

*vitae*  
**CHRISTOPHER H. GAMMONS**

Ph.D. Geochemistry and Mineralogy, The Pennsylvania State University, 1988  
B.S. Geology (High Honors, *Magna Cum Laude, Phi Beta Kappa*), Bates College, 1980  
Professional Geologist, State of Wyoming, 1999 to present

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### **Geology-Related Employment**

**2003-present** Professor, Montana Tech, Dept. of Geological Engineering  
**2013-2016** Head of the Dept. of Geological Engineering, Montana Tech  
**1999-2003** Associate Professor, Montana Tech, Dept. of Geological Engineering  
**1997-1999** Assistant Professor, Montana Tech, Dept. of Geological Engineering  
**1993-1996** 4/93 to 12/96: Research Associate/Faculty Lecturer, McGill University  
**1992-1993** 2/92 to 4/93: Postdoctoral Research Fellow, Swiss Fed. Inst. Tech. (ETH)  
**1988-1991** 11/88 to 11/91: Postdoctoral Research Fellow, Monash University, Australia  
**1979-1982** 4/79 to 8/79; 6/80 to 11/80; 4/81 to 9/82: Exploration Geologist, Anaconda Minerals Co.

### **Teaching Experience**

Classes I have taught include (19 different subjects): Hydrogeochemistry, Acid Rock Drainage, Environmental Geology, Geochemical Modeling, Hydrogeology, Introductory Petrology, Mineralogy and Petrology, Earth and Life History, Astrobiology and Evolution of the Early Earth, Economic Geology, Hydrothermal Ore Deposits, Advanced Topics in Economic Geology, Geothermal Systems, Isotope Geochemistry, Physical Geology, Geology of Montana, Introduction to Geologic Field Mapping, Field Geology (3 week summer course) and Field Hydrogeology (3 week summer course). I enjoy teaching, and have always received excellent student evaluations. This is true for introductory service classes, as well as graduate or upper level undergraduate courses.

### **Awards**

2017: Montana Tech "Lifetime Distinguished Researcher Award"  
2017: Montana Tech 20-year Dedicated Service Award  
2016: Stan and Joyce Lesar Professorship  
2016: Montana Tech "Merit Award"  
2013: Montana Tech "Merit Award"  
2012: Nominated for the "CASE Professor of the Year in Montana" award (application was unsuccessful)  
2012: Montana Tech "Distinguished Researcher Award".  
2009: Montana Tech "Rose and Anna Busch Faculty Achievement Award" for excellence in Teaching and Scholarly Activity.  
2005: "Editors' Citation for Excellence in Refereeing for Water Resources Research", an award conferred annually by the American Geophysical Union.  
2002: Montana Tech "Distinguished Researcher Award".  
2002: Nominated for the "Carnegie (CASE) Professor of the Year in Montana" award (application was unsuccessful)  
2000: Freeport Professorship

## **Professional Societies and Interests**

I am a member of the Geochemical Society, the Society of Economic Geologists, the Tobacco Root Geological Society, and the Montana Chapter of the American Water Resources Association. I am a Technical Advisor for the Clark Fork Watershed Education Program (CFWEP), and frequently lead field trips, lectures, or workshops for K-12 teachers and students.

## **Publications**

### **A: Journal publications**

*Geochimica et Cosmochimica Acta* (16); *Chemical Geology* (10); *Applied Geochemistry* (7); *Science of the Total Environment* (3); *Environmental Science and Technology* (3); *Economic Geology* (3); *Canadian Mineralogist* (2); *Mine Water and The Environment* (12); *Environmental Geology* (2); *Mineralium Deposita* (2); *Water Air and Soil Pollution* (1); *Water Resources Research* (1); *Biogeochemistry* (2); *Journal of Hydrology* (2); *Hydrological Processes* (1); *Aquatic Geochemistry* (1); *Geochemical Transactions* (1); *Journal of Alloys and Compounds* (1); *Journal of Volcanology and Geothermal Research* (1); others (7).

### **Montana Tech student co-authors are underlined**

86. Eastman, K.A., Doolittle, M.F., Gammons, C.H., Poulson, S.R. (2017) The Mount Evans gossan: a source of natural acid rock drainage and a possible source of metals and sulfur for the Butte porphyry-lode orebodies. *Northwest Geology*, v. 46, 67-74.
85. Shaw G., Mitchell, K., Gammons C.H. (2017) Estimating groundwater inflow and leakage outflow for an intermontane lake with a structurally complex geology: Georgetown Lake in Montana, USA. *Hydrogeology J.* 25, 135-149.
84. Gammons C.H., Szarkowski J., Stevenson R. (2016) New investigations of the mineralogy of silver in the world-class porphyry-lode deposits of Butte, Montana. *Mining Engineering, Web Exclusive*, June, 2016.
83. Parker S.R., West R.F., Boyd E.S., Feyhl-Buska J., Gammons C.H., Johnston T.B., Williams G.P., Poulson S.R. (2016) Biogeochemical and microbial seasonal dynamics between water column and sediment processes in a productive mountain lake: Georgetown Lake, MT, USA. *J. Geophysical Research – Biogeosciences* 121, 2064-2081, doi:10.1002/2015JG003309
82. Griffith A. and Gammons C.H. (2015) Mineral paragenesis of epithermal gold-silver veins at the Drumlummon mine, Marysville, Montana. *Northwest Geology*, v. 44, 37-46.
81. Williams G.P., Petteys K., Gammons C.H., Parker S.R. (2015) An investigation of acidic head-water streams in the Judith Mountains, Montana, USA. *Applied Geochemistry* v. 62, 48-60.
80. Tucci N.J., Gammons C.H. (2015) Influence of copper recovery on the water quality of the acidic Berkeley Pit lake, Montana, USA., *Environmental Science and Technology* 49, 4081-4088.
79. Castendyk D.N., Balistrieri L.S., Gammons C. and Tucci N. (2015) Modeling and management of pit lake water chemistry 2: Case Studies. *Applied Geochemistry* 57, 289-307.
78. Gammons C.H., Nimick D.A., and Parker S.R. (2015) Diel cycling of trace metals in streams draining abandoned mine lands: a review. *Applied Geochemistry* 57, 35-44.
77. Gammons C.H., Henne W., Poulson S.R., Parker S.A., Johnston T., Dore J., Boyd E. (2014) Stable isotopes track biogeochemical processes under ice cover in a shallow, productive lake. *Biogeochemistry* 120, 359-379.
76. White J., Gammons C.H., Zieg G.A. (2014) Paragenesis of cobalt and nickel in the Black Butte shale-hosted copper deposit, Belt Basin, Montana, USA. *Mineralium Deposita*, 49, 335-351, DOI: 10.1007/s00126-013-0492-1.
75. Parker S.R., Darvis M.N., Poulson S.R., Gammons C.H., Stanford J.A. (2014) Dissolved oxygen and dissolved inorganic carbon stable isotope composition and concentration fluxes across several shallow floodplain aquifers. *Biogeochemistry* 117, 539-552, DOI:10.1007/s10533-013-9899-0.
74. Gammons C.H., Pape B.L., Parker S.R., Poulson S.R., Blank C. (2013) Geochemistry, water balance, and stable isotopes of a "clean" pit lake at an abandoned tungsten mine, Montana, USA. *Appl. Geochem.* 36, 57-69.
73. Shaw G.E. White E., Gammons C.H. (2013) Characterizing groundwater-lake interactions and its impact on water quality. *Journal of Hydrology* 492, 69-78.
72. Gammons C.H., Brown A., Poulson S.R., and Henderson T. (2013) Using stable isotopes (S, O) of sulfate to track contamination of the Madison karst aquifer, Montana, from coal mine drainage. *Applied Geochemistry* 31, 228-238.
71. Parker S. R., C. H. Gammons, M. G. Smith, S. R. Poulson (2012) Behavior of stable isotopes of dissolved oxygen, dissolved inorganic carbon and nitrate in groundwater at a former wood treatment facility containing hydrocarbon contamination. *Applied Geochemistry* 27, 1101-1110.

70. Smith M.G., Parker S.R., Gammons C.H., Poulson S.R., Hauer F.R. (2011) Tracing dissolved O<sub>2</sub> and dissolved inorganic carbon stable isotope dynamics in the Nyack aquifer: Middle Fork Flathead River, Montana, USA. *Geochimica Cosmochimica Acta* 75, 5971-5986.
69. Nimick D.A., Gammons C.H. (2011) Diel biogeochemical processes in terrestrial waters: Preface to the Special Issue. *Chemical Geology*, 283, 1-2.
68. Nimick D.A., Gammons C.H., Parker S.R. (2011) Diel biogeochemical processes and their affect on the aqueous chemistry of streams: A review. *Chemical Geology*, 283, 3-17.
67. Gammons C.H., Babcock J., Parker S.R., Poulson S.R. (2011) Diel cycling and stable isotopes of dissolved oxygen, dissolved inorganic carbon, and nitrogenous species in a stream receiving treated municipal sewage. *Chemical Geology*, 283, 44-55.
66. Gammons C.H., Sotendahl J., and Everett D. (2010) Secondary enrichment of copper at the Madison Gold skarn deposit, Silver Star district, Montana. *Northwest Geology*, v. 39, 15-24.
65. Parker S.R., Gammons C.H., Poulson S.R., DeGrandpre M.D., Weyer C.L., Smith M.G., Babcock J.N., Oba Y. (2010) Diel behavior of stable isotopes of dissolved oxygen and dissolved inorganic carbon in rivers over a range of trophic conditions, and in a mesocosm experiment. *Chemical Geology* 269, 22-32.
64. Gammons C.H., Duaiame T.E., Parker S.R., Poulson S.R., Kennelly P. (2010) Geochemistry and stable isotope investigation of acid mine drainage associated with abandoned coal mines in central Montana, USA. *Chemical Geology* 269, 100-112.
63. Petriz K.M., Gammons C.H., and Nordwick S. (2009) Evaluation of the potential for beneficial use of contaminated water from a flooded mine shaft in Butte, Montana. *Mine Water and The Environment* 28, 264-273.
62. Kill Eagle J.L., Gammons C.H., Weight W.D., Babcock J., Jepson W., and Langner H. W. (2009) Results and lessons learned from a continuous tracer injection test in a small mountain stream receiving acid mine drainage. *Mine Water and The Environment* 28, 182-193.
61. Gammons C.H., Snyder D.M., Poulson S.R., and Petriz, K. (2009) Geochemistry and stable isotopes of the flooded underground mine workings of Butte, Montana. *Economic Geology*, v. 104, 1213-1234.
60. Gammons C.H., Nimick D.A., Parker S.R., Snyder D.M., McCleskey R.B., Amils R., Poulson S.R. (2008) Photoreduction fuels biogeochemical cycling of iron in Spain's acid rivers. *Chemical Geology* 252, 202-213.
59. Gammons C.H., Parker S.R., Pedrozo F. (2008) The Rio Agrio Basin, Argentina: A natural analog to watersheds affected by acid mine drainage. *Mining Engineering* 60(4), 74-78.
58. Parker S.R., Gammons C.H., Pedrozo F., Wood S.A. (2008) Diel changes in metal concentrations in a geogenically acidic river: Rio Agrio, Argentina. *Journal of Volcanology Geothermal Research* 178, 213-223.
57. Gammons C.H., T.M. Grant, D.A. Nimick, S.R. Parker, M.D. DeGrandpre (2007) Diel changes in water chemistry in an arsenic-rich stream and treatment-pond system. *Science of the Total Environment* 384, 433-451.
56. Roesler A.J., Gammons C.H., Druschel G.K., Oduro H., and Poulson S.R. (2007) Geochemistry of flooded underground mine workings influenced by bacterial sulfate reduction. *Aquatic Geochemistry* 13, 211-235.
55. Yu Y., Zhu Y., Gao Z., Gammons C.H., and Li D. (2007) An experimental study of arsenopyrite oxidation at pH 1.8 to 10.1 and 15 to 45°C. *Environmental Science and Technology* 41, 6460-6464.
54. Gammons C.H., Milodragovich L., and Belanger-Woods J. (2007) Influence of diurnal cycles on monitoring of metal concentrations and loads in streams draining abandoned mine lands: an example from High Ore Creek, Montana. *Environmental Geology* 53, 611-622.
53. Parker S.R., Gammons C.H., Poulson S.R., and DeGrandpre M.D. (2007) Diel changes in stream chemistry and isotopic composition of dissolved inorganic carbon, upper Clark Fork River, Montana, USA. *Applied Geochemistry* 22, 1329-1343.
52. Chapin T., Nimick D.A., Wanty R.B. and Gammons C.H. (2007) Diel cycling of zinc in a stream impacted by acid rock drainage: initial results from a new in-situ Zn analyzer. *Environmental Monitoring and Assessment*, 133, 161-167.
51. Nimick D.A., McCleskey R.B, Gammons C. H., Cleasby T.E., Parker S.R. (2007) Diel mercury concentrations cycles in streams affected by mining and geothermal discharge. *Science of the Total Environment*, 373, 344-355.
50. Parker S.R., Gammons C.H., Jones C. A., and Nimick D.A. (2007) Role of hydrous iron and aluminum oxide formation in attenuation and diel cycling of dissolved trace metals in an ARD-affected stream. *Water Air and Soil Pollution* 181, 247-263.
49. Gammons C.H. and Madison J.P. (2006) Contaminated alluvial groundwater in the Butte Summit Valley. *Mine Water and the Environment* 25(2), 124-129.
48. Gammons C.H. and Duaiame T.E. (2006) Long-term changes in the geochemistry and limnology of the Berkeley pit-lake, Butte, Montana. *Mine Water and the Environment* 25(2), 76-85.

47. Gammons C.H., Metesh J.J. and Duaiame T.E. (2006) An overview of the mining history and geology of Butte, Montana. *Mine Water and the Environment* 25(2), 70-75.
46. Gammons C.H., Metesh J.J., and Snyder, D.M. (2006) A survey of the geochemistry of flooded mine shaft water in the Butte District, Montana. *Mine Water and the Environment* 25(2), 100-107.
45. Twidwell L., Gammons C.H., Young C., and Berg R. (2006) Deepwater sediment/pore water characterization of the metal-laden Berkeley pit lake in Butte, Montana. *Mine Water and the Environment* 25(2), 86-92.
44. Gammons C.H. (2006) Geochemistry of perched water in an abandoned underground mine, Butte, Montana. *Mine Water and the Environment* 25(2), 114-123.
43. Gammons C.H., Poulson S.R., Pellicori D.A., Roesler A., Reed P.J., Petrescu E.M. (2006) The hydrogen and oxygen isotopic composition of precipitation, evaporated mine water, and river water in Montana, USA. *Journal of Hydrology* 328, 319-330.
42. Shope C.L., Xie Y., and Gammons C.H. (2006) The influence of hydrous Mn-Zn oxides on diel cycling of Zn in an alkaline stream draining abandoned mine lands. *Applied Geochemistry* 21, 476-491.
41. Wood S.A., Gammons C.H., and Parker S.R. (2006) The behavior of REE in naturally and anthropogenically acidified waters. *Journal of Alloys and Compounds* 418, 161-165.
40. Gammons C.H., Slotton D.G., Gerbrandt B., Weight W., Young C.A., McNearny R.L., Cámac E., Calderon R. and Tapia H. (2006) Mercury concentrations in fish, water, and stream sediment in the Rio Ramis-Lake Titicaca watershed, Peru. *Science of the Total Environment*, 368 (2-3), 637-648.
39. Pellicori D.A., Gammons C.H., and Poulson S.R. (2005) Geochemistry and stable isotope composition of the Berkeley pit lake and surrounding mine waters, Butte, Montana. *Applied Geochemistry* 20, 2116-2137.
38. Parker S.R., Poulson S.R., Gammons C.H., and DeGrandpre M. (2005) Biogeochemical controls on diel cycles in the stable isotopic composition of dissolved O<sub>2</sub> and DIC in the Big Hole River, Montana, USA. *Environmental Science and Technology* 39 (18): 7134-7140.
37. Gammons C. H., Wood S. A., Pedrozo F., Varekamp J., Nelson B., Shope C. L., and Baffico, G. (2005) Hydrogeochemistry and rare earth element behavior in a volcanically acidified watershed in Patagonia, Argentina. *Chemical Geology* 222, 249-267.
36. Gammons C.H., Wood S.A. and Nimick D.A. (2005) Diel behavior of rare earth elements in a mountain stream with acidic to neutral pH. *Geochim. Cosmochim. Acta* 69, 3747-3758.
35. Gammons C.H., Nimick D.A., Parker S.R., Cleasby T.E. and McCleskey, R.B. (2005) Diel behavior of Fe and other heavy metals in a mountain stream with acidic to neutral pH: Fisher Creek, Montana, USA. *Geochim. Cosmochim. Acta* 69, 2505-2516.
34. Cetiner Z.S., Wood S.A. and Gammons C.H. (2005) The aqueous geochemistry of the rare earth elements: Part XIV. The solubility of rare earth element phosphates from 23 to 150°C. *Chemical Geology* 217, 147-169.
33. Gammons C.H., Shope C.L., and Duaiame T.E. (2005) A 24-hour investigation of the hydro-geochemistry of storm water and baseflow in an urban area impacted by mining: Butte, Montana. *Hydrological Processes* 19, 2737-2753.
32. Gammons C.H., Poulson S.R., Metesh J.J., Duaiame T.E., and Henne A.R. (2003) Geochemistry and isotopic composition of H<sub>2</sub>S-rich flooded mine waters, Butte, Montana. *Mine Water and The Environment*, Vol. 22, 141-148.
31. Nimick D.A., Gammons C.H., Cleasby T.E., Madison J.M., Skaar D., and Brick C.M. (2003) Diel cycles in dissolved metal concentrations in streams: occurrence and possible causes. *Water Resources Research* 39, 1247. DOI: 10.1029/WR001571.
30. Gammons C.H., Wood S.A., Jonas J.P. and Madison J.P. (2003) Geochemistry of rare earth elements and uranium in the acidic Berkeley Pit lake, Butte, Montana. *Chemical Geology*, 198, 269-288.
29. Gammons C.H. and Matt D.O. (2002) Using fluid inclusions to help unravel the origin of hydrothermal talc deposits in southwest Montana. *Northwest Geology* v. 31, p. 44-53.
28. Gammons C.H., Wood S.A., and Li Youning (2002) Complexation of the rare earth elements with aqueous chloride at 200°C and 300°C and saturated water vapor pressure. In R. Hellmann and S.A. Wood, editors, Water-rock Interaction, Ore Deposits, and Environmental Geochemistry: A tribute to David A. Crerar. *Geochemical Society, Special Publication* No. 7, 191-207.
27. Newbrough P. and Gammons C.H. (2002) Experimental investigation of water-rock interaction and acid mine drainage at Butte, Montana. *Environmental Geology* 41(6), 705-719.
26. Gammons C.H. and Frandsen A.K. (2001) Fate and transport of metals in H<sub>2</sub>S-rich waters at a treatment wetland. *Geochemical Transactions*, Vol.2, 1-15.
25. Gammons C.H., Mulholland T.P., and Frandsen A.K. (2000) Comparison of filtered vs. unfiltered metal concentrations in aerobic and anaerobic treatment wetlands. *Mine Water and the Environment* 19: 111-123.

24. Gammons C.H. and Wood S.A. (2000) The aqueous geochemistry of REE. Part 8: Solubility of ytterbium oxalate and the stability of Yb(III)-oxalate complexes in water at 25° to 80°C. *Chemical Geology* 166, 103-124.

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Items listed below this line were for work done prior to Montana Tech

23. Hezarkhani A., Williams-Jones A.E., and Gammons C.H. (1999) Factors controlling copper solubility and chalcopyrite deposition in the Sungun porphyry copper deposit, Iran. *Mineralium Deposita* 34, 770-783.
22. Xiao Z., Gammons C.H. and Williams-Jones A.E. (1998) Experimental study of copper(I) chloride complexing in hydrothermal solutions at 40°C to 300°C and saturated vapor pressure *Geochim. Cosmochim. Acta.* 62, 2949-2964.
21. Gammons C.H. and Yu Y. (1997) The stability of silver bromide and iodide complexes at 25° to 300°C: Experiments, theory and geologic applications. *Chem. Geology* 137, 155-173.
20. Gammons C.H. (1997) Thermochemical sulfate reduction: a key step in the origin of sediment-hosted disseminated gold deposits. in (P. Vikre, T. B. Thompson, K. Bettles, O. Christensen, and R. Parratt, eds.), Carlin-type Gold Deposits Field Conference. Soc. Econ. Geol. Guidebook Series, Vol. 28, p. 141-146.
19. Gammons C.H. and Williams-Jones A.E. (1997) Chemical mobility of gold in the porphyry-epithermal environment. *Economic Geology* 92, 45-59.
18. Gammons C.H., Yu Y. and Williams-Jones A.E. (1997) The disproportionation of Au(I) chloride complexes at 25° to 150°C. *Geochim. Cosmochim. Acta* 61, 1971-1984.
17. Gammons C.H. and Seward T.M. (1996) The stability of manganese(II) chloride complexes at 25° to 300°C. *Geochim. Cosmochim. Acta* . 60, 4295-4311.
16. Gammons C.H., Wood S.A. and Williams-Jones A.E. (1996) The aqueous geochemistry of the rare earth elements. V. Stability of neodymium-chloride complexes to 300°C *Geochim. Cosmochim. Acta* . 60, 4615-4630.
15. Olivo G. and Gammons C.H. (1996) Thermodynamic and textural evidence for at least two stages of Au-Pd mineralization at the Cauê iron ore mine, Minas Gerais, Brazil. *Canadian Mineralogist.* 34, 547-557.
14. Gammons C.H. (1996) Experimental investigations of the hydrothermal geochemistry of Pt and Pd. V. Equilibria between Pt metal, Pt(II) and Pt(IV) chloride complexes at 25° to 300°C. *Geochim. Cosmochim. Acta* . 60, 1683-1694.
13. Gammons C.H. (1996) Hydrothermal synthesis of gold grains with apparent five-fold symmetry. *Canadian Mineralogist* 34, 1-8.
12. Yu Y., Gammons C.H., Mo D. and Wang M. (1995) Hydrothermal experiments using metallic alloy - a methodological investigation. *Acta Mineral. Sinica* 15, 55-60 [in Chinese].
11. Yu Y. and Gammons C.H. (1995) Controls on the fineness of gold in precious metal deposits. *Science in China, Series B*, 25, 412-417 [in Chinese].
10. Gammons C.H. and Williams-Jones A.E. (1995) Solubility of Au-Ag alloy + AgCl in HCl/NaCl solutions at 300°C: new data on the stability of Au(I) chloride complexes. *Geochim. Cosmochim. Acta.* 59, 3453-3468.
9. Gammons C.H. and Williams-Jones A.E. (1995) Hydrothermal geochemistry of electrum: Thermodynamic constraints. *Economic Geology* 90, 420-432.
8. Gammons C.H. (1995) Experimental investigations of the hydrothermal geochemistry of Pt and Pd. IV. Stoichiometry of Pt(IV) and Pd(II) chloride complexes to 300°C. *Geochim. Cosmochim. Acta* . 59, 1655-1668.
7. Renders P.J., Gammons C.H. and Barnes H.L. (1995) Precipitation and dissolution rate constants for cristobalite from 150 to 300°C. *Geochim. Cosmochim. Acta.* 59, 77-85.
6. Yu Y. and Gammons C.H. (1994) An experimental study on the stability of chloride complexes of platinum and palladium at 300°C. *Geological Review* 40, 354-360 [in Chinese].
5. Gu Y., Gammons C.H. and Bloom M.S. (1994) A one-term extrapolation method for estimating equilibrium constants of aqueous reactions at elevated temperatures. *Geochim. Cosmochim. Acta* . 58, 3545-3560.
4. Gammons C.H. and Bloom M.S. (1993) Experimental investigations of the hydrothermal geochemistry of Pt and Pd. II. Solubility of PtS and PdS in aqueous sulfide solutions to 300°C. *Geochim. Cosmochim. Acta* 57, 2451-2468.
3. Gammons C.H., Yu. Y. and Bloom M.S. (1993) Experimental investigations of the hydrothermal geochemistry of Pt and Pd. III. The solubility of Ag-Pd alloy + AgCl in NaCl/HCl solutions at 300°C. *Geochim. Cosmochim. Acta* 57, 2469-2480.
2. Gammons C.H., Bloom M.S. and Yu Y. (1992) Experimental investigations of the hydrothermal geochemistry of Pt and Pd. I. The solubility of Pt and Pd sulfides in NaCl/H<sub>2</sub>SO<sub>4</sub> solutions at 300°C. *Geochim. Cosmochim. Acta* 56, 3881-3894.
1. Gammons C.H. and Barnes H.L. (1989) The solubility of Ag<sub>2</sub>S in near-neutral aqueous sulfide solutions at 25 to 300°C: *Geochim. Cosmochim. Acta* 53, 279-290.

## **B: Peer-Reviewed Book Chapters**

7. Rodriguez A, Varekamp JC, van Bergen MJ, Kading TJ, Oonk P, Gammons CH, and Gilmore M (2015) Acid rivers and lakes at Caviahue-Copahue volcano as potential terrestrial analogues for aqueous paleo-environments on Mars. Chapter 7 in: Tassi F., Vaselli O., Caselli A.T. (Eds.) Copahue Volcano. Series: Active Volcanoes of the World. Springer, 33pp.
6. Smith K.S., McLemore V.T., Russell C.C., Todd A.S., Gusek J.J., Ford K.L., Caplan S., Gammons C.H., Kimball B.A., Kirk L.B., Moran P.B., Nimick D.A., Ramsey C.A., Wanty R.B., Wildeman T.R. (2014) Sampling considerations in the mining environment. Chapter 3 in Sampling and Monitoring for the Mine-Life Cycle, Society for Mining and Metallurgical Engineering (SME), 33-110.
5. Gammons C.H. and Tucci N.J. (2013) The Berkeley Pit Lake, Butte, Montana. Chapter 5.5 of Geller W., Schultze M., Kleinmann R., Wolkersdorfer C. (Eds.) Acidic Pit Lakes: The Legacy of Coal and Metal Surface Mines. Springer, New York, pp. 363-375.
4. Gammons C.H. and Tucci N. (2011) Monitoring the water quality of pit lakes. In McCullough C.D. ed., "Mine Pit Lakes: Closure and Management", Australian Centre for Geomechanics, Nedlands, Western Australia, ISBN 978-0-9870937-2-1, pp. 153-166.
3. Gammons C. H. (2009) Sampling and monitoring of pit lakes. Chapter 7 in Castendyk D.N. and Eary L.E. eds. Mine Pit Lakes: Characteristics, Predictive Modeling, and Sustainability. Society for Mining, Metallurgy, and Exploration, Littleton, CO, pp. 77-90.
2. Gammons C. H. (2009) Sub-aqueous oxidation of pyrite in pit lakes. Chapter 12 in Castendyk D.N. and Eary L.E. eds. Mine Pit Lakes: Characteristics, Predictive Modeling, and Sustainability. Society for Mining, Metallurgy, and Exploration, Littleton, CO, pp. 137-147.
1. Gammons C. H. (2008) Water chemistry sampling. Chapter 7 in Weight, W.D., Hydrogeology Field Manual, 2<sup>nd</sup> edition, McGraw-Hill, pp. 287-320.

## **C: Other Papers, Reports, and Conference Proceedings**

64. Kaplan J. M. and Gammons C.H. (2017) Field trip to the Madison Au-Cu deposit, Silver Star, Montana. Proc. MBMG Mines and Minerals Symposium, October, 2017, in press.
64. Schubert B. and Gammons C. H. (2017) New mineralogy, fluid inclusion, and S-isotope data for the Heddleston porphyry Cu-Mo deposit, Montana. Proc. MBMG Mines and Minerals Symposium, October, 2017, in press.
63. Gammons C.H. and Allin N.C. (2017) Stability of Fe(III) chloride complexes and hematite solubility to 300°C: Applications to the origin of IOCG deposits. Proc. 2017 SGA Meeting, Quebec City, August, 2017, 4pp.
62. Allin N.C. and Gammons C.H. (2017) Reduction of arsenite and sulfate by elemental copper, nickel and cobalt: implications to the formation of arsenide minerals in low temperature hydrothermal deposits. Proc. 2017 SGA Meeting, Quebec City, August, 2017, 4pp.
61. Gammons C.H. and Gnanou H. (2016) Preliminary mineralogy and sulfur-isotope investigation of the Apex deposit. Unpubl. report for Barrick Gold, 22pp.
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98. Williams R.D., Shaw S., Jepson W.E., Gammons C.H., and Kill Eagle J. (2009) Zortman-Landusky: Challenges in a decade of closure. Geol. Soc. Amer., Abstr. Prog. 41(7), 558.
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95. Nimick D.A., Gammons C. H., Berkas W.R., Cleasby T.E. (2009) A biological cause for large mid-summer diel streamflow cycles, upper Big Hole River, Montana. Geol. Soc. Amer., Abstr. Prog. 41(7), 198.
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93. Babcock J.N. and Gammons C. H. (2009) Diel cycles of nutrients and metals in a hypereutrophic stream, Silver Bow Creek, Montana. Geol. Soc. Amer., Abstr. Prog. 41(7), 198.
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85. Parker S.R., Gammons C.H., Poulson S.R. (2008) Diel behavior of stable isotopes of dissolved oxygen and inorganic carbon in rivers. Proc. 2008 V.M. Goldschmidt Conf., Vancouver, B.C., *Geochimica Cosmochimica Acta* 72(12), A723.
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83. Petritz K., Gammons C. H., Nordwick S., Zaluski M., Lewis N., Manchester K. (2007) Resource recovery from flooded underground mine workings – Butte, Montana. Proc. PNWIS 2007 Conference, Boise Idaho, Oct. 17-19, 2007.
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66. Wood S. A., Gammons C. H., and Parker S. R. (2005) The behavior of REE in naturally and anthropogenically acidified waters. Proc. 24<sup>th</sup> Int. Conf. on Rare Earth Element Research.
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56. \*Gammons C. H. (2004) Geochemistry of the Berkeley pit-lake, Butte Montana: Analogy to Lago Caviahue? [Abstract] *International Conference on Geogenically Acidic Water Systems: Volcanic Waters, Mining Lakes, and Rivers: Caviahue, Argentina, March 12-13, 2004.*
55. \*Gammons C. H., Wood S. A. and Pedrozo F. (2004) Hydrogeochemistry of rare earth elements in Rio Agrio and Lago Caviahue. [Abstract] *International Conference on Geogenically Acidic Water Systems: Volcanic Waters, Mining Lakes, and Rivers: Caviahue, Argentina, March 12-13, 2004.*
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41. \*Gammons C. H. and Matt D. O. (2002) Using fluid inclusions to unravel the origin of hydrothermal talc mineralization in SW Montana. Annual Meeting of the Tobacco Root Geological Society, Virginia City, MT, August 2002.
40. Wenz A., Gammons C. H., and Ridenour R. (2001) Diurnal fluctuations in pH, dissolved oxygen and other parameters in the Big Hole River and its tributaries. [abstract] 18th Annual Montana Water Conference, Amer. Water Resources Assoc., Missoula, MT, Oct. 2001.
39. Ridenour R. and Gammons C. H. (2001) Seasonal water quality monitoring along the Big Hole River, Southwest Montana, 2000-2001. [abstract] 18th Annual Montana Water Conference, Amer. Water Resources Assoc., Missoula, MT, Oct. 2001.
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35. Newbrough P. and Gammons C. H. (2000) Acid rock drainage on Butte Hill: A tale of two pits. Proc. American Water Resources Assoc., Montana Section, West Yellowstone, Oct. 2000.
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33. \*Gammons C. H. and Wood S. A. (2000) Rare earth element geochemistry in the acidic Berkeley Pit lake. Geol. Soc. Amer., Rocky Mountain Section. Missoula, MT, April, 2000.
32. Frandsen A. K. and Gammons C. H. (2000) Heavy metal complexation with aqueous sulfide in an anaerobic treatment wetland. Geol. Soc. Amer., Missoula, MT, April, 2000.
31. Jonas J. and \*Gammons C. H. (2000) Iron cycling in the Berkeley pit-lake, Butte, MT. Geol. Soc. Amer., Rocky Mountain Section. Missoula, MT, April, 2000.
30. Olivo G. R. and Gammons C. H. (2000) Palladium and gold remobilization during supergene alteration of the jacutinga ore in the Itabira District, Minas Gerais, Brazil. 31st International Geological Congress, Rio de Janeiro, August 6-17, 2000, p. C-36.
29. \*Gammons C. H. and Phillip A. (1999) Water quality of irrigation return flows, Big Hole River Basin, SW Montana (abstract). Amer. Water Resources Assoc., Great Falls, MT, Oct. 1999.
28. Gammons C. H. (1999) Complexation of heavy metals with aqueous sulfide in an anaerobic treatment wetlands, Butte, Montana. *V. M. Goldschmidt Conf.*, Harvard Univ., Aug., 1999.
27. Phillip A., \*Gammons C. H. and Marvin, R. K. (1999) Changes in water quality due to flood irrigation, Big Hole River, Southwest Montana. Rocky Mountain Section of Geol. Soc. America. April, 1999, Pocatello Idaho.
26. Xiao Z., Gammons C. H. and Williams-Jones A. E. (1999) Partitioning of copper chloride between solid and NaCl-H<sub>2</sub>O vapor at 360C. Proceed. 1999 GAC-MAC annual meeting.

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Items listed below this line were for work done prior to Montana Tech

25. Xiao Z., Gammons C. H. and Williams-Jones A. E. (1997) An experimental study of copper chloride complexing at temperatures from 40°C to 300°C and saturated vapor pressure. Proceed. 1997 GAC-MAC annual meeting, Ottawa, p. A60.
24. \*Gammons C. H., Xiao Z. and Williams-Jones A. E. (1996) Solubility of copper and gold in magmatic-epithermal systems. Geol. Soc. Amer., Abstr. Prog. 28(7), p. A402.

23. \*Gammons C. H. and Williams-Jones A. E. (1996) Solubility of gold in cooling orthomagmatic fluids. 1996 GAC-MAC annual meeting, Winnipeg, Manitoba.
22. \*Gammons C. H. (1996) Synthesis and origin of large gold crystals with decahedral (pentagonal dipyramid) morphology. 1996 GAC-MAC annual meeting, Winnipeg.
21. \*Gammons C. H. and Williams-Jones A. E. (1995) The use of binary alloys in solubility experiments. *Proc. V. M. Goldschmidt Conf.*, Penn State Univ., PA, May, 1995.
20. \*Gammons C. H., Williams-Jones A. E. and Wood S. A. (1995) Stability of Nd-chloride complexes at elevated temperature. *Geol. Soc. Amer. Abstr. Prog.*, 1995 annual meeting.
19. \*Gammons C. H. (1995) Hydrothermal synthesis of gold crystals with apparent five-fold symmetry. *Proc. V. M. Goldschmidt Conf.*, Penn State Univ., PA, May, 1995.
18. \*Gammons C. H. and Williams-Jones A. E. (1994) Solubility of Au-Ag alloys in hydrothermal brines. 1994 GAC-MAC annual meeting, Waterloo, Ontario.
17. \*Gammons C. H. and Seward T. M. (1993a) Experimental investigations of the hydrothermal chemistry of manganese. *Proceedings of the 4th International Hydrothermal Reactions Symposium*, 8/93, Nancy, France, 57-60.
16. \*Gammons C. H. and Seward T. M. (1993b) Stability of Mn(II) chloride complexes in hydrothermal fluids. Spring AGU meeting, Baltimore, Md.
15. Snee L. W., Lund K., Evans K.V., Gammons C. H. and Kunk M. J. (1991)  $^{40}\text{Ar}/^{39}\text{Ar}$  thermochronology of fracture-controlled mineral deposits of the Idaho batholith - age, thermal history, and origin (extended abstract): 1991 McKelvey Conference.
14. \*Gammons C. H. and Bloom M. S. (1990) Experimental investigations of the stability and stoichiometry of Pd(II), Pt(II) and Pt(IV) chloride complexes to 300°C: *Geol. Soc. Amer., Abstr. with Prog.*, 22(7), p. 158.
13. \*Gammons C. H. (1990) Factors controlling the composition of electrum in precious metal deposits: *10th Australian Geological Convention*, 2/90, Hobart, Australia.
12. \*Gammons C. H., Barnes H. L. and Soong C. (1988) Precipitation and dissolution kinetics of cristobalite under hydrothermal conditions: *Geol. Soc. Amer., Abstr. Prog.*, 20(7).
11. \*Gammons C. H., Shenberger D. M. and Barnes H. L. (1988) Role of electrum in the hydrothermal transport and deposition of gold and silver: *V. M. Goldschmidt Conference*, 5/88.
10. Barnes H. L., Gammons C. H. and Shenberger D. M. (1988) Comparison of silver and gold solubilities to 350°C (extended abstract): *Conference on Experimental Investigations of Hydrothermal Processes*, 2/88, Montreal, Quebec.
9. Shenberger D. M., Gammons C. H. and Barnes H. L. (1988) The solubility of gold and silver in aqueous sulfide solutions. *V.M. Goldschmidt Conf.*, 5/88, Balt. Md.
8. Barnes H. L. and Gammons C. H. (1988) The hydrothermal kinetics of cristobalite. *Proc. Internat. Congress of Geochemistry and Cosmochemistry*, 8/88, Paris, France. *Chemical Geology* 70, p. 76.
7. Rose A. W., Kuehn C. A., Shenberger D. M. and Gammons C. H. (1988) Geochemistry and origin of hydrothermal fluids having high Au/Ag, low base-metal gold deposits of Carlin, greenstone and related types. *V. M. Goldschmidt Conference*, 5/88, Balt. Md.
6. \*Gammons C. H., Barnes H. L. and Soong C. (1988) Precipitation and dissolution kinetics of cristobalite under hydrothermal conditions. *Geol. Soc. Amer., Abstr. with Prog.* 20(7), p. 40.
5. \*Gammons C. H. and Barnes H. L. (1987) Stability of silver-bisulfide complexes under hydrothermal conditions: applications to metal transport in geothermal systems: *Geol. Soc. Amer., Abstr. with Prog.* 19(7).
4. \*Gammons C. H., Rose A. W., Snee L. W. and Lund K. (1985) Paragenesis, fluid inclusions, and Ar-dating of the Big Creek mining district, Valley County, Idaho: *Geol. Soc. Amer., Abstr. with Prog.* 17(7), p.588.
3. Dresel P.E., Rose A.W., Gammons C. H. (1985) Geochemistry and origin of brines from western Pennsylvania: *Geol. Soc. Amer. Abstr. with Programs* 17(7), p. 567.
2. Snee L. W., Lund K. and Gammons C. H. (1985) Mineralization history of the central Idaho Batholith; importance of fracture-controlled Cretaceous activity: *Geol. Soc. Amer. Abstr. with Programs* 17(4), p. 265-266.
1. Carter A. S., Ebinger E. J., \*Gammons C. H., Proust R. D. and Rudnick B. (1980) Bedrock geology of a portion of the Poland 15' quadrangle, Maine. *The Maine Geologist* 6(3), p. 2.

### **Workshops/Short Courses Delivered**

9. "Geochemistry of nitrate and other N-compounds in mining-influenced waters". Invited presentation for Goldcorp Corporation: Safety, Environment, CSR and Security Summit, Hollywood, Florida, March 18, 2014.
8. "Monitoring the water quality of pit lakes". Invited presentation for a workshop entitled "Pit Lakes and Mine Closure: Design and Management", Lake Louise, Alberta, Sept. 17-18, 2011.
7. "What is pH?". Invited workshop presentation for Graymont Lime, Inc., Townsend, MT, May, 2011.

6. "Diel cycling of trace metals in streams draining abandoned mine lands". Invited speaker for SEG workshop entitled: "Environmental Geochemistry for Modern Mining", Denver, CO, Oct. 2010.
5. "Diurnal cycling of chemical constituents in surface water and related media – scientific and regulatory considerations". Invited speaker and co-organizer of workshop, Trenton, N.J., Dec. 12, 2008.
4. "Field Methods". Invited presentation for a workshop on "Irrigation Management in Transitioning Western Landscapes". 2007 Annual Montana Water Conference, Livingston, MT, Oct. 2007.
3. "Geochemistry of the Berkeley Pit Lake, Butte, Montana". Invited presentation for 13<sup>th</sup> Annual British Columbia MEND ML/ARD Workshop, Vancouver, Canada, Nov. 29, 2006.
2. "Geochemistry of the Flooded Underground Mines of Butte". Invited presentation for 13<sup>th</sup> Annual British Columbia MEND ML/ARD Workshop, Vancouver, Canada, Nov. 30, 2006.
1. "Clark Fork River, Groundwater Quality Concerns". Invited presentation for a workshop on Managing Clark Fork River Basin Ground Water, Missoula, MT, Sept. 27, 2006.

### **Research Grants (\* denotes that I am the PI of the grant)**

#### **Grants awarded [Total grant money awarded 1997-2016: ~ \$2.89 million]**

- 2017: \*Montana NRDP: "Using pore water diffusion samplers to investigate metal loading from stream sediment in Blacktail Creek and Lower Area One". \$37,425
- 2017: \*Barrick Minerals: "Geochemical and mineralogical studies of the Apex gold deposit". \$8,000.
- 2016: Office of Surface Mining: "Developing an isotopic fingerprint of acid mine drainage to identify underground controls on groundwater flow paths" [with PI Shawn Kuzara, MBMG-Billings], \$199,954.
- 2016: \*NSF#1624420 "Solubility of Iron Oxides and Gold in Acidic Hydrothermal Brines: Applications to the Origin of Iron Oxide Copper-gold Deposits". \$115,905.
- 2016: \*Montana DEQ: "MAS summer stream sampling, 2016" \$45,980
- 2016: \*NSF-EPSCoR: "Seasonal changes in gradients in water column and sediment geochemistry and microbial community structure and diversity in Georgetown Lake" [with Alysia Cox, co-PI]. \$21,000
- 2015: \*Montana DEQ: "MAS summer stream sampling, 2015" \$44,325
- 2015: \*Montana NRDP: "Mineralogy and environmental geochemistry of slag in Lower Area One, Butte". \$13,000
- 2014: \*Tintina Resources: "Using Sr-isotopes and other methods to better understand the genesis of the Black Butte stratiform Cu deposits". \$7,177.
- 2014: \*MT Tech Faculty Development Grant: "Exploring new methods to remove nitrogenous compounds from mine wastewater". \$7,000.
- 2014: \*NSF-EPSCoR: "Year 3: Microbial contributions to C/N cycling and transport" \$26,000
- 2013: NSF-Major Research Instrumentation: "RUI and MRI: Acquisition of a Picarro Carbon Isotope Analyzer" [with Steve Parker, PI]. \$186,000
- 2013: \*BP-ARCO: "Biogeochemical cycling of arsenic in Warm Springs Ponds: Phase II". \$57,000 Jan. 1, 2013 through Dec. 31, 2014.
- 2013: NSF-EPSCoR: "Microbial contributions to C/N cycling and transport" [with Tim McDermott and John Dore, MSU] \$25,000.
- 2012: NSF-EPSCoR: "Seasonality and sources of recharge water to the Nyack floodplain in relation to rates of biogeochemical processes and ecosystem function". [with Steve Parker, PI] \$29,500.
- 2012: \*NSF-EPSCoR: "Linking microbial processes to landscape-scale trace gas fluxes via hydrologic controls on soil chemistry in a forested montane ecosystem". [with John Dore, MSU, PI] \$58,000.
- 2012: \*BLM: "Judith Mountains Acid Rock Drainage Characterization: Year 2". [with Steve Parker, MT Tech] \$34,990, Oct-2012 to Sept 2013.
- 2011: \*BLM: "Judith Mountains Acid Rock Drainage Characterization: Supplemental Funding". [with Steve Parker, MT Tech] \$5,300, Oct-2011 to Dec. 2012.
- 2011: \*BLM: "Judith Mountains Acid Rock Drainage Characterization". [with Steve Parker, MT Tech] \$34,290, Oct-2011 to Sept. 2012.
- 2011: \*Tintina Gold Exploration: "Paragenesis and mineralogy of the Sheep Creek stratiform Cu-Co deposit, Montana" \$7,000, Jan 2011 through May 2012.
- 2010: \*RX Exploration: "Economic geology of the Drumlummon and surrounding mines, Marysville District, Montana". \$10,000, Dec. 2010 through May 2012.
- 2010: \*Newmont Mining: "Modeling groundwater flow in the upper plate bedrock aquifer of the Tuscarora Mountains, Nevada". [With Glenn Shaw, MT Tech] \$48,143, Dec. 2010 through May 2012.
- 2010: \*BP-ARCO: "Biogeochemical cycling of arsenic in Warm Springs Ponds". \$95,000. June 1, 2010 through Sept. 30, 2011.

- 2009: \*Montana NRD: "Installation of a monitoring well field on the reclaimed Silver Bow Creek floodplain". \$5000, Aug. 1 2009 to July 31, 2012.
- 2008: NSF-EAR0739054: "Stable isotopes of dissolved oxygen as tracers of chemical and biological processes in groundwater". \$177,297, April 1, 2008 to March 31, 2010. [With Steve Parker, MT Tech]
- 2006: \*USGS-104b: "Temporal and spatial changes in the concentration and isotopic composition of nutrients in the upper Silver Bow Creek drainage, Montana: Year 2". \$7,000, March 1, 2007 to Dec. 31, 2008.
- 2006: EPA-DOE "Radionuclides in mine-impacted waters within the Boulder Batholith, Montana". \$70,000, Jan. 1, 2007 to Dec. 31, 2007. [With Willis Weight, MT Tech]
- 2005: \*EPA-DOE: "Vertical gradients in biogeochemistry of flooded mine shafts in the Butte, Montana flooded mine complex". \$50,000, Jan. 1, 2005 to Dec. 31, 2005.
- 2005: \*USGS-104b: "Temporal and spatial changes in the concentration and isotopic composition of nitrate in the upper Silver Bow Creek drainage, Montana". \$14,600, March 1, 2006 to Dec. 31, 2007.
- 2005: U.S. Dept. of State: "Geochemistry of the Rio Tinto: A Proposal for International Research and Collaboration with the University of Automona, Madrid, Spain". \$6,500
- 2005: US EPA: "Diel hydrogeochemistry of arsenic and other trace elements in Silver Bow Creek near the Warm Springs Ponds: A proposal for continued studies in 2005". \$9,000 [with David Nimick, USGS].
- 2003: \*EPA-DOE "Geochemistry and isotopic composition of H<sub>2</sub>S-rich water in flooded underground mine workings, Butte, Montana" \$60,000
- 2003: U.S. Dept. of State: "Environmental Geochemistry of the Rio Agrio: A Proposal for International Research and Collaboration with the Universidad Nacional del Comahue, Argentina, Project Extension" \$7,000.
- 2003: NSF: Hydrological Sciences Division "An autonomous freshwater pH sensor: Development and applications". \$300,000 [PI: Mike DeGrandpre, Univ. of Montana; co-PIs Johnnie Moore, U-M, Chris Gammons.]
- 2002: \*EPA-EPSCoR "Investigations into the origin of diel cycling of heavy metals in streams" \$280,000.
- 2002: Montana DEQ, 319 Grant "Big Hole River Quality and Quantity" \$5,000
- 2002: \*EPA-DOE "Subaqueous pyrite oxidation and stable isotope geochemistry of an acidic pit lake" \$50,000.
- 2002: \*USDA-FS "Hydrogeochemistry of a natural wetland receiving acid mine drainage" \$10,000
- 2002: \*BLM "Hydrogeological investigation of Indian Creek" \$23,000
- 2002: \*BLM "Hydrogeological investigation of Big Pipestone Creek" \$23,000
- 2002: \*BLM "Analytical support for hydrogeological investigations" \$5,000
- 2001: U.S. Dept. of State: "Environmental Geochemistry of the Rio Agrio: A Proposal for International Research and Collaboration with the Universidad Nacional del Comahue, Argentina" \$4,000.
- 2001: \*USAID: "Preliminary assessment of the impacts of active and abandoned mines on the water quality of the Rio Ramis watershed and Lake Titicaca, Peru" \$10,000.
- 2000: \*Big Hole River Foundation: "Diel changes in water quality, Big Hole River", \$3,000.
- 2000: \*EPA-DOE "Investigations of natural wetlands near abandoned mine sites, Montana". \$50,000
- 2000: \*Montana DEQ, 104B Grant: "Baseline investigation of seasonal water quality along the Big Hole River, Montana"; \$9,000.
- 1999: \*MONTS-NSF "Fluid inclusion study of hydrothermal talc deposits". \$25,000
- 1999: BLM: "Stream reference sites, Big Hole River Basin, SW Montana". \$25,000 [with Rich Marvin, Montana Bureau of Mines and Geology]
- 1998: \*EPA-DOE: "Water-rock interaction in the Berkeley Pit": \$50,000
- 1998: \*Big Hole River Foundation: "Changes in water quality due to flood irrigation": \$5,000
- 1997: \*NSF: Petrology and Geochemistry division: "Experimental determination of REE-complex stability constants and monazite solubilities in hydrothermal solutions": \$81,536
- 1997: \*Montana Tech Seed Grant. "Hydrothermal Workstation": \$5,000

## **Student Advising**

**Graduate theses supervised** (The following is a list of students for which I served or am presently serving as thesis advisor. NOTE: Montana Tech does not have a Ph.D. program)

- 1) Ping Wang (Montana Tech, Dept. of Chem & Geochem) M.S., 1998  
"Chemistry of dissolved, colloidal and precipitated metals in constructed wetlands, Butte, Montana"
- 2) Jiangwei Zhang (Montana Tech, Dept. of Chem & Geochem) M.S., 1998

- “Removal of metal contamination in water using constructed wetlands: summary of results from Cells #1, #4, and #6 of the Wetlands Demonstration Project 1”
- 3) Abbie Philip (Montana Tech, Dept. of Chem & Geochem) M.S., 1999  
“A chemical survey of irrigation and return flow waters in the Big Hole River Basin of Southwest Montana”
  - 4) Duane Matt (Montana Tech, Dept. of Geol. Engineering) M.S., 1999  
“Fluid inclusion study of the origin of the Cadillac talc deposit, Johnny Gulch, MT”
  - 5) Pamela Newbrough (Montana Tech, Dept of Geol. Engineering) M.S., 2000  
“Water-rock interaction and acid rock drainage of the Berkeley and East Continental Pits, Butte, Montana”
  - 6) Angela Frandsen (Montana Tech, Dept. of Env. Engineering) M.S., 2000  
“Fate and transport of heavy metals in sulfide-rich waters: applications to anaerobic treatment wetlands”
  - 7) Ying Xie (Montana Tech, Dept. of Env. Engineering) M.S., 2002  
“Experimental investigation of the causes of diel cycling of zinc in streams contaminated with acid mine drainage”
  - 8) Kim Mitman (Montana Tech, Dept. of Geol. Engineering) M.S., 2002  
“The potential for natural wetlands to remediate copper-contaminated water”
  - 9) Rebecca Ridenour (Montana Tech, Dept. of Chem & Geochem.) M.S., 2002  
“A seasonal and spatial chemical study of the Big Hole River, Southwest Montana”
  - 10) Adam Wenz (Montana Tech, Dept. of Chem & Geochem.) M.S., 2003  
“Field and laboratory studies of diurnal fluctuations in metals and nutrients in the Big Hole River, SW Montana”
  - 11) Chris Shope (Montana Tech, Dept. of Geol. Engineering) M.S., 2003  
“Field and laboratory investigation of the hydrogeochemistry of High Ore Creek, Basin, Montana”
  - 12) Lica Milodragovic (MT Tech, Dept. of Geol. Engineering) M.S., 2003  
“Hydrogeochemistry of the Ontario Mine wetland”
  - 13) Damon Pellicori (MT Tech, Dept. of Geol. Engineering) M.S., 2004  
“An investigation of the Berkeley pit-lake, Butte, Montana:  
1) Geochemistry and stable isotope compositions of mine waters;  
2) Pyrite oxidation experiments”
  - 14) Aaron Berger (MT Tech, Dept. of Geol. Engineering) M.S., 2004  
“Hydrology, water quality, and sediment transport rates in the Pipestone Creek watershed, Jefferson County, Montana”
  - 15) Jason Landskron (MT Tech, Dept. of Geol. Engineering) M.S., 2008  
“Hydrogeological investigation of Indian Creek, Montana”
  - 16) Amber Roesler (MT Tech, Dept. of Chemistry & Geochemistry) M.S., 2005  
“Geochemistry and stable isotope study of the West Camp groundwater extraction well, Butte, Montana”
  - 17) Stephen Parker (Univ. of Montana, Dept. of Chemistry) Ph.D., 2005  
“Investigations into the diel cycling of metals in streams”
  - 18) Tracy Grant (MT Tech, Dept. of Chemistry & Geochemistry) M.S., 2006  
“Hydrogeochemistry of arsenic and trace metals in lower Silver Bow Creek below Warm Springs Ponds, Montana”
  - 19) Dean Snyder (MT Tech, Dept. of Geol. Engineering) M.S., 2012  
“Vertical gradients in geochemistry of flooded underground mine workings in Butte, Montana.”
  - 20) Jane Fillmore (MT Tech, Dept. of Geol. Engineering) M.S., 2009  
“Hydrogeochemistry and possible remedial options for acid drainage from the Alta Mine, Jefferson County, Montana”
  - 21) Beverly Plumb (MT Tech, Dept. of Chemistry & Geochemistry) M.S., 2008  
“Geochemistry of nutrients in Silver Bow Creek, Butte, Montana”
  - 22) Keri Petritz (MT Tech, Dept. of Environmental Eng.) M.S., 2008  
“Chemistry and resource recovery potential of flooded mine water in the Belmont underground mine, Butte, Montana”
  - 23) John Babcock (MT Tech, Dept. of Geol. Engineering) M.S., in progress

- “Diel cycling of nutrients and metals in Silver Bow Creek”
- 24) John Kill Eagle (MT Tech, Dept. of Geol. Engineering) M.S., 2008  
 “Application of a continuous tracer injection test to investigate acid rock drainage in Swift Gulch, Little Rocky Mountains, Montana”
- 25) M. Garrett Smith (co-advised with Steve Parker, MT Tech, Dept. of Chemistry & Geochemistry) M.S., 2010  
 “Stable isotopes of O<sub>2</sub> and dissolved inorganic carbon in the Nyack aquifer”
- 26) Shawn Kuzara (MT Tech, Dept. of Geol. Engineering) M.S., 2011  
 “Groundwater-surface water interactions in the Stillwater River watershed, Montana”
- 27) Mike Peet (MT Tech, Dept. of Geol. Engineering) M.S., 2011  
 “Geologic structures in the Continental porphyry Cu-Mo deposit, Butte”
- 28) Jill Sotendahl (MT Tech, Dept. of Geological Engineering) M.S., 2012  
 “Mineralogy and genesis of the Madison Gold skarn deposit”
- 29) Tessa Saylor (MT Tech, Dept. of Geological Engineering) M.S., in progress  
 “In-situ reclamation of the Emma Mine tailings impoundment”
- 30) Amanda Griffith (MT Tech, Dept. of Geological Engineering) M.S., 2013  
 “Paragenesis and fluid inclusion study of the Drumlummon Au-Ag mine”
- 31) John Lamsma (MT Tech, Dept. of Geological Engineering) M.S., 2012  
 “Economic geology of the eastern margin of the Continental porphyry deposit, Butte”
- 32) Bill Henne (MT Tech, Dept. of Geological Engineering) M.S., 2011  
 “Using chemical and isotopic tracers to track biogeochemical processes under ice cover at Georgetown Lake, Montana”
- 33) Joshua Lee (MT Tech, Dept. of Geological Engineering) M.S., 2012  
 “Geochemistry of arsenic in Warm Springs Ponds”
- 34) Joshua White (MT Tech, Dept. of Geological Engineering) M.S., 2012  
 “Paragenesis of cobalt and nickel at the Black Butte stratiform Cu-Co deposit, MT”
- 35) George Williams (co-advised with Steve Parker, MT Tech, Dept. of Chemistry/Geochemistry) M.S., 2014  
 “Geochemistry of natural acid rock drainage in the Judith Mountains, Montana”
- 36) Patrick Haley (MT Tech, Dept. of Geological Engineering) M.S., in progress  
 “Using stable isotopes of water to constrain flow paths and residence times in a gravel-bed, river-floodplain aquifer”
- 37) Dustin Jensen (MT Tech, Dept. of Geological Engineering) M.S., 2015  
 “Rapid analysis of secondary manganese oxides using portable XRF: Applications to environmental geochemistry and mineral exploration”
- 38) Capri Gillam (MT Tech, Dept. of Environmental Engineering) M.S., 2015  
 “Biogeochemical cycling in a headwater stream and riparian zone”
- 40) Ryan Stevenson (MT Tech, Dept. of Geological Engineering) M.S., 2015  
 “Stable isotopes of hydrothermal carbonate minerals in the Butte porphyry-lode deposits, MT”
- 41) Heather Boese (MT Tech, Dept. of Environmental Engineering) M.S., 2015  
 “Biogeochemistry of arsenic in Warm Springs Ponds: New Field and experimental results”
- 42) Jenna Kaplan (MT Tech, Dept. of Geological Engineering) M.S., 2016  
 “Mineralogy and environmental geochemistry of slag in Lower Area One, Butte, Montana”
- 43) Sara Edinberg (MT Tech, Dept. of Geological Engineering) M.S., 2016  
 “Natural acid rock drainage and ferricrete chemistry of the Judith Mountains, Montana”
- 44) Corey Swisher (MT Tech, Dept. of Geological Engineering) M.S.,  
 2017  
 “Hydrogeology and geochemistry of groundwater seepage at the abandoned Black Pine mine, Philipsburg District, Montana”
- 45) Joshua Messenger (MT Tech, Dept. of Geological Engineering) M.S., 2016  
 “Paragenesis and geochemistry of the Calvert tungsten skarn deposit, Pioneer Mountains, Montana”
- 46) Jarred Zimmerman (MT Tech, Dept. of Geological Engineering) M.S., 2016  
 “Geochemistry, fluid inclusions, and stable isotopes of polymetallic vein deposits in the Emery District, Montana”
- 47) Alero Gure (MT Tech, Dept. of Chemistry and Geochemistry) M.S., 2016  
 “Anaerobic dissociation of thiocyanate under controlled pH and temperature”
- 48) Kyle Eastman (MT Tech, Dept. of Geological Engineering) M.S., 2017  
 “Geochemistry of supergene enrichment at the Continental porphyry Cu-Mo mine, Butte”

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|--|-------------------|
| 49) Hamadou Gnadou (MT Tech, Dept. of Geological Engineering)                                    | M.S., in progress |
| “Mineralogy and S-isotope study of the Apex and Bonanza deposits, Golden Sunlight mine, Montana” |                   |
| 50) Nick Allin (MT Tech, Dept. of Geological Engineering)  | M.S., in progress |
| 51) Garrett Hill (MT Tech, Dept. of Geological Engineering)                                      | M.S., in progress |
| “Origin of the hydrothermal talc and chlorite deposits of southwest Montana”                     |                   |
| 52) Jon Szarkowski (MT Tech, Dept. of Geological Engineering)                                    | M.S., in progress |
| 53) Robert Rader (MT Tech, Dept. of Geological Engineering)                                      | M.S., in progress |
| 54) Francis Grondin (MT Tech, Dept. of Geological Engineering)                                   | M.S., in progress |
| 55) Alex Brown (MT Tech, Dept. of Geological Engineering)  | M.S., in progress |

### Non-Thesis Graduate Research Projects Supervised

- |  |            |
|--|------------|
| 1) Lauren Gordon (MT Tech, Dept. of Geological Engineering)  | M.S.,      |
| 2011   |            |
| “Comparison of sediment pore-water chemistry in ponds underlain by mine tailings vs. natural soil: Warm Springs Ponds, Montana”                                |            |
| 2) Barbara Pape (MT Tech, Dept. of Geological Engineering)   | M.S., 2011 |
| “Limnology and geochemistry of a clean lake filling an abandoned open pit tungsten mine”   |            |
| 3) Katie Petteys (MT Tech, Dept. of Geological Engineering)  | M.S., 2013 |
| “Hydrogeochemistry of Collar Gulch, Judith Mountains, Montana”   |            |
| 4) Allison Brown (MT Tech, Dept. of Geological Engineering)  | M.S., 2014 |
| “Geochemistry of groundwater in the Big Sky area, MT”  |            |
| 5) Amber McGivern (MT Tech, Dept. of Geological Engineering)   | M.S., 2014 |
| “Geochemistry and stable isotopes of water in the Continental Pit, Butte, Montana”   |            |
| 6) Tyler Hagan (MT Tech, Dept. of Geological Engineering)  | M.S., 2015 |
| “Hydrology and geothermal potential of flooded mine shafts in Butte, MT”   |            |
| 7) Aaron Zosel (MT Tech, Dept. of Geological Engineering)  | M.S., 2015 |
| “Development and application of a method for unwrapping single images of Cylindrical objects”  |            |
| 8) Matt Berzel (MT Tech, Dept. of Geological Engineering)  | M.S., 2017 |
| “Tracking potential leakage of tailings-lake water into background groundwater in Butte, Montana, using geochemical and stable isotope tracers”                |            |
| 9) Meg Doolittle (MT Tech, Dept. of Geological Engineering)  | M.S., 2017 |
| “Naturally occurring acid rock drainage in the Anaconda-Pintler Mountain Range, Montana: A case study of geochemistry in two streams flowing from Mount Evans” |            |
| 10) Ben Schubert (MT Tech, Dept. of Geological Engineering)  | M.S., 2017 |
| “Geochemistry and fluid inclusion study of the Heddeleston porphyry Cu-Mo deposit, Montana”  |            |

### Graduate students for whom I served on thesis committee

- 1) Jennifer Saran (Metall. Eng.)
- 2) Troy Gill (Env. Eng.)
- 3) Russell Reed (Env. Eng.)
- 4) Cindy Drake (Env. Eng.)
- 5) Karin Mainzhausen (Env. Eng.)
- 6) Mark Peterson (Env. Eng.)
- 7) Tim Mulholland (Env. Eng.)
- 8) Erik Ryan (Env. Eng.)
- 9) Jim Jonas (Chem & Geochem.)
- 10) Licette Hammer (Chem & Geochem.)
- 11) Amy Husky (Geol. Eng.)
- 12) Drake McKee (Geol. Eng.)
- 13) Alan English (Geol. Eng.)
- 14) Melissa Schaar (Geol. Eng.)
- 15) Mike Borduin (Geol. Eng.)
- 16) Mike Brayton (Geol. Eng.)

- 17) Marge Willett (Chem & Geochem)
- 18) Barry Duff (Env. Eng.)
- 19) Mark Thompson (Env. Eng.)
- 20) Brian Beam (Env. Eng.)
- 21) Catherine Williams-Beam (Env. Eng.)
- 22) Janell Foley (Geol. Eng.)
- 23) Brock Bolin (Geophys. Eng.)
- 24) Debbie Smith (Geophys. Eng.)
- 25) Troy Broyston (Geophys. Eng.)
- 26) Marko Adzic (Mining Eng.)
- 27) Matt Haas (Mining Eng.)
- 28) Ted Duaine (Env. Eng.)
- 29) Steve Parker (Univ. of Montana, Ph.D.)
- 30) Lois Olsen (Montana State Univ., M.S.)
- 31) Varadharajan Kailasam (Env. Eng.)
- 32) Devin Clary (Env. Eng.)
- 33) Kim Draper (Env. Eng.)
- 34) Andrew Sudbrink (Geol. Eng.)
- 35) Edwin Devakumar (Mining Eng.)
- 36) Matthew Garrett Smith (Chem/Geochem)
- 37) Greg Bryce (Geol. Eng.)
- 38) Kevin Chandler (Geol. Eng.)
- 39) Russell Akers (Geophys. Eng.)
- 40) Marissa Darvis (Chem/Geochem)
- 41) Jason Wright (Geol. Eng.)
- 42) Elizabeth Bramlett (Geol. Eng.)
- 43) Katie Mitchell (Geol. Eng.)
- 44) Mike Hanley (Geol. Eng.)
- 45) Tyler Johnston (Chem/Geochem)
- 46) Martin Lorenzo (Env. Engin.)
- 47) Sarah Lupton (Geol. Eng.)
- 48) John Anderson (Geol. Eng.)
- 49) Billy Rhyne (Geol. Eng.)
- 50) Ryan Winter (Geol. Eng.)
- 51) Connie Thompson (Geol. Eng.)
- 52) Mo Li (Geophysical Engin.)
- 53) Maurice Ayisi (Geol. Eng.)
- 54) Jeremy Harwood (Geol. Eng.)
- 55) Georgia Dahlquist (Chem/Geochem)
- 56) Renee Schmidt (Chem/Geochem)
- 57) Andrew Spencer (Geol. Eng.)
- 58) Shanna Law (Chem/Geochem)
- 59) Elliott Mazur (Geol. Eng.)
- 60) Mandy Brewer (Geol. Eng.)

**B.S. thesis** (NOTE: Montana Tech does not have a B.S. thesis program)

- |   |                |
|---|----------------|
| 1) Trevor Blair (McGill Univ., Dept. of Earth & Planetary Sci.)   | Graduated 1997 |
| "Thermochemical arsenite reduction (TAR): A new hypothesis for the origin of<br>"Cobalt-type" Ni-Co-arsenide vein deposits" |                |

**Undergraduate Research Projects supervised**

- |  |           |
|--|-----------|
| Amber Roessler (Dept. of Chem. & Geochem.)   | 2000-2001 |
| 1) "Using stable isotopes of sulfur to determine the origin of H <sub>2</sub> S<br>in flooded mine workings on Butte Hill" |           |
| 2) "Sequential extractions to determine the speciation of metals<br>in wetland soils"                                      |           |
| 3) "Survey of metal content of surface biofilms and metal oxide"   |           |
|  | 2001-2002 |
|  | 2002-2003 |

crusts on stream sediment in the Basin-Boulder area”		
Adam Wenz (Dept. of Chem. & Geochem.)		
4) "Diel fluctuations in water quality along the Big Hole River"		2000-2001
5) "Diel fluctuations in metals and nutrients along the Big Hole River"		2001-2002
Zane Leonard (Dept. of Geol. Engineering)		
6) "Fluid inclusion study of the origin of hydrothermal talc mineralization in the Ruby Range, Montana"		2001-2002
Greg Lorenson (Dept. of Geol. Engineering)		
7) "Hydrogeochemistry and soil chemistry of the Ontario Mine wetland"		2002-2003
8) "Geochemistry of selenium in German Gulch"		2003-2004
Melissa Hayes (Dept. of Geol. Engineering)		
9) "Experimental investigation of diurnal changes in water chemistry along the Big Hole River"		2002-2003
Stacy Wilcox and Ericka Sholey (Dept. of Geol. Engineering)		2006-2007
10) "Nutrients in upper Silver Bow Creek"		
Stacy Wilcox (Dept. of Geol. Engineering)		
11) "Diel streamflow cycles in upper Big Hole River"		2007-2008
Brian Kuhn (Dept. of Geol. Engineering)		
12) "Behavior of dissolved oxygen in polluted vs. unpolluted fluvial groundwater"		2008-2009
13) "Geology and geochemistry of veins in the Orphan Girl mine, Butte"		2011-2012
Amber McGivern (Dept. of Geol. Engineering)		
14) "Chemistry of shallow groundwater in the Silver Bow Creek floodplain"		2009-2010
15) "Year 2: Chemistry of groundwater at Miles Crossing"		2010-2011
Allison Brown (Dept. of Geol. Engineering)		
16) "Contamination of groundwater from abandoned coal mines near Stockett, MT"		2009-2010
17) "Year 2: Contamination of groundwater from abandoned coal mines"		2010-2011
Heidi Reid (Dept. of Mechanical Engineering)		
18) "Linking trace gas fluxes to soil water and groundwater geochemistry"		2012-2013
Tom Prescott (Dept. of Environ. Engineering)		
19) "Sediment geochemistry in Warm Springs Ponds"		2012-2013
Jon Szarkowski (Dept. of Geol. Engineering)		
20) SURF: "Mineralogy and isotopes of silver-rich veins of Butte"		2015
21) SURF: "Further studies of the complex mineralogy of the Butte ore bodies"		2016
Zane White and Robert Hofer		
22) "Mineralogy of a Cu- and U-rich breccia pipe in northern Arizona"		2017-2018