

DHANPAT RAI

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EDUCATION

Ph.D.	Soil Science (Chemistry-Mineralogy), Oregon State University	1970
M.Sc.	Soil Science, Punjab Agricultural University, India	1965
B.Sc.	Agriculture (Chemistry Major), Punjab Agricultural University, India	1963

EMPLOYMENT HISTORY

<u>Position</u>	<u>Institution</u>	<u>Year</u>
Technical Director	Rai Enviro-Chem	March 07-present
Laboratory Fellow	Pacific Northwest National Laboratory	2002-March 07
Senior Staff Scientist	Pacific Northwest National Laboratory	1990-2002
Staff Scientist	Pacific Northwest National Laboratory	1981-1990
Senior Research Scientist	Pacific Northwest National Laboratory	1975-1981
Technical Group Manager	Pacific Northwest National Laboratory	1997-2002
Technical Leader	Pacific Northwest National Laboratory	1981-1992
Research Associate/ Assistant Professor	New Mexico State University	1974-1975
Post-Doctoral Fellow	Colorado State University	1971-1973
Post-Doctoral Fellow	Oregon State University	1970-1971

EXPERIENCE

Dr. Rai has extensive background and research experience in environmental chemistry of actinides and other trace elements. He has been principal investigator and project manager for multimillion dollar projects requiring interdisciplinary approaches.

Dr. Rai joined Battelle, Pacific Northwest Laboratory, as a Senior Research Scientist in May 1975 and was promoted to Staff Scientist in April 1981 and to Senior Staff Scientist, the highest technical rank achievable at Battelle, in April 1990. He was, until his retirement, laboratory fellow in the Chemical Sciences Division. In addition to his scientific ranks, Dr. Rai also served as a technical leader/ technical group manager of Geochemical Processes Group from 1981 to 1992, and of the Actinide and Trace Metal Geochemistry Group from 1997 to 2002. As a Technical Leader and Senior Scientist, Dr. Rai was responsible for staff evaluation and development, as well as providing guidance and technical oversight for ongoing research activities. From September 1980 through September 1994, concurrently with his work at Battelle, he was an adjunct faculty member of the Chemistry Department at Washington State University.

Dr. Rai's main thrust of research at PNNL has been in understanding the environmental chemistry of hazardous constituents, especially as it relates to the potential mobility of actinides, fission products, and other trace elements in groundwater. His technical areas of expertise include low-temperature aqueous thermodynamics of dilute to concentrated electrolytes, redox reactions, and mineral weathering. He has been a principal investigator and project manager for numerous studies, funded by United States Department of Energy, Japan Atomic Energy Agency, Mitsubishi Materials Corporation, and the Electric Power Research Institute, dealing with the development of fundamental data for predicting the geochemical behavior of hazardous constituents contained in nuclear and fossil fuel combustion wastes disposed of in geologic environments. The studies that bear upon these research areas are listed under "Project Management" and "Publications" headings of his resume.

For the past 43 years, Dr. Rai secured funding for and has managed and conducted approximately \$44 million worth of research dealing with the development of experimental techniques and thermochemical data for actinides and trace elements of environmental concern for application to nuclear and fossil fuel waste disposal in geologic systems.

PROFESSIONAL ACCOMPLISHMENTS

- Authored 240+ publications
- Scientist V, VI, and then Laboratory Fellow; highest technical rank achievable at PNNL since 1990
- Invited by Nuclear Energy Agency of the Organization for Economic Co-operation and Development (NEA-OECD) to be a coauthor of a book on “Chemical Thermodynamics of Thorium”, which was published by NEA-OECD in 2008.
- Formal invited-peer reviewer of the following technical books published by NEA-OECD/Elsevier Science Publishers B. V: “Chemical Thermodynamics of Neptunium and Plutonium. Published in 2000” and “Update on the Chemical Thermodynamics of U, Am, Np, Pu, and Tc. Published in 2003”.
- Invited participant to Joint Russian Academy of Sciences and U. S. Department of Energy workshop on Actinide Science (2000).
- Pacific Northwest National Laboratory wide contributions: member of panels to develop policy on promotion criteria for scientist category; effective marketing strategies; review of documents; quality of life survey at PNNL; member of scientific advisory panel for Environmental Molecular Sciences Laboratory (1996-1998)
- Associated Western Universities and Department of Energy Laboratory Distinguished Lecturer (1992-1993)
- Adjunct faculty member of Chemistry Department, Washington State University, Tri-Cities (1980 - 1994)
- Soil Science Society of America representative to the International Union of Pure and Applied Chemists (1987).
- Consultant to several major industrial/government concerns (including Japan Nuclear Energy Agency and its predecessor organizations, Waste Isolation Pilot Project (WIPP) of US DOE, Electric Power Research Institute, New Jersey Department of Environmental protection, and several fossil fuel burning power plants in the US).
- Numerous invited presentations/participations (60) at meetings of many professional societies including American Chemical Society, Soil Science Society of America, and NEA-OECD.
- Professional and honorary affiliations include: currently a member of American Chemical Society and past member of Sigma XI, Soil Science Society of America, American Society of Agronomy, International Society of Soil Science.

INVITED PARTICIPATION (Numerous presentations were made to technical audiences: only invited presentations/participations are listed below)

Research paper on “Thermodynamic Approach for Predicting Actinide Concentrations in Leachates from Radioactive Waste Glasses” as a part of symposium on “Aqueous Chemistry and Thermodynamics of Actinides and Fission Products: A Tribute to Volker Neck”. American Chemical Society national meeting, August 22-26, 2010, Boston.

Invited by Karlsruhe Institute of Technology, Germany, to participate in an International Memorial workshop in honor of Volker Neck on “Aquatic Chemistry and Thermodynamics of Actinide and long-lived fission products”. May 20th 2010.

Member of program committee. Plutonium Futures – The Science 2006, A Topical Conference on Plutonium and Actinides. July 9-13, 2006. Pacific Grove, California, USA.

Invited by Thermodynamic Data Base Project Coordinator of OECD/NEA, Federico Mompean, on behalf of the TDB III Management Board and the NEA Data Bank to be a co-author of a book on Thermodynamics of Thorium. March 29, 2004.

Research paper on “Speciation, Dissolution, and Redox Reactions of Chromium Relevant to Pretreatment and Separation of High-Level Tank Wastes” as a part of a symposium on nuclear waste management. 226th American Chemical Society national meeting, September 7-11, 2003, New York City.

Research paper on “Development of Biodegradable Isosaccharinate-containing Foams for Decontamination of Actinides” as a part of a symposium on nuclear waste management. 226th American Chemical Society national meeting, September 7-11, 2003, New York City.

Formal Peer Reviewer invited by Thermodynamic Data Base Project Coordinator of OECD/NEA, Federico Mompean . Reviewer for “Update on the Chemical Thermodynamics of U, Am, Np, Pu, and Tc”. Elsevier Science Publishers B. V. February, 2003.

Paper on status of actinide thermodynamics. “Status and Future Needs in Actinide Chemistry for Performance Assessment of Nuclear Waste Disposal.” The 3rd NUCEF (Nuclear Fuel Cycle Safety Engineering Research Facility) International Symposium sponsored by Japan Atomic Energy Research Institute, Tokai, Japan. October 31 through November 2, 2001.

Formal Peer Reviewer invited by Thermodynamic Data Base Project Coordinator of OECD/NEA, Erik Osthols. Reviewer for “Chemical Thermodynamics of Neptunium and Plutonium, Vol. 4. of Chemical Thermodynamics”. Elsevier Science Publishers B. V. September, 2000.

Session chairman. “Database Development and Modeling”. Joint Russian Academy of Sciences and U.S. Department of Energy Workshop on “Actinide Science Relevant to the Environment, Radioactive Waste Management and Migration Behavior of Actinides and Fission Products in the Geosphere”. Moscow, Russia. May 16-17, 2000

Research Paper. “Thermodynamics of Actinides in Concentrated Electrolytes”. Joint Russian Academy of Sciences and U.S. Department of Energy Workshop on “Actinide Science Relevant to the Environment, Radioactive Waste Management and Migration Behavior of Actinides and Fission Products in the Geosphere”. Moscow, Russia. May 16-17, 2000

Invited by Office of Science of U.S. DOE to be a participant in Joint Russian Academy of Sciences and U.S. Department of Energy Workshop on “Actinide Science Relevant to the Environment, Radioactive Waste Management and Migration Behavior of Actinides and Fission Products in the Geosphere”. Moscow, Russia. May 16-17, 2000

Session chairman. “Nuclear Waste Remediation and Long-Term Storage Repository.” 219th American Chemical Society National Meeting, San Francisco, California. March 26-30, 2000.

Research paper. “Aqueous Thermodynamics of Actinides in Concentrated Electrolytes: Applications to the WIPP Repository”. 219th American Chemical Society National Meeting, San Francisco, California. March 26-30, 2000.

An overview paper. “An Overview of Actinide Redox Speciation Methods, Other Than Chemical Separation Techniques: Their Applicability, Advantages, and Limitations”. An international workshop organized by OECD Nuclear Energy Agency on Evaluation of Speciation Technology. October 26-28, 1999, Tokai, Japan.

Panel leader. “Methods of Redox Speciation”. International workshop organized by OECD Nuclear Energy Agency on Evaluation of Speciation Technology. October 26-28, 1999, Tokai, Japan.

Member of International Scientific Steering Committee. An international workshop organized by OECD Nuclear Energy Agency on Evaluation of Speciation Technology. October 26-28, 1999, Tokai, Japan.

Session chairman. “Solubility and Dissolution Reactions”. 7th International Conference on the Chemistry and Migration Behavior of Actinides and Fission Products in the Geosphere, September 26 - October 1, 1999, Lake Tahoe, CA.

Research paper. “Carbonato Complexes of Tetravalent Actinides”. Workshop on Solubility of Actinides in Relation with Nuclear Waste Matrices. Hosted by SCKXCEN, the Belgian Nuclear Research Center, Mol, Belgium, May 20-21, 1999.

Panel leader. “Effect of Radiolysis on Solubility.” Workshop on Solubility of Actinides in Relation with Nuclear Waste Matrices. Hosted by SCKXCEN, the Belgian Nuclear Research Center, Mol, Belgium, May 20-21, 1999.

Research paper. “Effect of Radiolysis on Solubility.” Workshop on Solubility of Actinides in Relation with Nuclear Waste Matrices. Hosted by SCKXCEN, the Belgian Nuclear Research Center, Mol, Belgium, May 20-21, 1999.

Actinide research status paper. “Obtaining Thermodynamic Data for Actinides; Techniques, Difficulties.” Belgian Nuclear Research Center, Mol, Belgium. May 19, 1999.

Session chairman. “Heavy element complexes: The Consequence of Theory and Experiment, Section C.” 217th American Chemical Society National Meeting, Anaheim, California. March 21-25, 1999.

Plenary talk. “Identification and Modeling of Carbonato Complexes of Tetravalent Actinides.” 217th American Chemical Society National Meeting, Anaheim, California. March 21-25, 1999.

Keynote speech. "Difficulties in Acquiring Thermodynamic Data for Actinides." Sixth International Conference on the Chemistry and Migration of Actinides and Fission Products in the Geosphere, Sendai, Japan. October 26-31, 1997.

Research paper. "Fundamental Reactions Controlling Leachability of Wastes." Presented at the American Chemical Society Symposium and Environmental Exposition, Birmingham, Alabama, September, 1996.

Research paper. "Aqueous Speciation and Solubilities of Tetravalent Actinide Hydrated Oxides in Concentrated Cl, SO₄, and CO₃ Solutions: Challenges and Progress." Presented at the 212th ACS National Meeting, Orlando, Florida, August, 1996.

Research paper. "Solubilities and Aqueous Complexation of Rare Earths in Concentrated OH, CO₃, SO₄, Cl, MoO₄, and PO₄ Solutions." Presented at the 21st Rare Earth Research Conference, Duluth, Minnesota, July 7-12, 1996.

Keynote speech. "Development of Data and Model to Predict Concentrations in Leachates From Coal Combustion Wastes," presented at the meeting of the Air and Water Management Association, Grand Canyon Section, Tucson, Arizona, April 22, 1993.

Research paper. "FOWL-GHJ - The Fossil Fuel Combustion Waste Leaching Code: Version 2.0," presented at the American Chemical Society Annual Meeting, Denver, Colorado, April 2, 1993.

Research paper. "Identification of Specific Chemical Reactions that Control Aqueous Concentrations in Coal Combustion Leachates," presented at the American Chemical Society Annual Meeting, Denver, Colorado, April 2, 1993.

Research paper. "Phosphate, Sulfate, Molybdate, Fluoride Complexes of Nd/Am," presented at the American Chemical Society Annual Meeting, Denver, Colorado, April 1, 1993.

Research directions. "Fundamental and Empirical Approaches to Predicting Leaching Behavior of Immobilized Waste Forms," presented at the Materials Modeling, Corrosion, Reliability, and Service Life Issues in Waste Remediation sponsored by Los Alamos Technology Office and National Institute of Standards and Technology, Boulder, Colorado, March 29-30, 1993.

NSF EPSCoR ADP Groundwater Research Cluster Visiting Scientist, University of Wyoming, Laramie, Wyoming, November 24-25, 1992.

University-wide Seminar. "Predicting the Fate and Migration of Elements in Subsurface Environments," presented at the University of Wyoming, Laramie, Wyoming, November 25, 1992.

University-wide Seminar. "Developing the Fundamental Understanding of Contaminant Behavior," presented at the University of Wyoming, Laramie, Wyoming, November 24, 1992.

Review paper. "Baseline of Knowledge on the Characteristics of Coal Combustion By-Products," presented at Management Options for Coal Combustion By-Products: Waste or Asset? The Ohio Alliance for the Environment, Electric Power Research Institute, and American Coal Association, Columbus, Ohio, June 11-12, 1991.

Seminar. "Predicting Geochemical Behavior of Elements: Solubility of UO₂XxH₂O and U(IV) Hydrolysis," presented to the Department of Soil and Water Science, University of Arizona, Tucson, Arizona, January 16, 1990.

Research paper. "Experimental Evaluation of Thermodynamic Properties of (Ba,Sr)(SO₄,CrO₄)," presented at the symposium on Chemistry of Solid Solutions, Soil Science Society of America, Las Vegas, Nevada, October 15-20, 1989.

Research paper. "Thermodynamic Approach and Data to Predict Leachate Concentrations," presented at the First EPRI/EPA Environmental Research Conference. Electric Power Research Institute and U.S. Environmental Protection Agency, Washington, D.C., May 2-4, 1989.

Session chairman. Waste Composition and Mobilization Chemistry Session of First EPRI/EPA Environmental Research Conference. Electric Power Research Institute and U.S. Environmental Protection Agency, Washington, D.C., May 2-4, 1989.

Research paper. "Geochemical Evaluation of Reduced Subsurface Environments," presented at the New Field Techniques for Quantifying the Physical and Chemical Properties of Heterogeneous Aquifers, National Water Well Association, Dallas, Texas, March 20-23, 1989.

Review paper. "Environmental Chemistry of Chromium," presented at the symposium on the Chromium Paradox in Modern

Life. Association of Government Toxicologists, Bethesda, Maryland, May 23-24, 1988.

Review paper. "Chemical Remediation of Chromium-Contaminated Sites," presented at the Conference on Developing and Implementing Alternative Remedial Technologies. State of New York Legislative Commission on Toxic Substances and Hazardous Wastes, Grand Island, New York, April 28-29, 1988.

Review paper. "Role of Chromium Chemistry in Remediating Chromium-Contaminated Sites," presented to the New Jersey Department of Environmental Protection, Trenton, New Jersey, December 3, 1987.

Research paper. "Fundamental Approach for Predicting Pore-Water Composition in Fossil Fuel Combustion Wastes," presented at the Symposium on Fly Ash and Coal Conversion By-Products. Materials Research Society, Boston, Massachusetts, November 30 - December 2, 1987.

Research paper. "Evaluation of Fundamental Data Needs for Predicting the Geochemical Behavior of Elements," presented at the golden anniversary symposia on Future Developments in Soil Science. Soil Science Society of America, New Orleans, Louisiana, November 30 - December 5, 1986.

Research paper. "Chemical Characteristics of Fossil Fuel Wastes," presented at the symposium on Fly Ash and Coal Conversion By-Products. Materials Research Society, Boston, Massachusetts, December 1-6, 1986.

Research paper. "Measured and Extrapolated Values of Solubility Products of Tetravalent Actinide Hydrated Oxides," presented at the symposium on Geochemical Aspects of Radioactive Waste Disposal. American Chemical Society, Anaheim, California, September 7-12, 1986.

Research paper. "Solubility-Controlling Solids of Cr(III) and Cr(III)/Cr(VI) Transformation Reactions," presented at the Chromium Symposium sponsored by the Industrial Health Foundation, Arlington, Virginia, May 20-21, 1986.

Research paper. "Mineral Equilibria and the Soil System," presented at the American Society of Agronomy Annual Meetings, December 1-5, 1985.

Participant planning workshop on Fundamental Geochemistry Needs for Nuclear Waste Isolation. U.S. Department of Energy (OBES, OCRWM) and U.S. Nuclear Regulatory Commission, Los Alamos, New Mexico, June 20-22, 1984.

Research paper. "Solubility Constraint: An Important Consideration in Safety Assessment of Nuclear Waste Disposal," presented at the international symposium on the Scientific Basis for Nuclear Waste Management. Materials Research Society, Boston, Massachusetts, November 14-17, 1983.

Research paper. "The Effect of Aging Np(IV) Hydrated Oxide," presented at an international symposium on the Geochemical Behavior of Disposed Radioactive Waste. American Chemical Society, Seattle, Washington, March 20-25, 1983.

Research paper. "Solubility of Actinide Solids Under Oxidic Conditions," presented at a symposium on the Geochemistry of Radionuclide Migration/Retardation. Geological Society of America, New Orleans, Louisiana, October 17, 1982.

Session chairman. Symposium on the Chemistry of Plutonium. American Chemical Society Annual Meeting, Kansas City, Missouri, September 12-17, 1982.

NSF grant recipient to attend the 12th International Congress of Soil Science. International Society of Soil Science, New Delhi, India, February 8-16, 1982.

Review paper. "Environmental Chemistry of the Actinides," presented at a meeting of the Richland Section of the American Chemical Society, Richland, Washington, January 21, 1982.

Review paper. "Mobility of Radioactive Chemicals in Soils," presented at a symposium on Chemical Mobility and Reactivity in Soil Systems. American Society of Agronomy, Atlanta, Georgia, November 29 - December 4, 1981.

Participant. Planning workshop on Pollutant Migration from Utility Solid Wastes. Electric Power Research Institute, Nashville, Tennessee, November 10-12, 1981.

Discussion leader. Specific Ion Effects and Solubility Limits; review paper, "Solubility Controlling Solid Phases of Actinides in Wastes," presented at a workshop on Leaching Mechanisms. High Level Waste Office and Materials Characterization Center, Seattle, Washington, October 27-28, 1981.

Research paper. "Maximum Concentrations of Actinides in Geologic Media," presented at the American Nuclear Society

and European Nuclear Society 1980 International Conference, November 16-21, 1980.

Session chairman. “Plutonium and Environment”. Workshop on the Migration of Long-Lived Radionuclides in the Geosphere. Commission of the European Communities and OECD Society 1980 International Conference, Brussels, Belgium, November 16-21, 1980.

Research paper, “Preliminary Results on Comparison of Adsorption-Desorption Methods and Statistical Techniques to Generate K_d Predictor Equations,” presented at a workshop on the Migration of Long-Lived Radionuclides in the Geosphere. Commission of the European Communities and OECD Society 1980 International Conference, Brussels, Belgium, November 16-21, 1980.

PROJECT MANAGEMENT

Summary of Key Grants and Contracts for which Dr. Dhanpat Rai Was Principal Investigator and Project Manager

<u>Project</u>	<u>Period</u>	<u>Funding (\$ millions)</u>	<u>Client^(a)</u>
Develop and show application of fundamental data to predict chemistry of fossil fuel waste leachate for major and trace elements (e.g., Ca, Ba, Sr, sulfite, Cr, Cu, and Zn)	1985 - 1996	8.8	EPRI
Develop thermochemical and other fundamental geochemical data for Cr, Cd, B, Se, As, and V to predict their geochemical behavior	1982 - 1996	8.4	EPRI
Determine environmental impacts of co-managing high- and low-volume wastes	1995 - 2000	2.8	EPRI
Develop thermochemical data for actinides to predict their geochemical behavior			
- Predicting leachability of low level waste glasses	1995	0.4	USDOE
- Actinide solubilities in brine	1994 - 2001	3.2	USDOE (WIPP)
- Solubilities, complexation, redox reactions, and high temperature thermodynamics of actinides	1988 - 2007	7.1	JAEA
	1997 - 2007	3.6	USDOE (EMSP/NABIR) ^(b)
	1996 - 2000	1.2	USDOE (PIP) ^(b)
	1979 - 1987	7.0	USDOE ^(c)
- Actinide behavior in cementitious and low-level wastes	1995 - 1998	1.0	MMC
- Thermodynamics of elements important in nuclear waste disposal	2007 - Present	0.7	JAEA

^(a) EPRI, Electric Power Research Institute; USDOE, U.S. Department of Energy; WIPP, Waste Isolation Pilot Project; JAEA, Japan Atomic Energy Agency (Formerly PNC, Japan Power Reactor and Nuclear Fuel Development corp.; JNC, Japan Power Reactor and Nuclear Cycle Development Institute) ; MMC, Mitsubishi Materials Corporation, Japan; EMSP, Environmental Management Sciences Program; NABIR, Natural and Accelerated Bioremediation Research.

^(b) Different projects obtained under this category are Pu redox reactions (EMSP No. 27623), Cr behavior in high-level waste tanks (EMSP Nos. 65368 & 81896), Microbially promoted solubilization of Pu from steel corrosion products (EMSP; Co-PI), Biodegradation of PuEDTA (NABIR No. 26789; Co-PI), and Plutonium Immobilization Project (PIP), Development of biodegradable isosaccharinate-containing foams for decontamination of actinides (EMSP No. 82715).

^(c) U. S. High-level waste repository programs: Waste Isolation Safety Assessment Program (WISAP), Geomedia Interaction Studies (GMIS) program, Waste-Rock Interaction Technology (WRIT) program, Basalt Waste Isolation Program (BWIP).

PUBLICATIONS

Summary of Publications

<u>Type</u>	<u>Total</u>
Journal articles	115
Books, book chapters and conference articles	36
Technical reports	<u>92</u>
Total	243

Journal Articles

Rai, Dhanpat, A. R. Felmy, D. A. Moore, A. Kitamura, H. Yoshikawa, R. Doi, and Y. Yoshida. 2013. Thermodynamic Model for the Solubility of Ba(SeO₄, SO₄) Precipitates. *Radiochimica Acta* (In Review)

Rai, Dhanpat, A. R. Felmy, D. A. Moore, A. Kitamura, H. Yoshikawa, R. Doi, and Y. Yoshida. 2013. Thermodynamic Model for the Solubility of BaSeO₄(cr) in the Aqueous Ba²⁺-SeO₄²⁻-Na⁺-H⁺-OH⁻-H₂O System: Extending to High Selenate Concentrations. *Radiochimica Acta* (In Review)

Rai, Dhanpat, M. Yui, A. Kitamura, H. Yoshikawa, and A. R. Felmy. 2013. Thermodynamic Model for the Solubility of NdF₃(cr) in the Na⁺-NH₄⁺-Nd³⁺-F⁻-H₂O System at 25°C. *Journal of Solution Chemistry* **42**: 1500-1517 (DOI 10.1007/s10953-013-0049-z)

Rai, Dhanpat, M. Yui, and A. Kitamura. 2012. Thermodynamic Model for Amorphous Pd(OH)₂ Solubility in the Aqueous Na⁺-K⁺-H⁺-OH⁻-Cl⁻-ClO₄⁻-H₂O System at 25°C: A Critical Review. *Journal of Solution Chemistry* **41**: 1965-1985 (DOI 10.1007/s10953-012-9918-0).

Rai, Dhanpat, M. Yui, D. A. Moore. 2012. Isosaccharinate Complexes of Fe(III). *Journal of Solution Chemistry* **41**: 1906-1921 (DOI 10.1007/s10953-012-9911-7)

Felmy, A. R., D. A. Moore, K. M. Rosso, O. Qafoku, Dhanpat Rai, E. C. Buck, and E. S. Ilton. 2011. Heterogeneous Reduction Reactions of PuO₂ with Fe(II): Importance of the Fe(III) Reaction Product. *Environmental Science and Technology* **45**: 3952-3958 (dx.doi.org/10.1021/es10421g).

Rai, Dhanpat, M. Yui, A. Kitamura, and B. Grambow. 2011. Thermodynamic Approach for Predicting Actinide and Rare Earth Concentrations in Leachates from Radioactive Waste Glasses. *Journal of Solution Chemistry* **40**: 1473-1504 (DOI 10.1007/s10953-011-9725-z)

Rai, Dhanpat, M. Yui, H. T. Schaeff, and A. Kitamura. 2011. Thermodynamic Model for SnO₂(cr) and SnO₂(am) Solubility in the Aqueous Na⁺-H⁺-OH⁻-Cl⁻-H₂O System. *Journal of Solution Chemistry* **40**: 1155-1172 (DOI 10.1007/s10953-011-9723-1).

Rai, Dhanpat, D. A. Moore, A. R. Felmy, K. M. Rosso, H. Bolton, Jr. 2010. PuPO₄(cr, hyd.) Solubility Product and Pu³⁺ Complexes With Phosphate and Ethylenediaminetetraacetic Acid. *J. Solution Chemistry* **39**: 778 – 807.

Rai, Dhanpat, Mikazu Yui, H. T. Schaeff, and A. Kitamura. 2010. Thermodynamic Model for BiPO₄(c) and Bi(OH)₃(am) Solubility in the Aqueous Na⁺-H⁺-H₂PO₄⁻-HPO₄²⁻-PO₄³⁻-OH⁻-Cl⁻-H₂O System. *Journal of Solution Chemistry* **39**: 999-1019.

Rai, Dhanpat, Mikazu Yui, D. A. Moore, L. Rao 2009. Thermodynamic Model for ThO₂(am) Solubility in Isosaccharinate Solutions. *Journal of Solution Chemistry* **38**: 1573 - 1587

Rai, Dhanpat, Mikazu Yui, D. A. Moore, G. J. Lumetta, K. M. Rosso, Y. Xia, A. R. Felmy, and F. N. Skomurski. 2008. Thermodynamic Model for ThO₂(am) Solubility in Alkaline-Silica Solutions. *Journal of Solution Chemistry* **37**: 1725-1746.

Rai, Dhanpat, D. A. Moore, K. M. Rosso, A. R. Felmy, H. Bolton, Jr.. 2008. Environmental Mobility of Pu(IV) in the Presence of Ethylenediaminetetraacetic acid: Myth or Reality. *Journal of Solution Chemistry* **37**: 957 – 986.

- Rai, Dhanpat, D. A. Moore, N. J. Hess, K. M. Rosso, L. Rao, S. M. Heald. 2007. Chromium(III) Hydroxide Solubility in the Aqueous K^+ - H^+ - OH^- - CO_2 - HCO_3^- - CO_3^{2-} - H_2O System: A Thermodynamic Model. *Journal of Solution Chemistry* **36**(10): 1261-1285
- Jiang, H., L. Rao, Z. Zhang, and Dhanpat Rai. 2006. Characterization and Oxidation of Chromium(III) by Sodium Hypochlorite in Alkaline Solutions. *Inorganica Chimica Acta* **359**: 3237-3242.
- Rai, Dhanpat, Y. Xia, L. Rao, N. J. Hess, A. R. Felmy, D. A. Moore, D. E. McCready. 2005. Solubility of $(UO_2)_3(PO_4)_2 \cdot 4H_2O$ in H^+ - Na^+ - OH^- - $H_2PO_4^-$ - HPO_4^{2-} - PO_4^{3-} - H_2O and its Comparison to the Analogous PuO_2^{2+} System. *Journal of Solution Chemistry* **34**: 469-498.
- Rai Dhanpat, M. Yui, N. J. Hess, A. R. Felmy, D. A. Moore. 2005. Thorium Reactions in Borosilicate-Glass/water Systems. *Radiochimica Acta* **93**: 443-455.
- Rai, Dhanpat, D. A. Moore, N. J. Hess, L. Rao, S. B. Clark. 2004. Chromium(III) Hydroxide Solubility in the Aqueous Na^+ - OH^- - $H_2PO_4^-$ - HPO_4^{2-} - PO_4^{3-} - H_2O System: A Thermodynamic Model. *Journal of Solution Chemistry* **33**: 1213-1242.
- Rao, L., A. Yu. Garnov, Dhanpat Rai, Y. Xia, R. C. Moore. 2004. Protonation and Complexation of Isosaccharinic Acid With U(VI) and Fe(III) in Acidic Solution: Potentiometric and Calorimetric Studies. *Radiochimica Acta* **92**: 575-581
- Hess, N. J., Y. Xia, Dhanpat Rai, S. D. Conradson. 2004. Thermodynamic Model for the Solubility of $TcO_2 \cdot xH_2O(am)$ in the Aqueous $Tc(IV)$ - Na^+ - H^+ - Cl^- - OH^- - H_2O System. *Journal of Solution Chemistry* **33**: 199-226.
- Rai, Dhanpat, N. J. Hess, M. Yui, A. R. Felmy, D. A. Moore. 2004. Thermodynamics and Solubility of $(U_xNp_{1-x})O_2(am)$ Solid Solution in the Carbonate System. *Radiochimica Acta* **92**: 527-535.
- Zhang, Z., L. Rao, Dhanpat Rai, S. B. Clark. 2004. Characterization of Chromium(III) Hydroxide Solids and Their Oxidation by Hydrogen Peroxide. *Materials Research Society Symposium Proceedings* **824**: CC6.5.1 – CC6.5.6.
- Rai, Dhanpat, N. J. Hess, Y. Xia, L. Rao, H. M. Cho, R. C. Moore, Luc R. Van Loon. 2003. Comprehensive Thermodynamic Model Applicable to Highly Acidic to Basic Conditions for Isosaccharinate Reactions with Ca(II) and Np(IV). *Journal of Solution Chemistry* **32**: 665-689.
- Cho, H. M., Dhanpat Rai, N. J. Hess, Y. Xia, and L. Rao. 2003. Acidity and Structure of Isosaccharinate in Aqueous Solution: A Nuclear Magnetic Resonance Study. *Journal of Solution Chemistry* **32**: 691-702.
- Yui, M., Dhanpat Rai, M. Ochs, and M. Shibata. 2003. Applicability of Thermodynamic Database of Radioactive Elements Developed for the Japanese Performance Assessment of HLW Repository. *Journal of Nuclear Science and Technology* **40**: 356-362.
- Rai, Dhanpat, A. R. Felmy, M. Yui. 2003. Thermodynamic Model for the Solubility of $NdPO_4(c)$ in the Aqueous Na^+ - H^+ - $H_2PO_4^-$ - HPO_4^{2-} - OH^- - Cl^- - H_2O System. *Journal of Radioanalytical and Nuclear Chemistry* **256**: 37-43.
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