GORDON N. KEATING

GISLab, Environmental Geology and Risk Analysis Group (EES-9), Earth and Environmental Sciences Division, MS D452, Los Alamos National Laboratory, Los Alamos, NM 87545; (505) 667-5902; 667-1628 (fax); gkeating@lanl.gov

EDUCATION

Ph.D. with Distinction, Geology, **University of New Mexico**, Albuquerque, NM, 2000. Dissertation Title: *Multiphase Thermal Modeling in Volcanic and Contact Metamorphic Terranes*, Advisors: Gary Smith (UNM), Greg Valentine (LANL).

M.S. Geology, **Michigan Technological University**, Houghton, MI, 1992. Thesis Title: *A Simulation of Magma-Seawater Interaction at Augustine Volcano, Alaska*, Advisors: William Rose, John Gierke.

B.A. with Distinction, Geology, **Carleton College**, Northfield, MN, 1988; cum laude.

HONORS AND AWARDS

2004-08 3 Los Alamos Spot Awards for work on Yucca Mountain Project volcanism
2005 Los Alamos Award, Resumption of Activities after LANL Stand-Down
2003 Los Alamos Award, Enterprise GIS Science and Technology
1998 Excellence in Graduate Research Award, Sigma Xi

RESEARCH AND PROFESSIONAL EXPERIENCE

Technical Staff Member (2003-present) GISLab, EES-9, LANL

Performing physical volcanology and modeling activities for the Yucca Mountain Project, Lead for igneous consequences analysis for YMP; Lead for GIS integration for the LANL carbon sequestration program; Lead for development of energy-water sustainability web portal for Sonoma County, CA, including interactive systems model and public participation; Lead for decision support and earth science applications in the GISLab team.

Postdoctoral Research Associate 2000-2003, GISLab, EES-9, LANL

Developed enterprise GIS for the Cerro Grande Wildfire Rehabilitation Project (CGRP), including a spatial data warehouse, Internet GIS (ArcIMS), and Web-based consensus-building tools. Developed physical volcanology and GIS techniques for evaluating the probability of disruptive volcanic events at Yucca Mountain, Nevada. Investigated online consensus-building and conflict-clarification techniques and public-participation GIS. Developed GIS tools and performed petrographic analyses to characterize volcanic stratigraphy at the Nevada Test Site in support of the Underground Test Areas (UGTA) environmental restoration project.

Graduate Research Assistant, Guest Scientist 1995-2000, Geoanalysis Group, LANL

Dissertation research: developed numerical methods in high-temperature and -pressure thermodynamics for use in models of igneous and metamorphic heat- and fluid-flow systems. Applied models to investigations of cooling processes in ash-flow tuffs, to the duration of geomagnetic reversal preserved in the contact metamorphic aureole of the Paiute Ridge, NV, intrusive complex, and to the nature of heat transfer in the contact aureole of the Grants Ridge, NM, intrusion. Wrote and assisted in writing successful grant proposals.

RESEARCH AND PROFESSIONAL EXPERIENCE (continued)

Project Hydrogeologist 1991-1994; RMT, Inc., Madison, WI

Designed, coordinated, and performed multi-year field investigations of soil and groundwater contamination for petroleum hydrocarbons, cholorinated solvents, and heavy metals. Designed and performed aquifer hydraulic testing. Performed 3-dimensional numerical modeling of groundwater flow and solute transport. Performed capture zone analyses for remediation design and wellhead protection plans. Developed project proposals, budgets, and workplans for projects regulated by local, state, and federal agencies. Organized field, analytical, and modeling data and interpretations into detailed reports for regulatory agencies.

Physical Science Technician 1988-1989, U.S. Geological Survey, Menlo Park, CA and Cascades Volcano Observatory, Vancouver, WA

Mapped and interpreted Holocene volcanic stratigraphy in the Lassen National Park region as part of a regional project. Monitored eruptive activity at Mount St. Helens, including dome magnetic and deformation studies. Measured regional ground deformation due to magma movement as part of geodetic studies at Yellowstone National Park, Wyoming, and Medicine Lake Volcano, California. Prepared hazard maps for international sites at risk from volcanic eruption. Used GIS to study morphologic changes in Mount St. Helens' crater. Maintained volcano monitoring equipment (seismometers, tiltmeters, strain meters).

Geologist 1986, Geo-technical Associates, Inc., Collinsville, Illinois

Investigated geological and geotechnical evidence for coal mine subsidence, including evaluation of the extent of ground deformation through the installation and monitoring of level-survey networks and tiltmeters and inspections of homes. Researched historical mining activity in effected areas.

PROFESSIONAL ACTIVITIES

Proposal reviewer: National Science Foundation, Institute of Geophysics and Planetary Physics

Reviewer: Journal of Volcanology and Geothermal Research, Bulletin of Volcanology, Journal of Geophysical Research, EOS, and Nuclear Technology

Member : LANL EES Division Science and Engineering Leadership Team

GIS Technical Advisory Team, Regional Development Corporation (Santa Fe), proposal review, regional GIS to promote economic development.

Liaison, Bandelier National Monument; represented Bandelier interpretation needs at the NPS/USGS Volcanism in the National Parks conference, Sept. 2000.

RECENT FUNDED PROPOSALS; FELLOWSHIPS AND GRANTS

Keating, Ziock, Witkowski, 2007. Energy-Water Systems, Carbon Management, and Social Impact, Sonoma County, California, ($25K)

Ziock, Rasmussen, Keating, et al., 2007. Energy Systems, Planetary Management, and Social Impact, LANL ADCLES, ($50K)

Keating, 2005. GIS support for the Probabilistic Volcanic Hazards Assessment, Yucca Mountain Project ($100K)

Institute of Geophysics and Planetary Physics grant (with G. Valentine and J. Geissman); 1996, $23000, renewed 1997, 1998.

Associated Western Universities Laboratory Graduate Fellowship, 1996

PROFESSIONAL AFFILIATIONS

American Geophysical Union, Geological Society of America, Sigma Xi, Phi Kappa Phi

PUBLICATIONS

Journal Articles

Keating, G.N., J.D. Pelletier, G.A. Valentine, and W. Statham, Evaluating suitability of a tephra dispersal model as part of a hazards assessment framework, *J. Volcanolology and Geothermal Research*, in press.

Keating, G.N., D.J. Krier, G.A. Valentine, and F.V. Perry, 2008, Shallow Plumbing Systems for Small-Volume Basaltic Centers, *Bulletin of Volcanology* 70: 563-582, DOI: 10.1007/s00445-007-0154-1.

Pelletier, J.D., M.L. Cline, S.B. DeLong, C.D. Harrington, and **G.N. Keating**, 2008, Dispersion of channel-sediment contaminants in distributary fluvial systems: Application to fluvial tephra and radionuclide redistribution following a potential volcanic eruption at Yucca Mountain, *Geomorphology* 94: 226-246, doi:10.1016/j.geomorph.2007.05.014.

Witkowski, M.S., P.M. Rich, and **G.N. Keating**. 2007, Metrics of success for enterprise geographic information systems (EGIS). *J. Map and Geography Libraries* 4(1): 59-82.

Valentine, G.A., and **G.N. Keating**, 2007, Eruptive styles and inferences about plumbing systems at Hidden Cone and Little Black Peak scoria cone volcanoes (Nevada, U.S.A.), *Bulletin of Volcanology* 70: 105-113; DOI 10.1007/s00445-007-0123-8.

Valentine, G.A., F.V. Perry, D.A. Krier, **G.N. Keating**, R.E. Kelley, and A.H. Cogbill, 2006, Small-volume basaltic volcanoes: eruptive products and processes, and post-eruptive geomorphic evolution in Crater Flat (Pleistocene) southern Nevada, *GSA Bulletin* 118 (11/12): 1313–1330; doi: 10.1130/B25956.1.

Pelletier, J.D., C.D. Harrington, J.W. Whitney, M. Cline, S.B. DeLong, **G. Keating**, and T. Ebert, 2005, Geomorphic control of radionuclide diffusion in desert soils, *Geophysical Research Letters* 32, L23401, doi:10.1029/2005GL024347.

Keating, G.N., 2005, The role of water in cooling ignimbrites, *J. Volcanology and Geothermal Research* 142: 145-171.

Mynard, C.R., **G.N. Keating,** and P.M. Rich, 2005, GIS for Emergency Response: Lessons from the Cerro Grande Wildfire, *J. Emergency Management* 3: 19-28.

Keating, G.N., P.M. Rich, and M.S. Witkowski, 2003, Challenges for enterprise GIS, *URISA Journal*15(2): 25-39.

Rasmussen, S., M. Raven, **G.N. Keating**, and M. Bedau, 2003, Collective intelligence of the Artificial Life community on its own successes, failures, and the future, *Artificial Life* 9(2): 207-235.

Keating, G.N., J.W. Geissman, and G.A. Zyvoloski, 2002, Multiphase modeling of contact metamorphic systems and application to transitional geomagnetic fields, *Earth and Planetary Science Letters* 128: 425-444.

WoldeGabriel, G., **Keating, G.N.**, and G.A. Valentine, 1999, Effects of shallow basaltic intrusion into pyroclastic deposits, Grants Ridge, New Mexico, USA, *J. Volcanology and Geothermal Research* 92: 389-411.

Keating, G.N. and G.A. Valentine, 1998, Proximal stratigraphy and syn-eruptive faulting in rhyolitic Grants Ridge Tuff, New Mexico, USA, *J. Volcanology and Geothermal Research* 81(1-2): 37-49.

Wobus, R.A., D.W. Mochel, S.A. Mertzmann, E.A. Eide, M.A. Rothwarf, B.M. Loeffler, D.A. Johnson, **G.N. Keating**, K. Sultze, A.E. Benjamin, E.A. Venzke, and T. Filson, 1990, Geochemistry of high-potassium rocks from the mid-Tertiary Guffey volcanic center, Thirtynine Mile volcanic field, central Colorado, *Geology* 18: 642-645.

PUBLICATIONS (continued)

Book Chapters

Mynard, C.R., **G.N. Keating**, and P.M. Rich. 2006. Mutualism among GIS community pays off in a New Mexico fire emergency. *In* Christopher Thomas, ed., Standards for Success: GIS for Federal Progress and Accountability. ESRI Press, Redlands, CA, 100 p.

Reports

Keating, G.N., 2007, Atmospheric dispersal and deposition of tephra from a potential volcanic eruption at Yucca Mountain, Nevada, Yucca Mountain Program Model Report MDL-MGR-GS-000002 Rev. 03, 300 p.

Keating, G.N., 2007, Total System Performance Assessment (TSPA) Data Input Package For Ashplume Input Parameters, Yucca Mountain Program Report TDL-TDIP-DE-000003, Rev. 00, 130 p.

Mynard, C.R., **G.N. Keating**, P.M. Rich, and D.R. Bleakly, 2003, Geographic information system (GIS) emergency support for the May 2000 Cerro Grande Wildfire, Los Alamos, New Mexico, USA, Los Alamos National Laboratory Report LA-14007.

Witkowski, M.S., P.M. Rich, and **G.N. Keating**, 2003, A Prototype for Enterprise GIS, Los Alamos National Laboratory Report LA-14027.

Keating, G.N., P.M. Rich, M.S. Witkowski, C.M. Batts, J.H. Deming, M.A. Jones, S.P. Linger, C.R. Mynard, T.L. Riggs, and D. Walther, 2002, Challenges for enterprise GIS in post-wildfire hazard mitigation and emergency management, Los Alamos National Laboratory Report LA-13930.

Mynard, C.R., **G.N. Keating**, P.M. Rich, and D. Bleakly, 2002, GIS Emergency Support For the May 2000 Cerro Grande Wildfire, Los Alamos, New Mexico, USA, Los Alamos National Laboratory Report LA-UR-02-6746.

Keating, G.N., S. Rasmussen, and M. Raven, 2002, Web-based consensus-building and conflict-clarification for EES Division's strategic planning process: New technical directions, Los Alamos National Laboratory Report LA-UR-02-3830.

Keating, G.N., S. Rasmussen, and M. Raven, 2001, Consensus-building tools for post-wildfire GIS design, Los Alamos National Laboratory Report LA-13894-MS, 30 p.

Keating, G., S. Rasmussen, M. Raven, E. Tso, J. Cocq, and P. Dotson, 2001, Use of web-based consensus building and conflict clarification process for the Navajo Nation governmental efficiency evaluation, Los Alamos National Laboratory Report LA-UR-01-6207, 42 p.

Lichtner, P.C., **G.N. Keating**, and J.W. Carey, 1999, The Paiute Ridge intrusive complex as a natural analogue for the potential nuclear waste repository at Yucca Mountain, Nevada, Los Alamos National Laboratory Report LA-13610-MS, 34 p.

Maps

Mills, Hugh H. and **Gordon N. Keating**, 1992, Maps showing posteruption erosion, deposition, and dome growth in Mount St. Helens crater, Washington, determined by a geographic information system, U.S. Geological Survey Miscellaneous Investigations Series Map I-2297, scale 1:12,000, 4 sheets.

PUBLICATIONS (continued)

Recent Meeting Abstracts, Presentations, and Proceedings

Keating, G N, G A Valentine, D J Krier, F V Perry, S Dartevelle, 2007, Geometry of Shallow Plumbing Systems for Small-Volume Basaltic Volcanoes and Implications for Conduit Formation, IUGG XXIV, Perugia Italy, July 2-13, 2007; invited.

Middleton, R.S., H. Herzog, **G. Keating**, M. Kuby, and X. Liao, 2007, Optimization for Geologic Carbon Sequestration and Carbon Credit Pricing, Sixth Annual Conference on Carbon Capture and Sequestration, May 7-10, 2007, Pittsburg, Pennsylvania.

Thomas McTighe, T., **G.N. Keating**, R. Pawar, P. Stauffer, and H. Viswanathan, 2007, A Distributable Application Toolset for Assessing the Performance of Carbon Sequestration Efforts with Site-Specific Variables, Sixth Annual Conference on Carbon Capture and Sequestration, May 7-10, 2007, Pittsburg, Pennsylvania.

Witkowski, M.S., **G. Keating**, M. Greene, and R. Middleton, 2007, Towards a Common Framework for CO_2 Sequestration Data Visualization, Sixth Annual Conference on Carbon Capture and Sequestration, May 7-10, 2007, Pittsburg, Pennsylvania.

Rasmussen, S., D. Mangalagiu, H. Ziock, J. Bollen, and G. Keating, 2007, Collective intelligence for decision support in very large stakeholder networks: the future US energy system, Proceedings of the IEEE Symposium on Artificial Life, CI-ALife 2007, April 1-5 2007; Honolulu, HI, pp. 468-475, doi: 10.1109/ALIFE.2007.367832.

Keating, G.N., G.A. Valentine, D.J. Krier, and F.V. Perry, 2006, Shallow plumbing systems for small-volume basaltic centers, American Geophysical Union Fall Meeting, December 11-15, 2006, San Francisco, CA

G.N. Keating, T. McTighe, R.S. Middleton, M.S. Witkowski, H.S. Viswanathan, P.H. Stauffer, and P.M. Rich, 2006, Integration of a CO2 sequestration system model and diverse geospatial data using GIS applications, Fifth Annual Conference on Carbon Capture and Sequestration, Alexandria, VA, May 8-11, 2006.

Carr, T.R., P.M. Rich, J.D. Bartley, and **G.N. Keating**, 2006, Carbon Cyberinfrastructure: the Future of NatCarb, Fifth Annual Conference on Carbon Capture and Sequestration, Alexandria, VA, May 8-11, 2006.

Viswanathan, H.S., **G.N. Keating**, et al. 2006, CO2-PENS: A CO2 sequestration systems model for geologic sequestration, Fifth Annual Conference on Carbon Capture and Sequestration, Alexandria, VA, May 8-11, 2006.

G.N. Keating, J.D. Pelletier, G.A. Valentine, 2005, Eruption to Dose: Coupling a Tephra Disperal Model Within a Performance Assessment Framework, AGU fall meeting, San Francisco, Dec. 4-9, 2005.

Krier, D J, **G N Keating**, G A Valentine, F V Perry, 2005, Some Natural Conduit Analogues for Potential Igneous Activity at Yucca Mountain, AGU fall meeting, San Francisco, Dec. 4-9, 2005.

Keating, G.N., P.M. Rich, M.S. Witkowski, and H.S. Viswanathan, 2005, GIS Knowledge Integration for Carbon Sequestration: The Cyberinfrastructure Approach, Proceedings of the Fourth Annual DOE/NETL Conference on Carbon Capture and Sequestration, Alexandria, VA, May 2-5, 2005, pp. 683-696.

Keating, G.N., T.L. Riggs, P.M. Rich, M.S. Witkowski, and H.S. Viswanathan, 2005, GIS-Based Decision Support for Carbon Sequestration, AGU Chapman Conference on The Science and Technology of Carbon Sequestration, San Diego, CA, January 16-20, 2005.

P.M. Rich, **G.N. Keating**, T.L. Riggs, M.S.Witkowski, 2005, A Vision for Carbon Cyberinfrastructure, AGU Chapman Conference on The Science and Technology of Carbon Sequestration, San Diego, CA, January 16-20, 2005.

PUBLICATIONS (continued)

Recent Meeting Abstracts, Presentations, and Proceedings (continued)

Viswanathan H.S., G. Guthrie, R. Pawar, **G. Keating**, P.C. Lichtner, and J.W. Carey, 2005, The Development of a Preliminary Performance Assessment Framework for Geologic CO_2 Sequestration, AGU Chapman Conference on The Science and Technology of Carbon Sequestration, San Diego, CA, January 16-20, 2005.

Keating, G.N., A.H. Cogbill, F.V. Perry, and R.P. Prueitt. 2004, High-resolution aeromagnetic survey map of part of the southwest Nevada volcanic field, Environmental Systems International User Conference, San Diego, CA, Aug 9-13, 2004.

WoldeGabriel, W., **Keating, G.N.**, et al., 2003, Stratigraphy, basin profiles, and structure in the eastern part of the Nevada Test Site, Nevada, Geological Society of America, Seattle, Washington, October 2003.

Krier D., G. Heiken, **G. Keating**, and F. Perry, 2003, Evaluating risk to an underground facility from a strombolian eruption, International Union of Geodesy and Geophysics, Sapporo, Japan, July 2003.

Keating, G.N. and T.L. Riggs, 2003, Micro-GIS: Petrographic analysis in a geographic framework, ESRI International User Conference, San Diego, CA, July 7-11, 2003.

Rasmussen, S., M. Raven, **G. Keating**, and M. Bedeau, 2002, Collective intelligence of the Artificial Life community: Successes, failures, and the future, Int'l Conference of Artificial Life 8, University of New South Wales, Australia, Dec. 9-13.

Witkowski, M.S., P.M. Rich, and **G.N. Keating**, S.P. Linger, and T.L. Riggs, 2002, Spatial data warehouse design for enterprise GIS, GIScience 2002, Boulder CO, Sept. 25-28, 2002.

Valentine, G.A. and **G.N. Keating,** 2000, Integration between data, simulation, and risk assessment: examples from other disciplines and implications for volcanology, Eos, Trans. Amer. Geophys. Union v. 81 (48), Fall Meeting Suppl., Abstract V51C-05, December 2000, San Francisco.

Keating, G.N. and J.W. Geissman, 1999, The rate of change of the transitional field: An estimate based on multiphase modeling and data from the Paiute Ridge intrusive complex, Nevada, Eos, Trans. Amer. Geophys. Union, v. 80, p. F285, December 1999, San Francisco.

Woldegabriel, Giday, **Gordon N. Keating**, and Greg. A. Valentine, 1999, Effects of shallow basaltic intrusion into silicic tephra, Grants Ridge, Proceedings of the New Mexico Geological Society 1999 Annual Spring Meeting, Socorro, NM, p. 46.

Keating, G.N., G.A. Zyvoloski, and G.A. Valentine, 1998, Multiphase thermal modeling of cooling ignimbrites, EOS, Trans. Amer. Geophys. Union, v. 79, no. 45, December, 1998.