

BACKGROUND

GEOLOGICA GEOTHERMAL GROUP provides high-quality global geothermal resource exploration, development, and assessment services, as well as environmental consulting services, for private and public sector clients.

After 15 years as Principal of **GEOLOGICA, INC.**, President Jill R. Haizlip founded **GEOLOGICA GEOTHERMAL GROUP** in late 2014 in order to continue and expand on the success and capabilities of the Geologica Geothermal Team. The **GEOLOGICA GEOTHERMAL GROUP** team is led by senior professionals, with over 30 years of experience, in disciplines related to geothermal resources from the initial stages of exploration, development, assessment, production and operations as well as environmental consulting experience. We provide senior level technical and management expertise, strategic planning, risk assessment and mitigation, and project coordination.

GEOLOGICA GEOTHERMAL GROUP'S technical expertise includes geology, hydrogeology, geochemistry, geophysics, reservoir engineering, numerical simulation, data management, geographical information systems, remote sensing, reservoir assessment and management, environmental science, permitting, and regulations as well as geotechnical, and civil engineering services. We have excellent associations with experts in drilling, power generation, and project design including wellfield, gathering system, and surface facilities.

GEOLOGICA GEOTHERMAL GROUP'S mission is client satisfaction. We assemble the most qualified team of people with expertise in the critical areas required by each client and/or project.



GEOTHERMAL SERVICES

GEOLOGICA GEOTHERMAL GROUP personnel have contributed to all phases of geothermal resource development. Highlights include:

- Preliminary and detailed geoscientific studies (geological, geochemical, hydrogeological, volcanological, geophysical) for evaluating resource potential for development and sustainable operations
- Environmental studies, risk assessment, permitting and regulatory compliance
- Resource characterization and assessment for due diligence, financial valuation of undeveloped resources and developed and operating projects
- Resource monitoring and maintenance programs for sustainable reservoir management
- Targeting, planning, drilling and logging of exploration, production and injection wells
- Well flow testing-data collection and analysis
- Geochemical sampling and data evaluation – steam, thermal and cold waters, soil gas, exploration/production well fluids, power plants, water, soils, rocks and other solids
- Exploration and field development planning
- Geothermal project feasibility studies for power generation and direct use
- Due diligence assessments of resource, environmental conditions and existing facilities
- Database development to support geothermal resource exploration, development and management
- Numerical reservoir simulation and reservoir engineering and management
- Conceptual and spatial reservoir modeling and assessment in 2D and 3D
- Resource design criteria/parameters for power plant and gathering system design including scale mitigation, gas loading and corrosion mitigation hydrogen sulfide abatement
- Steam purity analysis at power plant inlets
- Air quality, water quality and waste management

REPRESENTATIVE PROJECT EXPERIENCE

Coso Geothermal Field

Coso Energy/Coso Operating Company/TerraGen

- Reservoir characterization: temperature, reservoir saturation using hydrochemistry for reservoir management, injection strategy.
- Environmental permitting for water extraction and transfer for injection supplementation

U.S. Navy Geothermal Program Offices

- Annual geochemical evaluation for geothermal reservoir characteristics as part of U.S. Navy's monitoring of the Coso Geothermal Resource.

The Geysers

Western GeoPower Inc./US Geothermal/Ram Power

- Resource evaluation of the southwest area at The Geysers, CA using geochemistry.
- Mass flow, enthalpy and noncondensable gas projections for select development scenarios.
- Corrosion potential and mitigation
- Performed evaluation of noncondensable gas loading for gas ejection and gas emission control sizing.
- Environmental review of soil and groundwater contamination, prepare and implement soil and hazardous materials clean-up

Salton Sea

CalEnergy, multiple power plants

- Provided groundwater monitoring evaluation for discharge pond permitting.
- Well site geology, fluid geochemistry for reservoir management
- Fluid chemistry for air emissions/permitting

Western U.S. Geothermal Areas

Open Mountain Energy, UBS Global Asset

- Resource evaluation and development forecasts for investment due diligence in multiple projects in Nevada, California, Oregon, Utah and Hawaii

Asia-Pacific

Sorik Marapi Geothermal Project (SMGP)

Sokoria Geothermal Indonesia (SGI)

- Supporting the 240 MW GPP in **Sorik Marapi, Northern Sumatra, Indonesia**, and 30 MW GPP in **Sokoria, Flores, Indonesia**, provided well test planning and analysis, wellbore models, projected stable production flow rates and enthalpy for plant design, optimized well testing, updated conceptual model and targeted production and injection wells. Original structural and geologic mapping in the field on top of LiDAR dataset and built kinematic structural model.
- Currently providing well targeting, drilling engineering, drilling supervision, well site geology, well testing and well test analysis for production and injection drilling campaigns in both areas.

Western Turkey/Eastern Europe

Zorlu Energy

- Provided flow testing and evaluation on 15 wells, geochemistry, environmental assessment and resource development plan, resource and chemical design criteria, start-up testing for the 75 MW expansion of the **Kizildere Geothermal Field, Denizli Province, Turkey**
- Resource Assessment, Well testing, and analysis, Feasibility Study, Design Criteria 45 MW **Alasehir Geothermal Project, Turkey.**

Gurmat Energy (Power Engineers/Veizades)

- Collected resource data through production and injection tests, interference testing and geochemical sampling. Resource development plans and power plant design criteria for a 45 MW geothermal power project, a conceptual resource model and numerical simulation for the **Germencik Geothermal Field, Aydin Province, Turkey.**

Sis Enerji

- Provide well test planning, implementation, and data evaluation as well as reservoir modeling, and well targeting support for the Sogukyurt and Ozmen geothermal fields near **Alasehir, Turkey.**

Kaishan Renewable Energy Development

- Resource assessment of Turawell Geothermal Project in **Turawell, Hungary.**

Africa

Electricite de Djibouti

- Conceptual modeling, drilling target confirmation, well prognosis and design, drilling specifications, drill site management, wellsite geology, well testing, well test analysis, feasibility study and project management as part of the planning, oversight, and evaluation of multiple exploration wells as Geothermal Consulting Company for EdD in **Fiale Caldera, Lake Asal, Djibouti.**

Geothermal Development Company (GDC)/ICEIDA

- Geochemical Survey of Suswa Geothermal Area: Exploration and Capacity Building Program, Conceptual Model+Well Targets (with EFLA)

Kalahari GeoEnergy

- Preliminary Resource Assessment, Geology, Geochemistry, Geophysics and Conceptual modeling, Exploration Slimhole Targeting, Drilling and Testing, Updated Resource Assessment and Feasibility Study (ongoing), **Bwengwaa River Geothermal Project, Zambia**

Kaishan Renewable Energy Development

- Field reconnaissance, preliminary resource evaluation, and exploration plan for the **Magadi geothermal license in Kenya.**



OVERALL PROJECT EXPERIENCE

INTERNATIONAL PROJECTS

Western Turkey/Eastern Europe

Kizildere Geothermal Field, Denizli, Turkey

Geothermal Resource Assessment, Feasibility Study of 75 MW Expansion, Testing and Management

Germencik Geothermal Field Aydin, Turkey

Flow Testing: Design and Implementation

Geothermal Resource Assessment and Development Feasibility Study + Start-up Support

Tuzla Geothermal Field, Turkey

Resource Evaluation and Assessment

Sogukyurt-Tepekoy Geothermal Areas, Turkey

Well Testing, Well Targeting, Resource Evaluation

Gumuskoym Geothermal Field, Western Turkey

Geothermal Resource Assessment and Well Testing

Alasehir Geothermal Field, Turkey

Preliminary and Detailed Feasibility Studies

Well Testing and Reservoir Modeling

Alasehir-Manissa-Kavaklidir, Turkey

Resource Assessment and Geophysical Exploration

Denizli-Salavatli-Tekkehamam, Turkey

Preliminary Geothermal Resource Assessment

Well Planning and Testing

Aydin, Turkey

Preliminary Resource Assessment

Kutahya Geothermal Area, Turkey

Geothermal Resource Review

Turawell, Hungary

Geothermal Resource Evaluation

Africa

Olkaria, Kenya

Resource and Environmental Assessment

Lochinvar, Zambia

Preliminary Resource Assessment and Exploration

Fiale Caldera, Djibouti

Resource Review and Exploration Drilling Oversight

Tenerife, Canary Islands

Geochemical Evaluation of Geothermal Potential

Asia-Pacific

Hot Dry Rock, Australia

Geochemical Evaluation of Geothermal Resource

Lihir Geothermal Field, Papua New Guinea

Geothermal Resource Assessment and Development Feasibility Study

Mahanagdong, Upper Mahio and Malitbog, The Philippines

Steam Chemistry and Power Plant Efficiency

Malitbog Low Pressure Operation Reservoir Impact Assessment

Sarulla, North Sumatra, Indonesia

Due Diligence for Geothermal Resource Development

Ulubelu, Sumatra, Indonesia

Silica Scale Potential Study

Indonesia

Survey of Geothermal Development Opportunities

Darajat, West Java, Indonesia

Geochemical Analysis and Resource Evaluation

Cibuni and Ciater, West Java, Indonesia

Preliminary Resource Assessment

Bedugal, Island of Bali, Patuha, West Java, Indonesia

Geochemical Resource Characterization and Exploration

Central Java, Indonesia

Preliminary Resource Assessment

Tutuila and Manu'a Islands, American Samoa

Preliminary Resource Assessment

Geothermal Geological and Geochemical Exploration

Geophysical (MT) Surveys

Central/South Americas/Carribbean

Island of St. Vincent, Carribbean

Geothermal Exploration and Environmental Baseline

Dominica, Carribbean

Environmental Mitigation Plan

Island of Nevis, Carribbean

Geothermal Resource Development Strategy

El Tatio, Chile

Environmental Monitoring and Mitigation

San Jacinto II and III, Nicaragua

Silica Scale/Steam Purity Study



OVERALL PROJECT EXPERIENCE

DOMESTIC PROJECTS

The Geysers, CA

*Steam Chemistry, Evaluation
Geothermal Resource Potential
Soil and Groundwater Investigation and Clean-up
Air Quality, Permitting, Steam Sampling*

Coso Geothermal Area, China Lake, CA

*Geochemical Evaluation and Monitoring
Coso Hot Spring Monitoring*

Haiwee Geothermal Lease Area, CA

Haiwee Programmatic EIS

Rose Valley, Inyo County, CA

*Rose Valley Water Transfer to Coso Geothermal
Project EIR*

Island of Hawaii and the Puna Geothermal System

Resource Review for Power Generation Potential

Roosevelt HS, Blundell Power Plant, UT

*Reservoir Assessment using Geochemistry
Injection Well Evaluation and Decline Mitigation*

Star Peak-Rye Patch-Humboldt House, NV

*Data Review and Preliminary Resource Assessment
Well Flow and Interference Testing*

Blue Mt., Patua, Soda Lake, NV

Operating Reservoir Management Assessment

Clifton Hot Springs, AZ

Arizona Geothermal Resource Potential

Colorado

*Statewide Geothermal Resource Review
Resource Exploration - Canyon City/Florence Area*

Salton Sea, CA

*Groundwater Monitoring
Resource Management and Drilling Support
Air Emissions, Permitting*

East Mesa Geothermal Field, El Centro, CA

Environmental and Resource Due Diligence

Casa Diablo and Heber, CA

*Environmental and Resource Due Diligence for
Geothermal Asset Sale*

Medicine Lake Highlands

*Fourmile Hill Geothermal Development Project-
Engineering Analysis for the ATC/PTO Permit*

Long Valley Caldera, Mammoth Lakes, CA

*Geothermal Resource Characterization
Technical Support for Environmental Documentation*

Newberry Volcano, Deschutes County, OR

*Geothermal Resource Characterization, Environmental
Assessments, Well Sampling*

CLIENT LIST

- **Allied Nevada Gold**
- **American Samoa Power Authority**
- **Amoseas Indonesia**
- **Arizona Public Service**
- **Ayvacik Geothermal Energy**
- **BM Energy**
- **BHE Renewables**
- **CalEnergy/CalEnergy International**
- **Calpine**
- **Cerberus**
- **EAGER**
- **EBRD**
- **EFLA**
- **Electricite de Djibouti**
- **ESA Inc.**
- **Fervo Energy**
- **Fina Enerji**
- **GDC**
- **Global Power Solutions**
- **Greeneco Energy**
- **GreenMax Capital Advisors**
- **Growth Capital Holdings**
- **Gurmat Energy**
- **Imparator Energy**
- **International Finance Corporation (World Bank)**
- **Inyo County**
- **Kalahari GeoEnergy**
- **Karadeniz Energy**
- **Kayen Kayi Electric**
- **KenGen**
- **KS Orka**
- **Lihir Gold**
- **Mammoth-Pacific Ltd.**
- **Marco Power**
- **Maspo Energy**
- **MHA Environmental Consulting Inc.**
- **Mono County Energy Management**
- **Nemrut Geothermal**
- **Northwest Geothermal Company**
- **Open Mountain Energy**
- **OMV**
- **OrkaTerra**
- **Ormat Energy Systems Inc.**
- **PacificCorp Blundell**
- **Pandawa Energy**
- **Petratherm**



OVERALL PROJECT EXPERIENCE

- *Power Engineers, Inc.*
- *PT Sorik Marapi Geothermal Power*
- *Presco Energy*
- *Ram Power*
- *Remtak*
- *Salt River Project*
- *Sis Enerji*
- *Stone & Webster-Shaw Group*
- *Surprise Valley Electric Company*
- *Terra-Gen Power, Coso Operating Company (COC)*
- *Turawell Geothermal Power*
- *Turcas BM Kuyucak Jeotermal*
- *UBS Global Asset Management*
- *US Geothermal/WesternGeoPower*
- *U.S. Navy Geothermal Program Office*
- *US Trade and Development Agency*
- *Veizades & Associates*
- *Workmen Energy*
- *Zorlu Energy*

Associated Firms

Depending on project requirements, **GEOLOGICA GEOTHERMAL GROUP** typically teams with one or more of the following:

- Cumming Geoscience
- Sussman Geothermal Consulting
- Medi Enerji
- Leidos
- Veizades & Associates, Inc.
- Stimac Geothermal Consulting
- Steve Pye Consulting
- Terrane Apps
- Geothermal Resource Group
- EFLA Consulting Engineers
- Power Engineers, Inc.
- Global Power Solutions
- Middle Earth Geoscience
- Panorama Environmental, Inc.
- APEX Engineers
- WilDril, Inc
- Solutions Team, Inc
- Wincho Consulting, Ltd
- Core Tech Services and Supply LLC
- Roger Almond Consulting LLC

CONTACT INFORMATION

San Francisco, CA
Jill Robinson Haizlip
President

GEOLOGICA GEOTHERMAL GROUP, Inc.
5 Third Street, Suite 420
San Francisco, CA 94103
Phone: +1 (415) 691-7628
jhaizlip@geologica.net

Reno, NV
Leland C. Davis
Vice President, Operations

GEOLOGICA GEOTHERMAL GROUP, Inc.
502 Wells Ave, Suite 100
Reno, NV 89502
Phone: +1 (775) 525-0019
ldavis@geologica.net

San Diego, CA
Dr. Sabodh Garg
Vice President, Reservoir

GEOLOGICA GEOTHERMAL GROUP, Inc.
9920 Pacific Heights Blvd, Suite 150
San Diego, CA 92121
Phone: +1 (858) 263-3214
sgarg@geologica.net

Istanbul, Turkey
Umut Bariş Ülgen
President, Medi Enerji
Phone: +90 532 371 87 99
ulgenu@gmail.com



KEY PERSONNEL

GEOLOGICA GEOTHERMAL GROUP'S staff, associates, and affiliates are highly trained professionals who typically have advanced degrees and/or professional certifications in their fields of expertise and are well known and respected professionals in the geothermal industry. Brief summaries of key professionals available are provided below.

Jill Haizlip, President Principal Geochemist

Ms. Haizlip is Geologica's President and Principal Owner. She is a geologist and hydrogeochemist who has spent more than 30 years working on the exploration and development of geothermal resources. Her primary expertise is in the area of applied hydrogeochemistry related to understanding geothermal systems and utilization and treatment of natural thermal and non-thermal waters for power generation and direct use. She has been the principal investigator on geothermal resource assessments, feasibility studies, as well as issues related to well testing, resource data collection, environmental compliance and geothermal fluid chemistry. She has published on many geothermal topics including writing chapters on geochemistry for industry-standard texts.

Leland Davis, Vice President – Operations, Sr. Project Manager/Geoscientist-Well Testing

Mr. Davis is Geologica's Vice President of Operations and Sr. Project Manager. He is a Sr. Geoscientist with an expertise in Well Testing who has spent 10 years with Geologica working on the exploration and development of geothermal resources, including well testing in California, Nevada, Utah, Alaska, Nicaragua, Djibouti, Zambia, Indonesia, and Turkey. His primary expertise is in reservoir data collection, well testing, and resource analysis including computer based GIS mapping and conceptual modeling. His broad work experience across multiple disciplines in 10+ years with Geologica provides a practical understanding of all facets of geothermal development including geology, geophysics, geochemistry, conceptual modeling, well targeting and design, reservoir engineering, and conceptual power plant design. He has provided key technical support on geothermal resource assessments, feasibility studies, and wellfield management, as well as planning and execution related to well testing, resource data collection, and environmental compliance.

Nicholas Hinz, Vice President – Geoscience Senior Geologist

Mr. Hinz is Geologica's Vice President of Geoscience and Senior Geologist. He has 20 years of field-based

experience with structural geology and geothermal projects located throughout North America, East Africa, Turkey, Asia, and the Caribbean. Mr. Hinz joins the Geologica Team after more than 10 years as a Research Associate at University of Nevada, Reno and the Great Basin Center for Geothermal Energy. His past industry experiences have included broad regional assessments and evaluations of individual resources, including both volcano-hosted and fault-hosted resources. He specializes in detailed geologic mapping and stress calculations for the purpose of characterizing fracture permeability, refining conceptual models, and well targeting. Mr. Hinz has completed projects in a variety of environments and geologic settings including volcanic arcs, rifts, and along continental strike-slip fault zones. He has published extensively on geologic and geothermal topics, frequently leads field trips for professional organizations and assists with geothermal training workshops.

Dr. Sabodh K. Garg, Vice President – Reservoir Principal Reservoir Engineer

Dr. Sabodh Garg joins the Geologica Team in 2019 as Vice President for Reservoir Engineering and Principal Reservoir Engineer at Geologica. He has collaborated with Geologica on numerous projects over the last 10 years through his previous position as program manager of resource technology for Leidos and Science Applications International Corporation – SAIC. He has been an active participant in geothermal R&D since the mid-1970's and specializes in geothermal reservoir engineering, geophysical survey interpretation, resource assessment, and development planning. He has carried out technical studies in geothermal reservoir mechanics, pressure transient analysis, multi-phase non-isothermal flow, rock mechanics, and the behavior of geopressured reservoirs. Dr. Garg has served on numerous geothermal and energy-related boards and panels, including *Geothermics*, *Energy Sources*, U.S. Academy of Sciences, and DOE review panels, and is recipient of the GRC Special Achievement Award (2001), the GRC 2003 Joseph W. Aidlin Award, and the GRC 2017 Hank Ramey Reservoir Engineering Award.

Mike Krahrmer Senior Geologist – Wellsite

Mr. Krahrmer joins Geologica in 2019 with over 30 years' experience as a well-site geologist in the US and around the world. Mr. Krahrmer specializes in all facets of drill-site geology related to geothermal exploration and development. His expertise includes cuttings and coring analysis, mineral alteration interpretation, and drilling oversight.



KEY PERSONNEL

Key Additional Staff include:

John W. Pritchett, Numerical Simulation

Steven Fercho, Sr. Project Geologist – Wellsite/
Leapfrog Modelling

Dr. Kunhwi Kim, Junior Reservoir Engineer

Jesse Turk, Project Geologist – Wellsite

Gabe Matson, Project Geoscientist – Geophysics

Colin Carver, Project Geoscientist – Well Testing/
Geochemistry

Amanda Fishbin, Project Geoscientist – GIS/Geology

Associates

William Cumming, Cumming Geoscience Principal Geophysicist

Mr. Cumming is an internationally recognized expert, specializing in geothermal exploration and development. His 32 years of experience in the geothermal industry include 20 years with Unocal Corporation (now Chevron) in positions from Geophysicist to Chief Geoscientist. Among his principal responsibilities in worldwide geothermal operations were conducting and interpreting geophysical surveys, integrating geoscience data sets, developing representative ranges of resource conceptual models, designing and coordinating well target and resource capacity risk analyses, and managing geoscience quality assurance.

As an independent consultant from 2000 to present, Bill provides technical and management consulting services for geophysical surveys, geothermal resource assessment and well targeting, geothermal investment due diligence analyses, professional training and geophysical research. In support of geothermal exploration and development, he has used a wide variety of geophysical methods, including MT, TEM, CSAMT, galvanic resistivity (VES), helicopter EM, reflection and refraction seismic, earthquake, gravity, precision gravity, leveling, dGPS, and aeromagnetic surveys.

David Sussman, Sussman Geothermal Consulting Program Director/Principal Geologist

David Sussman is an experienced geothermal adviser with over 30 years of experience working in the geothermal sector. He brings extensive experience working in both the private and public sector in East Africa, Latin America and Southeast Asia. He has led

numerous assignments advising private and public development organisations on strategy, policy, regulation and financing as well as managing scientific and geothermal energy exploration and the development of projects. Through his work David has developed an in-depth understanding of the implications of different business models employed by governments on the developability, costs and risks of successful long-term geothermal operations. He is based in Sebastopol, California, USA.

Umut Bariş Ülgen, Medi Enerji Turkish Projects Manager/Principal Geologist

Mr. Ülgen has 20 years of experience on geological research, data and GIS management. He worked for 7 years in ITU as research assistant. He assisted GIS and geological data analysis lectures. He worked for 5 years in EU funded projects as researcher and expert engineer on active tectonics of North Anatolian fault system and attended several scientific surveys on Aegean, Marmara and Blacksea. 2012 he started working on geothermal sector in SİS Enerji Üretim A.Ş. company. While working as geological research group member he worked on site as company man and mud-logger, geologist for one year. On 2013 Mr. Ülgen became the coordinator and lead, geological research, drilling and power plant teams. He was responsible for well targeting, Drilling planning, well testing. He represented the Sis Energy in Özmen-1 and Özmen 3 GEPP technical and financial meetings and coordinated all departments and vendors during development of both GEPP's. His expertise is Geological modeling, well testing, data management and GIS database development.

Additional information including CVs available upon request.

Learn more at www.geologica.net

