northern Thailand region. Three thermal boundaries, including the brittle-ductile transition (BDT), the Curie point depth (CPD), and the base of the uppermost mantle or lithosphere base, are examined, each boundary serving as a crucial marker in the geological context. The BDT's temperature signifies the point at which quartz and feldspar compositions begin to exhibit ductile behavior, subsequently marking the termination depth for shallow earthquakes. Therefore, the BDT depth of the Northern Thailand region is indicated from the base of the seismogenic zone or cutout depth encompassing 95% of local earthquakes (D95) and then correlated with all geotherms functions to obtain the average temperature of BDT which is equal to 318.7 ℃. The temperature of 550 ℃ indicates CPD, the temperature at the depth where magnetite loses its magnetic properties and typically serves as a thermal reference point. The depths at a temperature of 1200 ℃ are defined as the uppermost mantle base, which is an indicative boundary of the near-solidus state as temperature increases. The study reveals linear relationships among geological boundaries, such as the correlations between the upper-lower crust boundary and the BDT or CPD. The BDT in the shallow crust aligns with the upper-lower crust boundary and vice versa for the CPD. The uppermost mantle base depth suggests a subduction process between the Sibumasu Terrane and Inthanon Zone.

Keywords: thermal structure, geotherm, brittle-ductile transition, Curie point depth, lithosphere