

**William L. Osborn**  
**Geothermal Resources**  
**Exploration, Development and Operations**  
**EGS, Mineral Extraction and Innovative Technologies**

**PROFESSIONAL EXPERIENCE**

**2009 - Present President, Geothermal Solutions, Inc.**

- Independent consultant with over 30 years' experience in international geothermal industry
- Geosciences, resource development, well drilling and testing, power plant operations, advanced technology development
- Development, funding and implementation of innovative technologies
  - Extraction of lithium and other metals from geothermal brine
  - Enhanced Geothermal Systems (EGS) development
  - Supercritical and Superhot geothermal systems

**2017 Chief Technical Officer, OrkaTerra Energy LLC**

- Short-lived subsidiary of Kaishan Group of companies, focused on development of geothermal resources in Latin America
- Evaluated development potential of dozens of Chilean and Peruvian geothermal fields
- Formulated comprehensive development plan for the Tinguiririca geothermal field (**Chile**), including 250 MW resource assessment, wellfield drilling and testing plan, power plant siting and conceptual modeling, environmental permitting and civil engineering

**2012 - 2017 Vice President, Geothermal Resource Group, Inc.**

- Manager of global operations and business development
- Geothermal resource exploration, including geoscience, reservoir engineering, drilling planning and supervision, well testing, and resource evaluation to bankable feasibility studies in
- Project locations including USA, Indonesia, Turkey, Philippines, **Nicaragua, El Salvador, Chile, Bolivia, Montserrat, Guadeloupe, Dominica**, St Kitts and Nevis, Rwanda, Ethiopia, Tanzania, and Djibouti

**2009 - 2012 VP Project Development, AltaRock Energy, Inc.**

- Project Manager for \$44m U.S. DOE-sponsored *Newberry Volcano* Enhanced Geothermal Systems Demonstration
- Funding application and administration, project management, industry/academia/government coordination, geoscience investigation, EGS stimulation modeling, community engagement and regulatory permitting

**2004 - 2009 Vice President, PowerChem Technology LLC**

- Chemical engineering products and services for the global geothermal industry
- Power plant and wellfield chemical engineering, scaling and corrosion control, steam purity, cooling system operations and water treatment

**2002 - 2004 General Manager, CalEnergy Minerals LLC, Salton Sea Geothermal Field**

- Achieved world's first commercial production of Zinc extracted from a geothermal system
- Managing 75 operations, maintenance and engineering staff with \$25m annual operating budget
- Pilot testing of Manganese extraction using solvent extraction
- Laboratory bench-scale extraction of Platinum Group Elements using ion exchange

**2000 - 2002 Resource and Analytical Services Manager, CalEnergy, Salton Sea Geothermal Field**

- Constructed, staffed and managed sophisticated laboratory with team of 15 chemists and technicians
- Managed resource team of geologists, geochemists, reservoir engineers and drilling professionals
- Implemented DOE-funded multi-disciplinary review of *Salton Sea* resource model
- Effectively managed \$18m annual drilling and workover budget

**1999 - 2000 Geochemist, CalEnergy Operating Corporation, Salton Sea Geothermal Field**

- Executed comprehensive brine analysis program using state-of-the-art analytical methods for parts per trillion detection limits

**1996 - 1999 Development Geochemist, Bali Energy Limited/CalEnergy International, Indonesia**

- Supervised flow test and geochemical sampling program at three geothermal fields concurrently
- Improved drilling success rate by building reservoir geochemistry models of *Dieng*, *Patuha* and *Bali* geothermal fields during development

**1992 - 1996 Geochemical Supervisor, CalEnergy Operating Company, Coso Geothermal Field**

- Increased well productivity and power generation by implementing field-wide well bore scale inhibitor program for over 40 wells

**1988 - 1992 Geochemist, Geothermal Resources Intl. / Mission O&M, East Mesa Geothermal Field**

- Broad range of responsibilities including geology, geochemistry, drilling and environmental compliance
- Conducted pilot testing and power plant implementation of carbonate scale inhibitor in pumped flash power plant

**1986 - 1988 Laboratory Assistant, University of California at Riverside**

- Geothermal mud logging and flow test sampling at Salton Sea Geothermal Field for Magma Power Company
- XRD automation software commissioning, fluid inclusion analysis, petrographic thin section production

## EDUCATION

- M.Sc., Geochemistry, 1988      University of California at Riverside  
Riverside, California
- B.Sc., Geology, 1985            University of California at Santa Cruz  
Santa Cruz, California

## Publications

- (1989) *Formation, diagenesis, and metamorphism of sulfate minerals in the Salton Sea Geothermal System, California, U.S.A.* W. L. Osborn. Master of Science Thesis (M.S.), University of California at Riverside.
- (1990) *Scale inhibitor testing at East Mesa.* Osborn, W. L., Hirtz, P. and Robinson Haizlip, J. Geothermal Resources Council Transactions Volume 14-Part II pp. 1627-1635.
- (1995) *Measurement of velocity profiles in production wells using wireline spinner surveys and rhodamine WT fluorescent tracer; Coso geothermal field (California).* Osborn, W. L. and Spielman, P. Proceedings of the World Geothermal Congress V.3. pp. 1893-1898.
- (2001) *Gold-Bearing Arsenide and Other Production-Well Scales from the Salton Sea Geothermal Field, California.* Lutz, S.J., Hulen, J.B. and Osborn, W.L. Stanford Geothermal Program Proceedings V.26 pp. 378-389.
- (2002) *Refined Conceptual Modeling and a New Resource Estimate for the Salton Sea Geothermal Field, Imperial Valley, California.* Hulen, J.B., Kaspereit, D., Norton, D.L., Osborn, W. and Pulka, F.S. Geothermal Resources Council Transactions, V.26 pp. 29-36.
- (2003) *The Role of Sudden Dilational Fracturing in Evolution and Mineralization of the Southwestern Salton Sea Geothermal System, Imperial Valley, California.* Hulen, J., Norton, D.L., Moore, J.N., Osborn, W., van de Putte, T., and Kaspereit, D. Stanford Geothermal Workshop Proceedings V.28.
- (2007) *Carbonate Scale Inhibition in a High-Gas Geothermal Well, Germencik, Turkey.* Osborn, W.L., Demirci, N., Gulgor, A., Erkan, B. and Yildirim, N. Geothermal Resources Council Transactions V.31 pp.29-36.
- (2010) *Newberry Volcano EGS Demonstration.* Osborn, W., Petty, S., Nofziger, L., and Perry, D. Geothermal Resources Council Transactions V.34 pp. 413-418.
- (2011) *The Role of Stress Modeling in Stimulation Planning at the Newberry Volcano EGS Demonstration.* Cladouhos, T., Petty, S., Callahan, O., Osborn, W., Hickman, S. and Davatzes, N. Stanford Geothermal Program Proceedings V.36 pp. 630-637.
- (2011) *Newberry Volcano EGS Demonstration – Phase I Results.* Osborn, W., Petty, S., Cladouhos, T., Iovenitti, J., Nofziger, L., Callahan, O., Perry, D., and Stern, P. Geothermal Resources Council Transactions, V.34 pp.499-505.

- (2011) *Newberry Volcano EGS Demonstration Stimulation Modeling*. Cladouhos, T.T., Clyne, M., Nichols, M., Petty, S., Osborn, W.L. and Nofziger, L. Geothermal Resources Council Transactions, V. 35 pp. 317-322.
- (2012) *Newberry Volcano EGS Demonstration – Phase I Results*. Cladouhos, T., Osborn, W.L., Petty, S., Bour, D., Iovenitti, J., Callahan, O., Nordin, Y., Perry, D. and Stern, P.L. Stanford Geothermal Program Proceedings, V.37 pp. 659-670.
- (2014) *Successful Discovery Drilling in Roseau Valley, Commonwealth of Dominica*. Osborn, W., Hernandez, J. and George, A. Stanford Geothermal Program Proceedings V.39.
- (2014) *Thermal Stimulation and Injectivity Testing at Raft River, ID EGS Site*. Bradford, J.; Ohren, M.; Osborn, W.; McLennan, J.; Moore, J.; Podgorney, R. Stanford Geothermal Program Proceedings V.39.
- (2015) *Recent Thermal and Hydraulic Stimulation Results at Raft River, ID EGS Site*. Bradford, J.; Moore, J.; Ohren, M.; McLennan, J.; Osborn, W.; Majer, E.; Nash, G.; Podgorney, R.; Freifeld, B.; Nye, R.; Rickard, W.; Waters, D.; Glaspey, D. Stanford Geothermal Program Proceedings V.40.
- (2016) *Field Management and Expansion Potential of the Momotombo Geothermal Field Using Numerical Simulation and Conceptual Modeling*. Kaspereit, D.; Rickard, W.; Osborn, W. L.; Mann, M., and Perez, M.. Proceedings, 41st Workshop on Geothermal Reservoir Engineering Stanford University.
- (2016) *Updated Conceptual Model and Reserve Estimate for the Salton Sea Geothermal Field, Imperial Valley, California*. Kaspereit, D., Mann, M., Sanyal, S., Rickard, W., Osborn, W. L.; and Hulen, J. GRC Transactions, Vol. 40.
- (2016) *Combining High-Enthalpy Geothermal Generation and Hydrogen Production by Electrolysis Could Both Balance the Transmission Grid and Produce Non-Polluting Fuel for Transportation*. Shnell, J., Newman, J.S., Raju, A., Nichols, K., Elders, W.A., Osborn, W.L. and Hiriart, H.L. Proceedings, 41st Workshop on Geothermal Reservoir Engineering Stanford University.
- (2016) *Resource Management Using Numerical Modeling and Apparent Productivity Index*. Osborn, William L.; Kaspereit, Dennis; Rickard, William; Mann, Mary; and Perez, Magdalena. 5th ITB International Geothermal Workshop, Bandung, Indonesia.
- (2017) *Improved Test Method for Slim Hole and Microbore Exploration Drilling*. Kaspereit, D. and Osborn, W. Proceedings, 42nd Workshop on Geothermal Reservoir Engineering Stanford University.
- (2018) *Supercritical Geothermal Cogeneration: Combining Leading-Edge, Highly-Efficient Energy and Materials Technologies in a Load-Following Renewable Power Generation Facility*. Shnell, J., Elders, W.A., KostECKI, R., Nichols, K., Osborn, W.L., Tucker, M.C., Urban, J.J. and Wachsman, E.D. Geothermal Resources Council Transactions, V. 42.
- (2019) *The Future Role of Geothermal Resources in Reducing Emissions of Greenhouse Gases in California and Beyond*. Elders, W.A., Osborn, W.L., Raju, A. and Martinez-Morales, A. Proceedings, 44th Workshop on Geothermal Reservoir Engineering Stanford University.

(2019) *Exploration and Development of Supercritical Geothermal Resources on the Ocean Floor*.  
Shnell, J., Elders, W.A., Orcutt, J. and Osborn, W.L. Proceedings, 44th Workshop on  
Geothermal Reservoir Engineering Stanford University.