

NAME: MAXWELL WILMARTH

Position: Senior Geologist

Technical Expertise: Resource Assessment, Conceptual Modelling, Wellsite Geology

Experience Summary

Maxwell Wilmarth has 15 years of experience in the Geothermal and Environmental Consulting Industries, of which 10 years have been solely devoted to Geothermal. Mr. Wilmarth has provided wellsite geology, geologic borehole logging, and conceptual modeling at a large number of geothermal exploration projects in California, Oregon, Nevada, American Samoa, Armenia, Chile, Indonesia and New Zealand, as well as performed desktop studies for dozens of geothermal projects worldwide.

Education

- B.A. Geology, University of California, Berkeley
- M.A. Earth and Planetary Science, University of California, Berkeley

Employment History

- Senior Geologist, Geologica Geothermal Group (San Francisco, Calif.) Sep. 2015 to Present
- Project Geologist, Mighty River Power (Rotorua, New Zealand) Aug. 2013 to Sep. 2015
- Project Geologist, Geoglobal Energy (Santa Rosa, Calif.) Oct. 2008 to Aug. 2013
- Consulting Geologist, Nevada Geothermal Power (Reno, Nev.) Feb. 2008 to Oct. 2008
- Consulting Geologist, Geotermia del Pacifico (Santiago, Chile) Dec. 2007 to Feb. 2008
- Staff Geologist, Various environmental geology firms in California Jul. 2003 to Feb. 2007

Languages

- English
- Spanish

Select Geothermal and Environmental Experience Highlights

Wellsite Geology Experience

- As Wellsite Geologist, performed wellsite geology at the Salton Sea for drilling program lasting six months and consisting of two rigs running simultaneously. Performed onsite daily wellsite geology for the drilling of three new wells and several re-drills of existing wells. Targeted wells, developed directional plans, and picked casing set depths for wells in real time. Worked with mud loggers, drilling engineers and management to successfully re-power the CalEnergy facilities. Wells produced or injected >20 MW/well of brine equivalent.
- As Project Geologist, performed wellsite geology for first make-up production well at Ngatamariki in New Zealand. Managed mud loggers and worked with drilling team to target, plan, write prognosis

and business case for well, and oversaw logging. Well targeted high-enthalpy, high permeability upflow of system and well was successful, capable of generating >40 MW_{net}.

- As Project Geologist, targeted, planned and wrote prognoses for make-up injection and production wells at Kawerau.
- As Project Geologist helped target, plan, wrote prognoses, performed wellsite geology and testing of three exploration wells at Tolhuaca. One well (Tol-4) was the most productive geothermal well ever drilled in South America (12 MW).
- As Staff Geologist, contributed to targeting, well site geology, and testing of four production and injection wells during development drilling of the Blue Mountain geothermal field in Nevada.
- As wellsite Geologist, logged core and cuttings and performed well-site geology for two slim holes (>1000 m deep) at Tolhuaca in southern Chile, discovering a moderate-temperature vapour-dominated resource (>150°C) and a high-temperature liquid-dominated resource (>300°C). Logged wells with a Kuster K10 PT tool.
- As Wellsite Geologist, logged core and cuttings and performed well-site geology for one slim hole (>500 m deep) at Puchuldiza in northern Chile, discovering a moderate-temperature vapour-dominated resource (>150°C). Logged wells with a Kuster K10 PT tool.
- As Wellsite Geologist, performed wellsite geology, well logging, resource evaluation, and conceptual modelling for two core holes at greenfield geothermal prospect on island of Tutuila, American Samoa.

Resource Assessment Experience

- Logged and tested first geothermal exploration well in the Caucasus Mountains of Eastern Europe, for project funded by the World Bank. Identified geothermal resource, interpreted well test results in geologic context to identify feed zones and reservoir properties, and then integrated these results into an updated conceptual model of the geothermal field.
- Developed conceptual model and contributed to drilling targeting and drilling planning for high-temperature greenfield geothermal prospect in Fiale Caldera, Republic of Djibouti.
- Contributed to conceptual models and resource capacity estimates for four exploration projects in Chile, two projects in Nevada, two projects in California, and three projects in New Zealand.
- Built conceptual model for East Kilauea Rift Zone and Puna, Hawai'i.
- Contributed to conceptual model, resource assessment, and resource capacity estimate for geothermal development project at Kuyucak, western Turkey.
- Contributed to conceptual model, resource assessment, and resource capacity estimate for three fields in New Zealand – Ngatamariki, Kawerau, and Mokai.

Other Experience

- Completed and presented Annual Reports for two operating geothermal fields (Ngatamariki and Kawerau) to regulatory agencies at the Waikato Regional Council and Bay of Plenty Regional Council In New Zealand. Reports included assessments of impact from geothermal energy developments to surface thermal features, vegetation, shallow groundwater aquifers, agriculture, human health, and communities from production, injection, surface river discharges, H₂S emissions, and noise.



- Completed and submitted to Waikato Regional Council the Ngatamariki System Management Plan (SMP), including strategy to mitigate impacts to neighbouring geothermal field with high cultural and touristic value.
- Competed and presented to local community the Kawerau Liaison Group Monitoring Report, a community-focused progress report on environmental issues related to a 153 MW geothermal development including H₂S monitoring and micro-seismicity.
- Designed, procured, installed, telemetered, and monitored meteorological stations at geothermal exploration sites in northern and southern Chile exposed in extreme environments. One site (Puchuldiza) was at 4500 m elevation and the other (Tolhuaca) experienced >10 m of snowfall with blizzard conditions.
- Contributed to Environmental Impact Assessments (EIAs) approved by the Chilean Ministry of Energy for hydrological and geothermal well drilling at Tolhuaca.
- Permitted water supply, temperature gradient, and geothermal exploration wells with Bureau of Land Management and Nevada Bureau of Mines and Geology at three sites in Nevada including evaluation of environmental impacts of drilling.
- Conducted and reported on numerous environmental investigations of shallow groundwater aquifers in Northern California, including remediation plans, and reported to local and state regulatory agencies.
- Reviewed all available well data in northeast sector of The Geysers for hydrological study evaluating availability of shallow groundwater aquifers for supplementary injection.
- With Bill Cumming, designed, contracted, filed-supported, processed, and interpreted MT and TDEM surveys at four geothermal exploration prospects in Chile (Tolhuaca, Alitar, Puchuldiza, and Mariposa).
- Performed geochemical sampling of hot springs and fumaroles at seven geothermal exploration projects in Chile and five in the western US.
- Contracted and participated in shallow temperature (2 m) probe survey at geothermal exploration prospect in Nevada with the Desert Research Institute. The study successfully mapped elevated shallow temperatures consistent with a geothermal outflow from the range-front fault.
- Contracted for construction and helped design an improved shallow temperature (2 m) probe drilling rig mounted on a 4WD UTV for exploration in northern Chile. Shipped rig from northern California to Chile. Planned, organized, managed and executed two shallow temperature surveys at Puchuldiza with team of five people. Surveys identified prospective extensions of thermal anomalies from known thermal areas.
- Designed and planned soil gas pilot exploration project for Puchuldiza.
- Reviewed all available well data for Salton Sea Geothermal Field and developed cross-sections of reservoir in support of major investment in the resource.
- Mapped shallow temperature anomaly and designed temperature gradient (TG) drilling program for Hudson Ranch (Salton Sea Geothermal Field).
- Contributed to resource exploration plan for successful grant application to the US Department of Energy (DOE) to explore Gabbs Valley prospect in Nevada.



- Reviewed and built conceptual model for East Kilauea Rift Zone, Hawaii in support of investment decision in greenfield geothermal exploration.
- Reviewed exploration data for numerous green and brownfield geothermal prospects in Chile, Peru, Argentina, the Caribbean, California, Nevada, Oregon, Idaho in support of investment decisions.
- Performed original research on the power density method of resource capacity evaluation using calibrated data from over 80 operating geothermal fields. Published in Stanford Geothermal Workshop and World Geothermal Congress.
- Performed original research on mapping of normalized well injectivities for targeting of production and injection wells. Published in World Geothermal Congress.
- Performed original research on relationship of geothermal wells' productivity index (PI) with initial injectivity index (II) as a function of feedzone enthalpy.
- Mapped geology and explored for thermal features at Tolhuaca, discovering and naming numerous hot springs and fumaroles and taking first temperature measurements and geochemical samples.
- Built electronic system for cataloguing and tracking geological core and drill cuttings samples for >100 well library in New Zealand.

Courses Taught

Presented Geothermal Exploration session of “Project Development Strategy and Economic and Investment Evaluations”, pre-conference workshop of the IIGCE in Jakarta, Indonesia (2017).

Presented Resource Capacity Estimation session and served as team coach for “Conceptual Models of Geothermal Systems”, pre-conference workshop of the Geothermal Resources Council Annual Meeting in Sacramento, California (2016).

Publications

- Wilmarth, M.**, Gilliland, J., Daskin, C., Babayan, T., Karkar, Armenia – Slimhole Drilling and Testing Results, Geothermal Resource Council Transactions, V. 41 (2017).
- Stimac, J., **Wilmarth, M.**, Mandeno, P.E., Dobson, P., Winick, J., Review of Exploitable Supercritical Geothermal Resources to 5 km at Geysers-Clear Lake, Salton Sea, and Coso, Geothermal Resource Council Transactions, V. 41 (2017).
- Wilmarth, M.**, Haizlip, J., Cumming, W., Tutuila, American Samoa: A Case History of Geothermal Exploration on a Deep Sea Island, Stanford Geothermal Workshop, Palo Alto, California (2017).
- Wilmarth, M.**, Sewell, S., Cumming, W., Resistivity Imaging and Interpretation Strategies to Reduce Uncertainty in Geothermal Resource Capacity Estimation, Poster Session at American Geophysical Union, San Francisco, California (2015).
- Coolbaugh, M., Shevenell, L., Hinz, N.H., Stelling, P., Melosh, G., Cumming, W., Kreemer, C., **Wilmarth, M.**, Preliminary Ranking of Geothermal Potential in the Aleutian and Cascade Volcanic Arcs, Part II, Geothermal Resource Council Transactions, v.39 (2015).
- Chambefort, I., Buscarlet, E., Wallis, I.C., Sewell, S., **Wilmarth, M.**, A Review of the Ngatamariki Geothermal Field, *Geothermics* (2015).



- Wilmarth, M.** and Azwar, L., Permeability Mapping, Proceedings World Geothermal Congress 2015, Melbourne, Australia (2015).
- Wilmarth, M.** and Stimac, J., Power Density in Geothermal Fields, Proceedings World Geothermal Congress 2015, Melbourne, Australia (2015).
- Wilmarth, M.** and Stimac, J., Worldwide Power Density Review, Stanford Geothermal Workshop, Palo Alto, California (2014).
- Lohmar, S., Stimac, J., Colvin, A., González, A., Iriarte, S., Melosh, G., **Wilmarth, M.**, Sussman, D.: Tolhuaca volcano [Southern Chile, 38.3° Latitude S]: New learnings from surface mapping and geothermal exploration wells, Congreso Geológico Chileno, 13, Antofagasta, Chile (2012).
- Wilmarth, M.**, Cumming, W., Melosh, G., Sussman, D., A Resistive Donut Hole Interpreted as a Shallow, Fractured, Vapor-Dominated Geothermal Reservoir, Invited Speaker, American Geophysical Union, San Francisco, California (2011).
- Wilmarth, M.**, Melosh, G., Sussman, D., Swanson, R., Cumming, W., Colvin, A., Iriarte, S., and Lohmar, S., Tolhuaca Drilling Update, Poster Session at Geothermal Resource Council Annual Meeting in Sacramento, California (2010).
- Melosh, G., Cumming, W., Benoit, D., **Wilmarth, M.**, Colvin, A., Winick, J., Soto-Neira, E., Sussman, D., Urzúa-Monsalve, L., Powell, T., and Peretz, A., Exploration Results and Resource Conceptual Model of the Tolhuaca Geothermal Field, Chile, Proceedings World Geothermal Conference 2010, Bali, Indonesia (2010).
- Melosh, G., Cumming, W., Sussman, D., Benoit, D., Soto-Neira, E., **Wilmarth, M.**, Colvin, A., Winick, J., and Fredes, L., Rapid Exploration of the Tolhuaca Prospect, Southern Chile, Geothermal Resource Council Transactions, Vol. 33, p. 505-508. (2009).

