



## MATTHEW D. MINNICK, PhD

### GEOHERMAL & CCUS PROGRAM MANAGER

#### OVERVIEW

Dr. Matthew (Matt) Minnick has 17 years of experience in geological engineering focused on geothermal resource assessment, subsurface flow modeling, 3D earth modeling, advanced GIS applications, and geohydrology. He is active in project management and business development to expand RESPEC's services in geothermal and hydrogeology. His geothermal experience ranges from traditional high-enthalpy systems in the Taupo Volcanic Zone of New Zealand and volcanic arc systems in Colombia, South America, to lower-enthalpy, sedimentary heat reservoirs, and direct-use applications. He is an active member of the Geothermal Resources Council. His geothermal clients include Mercury Energy (formerly Mighty River Power), Dewhurst Group, DEEP Earth Energy Corporation (DEEP), and Clarke Lake Geothermal Partnership (CLGP). He is the Chief Reservoir Engineer on the CLGP and DEEP and is responsible for all subsurface geothermal resource characterization, reservoir modeling, wellfield development, and engineering. He is on the technical review committee for the Latin America Geothermal Development Fund (LAGDF). The LAGDF is a geothermal risk mitigation fund run by KfW in Germany to support geothermal exploration projects in Central and South America. In addition to geothermal, his project experience includes two-phase flow numerical modeling, carbon capture storage (CCS), Underground Injection Control (UIC) Class I hazardous and non-hazardous and Class VI well permitting and reservoir engineering, slope stability investigations, materials testing, 3D geologic modeling, GIS data model design, and advanced spatial simulation development. Matt has extensive experience in subsurface flow simulation using multiple codes, including MODFLOW, MT3DMS, PARFLOW, SEEP2D, SWIFT, TOUGH3 and iTOUGH2, and CMG-GEM.

#### TECHNICAL EXPERIENCE

**Geothermal Resource Development and Reservoir Engineering.** Matt has been active in the geothermal industry since 2009. He has been involved in various geothermal development projects, including exploration, 3D conceptual modeling, geothermal data interpretation, well siting, site instrumentation, reservoir engineering, and resource management. He has been developing 3D conceptual geothermal reservoir models for Mighty River Power in New Zealand since 2009 and Dewhurst Group since 2012. He has been involved with modeling four high-temperature geothermal reservoirs in the Taupo Rift Zone at Rotokawa, Kawerau, Mokai, and Ngatamariki. He is actively modeling a geothermal greenfield in the Nereidas Valley on Colombia's west flank of the Nevada Del Ruiz Volcanic Massif. Matt developed custom applications for visualizing and analyzing geothermal reservoir data in CTECH's Mining Visualization Systems and MATLAB. He is the Chief Reservoir Engineer on the CLGP and is responsible for all subsurface geothermal resource characterization and engineering. He is on the technical review committee for the LAGDF. The LAGDF is a geothermal risk mitigation fund run by KfW in Germany to support geothermal exploration projects in Central and South America. Matt's experience with applications includes Micro Seismic hypocenter 4D visualizations, Magnetotelluric 3D Inversion integration, four-dimensional (4D) geochemistry trend modeling, and visualizing numeric geothermal reservoir simulation scenarios from TETRAD and TOUGH2. He assists DEEP in Saskatchewan, Canada, with sedimentary heat resource assessment and modeling, pilot well targeting, and drilling program development. This milestone project will be Canada's first geothermal power plant and commercial-scale sedimentary heat geothermal power plant in North America.

**Subsurface Flow Modeling.** Matt has extensive experience and training in subsurface flow modeling to simulate pressures, heat flow, and geochemistry in multiphase and multicomponent systems using a wide range of simulation codes. Matt has helped develop single-phase isothermal groundwater flow models in MODFLOW for the Piceance Basin, Colorado; Mount Bellevue, Texas; and Dewey Burdock, South Dakota;

#### TECHNICAL EXPERTISE

- / Geothermal Resource Development and Geothermal Reservoir Engineering
- / Subsurface Flow Modeling
- / Carbon Capture Storage
- / 3D Geological Modeling
- / Advanced Spatial Simulation and GIS Development
- / Data-Mining and Machine-Learning Methods
- / Geotechnical Engineering Slope Stability

#### EDUCATION

- / PhD in Geological Engineering, Minor in Computer Science, Colorado School of Mines, Golden, CO (2018)
- / MS in Geological Engineering, South Dakota School of Mines & Technology, Rapid City, SD (2008)
- / BS in Geological Engineering, South Dakota School of Mines & Technology, Rapid City, SD (2000)

#### REGISTRATIONS & LICENSES

- / Engineer-in-Training (EIT) in South Dakota

#### PROFESSIONAL MEMBERSHIPS

- / Association of Engineering Geologists
- / Geothermal Resources Council

#### CERTIFICATIONS & TRAINING

- / Lawrence Berkeley National Lab TOUGH2 Short Course (2012)
- / Lawrence Berkeley National Lab iTOUGH2 Short Course (2012)
- / ESRI Online Course, Building Effective Web Applications using ArcGIS API for Flex (2011)
- / ESRI Online Course, Creating Effective Web Applications using ArcGIS Server (2011)
- / CTECH Mining Visualization Systems Advanced Training Course (2008)

#### WORK HISTORY

- / RESPEC (2007–Present)
- / Colorado School of Mines (2009–2013)
- / FMG Engineering (2003–2004)



and for the Wharf Gold Mine in the Black Hills of South Dakota. He has also developed TOUGH3 and SWIFT reservoir simulations for UIC Class I injection-well plume-migration simulations and pressure buildup models. He recently completed a CCS permitting and engineering assessment using TOUGH3.

**3D Geological Modeling.** Matt has built 3D geological models of many different geologic settings for varying applications. These include in situ uranium mining, underground hydrocarbon storage caverns, salt domes, sinkholes, salt and potash deposits, and geothermal fields. He recently applied a neural network model of salt purity based on geophysical logs to predict salt quality and new well locations in a 3D structural framework.

**Advanced Spatial Simulation and GIS Development.** Matt has extensive experience developing advanced spatial simulations using ArcGIS, custom Data Models, geohydrologic systems models, and MATLAB. He has developed a GIS database and Web GIS mapping application for the Department of Energy that focuses on water resources related to oil shale development in the Piceance Basin of western Colorado. He has coded a spatial simulation of a commercial retorting operation in the Piceance Basin using MATLAB. This simulation uses an artificial intelligence algorithm known as Reinforcement Learning to control simulated retorting operations to predict oil production and water use.

**Data-Mining and Machine-Learning Methods.** During his PhD studies at the Colorado School of Mines, Matt focused on applying data mining and machine-learning methods to geoscience problems. He has used artificial intelligence algorithms for spatial simulations, neural networks for predictive 3D geological models, and classification studies for geothermal data interpolations. Matt's dissertation included research into applying reinforcement learning to multi-agent simulations to pseudo-optimize water resource utilization for oil shale retorting.

**Geotechnical Engineering Slope Stability.** Matt's Master of Science degree program focused on geotechnical applications primarily related to slope stability characterization, site investigations, modeling, and remediation. He did a regional landslide analysis for the Pennington County Planning Commission. The project entailed low-altitude flyovers and failure mapping, geotechnical drilling and soil sampling, soils strength testing, equilibrium modeling, and regional hazard mapping. Mr. Minnick also has 2 years of experience conducting geotechnical field investigations, material testing, and soils laboratory testing, including laboratory certification procedures for the United States Army Corp of Engineers.

## PUBLICATIONS & PRESENTATIONS

**Minnick, M. and Y. Champollion, 2024.** *DEEP Earth Energy Well Test Program Results Summary*, RSI-3407, prepared by RESPEC, Rapid City, SD, for DEEP Earth Energy Corporation, Saskatoon, SK.

**Minnick, M. and K. Glover, 2022.** *Calpine Sutter Carbon Capture & Storage Reservoir Simulation, Sutter County, California*, RSI-3242, prepared by RESPEC, Rapid City, SD, for Black & Veatch, Houston, TX.

**Minnick, M., E. Renaud, and Y. Champollion, 2021.** *Deep Geothermal Resource and Reservoir Engineering Feasibility Study*, RSI-3125, prepared by RESPEC, Rapid City, SD, for DEEP Earth Energy Corp., Saskatoon, SK.

**Minnick, M., D. Shewfelt, C. Hickson, J. Majorowicz, and T. Rowe, 2018.** *Nunavut Geothermal Feasibility Study*, RSI-2828, prepared by RESPEC, Saskatoon, SK; Tuya Terra Geo Corp., Burnaby, BC; and the Qikiqtaaluk Business Development Corp., Iqaluit, NU, for Qulliq Energy Corporation, Iqaluit, NU.

**Zhou, W., M. D. Minnick, and C. Cui, 2018.** "GIS for Natural Resources (Mineral, Energy, and Water)," *Comprehensive Geographic Information Systems*, B. Huang (ed.), Vol. 2, pp. 158–186.

**Minnick, M. D., 2017.** *Multi-Agent Simulation and Geospatial Infrastructure for Oil Shale Production and Water Resource Utilization in the Piceance Basin*, PhD thesis, Colorado School of Mines, Golden, CO.

**Minnick, M. D., 2016.** *Microseismic Uncertainty Envelop Visualization in Earth Volumetric Studios*, RSI-2668, prepared by RESPEC, Rapid City, SD, United States, for Mercury Energy, Rotorua, New Zealand.

**Minnick, M. D., W. Zhou, E. Mattson, M. Geza, and K. E. Murray, 2015.** "GIS-Based Geospatial Infrastructure of Water Resource Assessment for Supporting Oil Shale Development in Piceance Basin of Northwestern Colorado," *Computers and Geosciences*, Vol. 77, pp. 44–53.

**Minnick, M. D., 2013.** *Preliminary Three-Dimensional Conceptual Model and Prefeasibility Study, Nereidas Valley, Colombia*, RSI-2402, prepared by RESPEC, Rapid City, SD, for Dewhurst Group, LLC, Germantown, MD.

**Minnick, M. D., W. Zhou, and H. Y. Luo, 2012.** An Overview of GIS Applications in Landslide Susceptibility Study Through Case Studies, prepared by Colorado School of Mines, Department of Geology and Geological Engineering, Golden, CO (under review).



**Minnick, M. D. and W. Zhou, 2011.** "A Web Based Dynamic Water Resources Application for Oil Shale Development," *National Oil Shale Symposium*, Colorado School of Mines, Golden, CO, October 17–21.

**Minnick, M. D. and W. Zhou, 2010.** "3D Geologic Modeling of the Piceance Basin in Support of Dynamic Systems and Groundwater Modeling for Oil Shale Development," *National Oil Shale Symposium*, Colorado School of Mines, Golden CO, October 18–22.

**Minnick, M. D. and W. Zhou, 2009.** "GIS and Web Based Water Resources Management for Oil Shale Development, Part 1," *National Oil Shale Symposium*, Colorado School of Mines, Golden CO, October 19–21.

**Minnick, M. D., 2009.** *Preliminary Three-Dimensional Visualization of the Rotokawa Geothermal Field*, RSI-2081, prepared by RESPEC, Rapid City, SD, United States, for Mighty River Power, Auckland, New Zealand.

**Minnick, M. D., 2009.** *Capitan Reef Injection Well Impact Study*, RSI-2048, prepared by RESPEC, Rapid City, SD, for New Mexico Oil Conservation Division, Santa Fe, NM.

**Minnick, M. D. and A. L. Lisenbee, 2007.** *Historic Pollution Problems in Western Pennington County*, prepared for West Dakota Water Development District, Rapid City, SD.

**Minnick, M. D. and L. D. Stetler, 2007.** *Susceptibility for Slope Failure Due to Future Development and Land Use Along Highway 79 in the Hermosa NW Quadrangle, Pennington County*, prepared for Pennington County Planning Commission, Rapid City, SD.

**Minnick, M. D. and L. D. Stetler, 2007.** *Black Hills Development Suitability Risk Model*, RSI-1953, prepared by RESPEC, Rapid City, SD, for Pennington County Planning Department, Rapid City, SD.