

# **Geothermal Resources Council Annual Meeting (GRC 2015)**

Geothermal: Always On

Geothermal Resources Council Transactions Volume 39

Reno, Nevada, USA  
20 – 23 September 2015

Part 1 of 2

ISBN: 978-1-5108-1724-1

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2015) by Geothermal Resources Council  
All rights reserved.

Printed by Curran Associates, Inc. (2016)

For permission requests, please contact Geothermal Resources Council  
at the address below.

Geothermal Resources Council  
P.O. Box 1350  
Davis, California 95617  
USA

Phone: (530) 758-2360  
Fax: (530) 758-2839

[grc@geothermal.org](mailto:grc@geothermal.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## **Basin & Range**

Benoit, D. . . . .	3
<i>A Case History of the Dixie Valley Geothermal Field, 1963–2014</i>	
Gwynn, M. . . . .	13
<i>Geothermal Potential in the Basins of East-Central and Southeastern Nevada</i>	
Kirby, S., S. Simmons, M. Gwynn, R. Allis, and J. Moore . . . . .	25
<i>Comparisons of Geothermal Systems in Central Nevada: Evidence for Deep Regional Geothermal Potential Based on Heat Flow, Geology, and Fluid Chemistry</i>	
McCurry, M., D. M. Pearson, J. Welhan, S. K. Natwotniak, and M. Fisher . . . . .	35
<i>Origin and Potential Geothermal Significance of China Hat and Other Late Pleistocene Topaz Rhyolite Lava Domes of the Blackfoot Volcanic Field, SE Idaho</i>	
Moulding, A., and T. Brikowski . . . . .	49
<i>Influence of Continuously Variable Permeability and Basin Rock Properties on Three Dimensional Heat and Mass Balance Models of Basin &amp; Range Geothermal Systems</i>	
Simmons, S., S. Kirby, J. Moore, P. Wannamaker, and R. Allis. . . . .	55
<i>Comparative Analysis of Fluid Chemistry From Cove Fort, Roosevelt and Thermo: Implications for Geothermal Resources and Hydrothermal Systems on the East Edge of the Great Basin</i>	

## **Country Update**

Boyd, T. L., A. Sifford, and J. W. Lund. . . . .	65
<i>The United States of America Country Update 2015</i>	
Crewson, J., and A. Thompson . . . . .	75
<i>Breaking Down the Barriers to Geothermal Energy in Canada: Bridging the Knowledge Gap and Overcoming the Status Quo</i>	
Lund, J. W., R. Bertani, and T. L. Boyd . . . . .	79
<i>Worldwide Geothermal Energy Utilization 2015</i>	
Williams, C. F., J. DeAngelo, and M. J. Reed . . . . .	93
<i>Revisiting the Assessment of Geothermal Resources &lt;90 °C in the United States</i>	

## **Direct Use**

Dell, R., R. Unnthorsson, C. S. Wei, and W. Foley . . . . .	101
<i>Accelerated Plant Growth Results From an Intensive Shallow Bottom Heat System Using Waste Geothermal Hot Water and Steam Condensate in Iceland</i>	

Farabi Asl, H., H. Fujii, and H. Kosukegawa. . . . .	109
<i>Heat Exchange Rate Enhancement in Ground Heat Exchangers by Water Injection and Pumping</i>	
Foley, W., R. Dell, C. S. Wei, and R. Unnthorsson . . . . .	117
<i>Point of Use Thermoelectric Powered Automated Irrigation System for an Intensive Shallow Bottom Heat System Using Waste Geothermal Hot Water and Steam Condensate in Iceland</i>	
Gehring, M. . . . .	125
<i>Use of Waste Heat From Geothermal Power Plants Focusing on Improving Agriculture in Developing Countries</i>	
Jalilinasrabad, S. . . . .	133
<i>Geothermal Direct Utilization-Design and Optimization</i>	
Parlaktuna, M. . . . .	145
<i>Evolution of Balçova Geothermal District Heating System – Turkey</i>	
Patsa, E., S. J. Zarrouk, and D. Van Zyl . . . . .	151
<i>The Lindal Diagram for Mining Engineering</i>	
Uwera, J., R. Itoi, S. Jalilinasrabad, T. Jóhannesson, and D. Ö. Benediktsson . . . . .	157
<i>Design of a Cooling System Using Geothermal Energy for Storage of Agricultural Products With Emphasis on Irish Potatoes in Rwanda, Africa</i>	
Wei, Z., J. Lv, and L. Jiulong . . . . .	165
<i>Study of Thermal Performance and Operation Strategy of a Compound Ground Source Heat Pump Heating System</i>	

## **Drilling**

Denninger, K., A. Eustes, C. Visser, W. Baker, D. Bolton, J. Bell, S. Bell, A. Jacobs, U. Nagandran, M. Tilley, and R. Quick . . . . .	171
<i>Optimizing Geothermal Drilling: Oil and Gas Technology Transfer</i>	
Kahutu, J., and V. Atwa. . . . .	181
<i>Comparison of Drilling Technologies Between Top Drive and Rotary Table in Geothermal Fields: A Case Study of Olkaria Geothermal Fields</i>	
Karanja, N. . . . .	185
<i>Challenges of Cementing Olkaria Geothermal Field</i>	
Khaemba, A. W. . . . .	191
<i>Well Design and Well Workover to Land Deep Production Casings in the Menengai Field</i>	

Miyora, T., M. Þ. Jónsson, and S. Þórhallsson . . . . .	197
<i>Modelling of Geothermal Drilling Parameters – A Case Study of Well MW-17 in Menengai Kenya</i>	
Pyatina, T., and T. Sugama . . . . .	209
<i>Use of Carbon Microfibers for Reinforcement of Calcium Aluminate-Class F Fly Ash Cement Activated With Sodium Meta-Silicate at up to 300°C</i>	
Wilson, D. R., J. Gilliland, and A. Austin . . . . .	217
<i>Broaching: An Effective Method of Well Intervention for Calcite Scale Removal</i>	

### **East African Rift**

Admassu, E., and S. Worku . . . . .	225
<i>Characterization of Quaternary Extensional Structures: Tulu-Moye Geothermal Prospect, Ethiopia</i>	
Barasa, P. J., and R. W. Mathenge. . . . .	233
<i>Stakeholder Engagement Through Participatory Research: A Case Study of Eburru Geothermal Wellhead Generator in Nakuru County, Kenya</i>	
Harðarson, B. S. . . . .	239
<i>The Western Branch of the East African Rift: A Review of Tectonics, Volcanology and Geothermal Activity</i>	
Ronoh, I. . . . .	247
<i>Evolution and Geology of Eburru-Badlands Geothermal Prospect – Central Kenyan Rift</i>	
Wamalwa, R. . . . .	255
<i>The Initial-State Geochemistry as a Baseline for Geochemical Monitoring at Olkaria Domes, Kenya</i>	

### **Enhanced Geothermal Systems**

Bradford, J., J. McLennan, J. Moore, R. Podgorney, and S. Tiwari . . . . .	261
<i>Hydraulic and Thermal Stimulation Program at Raft River Idaho, A DOE EGS</i>	
Cladouhos, T. T., M. E. Uddenberg, M. W. Swyer, S. Petty, and Y. Nordin . . . . .	269
<i>Production Well Targeting at Newberry Volcano EGS Demonstration</i>	
Dreger, D. S., R. Gritto, and O. S. Boyd . . . . .	279
<i>Analysis of Seismic Moment Tensor, Finite-Source Scaling and Fluid Imaging During EGS Resource Development at The Geysers, CA</i>	
Farmahini-Farahani, M., and A. Ghassemi . . . . .	285
<i>Simulation of Injection and Production and MEQ in Large-Scale Fracture Networks</i>	

Faulds, J. E., D. Blankenship, N. H. Hinz, A. Sabin, J. Nordquist, S. Hickman, J. Glen, M. Kennedy, D. L. Siler, A. Robertson-Tait, C. Williams, P. Drakos, and W. Calvin . . . . .	293
<i>Geologic Setting of the Proposed Fallon Forge Site, Nevada: Suitability for EGS Research and Development</i>	
Finnila, A., W. Dershowitz, T. Doe, and R. McLaren . . . . .	303
<i>Hydro-Shearing and Hydraulic Fracturing for Enhanced Geothermal Systems in Archetypical Normal, Strike-Slip, and Thrust Faulting Terrains</i>	
Kelkar, S., D. Martinez, D. Brown, and L. House . . . . .	315
<i>Data Archiving and Lessons Learned From the Pioneering Hot Dry Rock Project at Fenton Hill, USA</i>	
Li, K., B. Pan, and R. Horne . . . . .	321
<i>Fracture Characterization Using Resistivity Measured at Different Frequencies in Rocks</i>	
Numakura, T., N. Watanabe, K. Sakaguchi, T. Kikuchi, and N. Tsuchiya . . . . .	329
<i>Permeability Measurements of Fractured Granite at 350-450 °C Under Confining Stress</i>	
Olson, J., A. Eustes, W. Fleckenstein, E. Eker, R. Baker, and C. Augustine . . . . .	335
<i>Completion Design Considerations for a Horizontal Enhanced Geothermal System</i>	
Sabin, A., K. Blake, M. Lazaro, D. Blankenship, M. Kennedy, J. McCullough, S. DeOreo, S. Hickman, J. Glen, O. Kaven, C. Williams, G. Phelps, J. E. Faulds, N. Hinz, W. Calvin, D. Siler, and A. Robertson-Tait . . . . .	345
<i>Geologic Setting of the Proposed West Flank Forge Site, California: Suitability for EGS Research and Development</i>	
Vazquez-Rubio, I. G., D. Bahrami, and G. Danko . . . . .	353
<i>Numerical Simulation Model Comparisons for Enhanced Geothermal Reservoirs</i>	
Welhan, J. A. . . . .	363
<i>Thermal and Trace-Element Anomalies in the Eastern Snake River Plain Aquifer: Toward a Conceptual Model of the EGS Resource</i>	

**Exploration**

Allis, R., C. Hardwick, M. Gwynn, and S. Johnson . . . . .	379
<i>Pavant Butte, Utah Geothermal Prospect Revisited</i>	
Allis, R., M. Gwynn, C. Hardwick, G. Mines, and J. Moore . . . . .	389
<i>Will Stratigraphic Reservoirs Provide the Next Big Increase in U.S. Geothermal Power Generation?</i>	
Bellani, S., G. Magro, and F. Gherardi . . . . .	399
<i>Heat Flow and Helium Isotopes in the Geothermal Areas of Tuscany (Central Italy)</i>	

Blake, K., A. Tiedeman, A. Sabin, M. Lazaro, D. Meade, and W-C. Huang . . . . .	407
<i>Naval Air Station Fallon Mainside: Update of Geothermal Exploration</i>	
Lindsey, C., J. Fairley, P. Larson, and N. McMillan . . . . .	415
<i>Stochastic Modeling and Analysis of Temperature Data From Hot Springs in Yellowstone Caldera, Wyoming, USA</i>	
Lindsey, C., B. Lubenow, J. Fairley, and P. Larson . . . . .	421
<i>Ice Box Calorimetry: A Test of Applicability in Non-Steaming Geothermal Areas</i>	
Mellors, R. J., V. Camp, D. Harris, and A. Al-Amri . . . . .	425
<i>Investigating Potential Geothermal Resources in Western Saudi Arabia</i>	
Mink, L., J. Smith, K. Skeehan, and P. Foley . . . . .	429
<i>Plumbing and Political Will: Low Temperature Geothermal Power Exploration in Pagosa Springs, Colorado</i>	
Siler, D. L., J. E. Faulds, and N. H. Hinz . . . . .	437
<i>Earthquake-Related Stress Concentrations and Permeability Generation in Geothermal Systems</i>	

## **Geochemistry**

Chandrasekhar, V., D. Chandrasekharam, G. Trupti, and H. K. Singh . . . . .	447
<i>Fluoride in Geothermal Waters, India</i>	
Libbey, R. B., and A. E. Williams-Jones. . . . .	451
<i>Applications of Downhole Litho-geochemistry to Geothermal Exploration</i>	
McConville, E. G., P. Candela, P. Piccoli, and J. Moore . . . . .	465
<i>Variations in the Composition of Epidote in the Karaha-Telaga Bodas Geothermal System</i>	
Mizushima, A., H. Mikada, and J. Takekawa . . . . .	489
<i>The Importance of Hydrodynamic Conditions in Silicate Scale Growth Inferred From Numerical Simulation</i>	
Neupane, G., E. D. Mattson, T. L. McLing, P. F. Dobson, M. E. Conrad, T. R. Wood, C. Cannon, and W. Worthing . . . . .	495
<i>Geothermometric Temperature Comparison of Hot Springs and Wells in Southern Idaho</i>	
Wamalwa, R. . . . .	503
<i>Assessment of the Downhole Geochemical Report of OW-917</i>	
Zarei, E., F. Tutti, S. Porkhial, and N. M. Astanah . . . . .	507
<i>Geochemistry and Alteration Mineralogy of Well NWS-10, Mt. Sabalan Geothermal Field, NW-Iran</i>	

## Geology

- Callahan, O. A., T. T. Cladouhos, B. Larson, and R. A. Ketcham . . . . . 513  
*The Thermal History of Garland Mineral Springs, North Cascades, Washington, From Apatite Fission Track Analysis of Well Cuttings From Geothermal Exploration Well GAR-1*
- Etzel, T. M., J. N. Moore, J. R. Bowman, C. G. Jones, R. G. Intani, G. Golla, and G. Nash . . . . . 529  
*Tourmaline in Geothermal Systems: An Example From Darajat, Indonesia*
- Harðarson, B. S., S. G. Kristinsson, R. Karlsdóttir, and G. M. Einarsson . . . . . 537  
*Geothermal Implications of Rift Zone Mini-Grabens—Geological and Geophysical Structure of the Reykjafell Mini-Graben, Hengill Geothermal Field, SW Iceland*
- Lynne, B. Y. . . . . 545  
*Examining Subsurface Processes Captured in Geothermal Host Rocks Using Computerised Tomography and Scanning Electron Microscopy*
- Molisee, D. D., and J. W. Bell . . . . . 551  
*Structural Constraints of Buffalo Valley Hot Springs, North-Central Nevada*
- Mwania, M. M. . . . . 559  
*Evaluation of Subsurface Structures Using Hydrothermal Alteration Mineralogy — A Case Study of Olkaria South East Field*
- Ruiz, D. A. R, and R. H. Zúñiga . . . . . 567  
*Distribution of Hydrothermal Alteration in the Cerritos Colorados Geothermal Field, Mexico*
- Sadowski, A. J., and J. E. Faulds . . . . . 573  
*Structural Controls of the Black Warrior Blind Geothermal System, Washoe-Churchill Counties, Truckee Range, Northwestern Nevada, USA*

## Geophysics

- Crowell, J. . . . . 583  
*Quantifying How Errors in Thermal Conductivity Estimates Affect Geothermal Production Models*
- Durán, E., K. van Wijk, L. Adam, and I. Wallis . . . . . 587  
*Separating Intrinsic From Scattering Seismic Wave Attenuation From Sonic Logs in a Geothermal Field*
- Hardwick, C. L., R. Allis, and P. E. Wannamaker . . . . . 593  
*Observations and Implications of Magnetotelluric Data for Resolving Stratigraphic Reservoirs Beneath the Black Rock Desert, Utah, USA*
- Hartline, C. S., M. A. Walters, and M. C. Wright . . . . . 603  
*Three-Dimensional Structural Model Building, Induced Seismicity Analysis, Drilling Analysis, and Reservoir Management at The Geysers Geothermal Field, Northern California*



Hutchings, L., J. Savy, C. Bachmann, O. Heidbach, M. Miah, N. Lindsey, A. Singh, and R. Laboso . . . . .	615
<i>Examination of a Site-Specific, Physics-Based Seismic Hazard Analysis, Applied to Surrounding Communities of The Geysers Geothermal Development Area</i>	
McDonald, M. R., W. D. Gosnold, and S. H. Nordeng. . . . .	627
<i>Preliminary Results of a Heat Flow Study of the Williston Basin Using Temporarily Abandoned Oil Wells, Western North Dakota</i>	
Sugihara, M., K. Nawa, T. Ishido, N. Soma, and Y. Nishi . . . . .	635
<i>Potentiality of Continuous Measurements Using a Small-Sized Superconducting Gravimeter for Geothermal Reservoir Monitoring</i>	

### ***Injection***

Cui, M., H. Lei, and C. Dai . . . . .	645
<i>Particle Deposition in Porous Media: A Review</i>	

### ***Oil & Gas***

Gosnold, W., A. Crowell, S. Nordeng, and M. Mann . . . . .	653
<i>Co-Produced and Low-Temperature Geothermal Resources in the Williston Basin</i>	
Hardwick, C. L., H. W. Willis, and M. L. Gwynn . . . . .	661
<i>A Basin-Scale Geothermal Assessment of Co-Produced Waters in Oil and Gas Fields: Uinta Basin, Utah, USA</i>	
Wendt, D. S., G. L. Mines, C. J. Orme, and A. D. Wilson . . . . .	671
<i>Produced Water Treatment Using Switchable Polarity Solvent Forward Osmosis (SPS FO) Technology</i>	

### ***Play Fairways***

Coolbaugh, M., L. Shevenell, N. H. Hinz, P. Stelling, G. Melosh, W. Cumming, C. Kreemer, and M. Wilmarth . . . . .	677
<i>Preliminary Ranking of Geothermal Potential in the Cascade and Aleutian and Volcanic Arcs, Part III: Regional Data Review and Modeling</i>	
Faulds, J. E., N. H. Hinz, M. F. Coolbaugh, L. A. Shevenell, D. L. Siler, C. M. dePolo, W. C. Hammond, C. Kreemer, G. Oppliger, P. E. Wannamaker, J. H. Queen, and C. F. Visser . . . . .	691
<i>Integrated Geologic and Geophysical Approach for Establishing Geothermal Play Fairways and Discovering Blind Geothermal Systems in the Great Basin Region, Western USA: A Progress Report</i>	
Forson, C., M. W. Swyer, G. M. Schmalzle, J. L. Czajkowski, T. T. Cladouhos, N. Davatzes, D. K. Norman, and R. A. Cole . . . . .	701
<i>Geothermal Play-Fairway Analysis of Washington State Prospects</i>	

Gutiérrez-Negrín, L. C. A. . . . .	711
<i>Cerro Prieto, Mexico – A Convective Extensional Geothermal Play</i>	
Hinz, N. H., M. Coolbaugh, L. Shevenell, G. Melosh, W. Cumming, and P. Stelling . . . . .	717
<i>Preliminary Ranking of Geothermal Potential in the Cascade and Aleutian Volcanic Arcs, Part II: Structural – Tectonic Settings of the Volcanic Centers</i>	
Jordan, T., E. Camp, J. Smith, C. Whealton, F. Horowitz, J. Stedinger, J. Tester, M. Richards, M. Hornbach, Z. Frone, R. Bolat, B. Anderson, X. He, and K. Welcker . . . . .	727
<i>Low-Temperature Geothermal Energy Characterization by Play Fairway Analysis for the Appalachian Basin of New York, Pennsylvania and West Virginia</i>	
Lautze, N., D. Thomas, N. Hinz, N. Frazer, G. Ito, D. Waller, H. Schuchmann, and M. Brady . . . . .	733
<i>Integration of Data in a Play Fairway Analysis of Geothermal Potential Across the State of Hawaii</i>	
McClain, J. S., P. Dobson, C. Cantwell, M. Conrad, C. Ferguson, A. Fowler, E. Gasperikova, W. Glassley, S. Hawkes, P. Schiffman, D. Siler, N. Spycher, C. Ulrich, Y. Zhang, and R. Zierenberg. . . . .	739
<i>Geothermal Play Fairway Analysis of Potential Geothermal Resources in NE California, NW Nevada, and Southern Oregon: A Transition between Extension-Hosted and Volcanically-Hosted Geothermal Fields</i>	
Nash, G. D., and C. R. Bennett . . . . .	743
<i>Adaptation of a Petroleum Exploration Tool to Geothermal Exploration: Preliminary Play Fairway Model of Tularosa Basin, New Mexico, and Texas</i>	
Person, M., S. Kelley, R. Kelley, S. Karra, D. Harp, J. Witcher, J. Bielicki, G. Sutula, R. Middleton, and J. D. Pepin . . . . .	751
<i>Hydrogeologic Windows: Detection of Blind and Traditional Geothermal Play Fairways in Southwestern New Mexico Using Conservative Element Concentrations and Advective-Diffusive Solute Transport</i>	
Shervais, J. W., J. M. Glen, L. M. Liberty, P. Dobson, E. Gasperikova, E. Sonnenthal, C. Visser, D. Nielson, S. Garg, J. P. Evans, D. Siler, J. DeAngelo, N. Athens, and E. Burns . . . . .	761
<i>Snake River Plain Play Fairway Analysis – Phase 1 Report</i>	
Shevenell, L., M. Coolbaugh, N. H. Hinz, P. Stelling, G. Melosh, W. Cumming, and C. Kreemer . . . . .	771
<i>Preliminary Ranking of Geothermal Potential in the Cascade and Aleutian Volcanic Arcs, Part I: Data Collection</i>	
Wannamaker, P. E., A. J. Meigs, B. M. Kennedy, J. N. Moore, E. L. Sonnenthal, V. Maris, and J. D. Trimble . . . . .	785
<i>Play Fairway Analysis of the Central Cascades Arc-Backarc Regime, Oregon: Preliminary Indications</i>	

Wannamaker, P.E., J. N. Moore, K. L. Pankow, S. D. Simmons, G. D. Nash, V. Maris, C. Batchelor, and C. L. Hardwick . . . . .	793
<i>Play Fairway Analysis of the Eastern Great Basin Extensional Regime, Utah: Preliminary Indications</i>	

**Power Plant**

Agahi, R., and F. Mohr . . . . .	805
<i>Evaluation of Inflow Radial Turbo Expander Field Performance for a 25 MW Geothermal Organic Rankine Cycle Train</i>	
Avery, J., B. Benn, K. E. McIntush, D. Mamrosh, and C. Beitler . . . . .	809
<i>Use of a Waste Heat Boiler to Capture Energy From Flammable Noncondensable Gas at Geothermal Power Plants</i>	
Bierre, E., and R. Fullerton . . . . .	819
<i>Tubular Biofilm Reactor for Hydrogen Sulphide Removal From Geothermal Cooling Water</i>	
Bonafin, J., C. R. di Schio, and A. Duvia . . . . .	827
<i>Turboden, a Presentation of Recent Worldwide Developments and the Latest Technical Solutions for Large-Scale Geothermal ORC Power-Plants</i>	
DiPippo, R., and K. Kitz . . . . .	833
<i>Geothermal Binary Power Plants at Raft River, San Emidio, and Neal Hot Springs: Part 1 – Plant Descriptions and Design Performance Comparison</i>	
García-Gutiérrez, A., R. Ovando-Castelar, J. I. Martínez-Estrella, I. Canchola-Félix, and P.V. Jacobo-Galván . . . . .	847
<i>Evaluation and Optimization of the Cerro Prieto Geothermal Field Steam Transportation Network Efficiency – Estimation of Heat Losses From Pipe Fittings</i>	
Huang, D., Z. Wang, and W. Fu . . . . .	855
<i>Predictive Functional Control Applied in Vapor Temperature Control of Organic Rankine Cycle System</i>	
Inanli, M., and P. Valdimarsson . . . . .	861
<i>Rerouting the Condensate in an ORC Geothermal Power Plant</i>	
Kolar, M., S. Osgood, and W. Echt . . . . .	867
<i>Coso Case Study: 22 Years of Reliable Sulfur Removal</i>	
Reede, C., H. Doumanidis, M. Aureli, and M. Curie . . . . .	873
<i>Thrust Bearing Load Observations in Deep Well Enclosed Lineshaft Pumps</i>	
Rivas-Cruz, F., A. García-Gutiérrez, J. I. Martínez-Estrella, and Á. A. Ortiz-Bolaños . . . . .	881
<i>Design and Evaluation of Geothermal Steam Separators: A Review of the State of Art</i>	

Shurtleff, P., and W. Harvey . . . . .	887
<i>Displaced Exergy: The Valuation of Thermal Power</i>	
Wendt, D., G. L. Mines, C. S. Turchi, G. Zhu, S. Cohan, L. Angelini, F. Bizzarri, D. Consoli, and A. De Marzo . . . . .	891
<i>Stillwater Hybrid Geo-Solar Power Plant Optimization Analyses</i>	
Williams, T., and Greg Mines . . . . .	901
<i>DOE-GTO Low Temperature Project Case Study</i>	
Wolf, N., and A. Gabbay . . . . .	907
<i>Sarulla 330 MW Geothermal Project Key Success Factors in Development</i>	

## **Regulatory**

Ndetei, C. J. . . . .	915
<i>Assessment of Air Quality for Development Options at Olkaria Geothermal Field in Kenya</i>	
Norris, T. R., and K. DeAnda . . . . .	925
<i>Progress in Silencing ORC Turboexpanders in Geothermal Service</i>	
Schroeder, J. N., R. M. Horner, C. B. Harto, and C. E. Clark . . . . .	929
<i>Alternative Water Policy Assessment for Enhanced Geothermal Systems — A Case Study</i>	

## **Reservoir Engineering/Modeling**

Kumar, D., and A. Ghassemi . . . . .	937
<i>3D Simulation of Mixed-Mode Poroelastic Fracture Propagation for Reservoir Stimulation</i>	
Ratouis, T. M. P., M. J. O’Sullivan, and J. P. O’Sullivan . . . . .	947
<i>Modelling the Effects of Seasonal Variations in Rainfall and Production Upon the Aquifer and Surface Features of Rotorua Geothermal Field</i>	
Zerpa, L. E., J. Cho, and C. Augustine . . . . .	959
<i>Assessing the Effect of Realistic Reservoir Features on the Performance of Sedimentary Geothermal Systems</i>	
Zhang, Y., T. S. Manley, K. Li, and R. N. Horne. . . . .	967
<i>DNA-Encapsulated Silica Nanoparticle Tracers for Fracture Characterization</i>	

## **Resource Assessment**

Getman, D., A. Anderson, and C. Augustine . . . . .	977
<i>Geothermal Prospector: Supporting Geothermal Analysis Through Spatial Data Visualization and Querying Tools</i>	

Terry, R., and K. Young . . . . .	987
<i>Using Geothermal Play Types as an Analogue for Estimating Potential Resource Size</i>	
Young, K. R., A. M. Wall, and P. F. Dobson . . . . .	995
<i>Geothermal Resource Reporting Metric (GRRM) Developed for the U.S. Department of Energy’s Geothermal Technologies Office</i>	

**Resource Management**

Bergfeld, D., R. G. Vaughan, W. C. Evans, and E. Olsen . . . . .	1007
<i>Monitoring Ground-Surface Heating During Expansion of the Casa Diablo Production Well Field at Mammoth Lakes, California</i>	

**Scaling & Mineral Extraction**

Clemente, V. C., K. S. Faja, M. H. Reed, L. M. Daco-ag, and R. J. T. Tamboboy. . . . .	1017
<i>Assessment of CHIM-XPT and Watch in Predicting the Calcite Scaling Potential of Geothermal Wells</i>	
Noack, C. W., K. Perkins, N. Washburn, D. A. Dzombak, and A. K. Karamalidis . . . . .	1023
<i>Screening the Effects of Ligand Chemistry and Geometry on Rare Earth Element Partitioning From Saline Solutions to Functionalized Adsorbents</i>	
Rajterowski, J., J. E. Renew, and R. Melsert . . . . .	1025
<i>Modular Solid-State Thermoelectric Power Generation and High-Value Lithium Recovery From Low-Temperature Geothermal Brines</i>	
Yanagisawa, N. . . . .	1029
<i>Case Study of the Change of Scale With Production</i>	

**Sedimentary Basin**

Crowell, A. . . . .	1035
<i>Geostatistical Analysis of Bottom-Hole Temperatures in the Denver and Williston Basins: North America</i>	
Hartig, C. M. . . . .	1039
<i>Discrete Fracture Network Simulation for Sedimentary Enhanced Geothermal Systems: Red River Formation, Williston Basin, North Dakota</i>	
Morgan, P. . . . .	1049
<i>Sedimentary Basin Geothermal Resources in the Piceance Basin, Colorado</i>	

**Tools**

Balamir, O., W. M. Rickard, F. Wilson, K. Harestad, and P. A. Årebråt . . . . .	1059
<i>Cementing Tool Supports Cement Plug in Large Diameter Geothermal Well Casing</i>	

Brambilla, N., and F. Martini . . . . .	1065
<i>Ultra-High Temperature (250°C+) and Wide Operating Temperature Range Ultracapacitor Enabling Downhole Power Source for Geothermal Exploration</i>	
Erkan, K., M. Doğruel, K. Bayat, B. Akkoyunlu, M. Tayanç, E. Balkan, and S. Hamamcı . . . . .	1069
<i>Development of a Digital Output Temperature Probe for Precision Measurements</i>	
Holbein, B., J. Isele, and L. Spatafora . . . . .	1073
<i>Integrated Cooling Systems for an Extended Operation Range of Borehole Tools</i>	
Kerr, R., B. D. Gleason, A. Olzick, and B. Denzel . . . . .	1079
<i>A New Technique and Sensor for Determining Steam Quality Along a Wellbore</i>	

***Alphabetical Index of Authors***