Geodynamics of Sibumasu Block in Southern Thailand: Interpretation from Heat Flow Map

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Southern Thailand, located on the thick and stable Sibumasu continental block, is known for its high heat flow despite lacking volcanic activity (Sautter *et al*., 2017). This study employs the Curie Point Depth (CPD) calculation, an indirect method, to evaluate land heat flow (e.g., Hsieh *et al*., 2014; Li *et al*., 2017; Qudsi, 2019). By analyzing airborne magnetic data and utilizing spectral analysis, the study generates CPD, thermal gradient, and heat flow maps for southern Thailand (e.g., Carrillo-de la Cruz *et al*., 2020; Núñez Demarco *et al*., 2021). The findings reveal heat flow values ranging from 61.54 mW/m² to 154.25 mW/m², with an average of 90.36 mW/m², surpassing the typical heat flow of 65 mW/m² for continental crust (Turcotte & Schubert, 2002). The study identifies five distinct zones characterized by higher heat flow compared to the surrounding areas: the Ranong fault zone (RF), Khlong Marui fault zone (KMF), coastline of Surat Thani and Nakhon Si Thammarat, Trang and Satun zone, and the Bentong-Roab suture (BRS). The RF and KMF represent active strike-slip faults that penetrate the continental crust into the upper mantle (Kanjanapayont *et al*., 2012; Sautter *et al*., 2017), while the BRS denotes a weak zone marking the suture between Sibumasu and Indochina terranes (Metcalfe, 2000), potentially extending into the mantle. The elevated heat flow observed along the coastline of Surat Thani and Nakhon Si Thammarat, as well as in the Trang and Satun zone, may be influenced by burial faults or fractures. Interpretation with P-wave tomography suggests a possible high heat mantle anomaly under southern Thailand (Huang *et al*., 2015). These initial findings suggest that the high heat flow in the thick and stable continental crust of Sibumasu originates from mantle upwelling caused by surrounding subducted plates under Eurasia. These heat sources manifest through weak zones in extensional regimes such as the RF, KMF, and possible undefined burial faults or fractures, as well as the BRS. The study provides preliminary understanding of present-day geodynamics of the Sibumasu block and its potential implications for mineral resources, petroleum exploration, geothermal energy, and carbon capture and storage.

References

Carrillo-de la Cruz J.L., Prol-Ledesma R.M., Velázquez-Sánchez P. & Gómez-Rodríguez D., 2020. MAGCPD: a MATLAB-based GUI to calculate the Curie point-depth involving the spectral analysis of aeromagnetic data. *Earth Science Informatics*, 13(4): 1539–1550. https://doi.org/10.1007/s12145-020-00525-x.

Hsieh H.H., Chen C.H., Lin P.Y. & Yen H.Y., 2014. Curie point depth from spectral analysis of magnetic data in Taiwan. *Journal of Asian Earth Sciences*, 90: 26–33. https://doi.org/10.1016/j.jseaes.2014.04.007.

Huang Z., Zhao D. & Wang L., 2015. P wave tomography and anisotropy beneath Southeast Asia: Insight into mantle dynamics. *Journal of Geophysical Research: Solid Earth*, 120(7): 5154–5174. https://doi.org/10.1002/2015JB012098.

Kanjanapayont P., Grasemann B., Edwards M.A. & Fritz H., 2012. Quantitative kinematic analysis within the Khlong Marui shear zone, southern Thailand. *Journal of Structural Geology*, 35: 17–27. https://doi.org/10.1016/j.jsg.2011.12.002.

Li C.F., Lu Y. & Wang J., 2017. A global reference model of Curie-point depths based on EMAG2. *Scientific Reports*, 7(1): 45129. https://doi.org/10.1038/srep45129.

Metcalfe I., 2000. The Bentong–Raub Suture Zone. *Journal of Asian Earth Sciences*, 18(6): 691–712. https://doi.org/10.1016/S1367-9120(00)00043-2.

Núñez Demarco P., Prezzi C. & Sánchez Bettucci L., 2021. Review of Curie point depth determination through different spectral methods applied to magnetic data. *Geophysical Journal International*, 224(1): 17–39. https://doi.org/10.1093/gji/ggaa361.

Qudsi I., 2019. Curie point depth mapping underneath Botswana for geothermal prospect identification using aeromagnetic data (Master thesis, University of Twente). http://essay.utwente.nl/83453/1/qudsi.pdf.

Sautter B., Pubellier M., Jousselin P., Dattilo P., Kerdraon Y., Choong C.M. & Menier D., 2017. Late Paleogene rifting along the Malay Peninsula thickened crust. *Tectonophysics*, 710–711: 205–224. https://doi.org/10.1016/j.tecto.2016.11.035.

eISSN 2353-3641 | ISSN 1731-0830