Rolf S. Arvidson

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Experimental geochemist with 30 years experience as a university research scientist in earth and material sciences. Broad expertise in the interactions of natural and synthetic materials with their physical, chemical, and biological environment. A leader and a collaborative team player in training and supervising students, whether as undergraduates, graduate students, postdoctoral scientists. Career focus on the physical chemistry of mineral dissolution and growth, applied to critical processes governing stability, reactivity, transport of all materials, as well as their social and economic impact in all environments. Designer of experimental, analytical, simulation, and computer modeling approaches to the study of reactions at the nanoscale. Solid publication history: results of funded work published in >140 peer-reviewed papers and conference abstracts in top tier earth, materials science journals. Secondary school science teacher with pending Texas certification in Science (grades 7-12).

professional history and activities

- Teacher, Science (AP Environmental Science, Chemistry). Elkins High School, Fort Bend Independent School District, Sugar Land TX 77479. Acquired Intern Certification 2/2025, Full Certification anticipated 2026.
- Laboratory Manager & Senior Research Scientist. MARUM Ctr. Environmental Sci. & Dept. Geosciences, Univ. Bremen, 10/11/2012 to 3/31/2018, 60–70 hrs/week. Retired, March 2018; Guest Scientist, April 2018 – present
  - Managed research activities in surface science laboratory for vertical scanning interferometry (VSI), atomic force microscopy (AFM), Raman spectrometry, hydrothermal mineral-fluid experimentation and analysis, computer modeling and simulation.
  - Supervised research for application of surface microscopy (AFM, VSI) to problem of early cement hydration. Member of multi-disciplinary international working group for this project (industry and FHWA government, academic engineers and scientists): managed in-house budget, designed experiments, material, supervised graduate student research.
  - Lecturer in graduate courses in Materials Science, Chemical Thermodynamics & Kinetics (2013–2018). Supervisor and thesis referee for graduate student research.
  - System administrator of Linux high performance research computing cluster and secure web server.
- Senior Research Scientist. Dept. Earth Science, Rice University, Houston TX 77005, 10/1999 to 8/2012, 60–70 hrs/week
  - Designed and conducted experimental, theoretical, and modeling research on mineral-water kinetics and thermodynamics. Planned projects and budgets, designed experimental systems, analytical routines, published peer-reviewed research results in top tier journals and reports to extramural funding agencies. Author US Patent *8164756 B2*.
  - Invited lecturer and speaker: Tutorial Workshop, American Ceramic Society/Cement Division (2012); Rice University Brine Chemistry Consortium Short Course (2005); Bureau of Economic Geology Seminar & Workshop, Jackson School of Geosciences, University of Texas at Austin (2005).
  - Supervised research of postdocs, graduate and undergraduate students. Mentor, CBEN Nanotechnology Research Experience for Undergraduates. Lecturer in mineralogy (1999).
- Postdoctoral Researcher. Dept. Oceanography, Texas A&M Univ., College Station TX 77843, 10/1999 to 8/2012, 60–70 hrs/week
  - Team Scientist and collaborator in multi-disciplinary, multi-investigator MMS-funded oceanographic research project CHEMO-II '*Stability and change in Gulf of Mexico chemosynthetic communities*'. Supervised shipboard data collection, analytical work in sedimentary geochemistry laboratory, generated over 10,000 solid phase, porewater analyses and radioactivity assays of microbial sulfate reduction rate.[1]
- Research Assistant. School of Ocean and Earth Science and Technology, University of Hawai'i at Mānoa, Honolulu HI 96822, 9/1989 to 5/1997.
- Teaching and Research Assistant. Department of Geology, University of Iowa, Iowa City IA 52242, 9/1987 to 5/1989.
- Exploration Geologist. Petroventures, Denver CO 80202, 1/1980 to 5/1986.

core skills

- Author, multi-disciplinary project collaborator, editor, referee, with excellent track record of professional scholarship. Strong experience in presentations to the scientific community and the general public. Educator, mentor, trainer, group leader.
- Integrating experimental, model, and field studies. Deep understanding of reaction kinetics, thermodynamics, and environmental cycling of important mineral phases.
- Technical prowess in design of innovative experimental and analytical systems, patent holder. Expertise in computer languages and software code (C++, Fortran, Python, R, Matlab) generation in research and teaching environments.

career achievements

- Author of the kinetic equation for dolomite growth from solution [11] (now assimilated into reactive-transport modeling codes, e.g. TOUGHREACT).
- Novel, direct measurements of dissolution rates for mineral phases important to environmental science and industry. My work on calcite dissolution[12,13] introduced the concept of intrinsic rate variability, identified the problems of describing rates via fixed constants, and the necessity of a probabilistic approach.[12,14–18]

- Lead architect of MAGic, software modeling surface and burial reservoir evolution over deep geologic time, with results tying changes in atmospheric and seawater CO_2 content to the sedimentary rock record.[2–5]
- Design of an environmental fluid cell providing near-real-time analysis of reacting mineral surfaces[18], lateral resolution enhancement of a white light interferometer via analytical, computational, and machine control techniques[6], and design of numerous reactors for varied applications, ranging from the extremely rapid dissolution of cement clinker during early cement hydration to extremely slow silicate dissolution and dolomite growth.[11,14]

current research interests

- The 'scaling' (length, time, rate) problem: relationship of nanoscale observations to macroscopic stability, reactivity of materials in environmental and industrial processes (e.g., weathering, oxidation, corrosion, biological interaction)[7–9], predictive capability valuable to environmental policymakers, industry.
- Simulation of particle reactions via kinetic Monte Carlo techniques. In nanomaterial systems, use of a large number of such simulations can create a 'virtual powder', yielding insight into statistical variation in reactivity over time.[10]

education, academic honors, & scholarship awards

- Currently pursuing full Texas certification in Science, grades 7-12, TEA Intern Certification granted 2/2025.
- PhD Oceanography 1998, University of Hawaii at Manoa. Dissertation: '*The kinetics of dolomite precipitation with application to changes in seawater saturation state over the past 100 Ma*'. Seven journal papers published as a student, four as first author. GPA 3.93/4.00. Supervisor: FT Mackenzie. Research awards: 1995 ARCS Scholar (ARCS Foundation), 1993 Outstanding Student Research Award (Geological Society of America), 1992–1993 J. Watamull Scholarship Award (Watamull Foundation, Honolulu HI). Research cruises: WOCE (1994 P31, R/V Thomas G. Thompson) and MIDPAC 4 (1989 SO 66, R/V Sonne).
- MS Geology 1990, University of Iowa '*Stratigraphy, carbonate petrology, diagenesis, and trace element geochemistry of the Wyandotte Limestone (Upper Pennsylvanian), Miami County, Kansas*'. 3.90/4.00 GPA. Supervisor: PH Heckel.
- BS Geology 1980, University of Washington

service to the scientific community

- Associate Editor, *Aquatic Geochemistry*, 2010 – present.
- Editorial Board Member, *Chemical Geology*, 2016 – present.
- Guest Editor, American Journal of Science, 2017 – 2020, Special Issue, 'Directions in Fluid-Solid Interaction Theory'.
- Recognized as external referee for leading journals in earth and environmental sciences and chemistry, 1999 – present. Outstanding Reviewer (top 10th percentile) for Chem. Geology (2017) and Geochim. Cosmochim. Acta (2018).

cited work

[1] R.S. Arvidson, J.W. Morse, and S.B. Joye, The sulfur biogeochemistry of chemosynthetic cold seep communities, Gulf of Mexico, USA, *Mar. Chem.* **87**(3-4), 97–119 (2004).

[2] *R.S. Arvidson, F.T. Mackenzie, and M. Guidry, MAGic: A Phanerozoic model for the geochemical cycling of major rock-forming components, Am. J. Sci.* **306***(3), 135–190 (2006).*

[3] *R.S. Arvidson, M.W. Guidry, and F.T. Mackenzie, Dolomite controls on Phanerozoic seawater chemistry, Aquat. Geochem.* **17***(4-5), 735–747 (2011).*

[4] *R.S. Arvidson, M. Guidry, and F.T. Mackenzie, Geologic history of seawater: A* MAGic *approach to carbon chemistry and ocean ventilation, Chem. Geol. (invited paper)* **362***(20), 287–304 (2013).*

[5] *R.S. Arvidson, F.T. Mackenzie, and R.A. Berner, The sensitivity of the Phanerozoic inorganic carbon system to the onset of pelagic sedimentation, Aquat. Geochem. (invited paper)* **20***(2–3), 343–362 (2014).*

[6] *R.S. Arvidson, C. Fischer, D.S. Sawyer, G. Scott, D. Natelson, and A. Lüttge, Lateral resolution enhancement of vertical scanning interferometry by sub-pixel sampling, Microsc. Microanal.* **20***(1), 90–98 (2014).*

[7] *A. Lüttge, R.S. Arvidson, and C. Fischer, A stochastic treatment of crystal dissolution kinetics, Elements* **9***(3), 183–188 (2013).*

[8] *A. Luttge, R.S. Arvidson, C. Fischer, and I. Kurganskaya, Kinetic concepts for quantitative prediction of fluid-solid interactions, Chem. Geol. (invited paper)* **504** *216–235 (2019).*

[9] *I. Lange, M. Toro, R.S. Arvidson, and A. Luttge, The role of crystal heterogeneity in alkali feldspar dissolution kinetics, Geochim. Cosmochim. Acta.* **309** *329-351 (2021).*

[10] *L. Briese, R.S. Arvidson, and A. Luttge, The effect of crystal size variation on the rate of dissolution – A kinetic Monte Carlo study, Geochim. Cosmochim. Acta* **212** *167–175 (2017).*

[11] R.S. Arvidson and F.T. Mackenzie, The dolomite problem: Control of precipitation kinetics by temperature and saturation state, *Am. J. Sci.* **299**(4), 257–288 (1999).

[12] R.S. Arvidson, I.E. Ertan, J.E. Amonette, and A. Luttge, Variation in calcite dissolution rates: A fundamental problem?, *Geochim. Cosmochim. Acta* **67**(9), 1623–1634 (2003).

[13] C. Fischer, R.S. Arvidson, and A. Lüttge, How predictable are dissolution rates of crystalline material?, *Geochim. Cosmochim. Acta* **98**(0), 177–185 (2012).

[14] R.S. Arvidson, M.S. Beig, and A. Luttge, Single-crystal plagioclase feldspar dissolution rates measured by vertical scanning interferometry, *Am. Mineral.* **89**(1), 51–56 (2004).

[15] R.S. Arvidson, M. Collier, K.J. Davis, M.D. Vinson, J.E. Amonette, and A. Luttge, Magnesium inhibition of calcite dissolution kinetics, *Geochim. Cosmochim. Acta* **70**(3), 583–594 (2006).

[16] R.S. Arvidson and A. Luttge, Mineral dissolution kinetics as a function of distance from equilibrium - New experimental results, *Chem. Geol. (invited paper)* **269**(1-2), 79–88 (2010).

[17] P. Juilland, L. Nicoleau, R. Arvidson, and E. Gallucci, Advances in dissolution understanding and their implications for cement hydration, *RILEM Technical Letters* **2** 90–98 (2017).

[18] I. Bibi, R.S. Arvidson, C. Fischer, and A. Luttge, Temporal evolution of calcite surface dissolution kinetics, *Minerals* **8**(6), 256 (2018).