IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024

Unveiling Antarctica's Heat: A Review of Geothermal Heat Flow Estimation and the Rise of Machine Learning

Priyanka Barikrao Palve and Prof. S. P. Vidhate
Department of Computer Engineering
Vishwabharati Academy's College Of Engineering, Sarola Baddi, Ahmednagar, India

Abstract: *Antarctica, characterized by its extreme environment and sparse data availability, presents a formidable challenge for estimating geothermal heat flow, a key parameter influencing its geological and glaciological processes. This review paper analyzes existing literature surveys on predicting geothermal heat flow in Antarctica, focusing on various methodologies employed, data sources utilized, and challenges encountered. Highlight the transition from traditional techniques reliant on sparse direct measurements to adopting machine learning (ML) approaches leveraging diverse datasets. The review synthesizes insights from studies utilizing geological, geophysical, and remote sensing data, alongside advancements in ML algorithms, to improve the spatial resolution and accuracy of heat flow predictions. Through a comprehensive examination of the literature, identify key trends, knowledge gaps, and future directions for research in this critical domain.*

Keywords: component, formatting, style, styling, insert

REFERENCES

[1]. M. Lösing, J. Ebbing, "Predicting Geothermal Heat Flow in Antarctica With a Machine Learning Approach,"Journal of Geophysical Research: Solid Earth, 2021

[2]. Anya M. Reading, Tobias Stål, Jacqueline A. Halpin, Mareen Lösing, Jörg Ebbing, Weisen Shen, Felicity S. McCormack, Christine S. Siddoway & Derrick Hasterok, "Antarctic geothermal heat flow and its implications for tectonics and ice sheets," nature reviews Earth & environment, 2022

[3]. Whitehouse, P. L., Gomez, N., King, M. A. & Wiens, D. A. Solid Earth change and the evolution of the Antarctic Ice Sheet. Nat. Commun. 10, 503 (2019).

[4]. Stål, T. et al. Properties and biases of the global heat flow compilation. Front. Earth Sci., 2022

[5]. Amatulli, G., McInerney, D., Sethi, T., Strobl, P., and Domisch, S. (2020). Geomorpho90m, empirical evaluation and accuracy assessment of global high-resolution geomorphometric layers. *Sci. Data, 2020*

[6]. Artemieva, I. M. (2022). Antarctica ice sheet basal melting enhanced by high mantle heat. *Earth-Science Rev*

[7]. N.R. Golledge, E.D. Keller, N. Gomez, et al., "Global environmental consequences of twenty-first-century ice-sheet melt,"Nature, 566 (2019)

[8]. JW Goodge, "Crustal heat production and estimate of terrestrial heat flow in central East Antarctica, with implications for thermal input to the East Antarctic ice sheet," Cryosphere, 12 (2018)

[9]. E. Rignot, J. Mouginot, B. Scheuchl, et al."Four decades of Antarctic Ice Sheet mass balance" Proc. Natl. Acad. Sci. U. S. A., 116 (2019)

[10]. W. Shen, D.A. Wiens, A.J. Lloyd, A.A. Nyblade, "A geothermal heat flux map of Antarctica empirically constrained by seismic structure," Geophys. Res. Lett., 47 (2020)

[11]. T. Stål, A.M. Reading, J.A. Halpin, J.M. Whittaker, "Antarctic geothermal heat flow model: Aq1", Geochem. Geophys. Geosyst., 22 (2020)

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024

[12]. P. Talalay, Y. Li, L. Augustin, et al., "Geothermal flux beneath the Antarctic Ice Sheet derived from measured temperature profiles in deep boreholes," Cryosphere (2020)

[13]. Burton-Johnson, A., Dziadek, R., and Martin, C. (2020). Geothermal heat flow in Antarctica: Current and future directions. *Cryosphere Discuss., 2020*

[14]. Colgan, W., Wansing, A., Mankoff, K., Lösing, M., Hopper, J., Louden, K., et al. (2022). Greenland geothermal heat flow database and map (version 1). *Earth Syst. Sci, 2022*

[15]. Goes, S., Hasterok, D., Schutt, D. L., and Klöcking, M. (2020). Continental lithospheric temperatures: A review. *Phys. Earth Planet. Interiors, 2020*

[16]. Haeger, C., Kaban, M. K., Tesauro, M., Petrunin, A. G., and Mooney, W. D. (2019). 3-D density, thermal, and compositional model of the antarctic lithosphere and implications for its evolution. *Geochem. Geophys. Geosyst.2019*

[17]. Hasterok, D., Halpin, J., Collins, A., Hand, M., Kreemer, C., Gard, M., et al. (2022). New maps of global geological provinces and tectonic plates. *Earth-Science Rev, 2022*

[18]. M.L. Blades *et al.,* "Age and hafnium isotope evolution of Sudanese Butana and Chad illuminates the Stenian to Ediacaran evolution of the south and east Sahara," Precambrian Res., (2021)

[19]. Li, M., Huang, S., Dong, M., Xu, Y., Hao, T., Wu, X., et al. (2021). Prediction of marine heat flow based on the random forest method and geological and geophysical features. *Mar. Geophys. Res., 2021*

[20]. Lösing, M., Ebbing, J., and Szwillus, W. (2020). Geothermal heat flux in Antarctica: Assessing models and observations by Bayesian inversion. *Front. Earth Sci. (Lausanne).*

[21]. Lucazeau, F. (2019). Analysis and mapping of an updated terrestrial heat flow data set. *Geochem. Geophys. Geosyst.*

[22]. Shen, W., Wiens, D. A., Lloyd, A. J., and Nyblade, A. A. A. (2020). A geothermal heat flux map of Antarctica empirically constrained by seismic structure. *Geophys. Res. Lett.*

[23]. Stål, T., Reading, A. M., Halpin, J. A., and Whittaker, J. M. (2021). Antarctic geothermal heat flow model: Aq1. *Geochem. Geophys. Geosyst*

[24]. Gard, M., Hasterok, D. & Halpin, J. A. Global whole-rock geochemical database compilation. Earth Syst. Sci. Data 11, 1553–1566 (2019).

[25]. Gard, M., Hasterok, D., Hand, M. & Cox, G. Variations in continental heat production from 4 Ga to the present: evidence from geochemical data. Lithos 342–343, 391–406 (2019).

[26]. Goes, S., Hasterok, D., Schutt, D. L. & Klocking, M. Continental lithospheric temperatures: a review. Phys. Earth Planet. Inter. 306, 106509 (2020).

[27]. Mony, L., Roberts, J. L. & Halpin, J. A. Inferring geothermal heat flux from an ice-borehole temperature profile at Law Dome, East Antarctica. J. Glaciol. 66, 509–519 (2020).

[28]. Lucazeau, F. Analysis and mapping of an updated terrestrial heat flow data set. Geochem. Geophys. Geosyst. 20, 4001–4024 (2019).

[29]. Artemieva, I. M., Thybo, H., Jakobsen, K., Sorensen, N. K. & Nielsen, L. S. Heat production in granitic rocks: global analysis based on a new data compilation. Earth Sci. Rev. 172, 1–26 (2017)

[30]. Willcocks, S., Hasterok, D. & Jennings, S. Thermal refraction: implications for subglacial heat flux. J. Glaciol. 67, 875–884 (2021)

[31]. Dow, C. et al. Totten glacier subglacial hydrology determined from geophysics and modeling. Earth Planet. Sci. Lett. 531, 115961 (2020).

[32]. Jordan, T. A. et al. Anomalously high geothermal flux near the South Pole. Sci. Rep. 8, 16785 (2018)

[33]. Macelloni, G. et al. On the retrieval of internal temperature of Antarctica Ice Sheet by using SMOS observations. Remote. Sens. Environ. 233, 111405 (2019).

[34]. Fudge, T. J., Biyani, S. C., Clemens-Sewall, D. & Hawley, R. L. Constraining geothermal flux at coastal domes of the Ross Ice Sheet, Antarctica. Geophys. Res. Lett. 46, 13090–13098 (2019).

[35]. Jordan, T. A., Riley, T. R. & Siddoway, C. S. The geological history and evolution of West Antarctica. Nat. Rev. Earth Environ. 1, 117–133 (2020).