

## Pierre D. Glynn

### Professional experience

Jan. 1989 – present: Hydrologist, U.S. Geological Survey (USGS), Reston, VA

- **March 2005 – Present: Chief, Eastern Region Branch, National Research Program.** Responsible for managing 100-person Branch and helping set science directions, project budgets, and funding priorities for the \$40 Million National Research Program (NRP) in Hydrology (<http://water.usgs.gov/nrp/>; 320-person USGS R&D program). Commonly serve as Acting Chief Scientist for Hydrology, often for extended periods (e.g. June 2008, May and July 2005). Responsible for setting science directions and establishing science teams for Bureau and NRP initiatives such as: shale gas and hydrofracking, 3D modeling & visualization, lower Mississippi issues, Upper Klamath basin, and other areas and programs as needed. Member of the USGS Regional Executive/Chief Scientist team, acting as Chief Scientist for Hydrology on the team. Helped manage and lead new science directions for the WEBB (Water, Energy, & Biogeochemical Budgets) small watershed research program (started mercury, web data access, eco-hydrology, and climate initiatives).
- **June – Sept. 2004: Acting Chief Scientist for Hydrology.** In addition to continuing my Staff Assistant duties, my Chief Scientist responsibilities included: participating on the 2<sup>nd</sup> level 2004 Research Grade Evaluation panel; preparing (and being accountable for) the 2005 National Research Program budget; co-leading the 2005 NRP In-depth Project Review and Budget Meeting; numerous interactions with other federal agencies and with Department of Interior.
- **Nov. 2001 – Feb. 2005: Staff Assistant to Chief Scientist for Hydrology.** Responsible for the Research Grade Evaluation peer-review process in the USGS Water Discipline. Directed USGS National Research Council post-doctoral fellowship program, establishing science directions and finding funds and opportunities. Program Coordinator in charge of leading the WEBB small watershed program. Water Discipline representative on the USGS Climate Change working group. Helped manage the National Research Program. Responsible for assembling science teams in USGS priority areas, and for guiding USGS Water Discipline collaborations with universities. Served as Acting Chief Scientist for Hydrology as needed and during a 4-month period as described above.
- **Jan. 1989 - Nov. 2001: Research Hydrologist, National Research Program.** Research interests: Modeling of radionuclide transport and performance assessments for Nuclear Waste Disposal sites (INEEL and Sweden); unsaturated-zone and ground-water geochemical investigations and modeling at Pinal Creek Toxics site, AZ and Äspö Hard-Rock Lab, Sweden; <sup>14</sup>C dating of perched waters at Yucca Mountain. Expert in thermodynamics of mineral/impurity/water interactions, in geochemical modeling and in ground-water geochemistry and contaminant transport.
- **Jan. 1987 – Jan. 1989: NRC Research Associate at the U.S Geological Survey.** Competitively awarded National Research Council Postdoctoral Fellowship, National Academy of Sciences. Conducted research on the thermodynamics of mineral/water interactions: created thermodynamic models and predictions of how mineral impurities affect mineral solubilities and how impurities are released or taken up by minerals; tested the models through laboratory experiments and field observations. My research has been applied in many different fields, including nuclear waste disposal,

contaminant transport, and the chemical evolution of natural waters.

## Education

- 1982–1986 University of Waterloo Ontario, Canada  
**Ph.D.** Earth Sciences. Ground-water hydrology and chemistry. Thesis: *Thermodynamic behaviour of solid-solution aqueous-solution systems: a theoretical and experimental investigation* (Thesis Advisor: Eric Reardon).
- 1980–1982 University of Quebec Montreal, Canada  
**M.Sc.** Earth Sciences. Isotope geochemistry and  $^{14}\text{C}$  dating. Thesis: *On the ground transfer of atmospheric  $^{14}\text{CO}_2$  as a function of latitude ( $46^\circ\text{N}$ - $76^\circ\text{N}$ ) and season in Quebec and Baffin Island.* (Thesis Advisor: Claude Hillaire-Marcel).
- 1977–1980 Columbia University New York, New York  
**B.A.** Major in Earth Sciences. (Advisors: Wally Broecker and Rhodes Fairbridge)

## Teaching Experience

- Annual/Biennial USGS National Training Center Courses: co-taught Geochemistry for Ground-Water Systems course (13 times) and Advanced Geochemical Modeling Workshop (7 times).
- Argonne National Lab: co-taught IAEA Isotope Hydrology Course (twice).
- International Ground Water Modeling Center: co-taught Principles and Applications of Chemical Reactions in Ground Water (6 times).
- IAEA Headquarters, Vienna: co-taught Numerical Flow and Transport Modeling in Groundwater Systems.
- Budapest, Hungary (Eötvös Loránd University): co-taught Principles and Applications of Chemical Reactions in Ground Water.

## Awards, Honors, Training

### Awards and Honors:

- USGS Superior Service Award
- USGS GEM (Going the Extra Mile) Award
- Multiple USGS STAR/Performance Awards

### Leadership and Management training received:

- 1) Federal Executive Institute, “Leadership for a Democratic Society”, 4-week class (April/July 2008).
- 2) USGS Leadership 101 and 201 classes (1 week each in 2005 and 2006).
- 3) USGS Leadership Intensive class (2-day class in 2003).
- 4) USGS Supervisory Challenges (1-week course; 2011).

**Technical training received:** Seven courses and workshops on various aspects of groundwater flow, contaminant transport, reactive transport, and watershed modeling.

## Science leadership

- 1) Fifty-six publications as of January 2013, in addition to contributions to several interagency reports (for OSTP, USGCRP, DOE) and a report to Congress on studies of the Long-term Estuary Assessment Group in the Lower Mississippi. Multiple (100’s) of research & management presentations, and science direction presentations, such as most recently:
  - Invited Plenary Speaker, Society of Toxicology Contemporary Concepts in Toxicology Workshop (SOT CCT, May 2012): *Integrated Environmental Modeling in the USGS.*
  - Presentation to an invited group of representatives from European Geological Surveys on *USGS Water Research Studies Related to Shale Gas Extraction* (April 2012).
  - Invited presentation, closed session workshop, National Science Foundation sponsored meeting on hydrofracking, Duke University (January 9-10, 2012): *USGS Studies Related to Hydraulic Fracturing & Gas Drilling.*
  - Session Lead, panel lead and presenter, Geological Society of America annual meeting (October 2011): *Small watershed ecosystem studies: brief history and future directions.* (I also gave an expanded version of this talk in April 2012 in an

- invited presentation at the Lamont-Doherty Earth Observatory).
  - Invited presentation, 3D Geologic Mapping workshop, Geological Society of America annual meeting (October 2011): *3D/4D modeling, visualization and information frameworks: current US Geological Survey practice and needs*.
  - Summit organizer and presenter, First International Summit on Integrated Environmental Modeling (IEM), December 2010, Reston: *IEM drivers & philosophy: one emerging perspective & The challenges ahead for IEM*.
  - Invited presentation, session on Advances in Hydrology since the 1991 NRC “Blue Book”, American Geophysical Union Annual meeting (Dec 2009): *Geochemistry and the Understanding of Groundwater Systems*.
- 2) Chair, January 2009 – December 2010, Interagency Steering Committee for Multimedia Environmental Modeling (ISCMEM). Re-elected Chair for calendar year 2010 by special request. USGS representative on ISCMEM Steering Committee (Fall 2006-present).
- Created 2 new working groups; brought in additional agencies, working group chairs and participants. Drafted/formalized ISCMEM proposal endorsement principles.
  - Organized and recruited scientists and managers for 2009 and 2010 ISCMEM Annual meetings. Hosted and co-organized First International Summit (Dec 2010) on Integrated Environmental Modeling (IEM). Co-author on Summit report (to be published by British Geological Survey). Co-author on “Roadmap paper” on Integrated Environmental Modeling (submitted to Journal of IEMSS).
- 3) Other Service on Interagency/Institution working groups/committees:
- Carbon Cycle Interagency Working Group under OSTP/USGCRP (USGS/DOI representative 2010-2011). I currently serve as back-up USGS representative.
  - Interagency Conference on Research in the Watersheds (ICRW) Organizing Committee (since 2009).
  - Water resources impacts of geologic carbon sequestration (OSTP/SWAQ working group; 2008).
  - USGS representative (backup for Bob Hirsch) on Energy-Water roadmap effort (Federal/State/National Lab effort; 2007).
  - Perchlorate (OSTP IWG on perchlorate research; 2004-2009).
  - Ohio River Valley Water Sanitary Commission (ORSANCO) Research Committee (2007-present).
  - Interagency Water Resources Research Coordinating Committee (2002-2005).
  - “Lower Mississippi/Greater New Orleans water/environmental observatory” (USGS/Tulane/Xavier/Nicholls State Partnership; 2003-present).
  - Upper Klamath Basin (USGS/USBR studies; 2003-2008).
- 4) Service on USGS committees, panels, and review teams:
- Recruited NRP scientists for USGS shale gas and hydrofracking studies. Helped write and put together budget justifications that resulted in new FY2013 proposed Obama administration funding of \$2 Million for NRP (\$13 Million for USGS). Reviewed draft USGS/DOE/EPA Comprehensive Science Plan. Gave Invited presentation on USGS shale gas and hydrofracking studies at NSF-sponsored workshop at Duke University (January 2012).
  - Regional Executive/Chief Scientist Team (June 2008-July 2009; represented Chief Scientist for Hydrology; led RECST efforts on Research Grade Evaluation and USGS Strategic Science Planning).
  - ST-supervisor representative on 3-person panel standardizing and assessing USGS ST (super-grade scientists) performance evaluations (2011).
  - Co-leader/co-founder of USGS 3D modeling and visualization initiative and committee (2009-present). Recruited industry demonstrations and workshops; obtained USGS access to software supported by British Geological Survey and

- other International Surveys.
- Member of USGS patent evaluation committee (March 2012-present)
  - Research Grade Evaluation panels (2002-present; chaired & served on 1<sup>st</sup> & 2<sup>nd</sup> level water panels; served on 1<sup>st</sup> level Geology & Biology panels).
  - USGS Carbon Cycle Coordinating Committee (2002-2005).
  - USGS Director's Ecosystem Council (June 2008-2010).
  - Reston Ecosystem Services Reading Group (Leader/founder; 2009).
  - Biological Resources Discipline Wildlife Program Review Committee (Water Discipline representative).
  - Other USGS panels/reviews, including: USGS Data Integration Council (June 2009); postdoctoral scientist evaluations (2002-present); USGS 2010 modeling conference committee; National Institutes for Water Resources-USGS National Competitive Grant panel; USGS Venture Capital and other funding initiative panels; Leetown Science Center Biology program reviews (Landscape ecology; In-stream flows and biotic health); USGS Water Science Center Reviews.
- 5) Service on external panels/reviews:
- 2012 George Mason Science Advisory Group for Water and Environment Graduate Program
  - 2012 CUAHSI Management Review Panel
  - 2012 NSF interdisciplinary panel "Water Sustainability and Climate"
  - Fall 2010 and 2009 NSF EPSCoR (Experimental Program to Stimulate Competitive Research) panels (\$20 Million awards);
  - USGS observer on NSF Hydrology panels (2007-2009);
  - Swedish Government panels related to nuclear waste disposal (1994-2002; 2007);
  - Other panel/review teams for: International Atomic Energy Agency, Nuclear Energy Agency, Idaho National Lab, Yucca Mtn., US Agency for International Development.
- 6) Member of Editorial Board for CRC Multiphysics Modeling Series (2011-present). Groundwater geochemistry advisor for Hydrogeology Journal (1996-present). Associate Editor, Ground Water (1996-2001).
- 7) Volunteer for Rocky Mountain National Park (2007-present). Give yearly presentations (7 to date) on Ecosystem Connections (e.g. "Tree rings, the North Atlantic, Fire and What It Means to the Kawuneeche Valley and Areas Downstream"; "Microbes, Moose and More"; "The Upper Colorado River: Heart of Many Waters, Water of Many Hearts"). Invited reviewer & backcover commenter for "The Moon in the Nautilus Shell: Discordant Harmonies reconsidered" by Daniel Botkin, Oxford University Press (2012).

**Professional Societies**

American Association for the Advancement of Science. American Institute of Biological Sciences. American Geophysical Union. Geological Society of America. The Geochemical Society. International Association of Hydrogeologists.

## Synopses of selected papers

Plummer, L.N. and Glynn, P.D., 2013, Radiocarbon dating in groundwater systems. Guidebook on Dating of Old Groundwaters, Chapter 4, International Atomic Energy Agency, (*in press*).

Plummer, L.N., Sanford, W.E. and Glynn, P.D., 2013, Characterization and conceptualization of groundwater-flow systems. Guidebook on Dating of Old Groundwaters, Chapter 2, International Atomic Energy Agency, (*in press*).

IAEA guidebooks on isotope hydrology are internationally distributed and widely used by water resources managers and scientists. My co-authored chapter with Niel Plummer will promote effective and realistic dating (and flow/residence time characterization) of groundwater systems using  $^{14}\text{C}$  and ancillary geochemical tools. The other chapter with Ward Sanford will promote effective and realistic characterization of groundwater systems.

Glynn, P.D., Larsen, M.C., Greene, E.A., Buss, H.L., Clow, D.W., Hunt, R.J., Mast, M.A., Murphy, S.F., Peters, N.E., Sebestyen, S.D., Shanley, J.B., and Walker, J.F., 2009, Selected achievements, science directions, and new opportunities for the WEBB small watershed research program, p. 39-52, <http://pubs.usgs.gov/sir/2009/5049/pdf/Glynn.pdf>, in Webb, R.M.T., and Semmens, D.J., eds., *Planning for an uncertain future—Monitoring, integration, and adaptation. Proceedings of the Third Interagency Conference on Research in the Watersheds: U.S. Geological Survey Scientific Investigations Report 2009-5049* (<http://pubs.usgs.gov/sir/2009/5049/>). Provides a summary of research and monitoring activities conducted over the first 18 years of the WEBB program, with an emphasis on the documentation of climate change effects on water, solute, nutrient, carbon and mercury dynamics. Stresses the need for more investigations into ecological effects and responses that are coupled with physico-chemical effects. Argues for greater use of remote sensing, geographic modeling, and habitat/watershed modeling tools; and closer integration with the USGS- and NSF-led National Phenology Network. Emphasizes need to better understand process/system response times and quantify ecosystem services. Suggests the use and further development of ecosystem health indicators for the WEBB watersheds (such as those used in the recent Heinz Center report on the topic).

Glynn, P.D., and Plummer, L.N., 2005, Geochemistry and the understanding of ground-water systems: *Hydrogeology Journal*, v. 13, p. 263-287. Comprehensive review of geochemical tools and techniques for understanding flow and transport properties of ground-water systems (e.g., dating techniques, extracting archives of paleo-environmental information, use of geochemical and flow/transport modeling approaches). Suggests key science directions for further research on the use of geochemistry to understand ground-water systems. Offers thermodynamic perspective that could facilitate an integrated understanding of the physical, chemical, and biological processes affecting ground-water systems.

Glynn, P.D., 2003, Modeling Np and Pu transport with a surface complexation model and spatially variant sorption capacities: implications for reactive transport modeling and performance assessments of nuclear waste disposal sites, *Computer & Geosciences, Special issue on Reactive Transport Modeling in the Geosciences*, Browning, L., and Murphy, W.M., (eds), v. 29, p. 331-349. Critical analysis of theories commonly used to describe the sorption of ground-water contaminants and their retarded transport. Contrasts these techniques with some more complex, but fundamentally more accurate, thermodynamic theories of sorption mechanisms. Conclusions suggest that theories and concepts commonly used in predicting contaminant transport in ground-water systems have highly significant flaws.

Glynn, P.D., 2000, Solid-solution solubilities and thermodynamics: sulfates, carbonate and halides, *In: Sulfate Minerals-Crystallography, Geochemistry and Environmental Significance*, Alpers, C.N., Jambor, J.L., and Nordstrom, D.K., (eds), *Reviews in Mineralogy and Geochemistry*, v. 40, p. 481–511. Significant extension of my earlier papers in *American Journal of Science* and *Geochimica et Cosmochimica Acta*. Comprehensive review and analysis of thermodynamic theory and principles

controlling mineral/impurities/water interactions at low temperatures. Suggests techniques that can be used to estimate the thermodynamic properties of impure minerals at low temperatures; compiles available data on the properties of sulfate, carbonate and halide impure minerals. *Data and concepts presented in this paper are being used to: explain the behavior of cement; assess and predict the behavior of radionuclides in nuclear fuel and under conditions of environmental release; understand the geochemistry of acid-mine drainage and the leaching of uranium mill tailings; explain high fluoride concentrations of ground waters in the Black Creek aquifer (SC).*

Glynn, P.D. ,and Voss, C.I., 1999, Geochemical characterization of Simpevarp ground waters near the Äspö Hard Rock Laboratory, *Swedish Nuclear Power Inspectorate (SKI), SKI report 96:29, 210 p.* Investigates the geochemistry of ground waters near the Äspö Hard Rock Laboratory, an analog to a high-level nuclear-waste repository. Considers geochemical data available; gains/infers hydrologic information from the data (water ages, origins, evolutionary processes, hydrologic connections, water volume to surface area ratio: a critical parameter used in performance assessment modeling of nuclear waste sites). Investigates potential effects of glaciation, deglaciation, permafrost, seawater intrusion and glacial rebound on the geochemical evolution over the next 120,000 years. Concludes that contrary to previous assumptions of Swedish government agencies (the Swedish equivalents of NRC and DOE) there is a strong possibility that waters with significant dissolved oxygen could contact the “near-field” waste environment and potentially mobilize radionuclides such as Pu, Np, Tc, and U. *Report had a major impact on site characterization and performance assessment efforts in the Swedish Nuclear Waste program and offered important lessons for nuclear waste disposal in the US, Canada & other countries.*

Glynn, P.D., Brown, J.G., 1996 (updated by Glynn and Brown, 2012, CRC Press), Reactive transport modeling of acidic metal-contaminated ground water at a site with sparse spatial information, *In: Reactive Transport in Porous Media: General Principles and Application to Geochemical Processes, Steefel, C.I., Lichtner, P. and Oelkers, E., (eds), Reviews in Mineralogy, v. 34, p. 377-438.* Detailed description of the use, assumptions, and limitations of inverse geochemical modeling in the investigation of dynamically-evolving ground-water contaminant systems. Illustrates the steps involved in conducting an integrated inverse and forward geochemical modeling study of a contaminated ground-water site. Sensitivity analysis highlighted and prioritized uncertainties needed to be resolved at the Pinal Creek site to obtain a better predictive model of contaminant transport. *A revised and updated version of this paper, that additionally provides an overview of work done at the Pinal Creek site since 1996, was invited and published in January 2012 in a CRC volume on “Geochemical Modeling of Groundwater, Vadose and Geothermal Systems”*