UNIVERSITAS
GADJAH MADA
Pemodelan 3D Perpindahan Panas (Heat Transfer) pada Sistem Panas Bumi Dieng Menggunakan Software COMSOL Multiphysics
Alaina Icvia Maulida, Prof. Dr. Ir. Agung Harijoko, S.T., M.Eng., IPM.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

DAFTAR PUSTAKA

Akbar, R. (2017). *Pemodelan lapangan panasbumi Dieng, Indonesia dengan software Petrasim*. ReTII.

Aliyu, M. D., & Archer, R. A. (2021). Numerical simulation of multifracture HDR geothermal reservoirs. *Renewable Energy, 164*, 541–555.

Aliyu, M. D., & Archer, R. A. (2021). A thermo-hydro-mechanical model of a hot dry rock geothermal reservoir. *Renewable Energy, 176*, 475–493.

Aliyu, M. D., & Chen, H. P. (2018). Enhanced geothermal system modelling with multiple pore media: Thermo-hydraulic coupled processes. *Energy, 165*, 931–948.

Andersen, C., & Weis, P. (2020). Heat transfer from convecting magma reservoirs to hydrothermal fluid flow systems constrained by coupled numerical modeling. *Geophysical Research Letters, 47*(23), e2020GL089463.

Annen, C., Blundy, J. D., & Sparks, R. S. J. (2006). The genesis of intermediate and silicic magmas in deep crustal hot zones. *Journal of Petrology, 47*(3), 505–539.

Audet, P., Currie, C. A., Schaeffer, A. J., & Hill, A. M. (2019). Seismic evidence for lithospheric thinning and heat in the northern Canadian Cordillera. *Geophysical Research Letters, 46*(8), 4249–4257.

Awang, H. S., & Margaretha, E. M. P. (2002). Lekukan struktur Jawa Tengah: Suatu segmentasi sesar mendasar. *Basement Tectonics of Central Java, Indonesian Association of Geologists (IAGI) Yogyakarta–Central Java Section: Geology of Yogyakarta and Central Java*.

Axelsson, G., & Gunnlaugsson, E. (2000, May). Geothermal utilization, management and monitoring, in long-term monitoring of high and low-enthalpy fields under exploitation. In *World Geothermal Congress* (pp. 3–10).

Boedihardi, M., & Suranto, S. S. (1991). *Evaluation of the Dieng geothermal field: Review of development strategy*.

Bogie, I., Sugiono, S. R., & Malik, D. (2010). Volcanic landforms that mark the successfully developed geothermal systems of Java, Indonesia identified from ASTER satellite imagery. In *Proceedings World Geothermal Congress*.

Carslaw, H., & Jaeger, J. (1959). *Conduction of heat in solids* (2nd ed.). Oxford University Press.

Clauser, C., & Huenges, E. (1995). Thermal conductivity of rocks and minerals. In T. J. Ahrens (Ed.), *Rock physics and phase relations: A handbook of physical constants* (pp. 105–126). American Geophysical Union.

UNIVERSITAS
GADJAH MADA
Pemodelan 3D Perpindahan Panas (Heat Transfer) pada Sistem Panas Bumi Dieng Menggunakan Software COMSOL Multiphysics
Alaina Icvia Maulida, Prof. Dr. Ir. Agung Harijoko, S.T., M.Eng., IPM.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Clauser, C., & Villinger, H. (1990). Analysis of conductive and convective heat transfer in a sedimentary basin, demonstrated for the Rheingraben. *Geophysical Journal International, 100*(3), 393–414.

Clauser, C., Huenges, E., & Ahrens, T. J. (1995). *Rock physics and phase relations: A handbook of physical constants*. American Geophysical Union.

COMSOL. (2022). *COMSOL Multiphysics reference manual* (Version 6.0). COMSOL Inc. https://www.comsol.com/documentation

Coumou, D., Driesner, T., & Heinrich, C. A. (2008). The structure and dynamics of mid-ocean ridge hydrothermal systems. *Science, 321*(5897), 1825–1828.

Curewitz, D., & Karson, J. A. (1997). Structural settings of hydrothermal outflow: Fracture permeability maintained by fault propagation and interaction. *Journal of Volcanology and Geothermal Research, 79*(3–4), 149–168.

De Paoli, C., Orban, P., N'Depo, Y., Dupont, N., Martin, T., Fernandez Acevedo, E., Moermans, G., Neven, T., Schelings, C., Teller, J., Kaufmann, O., Harcouët-Menou, V., & Dassargues, A. (2024, September). *Simulating heat transfer for geothermal energy and heat storage in a flooded legacy coal mine in Liège (Belgium).* In *World Groundwater Congress IAH 2024*.

Dickson, M. H., & Fanelli, M. (2013). *Geothermal energy: Utilization and technology*. Routledge.

Fanwen, M., Jiangtao, H., Wenyu, L., & Lijia, L. (2021). Magmatic geothermal genesis model in the Huailai area based on the constraints of the crust–mantle-scale geoelectric structure. *Applied Sciences, 11*(5), 2086.

Faulds, J. E., Coolbaugh, M. F., Benoit, D., Oppliger, G., Perkins, M., Moeck, I., & Drakos, P. (2010). Structural controls of geothermal activity in the northern Hot Springs Mountains, western Nevada: The tale of three geothermal systems (Brady's, Desert Peak, and Desert Queen). *Geothermal Resources Council Transactions, 34*, 675–683.

Fournier, R. O. (1977). Chemical geothermometers and mixing models for geothermal systems. *Geothermics, 5*(1–4), 41–50.

Gelman, S. E., Gutiérrez, F. J., & Bachmann, O. (2013). On the longevity of large upper crustal silicic magma reservoirs. *Geology, 41*(7), 759–762.

Giggenbach, W. F. (1988). Geothermal solute equilibria: Derivation of Na-K-Mg-Ca geoindicators. *Geochimica et Cosmochimica Acta, 52*(12), 2749–2765.

Goff, F., & Janik, C. J. (2000). Geothermal system. In H. Sigurdsson (Ed.), *Encyclopedia of volcanoes* (pp. 817–834). Academic Press.

UNIVERSITAS
GADJAH MADA
Pemodelan 3D Perpindahan Panas (Heat Transfer) pada Sistem Panas Bumi Dieng Menggunakan Software COMSOL Multiphysics
Alaina Icvia Maulida, Prof. Dr. Ir. Agung Harijoko, S.T., M.Eng., IPM.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

González, J., Zambra, C. E., González, L., Clausen, B., & Vasco, D. A. (2022). Simulation of cooling in a magma chamber: Implications for geothermal fields of southern Peru. *Geothermics, 105*, 102515.

González-Acevedo, Z. I., & García-Zarate, M. A. (2018). Geothermal energy as an alternative to reduce atmospheric emissions and provide green energy. In *Green technologies to improve the environment on Earth*. IntechOpen.

Grant, M. A., & Bixley, P. F. (2011). *Geothermal reservoir engineering*. Academic Press.

Grehenson, G. (2024). Pemanfaatan energi geothermal masih 11%, ini tanggapan pakar geologi UGM. https://ugm.ac.id/id/berita/pemanfaatan-energi-geothermal-masih-11-ini-tanggapan-pakar-geologi-ugm/

Guan, J., Wan, W., Wang, Y., Qu, Z., Zhang, Q., Luo, J., Zhang, X., & Zhao, X. (2025). Thermal properties and geothermal effects of magmatic rocks in Jiangsu Province, China. *Geosciences, 16*(1), 6.

Guerrero, F. J., Sosa-Ceballos, G., Prol-Ledesma, R. M., Jácome-Paz, M. P., Calò, M., de la Cruz, L. M., & Macías, J. L. (2021). A numerical model for the magmatic heat reservoir of the Las Tres Virgenes volcanic complex, Baja California Sur, Mexico. *Journal of Volcanology and Geothermal Research, 414*, 107227.

Hamilton, W. B. (1979). *Tectonics of the Indonesian region* (No. 1078). U.S. Government Printing Office.

Harijoko, A., Uruma, R., Wibowo, H. E., Setijadji, L. D., Imai, A., Yonezu, K., & Watanabe, K. (2016). Geochronology and magmatic evolution of the Dieng Volcanic Complex, Central Java, Indonesia and their relationships to geothermal resources. *Journal of Volcanology and Geothermal Research, 310*, 209–224.

Haryanto, I. (2006). Struktur geologi Paleogen dan Neogen di Jawa Barat. *Bulletin of Scientific Contribution, 4*(1), 88–95.

Hayba, D. O., & Ingebritsen, S. E. (1997). Multiphase groundwater flow near cooling plutons. *Journal of Geophysical Research: Solid Earth, 102*(B6), 12235–12252.

Heap, M. J., Kushnir, A. R., Vasseur, J., Wadsworth, F. B., Harlé, P., Baud, P., Kennedy, B. M., Troll, V. R., & Deegan, F. M. (2020). The thermal properties of porous andesite. *Journal of Volcanology and Geothermal Research, 398*, 106901.

Hochstein, M. P., & Browne, P. R. (2000). Surface manifestations of geothermal systems with volcanic heat sources. In *Encyclopedia of volcanoes*. Academic Press.

Hochstein, M. P., & Sudarman, S. (2008). History of geothermal exploration in Indonesia from 1970 to 2000. *Geothermics, 37*(3), 220–266.

Hochstein, M. P., & Sudarman, S. (2015, April). Indonesian volcanic geothermal systems. In *Proceedings World Geothermal Congress* (pp. 19–25). World Geothermal Congress 2015 Melbourne.

UNIVERSITAS
GADJAH MADA
Pemodelan 3D Perpindahan Panas (Heat Transfer) pada Sistem Panas Bumi Dieng Menggunakan Software COMSOL Multiphysics
Alaina Icvia Maulida, Prof. Dr. Ir. Agung Harijoko, S.T., M.Eng., IPM.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Hochstein, M. P., Zhongke, Y., & Ehara, S. (1990). The Fuzhou geothermal system (People's Republic of China): Modelling study of a low temperature fracture-zone system. *Geothermics, 19*(1), 43–60.

Hurley, M. J., Gottuk, D. T., Hall, J. R., Jr., Harada, K., Kuligowski, E. D., Puchovsky, M., Torero, J. L., Watts, J. M., Jr., & Wieczorek, C. J. (Eds.). (2015). *SFPE handbook of fire protection engineering*. Springer.

Incropera, F. P., DeWitt, D. P., Bergman, T. L., & Lavine, A. S. (1990). *Fundamentals of heat and mass transfer* (Vol. 6). Wiley.

Ingebritsen, S. E., Sanford, W. E., & Neuzil, C. E. (1998). *Groundwater in geologic processes*. Cambridge University Press.

Jovian, A. H. (2025). *Rekonstruksi sistem magma Gunung Pagerkandang, Gunung Merdada dan Gunung Pakuwaja, Kompleks Vulkanik Dieng, Jawa Tengah, Indonesia* [Tesis magister, Universitas Gadjah Mada].

Lagardère, C., Do Couto, D., Verlaguet, A., Jolivet, L., Leroy, S., & Gola, G. (2025, April). Thermo-hydro-mechanical modelling of the Larderello geothermal system, Tuscany, Italy: Emphasis on the role of tectonic structures. In *EGU General Assembly 2025*.

Lesher, C. E., & Spera, F. J. (2015). Thermodynamic and transport properties of silicate melts and magma. In *The encyclopedia of volcanoes* (pp. 113–141). Academic Press.

Lienhard, J. H. (2020). *A heat transfer textbook* (5th ed.). Dover Books on Engineering.

Liu, H., Wang, H., Lei, H., Zhang, L., Bai, M., & Zhou, L. (2020). Numerical modeling of thermal breakthrough induced by geothermal production in fractured granite. *Journal of Rock Mechanics and Geotechnical Engineering, 12*(4), 900–916.

Logan, D. L. (2011). *A first course in the finite element method* (Vol. 4). Thomson.

Logg, A., Mardal, K. A., Wells, G. N., et al. (2012). *Automated solution of differential equations by the finite element method*. Springer. https://doi.org/10.1007/978-3-642-23099-8

Luthfian, A. (2014). *Geologi regional Dieng* [Skripsi].

Magnúsdóttir, M. (2024). *Integrating wind and geothermal energy to strengthen the renewable energy portfolio in Iceland* [Doctoral dissertation].

Matsumoto, M., Ehara, S., Fujimitsu, Y., & Nishijima, J. (2006). Numerical investigation on cooling process of a magma chamber in geothermal system: Suggestion of a numerical model and analysis of early cooling process. *Journal of the Geothermal Research Society of Japan, 28*(4), 413–430.

Maulida, A. I. (2023). *Geologi dan geokimia fluida dari lapangan panas bumi Dieng, Jawa Tengah* [Skripsi].

UNIVERSITAS
GADJAH MADA
Pemodelan 3D Perpindahan Panas (Heat Transfer) pada Sistem Panas Bumi Dieng Menggunakan Software COMSOL Multiphysics
Alaina Icvia Maulida, Prof. Dr. Ir. Agung Harijoko, S.T., M.Eng., IPM.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Moeck, I. S. (2014). Catalog of geothermal play types based on geologic controls. *Renewable and Sustainable Energy Reviews, 37*, 867–882.

Nicholson, K. (1993). *Geothermal fluids: Chemistry and exploration techniques*. Springer Science & Business Media.

Nield, D. A., & Bejan, A. (2006). *Convection in porous media* (Vol. 3). Springer.

Noorollahi, Y., Golshanfard, A., Ansaripour, S., Khaledi, A., & Shadi, M. (2021). Solar energy for sustainable heating and cooling energy system planning in arid climates. *Energy, 218*, 119421.

Nurpratama, M. I., Atmaja, R. W., Wibowo, Y. T., Harijoko, A., Husein, S., Sudarno, I., Setianto, A., & Utami, P. (2015). Detailed surface structural mapping of the Dieng Geothermal Field in Indonesia. In *World Geothermal Congress*.

Olasolo, P., Juárez, M. C., Morales, M. P., & Liarte, I. A. (2016). Enhanced geothermal systems (EGS): A review. *Renewable and Sustainable Energy Reviews, 56*, 133–144.

O'Sullivan, M. J., Yeh, A., & Mannington, W. I. (2009). A history of numerical modelling of the Wairakei geothermal field. *Geothermics, 38*(1), 155–168.

Pramudiohadi, E. W. (2007, June). Pemodelan reservoir lapangan panasbumi Dieng Blok Sileri. In *Prosiding Seminar Nasional 2007* (pp. 22-1). Fakultas Teknologi Mineral UPN "Veteran" Yogyakarta.

Purnomo, J., & Purwoko. (1994). Kerangka tektonik dan stratigrafi Pulau Jawa secara regional dan kaitannya dengan potensi hidrokarbon. In *Proceedings Geologi dan Geotektonik Pulau Jawa: Seminar Jurusan Teknik Geologi, Fakultas Teknik*.

Qarinur, M., Ogata, S., Kinoshita, N., & Yasuhara, H. (2020). Predictions of rock temperature evolution at the Lahendong geothermal field by coupled numerical model with discrete fracture model scheme. *Energies, 13*(12), 3282.

Raguenel, M., Driesner, T., & Bonneau, F. (2019). Numerical modeling of the geothermal hydrology of the Volcanic Island of Basse-Terre, Guadeloupe. *Geothermal Energy, 7*(1), 28.

Rui, F., Zhao, G. F., Zhang, Y., Fan, L., & Zhao, X. (2024). Study on the mechanism of rock damage under microwave and laser irradiation through multiscale and multiphysics numerical modelling. *Rock Mechanics and Rock Engineering, 57*(2), 1079–1102.

Rumpf, M. E., Williams, K., & Kestay, L. (2018). *A multi-phase heat transfer model of cooling lava*. COMSOL. https://www.comsol.com/paper/a-multi-phase-heat-transfer-model-of-cooling-lava-66842

UNIVERSITAS
GADJAH MADA
Pemodelan 3D Perpindahan Panas (Heat Transfer) pada Sistem Panas Bumi Dieng Menggunakan Software COMSOL Multiphysics
Alaina Icvia Maulida, Prof. Dr. Ir. Agung Harijoko, S.T., M.Eng., IPM.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Salsabilla, N. S., & Hsieh, J. C. (2024). Numerical study for effect of injection parameters on reservoir: A case study for Lahendong, Indonesia. In *E3S Web of Conferences* (Vol. 479, p. 01002). EDP Sciences.

Scott, S. W., O'Sullivan, J. P., Maclaren, O. J., Nicholson, R., Covell, C., Newson, J., & Guðjónsdóttír, M. S. (2022). Bayesian calibration of a natural state geothermal reservoir model, Krafla, North Iceland. *Water Resources Research, 58*(2), e2021WR031254.

Shalihin, M. G. J., Darmawan, D., Abi Tiyana, R., & Chandra, V. R. (2022). The geology and geothermal system of the Dieng Geothermal Field, Central Java, Indonesia. In *Proceeding 47th Workshop on Geothermal Reservoir Engineering* (pp. 622–625).

Simandjuntak, T. O., & Barber, A. J. (1996). Contrasting tectonic styles in the Neogene orogenic belts of Indonesia. *Geological Society, London, Special Publications, 106*(1), 185–201.

Sirait, P., Ridwan, R. H., & Battistelli, A. (2015). Reservoir modeling for development capacity of Dieng geothermal field, Indonesia. In *Fortieth Workshop on Geothermal Reservoir Engineering*. Stanford University.

Stacey, F. D., & Davis, P. M. (2008). *Physics of the Earth*. Cambridge University Press.

Sudrajat, M. A., & Susilo, B. K. (2020). Analisis tingkat kerawanan longsor menggunakan metode fuzzy logic dan kinematik daerah Giyombong dan sekitarnya, Jawa Tengah. *Prosiding Applicable Innovation of Engineering and Science Research, 2020*(1), 526–534.

Suhendro, I., Isnain, M. N., & Wahyudi, R. (2022). Rock characteristics of post-caldera volcanoes in Dieng volcanic complex (DVC), Central Java, Indonesia. *Journal of Geoscience, Engineering, Environment, and Technology, 7*(4), 151–157.

Sukhyar, R. (1994). Dieng Plateau, Central Java. In *Guidebook of the 1994: Fifth Field Workshop on Volcanic Gases, Volcanological Survey of Indonesia, Bandung*.

Suwana, A. (1986). *Chemistry of the Dieng geothermal system*. *Geothermal Diploma Project Report, 86*.

Thorgilsson, G., Axelsson, G., Berthet, J. C., Magnúsdóttir, L., Árnason, K., Gunnarsson, G., & Júlíusson, E. (2018). Modelling of the deep roots of volcanic geothermal systems. In *Proceedings of the Forty-Second Workshop on Geothermal Reservoir Engineering*.

Turcotte, D. L., & Schubert, G. (2014). *Geodynamics*. Cambridge University Press.

van Bemmelen, R. W. (1949). *General geology of Indonesia and adjacent archipelagoes*. In *The geology of Indonesia*.

UNIVERSITAS
GADJAH MADA
Pemodelan 3D Perpindahan Panas (Heat Transfer) pada Sistem Panas Bumi Dieng Menggunakan Software COMSOL Multiphysics
Alaina Icvia Maulida, Prof. Dr. Ir. Agung Harijoko, S.T., M.Eng., IPM.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

van Bergen, M. J., Bernard, A., Sumarti, S., Sriwana, T., & Sitorus, K. (2000). *Crater lakes of Java: Dieng, Kelud and Ijen*. Excursion Guidebook, IAVCEI General Assembly, Bali-2000.

Verma, S. P., & Gómez-Arias, E. (2013). Three-dimensional thermal sensitivity analysis of cooling of a magma chamber in the Los Azufres geothermal field, Michoacán, Mexico. *Geothermal Energy, 1*(1), 5.

Vosteen, H. D., & Schellschmidt, R. (2003). Influence of temperature on thermal conductivity, thermal capacity and thermal diffusivity for different types of rock. *Physics and Chemistry of the Earth, Parts A/B/C, 28*(9–11), 499–509.

Wang, D., Wu, X., Zhao, P., Fang, H., Dang, Z., Shi, Z., & Huo, C. (2025). Comparative investigation of the heat extraction performance of an enhanced geothermal system using H_2, CO_2, and H_2O as working fluids. *Energy Geoscience*, 100429.

Watanabe, N., Saito, K., Okamoto, A., Nakamura, K., Ishibashi, T., Saishu, H., Komai, T., & Tsuchiya, N. (2020). Stabilizing and enhancing permeability for sustainable and profitable energy extraction from superhot geothermal environments. *Applied Energy, 260*, 114306.

Wiyuda, M. A., Samodra, S. B., & Utami, P. (2022). Investigasi bawah permukaan pada area Kawah Sikidang, Dieng, Jawa Tengah menggunakan metode geolistrik. *Journal of Applied Geoscience and Engineering, 1*(2), 82–92.

Wohletz, K., & Heiken, G. (1992). *Volcanology and geothermal energy*. University of California Press.

Xiong, W. (2010). *Applications of COMSOL Multiphysics software to heat transfer processes* [Thesis, Arcada – Nylands svenska yrkeshögskola]. https://www.theseus.fi/handle/10024/17165

Zambra, C. E., Gonzalez-Olivares, L., González, J., & Clausen, B. (2022). Temporal evolution of cooling by natural convection in an enclosed magma chamber. *Processes, 10*(1), 108.

Zen, M. T. (1971). Geothermal system of the Dieng-Batur volcanic complex. *Proceedings, Institut Teknologi Bandung, 6*(1).

Zienkiewicz, O. C., & Taylor, R. L. (2005). *The finite element method for solid and structural mechanics*. Elsevier.

Zoth, G., & Hänel, R. (1988). Appendix. In *Handbook of terrestrial heat-flow density determination* (pp. 449–466). Kluwer.