Everett L. Shock

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Education

B.S. Earth Sciences, University of California, Santa Cruz, 1978
Ph.D. Geology, University of California, Berkeley, 1987

Positions Held

Professor, School of Earth and Space Exploration (formerly Department of Geological Sciences) and School of Molecular Sciences (formerly Department of Chemistry & Biochemistry), Arizona State University (since June 2002)
Faculty Associate, Center for Fundamental and Applied Microbiomics, Biodesign Institute, Arizona State University (since 2016)
Co-director, Environmental Life Sciences Graduate Program, Arizona State University (2013-2017)
Chairman, Environmental Studies Program, Washington University, St. Louis, MO (1993-2001)
Professor, Associate Professor, Assistant Professor, Department of Earth and Planetary Sciences, Washington University, St. Louis, MO (1987-2002)
Research Assistant, U.C. Berkeley: theoretical research in high-pressure/temperature inorganic and organic aqueous solution chemistry, chemical interaction of minerals and organic compounds with aqueous solutions in geochemical processes (six years)
Physical Sciences Technician and Lab Supervisor, U.S. Geological Survey, Menlo Park, CA (two years)

Awards & Honors

Geochemistry Medal, American Chemical Society, 2019
Designation of a hyperthermophilic archeon as *Thermogladius shockii,* 2011
Fellow, Geochemical Society and European Association for Geochemistry, 2009
Distinguished Geoscience Lecturer, Sandia National Laboratory, 2008
Steinbach Scholar, Woods Hole Oceanographic Institute, 2007
Fellow, American Geophysical Union, 2005
Hooker Distinguished Visiting Professor, McMaster University, 2004
Visiting Scholar, Western Michigan University, 2003
Outstanding Faculty Mentor Award, Graduate Student Senate, Washington University, 2000
C. Hewitt Dix Lecturer, Division of Geological and Planetary Sciences, California Institute of Technology, 1999
Paul Gast Lecturer, European Association for Geochemistry, Goldschmidt Conference, Toulouse, 1998
Crosby Lecturer, MIT, 1994
Buffon Society Special Investigator Award, 1994

Experience and Service

Co-chair of Habitability Assessment Board, Europa Clipper (2019-2022)
Governance Board ASU Chemical and Environmental Characterization Core Facility (starting July 2020)

Co-organizer of AGU session “Exploring the Biotic Fringe” (Dec 2019)
Member of Extreme Biophysics Research Coordination Network (since 2018)
Member of SUBSEA team (2017-2021); Lō‘ihi seamount expedition (2018); Gorda Ridge expedition (2019).
Member of the Europa Clipper Project Science Group, and Co-I through MASPEX-Europa (since 2015).
Center for Bio-Mediated and Bio-Inspired Geotechnics (CBBG, NSF-ERC, since 2015)
Deep Life Modeling and Visualization co-chair, Deep Life Community of the Deep Carbon Observatory (2015-2019)
Project Steering Committee - Oman Drilling Project (2014-2019)
Proponent of successful proposal for IODP Expedition 370: “The Temperature Limits of Life” (2016 - 2017)
Scientific Committee, Extremophiles 2014, St Petersburg, Russia, Sept 2014
Scientific Committee, International Society for the Origins of Life 2014, Nara, Japan, July 2014
Co-organizer of session on “Windows Into to the Deep Subsurface Biosphere: Coupled Geochemical and Biological Investigations of Terrestrial Hot Spring Ecosystems” at Fall AGU (2013)
Science Definition Team for Europa Missions, NASA (2011-2014)
Center for Dark Energy Biosphere Investigations (C-DEBI) science steering committee: crust steering committee (2010-2014)
Co-organizer of session on “Organic Compound Transformations at High Pressures and Temperatures” at Fall AGU (2011)
Co-organizer of session on “Omics Approaches to Geobiology” at Fall AGU (2010)
Co-organizer of session on ‘Hydrothermal Organic Geochemistry’ at Goldschmidt conference (2010)
Organizer of session on ‘Energy Flow in Microbial Ecosystems’ at AbSciCon (2010)
Co-organizer of session at Goldschmidt conference (2009)
Co-organizer of session at AGU Joint Assembly (2009)
Organizer and Host for ‘Hot Life in the Desert’ meetings (I-XII), Arizona State University (2006-2017)
Instructor, International Geobiology Course, Colorado School of Mines (2008)
Member of NRC Committee on Origin and Evolution of Life (2007-2011)
Editorial Advisory Board of *Elements* (2005-2009)
Editor for AGU’s Biogeoscience Editor’s Choice Virtual Journal (2002 - 2005)
Co-organizer of special session at the American Society of Limnology & Oceanography meeting (2007)
Co-organizer of special Biogeosciences sessions at Fall AGU meeting (2002, 2003, 2004, 2005)
Co-organizer of special biogeochemistry session at the American Chemical Society meeting (2005)
Member of Editorial Board of *Earth and Planetary Science Letters* (2001 - 2007)
Associate Editor of *Geochemistry, Geophysics, Geosystems* (1999 - 2005)
Organizing Committee: First American-German Conference on “Changing Earth and its Impact on Human Habitat” sponsored by NSF and DFG, Washington, DC. (2004)
Member of Editorial Board of *Geofluids* (1999 - 2003)
Co-organizer of Pardee Symposium: “The Future of Biogeochemistry: A Symposium in Honor of Harold Helgeson,” GSA Annual Meeting (2001)
Committee on Planetary and Lunar Exploration, Space Studies Board, (COMPLEX) National Research Council (1997 - 2000)
Board of Directors, Geochemical Society (1998 - 2001)
Co-organizer of Pardee Symposium: “New Insights on Organic Metamorphism in the Earth,” GSA Annual Meeting (1999)
JOIDES Program Planning Group on the Deep Biosphere (1997 - 1999)

Joint Publications Committee, Geochemical Society & Meteoritical Society (1998 - 2000)
Organizer of first Geochemical Perspectives on Environmental Processes (GPEP) meeting, Washington University (1998)
Organizer of GPEP-2000: *New Geochemical Tracers*, Washington University (2000)
Organizing Committee for Conference on the Origin of the Earth and Moon (1997 - 1998)
Scientific Organizing Committee for Workshop on Early Mars: Geologic and Hydrologic Evolution, Physical and Chemical Environments, and the Implications for Life. Lunar and Planetary Institute, Houston (1997)
Program Committee, Geochemical Society (1995 - 1997)
NASA-Exobiology Mars Strategy Committee (1994 - 1995)
Organizing Committee for 13th IUPAC Conference on Chemical Thermodynamics, Clermont-Ferrand, France (1994)
Member of SCOR Working Group 91 "Chemical Evolution and Origin of Life in Marine Hydrothermal Systems." (1990 - 1992)

Field Expeditions

Continental Hydrothermal System, Yellowstone National Park, USA; 1999, 2000, 2001, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2021, 2022. Involving >180 scientists from Arizona State University, Washington University, University of New Mexico, Yale, Stanford, MIT, University of Colorado, Carleton College, University of Waikato, McMaster University, Lawrence Livermore National Lab, Woods Hole Oceanographic Institution, University of North Carolina, University of Nevada-Las Vegas, NASA-Ames, University of Illinois-Chicago, Montana State University, University of Oslo, Universidad Nacional Autónoma de México, China University of Geosciences – Wuhan, University of the Philippines, ETH-Zurich, Northwestern University, Montana Tech, UCLA, University of Wyoming, and Johns Hopkins.
Shallow Marine Hydrothermal System, Vulcano, Aeolian Islands, Sicily; 1999; 2001; 2007
Subglacial Ecosystem, Robertson Glacier, Alberta, Canada; 2009, 2010
Serpentinizing System, Samail ophiolite, Sultanate of Oman; 2009, 2010, 2012, 2014
Hydrothermal System, Southeast Iceland; 2011
Lōʻihi Seamount and its submarine hydrothermal system (SUBSEA), 2018
Gorda Ridge submarine hydrothermal system (SUBSEA), 2019

Codes

Boyer, G., Robare, J., Ely, T., & Shock, E. (2021). AqEquil: Python package for aqueous geochemical speciation (0.13.4). Zenodo. https://doi.org/10.5281/zenodo.5768107
Boyer, G., Robare, J., Shock, E. (2021) AqOrg v0.1.11 (v0.1.11) Zenodo. https://doi.org/10.5281/zenodo.5539934

Patents

Robinson, K., Gould, I., Bockisch, C., Shock, E., Hartnett, H., Williams, L. *Hydrothermal Production of Alkanes*. US 11,332,419 B2 (17 May 2022).

Publications

Shock, E.L., and Helgeson, H.C. (1988) Calculation of the thermodynamic and transport properties of aqueous species at high pressures and temperatures: Correlation algorithms for ionic species and equation of state predictions to 5 kb and 1000°C. *Geochim. Cosmochim. Acta*, **52**, 2009-2036.
Shock, E.L. (1988) Organic acid metastability in sedimentary basins. *Geology*, **16**, 886-890.
Helgeson, H.C., Oelkers, E.H., Shock, E.L., and Sverjensky, D.A. (1988) Calculation of the thermodynamic and transport properties of aqueous species at supercritical

temperatures and pressures. Proceedings of the International Symposium on Supercritical Fluids, (M. Perrut, ed., Société Française de Chimie) Tome 1, 279-294.
Helgeson, H.C., Shock, E.L., Sverjensky, D.A., and Oelkers, E.H. (1988) Calculation of equilibrium constants for reactions among minerals, gases, and aqueous species in geothermal systems. *Rendiconti della Societa Italiana di Mineralogia e Petrologia*, **43**, 1159-1174.
Shock, E.L., Helgeson, H.C., and Sverjensky, D.A. (1989) Calculation of the thermodynamic and transport properties of aqueous species at high pressures and temperatures: Standard partial molal properties of inorganic neutral species. *Geochim. Cosmochim. Acta*, **53**, 2157-2183.
Shock, E.L. (1989) Corrections to "Organic acid metastability in sedimentary basins." *Geology*, **17**, 572-573.
Shock, E.L., and Helgeson, H.C. (1990) Calculation of the thermodynamic and transport properties of aqueous species at high pressures and temperatures: Standard partial molal properties of organic species. *Geochim. Cosmochim. Acta*, **54**, 915-945.
Shock, E.L. (1990) Do amino acids equilibrate in hydrothermal fluids? *Geochim. Cosmochim. Acta*, **54**, 1185-1189.
Sassani, D.C., and Shock, E.L. (1990) Speciation and solubility of palladium in aqueous magmatic-hydrothermal solutions. *Geology*, **18**, 925-928.
Shock, E.L. (1990) Geochemical constraints on the origin of organic compounds in hydrothermal systems. *Origins of Life and Evolution of the Biosphere*, **20**, 331-367.
Shock, E.L., and Schulte, M.D. (1990) Summary and implications of reported amino acid concentrations in the Murchison meteorite. *Geochim. Cosmochim. Acta*, **54**, 3159-3173.
Shock, E.L., and Schulte, M.D. (1990) Amino acid synthesis in carbonaceous meteorites by aqueous alteration of polycyclic aromatic hydrocarbons. *Nature*, **343**, 728-731.
Shock, E.L. (1992) Stability of peptides in high temperature aqueous solutions. *Geochim. Cosmochim. Acta*, **56**, 3481-3491.
Sassani, D.C., and Shock, E.L. (1992) Estimation of standard partial molal entropies of aqueous ions at 25°C and 1 bar. *Geochim. Cosmochim. Acta*, **56**, 3895-3908.
Holm, N.G., Cairns-Smith, A.G., Daniel, R.M., Ferris, J.P., Hennet, R.J.-C., Shock, E.L., Simoneit, B.R.T. and Yanagawa, H. (1992) Future Research. In: Marine Hydrothermal Systems and the Origin of Life, (ed. N. Holm) a special issue of *Origins of Life and Evolution of the Biosphere*, **22**, 181-190.
Shock, E.L. (1992) Chemical environments in submarine hydrothermal systems. In: *Marine Hydrothermal Systems and the Origin of Life*, (ed. N. Holm) a special issue of *Origins of Life and Evolution of the Biosphere,* **22**, 67-107.
Shock, E.L. (1992) Hydrothermal organic synthesis experiments. In: *Marine Hydrothermal Systems and the Origin of Life,* (ed. N. Holm) a special issue of *Origins of Life and Evolution of the Biosphere,* **22***,* 135-146.
Shock, E.L., Oelkers, E.H., Johnson, J.W., Sverjensky, D.A., and Helgeson, H.C. (1992) Calculation of the thermodynamic properties of aqueous species at high pressures and temperatures: Effective electrostatic radii, dissociation constants, and standard partial molal properties to 1000°C and 5 kb. *J. Chem. Soc., Faraday Trans.* **88**, 803-826.
Helgeson, H.C., Knox, A.M., Owens, C.E., and Shock, E.L. (1993) Petroleum, oil field waters and authigenic mineral assemblages: Are they in metastable equilibrium in hydrocarbon reservoirs? *Geochim. Cosmochim. Acta* **57,** 3295-3339.
Shock, E.L. (1993) Hydrothermal dehydration of aqueous organic compounds. *Geochim. Cosmochim. Acta.* **57**, 3341-3349.
Schulte, M.D., and Shock, E.L. (1993) Aldehydes in hydrothermal solutions: Standard partial molal thermodynamic properties and relative stabilities at high temperatures and pressures. *Geochim. Cosmochim. Acta* **57**, 3835-3846.
Shock, E.L., and Koretsky, C.M. (1993) Metal-organic complexes in geochemical processes: Calculation of standard partial molal thermodynamic properties of aqueous acetate

complexes at high pressures and temperatures. *Geochim. Cosmochim. Acta* **57**, 4899-4922.
Shock, E.L., and McKinnon, W.B. (1993) Hydrothermal processing of cometary volatiles--Applications to Triton. *Icarus* **106**, 464-477.
Shock, E.L. (1994) Application of thermodynamic calculations to geochemical processes involving organic acids. In: *The Role of Organic Acids in Geological Processes* (eds.: M. Lewan and E. Pittman) Springer-Verlag pp. 270-318.
Shock, E.L. (1994) Hydrothermal systems and the emergence of life. *Geotimes*, **39**, 12-14.
Shock, E.L. (1994) Catalysing methane production. *Nature*, **368**, 499-500.
Shock, E.L. (1994) Erratum to D. C. Sassani and E.L. Shock (1992) "Estimation of standard partial molal entropies of aqueou sions at 25°C and 1 bar" *Geochim. Cosmochim. Acta* **58**, 2756-2758.
Shock, E.L., and Koretsky, C.M. (1995) Metal-organic complexes in geochemical processes: Estimation of standard partial molal thermodynamic properties of aqueous complexes between metal cations and monovalent organic acid ligands at high pressures and temperatures. *Geochim. Cosmochim. Acta* **59**, 1497-1532.
Shock, E.L. (1995) Organic acids in hydrothermal solutions: Standard molal thermodynamic properties of carboxylic acids and estimates of dissociation constants at high temperatures and pressures. *American Journal of Science* **295**, 496-580.
Shock, E.L. (1995) Methane: An open or shut case? *Nature* **378**, 338-339.
Oelkers, E.H., Helgeson, H.C., Shock, E.L., Sverjensky, D.A., Johnson, J.W., and Pokrovskii, V. (1995) Summary of the apparent standard partial molal Gibbs free energies of formation of aqueous species, minerals, and gases at pressures from 1 to 5000 bars and temperatures from 25° to 1000°C. *Journal of Physical and Chemical Reference Data* **24**, 1401-1560.
Shock, E.L., McCollom, T. and Schulte, M.D. (1995) Geochemical constraints on chemolithoautotrophic reactions in hydrothermal systems. *Origins of Life and Evolution of the Biosphere* **25**, 141-159.
Haas, J.R., Shock, E.L., and Sassani, D.C. (1995) Rare earth elements in hydrothermal systems: Estimates of standard partial molal thermodynamic properties of aqueous complexes of the REE at high pressures and temperatures. *Geochim. Cosmochim. Acta* **59**, 4329-4350.
Griffith, L.L., and Shock, E.L. (1995) A geochemical model for the formation of hydrothermal carbonate on Mars. *Nature* **377**, 406-408.
Schulte, M.D., and Shock, E.L. (1995) Thermodynamics of Strecker synthesis in hydrothermal systems. *Origins of Life and Evolution of the Biosphere* **25**, 161-173.
Shock, E.L. (1996) Hydrothermal systems as environments for the emergence of life. In: *Evolution of Hydrothermal Ecosystems on Earth (and Mars?)* Wiley, Chichester (Ciba Foundation Symposium **202**) p. 40-60.
Griffith, L.L. and Shock, E.L. (1997) Hydrothermal hydration of martian crust: Illustration via geochemical model calculations. *Jour. Geophys. Res.* **102**, 9135-9143.
Shock, E.L. (1997) High temperature life without photosynthesis as a model for Mars. *Jour. Geophys. Res.* **102**. 23,687-23,694.
Shock, E.L., Sassani, D.C., Willis, M. and Sverjensky, D.A. (1997) Inorganic species in geologic fluids: Correlations among standard molal thermodynamic properties of aqueous ions and hydroxide complexes. *Geochim. Cosmochim. Acta* **61**, 907-950.
Sverjensky D.A., Shock, E.L., and Helgeson, H.C. (1997) Prediction of the thermodynamic properties of aqueous metal complexes to 1000°C and 5 kb. *Geochim. Cosmochim. Acta* **61**, 1359-1412.
Dale, J.D., Shock, E.L., Macleod, G., Aplin, A.C. and Larter, S.R. (1997) Standard partial molal properties of aqueous alkylphenols at high pressures and temperatures. *Geochim. Cosmochim. Acta* **61**, 4017-4024.

Shock, E.L., Sassani, D.C. and Betz, H. (1997) Uranium in geologic fluids: Estimates of oxidation potentials and hydrolysis constants at high temperatures and pressures. *Geochim. Cosmochim. Acta* **61**, 4245-4266.

McCollom, T.M. and Shock, E.L. (1997) Geochemical constraints on chemolithoautotrophic metabolism by microorganisms in seafloor hydrothermal systems. *Geochim. Cosmochim. Acta* **61**, 4375-4391.

McCollom, T.M., and Shock, E.L. (1998) Fluid-rock interactions in the lower oceanic crust: Thermodynamic models of hydrothermal alteration. *Jour. Geophys. Res.* **103**, 547-575.

Jakosky, B.M. and Shock, E.L. (1998) The biological potential of Mars, the early Earth and Europa. *Jour. Geophys. Res.* **103**, 19359-19364.

Amend, J.P. and Shock, E.L. (1998) Energetics of amino acid synthesis in hydrothermal ecosystems. *Science* **281**, 1659-1662.

Sassani, D.C., and Shock, E.L. (1998) Solubility and transport of platinum-group elements in supercritical fluids: Summary and estimates of thermodynamic properties for Ru, Rh, Pd, and Pt solids, aqueous ions and aqueous complexes. *Geochim. Cosmochim. Acta* **62**, 2643-2671.

Shock, E. L. (1998) Co-transport of metals and organic compounds in geochemical, biochemical and environmental processes. In: (Marini, L. and Ottonello, G., eds), *Proceedings of the Rome Seminar on Environmental Geochemistry*, Pacini Editore, 73-102.

Shock, E.L., McCollom, T. and Schulte, M.D. (1998) The emergence of metabolism from within hydrothermal systems. In: *Thermophiles: the keys to molecular evolution and the origin of life?* (Wiegel and Adams, eds.) Taylor & Francis, London, 59-76.

Shock, E. L. and Schulte, M. D. (1998) Organic synthesis during fluid mixing in hydrothermal systems. *Jour. Geophys. Res.* **103**, 28513-28527.

Prapaipong, P., Shock, E.L. and Koretsky, C.M. (1999) Metal-organic complexes in geochemical processes: Temperature dependence of standard partial molal thermodynamic properties of aqueous complexes between metal cations and dicarboxylate ligands. *Geochim. Cosmochim. Acta* **63**, 2547-2577.

Haas, J.R and Shock, E.L. (1999) Halocarbons in the environment: Estimates of thermodynamic properties for aqueous chloroethylene species and their stabilities in natural settings. *Geochim. Cosmochim. Acta* **63**, 3429-3441.

McCollom, T.M., Simoneit, B.R.T. and Shock, E.L. (1999) Hydrous pyrolysis of polycyclic aromatic hydrocarbons and implications for the origin of PAH in hydrothermal petroleum. *Energy & Fuels* **13**, 401-410.

Murphy, W. M. and Shock, E.L. (1999) Environmental aqueous geochemistry of actinides. *Reviews in Mineralogy* **38**, 221-253.

Schulte, M., Shock, E., Obsil, M., and Majer, V. (1999) Volumes of aqueous alcohols, ethers, and ketones to T = 523K and p = 28 MPa. *Jour. Chem. Thermodynamics* **31**, 1195-1229.

Zolotov, M. and Shock, E. (1999) Abiotic synthesis of polycyclic aromatic hydrocarbons on Mars. *Jour. Geophys. Res.* **104**, 14033-14049.

Zolotov, M.Yu. and Shock, E. L. (2000) A thermodynamic assessment of the potential synthesis of condensed hydrocarbons during cooling and dilution of volcanic gases. *Jour. Geophys. Res.* **105**, 539-559.

Plyasunov, A.V. and Shock, E.L. (2000) Thermodynamic functions of hydration of hydrocarbons at 298.15 K and 0.1 MPa. *Geochim. Cosmochim. Acta* **64**, 439-468.

Zolotov, M.Yu. and Shock, E.L. (2000) An abiotic origin for hydrocarbons in the Allan Hills 84001 martian meteorites through cooling of magmatic and impact-generated gases. *Meteoritics Planet. Sci.* **35**, 629-638.

Amend, J.P. and Shock, E.L. (2000) Thermodynamics of amino acid synthesis in hydrothermal systems on the early Earth. In: *Perspectives in Amino Acid and Protein Geochemistry*, (eds: G.A. Goodfriend, M.J. Collins, M.L. Fogel, S.A. Macko, and J.F. Wehmiller), Oxford University Press, 23-40.

Shock, E.L., Amend, J.P. and Zolotov, M.Yu. (2000) The early Earth vs. the origin of life. In: *The Origin of the Earth and Moon* (R. Canup and K. Righter, eds.) University of Arizona Press, p. 527-543.

Plyasunov, A.V., O'Connell, J.P., Wood, R.H. and Shock, E.L. (2000) Infinite dilution partial molar properties of aqueous solutions on nonelectrolytes. II. Equations for the standard thermodynamic functions of hydration of volatile nonelectrolytes over wide ranges of conditions including subcritical temperatures. *Geochim. Cosmochim. Acta* **64**, 2779-2795.

Plyasunov, A.V. and Shock, E.L. (2000) Standard state Gibbs energies of hydration of hydrocarbons at elevated temperatures as evaluated from experimental phase equilibria studies. *Geochim. Cosmochim. Acta* **64**, 2811-2833.

Shock, E.L. (2000) Thermodynamic response of organic compounds in geochemical processes of sedimentary basins. *Reviews in Economic Geology*, *Vol. 9. Ore Genesis and Exploration: The Roles of Organic Matter* (eds: T.H. Giordano, R.M. Kettler, S.A. Wood) Society of Economic Geologists, Inc., Littleton, CO, pp. 105-117.

Shock, E. (2000) Organic acids. *Oxford Companion to the Earth* (P.L. Hancock and B. Skinner, eds), Oxford University Press. p.761.

Shock, E. (2000) Origin of life: Geochemical constraints. *Oxford Companion to the Earth* (P.L. Hancock and B. Skinner, eds), Oxford University Press. pp.763-766.

Wetzel, L.R. and Shock, E.L. (2000) Distinguishing ultramafic- from basalt-hosted submarine hydrothermal systems by comparing calculated vent fluid compositions. *Jour. Geophys. Res.* **105**, 8319-8340.

Shock, E.L. (2001) Hydrothermal water/rock/organic/microbe interactions. Proceedings Water/ Rock Interaction Conference, ed. R. Cidu, A.A. Balkema Publishers, pp. 61-70.

Shock, E.L. (2001) Geochemical habitats in hydrothermal systems. In: First Steps in the Origin of Life in The Universe, Proceedings of the Sixth Trieste Conference on Chemical Evolution, ed. J. Chela-Flores, Kluwer 179-185.

Wetzel, L.R., Raffensperger, J.P., and Shock, E.L. (2001) Predictions of hydrothermal alteration within near-ridge oceanic crust from coordinated geochemical and fluid flow models. *Jour. Volcanology and Geothermal Res.* **110**, 319-342.

Plyasunov, A.V., O'Connell, J.P., Wood, R.H. and Shock, E.L. (2001) Semiempirical equation of state for the infinite dilution thermodynamic functions of hydration of nonelectrolytes over wide ranges of temperature and pressure. *Fluid Phase Equilibria* **183/184**, 133-142.

Plyasunov, A.V. and Shock, E.L. (2001) The Krichevskii parameter for aqueous nonelectrolytes. *Jour. Supercritical Fluids* **20**, 91-103.

Zolotov, M.Yu. and Shock, E.L. (2001) Stability of condensed hydrocarbons in the solar nebula. *Icarus* **150**, 323-337.

Zolotov, M.Yu. and Shock, E.L. (2001) The composition and stability of salts on the surface of Europa and their oceanic origin. *Jour. Geophys. Res.* **106**, 32815-32828.

Plyasunov, A.V. and Shock, E.L. (2001) Group contribution values of the infinite dilution thermodynamic functions of hydration for aliphatic non-cyclic hydrocarbons, alcohols and ketones at 298.15 K and 0.1 MPa. *Journal of Chemical and Engineering Data* **46**, 1016-1019.

Amend, J.P. and Shock, E.L. (2001) Energetics of overall metabolic reactions in thermophilic and hyperthermophilic Archaea and Bacteria. *FEMS Microbiology Reviews* **25**, 175-243.

Criss, R.E. and Shock, E.L. (2001) Flood enhancement through flood control. *Geology* **29**, 875-878.

Stueber, A.M., Thompson, E.S., Criss, R.E. and Shock, E.L. (2001) Land use, hydrology and water quality in a karst watershed: Resolution of water quality issues at the local level. Proceedings of the annual Illinois Groundwater Consortium Conference, available online at: www.siu.edu/worda/igc/proceedings/01/stueber.pdf

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Schulte, M.D., Shock, E.L., and Wood, R.H. (2001) The temperature dependence of the standard state thermodynamic properties of aqueous nonelectrolytes. *Geochim. Cosmochim. Acta* **65**, 3919-3930.

Prapaipong, P. and Shock, E.L. (2001) Estimation of standard-state entropies of association for aqueous metal—organic complexes and chelates at 25°C and 1 bar. *Geochim. Cosmochim. Acta* **65**, 3931-3953.

Sakane, S., Liu, W. Doren, D.J., Shock, E.L. and Wood, R.H. (2001) Prediction of the Gibbs energies and an improved equation of state for water at extreme conditions from ab initio energies with classical simulations. *Geochim. Cosmochim. Acta* **65**, 4067-4075.

Reysenbach, A.-L. and Shock, E.L. (2002) Merging genomes with geochemistry in hydrothermal ecosystems. *Science* **296**, 1077-1082.

Shock, E.L. (2002) Seeds of life? *Nature* **416,** 380-381.

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Shock, E.L., Carbery, K., Noblitt, N., Schnall, B., Kogan, P., Rovito, S., Berg, A. and Liang, J. (2003) Water and solute sources in an urban stream, River des Peres, St. Louis, Missouri,. In: *At the Confluence: Rivers, Floods, and Water Quality in the St. Louis Region* eds: (R.E. Criss and D.A. White) 150-160.

Stueber, A.M., Shock, E.L., Abendroth, M.T., Calero, G.A., and Torrico, A.C. (2003) Water quality in the karst terrain of southwestern Illinois. In: *At the Confluence: Rivers, Floods, and Water Quality in the St. Louis Region* eds: (R.E. Criss and D.A. White) 200-224.

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