

**Prof. Martin O. Saar, Ph.D.**

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**RESEARCH FIELD**

Subsurface fluid dynamics of multiscale, multiphase, multicomponent, reactive fluid (groundwater, CO<sub>2</sub>, hydrocarbon) and heat energy transport during processes such as water- and CO<sub>2</sub>-based geothermal energy extraction and use/conversion, geologic CO<sub>2</sub> storage, grid-scale subsurface energy storage, enhanced oil/gas recovery, and groundwater flow. Methods include computer simulations, laboratory experiments, and field analyses.

**POSITIONS****Academic:**

1.7.2020- Chair of the Institute of Geophysics, Dept. of Earth Sciences, ETH\*\* Zürich, Switzerland (CH)  
 2015- **now** Chair\* of Geothermal Energy and Geofluids, Dept. of Earth Sciences, ETH\*\* Zürich, CH  
 2015- **now** Adjunct Professor of Hydrogeology and Geofluids, Dept. of Earth Sciences, UMN\*\*\*, USA  
 2014-2014 Full Professor and Gibson Chair (Fall, 2014), Dept. of Earth Sciences, UMN, USA  
 2011-2014 Institute on the Environment Resident Fellow, UMN, USA  
 2011-2014 Associate Professor and Gibson Chair, Dept. of Earth Sciences, UMN, USA  
 2009-2011 McKnight Land-Grant Chair & Professor, College of Science & Engineering, UMN, USA  
 2008-2014 Affiliated Member of the Graduate Faculty, Computer Science and Engineering, UMN, USA  
 2006-2014 Member of the Graduate Faculty, Water Resources Sciences, UMN, USA  
 2005-2014 Gibson Chair of Hydrogeology and Geofluids, UMN, USA  
 2005-2011 Assistant Professor and Gibson Chair, Dept. of Geology & Geophysics, UMN, USA  
 2003-2004 Turner Postdoctoral Fellow, Dept. of Earth and Environm. Sci., U. of Michigan, MI, USA

\* Endowed by the Werner Siemens Foundation, \*\* ETH=Swiss Federal Institute of Technology, \*\*\* UMN=University of Minnesota

**Industry:**

2018-present Co-Founder, CO2 POWER GmbH, A CO2-Geothermal Energy Co., Zurich, Switzerland  
 2014-present Co-Founder & Chief Scientific Officer, TerraCOH, a COH-Geothermal Co., Minneapolis., MN, USA  
 2012-present Founder & Chief Manager, Geofluids LLC, a geofluids consulting firm, St. Paul, MN, USA  
 2011-2014 Co-Founder & Chief Scientific Officer, Heat Mining Company LLC, Rapid City, SD, USA  
 (became TerraCOH in 2014)

**EDUCATION**

2003 Ph.D. in Earth and Planetary Sciences, University of California, Berkeley, CA; Adviser: Dr. Michael Manga; Dissertation: Geological Fluid Mechanics Models at Various Scales  
 1998 M.Sc. in Geology, University of Oregon, Eugene, OR; Adviser: Dr. Michael Manga; Thesis: The Relationship Between Permeability, Porosity, and Microstructure in Vesicular Basalts  
 1995 Vordiplom (~B.Sc.) in Geology, Albert-Ludwigs University, Freiburg, Germany

**AWARDS AND SELECTED PATENTS** (16 international patents issued; several pending)

2018 Saar, M.O. and B.M. Adams, ETH Zurich, Extension of a geothermal energy system, Application Nr. 18 207 841.0, Nov. 22, 2018.  
 2014-present Saar, M.O., Randolph, J.B., Kuehn, T.H., the Regents of the University of Minnesota, and Heat Mining Company LLC, Geothermal energy generation system comprises injection wells for accessing reservoir containing native fluid comprising hydrocarbon, production wells, non-water based working fluid supply apparatus, and energy recovery apparatus, Pending Patent No. WO2014015307-A1.  
 2013 Saar, M.O., Randolph, J.B., Kuehn, T.H., Carpenter, K. & the Regents of the University of Minnesota & Heat Mining Company LLC, Carbon dioxide-based geothermal energy generation systems and methods related thereto U.S. Patent Application for CPG with Enhanced Oil Recovery (EOR), i.e., CPG-EOR (continuation-in-part of CPG parent patent; Patent No. US8,991,510; patent application number: 13/554,868)  
 2012-2015 Saar, M.O., Randolph, J.B., Kuehn, T.H., & the Regents of the University of Minnesota, Carbon dioxide-based geothermal energy generation systems and methods related thereto, U.S. Patent No.

- US8,316,955 B2 (issued 2012); Canada Patent No. 2.753.393 (issued 2013); Europe Patent No. 2406562 (issued 2014); Australia Patent No. 2010223059 (issued 2015).
- 2011 George W. Taylor Career Development Award for top tenure candidate in the College of Science and Engineering, University of Minnesota – Twin Cities
- 2011 Editor's Choice Award for 2011 Hydrogeology Journal article (see publications: Saar, 2011)
- 2009 Awarded 2009-2011 McKnight Land-Grant Professorship and Chair position, UMN
- 2005 Awarded endowed Gibson Chair position, University of Minnesota
- 2004 Awarded Turner Postdoctoral Fellowship, University of Michigan
- 2000 Outstanding Student Paper Award, American Geophysical Union
- 1997 Awarded: Staples Fellowship for Outstanding Scholastic Achievements, University of Oregon

### PUBLICATIONS IN JOURNALS (Indexed in Scopus)

Publication performance for M.O. Saar (as of May 29, 2020):			
Scopus:	h-index: 27	Number of citations:	2739
Google Scholar:	h-index: 33	Number of citations:	4086
<u>Authorship:</u>			
First Author	= Researcher who did most of the work		
<b>Bold</b> Author	= M.O. Saar		
<b>Black-Bold</b> Author	= M.O. Saar is Principal Investigator (PI) / Senior Scientist (typically last author)		
<u>Underlined</u> Author	= Current or former student, postdoc, or researcher advisees of M.O. Saar; For positions, see Advising Section.		
<u>Citations:</u>			
DOI numbers link to the paper's journal web site for download.			
In reverse chronological order.			

### 2020 (14 papers)

- 91) Rossi, E., **M.O. Saar**, and P. Rudolf von Rohr, *The influence of thermal treatment on rock-bit interaction: A study of a combined thermo-mechanical drilling (CTMD) concept*, **Geothermal Energy**, doi.org/10.1186/s40517-020-00171-y, 8:16, 2020.
- 90) Kittilä, A., M.R. Jalali, **M.O. Saar**, and X.-Z. Kong, *Solute tracer test quantification of the effects of hot water injection into hydraulically stimulated crystalline rock*, **Geothermal Energy in press since May 19, 2020**.
- 89) Fleming, M.R., B.M. Adams, T.H. Kuehn, J.M. Bielicki, and **M.O. Saar**, *Increased Power Generation due to Exothermic Water Exsolution in CO<sub>2</sub> Plume Geothermal (CPG) Power Plants*, **Geothermics**, doi.org/10.1016/j.geothermics.2020.101865 on March 31, 2019. → revisions #2: submitted on April 16, 2020. → **accepted on April 21, 2020**.
- 88) Ezekiel, J., A. Ebigbo, B.M. Adams, **M.O. Saar**, *Combining natural gas recovery and CO<sub>2</sub>-based geothermal energy extraction for electric power generation*, **Applied Energy**, doi.org/10.1016/j.apenergy.2020.115012, 269, 115012, 2020.
- 87) Leal, A.M.M., S. Kyas, D.A. Kulik, and **M.O. Saar**, *Accelerating Reactive Transport Modeling: On-Demand Machine Learning Algorithm for Chemical Equilibrium Calculations*, **Transport in Porous Media (TIPM)**, doi.org/10.1007/s11242-020-01412-1, 2020.
- 86) Kittilä, A., M.R. Jalali, M. Somogyvári, K.F. Evans, **M.O. Saar**, and X.-Z. Kong, *Characterization of the effects of hydraulic stimulation with tracer-based temporal moment analysis and tomographic inversion*, **Geothermics**, doi.org/10.1016/j.geothermics.2020.101820, 86:101820, 2020.
- 85) Ahkami, M., A. Parmigiani, P.R. Di Palma, **M.O. Saar**, and X.-Z. Kong, *A lattice-Boltzmann study of permeability-porosity relationships and mineral precipitation patterns in fractured porous media*, Special Issue: "SI: Coupled Thermal-Hydro-Mechanical-Chemical Processes in Fractured Media: Microscale to Macroscale Numerical Modeling" in **Computational Geosciences**, doi.org/10.1007/s10596-019-09926-4, 2020.
- 84) Vogler, D., S.D.C. Walsh, P. Rudolf von Rohr, and **M.O. Saar**, *Simulation of Rock Failure Modes in Thermal Spallation Drilling*, **Acta Geotechnica**, doi.org/10.1007/s11440-020-00927-7, 2020.

- 83) Vogler, D., S.D.C. Walsh, and M.O. Saar, *A Numerical Investigation into Key Factors Controlling Hard Rock Excavation via Electropulse Stimulation*, **Journal of Rock Mechanics and Geotechnical Engineering**, [doi.org/10.1016/j.jrmge.2020.02.002](https://doi.org/10.1016/j.jrmge.2020.02.002), 2020.
- 82) Nejati, M., A. Aminzadeh, T. Driesner, and M.O. Saar, *On the directional dependency of Mode I fracture toughness in anisotropic rocks*, **Theoretical and Applied Fracture Mechanics**, [doi.org/10.1016/j.tafmec.2020.102494](https://doi.org/10.1016/j.tafmec.2020.102494), 107:102494, 2020.
- 81) Rossi, E., S. Jamali, D. Schwarz, M.O. Saar, P. Rudolf von Rohr, *Field test of a Combined Thermo-Mechanical Drilling technology. Mode II: Flame-assisted rotary drilling*, **Journal of Petroleum Science and Engineering**, [doi.org/10.1016/j.petrol.2019.106880](https://doi.org/10.1016/j.petrol.2019.106880), 190:106880, 2020.
- 80) Rossi, E., S. Jamali, M.O. Saar, P. Rudolf von Rohr, *Field test of a Combined Thermo-Mechanical Drilling technology. Mode I: Thermal spallation drilling*, **Journal of Petroleum Science and Engineering**, [doi.org/10.1016/j.petrol.2020.107005](https://doi.org/10.1016/j.petrol.2020.107005), 190:107005, 2020.
- 79) Rossi, E., S. Jamali, V. Wittig, M.O. Saar, P. Rudolf von Rohr, *A combined thermo-mechanical drilling technology for deep geothermal and hard rock reservoirs*, **Geothermics**, [doi.org/10.1016/j.geothermics.2019.101771](https://doi.org/10.1016/j.geothermics.2019.101771), 85:101771, 2020.
- 78) von Planta, C., D. Vogler, X. Chen, M.G.C. Nestola, M.O. Saar and R. Krause, *Modelling of hydro-mechanical processes in heterogeneous fracture intersections using a fictitious domain method with variational transfer operators*, **Computational Geosciences** (SI: CouFrac 2018), [doi.org/10.1007/s10596-020-09936-7](https://doi.org/10.1007/s10596-020-09936-7), 2020.

### 2019 (11 papers)

- 77) Gischig V.S., D. Giardini, F. Amann, M. Hertrich, H. Krietsch, S. Loew, H. Maurer, L. Villiger, S. Wiemer, F. Bethmann, B. Brixel, J. Doetsch, N. Gholizadeh Doonechaly, T. Driesner, N. Dutler, K.F. Evans, M. Jalali, D. Jordan, A. Kittilä, X. Ma, P. Meier, M. Nejati, A. Obermann, K. Plenkers, M.O. Saar, A. Shakas, B. Valley, *Hydraulic stimulation and fluid circulation experiments in underground laboratories: stepping up the scale towards engineered geothermal systems*, **Geomechanics for Energy and the Environment**, [doi.org/10.1016/j.gete.2019.100175](https://doi.org/10.1016/j.gete.2019.100175), 100175, 2019.
- 76) Lima, M.G., D. Vogler, L. Querci, C. Madonna, B. Hattendorf, M.O. Saar, and X.-Z. Kong, *Thermally driven fracture aperture variation in naturally fractured granites*, EGW Special Issue in **Geothermal Energy**, [doi.org/10.1186/s40517-019-0140-9](https://doi.org/10.1186/s40517-019-0140-9), 7:23, 2019.
- 75) Ma, J., L. Querci, B. Hattendorf, M.O. Saar, X.-Z. Kong, *Toward a spatiotemporal understanding on dolomite dissolution in sandstone by CO<sub>2</sub>-enriched brine circulation*, **Environmental Science & Technology**, [doi.org/10.1021/acs.est.9b04441](https://doi.org/10.1021/acs.est.9b04441), 53:12458–12466, 2019.
- 74) von Planta C., D. Vogler, X. Chen, M.G.C. Nestola, M.O. Saar, and R. Krause, *Simulation of hydro-mechanically coupled processes in rough rock fractures using an immersed boundary method and variational transfer operators*, **Computational Geosciences**, [doi.org/10.1007/s10596-019-09873-0](https://doi.org/10.1007/s10596-019-09873-0), 23:1125-1140, 2019.
- 73) Kittilä, A., M.R. Jalali, K.F. Evans, M. Willmann, M.O. Saar, and X.-Z. Kong, *Field comparison of DNA-labeled nanoparticle and solute tracer transport in a fractured crystalline rock*, **Water Resources Research**, [doi.org/10.1029/2019WR025021](https://doi.org/10.1029/2019WR025021), 55:6577–6595, 2019.
- 72) Schädle, P., P. Zulian, D. Vogler, S. Bhopalam R., M.G.C. Nestola, A. Ebigbo, R. Krause, M.O. Saar, *3D non-conforming mesh model for flow in fractured porous media using Lagrange multipliers*, **Computers and Geosciences**, [doi.org/10.1016/j.cageo.2019.06.014](https://doi.org/10.1016/j.cageo.2019.06.014), 132:42–55, 2019.
- 71) Nejati, M., M.L.T. Dambly, and M.O. Saar, *A methodology to determine the elastic properties of anisotropic rocks from a single uniaxial compression test*, **Journal of Rock Mechanics and Geotechnical Engineering**, [doi.org/10.1016/j.jrmge.2019.04.004](https://doi.org/10.1016/j.jrmge.2019.04.004), 11, 1166-1183, 2019.
- 70) Nejati, M., A. Aminzadeh, M.O. Saar, and T. Driesner, *Modified semi-circular bend test to determine the fracture toughness of anisotropic rocks*, **Engineering Fracture Mechanics**, [doi.org/10.1016/j.engfracmech.2019.03.008](https://doi.org/10.1016/j.engfracmech.2019.03.008), 213: 153-171, 2019.
- 69) Myre, J.M., I. Lascu, E.A. Lima, J.M. Feinberg, M.O. Saar, and B.P. Weiss, *Using TNT-NN to unlock the fast full spatial inversion of large magnetic microscopy data sets*, **Earth, Planets and Space**, Special Issue on: **Recent Advances in Geo-, Paleo- and Rock- Magnetism**, [doi.org/10.1186/s40623-019-0988-8](https://doi.org/10.1186/s40623-019-0988-8), 71:14, 2019.
- 68) Ogland-Hand, J.D., J.M. Bielicki, Y. Wang, B.M. Adams, T.A. Buscheck, and M.O. Saar, *The Value of Bulk Energy Storage for Reducing CO<sub>2</sub> Emissions and Water Requirements from Regional Electricity Systems*, **Energy Conversion and Management**, [doi.org/10.1016/j.enconman.2018.12.019](https://doi.org/10.1016/j.enconman.2018.12.019), 181:674-685, 2019.

- 67) Dambly, M.L.T., M. Nejadi, D. Vogler, and **M.O. Saar**, *On the direct measurement of shear moduli in transversely isotropic rocks using the uniaxial compression test*, **International Journal of Rock Mechanics and Mining Sciences (IJRMMS)**, doi.org/10.1016/j.ijrmms.2018.10.025, 113:220-240, **2019**.

#### 2018 (8 papers)

- 66) Samrock, F., A.V. Grayver, H. Eysteinnsson, and **M.O. Saar**, *Magnetotelluric image of transcrustal magmatic system beneath the Tulu Moyo geothermal prospect in the Ethiopian Rift*, **Geophysical Research Letters**, doi.org/10.1029/2018GL080333, 45, 12,847-12,855, **2018**.
- 65) Kong, X.-Z., C.A. Deuber, A. Kittilä, M. Somogyvári, G. Mikutis, P. Bayer, W.J. Stark, and **M.O. Saar**, *Tomographic Reservoir Imaging with DNA-Labeled Silica Nanotracers: The First Field Validation*, **Environmental Science & Technology**, doi.org/10.1021/acs.est.8b04367 52:13681-13689, **2018**.
- 64) Mikutis, G., C.A. Deuber, L. Schmid, A. Kittilä, N. Lobsiger, M. Puddu, D.O. Asgeirsson, R.N. Grass, **M.O. Saar**, W.J. Stark, *Silica-encapsulated DNA-based tracers for aquifer characterization*, **Environmental Science & Technology**, doi.org/10.1021/acs.est.8b03285, 52:12142–12152, **2018**.
- 63) Ahkami, M., T. Roesgen, **M.O. Saar**, and X.-Z. Kong, *High-resolution temporo-ensemble PIV to resolve pore-scale flow in 3D-printed fractured porous media*, **Transport in Porous Media (TiPM)**, doi.org/10.1007/s11242-018-1174-3, 129:2 467-483, **2018**.
- 62) Hobé, A., D. Vogler, M.P Seybold, A. Ebigbo, R.R. Settgest, and **M.O. Saar**, *Estimating fluid flow rates through fracture networks using combinatorial optimization*, **Advances in Water Resources**, doi.org/10.1016/j.advwatres.2018.10.002, 122:85-97, **2018**.
- 61) Rossi, E., M.A. Kant, C. Madonna, **M.O. Saar**, and P. Rudolf von Rohr, *The effects of high heating rate and high temperature on the rock strength: Feasibility study of a thermally assisted drilling method*, **Rock Mechanics and Rock Engineering**, doi.org/10.1007/s00603-018-1507-0, 51:2957-2964, **2018**.
- 60) Amann Florian, Valentin Gischtig, Keith Evans, Joseph Doetsch, Reza Jalali, Benoît Valley, Hannes Krietsch, Nathan Dutler, Linus Villiger, Bernard Brixel, Maria Klepikova, Anniina Kittilä, Claudio Madonna, Stefan Wiemer, **M.O. Saar**, Simon Loew, Thomas Driesner, Hansruedi Maurer, and Domenico Giardini, *The seismo-hydro-mechanical behaviour during deep geothermal reservoir stimulations: open questions tackled in a decameter-scale in-situ stimulation experiment*, **Solid Earth**, doi.org/10.5194/se-9-115-2018, 115–137, **2018**.
- 59) Kant, M.A., E. Rossi, J. Duss, F. Amann, **M.O. Saar**, and P. Rudolf von Rohr, *Demonstration of thermal borehole enlargement to facilitate controlled reservoir engineering for deep geothermal, oil or gas systems*, **Applied Energy**, doi.org/10.1016/j.apenergy.2018.01.009, 212: 1501-1509, **2018**.

#### 2017 (5 papers)

- 58) Walsh, S.D.C., N. Garapati, A.M.M. Leal, and **M.O. Saar**, *Calculating thermophysical fluid properties during geothermal energy production with NESS and Reaktor*, **Geothermics**, DOI: doi.org/10.1016/j.geothermics.2017.06.008, 70:146-154, **2017**.
- 57) Leal, A.M.M., D.A. Kulik, W.R. Smith, and **M.O. Saar**, *An overview of computational methods for chemical equilibrium and kinetic calculations for geochemical and reactive transport modeling*, **Pure and Applied Chemistry**, doi.org/10.1515/pac-2016-1107, 89(5): 597-643, **2017**.
- 56) Myre, J.M., E. Frahm, D.J. Lilja, and **M.O. Saar**, *TNT-NN: A Fast Active Set Method for Solving Large Non-Negative Least Squares Problems*, **Procedia Computer Science** (strictly peer-reviewed), doi.org/10.1016/j.procs.2017.05.194, 108C:755-764, **2017**.
- 55) Luhmann, A.J., B.M. Tutolo, C. Tan, B.M. Moskowitz, **M.O. Saar**, W.E. Seyfried, Jr., *Whole rock basalt alteration from CO<sub>2</sub>-rich brine during flow-through experiments at 150°C and 150 bar*, **Chemical Geology**, doi.org/10.1016/j.chemgeo.2017.02.002, 453:92–110, **2017**.
- 54) Luhmann, A.J., B.M. Tutolo, B.C. Bagley, D.F.R. Mildner, W.E. Seyfried, Jr., and **M.O. Saar**, *Permeability, porosity, and mineral surface area changes in basalt cores induced by reactive transport of CO<sub>2</sub>-rich brine*, **Water Resources Research**, doi.org/10.1002/2016WR019216, 53:1-20, **2017**.

#### 2016 (4 papers)

- 53) Leal, A.M.M., D.A. Kulik, G. Kosakowski, and **M.O. Saar**, *Computational methods for reactive transport modeling: An extended law of mass-action, xLMA, method for multiphase equilibrium calculations*, **Advances in Water Resources**, doi.org/10.1016/j.advwatres.2016.08.008, 96:405-422, **2016**.

- 52) Leal, A.M.M., D.A. Kulik, and M.O. Saar, *Enabling Gibbs energy minimization algorithms to use equilibrium constants of reactions in multiphase equilibrium calculations*, **Chemical Geology**, doi.org/10.1016/j.chemgeo.2016.05.029, 437:170-181, 2016.
- 51) Buscheck, T.A., J.M. Bielicki, T.A. Edmunds, Y. Hao, Y. Sun, J.B. Randolph, and M.O. Saar, *Multifluid geo-energy systems: Using geologic CO<sub>2</sub> storage for geothermal energy production and grid-scale energy storage in sedimentary basins*, **Geosphere**, doi.org/10.1130/GES01207.1, 12(3):678-696, 2016.
- 50) Tutolo, B.M., D.F.R. Mildner, C.V.L. Gagnon, M.O. Saar, and W.E. Seyfried, Jr., *Nanoscale constraints on porosity generation and fluid flow during serpentinization*, **Geology**, doi.org/10.1130/G37349.1, 44:103-106, 2016.

#### 2015 (6 papers)

- 49) Tutolo, B.M., X.-Z. Kong, W.E. Seyfried Jr., and M.O. Saar, *High performance reactive transport simulations examining the effects of thermal, hydraulic, and chemical (THC) gradients on fluid injectivity at carbonate CCUS reservoir scales*, **Int. J. Greenhouse Gas Control**, doi.org/10.1016/j.ijggc.2015.05.026, 39:285-301, 2015.
- 48) Tutolo, B.M., A.J. Luhmann, X.-Z. Kong, M.O. Saar, and W.E. Seyfried Jr., *CO<sub>2</sub> sequestration in feldspar-rich sandstone: Coupled evolution of fluid chemistry, mineral reaction rates, and hydrogeochemical properties*, **Geochimica et Cosmochimica Acta**, doi.org/10.1016/j.gca.2015.04.002, 160:132-154, 2015.
- 47) Garapati, N., J.B. Randolph, and M.O. Saar, *Brine displacement by CO<sub>2</sub>, energy extraction rates, and lifespan of a CO<sub>2</sub>-limited CO<sub>2</sub> Plume Geothermal (CPG) system with a horizontal production well*, **Geothermics**, doi.org/10.1016/j.geothermics.2015.02.005, 55:182-194, 2015.
- 46) Adams, B.M., T.H. Kuehn, J.M. Bielicki, J.B. Randolph, M.O. Saar, *A Comparison of Electric Power Output of CO<sub>2</sub> Plume Geothermal (CPG) and Brine Geothermal Systems for Varying Reservoir Conditions*, **Applied Energy**, doi.org/10.1016/j.apenergy.2014.11.043, 140:365-377, 2015.
- 45) Luhmann, A.J., M. D. Covington, J.M. Myre, M. Perne, S.W. Jones, E.C. Alexander, Jr., and M.O. Saar, *Thermal damping and retardation in karst conduits*, **Hydrology and Earth System Sciences (HESS)**, doi.org/10.5194/hess-19-137-2015, 19:137-157, 2015.
- 44) Tutolo, B.M., A.T. Schaen, M.O. Saar, and W.E. Seyfried Jr., *Implications of the redissociation phenomenon for mineral-buffered fluids and aqueous species transport at elevated temperatures and pressures*, **Applied Geochemistry**, doi.org/10.1016/j.apgeochem.2014.11.002, 55:119-127, 2015.

#### 2014 (6 papers)

- 43) Buscheck, T.A., J.M. Bielicki, M. Chen, Y. Sun, Y. Hao, T.A. Edmunds, M.O. Saar, and J.B. Randolph, *Integrating CO<sub>2</sub> Storage with Geothermal Resources for Dispatchable Renewable Electricity*, **Energy Procedia**, doi.org/10.1016/j.egypro.2014.11.796, 63:7619-7630, 2014.
- 42) Garapati, N., J.B. Randolph, J.L. Valencia Jr., and M.O. Saar, *CO<sub>2</sub> -Plume Geothermal (CPG) Heat Extraction in Multi-layered Geologic Reservoirs*, **Energy Procedia**, doi.org/10.1016/j.egypro.2014.11.797, 63:7631-7643, 2014.
- 41) Luhmann, A.J., X.-Z. Kong, B.M. Tutolo, N. Garapati, B.C. Bagley, M.O. Saar, and W.E. Seyfried Jr., *Experimental dissolution of dolomite by CO<sub>2</sub>-charged brine at 100°C and 150 bar: Evolution of porosity, permeability, and reactive surface area*, **Chemical Geology**, doi.org/10.1016/j.chemgeo.2014.05.001, 380:145-160, 2014.
- 40) Adams, B.M., T.H. Kuehn, J.M. Bielicki, J.B. Randolph, and M.O. Saar, *On the importance of the thermosiphon effect in CPG (CO<sub>2</sub> Plume Geothermal) power systems*, **Energy**, doi.org/10.1016/j.energy.2014.03.032, 69:409-418, 2014.
- 39) Tutolo, B.M., X.-Z. Kong, W.E. Seyfried, Jr., and M.O. Saar, *Internal consistency in aqueous geochemical data revisited: Applications to the aluminum system*, **Geochimica et Cosmochimica Acta**, doi.org/10.1016/j.gca.2014.02.036, 133:216-234, 2014.
- 38) Tutolo, B.M., A.J. Luhmann, X.-Z. Kong, M.O. Saar, and W.E. Seyfried Jr., *Experimental observation of permeability changes in dolomite at CO<sub>2</sub> sequestration conditions*, **Environmental Science and Technology**, doi.org/10.1021/es4036946, 8:2445-2452, 2014.

#### 2013 (7 papers)

- 37) Kong, X.-Z., and M.O. Saar, *Numerical study of the effects of permeability heterogeneity on density-driven convective mixing during CO<sub>2</sub> dissolution storage*, **Int. J. Greenhouse Gas Control**, doi.org/10.1016/j.ijggc.2013.08.020, 19:160-173, 2013.
- 36) Adams, B.M., T.H. Kuehn, J.B. Randolph, M.O. Saar, *The reduced pumping power requirements from increasing the injection well fluid density*, **Geothermal Resources Council (GRC) Transactions**, 37:667-672, 2013.

- 35) Randolph, J.B., **M.O. Saar**, and J. Bielicki, *Geothermal energy production at geologic CO<sub>2</sub> sequestration sites: Impact of thermal drawdown on reservoir pressure*, **Energy Procedia**, doi.org/10.1016/j.egypro.2013.06.595, 37: 6625-6635, 2013.
- 34) Gottardi, R., P.-H. Kao, **M.O. Saar**, and C. Teyssier, *Effects of permeability fields on fluid, heat, and oxygen isotope transport in extensional detachment systems*, **Geochemistry Geophysics Geosystems**, doi.org/10.1002/ggge.20100, 1-30, 2013.
- 33) Luhmann, A.J., X.-Z. Kong, B.M. Tutolo, K. Ding, **M.O. Saar**, and W.E. Seyfried, Jr., *Permeability reduction produced by grain reorganization and accumulation of exsolved CO<sub>2</sub> during geologic carbon sequestration: A new CO<sub>2</sub> trapping mechanism*, **Environmental Science and Technology**, Special Issue: Carbon Sequestration, doi.org/10.1021/es3031209, 47:242–251, 2013.
- 32) Walsh, S.D.C., and **M.O. Saar**, *Developing extensible lattice-Boltzmann simulators for general-purpose graphics-processing units*, **Communications in Computational Physics**, doi.org/10.4208/cicp.351011.260112s, 13:867-879, 2013.
- 31) Kong, X.-Z., B.M. Tutolo, and **M.O. Saar**, *DBCCreate: A SUPCRT92-based program for producing EQ3/6, TOUGHREACT, and GWB thermodynamic databases at user-defined T and P*, **Computers and Geosciences**, doi.org/10.1016/j.cageo.2012.08.004, 51:415-417, 2013.

#### 2012 (4 papers)

- 30) Randolph, J.B., B.M. Adams, T.H. Kuehn, and **M.O. Saar**, *Wellbore heat transfer in CO<sub>2</sub>-based geothermal systems*, **Geothermal Resources Council (GRC) Transactions**, 36:549-554, 2012.
- 29) Covington, M.D., A.J. Luhmann, C.M. Wicks, and **M.O. Saar**, *Process length scales and longitudinal damping in karst conduits*, **Journal of Geophysical Research - Earth Surface**, doi.org/10.1029/2011JF002212, 117, F01025, 2012.
- 28) Alexander, S.C., and **M.O. Saar**, *Improved characterization of small "u" for Jacob pumping test analysis methods*, **Ground Water**, doi.org/10.1111/j.1745-6584.2011.00839.x, 2012.
- 27) Covington, M.D., A.F. Banwell, J. Gulley, **M.O. Saar**, I. Willis, C.M. Wicks, *Quantifying the effects of glacier conduit geometry and recharge on proglacial hydrograph form*, **Journal of Hydrology**, doi.org/10.1016/j.jhydrol.2011.10.027, Vol. 414-415, 59-71, 2012.

#### 2011 (6 papers)

- 26) Covington, M.D., A.J. Luhmann, F. Gabrovsek, **M.O. Saar**, and C.M. Wicks, *Mechanisms of heat exchange between water and rock in karst conduits*, **Water Resources Research**, doi.org/10.1029/2011WR010683, 47, W10514, 2011.
- 25) Randolph, J.B., and **M.O. Saar**, *Impact of reservoir permeability on the choice of subsurface geothermal heat exchange fluid: CO<sub>2</sub> versus water and native brine*, **Geothermal Resources Council (GRC) Transactions**, 35:521-526, 2011
- 24) Randolph, J.B. and **M.O. Saar**, *Coupling carbon dioxide sequestration with geothermal energy capture in naturally permeable, porous geologic formations: Implications for CO<sub>2</sub> sequestration*, **Energy Procedia**, doi.org/10.1016/j.egypro.2011.02.108, 4:2206-2213, 2011.
- 23) Davis, M.A., S.D.C. Walsh, and **M.O. Saar**, *Statistically reconstructing continuous isotropic and anisotropic two-phase media while preserving macroscopic material properties*, **Physical Review E**, 83.026706, doi.org/10.1103/PhysRevE.83.026706, 2011.
- 22) Randolph, J.B., and **M.O. Saar**, *Combining geothermal energy capture with geologic carbon dioxide sequestration*, **Geophysical Research Letters**, doi.org/10.1029/2011GL047265, 38, L10401, 2011.
- 21) **Saar, M.O.**, *Review: Geothermal heat as a tracer of large-scale groundwater flow and as a means to determine permeability fields*, special theme issue on Environmental Tracers and Groundwater Flow, editor-invited peer-reviewed contribution, **Hydrogeology Journal**, doi.org/10.1007/s10040-010-0657-2, 19:31-52, 2011.

#### 2010 (5 papers)

- 20) Walsh, S.D.C., and **M.O. Saar**, *Interpolated lattice Boltzmann boundary conditions for surface reaction kinetics*, **Physical Review E**, doi.org/10.1103/PhysRevE.82.066703, 82, 066703, 2010.
- 19) Dasgupta, S., **M.O. Saar**, R.L. Edwards, C.-C. Shen, H. Cheng, E.C. Alexander Jr., *Three thousand years of extreme rainfall events recorded in stalagmites from Spring Valley Caverns, Minnesota*, **Earth and Planetary Science Letters**, doi.org/10.1016/j.epsl.2010.09.032, 300:46-54, 2010.

- 18) [Myre, J., S.D.C. Walsh, D.J. Lilja, and M.O. Saar](#), *Performance analysis of single-phase multiphase, and multicomponent lattice-Boltzmann fluid flow simulations on GPU clusters*, **Concurrency and Computation: Practice and Experience**, [doi.org/10.1002/cpe.1645](https://doi.org/10.1002/cpe.1645), 23:332-350, 2010.
- 17) [Randolph, J.B. and M.O. Saar](#), *Coupling geothermal energy capture with carbon dioxide sequestration in naturally permeable, porous geologic formations: A comparison with enhanced geothermal systems*, **Geothermal Resources Council (GRC) Transactions**, 34:433-438, 2010.
- 16) [Walsh, S.D.C., and M.O. Saar](#), *Macroscale lattice-Boltzmann methods for low Peclet number solute and heat transport in heterogeneous porous media*, **Water Resources Research**, DOI: [doi.org/10.1029/2009WR007895](https://doi.org/10.1029/2009WR007895), 46, W07517, 2010.

#### 2009 (4 papers)

- 15) [Covington, M.D., C.M. Wicks, and M.O. Saar](#), *A dimensionless number describing the effects of recharge and geometry on discharge from simple karst aquifers*, **Water Resources Research**, [doi.org/10.1029/2009WR008004](https://doi.org/10.1029/2009WR008004), 45, W11410, 2009.
- 14) [Bailey, P., J. Myre, S.D.C. Walsh, D.J. Lilja, and M.O. Saar](#), *Accelerating Lattice Boltzmann Fluid Flow Simulations Using Graphics Processors*, 38<sup>th</sup> International Conference on Parallel Processing (ICPP), strictly peer-reviewed conference proceedings publication, [doi.org/10.1109/ICPP.2009.38](https://doi.org/10.1109/ICPP.2009.38), 550-557, 2009.
- 13) [Walsh, S.D.C., M.O. Saar, P. Bailey, and D.J. Lilja](#), *Acceleration of geo-science and engineering system simulations on graphics hardware*, **Computers and Geosciences**, [doi.org/10.1016/j.cageo.2009.05.001](https://doi.org/10.1016/j.cageo.2009.05.001), 35:2353-2364, 2009.
- 12) [Walsh, S.D.C., H. Burwinkle, and M.O. Saar](#), *A new partial-bounceback lattice-Boltzmann method for fluid flow through heterogeneous media*, **Computers and Geosciences**, [doi.org/10.1016/j.cageo.2008.05.004](https://doi.org/10.1016/j.cageo.2008.05.004), 35:1186-1193, 2009.

#### 2008 (2 papers)

- 11) [Walsh, S.D.C., and M.O. Saar](#), *Magma yield stress and permeability: Insights from multiphase percolation theory*, **Journal of Volcanology and Geothermal Research**, [doi.org/10.1016/j.jvolgeores.2008.07.009](https://doi.org/10.1016/j.jvolgeores.2008.07.009), 177:1011-1019, 2008.
- 10) [Walsh, S.D.C., and M.O. Saar](#), *Numerical Models of Stiffness and Yield Stress Growth in Crystal-Melt Suspensions*, **Earth and Planetary Science Letters**, [doi.org/10.1016/j.epsl.2007.11.028](https://doi.org/10.1016/j.epsl.2007.11.028), 267:32-44, 2008.

#### 2007 (0 papers)

#### 2006 (1 paper)

- 9) [Edwards, R.A., B. Rodriguez-Brito, L. Wegley, M. Haynes, M. Breitbart, D.M. Peterson, M.O. Saar, S.C. Alexander, E.C. Alexander Jr., F. Rohwer](#), *Using pyrosequencing to shed light on deep mine microbial ecology*, **BMC Genomics**, [doi.org/10.1186/1471-2164-7-57](https://doi.org/10.1186/1471-2164-7-57), 2006.

#### 2005 (2 papers)

- 8) [Christiansen, L.B., S. Hurwitz, M.O. Saar, S.E. Ingebritsen, P.A. Hsieh](#), *Seasonal seismicity at western United States volcanic centers*, **Earth and Planetary Science Letters**, [doi.org/10.1016/j.epsl.2005.09.012](https://doi.org/10.1016/j.epsl.2005.09.012), 240:307-321, 2005.
- 7) [Saar, M.O., M.C. Castro, C.M. Hall, M. Manga, and T.P. Rose](#), *Quantifying magmatic, crustal, and atmospheric helium contributions to volcanic aquifers using all stable noble gases: Implications for magmatism and groundwater flow*, **Geochemistry Geophysics Geosystems**, [doi.org/10.1029/2004GC000828](https://doi.org/10.1029/2004GC000828), 6, Q03008, 2005.

#### 2004 (2 papers)

- 6) [Saar, M.O., and M. Manga](#), *Depth dependence of permeability in the Oregon Cascades inferred from hydrogeologic, thermal, seismic, and magmatic modeling constraints*, **Journal of Geophysical Research**, [doi.org/10.1029/2003JB002855](https://doi.org/10.1029/2003JB002855), 109, Nr. B4, B04204, 2004.
- 5) [Jellinek, A.M., M. Manga, and M.O. Saar](#), *Did melting glaciers cause volcanic eruptions in eastern California? Probing the mechanics of dike formation*, **Journal of Geophysical Research**, [doi.org/10.1029/2004JB002978](https://doi.org/10.1029/2004JB002978), 109, Nr. B9, B09206, 2004.

#### 2003 (1 paper)

- 4) [Saar, M.O., and M. Manga](#), *Seismicity induced by seasonal groundwater recharge at Mt. Hood, Oregon*, **Earth and Planetary Science Letters**, [doi.org/10.1016/S0012-821X\(03\)00418-7](https://doi.org/10.1016/S0012-821X(03)00418-7), 214:605-618, 2003.

#### 2002 (1 paper)

- 3) Saar, M.O., and M. Manga, *Continuum percolation for randomly oriented soft-core prisms*, **Physical Review E**, [doi.org/10.1103/PhysRevE.65.056131](https://doi.org/10.1103/PhysRevE.65.056131), 65, 056131-1 to 6, 2002.

#### 2001 (1 paper)

- 2) Saar, M.O., M. Manga, K. Cashman, and S. Fremouw, *Numerical models of the onset of yield strength in crystal-melt suspensions*, **Earth and Planetary Science Letters**, [doi.org/10.1016/S0012-821X\(01\)00289-8](https://doi.org/10.1016/S0012-821X(01)00289-8), 187:367-379, 2001.

#### 2000 (0 papers)

#### 1999 (1 paper)

- 1) Saar, M.O., and M. Manga, *Permeability-porosity relationship in vesicular basalts*, **Geophysical Research Letters**, [doi.org/10.1029/1998GL900256](https://doi.org/10.1029/1998GL900256), 26:111-114, 1999.

### SELECTED CONFERENCE PROCEEDINGS AND REPORTS (since 2015) (MINIMALLY REVIEWED)

#### 2019

- Rossi, E., S. Jamali, M.O. Saar, P. Rudolf von Rohr, *Laboratory and field investigation of a combined thermo-mechanical technology to enhance deep geothermal drilling*, 81st EAGE Conference and Exhibition 2019, [doi.org/10.3997/2214-4609.201901604](https://doi.org/10.3997/2214-4609.201901604), 2019.

#### 2018

- Fleming, M.R., B.M. Adams, J.B. Randolph, J.D. Ogland-Hand, T.H. Kuehn, T.A. Buscheck, J.M. Bielicki, M.O. Saar, *High Efficiency and Large-scale Subsurface Energy Storage with CO<sub>2</sub>*, PROCEEDINGS, 43rd Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, February 12-14, 2018.

- Myre, J.M., E. Frahm, D.J. Lilja, and M.O. Saar, *TNT: A Solver for Large Dense Least-Squares Problems that takes Conjugate Gradient from Bad in Theory, to Good in Practice*, **IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW)**, strictly peer-reviewed proceedings, [doi.org/10.1109/IPDPSW.2018.00153](https://doi.org/10.1109/IPDPSW.2018.00153), 987-995, 2018.

#### 2017

- Garapati, N., B.M. Adams, J.M. Bielicki, P. Schädle, J.B. Randolph, T.H. Kuehn, M.O. Saar, *A Hybrid Geothermal Energy Conversion Technology - A Potential Solution for Production of Electricity from Shallow Geothermal Resources*, **Energy Procedia**, [doi.org/10.1016/j.egypro.2017.03.1852](https://doi.org/10.1016/j.egypro.2017.03.1852), 114: 7107-7117, 2017.

- Saar, M.O., *Novel Geothermal Technologies, in Potentials, costs and environmental assessment of electricity generation technologies*, edited by C. Bauer and S. Hirschberg, Swiss Federal Office of Energy, Swiss Competences Center for Energy Research "Supply of Electricity", Swiss Competence Center for Energy Research "Biomass for Swiss Energy Future", 2017.

#### 2015

- Saar, M.O., T.A. Buscheck, P. Jenny, N. Garapati, J.B. Randolph, D.C. Karvounis, M. Chen, Y. Sun, and J.M. Bielicki, *Numerical Study of Multi-Fluid and Multi-Level Geothermal System Performance*, Peer-Reviewed Proceedings of the World Geothermal Congress, Melbourne, Australia, 19-25 April, 2015.

- Buscheck, T.A., J.M. Bielicki, M. Chen, Y. Sun, Y. Hao, T.A. Edmunds, J.B. Randolph, and M.O. Saar, *Multi-Fluid Sedimentary Geothermal Energy Systems for Dispatchable Renewable Electricity*, Proceedings to the World Geothermal Congress, Melbourne, Australia, 19-25 April, 2015.



**ADVISING / SUPERVISING OF EMPLOYEES:**

<https://geg.ethz.ch/people>

**Current at ETH-Zürich, Switzerland**

2015-present	Dominique Ballarin	Office, Computer System, and Intra+Internet Administration
2015 (Dec.)-	Nils Knornschild	Laboratory and Field Technician (50%, other 50% with SCCER)
2018 (Jan.)-	Dr. Xiaodong Ma	Senior Researcher (OA): Geomechanics (10%, 90% SCCER)
2016 (Sep.)-	Dr. Daniel Vogler	Senior Researcher (OA): Rock mechanics modeling
2016 (Aug.)-	Dr. Anozie Ebigbo	Senior Researcher (OA): Numerical reservoir modeling
2015 (Sep.)-	Dr. Allan Leal	Senior Researcher (OA): Reactive transport modeling
2015 (March)-	Dr. Friedemann Samrock	Senior Researcher (OA): Magnetotellurics (MT) exploration
2015 (Jan)-	Dr. Xiang-Zhao Kong	Senior Researcher (OA): Experiments, pore-scale models
2019 (June)-	Dr. J. Ogland-Hand	Postdoc: CO <sub>2</sub> -Plume Geothermal (CPG) techno-economics
2019 (April)-	Dr. Shihuai Zhang	Postdoc: Geomechanics: Deep Underground Lab - Bedretto
2019 (Jan.)-	Dr. Jan Niederau	Postdoc: Geothermal heat-flow map of Aargau-Switzerland
2018 (Dec.)-	Dr. Svetlana Kyas	Postdoc: Machine-learning mathematics in Reaktor.org
2018 (Nov.)-	Dr. Daniel Birdsell	Postdoc: Thermo-poro-elastic modeling for Heatstore
2018 (Jan.)-	Dr. Benjamin Adams	Postdoc: CO <sub>2</sub> -Plume Geothermal (CPG) engineering
2020 (Mar.)-	Luise Dambly	Ph.D. Student: Geothermal exploration with MT in Ethiopia
2018 (Dec.)-	Batmagnai Erdenechimeg	Ph.D. Student: Geothermal exploration with MT in Mongolia
2018 (Oct.)-	Mohamed Ezzat Mostafa	Ph.D. Student: Development of plasma-based drilling
2018 (Sep.)-	Mahmoud Hefny	Ph.D. Student: CO <sub>2</sub> -Plume Geothermal in Egypt
2018 (Sep.)-	Isamu Naets	Ph.D. Student: Fluid/solute transport in fractures (w/ PIV)
2018 (Oct.)-	Powei Huang	Ph.D. Student: Scaling numerical reactive transport models
2018 (Feb.)-	Hoda Javanmard	Ph.D. Student: Hydro-mechanical processes
2017 (Oct.)-	Marina Lima	Ph.D. Student: Reactive transport in fractures
2016 (Nov.)-	Mehrdad Ahkami	Ph.D. Student: Multiphase flow through fractures (w/ PIV)
2016-2020	Edoardo Rossi	Ph.D. Student: Spallation drilling experiments
2016 (Sep.)-	Justin Ezekiel	Ph.D. Student: CO <sub>2</sub> -Plume Geothermal system modeling
2016 (June)-	Jin Ma	Ph.D. Student: Reactive transport experiments
2016 (Feb.)-	Philipp Schädle	Ph.D. Student: Numerical reservoir modeling
2015-2019	Anniina Kittilä	Ph.D. Student: Enhanced Geothermal System Investigation
2018 (Oct.)-	Xiaoqing Chen	Post-MSc. Assistant: FSI sims: fracture hydromechanics
2018 (Sep.)-	Joan Delort	Post-MSc. Assistant: Geothermal energy
2018 (sep.)-	Shiyi Li	Post-MSc. Assistant: Numerics
2019 (March)-	Kai Broeker	M.Sc. Student (IDEA League): Petrothermal energy systems
2019 (March)-	Marat Ravilov	M.Sc. Student (IDEA League): CO <sub>2</sub> -Plume Geothermal
2018 (Sep.)-	Anna Van Brummen	M.Sc. Student (IDEA League): CO <sub>2</sub> -Plume Geothermal
2015-present	SCCER-SoE	Co-supervision of Swiss Competence Center on Energy Research – Supply of Electricity (SCCER – SoE) personnel, focusing on 1) Geothermal Energy, 2) geologic CO <sub>2</sub> storage.

+ employee(s) at the University of Minnesota (UMN), USA (see below).

+ as external private consultant (Applied Mathematician and Computer Programmer), former postdoc and senior Research associate, Dr. Stuart Walsh (located in Sydney, Australia).

**Former at ETH Zürich, Switzerland:**

2018	Godong Cui	Academic guest: Numerics
2018	Ali Aminzadeh	Academic guest: rock mechanics
2017-2018	Anwar Al Assadi	Post-MSc. Assistant - visiting
2015-2017	Dr. Keith Evans	Senior Researcher (OA): DNA nanotracer tests
2015-2016	Dr. Nagasree Garapati	Postdoc: Ph.D. in Chemical Engineering, W. Virginia U.
2017	Marte Faber	M.Sc. (IDEA L.)
2017	Manos Pefkos	M.Sc. (IDEA L.)

2017	Dandan Li	M.Sc. (IDEA L.)
2017	Suzyrmar De Ponte	M.Sc. (IDEA L.) Student Modeling Anisotr. Frac. Prop.
2016-2017	Luise Dambly	M.Sc. (IDEA L.) Exper. for Anisotropic Fracture Prop.
2016-2018	Alex Hobe	M.Sc. Student in Numerical modeling
2017	DanDan Li	M.Sc. (IDEA L.) Student HM Effects/Fracturing in DFN
2016-2017	Raphael Allstadt	M.Sc. Student in Applied Geophysics: CPG simulations
2015-2016	Claudia Deuber	M.Sc. (Sep. 2016): DNA Nanotracers
2015-2017	Neeraj Shah	M.Sc. Student in Geothermal System Exploration Geophysics

**Service on graduate committees at ETH-Zürich (ETHZ), CH since 2015:**

Own students, listed above, are not listed in the table below.

<u>Name, First Name</u>	<u>Institution(s)</u>	<u>Degree</u>	<u>Status</u>	<u>Saar's Role</u>
Wenning, Quinn	ETHZ	Ph.D.	in progress	Ph.D. Potential Referent
Somogyvari, Mark	ETHZ	Ph.D.	Defense, March 29, 2017	Ph.D. Defense Chair
Achtziger, Peter	ETHZ	Ph.D.	Defense, March 24, 2017	Ph.D. Defense Chair
Kant, Michael	ETHZ-MAVT	Ph.D.	Defense, Sep. 8, 2017	Ph.D. Co-referent
Scott, Samuel	ETHZ	Ph.D.	Defense, July 22, 2016	Ph.D. Defense Chair
Wagner, Florian	ETHZ, GFZ	Ph.D.	Defense, May 04, 2016	Ph.D. Co-Examiner

**Former at the University of Minnesota (UMN), Minneapolis, USA:**

Junior Scientist, Lab and Project Manager:

2006-2017 Scott C. Alexander (partial (majority) support, permanent)

Research Associates:

2011-2018 Dr. Jimmy Randolph (Ph.D. in Geophysics, UMN, with Saar; research Associate)  
 2008-2010 Dr. Matt Covington (Ph.D. 2008, UCSC in Astrophysics, now Geology Professor at U. of Arkansas; co-advised with Prof. Wicks, Louisiana State U.)  
 2009-2011 Dr. Stuart Walsh (Ph.D. 2005, Melbourne, Applied Math, now Research Scientist at Monash University, Melbourne, Australia)

Post-doctoral Associates:

2015-2017 Dr. Ben Adams (co-advised by Prof. Kuehn, Mech. Engineer.; Ph.D. May, 2015, in Mechanical Engineering; Since June 2015: Postdoc with Saar and Kuehn at UMN)  
 2013-04/2015 Dr. Nagasree Garapati (Ph.D. in Chemical Engineering, Postdoc)  
 2010-2013 Dr. Xiang-Zhao Kong (Ph.D. 2010, Environmental Engineering, ETH-Zürich, CH; 2014: at University of Queensland, Brisbane, Australia)  
 2009-2011 Dr. Po-Hao Kao (Ph.D. 2007, Nation. Cheng Kung U., Taiwan, Engineering, now Senior Thermal Mechanical Engineer at Corning Inc.)  
 2006-2009 Dr. Stuart Walsh (Ph.D. 2005, Melbourne, Applied Math, now Research Scientist at Lawrence Livermore National Laboratory, CA)

Ph.D. Students (year = degree received):

2015 Dr. Ben Tutolo (co-advised with Bill Seyfried Jr.; B.S. in Env. Syst. Eng., Penn State; Ph.D., May 2015, in Aqueous Geochemistry and Geophysics; Since June 2015: Postdoc at Oxford University, GB)  
 2015 Dr. Ben Adams (co-advised by Prof. T. Kuehn, Mechanical Engineering; Ph.D. May, 2015, in Mechanical Engineering; Since June 2015: Postdoc with Saar and Kuehn at UMN.)  
 2013 Dr. Joseph Myre (Ph.D. in Computer Science with Saar and Lilja as advisers; received NSF Earth Sciences postdoc and started Sep. 1, 2013, with Saar's former postdoc, Dr. Covington, as Myre's postdoc adviser)  
 2011 Dr. Jimmy Randolph (Ph.D. degree in Geophysics; also a current postdoc with Saar and a private consultant for Heat Mining Company LLC)

M.S. Students (year = degree received):

2013 Jennifer Meester (M.S. degree in Water Resources Science, 2013)

2009	Ravi Appana	(M.S. degree in Geophysics, 2009, now Hydrogeology Consultant at Environmental Resources Management (ERM), India division)
2008	Judy Andrews	(M.S. degree in Geophysics)

Undergraduate Students (UMN) (year = degree received):

2013	Brian Demet	(B.S. in Geology, Undergraduate Research Opportunity (UROP))
2011	Ryan Toot	(B.S. in Geoengineering)
2009	Alex Morrison	(B.S. in Geology, transferred from Computer Science)
2008	Lillian Gorman	(B.S. in Geology, Geophysics, supported by UROP)
2008	Karli Anderson	(B.S. in Geology, Geophysics, IT Honors Thesis)
2008	Ryan O'Grady	(B.S. in Geology, Geophysics, UROP, now at the LRC at UMN)
2007	Steve Pinta	(B.S. in Geology, Geophysics)
2006	Julian (Nino) d'Andrea	(B.A. in Geology; UROP project)
2006	Abbey Duncan	(B.S. in Geology; UROP project & senior thesis)

Undergraduate Students (NSF-REU Summer Interns):

2013	Zoe Wu	(from Rice University)
2012	Daniel Friedman	(from Boston University)
2011	Gabriel Lotto	(from Binghamton University)
2010	Joseph Nelson	(from University of Virginia, now Ph.D. student at Stanford)
2009	Ben Tutolo	(from Penn State University, now Ph.D. student with Saar)
2008	Alina Blinova	(from Cornell University)
2008	Rachel Bernard	(from Princeton University)
2007	Holly Burwinkle	(from Clemson University, in Math)
2007	Danielle Grogan	(from Smith College)

**Service on graduate committees at UMN, USA since 2005:**

Own students, listed above, are not listed in the table below.

<u>Name</u>	<u>Academic Plan</u>	<u>Degree</u>	<u>Status</u>	<u>Saar's Role</u>	
Anger, Cale	Geol	M.S.	Completed	M.S.	Final Member
Bagley, Brian	Geophys	Ph.D.	Completed	Ph.D.	Final Reader
Bauer-Reich, Cherish	Geophys	Ph.D.	Active	Ph.D.	Prelim Member
Blanksma, Derrick	Geoengr	M.S.	Completed	M.S.	Final Member
Bordoloi, Ankur	AeroEM	Ph.D.	Active	Ph.D.	Final Member
Flemming, Mark	MechEng	Ph.D.	Active	Ph.D.	Prelim Member
Gottardi, Raphael	Geol	Ph.D.	Completed	Ph.D.	Prelim Member
Janke, Brian	Mech Engr	M.S./M.E.	Completed	M.S.	Final Member
King, Daniel	Geophys	Ph.D.	Completed	Ph.D.	Final Member
Larkin, Lauren	Geophys	M.S.	Completed	M.S.	Final Member
Luhmann, Andrew	Geol	Ph.D.	Completed	Ph.D.	Final Chair/Reader
Makhnenko, Roman	CivilEng	Ph.D.	Completed	Ph.D.	Final Member
Mascarenhas, Daniel	MechEng	M.S./M.E.	Completed	M.S.	Final Member
Qi, Chao	Geophys	Ph.D.	Active	Ph.D.	Final Member
Sawyer, Charles	MechEngr	M.S./M.E.	Completed	M.S.	Final Member
Stanley, Benjamin	Geol	Ph.D.	Completed	Ph.D.	Final Member
Tipping, Robert	WaterResSc	Ph.D.	Completed	Ph.D.	Final Member
Toraman, Erkan	Geol	Ph.D.	Active	Ph.D.	Prelim Member
Wang, Tao	Geophys	Ph.D.	Completed	Ph.D.	Reviewer

**INVITED TALKS** (only invited talks at Department Seminar Series, Conferences, Organizations; up-coming/past)

<u>MM/DD/YYYY</u>	<u>Location, Title</u>
11/14/2019	Schweizerischer Tag für Physik im Unterricht, ETH Zürich, Switzerland: Title: <i>Die Physik in der Geothermie</i>
10/09/2019	PTRC Aquistore Annual Meeting, Banff, Canada: Title: <i>Combining CCS with Geothermal Electricity Generation: CO<sub>2</sub>-Plume Geothermal (CPG)</i>
10/01/2019	WSO Geothermal Network Day, Stockholm, Sweden: Title: <i>Combining geologic CO<sub>2</sub> storage with geothermal power generation and subsurface energy storage – CCU3S</i>
09/10/2019	Geo-Energie – Suisse Company, Bern, Switzerland: Title: <i>Combining CCS with Geothermal Energy Extraction and Energy Storage</i>
08/06/2019	ARMA-CUPB Geothermal International, Beijing, China: Title: <i>CCUUUS: Combining CO<sub>2</sub> capture and geologic storage with 1) geothermal power generation, 2) subsurface, grid-scale energy storage, and 3) direct-air CO<sub>2</sub> capture</i>
08/03/2019	China Geological Survey (CGS), Beijing, China: Title: <i>Swiss Deep Geothermal Energy Projects</i>
08/02/2019	Chinese University of Geosciences (CUG), Wuhan, China: Title: <i>Combining geologic CO<sub>2</sub> storage with 1) geothermal power generation, 2) subsurface, grid-scale energy storage, and 3) direct-air CO<sub>2</sub> capture</i>
08/02/2019	Chinese University of Geosciences (CUG), Wuhan, China: Title: <i>Two contact-less drilling methods researched and developed at ETH Zurich</i>
07/12/2019	KAUST Board of Trustees visit at ETH Zürich, Switzerland: Title: <i>Overview of GEG research (includes combining CCS/EOR/EGR with geothermal energy extraction and conversion to electricity)</i>
05/23/2019	EuroWorkshop: Geology and the Energy Transition, TU Delft, The Netherlands: Title: <i>Combining CO<sub>2</sub> capture (CC) and geologic storage (S) with geothermal power generation (U) and subsurface energy storage (U) + DACS (U): CCUUUS</i>
05/07/2019	Gordon Research Conference (GRC), Les Diablerets Conference Center, Les Diablerets, Switzerland: Title: <i>Utilizing CO<sub>2</sub> capture (CC) and permanent geologic CO<sub>2</sub> storage (S) for geothermal energy extraction (U1), energy storage (U2) and direct air CO<sub>2</sub> capture (U3), resulting in CCUUUS (invited poster)</i>
01/29/2019	EPFL, Journée romande de la Géothermie, Lausanne, Switzerland: Title: <i>Two contactless drilling methods: Flame-Jet Spallation and Plasma-Pulse Geo Drilling</i>
2018	2018 Talks not entered yet
12/14/2017	American Geophysical Union, Fall Meeting, New Orleans, Sessions: Subsurface Bulk Energy Storage in Porous Media, Title: <i>Large temporal scale and capacity subsurface bulk energy storage with CO<sub>2</sub> → talk prepared by Saar but given by Jeff Bielicki due to an emergency</i>
11/23/2017	Energy and Environmental Research Division (ENE) Seminar at the Paul Scherrer Institute (PSI), Switzerland: Title: <i>A combined geothermal energy, bio-energy, carbon capture utilization and storage power plant with negative carbon emissions</i>
11/06/2017	Siemens AG, Power and Gas Division, Technology and Innovation, Title: <i>The market potential of geothermal energy</i>
08/29/2017	ETH Industry Day, Title: <i>Energy research in the Geothermal Energy and Geofluids Group at ETH Zurich.</i>
05/19/2017	Delft University of Technology, Department of Geoscience and Engineering, Delft Advanced Reservoir Simulation (DARSim) Lecture, Title: <i>Combining geothermal energy use with CO<sub>2</sub> storage or (enhanced) oil/gas production.</i>
05/08/2017	12 <sup>th</sup> CO <sub>2</sub> GEONET Open Forum (8-9 May, 2017 S. Servolo Island, Venice, Italy), Session: New opportunities and synergies for CCS, Title: <i>Making CO<sub>2</sub> sequestration affordable by coupling it with geothermal energy extraction</i>
03/09/2017	Graz University of Technology, Institute of Applied Geosciences, Austria, Title: <i>Kombinierte CO<sub>2</sub>-Sequestration und geothermische Energiegewinnung: Eine CO<sub>2</sub>-negative, erneuerbare Energie</i>

- 01/25/2017 „Ringvorlesung Geothermie“ des Lehrstuhls für Hydrogeologie der Technischen Universität München, Title: *DNA Nanotracer and geophysical quantification of pore space connectivity and heat transfer enhancement during EGS development*
- 08/15/2016 SedHeat Energy Storage in Sedimentary Basins (ESSB) Workshop, The Ohio State University, Columbus Ohio, USA, Title: *A Dual-Level Reservoir, Diurnal Cycle CO<sub>2</sub> Plume Geothermal (CPG) Energy Storage System (CPGES)*
- 04/08/2016 Xiangshan Science Conference – Beijing, China, Title: *Exploitation and utilization of Deep Geothermal Energy*
- 03/07/2016 Deutsche Physikalische Gesellschaft (DPG) Konferenz – Regensburg, Title: *Combined CO<sub>2</sub>-storage and geothermal energy extraction: potential and options*
- 11/23/2015 Rotary Club Baden Rohrdorferberg, Switzerland, Title: *Möglichkeiten und Grenzen der Geothermie in der Schweiz*
- 11/17/2015 Verein Geothermische Kraftwerke Aargau (VGKA), Title: *Geplante Forschung der «Geothermischen Energie und Geofluide Gruppe» von Professor Martin Saar, ETH Zürich, im Kanton Aargau*
- 11/12/2015 Freie Universität Berlin, Germany, Title: *A world beyond enhanced geothermal systems: Alternative unconventional geothermal energy utilization*
- 10/19/2015 European Geothermal Workshop (EGW), Title: *The new Geothermal Energy and Geofluids Group at ETH Zurich and an update on the progress in the Deep Underground Geothermal Lab in Switzerland*
- 09/24/2015 BIT New Energy Forum-2015, Xi'an, China, Title: *New Geothermal Energy Technologies: Combinations with CO<sub>2</sub> Storage and Superheating.*
- 09/16/2015 Geothermie.ch (Schweizerischen Vereinigung für Geothermie) und das Bundesamt für Energie, BFE, Roundtable Gespräch: Tiefe Geothermie, Title: *Effiziente Umwandlung von geothermischen Flüssigkeiten und deren Energie*
- 09/11/2015 Swiss Competence Center for Energy Research – Supply of Electricity (SCCER – SoE), First Annual Conference, Title: *Challenges for CO<sub>2</sub> Storage*
- 06/02/2015 Gordon Research Conference on Carbon Capture, Utilization, and Storage, May 31 - June 5, 2015, Stonehill College Easton, MA, USA: Title: *Combining geologic CO<sub>2</sub> Sequestration with Geothermal Energy Utilization*
- 05/21/2015 Fourth Internationaler Geothermie-Kongress 2015, St. Gallen, Switzerland, Title: *Hybrid-Systeme zur geothermischen Energie- und Treibstoffentwicklung bei niedrigen Untergrund-Temperaturen oder Flussraten*
- 05/11/2015 ETH-Zürich, Switzerland, Inaugural Lecture, Title: *Moving Mountains ... and Other Uses of Geothermal Energy.*
- 04/24/2015 World Geothermal Congress – Melbourne, Australia: Title: *Numerical Study of Multi-Fluid and Multi-Level Geothermal System Performance.*
- 11/25/2014 RWTH-Aachen, Title: *Extracting Geothermal Energy While Storing CO<sub>2</sub>.*
- 10/14/2014 Society of Petroleum Engineers (SPE), German Section (GSSPE), Hannover, Germany: Title: *Combining geothermal energy production with CO<sub>2</sub> storage and enhanced oil recovery*
- 10/10/2014 Dept. of Earth Sciences, ETH-Zürich, Switzerland, Title: *The Geothermal Energy and Geofluids Group at ETH-Zürich: Background and Vision*
- 09/26/2014 Columbia University, New York, NY, Title: *Heat and Fluid Mining in the 21<sup>st</sup> Century – Sustainable Energy Supply Reducing Climate Change*
- 05/16/2014 Northwestern University, Chicago, Northwestern Climate Change Symposium, Title: *CO<sub>2</sub> – Use it or lose it! How CO<sub>2</sub> can be used to extract geothermal energy instead of being lost to the atmosphere.*
- 03/11/2014 Technical University Munich, Germany, Conference/Workshop: Science transfer for the further expansion of deep geothermics in the southern German Molasse Basin, Title: *Using CO<sub>2</sub> as a heat extraction fluid in sedimentary geothermal systems – possibly an approach for the Molasse Basin*
- 10/25/2013 Queen's University, Kingston, Ontario, Canada: Title: *Geofluid dynamics in sedimentary basins.*

- 10/20/2013 Keynote talk at the Penrose Conference in Park City, Utah, entitled: Predicting and Detecting Natural and Induced Flow Paths for Geothermal Fluids in Deep Sedimentary Basins: Talk Title: *Permeability Effects on Water- and CO<sub>2</sub>-Based Heat Transfer*
- 09/06/2013 ETH-Zürich, Switzerland: Title: *Enhancing geothermal system performance – From enhanced permeability to CO<sub>2</sub>-enhanced heat extraction efficiency*
- 09/02/2013 Goldschmidt Conference, Florence, Italy: Title: *Fluid-mineral reactions during CO<sub>2</sub>-based geothermal energy extraction.*
- 05/21/2013 Northwestern University, Chicago, McCormick Fluids and Transport Seminar Series: Title: *Simulations and lab experiments of reactive multicomponent, multiphase fluid flow during geologic CO<sub>2</sub> sequestration and geothermal energy capture*
- 05/16/2013 Lawrence Livermore National Laboratory, Livermore, CA; Title: *Permeability reduction by grain reorganization and accumulation of exsolved CO<sub>2</sub> during geologic carbon sequestration: A new CO<sub>2</sub> trapping mechanism*
- 10/12/2012 Midwest Groundwater Conference, Minneapolis, MN: Title: *The multi-functionality of geologically sequestered carbon dioxide: From geothermal energy extraction to renewable energy storage.*
- 09/24/2012 New Horizons Oil and Gas Conference, Rapid City, SD, Title: *Using carbon dioxide as a geothermal heat mining fluid to pay for its geologic sequestration.*
- 09/21/2012 University of North Dakota; Title of general talk: *A new way to employ renewable geothermal energy in more regions worldwide.* Title of 2<sup>nd</sup>, more in-depth talk: *Reactive multiphase fluid flow during CO<sub>2</sub> sequestration and CO<sub>2</sub>-based geothermal energy extraction.*
- 06/27/2012 Geoforschungszentrum Potsdam, Germany, Title: *Combining Geothermal Energy Extraction and CO<sub>2</sub> Sequestration to Produce Clean, Renewable Carbon-Negative Electricity*
- 03/26/2012 Alberta Innovates (Calgary) Workshop: Integrated Geothermal and CO<sub>2</sub> Storage Systems - Using CO<sub>2</sub> as the geothermal fluid: Technical issues and relevance to CCS and energy conversion systems, Title: *CO<sub>2</sub> Plume Geothermal (CPG): Geothermal systems using CO<sub>2</sub> as the subsurface heat exchange fluid in naturally permeable geologic formations -- general concepts.*
- 02/18/2012 University of Minnesota, Carlson School of Management, 3M Seminar Series, Title: *Experiences commercializing CO<sub>2</sub>-Plume Geothermal through Heat Mining Company LLC.*
- 11/21/2011 American Physical Society – Division of Fluid Dynamics, Title: *Multiphase, multicomponent simulations and experiments of reactive flow, relevant for combining geologic CO<sub>2</sub> sequestration with geothermal energy capture.*
- 11/07/2011 E3 Conference, Institute on the Environment (IonE), Initiative for Renewable Energy and the Environment (IREE), University of Minnesota, Title: *Combining Geothermal Energy Capture with CO<sub>2</sub> Sequestration.*
- 04/11/2011 University of Minnesota, Department of Applied Economics, Title: *Putting CO<sub>2</sub> to work – Turning an environmental liability into a commodity that makes money.*
- 02/18/2011 University of Nebraska – Lincoln, Title: *Increasing geothermal heat extraction efficiency through CO<sub>2</sub> sequestration.*
- 10/20/2010 University of Minnesota, Institute on the Environment (IonE), Frontiers in the Environment Series, Title: *CO<sub>2</sub> – Use it or Lose it!*
- 10/18/2010 Royal Norwegian Embassy, Washington DC, Transatlantic Science Week, Title: *Carbon Capture and Storage and Clean Energy.*
- 10/07/2010 University of Minnesota, Department of Geology and Geophysics, Title: *The fluid- and thermodynamics of combining CO<sub>2</sub> sequestration with geothermal energy capture.*
- 04/07/2010 Massachusetts Institute of Technology (MIT), Title: *Combining CO<sub>2</sub> sequestration with geothermal energy utilization.*
- 02/17/2010 St. Anthony Falls Laboratory (SAFL), University of Minnesota, Title: *Two birds – one stone: Reducing CO<sub>2</sub> emissions from fossil-fuel-based power plants while producing geothermal electricity.*
- 12/13/2009 Hubbert Quorum, USGS-Menlo Park, Title: *Can CO<sub>2</sub> sequestration and geothermal energy utilization be combined?*

- 12/04/2009 University of Wisconsin – Madison, Title: *Can CO<sub>2</sub> sequestration and geothermal energy utilization be combined?*
- 11/17/2009 Initiative for Renewable Energy and the Environment (IREE) annual conference. Title: *Can CO<sub>2</sub> sequestration and geothermal energy utilization be combined?*
- 11/12/2009 Minnesota Groundwater Association, Title: *Preferred groundwater flow paths in aquifer systems.*
- 10/22/2009 University of British Columbia – Vancouver, Canada, Department of Earth and Ocean Science, Title: *A CO<sub>2</sub>-sequestering Geothermal Power Plant.*
- 10/22/2009 University of British Columbia – Vancouver, Canada, Department of Earth and Ocean Science, Title: *A bottom-up approach to fluid mechanics: From bouncing fluid packages to Navier-Stokes, slurry, and reactive flow.*
- 10/18/2009 Geological Society of America (GSA) Annual Conference, Portland, OR, Title: *Hydraulic parameters and groundwater flow patterns in the Oregon Cascades, determined using numerical models that are constrained by diverse data sets*, Geological Society of America Abstracts with Programs, 41: 7, p. 176.
- 03/20/2009 Beloit College, WI: Department of Mathematics and Computer Science, Title: *The mathematics of volcanic eruptions.*
- 02/24/2009 San Francisco State University, Title: *Probing groundwater resources via water-rock interactions: From aquifer deformation and cave formation to magmatic gas flow in water.*
- 02/11/2009 University of Colorado – Boulder, Department of Physics, Title: *Geophysical fluid dynamics in tectonic processes and within volcanoes.*
- 10/17/2008 University of Hawaii – Manoa, Title: *Volcano Hydrology: What we can learn about groundwater flow from its interactions with heat and gases.*
- 07/04/2008 Karlsruhe University, Germany, Title: *Coupled heat and stress transfer in geothermal fluid-rock systems.*
- 04/24/2008 Rice University, Title: *The rheology and permeability of magma in volcanic conduits: Implications for eruption dynamics*
- 04/04/2008 University of Wisconsin – Madison, Title: *Lattice-Boltzmann simulations of speleogenic processes and groundwater flow through karst.*
- 03/24/2008 Geological Society of Minnesota, Title: *The role of fluids in Geology.*
- 02/20/2008 North Dakota State University, Department of Geosciences and Department of Physics, Title: *Modeling geophysical fluid dynamics to study the flow of magma and other strange fluids.*
- 02/01/2008 University of Minnesota, Dept. of Aerospace Engineering and Mechanics, Title: *Modeling geophysical fluid dynamics to study the flow of magma and other strange slurries.*
- 11/27/2007 University of Minnesota, Initiative for Renewable Energy and the Environment (IREE: www.umn.edu/iree) conference, Title: *Geothermal Energy.*
- 11/07/2007 University of Arizona, Dept. of Hydrology and Water Resources, Title: *Effects of small-scale processes on large-scale fluid flow patterns and tracers.*
- 10/17/2007 Minnesota Geological Survey, Title: *Current Research in the Hydrogeology and Geofluids Group: From Small to Large Scale Fluid Flow Modeling.*
- 03/23/2007 University of Minnesota, Department of Water Resources Sciences Title: *Aquifers as selective filters for natural groundwater flow tracers.*
- 03/20/2007 HC-Itasca Company (FLAC), Minneapolis, Title: *Subsurface Fluid Dynamics: from magmatic volatile degassing to groundwater flow.*
- 02/16/2007 University of Minnesota - Twin Cities, Department of Civil Engineering, Title: *Interactions of magmatic/mantle volatile degassing with deep groundwater flow.*
- 02/07/2007 Ludwig-Maximilian's Univ., Munich, Dept. of Earth and Env. Sci., Title: *Subsurface Fluid Dynamics: From magmatic volatile degassing to groundwater flow.*
- 11/18/2005 Minnesota Groundwater Association (MGWA) Fall Conference Title: *Helium isotopes as natural tracers in volcanic and non-volcanic aquifers.*
- 05/19/2005 GSA North-Central conference, Minneapolis, MN: Symposium #3: Title: *Effective large-scale permeability of multiple geologic units.*

- 05/04/2005 University of Minnesota, St. Anthony Falls Lab.; Title: *Using spring water measurements of noble gases and heat as tracers of groundwater flow.*
- 04/13/2005 University of Colorado-Boulder, Department of Geological Sciences, Title: *Heat and helium as natural tracers of groundwater flow in volcanoes.*
- 10/07/2004 University of Windsor, Ontario, Canada, Department of Earth Sciences, Title: *Groundwater, heat, and noble gas transfer in volcanic systems.*
- 11/21/2003 Ludwig-Maximilian's University, Munich, Department of Earth and Environmental Science, Title: *Large-scale groundwater flow in the volcanic Oregon Cascades inferred from coupled heat and water transfer modeling and hydroseismic constraints.*
- 04/03/2003 University of Notre Dame, Department of Civil Engineering and Geological Sciences, Title: *Water, Heat, and Earthquakes: Hydrogeology of the Cascades.*
- 03/27/2003 Princeton University, Department of Geosciences, Title: *Water, Heat, and Earthquakes: Hydrogeology of the Cascades.*
- 03/24/2003 University of Minnesota - Twin Cities, Department of Geology and Geophysics, Title (talk 1): *Water, Heat, and Earthquakes: Hydrogeology of the Cascades.*, Title (talk 2): *Fluid Mechanics in Geology.*
- 03/18/2003 University of Michigan, Department of Geological Sciences, Title: *Hydrogeology in the Cascades inferred from thermal and seismic constraints.*
- 03/04/2003 USGS Menlo Park, 2002-2003 Volcano Hazards Team Seminar Series, Title: *Groundwater recharge induced seismicity, heat, and groundwater flow at Mt. Hood, Oregon.*
- 01/29/2003 University of Wisconsin - Eau Claire, Dept. of Geology, Title: *Groundwater flow in the Cascades inferred from coupled heat and water transfer modeling.*
- 11/25/2002 Central Michigan Univ., Dept. of Geology, Title: *Can rain cause earthquakes?*

#### PEDAGOGY TRAINING AND FACULTY DEVELOPMENT

- 2016 Refresh Teaching Lunch Seminar at ETH Zurich: Increasing Interactivity
- 2010 Andy Goodman Communications Workshop, provided through the Institute on the Environment (IonE) at UMN.
- 2010 Aldo Leopold Leadership Program (<http://leopoldleadership.stanford.edu>), Woods Institute for the Environment, Stanford University, held at the Institute on the Environment (IonE) at the University of Minnesota, August 23-27, 2010.
- 2005-2006 UMN faculty Early Career Teaching Program 2005-2006, Monthly teaching seminars over the course of an academic year covering topics such as teaching with technology, collaborative learning, teaching large classes, ...
- 2005 NSF on-the-cutting edge workshop: "Early Career Faculty Workshop: Teaching, Research, and Managing Your Career" (June 8-13, 2005)
- 2000 Using Technology in the Classroom (seminar at the University of Oregon)
- 1999 College Science Teaching (term-long course at the University of Oregon)
- 1999 Teaching Large Classes (seminar at the University of Oregon)

#### COURSES TAUGHT (past, current, and upcoming)

Some teaching evaluations are available at: <http://www.geo.umn.edu/orgs/geofluids>.

More teaching information is provided in the Statement of Teaching document. In the following:

ETHZ=Swiss Federal Institute of Technology – Zurich, UMN=University of Minnesota (as faculty member), UO=University of Oregon (as graduate student), ESCI=Dept. of Earth Sciences, GEO=Dept. of Geology and Geophysics (former department name). Several courses co-developed: General Hydrogeology, Fluid Earth Dynamics, Hydrogeology Field Camp. Main course development: Fluid Mechanics in Earth and Environmental Sciences.

Courses taught under Saar's Geothermal Energy and Geofluids professorship but not by Saar are indicated with the lecturer



2020 spring ETHZ Geothermal Energy Masters Course  
 2020 spring ETHZ Joint Applied Geophysics Masters Course I (co-taught) (1/2 semester)  
 2019 fall ETHZ Geophysik I (co-taught) (1/2 semester)  
 2019 fall ETHZ Oceanography and Hydrogeology BSc (only Hydrogeology portion: 1/3 semester)  
 2019 fall ETHZ Geology and Petrography BSc course (full semester)  
 2019 spring ETHZ Hydrogeology BSc course (full semester)  
 2019 spring ETHZ Geothermal Energy Masters Course (was fall term)  
 2019 spring ETHZ Joint Applied Geophysics Masters Course II (co-taught) (1/2 semester)  
 2019 spring ETHZ Joint Applied Geophysics Masters Course I (co-taught) (1/2 semester)

2018 fall ETHZ Geology and Petrography BSc course (2 lectures)  
 2018 fall ETHZ Geophysik I (co-taught) (1/2 semester)  
 2018 fall ETHZ Oceanography and Hydrogeology BSc (only Hydrogeology portion: 1/3 semester)  
 2018 spring ETHZ Joint Applied Geophysics Masters Course II (co-taught) (1/2 semester)  
 2018 spring ETHZ Joint Applied Geophysics Masters Course I (co-taught) (1/2 semester)

2017 fall ETHZ Geophysik I (co-taught) (1/2 semester)  
 2017 fall ETHZ Oceanography and Hydrogeology BSc (only Hydrogeology portion: 1/3 semester)  
 2017 fall ETHZ Geothermal Energy Masters Course  
 2017 spring ETHZ Joint Applied Geophysics Masters Course II (co-taught) (1/2 semester)  
 2017 spring ETHZ Joint Applied Geophysics Masters Course I (co-taught) (1/2 semester)

2016 fall ETHZ Geothermal Energy Masters Course  
 2016 fall ETHZ Groundwater Masters Course (co-taught)  
 2016 spring ETHZ Joint Applied Geophysics Masters Course II (co-taught) (1/2 semester)  
 2016 spring ETHZ Joint Applied Geophysics Masters Course I (co-taught) (1/2 semester)

2015 fall ETHZ Geothermal Energy Masters Course  
 2015 fall ETHZ Groundwater Masters Course (co-taught)  
 2015 spring ETHZ Joint Applied Geophysics Masters Course II (co-taught) (1/2 semester)  
 2015 spring ETHZ Joint Applied Geophysics Masters Course I (co-taught) (1/2 semester)

----- move to ETH Zurich (ETHZ) -----

2014 UMN ESCI 5205: Fluid Mechanics in Earth and Environmental Sciences  
 2014 UMN ESCI 4971W / 5971: Hydrogeology Field Camp

2013 UMN ESCI 4971W / 5971: Hydrogeology Field Camp  
 2013 UMN ESCI 4702 (formerly 5701): General Hydrogeology

2012 UMN ESCI 3203: Fluid Earth Dynamics  
 2012 UMN ESCI 4971W / 5971: Hydrogeology Field Camp  
 2012 UMN ESCI 4702: (formerly 5701): General Hydrogeology

2011 UMN ESCI 5205: Fluid Mechanics in Earth and Environmental Sciences  
 2011 UMN ESCI 3203: Fluid Earth Dynamics  
 2011 UMN ESCI 4971W / 5971: Hydrogeology Field Camp

----- Department Name ID changed from GEO to ESCI -----

2011 UMN GEO 4702 (formerly 5701): General Hydrogeology

2010 UMN GEO 3203: Geodynamics II - The Fluid Earth  
 2010 UMN GEO 4971W / 5971: Hydrogeology Field Camp  
 2010 UMN GEO 4702 (formerly 5701): General Hydrogeology

2009 UMN GEO 5205: Fluid Mechanics in Earth and Environmental Sciences  
 2009 UMN GEO 3203: Geodynamics II - The Fluid Earth  
 2009 UMN GEO 4971W / 5971: Hydrogeology Field Camp  
 2009 UMN GEO 4702 (formerly 5701): General Hydrogeology

2008 UMN GEO 3203: Geodynamics II - The Fluid Earth

2008	UMN GEO 4971W / 5971: Hydrogeology Field Camp
2008	UMN GEO 5701: General Hydrogeology
2008	UMN GEO 8980: Seminar: Volcanology
2007	UMN GEO 5205: Fluid Mechanics in Earth and Environmental Sciences
2007	UMN GEO 3203: Geodynamics II - The Fluid Earth
2007	UMN GEO 4971W / 5971: Hydrogeology Field Camp
2006	UMN GEO 3203: Geodynamics II - The Fluid Earth
2006	UMN GEO 5701: General Hydrogeology
2006	UMN GEO 4971: Hydrogeology Field Camp
2006	UMN GEO 1001: Earth and Its Environments (~160 students)
2005	UMN GEO 5701: General Hydrogeology
2005	UMN GEO 4971: Hydrogeology Field Camp
2005	UMN GEO 4010/8980: Coupled Heat and Fluid Flow in the Earth's Crust
2001	UO Taught an introduction to geology course
2001	UO Taught an advanced hydrogeology undergraduate course
1997-1999	UO Teaching Assistant (TA) for: Hydrogeology, Geophysics, Geological Fluid Mechanics

## SERVICE AND OUTREACH

### Service and Outreach:

7/2020-	<b>Chair of the Institute of Geophysics</b> , Dept. of Earth Sciences, ETH Zürich, Switzerland (CH)
12/2019	<b>Tenure case evaluation</b> for an Assistant Professor at the University of Geneva, Switzerland.
9/6-9/7/2018	<b>Member of the international evaluation committee of the Leibniz-Institut für Angewandte Geophysik (LIAG)</b> , Hannover, Germany.
2/26-3/1/2018	<b>Member of the international evaluation committee of the Helmholtz Geo-Forschungs-Zentrum (GFZ)</b> Potsdam, Germany.
2/22-23/2017	<b>Scientific Advisory Board</b> meeting (called Program Committee Meeting – PCM) of the Laboratory for (Nuclear) Waste Management at the <b>Paul Scherrer Institute</b> , Switzerland
01/31/2017	Habilitation Evaluation for the University of Darmstadt, Germany 2016-present <b>Outreach:</b> Board Member: Geothermie Schweiz (geothermie-schweiz.ch)
03/2-3/2016	Scientific Advisory Board meeting (called Program Committee Meeting – PCM) of the Laboratory for (Nuclear) Waste Management at the Paul Scherrer Institute, Switzerland
02/10/2016	CCES at ETH-Zurich: Challenger for: “The Role of the subsurface in the future energy system”
2015-2016	<b>Chair</b> of the “ <b>Energy Resource</b> ” Theme for sessions for the Goldschmidt Conference in Yokohama, Japan, held: 26 June – 1 July, 2016.
11/04/2015	<b>Outreach:</b> Poster presentation on “Neue CO <sub>2</sub> -neutrale Technologien” during Klimarunde at ETH Zurich, Switzerland
2015-present	<b>Member of the Steering Committee</b> of the <b>Deep Underground Geothermal (DUG) Lab, Swiss Competence Center for Energy Research – Supply of Electricity (SCCER-SoE)</b> , ETH-Zurich, Switzerland
2015-2017	<b>Swiss Competence Center for Energy Research – Supply of Electricity (SCCER-SoE)</b> Chair for the Task on CO <sub>2</sub> Sequestration Pilot and Demonstration Site Development
2015-present	<b>Co-Editor</b> of the journal: <b>Geothermal Energy</b> (Springer)
2015-present	<b>Reviewer</b> of typically 1 to 3 Swiss National Science Foundation (SNF) proposals per year.
2014	Habilitation Evaluation for ETH Zurich, Switzerland
2013	<b>Outreach:</b> Guest lecture in the field on volcano-hydrology and hot springs at Lassen Volcanic National Park contributing to NASA Ames’ public outreach program with Red Bluff, California, High School students.
2012-2013	<b>Committees:</b> 1) Undergraduate Studies, 2) Field Camp, 3) Computer, 4) Building
2011	<b>In the News:</b> Several general public articles following a UMN press release on the CO <sub>2</sub> -based Geothermal energy extraction technology we developed such as: Huffington Post: “Geothermal Technology Offers Path To Curbing CO <sub>2</sub> Emissions, Global Warming”, Discovery News: “Greenhouse gas pumped to boost clean energy”, Ars Technica “We might harvest the Earth’s heat while trapping

- carbon emissions”, Imperial College’s student newspaper, Felix: “Using carbon dioxide to fight warming”, and Smart Planet “A new geothermal technique packs a one-two punch”.
- 2010-2014 **Associate Editor of Hydrogeology Journal**  
(Official Journal of the International Association of Hydrogeologists - IAH)
- 12/29/2009 **In the News:** Discovery News article on geothermal energy research:  
news.discovery.com/earth/carbon-dioxide-capture-geothermal-green-energy.html
- 11/17/2009 **Outreach:** Talk at the Initiative for Renewable Energy and the Environment (IREE) annual conference.  
Title: Can CO<sub>2</sub> sequestration and geothermal energy utilization be combined? (see also: invited talks)
- 11/16/2009 **In the News:** MIT Technology Review: Saar et al. receive \$1.5M from DOE for geothermal  
energy research: www.technologyreview.com/energy/23953
- 11/12/2009 **Outreach:** Talk at the Minnesota Groundwater Association on preferred groundwater flow  
paths in aquifer systems. (see also invited talks)
- 11/04/2009 **In the News:** MinnPost.com article on Saar’s geothermal energy funding:  
www.minnpost.com/markneuzil/2009/11/04/13144/geothermal\_grants\_heat\_up\_in\_minnesota
- 09/29/2009 **Outreach:** Presentation to the Legislative-Citizen Commission on Minnesota Resources  
(LCCMR) on combining CO<sub>2</sub> sequestration with geothermal energy utilization in Minnesota:  
Utilizing low geothermal heat flow regions for geothermal electricity generation.
- 11/14/2008 **Outreach: Guest lecture** on the use of calculus in the geosciences, Department of  
Mathematics and Computer Science, Beloit College, Beloit, WI.
- 10/3-5/2008 **Outreach: Taught a three-day pumping test workshop** for hydrogeology professionals at  
the Hydrocamp Field Site in north-central Minnesota.
- 03/24/2008 **Outreach: Talk for the general public:** Geological Society of Minnesota, Title: The role of  
fluids in Geology. (see also invited talks)
- 03/12/2008 **Outreach: Guest lecture** on pumping test analyses, Geology Department, Macalester  
College, Saint Paul, MN
- 2007 **Session Chair**, AGU fall conference, San Francisco, Title: “Dynamics of Gas Transport in  
Magma I+II” (oral session)
- 2007 **Participant in Workshop:** “Connecting Geoscience Departments to the Future of Science:  
New Structures for Research and Curriculum.” Held at Carleton College, MN
- 2007 Served on **departmental committees:** 1) tectonics search for 2007/2008 position, 2) student  
fellowships and awards
- 2006-2010 Serving on **departmental committees:** 1) strategic hiring plan, 2) undergraduate studies,  
3) field camp, 4) computer, 5) awards
- 2006 Served on **departmental committees:** tectonics search for 2006/2007 position
- 2006 **In the News:** Served as expert geoscientist for a **documentary film** by German National TV  
(Focus TV on channel Pro-7) at Yellowstone National Park (3 days in May). Documentary  
was shown on national German TV following the docudrama “Supervolcano”.
- 2005 **Session Chair**, GSA Conference, Salt Lake City, Title: “Tribute to Hans-Olaf Pfannkuch:  
From Darcy to the Modern World of Environmental and Contaminant Hydrogeology”
- 2005 **Invited Department of Energy (DOE) research proposal reviewer and panel member** for  
proposals addressing dense-non-aqueous-phase liquid (**DNAPL**) cleanup (from previous  
underground storage/spilling by power plant operations) and related up-scaling of simulations  
and lab experiments to the field scale.
- 2005 **Session Chair**, AGU Conference, New Orleans, Title: “Volcano Hydrology”
- 2005 **Co-organizer of symposium** entitled: "Groundwater sustainability: methods for analysis,  
mapping, monitoring, and management of regional systems", GSA North-Central conference.
- 2005 Community Campaign Fund Drive organizer for the Department of Geology and Geophysics  
to motivate colleagues to contribute to the university’s donations for the community.
- 2003 **Co-leader** of 3-day GSA field trip: "Hydrogeology of Cascade Range Volcanoes: Mount St.  
Helens, Mount Hood, and Central Oregon"
- 2003-present **National Science Foundation (NSF) proposal reviews** (2 to 7 per year).
- 2003-present **Journal publication reviews** (~15 per year) for: Journal of Geophysical Research (Solid Earth, Earth  
Surface), Earth and Planetary Science Letters, Geophysical Research Letters, Water Resources  
Research, Geophysical Journal International, Journal of Volcanology and Geothermal Research,  
Seismological Research Letters, Geochemical Journal, Hydrogeology J.
- 2002 **Session Chair**, AGU conference, San Francisco, Title: “Geophysical Constraints on the Role  
of Fluids in the Crust”