

John F. Rakovan

New Mexico Bureau of Geology and Mineral Resources
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Research Interests:

My research focuses on fundamental aspects of mineralogy including as crystallography, crystal chemistry, and crystal growth, with an emphasis on their connection to environmental and technological uses of minerals, and mineral deposit formation. Much of this work deals with apatite supergroup minerals, native metals and clay minerals.

Professional Experience:

- State Mineralogist and Senior Mineral Museum Curator, New Mexico Bureau of Geology and Mineral Resources - New Mexico Tech (9/1/22 – present)
- Adjunct Professor, Department of Geology & Environmental Earth Science, Miami University (8/12/22-present)
- Adjunct Professor, Department of Earth and Environmental Earth Science, New Mexico Tech (11/3/23-present)
- Professor, Department of Geology & Environmental Earth Science, Miami University (7/1/11-present)
- Associate Professor, Department of Geology, Miami University (6/1/04-6/30/11)
- Assistant Professor, Department of Geology, Miami University (1/1/98-6/1/04)
- Postdoctoral research faculty in mineral-water interface geochemistry, Virginia Polytechnic Institute (4/1/96-12/1/97)

Recognitions:

- Honorary Lifetime Member of the Cincinnati Mineral Society (conferred 9/16/2022).
- 2021 Honorary Award recipient from the Eastern Federation of Mineralogical and Geological Societies for the AFMS Scholarship Foundation. \$8000 to give as 2 scholarships to graduate students in mineralogy (Stephanie Mounce & Calvin Anderson).
- Carnegie Mineralogical Award recipient 2019. Presented at the 2020 TGMS Show banquet. *This award honors outstanding individuals or groups whose contributions in mineralogical preservation, conservation, and education match the ideals advanced in Carnegie Museum of Natural History Hillman Hall of Minerals and Gems.*
- Eponym of the mineral rakovanite, $(\text{NH}_4)_3\text{Na}_3(\text{V}_{10}\text{O}_{28}) \cdot 12\text{H}_2\text{O}$, 2010.
- Fellow of the Mineralogical Society of America. 2007.
- National Geographic (online) article about our work on wire gold and silver. 5/22/2019.
<https://www.nationalgeographic.com/science/2019/05/worlds-rarest-form-natural-gold-reveals-secrets/>
- Los Alamos National Laboratory press release about our work on wire gold and silver. 3/2019.
<https://www.lanl.gov/discover/news-release-archive/2019/February/0213-gold-specimen-neutrons.php>
- Los Alamos National Laboratory press release about our work on gold crystallography. 4/3/2014.
<https://www.lanl.gov/newsroom/video/video-stories/worlds-largest-gold-crystal.php>
- Friends of Mineralogy Best Article award in Lithographie *Mineral Monograph* for "Color and Luminescence in Apatite." 2013.
- Friends of Mineralogy Best Article award in *Rocks & Minerals* for "Fluorite in Mississippi Valley-Type Deposits." 2013.
- Cincinnati Mineral Society educator of the year award. \$1000 stipend was used to establish an Undergraduate Research in Mineralogy fund. 1999.

Selected Appointments and Activities

- Executive Editor of *Rocks and Minerals* (5/01 – present)
- United States/MSA representative to the International Mineralogical Association (IMA) Commission on Museums (10/2022-present).
- Member and spokesperson for The Tender Energy Microspectroscopy Consortium for the TES (Tender Energy Spatially Resolved X-ray Absorption Spectroscopy) Beamline at the new National Synchrotron Light Source II. Other consortium members are Jay Brandes, The University of Georgia; Dean Hesterberg, North Carolina State University; George Flynn, State University of New York, Plattsburgh; Phoebe Lam, Woods Hole Oceanographic Inst.; Satish Myneni, Princeton University; Paul Northrup, Emma Troy Rasbury, Richard Reeder, and Donald Weidner Stony Brook University; Martin Schoonen, Brookhaven National Laboratory; Donald Sparks, University of Delaware; and Glenn Waychunas, Lawrence Berkeley National Laboratory.

- Fulbright Research Fellow and visiting Professor AGH University of Science and Technology, Krakow Poland 1/1/12-8/15/12.
- IMA Commission on New Minerals, Nomenclature and Classification Subgroup on Apatite Nomenclature (3/08-5/2010).
- National Science Foundation panel member in lead of the Advanced Photon Source Facility Review and funding (Spring/2006).
- Visiting Professor, Graduate School of Human and Environmental Studies, Kyoto University, Japan (1/05-8/05)
- Invited Associate Member of the Stony Brook NSF/DOE Center for Environmental Molecular Science (8/02-2008)
- Secretary of the International Mineralogical Association (IMA) Commission on Mineral Growth and Interface Processes 2002-2006).
- Associate Editor, American Mineralogist (5/99-5/02)
- Research Associate, Research and Collections Division, New York State Museum (7/02-present)
- Adjunct professor, Department of Chemistry, Miami University (11/99-9/1/2022)
- Guest researcher, Advanced Photon Source, Argonne National Laboratory (1998-present)
- Guest researcher, National Synchrotron Light Sources I and II, Brookhaven National Laboratory (1991-present)
- Guest researcher, Los Alamos Neutron Scattering Center (LANSCE), Los Alamos National Laboratory (2006-present)

Education:

- Ph.D. in geochemistry/mineralogy, State University of New York at Stony Brook (1/5/91-3/15/96)
- M.S. in clay mineralogy/crystallography, University of Illinois at Chicago (5/1/88-12/15/90)
- B.S. in geology, University of Illinois at Urbana-Champaign (9/1/86-5/12/88)
- Boston University (9/83-5/86)

Professional Affiliations:

- Mineralogical Society of America
- Geochemical Society
- Clay Mineral Society

Organized Short Courses/Workshops/Conference Sessions:

- 25) Co-organized (ongoing) the 43rd Annual (2023) New Mexico Mineral Symposium. To be held Nov. 10-12, 2023.
- 24) Co-organized and presented at the 50th Rochester Mineralogical Symposium (2023 online) 4/21-23/2023. Presentations available at: <https://www.youtube.com/playlist?list=PL4AllrO7xkRejCbVxCyUVkz-V3w9KXpBF>
- 23) Co-organized and hosted the 42nd Annual (2022) New Mexico Mineral Symposium. Nov. 11-13, 2022.
- 22) Co-organized and hosted the 2022 online Rochester Mineralogical Symposium 4/8-10/2022. Presentations available at: <https://www.youtube.com/playlist?list=PL4AllrO7xkRejCbVxCyUVkz-V3w9KXpBF>
- 21) Co-organized and convened 2022 GSA Joint North-Central/Southeastern Section Meeting Technical Session “Strategic Minerals of North American Midcontinent: Importance, occurrence, and U.S. initiatives. With Jared Freiburg and Craig Dietsch.
- 20) Organized and co-presented Crystallography mini-Workshop (with undergraduate student Mackenzie Rutherford and R. Peter Richards) for the 2021 online Rochester Mineralogical Symposium 4/17/2021. <https://www.youtube.com/playlist?list=PL4AllrO7xkRdSoS-4iyXVUKHf98hn34pj>
- 19) Co-organized and hosted the 2021 online Rochester Mineralogical Symposium 4/17/2021. Presentations available at: <https://www.youtube.com/playlist?list=PL4AllrO7xkRdSoS-4iyXVUKHf98hn34pj>
- 18) Co-organized and hosted the 2020 online Rochester Mineralogical Symposium 4/25/2020. Presentations available at: https://www.youtube.com/watch?v=RWIM1S_jWLM&list=PL4AllrO7xkRd_rartqBETPUBxfAGwTx6f
- 17) Co-organized the 2020 Midwest Chapter of the Friends of Mineralogy symposium. Saturday March 12, Miami University, Oxford, OH. Canceled due to COVID-19.
- 16) Co-organized and convened (with John Hughes and Jill Pasteris) theme colloquia “The Societal Relevance of Apatite” for the Mineralogical Society of America Centennial Symposium held in Washington DC June 20-21, 2019.
- 15) Co-organized and convened the 2019 Midwest Chapter of the Friends of Mineralogy symposium. Saturday March 9, Miami University, Oxford, OH.
- 14) Co-organized with Jessica J. Barnes Technical Session T114. “Apatite, from Magma to Medicine: In Honor of John M. Hughes. Geological Society of America Annual Meeting, Indianapolis. 11/7/2018.
- 13) Co-organized and convened the 2018 Midwest Chapter of the Friends of Mineralogy symposium. Saturday March 10, Miami University, Oxford, OH.
- 12) Co-organized and convened (with Virgil Lueth) with 2018 Mineralogical Society of America-Friends of Mineralogy-TGMS symposium on Crystals and Crystal Forms. Tucson, AZ. February x 2018.
- 11) Co-organized and convened the 2017 Midwest Chapter of the Friends of Mineralogy symposium on the ZnS polymorphs: sphalerite and wurtzite. Saturday March 11, Miami University, Oxford, OH.
- 10) Co-organized and convened the 2016 Midwest Chapter of the Friends of Mineralogy symposium on Midwest Fluorite Deposits. Saturday March 12, Miami University, Oxford, OH.
- 9) Co-organized and convened 2015 Midwest Chapter of the Friends of Mineralogy symposium on Native Metals.

- Saturday March 12, Miami University, Oxford, OH.
- 8) Co-organized (with Daniel Harlov, James Webster, and Francis McCubbin) a Technical Session “Apatite – a mineral for all seasons” for the 2014 annual Goldschmidt Conference in Sacramento, California.
 - 7) Co-organized and convened (with Clyde Spencer) 2014 Midwest Chapter of the Friends of Mineralogy Symposium and Field Conference on Mineral Replacement Reactions and Pseudomorphism. Saturday March 15, Miami University, Oxford, OH.
 - 6) Co-organized and convened (with Dr. Maciej Manecki) a 2-day workshop “Apatite group minerals in high and low temperature-pressure environments – unanswered questions and future research directions” AGH University of Science and Technology, Krakow Poland. June 8-9, 2012. Participants from Poland, Slovakia, Sweden, and Germany.
 - 5) Co-organized and convened 2009 Midwest Chapter of the Friends of Mineralogy Symposium and Field Conference Microdiamonds and meteorite impact structures Saturday September 5, Miami University, Oxford, OH.
 - 4) Co-organized and taught (with PHD student Olaf Borkiewicz) a 2-day workshop “Powder Diffraction Rietveld Refinement methods” at the 2nd Central-European Mineralogical Conference (CEMC) co-organized by the Mineralogical Society of Poland. September 10-11, 2008 Szklarska Poręba, South Western Poland.
 - 3) Co-organized and convened a Technical Session “T100. Whet your Apatite: Advances in Research of Natural and Biological Apatite” at the National Geological Society of America Meeting, Philadelphia, PA 10/22/2006. (Doreena Patrick, H. Catherine W. Skinner and John Rakovan)
 - 2) Co-organized and convened a two-day workshop on Phosphate Minerals sponsored by the Mineralogical Society of America and the US Department of Energy, Golden, CO 10/26-27/2002.
 - 1) Co-organized and convened a two-day Special Session on Phosphate Mineralogy, Petrology, and Materials Applications at the National Geological Society of America Meeting, Denver, CO 10/29-30/2002.

RESEARCH

Publications: (*graduate student authors indicated by * undergraduate student authors indicated by ***)

Ph.D. Dissertation

Rakovan, J. (1996) The role of crystal surface structure during growth: Trace element incorporation and epitaxy. Ph.D. dissertation, SUNY-Stony Brook.

M.S. Thesis

Rakovan, J. (1992) Rietveld Refinement of a I1b-2 clinocllore. M.S. thesis, UI-Chicago.

Edited Books and Journal Issues:

Harlov, D. and **Rakovan, J.**, Guest Editors (2015) Apatite - A mineral for all seasons. Elements 11 #3. ISSN: 1811-5209. p.155-224. <https://doi.org/10.2113/gselements.11.3.171>

Rakovan, J., Staebler, G. and Dallaire, D. Editors (2013) Apatite - The Great Pretender. Mineral monographs V. 17. Lithographie, LLC. Denver. 128 p.

Kohn, M., **Rakovan, J.**, and Hughes, J.M. Eds. (2002) Phosphates: Geochemical, Geobiological and Materials Importance. Reviews in Mineralogy and Geochemistry. Mineralogical Society of America. Washington, DC. 742 p. <https://doi.org/10.1515/9781501509636>

Papers published in refereed journals and books:

(*graduate student authors indicated by * undergraduate student authors indicated by ***)

- 126) Sordyl, J., **Rakovan, J.**, Burns, P.C., Topolska, J., Włodek, A., Szymanowski, J.E.S., Sigmon, J.E., Majka, J. and Maneck, M. (2023) Single crystal analysis of La-doped pyromorphite (Pb₅(PO₄)₃Cl). American Mineralogist, 108: (in Press) http://www.minsocam.org/MSA/Ammin/AM_Preprints.html
- 125) Betkowski*, W., **Rakovan, J.**, Harlov, D. (2023) Petrography, Mineralogy, and Geochemistry of the Llallagua Ore Body. Data In Brief. In press.
- 124) **Rakovan, J.** (2022) Who’s Who in Mineral Names: John M. Hughes. Rocks & Minerals. V. 97, p. 92-93. <https://doi.org/10.1080/00357529.2022.1989957>
- 123) **Rakovan, J.** (2022) Fluorescence Zoning: Examples in Apatite. Rocks & Minerals, 97:36-46. <https://doi.org/10.1080/00357529.2022.1989950>
- 122) Betkowski*, W., **Rakovan, J.**, Harlov, D. (2022) Geochronological characterization of Llallagua altered porphyry and hydrothermal assemblages from selected phosphate minerals and zircon. Lithos. <https://doi.org/10.1016/j.lithos.2021.106584>
- 121) Farfan, G.A., **Rakovan, J.**, Ackerson, M., Andrews, B.J., and Post, J.E. (2021) The origin of trapiche-like inclusion patterns in quartz from Inner Mongolia, China. American Mineralogist, 106: 1797–1808. <https://doi.org/10.2138/am-2021-7454>
- 120) Olds, T.A., Kampf, A.R., **Rakovan, J.**, Burns, P.C., Mills, O.P., and Laughlin-Yurs, C. (2021)

- Hydroxylpyromorphite, modern description and characterization of a mineral important to lead-remediation. *American Mineralogist*, 106: 922–929. <https://doi.org/10.2138/am-2021-7516>
- 119) **Rakovan, J.** (2021) Large Faceted Synthetic Forsterite and Synthetic Tephroite. *Gem-A*, 73: 469-470. <https://doi.org/10.15506/JoG.2021.37.5.469>
- 118) **Rakovan, J.** and Scovil, J. (2021) Apatite and the Apatite Supergroup. *Rocks & Minerals*, 96:13-19.
- 117) **Rakovan, J.** (2021) Coming to Terms with Fluorescence: A Short Glossary of Common Terms in the Context of Mineral Fluorescence. *Rocks & Minerals*, 96:20-23.
- 116) Manecki, M., Kwaśniak-Kominek*, M., Majka, J.M., **Rakovan, J.** (2020) Model of interface-coupled dissolution-precipitation mechanism of pseudomorphic replacement reaction in aqueous solutions based on the system of cerussite $PbCO_3$ - pyromorphite $Pb_5(PO_4)_3Cl$. *Geochemica et Cosmochimica Acta*. 289:1-13. <https://doi.org/10.1016/j.gca.2020.08.015>
- 115) Emprto*, C., Alvarez**, A., Anderkin*, C., **Rakovan, J.** (2020) The Crystallinity of Apatite in Contact with Metamict Pyrochlore from the Silver Crater Mine, ON, Canada. *Minerals*, 10, 244. <http://dx.doi.org/10.3390/min10030244>
- 114) Anderson*, C.A., Mathur, R., **Rakovan, J.**, Tremsin, A.S. (2019) A New Metal Isotope Fractionation Effect by Solid-State Ion Conduction. *Geology*, 47:617-620. *Article chosen for cover image of Journal*. <https://doi.org/10.1130/G45999.1>
- 113) Ertl, A., **Rakovan, J.**, Hughes, J. M., Bernhardt, H. J., and Rossman, G. R. (2019) Vanadium-rich muscovite from Austria: Crystal structure, chemical analysis, and spectroscopic investigations. *Canadian Mineralogist*, 57: 383-389.
- 112) **Rakovan, J.** and Speer, J.A. (2019) Chips from the Quarry: MSA Centennial Celebration. *Rocks & Minerals*, 94: 493-495.
- 111) **Rakovan, J.** and Gunter, M. (2019) A Year of Anniversaries for Alex Speer and the Mineralogical Society of America. *Rocks & Minerals*, 94: 404-406.
- 110) Ziga, D., **Rakovan, J.**, and Emprto, C. (2019) Re-emerging Treasures: Yellow Quartz from Cabiche Municipal de Quípama, Boyacá Department, Colombia. *Rocks & Minerals*, 94:240-247.
- 109) Hughes, J.M., Harlov, D., and **Rakovan, J.** (2018) Structural variations along the apatite F-OH join. *American Mineralogist*, 103:1981-1987.
- 108) **Rakovan, J.** (2018) Flattened Crystals. In *Letters*. *Rocks & Minerals*, 93:495-496.
- 107) **Rakovan, J.** (2018) Computer Programs for Drawing Crystal Shapes and Atomic Structures. *Rocks & Minerals*, 93:60-63.
- 106) Burke*, M. **Rakovan, J.**, and Krekeler, M. (2017) A Study by Electron Microscopy of Gold and Associated Minerals from Round Mountain, Nevada. *Ore Geology Reviews*, 91: 708-717.
- 105) **Rakovan, J.**, Lüders, V., Massanek, A. and Nolze, G. (2017) Gold Crystals from the Lena Goldfields, Bodaibo Area, Eastern Siberia, Russia: Exceptional Hoppered Octahedra and Pseudomorphs after Pyrite. *Rocks & Minerals*, 92: 410-425.
- 104) Betkowski*, V., **Rakovan, J.** and Harlov, D. (2017) Geochemical and textural characterization of phosphate accessory phases in the vein assemblage and metasomatically altered Llallagua tin porphyry, *Mineralogy and Petrology*, 111: 547–568.
- 103) Kelly*, S., **Rakovan, J.** and Hughes, J. M. (2017) Column Anion Arrangements in Chemically Zoned Chlorapatite and Fluorapatite from Kurokura, Japan. *American Mineralogist*, 102: 720–727.
- 102) Tremsin, A. S., **Rakovan, J.**, Shinohara, T., Kockelmann, W. Losko, A. S. and Vogel, S. C. (2017) Non-destructive analyses of bulk crystallinity and elemental composition by energy resolved neutron imaging: application to natural gold samples. *Nature-Science Reports*, 7:40759, 1-9.
- 101) Olds, T.A., Carlson, S.M., Kampf, A.R., **Rakovan, J.**, Laughlin-Yurs, C., Burns, P.C. and Mills, O.P. (2017) Hydroxylpyromorphite, IMA 2017-075. *CNMNC Newsletter No. 40*, December 2017, page 1580; *Mineralogical Magazine*, 81, 1577–1581.
- 100) Anderson, C.J. and **Rakovan, J.** (2017) Connoisseur's Choice: Wire Silver & Gold. *Rocks & Minerals*, 92:345-354.
- 99) Kleszczewska*, A.; Manecki, M.; Bajda, T.; Mozgawa, W.; **Rakovan, J.**; Borkiewicz*, O. (2016) Mimeticite formation from goethite adsorbed ions. *Microscopy and Microanalysis*, 22:698-705.
- 98) Betkowski*, V., Harlov, D. and **Rakovan, J.** (2016) Hydrothermal mineral replacement reactions for an apatite-monzonite assemblage in alkali-rich fluids at 300-600 °C and 100 MPa. *American Mineralogist*, 101: 2620–2637.
- 97) Hughes, J. M., Harlov, D., Kelly*, S., **Rakovan, J.**, and Wilke, M. (2016) Solid solution in the apatite OH-Cl binary system: compositional dependence of solid solution mechanisms in calcium phosphate apatites along the Cl-OH binary. *American Mineralogist*, 101:1783–1791.
- 96) Kampf, A.R., Richards, P.R., Nash, B.P. Murowchick, J.B., and **Rakovan, J.** (2016) Carlsonite, $(NH_4)_3Fe_3O(SO_4)_6 \cdot 7H_2O$, and huizingite-(Al), $(NH_4)_9Al_3(SO_4)_8(OH)_2 \cdot 4H_2O$, two new minerals from a natural fire in an oil-bearing shale near Milan, Ohio. *American Mineralogist*, 101:2095–2107.
- 95) Giera*, A., Manecki, M., Bajda, T., **Rakovan, J.**, Kwasniak-Kominek*, M., and Marchlewski*, T. (2016) Arsenate substitution in lead hydroxyl apatites: A Raman spectroscopic study. *Spectrochimica Acta Part A*, 152:370-377.
- 94) **Rakovan, J.**, Barnett, B. and White, J. (2016) Fluorapatite from the Foote Mine Kings Mountain North Carolina. *Rocks & Minerals*, 91:251-256.
- 93) **Rakovan, J.** and Laures, B.M. (2016) Large Cat's-eye Apatite from Madagascar. *The Journal of Gemology*, 35:186-

- 188.
- 92) Kwaśniak-Kominek*, M., Matusik, J., Bajda, T., Manecki, M., **Rakovan, J.**, Marchlewski*, T. and Szala, B. (2015) Fourier transform infrared spectroscopic study of hydroxylpyromorphite $Pb_{10}(PO_4)_6OH_2$ – hydroxylmimetite $Pb_{10}(AsO_4)_6(OH)_2$ solid solution series. *Polyhedron*, 99:103-111.
- 91) **Rakovan J.** and Pasteris, J.D. (2015) A Technological Gem: Materials, Medical, and Environmental Mineralogy of Apatite. In Harlov, D. and J. Rakovan (Guest Editors) *Apatite - A mineral for all seasons*. *Elements* 11:195-200. <https://doi.org/10.2113/gselements.11.3.195>
- 90) Hughes, J. M. and **Rakovan J.** (2015) Structure and Chemistry of Apatite and Apatite Supergroup Minerals. In Harlov, D. and J. Rakovan (Guest Editors) *Apatite - A mineral for all seasons*. *Elements* 11:165-170.
- 89) **Rakovan, J.** (2015) Connoisseur's Choice: Fluorapatite. *Rocks & Minerals*, 90:244-256
- 88) Topolska, J., Latowski, D., Kaschabek, S., Manecki, M., Merkel, B.J., and **Rakovan, J.** (2014) Pb remobilization by bacterially mediated dissolution of pyromorphite $Pb_5(PO_4)_3Cl$ in presence of phosphate-solubilizing *Pseudomonas putida*. *Environmental Science and Pollution Research*, 21(2):1079-1089.
- 87) **Rakovan, J.**, Gaillou, E., Post, J.E., Jaszczak, J.A. and Betts, J.H. (2014) Optically sector zoned (star) diamonds from Zimbabwe. *Rocks & Minerals*. 89:173-178.
- 86) **Rakovan, J.** (2014) In Memoriam: Sal Avella. *Rocks & Minerals*, 89:286-287.
- 85) **Rakovan, J.** (2014) Daylight Florescent Hyalite Opal from Mexico. *Mineralogical Almanac*, 19(3): 62.
- 84) **Rakovan, J.** (2014) Neutron Diffraction Analysis Verifies Existence of Some of the World's Largest Gold Crystals. *Rocks & Minerals*, 89:404-406.
- 83) Long**, J. M., **Rakovan, J.**, Jaszczak, J. Sommer, A. J. and Anczkiewicz, R. (2013) Fluorapatite from this remarkable occurrence of graphite and associated minerals, Karo Pit, Block D, Merelani Hills, Arusha Region, Tanzania. *Rocks & Minerals*. 88: 179-183.
- 82) Fisher, J. Lillie, R. and **Rakovan, J.** (2013) Fluorite in Mississippi Valley-Type Deposits. *Rocks & Minerals*. 88:20-47.
- 81) Swarnakar*, P., Kanel, S. R., Nepal, D., Jiang, Y., Jia, H., Kerr, L., Goltz, M. N., Levy, J., **Rakovan, J.** (2013) Silver deposited titanium dioxide thin film for photocatalysis of organic compounds using natural light. *Solar Energy*. 88:242-249.
- 80) **Rakovan, J.**, Spann, J.W. and Fast, J. (2013) Collector's Note: Unusual Fluorites from Inner Mongolia. *Rocks & Minerals*, 88:276-277.
- 79) Houran, J. and **Rakovan, J.** (2013) Collector's Note: Unusual Morganites from Corrego do Urucum, Galiléia, Minas Gerais, Brazil. *Rocks & Minerals*, 88:378-379.
- 78) **Rakovan, J.** (2013) PEG 2013: The 6th International Symposium on Granitic Pegmatites. *Rocks & Minerals*, 88:539-543.
- 77) **Rakovan, J.** (2013) Apatite from China and Japan. In *Apatite*, Rakovan and Staebler Editors. Mineral Monographs #17. Lithographie, LLC. p. 98-102.
- 76) **Rakovan, J.** (2013) Apatite from Nuristan, Afghanistan. In *Apatite*, Rakovan and Staebler Editors. Mineral Monographs #17. Lithographie, LLC. p. 96-97.
- 75) Martin, R. and **Rakovan, J.** (2013) The Geology of Apatite Occurrences. In *Apatite*, Rakovan, Staebler and Dallaire Editors. Mineral Monographs #17. Lithographie, LLC. p. 21-27.
- 74) **Rakovan, J.** and Waychunas, G. (2013) Color and Fluorescence. In *Apatite*, Rakovan and Staebler Editors. Mineral Monographs #17. Lithographie, LLC. p. 10-17.
- 73) **Rakovan, J.** and Hughes, J.M. (2013) Apatite—A Large and Illustrious Family. In *Apatite*, Rakovan and Staebler Editors. Mineral Monographs #17. Lithographie, LLC. p. 4-9.
- 72) Praszkiar, T. and **Rakovan, J.** (2012) Hourglass Figures - Bou Oudi Amethyst. In *Amethyst Uncommon Vintage*. Lithographie. P.102-105.
- 71) Eveleth, R.W. and Rakovan, J. (2012) Who's Who in Mineral Names: Nathaniel Kellogg Fairbank. *Rocks & Minerals*. V. 87, p. 71-73.
- 70) Freiburg, J. T. and **Rakovan, J.** (2012) The Conco Mine, North Aurora, Kane County, Illinois. *Rocks & Minerals*. 87:116-125.
- 69) **Rakovan, J.**, Schmidt*, Gunter, M., Nash, B., Marty, J, Kampf, A.R., and Wise, W.S. (2011) Hughesite $Na_3AlV_{10}O_{28} \cdot 22H_2O$, a new member of the pascoite family of minerals from the Sunday Mine, San Miguel County, Colorado. *Canadian Mineralogist*, 49:1253-1265.
- 68) Luo*, Y., **Rakovan, J.**, Tang, Y., Lupulescu, M.V., Hughes, J, and Pan, Y., (2011). Crystal chemistry of Th in fluorapatite. *American Mineralogist*. 96:23-33.
- 67) Hughes, J.M., Rakovan, J, Ertl, A., Rossman, G.R., Baksheev, I., Bernhardt, H.J. (2011) Dissymmetrization in tourmaline: The atomic arrangement of optically sectoral-zoned triclinic Ni-bearing Mg-rich tourmaline. *Canadian Mineralogist*, 49:29-40.
- 66) Rakovan, J. (2011) An Evening at the Blanchard. *Rocks & Minerals*, 86: 232-239.
- 65) Rakovan, J. (2010) Mineral Treasures of the World Exhibition Beijing, China. *Rocks & Minerals*, 85:434-439.
- 64) **Rakovan, J.** (2010) Apatite. McGraw-Hill Encyclopedia of Science and Technology, 10th Edition.
- 63) Hughes, J.M. and **Rakovan, J.** (2010) Monazite. McGraw-Hill Encyclopedia of Science and Technology, 10th Edition.
- 62) **Rakovan, J.**, Nakotte, H., Gasbarro*, N., Kothapalli, K. and Vogel, S. C. (2010) Natural Cold Working and the Crystallinity of Placer Gold. *IEEE Gold Rush*.

- 61) Borkiewicz*, O., **Rakovan, J.**, and Cahill, C. (2010) Time resolved in-situ studies of apatite formation pathways in aqueous solutions. *American Mineralogist*, 95:1224-1236.
- 60) Pasero, M., Kampf, A. R., Ferraris, C., Pekov, I.V., **Rakovan, J.**, White, T. (2010) Nomenclature of apatite supergroup minerals. *European Journal of Mineralogy*. *European Journal of Mineralogy*, 22:163-179.
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- 161) Shepherd, E., Rakovan, J., Mcnamara, K. C. (2023) Mineralogical differences as a function of color for Turquoise in New Mexico. American Geophysical Union meeting Fall 2023 San Francisco.
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- 158) **Rakovan, J.**, Anderson, C., Mathur, R., and Ferraris, C. (2022) Isotope Fractionation in Wire Silver Formation: Historic Specimens from Kongsberg, Norway. Geological Society of America National Meeting, Denver, program with abstracts. <https://doi.org/10.1130/abs/2022AM-381404>
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- 153) Murchland**, M., **Rakovan, J.**, Trela, J., Yu, M., Freiburg, J. and Nuelle, L.M. (2022) Hicks Dome Drill cores: Mineralogical and Geochemical Observations. Geological Society of America Joint North-Central/ South-Central Section Meeting Program with Abstracts <https://doi.org/10.1130/abs/2022NC-375661>
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- 133) Vogel, S., Alonso-Perez, R., Espy, M., Gautier, C., Losko, A., **Rakovan, J.**, and Keutsch, F. (2020) Characterization of the World's Finest Gold at LANL. Session on "Characterization of Minerals, Metals and Materials". The Minerals, Metals & Materials Society (TMS) 149th Annual Meeting San Diego, CA.
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- 131) Emproto*, C., Fink**, J., Mounce**, S., and **Rakovan, J.** (2020) CHEMISTRY OF APATITE FROM VEIN DIKE

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- 130) Fink**, J., Emproto*, C., and Chappell*, C. AN UNUSUAL OCCURRENCE OF ZINC SULFIDE FROM THE FRANCON QUARRY, MONTREAL, CANADA. Friends of Mineralogy Midwest Chapter 8th annual symposium, Miami University. Canceled due to COVID-19.
- 129) Mounce**, S., Emproto*, C., Murchland**, M., Rutherford**, M., and **Rakovan, J.** (2020) MELT AND MICROMINERAL INCLUSIONS IN APATITE, CALCITE, FLUORITE, ALBITE, AND AUGITE FROM THE WILBERFORCE AREA, ON, CANADA. Friends of Mineralogy Midwest Chapter 8th annual symposium, Miami University. Canceled due to COVID-19.
- 128) Murchland**, M., Rutherford**, M., Fink**, J., and **Rakovan, J.** (2020) OPTICALLY ANOMOUS FLATTENED CRYSTALS FROM MUSCOVITE. Friends of Mineralogy Midwest Chapter 8th annual symposium, Miami University. Canceled due to COVID-19.
- 127) Rutherford**, M., Murchland**, M., Fink**, J., and **Rakovan, J.** (2020) MINERALOGICAL CHARACTERISTICS OF OPTICAL ANOMALIES. Friends of Mineralogy Midwest Chapter 8th annual symposium, Miami University. Canceled due to COVID-19.
- 126) Emproto*, C., Fink**, J. and **Rakovan, J.** (2019) CARBONATE-HOSTED APATITE FROM THE GRENVILLE PROVINCE. 46th Rochester Mineralogical Symposium, Rochester, NY.
- 125) Fink**, J., Emproto*, C., Jaszczak, J.A., and **Rakovan, J.** (2019) INTERESTING INCLUSIONS IN GREEN MUSCOVITE FROM THE MERELANI HILLS, TANZANIA. 46th Rochester Mineralogical Symposium, Rochester, NY. Winner of the
- 124) Chappell*, J.C., **Rakovan, J.**, Sommer, A., Phillips, B., Horváth, L. and Horváth, E. (2019) AN "ORDINARY" MINERAL FROM AN EXTRAORDINARY LOCALITY: FLUORAPATITE FROM MONT SAINT-HILAIRE. 46th Rochester Mineralogical Symposium, Rochester, NY.
- 123) Emproto*, C., Fink**, J. and **Rakovan, J.** (2019) CARBONATE-HOSTED APATITE FROM THE GRENVILLE PROVINCE. Friends of Mineralogy Midwest Chapter 7th annual symposium, Miami University. Best student talk award.
- 122) Fink**, J., Emproto*, C., Jaszczak, J.A., and **Rakovan, J.** (2019) INTERESTING INCLUSIONS IN GREEN MUSCOVITE FROM THE MERELANI HILLS, TANZANIA. Friends of Mineralogy Midwest Chapter 7th annual symposium, Miami University. 2nd best student talk award.
- 121) Chappell*, J.C., **Rakovan, J.**, Sommer, A., Phillips, B., Horváth, L. and Horváth, E. (2019) AN "ORDINARY" MINERAL FROM AN EXTRAORDINARY LOCALITY: FLUORAPATITE FROM MONT SAINT-HILAIRE. Friends of Mineralogy Midwest Chapter 7th annual symposium, Miami University. 3rd best student talk award.
- 120) Brumm**, G., Mathur, R., Wilson, D., Rakovan, J. (2019) Biogeochemical Mineralization of Secondary Gold in Placer Deposits Supported through Isotopic Characterization. Juniata College Liberal Arts Symposium.
- 119) Alvarez**, A., Emproto*, C., Rakovan, J. (2019) The Effects of Radioactive Betafite on the Apatite Structure Miami University Undergraduate Research Conference.
- 118) Anderson*, C. Mathur, R., **Rakovan, J.**, and Tremsin, A. (2018) A NEW MECHANISM FOR TRANSITION METAL ISOTOPE FRACTIONATION BY SOLID-STATE ION CONDUCTION. Geological Society of America Meeting program with abstracts.
- 117) Hughes, J.M., Harlov, D., **Rakovan, J.** (2018) THE ATOMIC ARRANGEMENT OF CALCIUM PHOSPHATE APATITES ALONG A PORTION OF THE F-OH BINARY. Geological Society of America Meeting program with abstracts.
- 116) Tacker, R.C., **Rakovan, J.**, Harlov, D., Kelly*, S. and Hughes, J.M. (2018) INSIGHT INTO THE CL-OH APATITE BINARY FROM FTIR SPECTROSCOPY. Geological Society of America Meeting program with abstracts.
- 115) Chappell*, C. and **Rakovan, J.** (2018) UNIQUE CRYSTAL CHEMICAL ASPECTS OF FLUORAPATITE FROM MONT SAINT-HILAIRE. Geological Society of America Meeting program with abstracts.
- 114) Anderson*, C.J., **Rakovan, J.**, Böellinghaus, T. and Lüders, V. (2018) CRYSTALLINITY AND TEXTURE OF NATURAL AND SYNTHETIC WIRE SILVER. Friends of Mineralogy Midwest Chapter 6th annual symposium, Miami University.
- 113) Bergbower*, J., Dietsch, C., **Rakovan, J.** and Singer, J. (2018) TRACE AND RARE EARTH ELEMENT CHEMISTRY OF FLUORITE FROM THE ILLINOIS-KENTUCKY FLUORSPAR DISTRICT AND ITS IMPLICATIONS FOR THE ORIGINS OF MINERALIZING FLUIDS. Friends of Mineralogy Midwest Chapter 6th annual symposium, Miami University.
- 112) Betkowski*, W.B. and **Rakovan, J.** (2018) RESULTS OF GEOCHEMICAL AND GEOCHRONOLOGICAL CHARACTERIZATION OF LLALLAGUA ALTERED PORPHYRY AND HYDROTHERMAL VEIN ASSEMBLAGE IN CONTEXT OF PREEXISTING AGE DISCREPANCY. Friends of Mineralogy Midwest Chapter 6th annual symposium, Miami University.
- 111) Chappell*, C. and **Rakovan, J.** (2018) THORIUM RICH FLUORAPATITE FROM THE POUURETTE PEGMATITE, MONT SAINT-HILAIRE. Friends of Mineralogy Midwest Chapter 6th annual symposium, Miami University.
- 110) BERGBOWER*, J., DIETSCH, C., SINGER, J. W., and **RAKOVAN, J.** (2018) TRACE AND RARE EARTH

- ELEMENT ANALYSIS OF FLUORITE FROM THE ILLINOIS-KENTUCKY FLUORSPAR DISTRICT AND ITS IMPLICATIONS FOR THE ORIGINS OF MINERALIZING FLUIDS. North-Central GSA - 52nd Annual Meeting, abstracts with program.
- 109) Burke*, M. Krekler, M. and **Rakovan, J.** (2017) AN ELECTRON MICROSCOPY STUDY OF GOLD FROM ROUND MOUNTAIN. Geological Society of America meeting Program with Abstracts.
- 108) Ashley, K.T., Harlov, D., Hughes, J.M., **Rakovan, J.** Balhouse, B.N., Steele-MacInnis, and Bodnar, R.J. (2017) High-resolution Raman spectroscopy of apatite along the F-OH, F-Cl, and Cl-OH binary joins. Goldschmidt abstracts with program.
- 107) **Rakovan, J.**, A.S. Tremsin, S.C. Vogel, H. Nakotte (2017) NEW RESULTS AND METHODS IN THE NEUTRON ANALYSIS OF LARGE GOLD SPECIMENS FROM VENISUELA. Rochester Mineralogical Symposium program with abstracts. *Rocks & Minerals*, 93: 262-263.
- 106) Richards, H., S. Kelly, *J. Rakovan* (2017) STRUCTURAL AND CHEMICAL COMPLEXITIES OF HYDROXYLAPATITE FROM THE SAPO MINE, BRAZIL. Rochester Mineralogical Symposium program with abstracts. Awarded the Mandarino prize for the best undergraduate student presentation.
- 105) Anderson, C. J., **J. Rakovan**, T. Böellinghaus, and V. Lüders (2017) CRYSTALLINITY AND TEXTURE OF NATURAL AND SYNTHETIC WIRE SILVER. Rochester Mineralogical Symposium program with abstracts. Awarded the Mandarino prize for the best graduate student presentation. . *Rocks & Minerals*, 93:177-178.
- 104) Betkowski, W., and **Rakovan, J.** (2017) MINERALOGICAL CHARACTERIZATION OF PHOSPHATE ACCESSORY MINERALS THROUGHOUT THE LLALLAGUA TIN PORPHYRY, BOLIVIA. Rochester Mineralogical Symposium program with abstracts. . *Rocks & Minerals*, 93: 178-179.
- 103) Ziga, D., G. Accorsi, J. Hughes, *J. Rakovan* (2017) TRACING THE CONFLICT MINERAL WOLFRAMITE THROUGH CRYSTAL CHEMISTRY, STRUCTURE & SPECTRA. Rochester Mineralogical Symposium program with abstracts.
- 102) **Rakovan, J.** (2017) Fluorine and Fluorite from Mississippi-Valley-Type Deposits. MSA-FM-TGSM Tucson Mineralogical Symposium.
- 101) Richards, R.P., Kampf, T., Nash, B., Murowchick, J.B., and **J. Rakovan**. (2016) Shale fire minerals from the Huron River burn site near Milan, Ohio: “Final report”. Rochester Mineralogical Symposium program with abstracts.
- 100) Hughes, J.M., Harlov, D., Kelly, S., **Rakovan, J.**, and Nekvasil, H. (2016) The Crystal Chemistry of Natural Apatites. American Crystallographic Association meeting Denver.
- 99) Betkowski*, W., Harlov, D. and Rakovan, J. (2016) Geochemical characterization of phosphate accessory phases throughout metasomatically altered Llallagua tin porphyry. New insights into origin of rich vein mineralization. GAC-MAC annual meeting, Whitehorse, Yukon.
- 98) Alicja Giera*, Maciej Manckie, Rakovan, J. (2016). Monoclinic structure of hydroxylpyromorphite $Pb_{10}(PO_4)_6(OH)_2$ – hydroxylmimetite $Pb_{10}(AsO_4)_6(OH)_2$ solid solution series. EGU General Assembly
- 97) **Rakovan, J.** (2015) Mineralogy and Cultural History of the Naegi Pegmatite District, Nakatsugawa, Gifu Prefecture, Japan. 36th Annual New Mexico Mineral Symposium, Socorro, NM. Abstracts with program.
- 96) Kelly*, S., **Rakovan, J.**, Harlov, D., and Hughes, J.M. (2015) Investigation of the Column Anion Structure and Chemistry of Synthetic Apatites in the F-OH and OH-Cl Solution Series. American Exploration and Mining Association Abstracts with program.
- 95) Kelly*, S., Merrill, J., **Rakovan, J.**, Harlov, D., Heffernan, K.M., and Hughes, J.M. (2014) Investigation of the Column Anion Structure and Chemistry of Synthetic Apatites in the F-OH and OH-Cl Solution Series. Miami University Graduate Research Forum, 11-14-14.
- 94) Burke*, M., Krekler, M.P.S., and **Rakovan, J.** (2014) An Electron Microscopy Investigation of the Quartz-Gold Interface. Miami University Graduate Research Forum, 11-14-14.
- 93) Silverstein*, S., Krekler, M.P.S., and **Rakovan, J.** (2014) Morphological Evidence of Authigenic Gold Deposition in Lateritic Placer Deposits from the Guyana Shield of Venezuela. Miami University Graduate Research Forum, 11-14-14.
- 92) Betkowski, W., Harlov, D. and **Rakovan, J.** (2014) The complexity of monazite growth and reaction textures as clue to understanding 20My age discrepancy in Llallagua tin deposit, Bolivia. Miami University Graduate Research Forum, 11-14-14.
- 91) Silverstein*, J., Krekerker, M., and **Rakovan, J.** (2014) Morphological evidence of gold and the possibility of authigenic gold deposition in fluvial environments in laterites lateritic placer deposits from the Guyana shield of Venezuelan. Rochester Mineralogical Symposium Program with Abstracts also published in *Rocks & Minerals*, 91:181.
- 90) Merrill*, J., Kelly*, S., **Rakovan, J.**, Harlov, D., Heffernan, K.M., and Hughes, J.M. (2014) Using Single Crystal X-ray Diffraction Structure Refinement as a Means to Determine Apatite Halogen Chemistry. Rochester Mineralogical Symposium Program with Abstracts also published in *Rocks & Minerals*, 91:573.
- 89) Betkowski*, W.B., **Rakovan, J.**, Harlov, D. (2014) Apatite and Monazite Replacement Reactions: Insights into Pseudomorphism and the Petrogenesis of the Llallagua Tin Deposit. Rochester Mineralogical Symposium Program with Abstracts also published in *Rocks & Minerals*, 91:444-445.
- 88) Burke*, M., Krekerker, M., and **Rakovan, J.** (2014) A Microtextural Study of Selected Macrocryalline Gold Samples from Nevada. Southeastern Regional Geological Society of America Meeting Program with Abstracts. Blacksburg VA. April 10-11.

- 87) Silverstein*, J., Krekerker, M., and **Rakovan, J.** (2014) Scanning Electron Microscopy Investigation of Gold in a Laterite Sample from the Guyana Shield of Venezuela: A Case for Authigenic Deposition. Southeastern Regional Geological Society of America Meeting Program with Abstracts. Blacksburg VA. April 10-11.
- 86) Kelly*, S., Merrill*, J., **Rakovan, J.**, Harlov, D., Heffernan, K.M., and Hughes, J.M. (2014) Refinement of the Column Anion Structure and Chemistry of Synthetic Apatites in the F-OH and OH-Cl Solution Series. Southeastern Regional Geological Society of America Meeting Program with Abstracts. Blacksburg VA. April 10-11.
- 85) **Rakovan, J.**, Gaillou, E., Post, J.E., Jaszczak, J.A. and Betts, J.H. (2014) “Star” (sector zoned) diamonds from Zimbabwe. Rochester Mineralogical Symposium Program with Abstracts.
- 84) **Rakovan, J.**, Gaillou, E., Post, J.E., Jaszczak, J.A. and Betts, J.H. (2014) “Star” (sector zoned) diamonds from Zimbabwe. MSA-FM-TGSM Tucson. Mineralogical Symposium. Mineralogical Record. Rochester Mineralogical Symposium Program with Abstracts.
- 83) **Rakovan, J.** (2013) Apatite and other phosphates from Llallagua, Bolivia: An interesting story of hydrothermal mineralization and pseudomorphism. Rochester Mineralogical Symposium Program with Abstracts.
- 82) **Rakovan, J.** (2013) Fluorine and Fluorite from Mississippi-Valley-Type Deposits. MSA-FM-TGSM Tucson Mineralogical Symposium. Mineralogical Record.
- 81) Stozek*, S., Kosobudzka*, A., Manecki, M., Bajda, T., and **Rakovan, J.** (2012) Experimental and computer modeling of Cerussite $PbCO_3$ dissolution in the presence of arsenates and phosphates at pH from 3 to 11. XIII. International conference of young geologists Herlany, Slovakia. Abstracts with program.
- 80) Swarnakar*, P., Kanel, S.R., Goltz, M.N., Levy, J. **Rakovan, J.**, Kerr, L. (2012) Development of Silver-Modified Nano Titanium Dioxide Thin Film for Photocatalysis of Methyl Orange Using Solar Light.
- 79) Tselepis-Loertscher*, C., **Rakovan, J.**, and Krekeler, M.P.S (2012) Investigation of heterogeneous oxidation of manganese(II) and oxide formation on natural and synthetic goethite. Midwest regional Geological Society of America meeting, Abstracts with program.
- 78) Crimmins*, L., and **Rakovan, J.** (2012) Structure and chemistry of minerals in the Ca-As-P-(OH, F, Cl) apatite system: johnbaumite, svabite, and turneaureite from Franklin and Sterling Hill, New Jersey. Rochester Mineralogical Symposium Program with Abstracts also published in *Rocks & Minerals...*
- 77) Long*, J.M., **Rakovan, J.**, Jaszczak, J., and Trinchillo, D. (2012) Fluorapatite from a remarkable occurrence of graphite and associated minerals, Karo Pit, Block D, Merelani Hills, Tanzania. Rochester Mineralogical Symposium Program with Abstracts also published in *Rocks & Minerals*.
- 76) Kwaśniak-Kominek*, M., Manecki, M., Bajda, T., and Rakovan, J. (2012) Pseudomorphic replacement of single cerussite $PbCO_3$ crystals by hydroxylpyromorphite $Pb_5(PO_4)_3OH$ in phosphate solutions. European Geosciences Union General Assembly, Vienna. Abstracts with program.
- 75) Wajima, T. and **Rakovan, J.** (2011) Removal of Aqueous Fluoride Ions by Calcined Paper Sludge. The 6th International Symposium on Surface Science (ISSS-6), Abstracts with program. Tokyo, Japan
- 74) Krekeler, M.P.S., Fischer, T.B., **Rakovan, J.**, and Dong, H. (2011). Methods, perspectives and assessment of pure and applied mineralogical undergraduate research: a critical educational activity. Annual Geological Society of America meeting, Abstracts with program.
- 73) Bon*, C.E., **Rakovan, J.** The morphology and structure of smythite, $(Fe,Ni)_3S_4$, from Bloomington, IN. Rochester Mineralogical Symposium Program with Abstracts also published in *Rocks & Minerals*, 87:171-172.
- 72) Taylor*, A.R., Marchlewski*, T.A. and **Rakovan, J.** (2011) Pseudomorphic replacement of schulltenite by hydroxylmimetite. Rochester Mineralogical Symposium Program with Abstracts also published in *Rocks & Minerals*, 87:452-453.
- 71) **Rakovan, J.** and White J. (2011) Unusual spiral inclusions in crystals. Rochester Mineralogical Symposium Program with Abstracts also published in *Rocks & Minerals*, 87:449-450.
- 709) **Rakovan, J.** (2010) Crystallinity of Placer Gold and Testing the Authenticity of Large Gold Crystals. Rochester Mineralogical Symposium Program with Abstracts. P. 24.
- 69) **Rakovan, J.** (2010) Precursor evolution and metal uptake in apatite formation from aqueous solutions. Geological Society of America annual meeting Denver, CO. Abstracts with program.
- 68) Marchlewski*, T. A. and **Rakovan, J.** (2010) Simultaneous immobilization of As and Pb in contaminated soils. Goldschmidt Conference Abstracts with Program. P. 667.
- 67) Borkiewicz*, O., **Rakovan, J.** and Cahill, C. L. (2010) Formation of precursor phases during crystal growth of apatite under contaminated Earth-surface conditions. Goldschmidt Conference Abstracts with Program. P. 105.
- 66) Luo*, **Rakovan, J.**, and Hughes, J.M. (2010) Crystal Chemistry of Uranium and Thorium in Apatites. Goldschmidt Conference Abstracts with Program. P. 644.
- 65) Taylor*, A. R. Marchlewski*, T. A. and **Rakovan, J.** (2010) Investigation of Ca-Pb-P-As solid solutions in apatite. Goldschmidt Conference Abstracts with Program. P. 1030.
- 64) **Rakovan, J.**, Hughes, J.M., Ertl, A., Rossman, G.R., Baksheev, I., and Bernhardt, H.-J. (2010) Dissymmetrization and sectoral-twinning in Ni-rich tourmaline. International Mineralogical Association meeting Budapest, Abstracts with Program. 2SF02.

- 63) Luo*, Y., **Rakovan, J.**, Wright, S. (2009) Orientation Dependent Polarized Micro-XAS Study of U, Th and Sr in Single Crystal Apatites. Annual American Geophysical Union Spring meeting, Abstracts with Program, Toronto.
- 62) **Rakovan, J.**, Gasbarro*, N., Nakotte, H., Kothapalli, K. and Vogel, S. C. (2009) Natural Cold Working of Gold and Testing the Authenticity of Large Gold Crystals. Annual American Geophysical Union Spring meeting, Abstracts with Program, Toronto.
- 61) **Rakovan, J.** (2009) *Sakura Ishi* (Cherry Blossom Stones) from Kameoka Japan: Mica pseudomorphs of complex cordierite-indialite intergrowths. FM-MSA-TGMS Mineralogical Symposium, Tucson.
- 60) Lupulescu, M., and **Rakovan, J.** 2008. A new occurrence of tourmaline with tetrahedrally coordinated boron: Rossmanite and associated minerals from Newcomb, Essex County, NY. Rochester Mineralogical Symposium Technical Session. Rocks & Minerals.
- 59) Medici, J. and **Rakovan, J.** (2008) XIRidescent and other Fluorites from the Findlay Arch, Ohio. Tucson Mineralogical Symposium. Mineralogical Record.
- 58) **Rakovan, J.** and Avella, S.(2008) Amethyst Scepters, Ashaway Village, Hopkinton, Rhode Island. Tucson Mineralogical Symposium. Mineralogical Record.
- 57) **Rakovan, J.** (2007) *Sakura Ishi* from Kameoka Japan: Mica pseudomorphs of complex cordierite-indialite intergrowths. 28th Annual New Mexico Mineral Symposium, New Mexico Tech. New Mexico Geology V.29 #4 p.133
- 56) **Rakovan, J.** (2007) Key Note Speaker; Mineralogical Meanderings in Japan, 28th Annual New Mexico Mineral Symposium, New Mexico Tech. New Mexico Geology V.29 #4 p.135
- 55) **Rakovan, J.** Luo*, Y and Borkiewicz*, O. (2007) Synchrotron Microanalytical Methods in the Study of Trace and Minor Elements in Apatite. Mineralogia Polonica, V.30 p. 88.
- 54) Huerta*, M. and **Rakovan, J.** (2007) Growth induced dissymmetrization of fluorapatite from Llallagua, Bolivia: The relationship between compositional and optical zoning. 2004 Rochester Mineralogical Symposium Program and Abstracts and Rocks & Minerals, 82,143.
- 53) Borkiewicz*, O., **Rakovan, J.** and Cahill, C. L. (2006) Kinetics and pathways of apatite formation - In-situ time resolved studies. Annual Geological Society of America meeting, Abstracts with program.
- 52) **Rakovan, J.**, Luo*, Y., Elzinga, E.J., Pan, Y., Lupulescu, M., and Hughes, J.M. (2006) Site distribution and structural state of Th in fluoroapatite determined by single crystal XRD and EXAFS. International Mineralogical Association meeting in Kobe Japan, Abstracts with Program.
- 51) Luo*, Y., **Rakovan, J.**, Elzinga, E.J., Pan, Y., and Hughes, J.M. (2006) Crystal chemistry of Th in apatite: Geochemistry and environmental implications. American Geophysical Union annual Spring meeting, Abstracts with Program.
- 50) Borkiewicz*, O., **Rakovan, J.** and Cahill, C. L. (2006) In-situ time resolved studies of apatite formation pathways – implications for biological and environmental systems. American Geophysical Union annual Spring meeting, Abstracts with Program.
- 49) Lupulescu, M., **Rakovan, J.**, Dyar, D., and Pyle J. (2006) F-, Cl- and K-rich Amphiboles in iron Deposits of the Hudson Highlands, New York. Geological Society of America Northeastern Section 41st Annual Meeting Abstracts with Program.
- 48) **Rakovan, J.** (2006) Mineralogy of the Hansonburg Mining District, Bingham New Mexico and related Rio Grande Rift Barite-Fluorite-Galena Deposits. Rochester Mineralogical Symposium. Abstracts published in Rocks & Minerals.
- 47) **Rakovan, J.** (2006) *Sakura Ishi* from Kameoka Japan: Mica pseudomorphs of complex cordierite-indialite intergrowths. Rochester Mineralogical Symposium. Rochester, NY. Abstracts published in Rocks & Minerals
- 46) **Rakovan, J.**, Luo*, Y., Elzinga, E.J., Pan, Y., Lupulescu, M., and Hughes, J.M. (2005) Structural state of Th in fluoroapatite determined by single crystal XRD and EXAFS. Goldschmidt Conference Abstracts with Program.
- 45) Lev, S., Partey*, F., Casey, E., Widom, E., Lueth, V. and **Rakovan, J.** (2005) Source of fluorine and petrogenesis of the Rio Grande Rift type barite-fluorite-galena deposits. Goldschmidt Conference Abstracts with Program.
- 44) Luo*, Y., **Rakovan, J.**, Hughes, J.M., and Pan, Y. (2005) Investigating the site preference of U and Th in Cl, F, Sr apatites using single crystal X-ray diffraction. Goldschmidt Conference Abstracts with Program.
- 43) Krekeler*, K., **Rakovan, J.** and Guggenheim, S. (2004) Polysome-width variation in palygorskite-sepiolite minerals: A TEM and AFM investigation of structural variation and transformation. Annual Geological Society of America meeting, Abstracts with program.
- 42) Partey*, F., Widom, E., Lueth, V., Lev, S. **Rakovan, J.** (2004) Tracing the Source of Fluorine in the Fluorite Mineralization of the Southern Rio Grande Rift. NW Regional Geological Society of America meeting, Abstracts with program.
- 41) **Rakovan, J.** (2004) Apatite: Truly an interdisciplinary mineral. Rochester Mineralogical Symposium Program and Abstracts and Rocks & Minerals.
- 40) **Rakovan, J.** (2003) Lanthanides in Fluorite (REE:CaF₂): Probes of Crystal Surface Structure and Association in Color Centers. Materials Research Society National Meeting Program and Abstracts.
- 39) **Rakovan, J.** (2003) Exceptional Apatites from the Siglo XX mine, Llallagua Bolivia. Tucson Mineralogical Symposium. Mineralogical Record 34, 117-118.
- 38) Hughes, J.M, **Rakovan, J.** and Bracco, R., (2002) The atomic arrangement of ganophyllite with the 16.8 Å superstructure revealed. Annual Geological Society of America meeting, Abstracts with program.

- 37) **Rakovan, J.**, Reeder, R.J., Elzinga, E.J., Cherniak, D. Tait, C.D. and Morris, D.E. (2002) Crystal Chemistry of U(VI) in Apatite Determined by X-ray Absorption Spectroscopy. Annual Geological Society of America meeting, Abstracts with program.
- 36) Evensen, J.M., London, D., Hughes, J.M., **Rakovan, J.**, Hervig, R.L., Kaszuba, J.P. (2002) Crystal chemistry, crystallography, and petrogenesis of the beryllium micas. International Mineralogical Association Program with Abstracts.
- 35) Krekeler*, M., Guggenheim, S., and **Rakovan, J.** (2002) TEM Investigation of Apatite and oxide Minerals in Palygorskite deposits from the Hawthorne formation. Annual Clay Minerals Society meeting, Abstracts with program.
- 34) **Rakovan, J.** and Jaszczak, J. (2002) Constraints on graphite growth conditions and mechanisms during carbonate metamorphism from crystal surface microtopography. International Mineralogical Association Program with Abstracts, P. 100
- 33) Tait, C.D., Reeder, R.J., **Rakovan, J.**, Morris, D.E., Nugent, M., Lamble, G.M., Elzinga, E.J., and Cherniak, D.J. (2002) Incorporation of Uranium (VI) into Calcium Carbonates and Apatite. American Chemical Society annual meeting, Abstracts with program.
- 32) **Rakovan, J.** and Jaszczak, J. (2002) Graphite with growth spirals from Arises River Marbles, Wlotzkas Baken, western Namibia. Tucson Mineralogical Symposium. Mineralogical Record, 33, 79.
- 31) **Rakovan, J.**, Sutton, S. Newville, M. and Lanzirotti, A. (2002) The use of WDS in Synchrotron X-ray Fluorescence and Spectroscopy: Case studies involving heterogeneous reactivity at the Mineral-Water Interface. The Synchrotron Environmental Science II Conference, Advanced Photon Source, 2002.
- 30) Krekeler*, M., Guggenheim, S., and **Rakovan, J.** (2001) Palygorskite deposits from the Hawthorne Formation, Southern Georgia: A complex history of sedimentation and authigenesis. Annual Geological Society of America meeting, Abstracts with program. p
- 29) Bosze*, S.L and **Rakovan, J.** (2001) Surface structurally controlled sectoral zoning of REE in fluorite from Long Lake, NY and Bingham, NM: Implications for trace element heterogeneity in minerals from hydrothermal deposits. 2001 Goldschmidt Conference Abstracts with Program.
- 28) Hammerly*, E., Rakovan, J. and Guggenheim, S. (2001) An AFM study of the palygorskite/sepiolite to smectite transformation in the Meigs-Attapulgas-Quincy District. 2001 Goldschmidt Conference Abstracts with Program.
- 27) **Rakovan, J.**, Sutton, S. Newville, M. and Lanzirotti, A. (2001) The use of WDS in Synchrotron X-ray Fluorescence and Spectroscopy: Case studies involving heterogeneous reactivity at the Mineral-Water Interface. 2001 Goldschmidt Conference Abstracts with Program.
- 26) Wright*, C.L. and **Rakovan, J.** (2001) Color, its cause, and relation to REE chemistry and paragenesis of fluorites from the Hansonburg Mining District in Bingham, NM. 2001 Goldschmidt Conference Abstracts with Program.
- 25) Sauerbeck*, S.A., Hammerly*, E.C., Morton, J.P., Hughes, J.M., and **Rakovan, J.** (2001) The Mineralogy of the Pitcher's Mounds of the National League. Annual Butler University Undergraduate Research Conference, Abstracts with Program, p. 30
- 24) Hammerly*, E. and **Rakovan, J.** (2001) An Atomic Force Microscopy study of the palygorskite/sepiolite to smectite transformation. Annual Butler University Undergraduate Research Conference, Abstracts with Program, p. 30
- 23) Richards, R.P. and **Rakovan, J.** (2000) The first occurrence of apatite crystals in Ohio. Rochester Mineralogical Symposium. Rocks and Minerals, 75, 255.
- 22) McCall*, K., Jaszczak, J., **Rakovan, J.** (2000) Crystal growth mechanisms evidenced by growth spirals on natural graphite {001} surfaces. Annual Butler University Undergraduate Research Conference, Abstracts with Program, p. 22.
- 21) Spansky*, M., Bosze*, S. and **Rakovan, J.** (2000) Fluorite mineralogy and trace element chemistry in the Hansonburg District, NM. Annual Butler University Undergraduate Research Conference, Abstracts with Program, p. 21.
- 20) **Rakovan, J.**, Newville, M., and Sutton, S. (1999) Wavelength-dispersive XANES reveals mixed europium valence state in Llallagua apatite. Annual Geological Society of America meeting, Abstracts with program. p.A-358.
- 19) Bosze*, S. and **Rakovan, J.** (1999) Surface Controlled Heterogeneous Incorporation of REE, Sr and Y in Fluorite. Annual Geological Society of America meeting, Abstracts with program. p.A-358.
- 18) McCall*, K., **Rakovan, J.**, and Jaszczak, J. A. (1999) Multiple length scale growth spirals on natural graphite {001} surfaces. Annual Geological Society of America meeting, Abstracts with program. p.A-169.
- 17) Mayer, L. and **Rakovan, J.** (1998) Microtopographic of mineral surfaces as a tool to identify and date young fault ruptures in bedrock scarps. Annual Geological Society of America meeting, Abstracts with program, A-237.
- 16) **Rakovan, J.** (1998) Cathodoluminescence as a probe of heterogeneous reactivity at the mineral-water interface. Annual Geological Society of America meeting, Abstracts with program, A-59.
- 15) **Rakovan, J.** and Mayer L. (1998) Microscopic to macroscopic morphology: the exposure and evolution of mineral surface microtopography as an indicator of fault rupture ages. In the proceedings from Resolution of Geological Analysis and models for Earthquake Faulting Studies, Camerino, Italy.
- 14) **Rakovan, J.** and Hochella, M.F. Jr., (1998) Heterogeneous oxidation and precipitation of aqueous Mn(II) at the goethite surface: An SPM study. Microscopy and Microanalysis. 4, supplement 2, 600-601.
- 13) **Rakovan, J.** (1998) Sectoral zoning (SZ) of REEs in fluorite: Indication of the heterogeneous nature and distribution of surface protosites. International Mineralogical Association Program with Abstracts. A83.
- 12) **Rakovan, J.** and Schmidt, C. (1998) Fluorite from Akchatau and Karaoba Kazakhstan. Tucson Mineralogical

- Symposium. Mineralogical Record, 29, S2.
- 11) **Rakovan, J.**, and Hochella, M.F. Jr. (1997) In situ microscopic observations of Mn(II) sorption/oxidation on goethite in aqueous solution. American Chemical Society Geochemistry Division abstract 070, annual meeting.
 - 10) **Rakovan, J.**, McDaniel, D.K., and Reeder R.J. (1996) Single-crystal Sm-Nd dating of sectorally zoned Llalagua apatite yields a age of 43.8 +/- 4.7 Ma . Annual American Geophysical Society Spring meeting, Abstracts with Program, p. S278.
 - 9) **Rakovan, J.**, and Reeder, R.J. (1996) Luminescence Zoning in Minerals: A Phenomenon of Beauty and Illumination. Tucson Mineralogical Symposium. Mineralogical Record, 27, 22-23.
 - 8) **Rakovan, J.**, and Reeder, R.J. (1995) Spatially resolved REE heterogeneities (intra-sectoral zoning) in apatite using synchrotron X-ray fluorescence microanalysis. V.M. Goldschmidt Conference, Program and Abstracts, p.82.
 - 7) **Rakovan, J.**, and Reeder, R.J. (1994) Constraints on intra-sectoral zoning and dissymmetrization in minerals: The case of Grossular Garnet. Annual Geological Society of America meeting, Abstracts with program, p.A-481.
 - 6) **Rakovan, J.**, and Reeder, R.J. (1994) Sectoral and Intra-sectoral Zoning in Apatite. Rochester Mineralogical Symposium. Rocks and Minerals, 69, 133.
 - 5) **Rakovan, J.**, and Reeder, R.J. (1993) Dissymmetrization and trace element partitioning in apatite: Considerations of surface symmetry and structure. Annual American Geophysical Society Spring meeting, Abstracts with Program, p. 342.
 - 4) **Rakovan, J.**, Schoonen, M., and Reeder, R.J. (1993) Marcasite epitaxy on pyrite, Deep Tunnel project, Chicago, Illinois. Annual Geological Society of America meeting, Abstracts with program, p.A-439.
 - 3) **Rakovan, J.**, and Reeder, R.J. (1992) Differential Distribution of REE and Mn in apatite as controlled by crystal surface structure. Annual Geological Society of America meeting, Abstracts with program, p. A175.
 - 2) **Rakovan, J.**, Mitcheltree, D.B., and Benton, L (1992) Preliminary Investigation of the Origin of Amethyst Sceptered Quartz from Hopkinton, Rhode Island. Rochester Mineralogical Symposium. Rocks and Minerals, 67, 118.
 - 1) **Rakovan, J.**, and Guggenheim, S. (1992) Rietveld Refinement of a IIB-2 clinocllore. Annual Clay Mineral Society meeting, Program and Abstracts, p. 132.

Other Abstracts:

- 13) **Rakovan, J.** (2002) How and why minerals form faceted crystals. Friends of Mineralogy 5th Midwest Mineral Symposium, Symposium Program and Abstracts.
- 12) **Rakovan, J.**, Reeder, R.J., Elzinga, E.J., Cherniak, D. (2001) XAS Characterization of U in Fluorapatite. National Synchrotron Light Source 2001 Activity Report.
- 11) **Rakovan, J.**, Newville, M. and Sutton, S. (2000) Evaluation of Europium Oxidation State and Anomalous Partitioning Behavior in Intra-sectorally Zoned Apatite Using Wavelength Dispersive Micro-XANES. Advanced Photon Source Activity Report 2000.
- 10) Bosze*, S., **Rakovan, J.**, Shea, G, and Lanzirotti, A (1999) Wavelength dispersive SXRFMA of sectorally distributed REE heterogeneities in fluorite. National Synchrotron Light Source 1999 Activity Report.
- 9) **Rakovan, J.** and Shea, G. (1998) SXRFMA of Sectoral Zoning of Trace Elements in Hydrothermal Fluorite Crystals. National Synchrotron Light Source 1998 Activity Report.
- 8) **Rakovan, J.** and Reeder, R. J. (1996) Spatially Resolved Trace Element Heterogeneities in Apatite Measured via Synchrotron X-ray Fluorescence Microanalysis. National Synchrotron Light Source 1996 Activity Report. B-299.
- 7) **Rakovan, J.** and Reeder, R. J. (1996) Single Crystal Neutron Diffraction Study of Apatite Exhibiting Growth Related Sectoral and Intra-sectoral Dissymmetrization. IPNS 1991-1996 Progress Report, 273.
- 6) **Rakovan, J.** and Reeder, R. J. (1994) Differential incorporation of trace elements during growth of grossular and apatite: intra-sectoral zoning vs. dissymmetrization. National Synchrotron Light Source 1994 Activity Report. B-185.
- 5) **Rakovan, J.** and Reeder, R. J. (1994) Single Crystal Neutron Diffraction Study of Apatite Exhibiting Growth Related Sectoral and Intra-sectoral Dissymmetrization. LANSCE Progress Report, 165-166
- 4) **Rakovan, J.**, and Leinenweber, K. (1993) Dehydroxylation of Mg-rich chlorite at 2.5 and 4.1 Gpa. National Synchrotron Light Source Annual Report, p.B-131.
- 3) **Rakovan, J.**, Northrup, P., and Reeder, R. J. (1993) Surface structural controls on trace element incorporation during growth of minerals. National Synchrotron Light Source Activity Report, p.B-225.
- 2) Lanzirotti, A., Hanson G.N., Northrup, P., Reeder, R.J. and **Rakovan, J.** (1993) Monazite breakdown in chlorite schists National Synchrotron Light Source Activity Report.
- 1) Parise, J.B., Leinenweber, K. Weidner, D.J., **Rakovan, J.** Vaughan, M., Gwanmesia, G., and Liebermann, R.C. (1991) Preliminary studies of the potential for structure refinement at high pressures using the DIA apparatus: SiO₂, stishovite, at high pressure. National Synchrotron Light Source Annual Report, p221.

Educational Column in Rocks and Minerals

As part of my goal to help increase the scientific literacy of the general public, targeting specifically the focused audience of the mineral enthusiast community, I have contributed a regular educational column to *Rocks & Minerals* magazine called "A Word to The Wise" since 1/1/03 and miscellaneous other articles.

- 1) Pegmatite (2003) V.78 #3, p. 201

- 2) Skarn (2003) V.78 #4, p. 271
- 3) Manto (2003) V.78 #5, p. 351
- 4) Hypogene and Supergene (2003) V.78 #6, p. 419
- 5) Hydrothermal (2004) V.79 #1, p. 64-65
- 6) Placer (2004) V.79 #2, p. 133-134
- 7) EDS (2004) V.79 #3, p. 194-195
- 8) Zeolite (2004) V.79 #4, p. 171-173
- 9) XRD (2004) V.79 #5, p. 351-353
- 10) Growth Hillock (2004) V.79 #6, 415-417
- 11) Metasomatism (2005) V.80 #1, p. 63-64
- 12) Amygdule (2005) V.80 #3, p. 287
- 13) Pillow Basalt (2005) V.80 #4, p. 202-203
- 14) Gangue (2005) V.80 #5, p. 365-366
- 15) Solid Solution (2005) V.80 #6, p. 449-450
- 16) Mississippi Valley Type Deposit: MVT (2006) V.81 #1, p. 69-71
- 17) Diatreme (2006) V.81 #2, p. 153-154
- 18) A-Mica (2006) V.81 #3, p. 235
- 19) Epitaxy (2006) V.81 #4, p. 317-320
- 20) Desert Varnish (2006) V.81 #5, p. 393-394
- 21) Phase Transition (2006) V.81 #6, p.467-469
- 22) Greisen (2007) V.82 #2, p.157-159.
- 23) Nelsonite and Kiruna-type deposit (2007) V.82 #3, p.249-251
- 24) Hemimorphism (2007) V.82 #4, p.329-333
- 25) 4000+ (Mineral nomenclature) (2007) V.82 #5, p.423-424
- 26) Environmental Mineralogy (2008) V.83 #2, p.172-175
- 27) Kimberlite (2008) V.83 #3, p.267-268.
- 28) NYF pegmatite (2008) V.83 #4, p.351-353
- 29) Greenstone (2008) V.83 #6, p.553-554
- 30) Sectoral Zoning (2009) V.84 #2 p. 171-176.
- 31) Felsic/Mafic (2009) V.84 #6 p. 559-560
- 32) Materials Mineralogy (2010) V.85 #4 p.352-357
- 33) Serpentine (2011) V. 86 #1 p.63 – 67.
- 34) Opaques (2014) V. 89 #3 p.269
- 35) Blue Lava (2016) V. 91#1 p.83-84.
- 36) Geode (and friends) (2017) V. 92#1p.85-88.
- 37) Crystal Form (2018) V.93#1 p. 81-86.
- 38) Coordination (2023) V.98#1 p. 99-101.

Published Data Images

- Thin section Dress. Thin section image used by clothing designer Jeremy Laing as a print for several dresses and a blouse (Winter 2007 collection). Image and picture of dress published in *Rocks & Minerals* V.82 #4, p. 273.
- Cl and DIC photomicrographs of intrasectorally zoned apatite: in the “Handbook of Microscopy” (section on Cathodoluminescence Microscopy). Amelinckx et al Editors. VCH, Berlin.
- AFM image of goethite cleavage surface: Cover of “Mineral-Water Interfacial Reactions, Kinetics and Mechanisms” (D. Sparks and T. Grundl Eds.). American Chemical Society Symposium Series 715
- AFM image of a growth spiral on the of graphite: In “ Mineralogy - A Geologist's Point of View” by Malcolm Hibbard. McGraw-Hill Higher Education; ISBN: 0072345721
- CL, DIC, fluorescence and plain light images of apatites from Llallagua, Bolivia. In *Geonieuws* V. 29(8), 2004.

Papers on hold:

- Borkiewicz*, O., **Rakovan, J.** and Cahill, C. (In review) Impact of metal ions on apatite formation pathways in low temperature aqueous solutions – time resolved in situ studies. In Prep.
- Marchlewski, T.A. and Rakovan, J. (2015) Immobilization of Arsenic and Lead in Contaminated Soil by Ca, P and Cl Addition. In prep.
- Marchlewski, T.A. and Rakovan, J. (2015) Influence of calcium, phosphate and chloride amendments on adsorbed arsenic and lead immobilization. In Prep.
- Marchlewski, T.A., Taylor, A. and Rakovan, J. (2015) Experimental study of the pseudomorphic replacement of schultenite by hydroxylmimetite. In prep.
- Bosze*, S., **Rakovan, J.**, and Lueth, V.W. (In revision with provisional acceptance) Intra-deposit Rare Earth Element chemistry and paragenesis of fluorite from the Hansonburg Mining District, Bingham, New Mexico. *Economic Geology*.

- Borkiewicz*, O., **Rakovan, J.**, and Luo, Y. (in preparation) Low temperature aqueous incorporation of the uranyl ion into hydroxylapatite. For submission to Environmental Science and Technology.
- Rakovan, J.**, Gasbarro*, N., Nakotte, H., Kothapalli, K. and Vogel, S. C. (In preparation) Natural cold working and surface reconfiguration of gold crystals. For submission to American Mineralogist.
- Luo*, Y., **Rakovan, J.**, Hughes, J. Pan, Y., (In preparation) Orientation dependant single crystal X-ray Absorption Spectroscopy of apatite group minerals. For submission to American Mineralogist.
- Luo*, Y., **Rakovan, J.**, Hughes, J. Pan, Y., (In preparation) Single crystal EXAFS characterization of U and Th sites in fluor-, Chlor- and Strontium- fluor-, Chlor- apatites. For submission to American Mineralogist.

Grants:

Total: \$3,975,216.00

External:

Total External: \$3,632,204.00

- New Mexico Consortium. New Mexico Tech contribution to the NMC proposal for the Plutonium Workforce Development Initiative (PWDI): Creation of a diffraction Center at NMT. NMT component 757,124.14 (Year 1: \$ 618,538.77; Year 2: \$ 138,585.37).
- NSF-EAR #1927703. Collaborative Research: A New Mechanism for Metal Isotope Fractionation Induced by Natural Solid-State Ion Conduction. Award 8/1/2020-7/31/2024, amount \$362,036.00 (\$302,310.00. to Miami University, \$59,726 to Juniata College) coPIs Mehdi Zanjani and Ryan Mathur.
- The Mineralogical Research Initiative [MRI] through Collector's Edge: Structure, chemistry and growth mechanisms of wire silver. March 15, 2017- March 14, 2019. Amendment 5/2018 \$30,000.00. Grant #402891
- The Mineralogical Research Initiative [MRI] through Collector's Edge: Structure, chemistry and growth mechanisms of wire silver. March 15, 2017- March 14, 2019. \$70,000.00 sole PI.
- NSF-CHE#1532042: MRI: Acquisition of a Microfocus Single-Crystal Diffractometer," David L. Tierney and John F. Rakovan. August 1, 2015 – July 30, 2017, \$259,494.
- Ohio Board of Regents Action Fund/Miami University cost sharing "MRI: Acquisition of a Microfocus Single-Crystal Diffractometer," David L. Tierney and John F. Rakovan. August 1, 2015 - July 30, 2017, \$111,211.
- NSF EAR-1128957: "Development of a Tender-Energy Microspectroscopy and Imaging User Facility for Earth Sciences at NSLS and NSLS-II." National Science Foundation, Earth Sciences Instrumentation and Facilities Program. Lead Investigator Paul Northrup; Co-Investigators Jay Brandes, Dean Hesterberg, Phoebe Lam, John Rakovan, E. Troy Rasbury, Richard Reeder, Martin Schoonen, Donald Sparks. Award \$230,620. Miami component (listed under EAR-1128753 is \$1000). Term 03/27/13-12/31/2014
- Fulbright Research Fellowship Poland 1-15-2012 to 8-1-2012. \$29,500.00
- Advanced Photon Source General user proposal (GUP- 24477). Probing the depth of natural cold working of gold crystals. 1 day requested 2/2011 (1 day granted Beamline 11-ID-B, used 3/1). Value \$9600.
- NSF- REU supplement to EAR#0952298, \$4800.
- NSF-EAR#0952298: Coprecipitation of Pb and As in apatite and applications to environmental remediation. (sole PI) Submitted July 16, 2009. Granted \$245,682.00 8/11/2010.
- NSF EAR/IF MRI-0722807 additional funding. : "MRI: Acquisition of a High Resolution Analytical Transmission Electron Microscope for the Miami University Electron Microscope Facility" (with H. Dong(PI), R. Edelmann, S. Zou, and G. Pacey (PI),) Received 4/2009. \$22,368.00

For brevity synchrotron general user proposal grants listed 1-19 are in a different format than those below them.

1	NSLS X7B	Olaf	8/20/07	10/25/08-10/29/08	4	\$6720
2	APS 11-ID-C	Olaf	9/13/07	11/7/07-11/11/07	4	\$19200
3	NSLS X19A	Yun	8/24/07	11/13/07-11/16/07	4	\$6720
4	APS 13-IDC	Yun	8/29/07	11/25/07-11/27/07	2	\$9600
5	NSLS X11A	Olaf	11/20/07	3/26/08-3/30/08	4	\$6720
6	APS 11-ID-B	Olaf	12/19/07	2/15/08-2/19/08	4	\$19200
7	APS 5-BM-D	Olaf	12/19/07	3/3/08-3/8/08	3	\$14400
8	NSLS X6A	Olaf	12/3/07	2/27/08-3/2/08	5	\$8400
9	APS 15-ID	Greg	12/21/07	3/29/08-4/1/08	2.5	\$12000
10	NSLS X6B	Olaf	4/2/08	6/22/08-6/24/08	3	\$5040
11	NSLS X10C	Olaf	4/8/08	6/18/08-6/22/08	5	\$8400
12	APS 12-BMB	Olaf	4/25/08	7/15/08-7/20/08	5	\$24000
13	APS 15-ID	Greg	5/6/08	7/30/08-8/1/08	2.25	\$10800
14	NSLS X10C	Olaf	8/7/08	11/6/08-11/10/08	4	\$6720
15	NSLS X6B	Olaf	8/7/08	11/4/08-11/8/08	4	\$6720
16	APS 5-BMD	Olaf	8/28/08	12/1/08-12/5/08	3	\$14400
17	APS 12-BM	Olaf	8/28/08	10/15/08-10/20/08	5	\$24000
18	NSLS X27A	Yun	9/8/08	12/5/08-12/7/08	3	\$5040
19	NSLS X27A	Yun	11/19/08	Spring 2009	4	\$6720

- Apex Companies “further evaluation of Phosphate Induced Metal Stabilization on Former Refined Metals Site, Jacksonville, Florida”. \$124,410 (starting date 11/21/08; index).
- Apex Companies “Arsenic Source, Speciation and Treatment Study, Former Refined Metals Site Jacksonville, Florida”. \$41,795 (starting date 7/1/08; index G01518).
- NSF EAR/IF MRI-0722807: “MRI: Acquisition of a High Resolution Analytical Transmission Electron Microscope for the Miami University Electron Microscope Facility” (with H. Dong(PI), R. Edelmann, S. Zou, and G. Pacey (PI),) \$593,687 (notification 6/8/07, starting date 8/1/07).
- Ohio Board of Regents Action Fund “MRI: Acquisition of a High Resolution Analytical Transmission Electron Microscope for the Miami University Electron Microscope Facility” (with H. Dong(PI), R. Edelmann, S. Zou, and G. Pacey (PI),) NSF matching: \$125,000 (notification 6/8/07, starting date 8/1/07).
- National Synchrotron Light Source General user proposal. Micro-EXAFS of U and Th Doped Apatite. PASS # 6045 4 days requested 1/31/2007 (6 days granted on 4/15/07, used 6/19-6/25/07). Value 10,080.
- National Synchrotron Light Source General user proposal. EXAFS analysis of doped apatites. Pass # 9372. 4 days requested 1/31/2007 (4 days granted on X10C, used 6/14-6/25/08). Value \$6720.
- National Synchrotron Light Source General user proposal. Micro-EXAFS of U and Th Doped Apatite. PASS # 6045 4 days requested 9/30/2006 (6 days granted 12/11/06, used 2/13-2/19/2007). Value \$10,080.
- National Synchrotron Light Source General user proposal. Micro-EXAFS of U and Th Doped Apatite. PASS # 6045 4 days requested. 5/31/2006 (4 days granted on 6/15/06, used X27A 9/1-9/4/06). Value \$6720.
- National Synchrotron Light Source General user proposal. Micro-EXAFS of U and Th Doped Apatite. PASS # 6045 4 days requested. 1/30/2006 (3 days granted on 3/24/06, used X27A 6/18-6/24/06). Value \$5040.
- National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 4 days requested 9/30/2006 (4 days granted on X7B, used 2/16-2/20/07). Value \$6720.
- National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 4 days requested 5/31/2006 (4 days granted on X7B, used 9/8-9/13/06). Value \$6720.
- National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 4 days requested 1/30/2006 (3 days granted on X7B 3/24/06, used 6/15-6/20/06). Value \$5040.
- GSECARS Advanced Photon Source General user proposal (GUP-5839). Micro-EXAFS of U and Th in Apatite. 2-year program requested. 2 days requested 11/5/2006 (2 days granted Sector 13-BM, used 4/4 -4/6/07). Value \$9600.
- GSECARS Advanced Photon Source General user proposal (GUP-5839). Micro-EXAFS of U and Th in Apatite. 2-year program requested. 3 days requested 3/10/2006 (3 days granted Sector 13-BM, used Aug. 11-13). Value \$14,400.
- National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 4 days requested. 1/2005 (3 days granted 9/2005). Value \$5040.
- GSECARS Advanced Photon Source General user proposal. Micro-EXAFS of U and Th Doped Apatite. 3-days requested. 3/23/2005 (3 days granted in Oct 2005). Value \$14,400.
- National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 4 days requested. 5/2005 (3 days granted 10/2005). Value \$5040
- National Synchrotron Light Source General user proposal. Micro-EXAFS of U and Th Doped Apatite. PASS # 6045 4 days requested. 9/30/2005 (5 days granted for March 2006). Value \$8400.
- National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 4 days requested. 9/2005 (3 days granted 4/2006). Value \$5040.
- NSF EAR-0409435: (with John Hughes coPI). Crystal chemistry of U, Th and other Radionuclides in Apatite: Environmental and Geochemical Implications. \$200,000.00 (5/11/04).
- NSF EAR-0320872: “Acquisition of a Scanning Electron Microscope for Nanotechnology Investigations” (with G. Pacey (PI), H. Dong and R. Edelmann) \$191,388.00 (6/24/03).
- Ohio Board of Regents: “Acquisition of a Scanning Electron Microscope for Nanotechnology Investigations.” Matching funds against an NSF-IF proposal (pending). (with G. Pacey (PI), H. Dong and R. Edelmann). \$51,898 (01/03).
- National Synchrotron Light Source General user proposal “Crystal Chemistry of U and Th in apatite”. 15 days of experimental time granted to proposal #4782. (5/2002). Value: \$25,200.
- GSECARS Advanced Photon Source Beamtime Grant #G000216 “Distribution, composition and oxidation state of Fe and Ni impurities in a synthetic diamond crystal.” One day experimental time granted 6/2001. \$4800.
- NSF REU supplement to Grant EAR-0001215. \$5000. (6/2001).
- NSF-IF: Hughes, J.M., Rakovan, J., and Dong, H. “Acquisition of a CCD-detector Single Crystal X-ray Diffractometer.” \$140,288. (5/1/2000).
- Ohio Board of Regents: Rakovan, J., Dong, H., and Hughes, J.M. “Acquisition of a CCD-detector Single Crystal X-ray Diffractometer.” Matching funds against an NSF-IF proposal. \$70,144. (3/22/2000).

- National Synchrotron Light Source General user Grant #4405 “Determination of the site occupancy of Zn in the apatite structure”. 3 days of experimental time granted 11/2000. Value: \$5040.
- NSF: Grant EAR -0001215 “The palygorskite-sepiolite to smectite transformation and the influence on reactive surface sites”. \$154,941, Miami component \$26,954. (6/2000).
- GSECARS Advanced Photon Source Beamtime Grant #G000052 “XAS analysis of differential Eu²⁺/Eu³⁺ incorporation in apatite: the role of crystal surface structure during growth”. 3 days of experimental time granted 7/1999. Value: \$ 14,200
- GSECARS Advanced Photon Source Beamtime Proposal #G000067 “Differential incorporation of REE into multiple fluorite sectors: Surface structural controls on heterogeneous reactivity at the mineral water interface”. 2 days of experimental time granted 7/1999. Value: \$9600.
- NSF REU supplement to Grant EAR-9814691 for field work in Bingham, NM. \$9225. (4/1999),.
- NSF Grant EAR-9814691 "Probing the Structure and Energetics of Reactive Sites at the Mineral-Water Interface: Implications for Element Partitioning and Geochronology". \$61,546.00. (12/1998).
- National Synchrotron Light Source General user Grant #3538 “Determination of trace element heterogeneities in fluorite: Incorporation mechanism and potential geochronologic tool”. 15 days of experimental time granted 12/1998. Value: \$25,200.

Internal:

Total Internal: \$ 342,985.00

- Miami University Tech Fee Grant “Acquisition of a new powder X-ray diffractometer”. 11/2019 \$75,000.00. Total cost of the instrument was \$180,000.00. Matching funds: \$75,000.000 Dept. of Geology, plus \$10,000.00 from each of the following Depts. Chemistry, Physics, Paper Science and Chemical Engineering. Installed June 2020
- Miami University Committee on Faculty Research (CFR) Grant “Mineral replacement reactions in hydrothermal ore deposits: implications for petrogenesis & geochronology.” Awarded an RGA = \$25,507 and GPR = \$1500 (11/21/2012).
- Miami University “MRI: Acquisition of a High Resolution Analytical Transmission Electron Microscope for the Miami University Electron Microscope Facility” (with H. Dong(PI), R. Edlmann, S. Zou, and G. Pacey (PI),) NSF matching: \$125,000. (notification 6/8/07, starting date 8/1/07)
- Formation of joint degree programs with AGH, Poland and CUGS, China. \$10,000.00. (3/15/06)
- CAS Small Teaching Grant: “Teaching Materials for Mineralogy (GLG 201)”. \$700 (10/2005)
- CAS Small Teaching Grant: “Teaching Materials for Mineralogy (GLG 201)”. \$700 (10/2004)
- CAS Small Research Grant: “Acquisition of Analog Controller for new SEM”. \$700 (12/2004)
- CAS Small Teaching Grant: “Teaching Materials for Mineralogy (GLG 201)”. \$700 (12/2004) split among Rakovan, Hughes, and Hart proposals (we gave it all to Bill).
- Shoupp Award: Design of novel apatite lasers by engineered site distribution of REE activators. \$5000.00 (5/7/04).
- Hampton Fund: “Collaborative Research in Japan: Crystal Chemistry of Radionuclide Doped Apatites”. \$3500.00. (3/10/04).
- The 10x Postdoctoral Fellow Program. \$32,000.00 (2/11/04).
- Miami University Committee on Faculty Research (CFR) Grant “The Behavior and Fate of Aqueous Radionuclides During Calcium Phosphate Precipitation and Evolution in the Environment.” \$22,507 (11/02)
- President’s Academic Enrichment Award: “Enhancing the Role of Miami University in the Nanotechnology Revolution.” G.E. Pacey PI, J. Rakovan et al. coPIs. \$137,000.00. (2002).
- CAS Small Research Grant: “Workshop on Extended X-ray Absorption Fine Structure (EXAFS) Spectroscopy.” \$500 (10/23/02).
- CAS Small Teaching Grant: Teaching EXAFS in mineralogy and geochemistry. \$400 (10/23/02).
- CAS Small Instructional Grant: “Acquisition of WinXAS, a program for X-ray absorption spectroscopy data analysis”. \$250 (11/2001).
- CAS Small Research Grant: “Zeolite and Scarn Mineralogy”. \$500 (11/2001).
- CELT small grant to improve teaching: “Polariscope for a new course: The Geology of Gemstones”. \$285 (10/2000).
- CAS Small Instructional Grant: “Refractometer for a new course: The Geology of Gemstones”. \$500 (10/2000).
- CAS Small Research Grant: “Acquisition of a short wave ultraviolet illumination system for studies of mineral luminescence”. \$470 (10/2000).
- CELT small grant to improve teaching: “New Computers for the Geology Computer Laboratory”. \$300 (10/1999).
- CAS Small Instructional Grant: “New Computers for the Geology Computer Laboratory”. \$500 (Fall 1999).
- CAS Small Research Grant: “Uranium: Minerals, Chemistry, and the Environment” “. \$500 (Fall 1999).
- CAS Small Instructional Grant: “Teaching computational methods in geochemistry (GLG430/530)” \$500 (Fall 1998).
- CAS Small Research Grant: “Computational methods in geochemical research” \$500 (Fall 1998).

Submitted Proposals:

- 1) Miami University President’s Academic Enrichment Award: “Investigations in Ethnogeology” 3 year \$89,660.00 (3/98)

- 2) Miami University President's Academic Enrichment Award: "An Interdisciplinary Initiative in Environmental Chemistry". 2 year \$100,000.00 (3/98)
- 3) Miami workshop: Introduction to Scanning Probe Microscopy (6/10/98)
- 4) Department of Energy: Physical and chemical stability of natural and synthetic actinide rich apatites: Geological, mineralogical, and geochemical assessment of apatite as a nuclear waste form. 3 years \$59,089.00 (5/1/98)
- 5) NSF: Probing the structure and energetics of reactive sites at the mineral-water interface: Implications for element partitioning and geochronology. 3 years \$61,546.00 (6/1/98)
- 6) Nuclear Regulatory Commission: Field-based, 4-D assessment of radionuclide transport in a fluid saturated soil zone and underlying fractured crystalline bedrock: Coles Hill uranium deposit, Virginia. 4 years, \$1,115,253.00, Miami component \$60,428.00 (12/13/ 98).
- 7) Miami CAS Small Instructional Grant: "Teaching computational methods in geochemistry (GLG430/530)" \$500.00 (10/98)
- 8) Miami CAS Small Research Grant: "Computational methods in geochemical research" \$500.00 (10/98)
- 9) NSF: Microtopographic evolution of mineral surfaces as a tool to identify and date young fault scarps in bedrock. 2 years \$58,459.00 (11/17/98)
- 10) NSF: Dating young rock falls and glacial moraines using mineral surface microtopography as measured using Atomic Force Microscopy. 1 year 35,756.00 (12/11/98)
- 11) NSF: REU supplement, "Use of the trace element chemistry of fluorites from the Hansonburg Mining District in the study of its hydrothermal genesis." PI, 1 year \$9225 (2/1/99)
- 12) Miami University Workshop: Field Methods in Economic Geology: The Rio Grande Rift. (5/6/99)
- 13) The Mineralogical Society of America Grant for Research in Crystallography, "The role of crystal surface structure on ordering and dissymmetrization of crystals during growth." PI, 1 year \$3500 (5/99)
- 14) GSECARS Advanced Photon Source Beamtime Proposal: XAS analysis of differential $\text{Eu}^{2+}/\text{Eu}^{3+}$ incorporation in apatite: the role of crystal surface structure during growth.
- 15) GSECARS Advanced Photon Source Beamtime Proposal: Differential incorporation of REE into multiple fluorite sectors: Surface structural controls on heterogeneous reactivity at the mineral water interface.
- 16) Miami CELT small grant to improve teaching: "New Computers for the Geology Computer Laboratory" \$300 (9/99).
- 17) Miami CAS Small Instructional Grant: "New Computers for the Geology Computer Laboratory" \$500 (9/99).
- 18) Miami CAS Small Research Grant: "Uranium: Minerals, Chemistry, and the Environment" \$500 (9/99).
- 19) NSF: "The palygorskite-sepiolite to smectite transformation and the influence on reactive surface sites" 2 years, \$154,941, Miami component \$26,954 (12/1/99).
- 20) Miami University PhD enhancement "Mineral-Microbe Interactions in Environmental Geochemistry" 5 years, \$500,000 (2/24/2000)
- 21) Ohio Board of Regents: "Acquisition of a CCD-detector Single Crystal X-ray Diffractometer." Matching funds against an NSF-IF proposal. \$70,144 (3/22/2000).
- 22) NSF-IF: "Acquisition of a CCD-detector Single Crystal X-ray Diffractometer." \$140,288 (5/1/2000)
- 23) Ohio Board of Regents Incentive Fund Proposal "*Mineral-Microbe Interactions in Environmental Geochemistry*" Rakovan, J., Dong, H., Levy, J. and Hughes, J.M. 9/6/2000. \$431,524.00
- 24) Miami CAS Small Instructional Grant: Refractometer for a new course " The Geology of Gemstones" \$500 (10/2000)
- 25) Miami CAS Small Research Grant: Acquisition of a short wave ultraviolet illumination system for studies of mineral luminescence. \$470 (10/2000)
- 26) Miami CELT small grant to improve teaching: "Polariscope for a new course " The Geology of Gemstones" \$285 (10/2000)
- 27) NSF: "Colloid-Facilitated Bacterial Transport: Implications for Environmental Bioremediation" Dong, H. and Rakovan, J. \$130,000. (12/01/00)
- 28) GSECARS Advanced Photon Source Beamtime Proposal: Fe and Ni Impurities in Synthetic Diamonds (6/1/01).
- 30) Miami CAS Small Research Grant: "Acquisition of WinXAS, A Program for X-ray Absorption Spectroscopy Data Analysis". \$300 (11/2001)
- 30) Miami CAS Small Teaching Grant: "Acquisition of WinXAS, A Program for X-ray Absorption Spectroscopy Data Analysis". \$300 (11/2001)
- 31) Miami CAS Small Research Grant: "Zeolite and Scarn Mineralogy". \$500 (11/2001)
- 32) National Synchrotron Light Source General user proposal "Crystal Chemistry of U and Th in apatite". 15 days of experimental time requested 1/2002. Value: \$25,200. (Funded)
- 33) GSECARS Advanced Photon Source Beamtime Proposal: "Sectoral zoning of irradiation-induced color intensity in natural fluorites: Coupling between lanthanides and irradiation induced defects". 2 days of experimental time requested 3/2002. Value: \$9600. (Denied)
- 34) Miami President's Academic Enrichment Award: "Enhancing the Role of Miami University in the Nanotechnology Revolution." G.E. Pacey PI, J. Rakovan et al. coPIs. \$250,000.00 requested. (Funded)
- 35) Miami CRF Faculty Research Grant Proposal "The Behavior and Fate of Aqueous Radionuclides During Calcium Phosphate Precipitation and Evolution in the Environment." 10/02

- 36) Miami CAS Small Research Grant: Workshop on Extended X-ray Absorption Fine Structure (EXAFS) Spectroscopy. 10/02. \$500
- 37) Miami CAS Small Teaching Grant: Teaching EXAFS in mineralogy and geochemistry. 10/02. \$400
- 38) Ohio Board of Regents: "Acquisition of a Scanning Electron Microscope for Nanotechnology Investigations." Matching funds against an NSF-IF proposal. (with G. Pacey (PI), H. Dong and R. Edelman). \$51,898 (01/03).
- 38) NSF: "Acquisition of a Scanning Electron Microscope for Nanotechnology Investigations" (with G. Pacey (PI), H. Dong and R. Edelman. \$207,590 (01/23/03)
- 39) NSF Polar Programs: "The Role of Manganese Oxides in Trace Metal Cycling in Lake Vanda: Microbial and Geochemical Controls." (with William Green (PI), and H. Dong; \$414,922.00 (6/4/03)
- 40) NSF Collaborative Research: "Crystal Chemistry of U, Th and other Radionuclides in Apatite: Environmental and Geochemical Implications" (with John Hughes and Chris Cahill, \$251,453) (12/1/03)
- 41) Miami Hampton Fund: Collaborative Research in Japan: Crystal Chemistry of Radionuclide Doped Apatites. \$7550.00. (3/10/04).
- 42) Miami Shoupp Award: Design of novel apatite lasers by engineered site distribution of REE activators. \$7000.00 (3/23/04).
- 43) NSF Polar Programs: The Role of Manganese Oxides in Trace Metal Cycling in Lake Vanda: Microbial and Geochemical Controls. (with William Green (PI), and H. Dong; June 2004)
- 44) Miami CAS Small Research Grant: "Acquisition of Analog Controller for new SEM". \$700 (12/2004)
- 45) Miami CAS Small Teaching Grant: "Teaching Materials for Mineralogy (GLG 201)". \$700 (12/2004)
- 46) NSF Polar Programs: The Role of Manganese Oxides in Trace Metal Cycling in Lake Vanda: Microbial and Geochemical Controls. (with William Green (PI), and H. Dong; June 2005)
- 47) National Synchrotron Light Source General user proposal. MICROEXAFS of U and Th apatites. PASS # 2428 4 days requested. 9/30/2004 (denied).
- 48) National Synchrotron Light Source General user proposal. MICROEXAFS of U and Th apatites PASS # 4237 4 days requested. 1/2005 (denied)
- 50) National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 4 days requested. 1/2005 (3 days granted 9/2005). Value \$5040.
- 51) GSECARS Advanced Photon Source General user proposal. Micro-EXAFS of U and Th Doped Apatite. 3-days requested. 3/23/2005 (3 days granted in Oct 2005). Value \$14,400.
- 52) National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 4 days requested. 5/2005 (3 days granted 10/2005). Value \$5040
- 53) Advanced Light Source, Berkeley Laboratory, Beamtime Proposal. Micro-EXAFS of U and Th doped apatites. 8/2005. 4-days requested (denied).
- 54) Miami CAS Small Teaching Grant: "Teaching Materials for Mineralogy (GLG 201)". \$700 (9/2005)
- 55) National Synchrotron Light Source General user proposal . Micro-EXAFS of U and Th Doped Apatite. PASS # 6045 4 days requested. 9/30/2005 (5 days granted for March 2006). Value \$8400.
- 56) National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 4 days requested. 9/2005 (3 days granted 4/2006). Value \$5040.
- 57) GSECARS Advanced Photon Source General user proposal. Micro-EXAFS of U and Th Doped Apatite. 3-days requested. 10/23/2005 (denied)
- 58) Spring8, Kobe, Japan General user proposal. EXAFS Characterization of Ca Site Geometry in Apatite and Determination of Zn Site Occupancy and Distortion. 2 days requested. 11/15/2005 (denied)
- 59) Advanced Light Source, Berkeley Laboratory, Beamtime Proposal. Micro-EXAFS of U and Th doped apatites. 12/2005. 4-days requested (denied).
- 60) National Synchrotron Light Source General user proposal . Micro-EXAFS of U and Th Doped Apatite. PASS # 6045 4 days requested. 1/30/2006 (3 days granted on X27A 3/24/06). Value \$5040.
- 61) National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 4 days requested. 1/2006 (2 days granted on X7B 3/24/06). Value \$3360.
- 62) GSECARS Advanced Photon Source General user proposal (GUP-5839). Micro-EXAFS of U and Th in Apatite. 2-year program requested. 3/10/2006 (3 days granted Aug. 11-13). Value \$14,400
- 63) Proposal for the formation of joint degree programs with AGH University in Krakow, Poland and China University of Geosciences in Beijing, China. 3/15/06 \$10,000.00 granted.
- 64) President's Academic Enrichment Award: Spectroscopy across the Physical Sciences An Interdisciplinary Approach to Integrate Research and Teaching (Declined).
- 65) NSF Polar Programs: Geochemical and Microbial Controls on Manganese Oxide Reactivity: Implications for Trace Metal Cycling in Lake Vanda, Antarctica. (with William Green (PI), and H. Dong; June 2006). Requested \$372,433.00 (Declined).
- 66) NSF EAR-MRI: Acquisition of transmission electron microscope for nanotechnology investigations (with H. Dong (PI), R. Edelman, and S. Zou). 1/25/07, Requested \$600,000.00.
- 67) Ohio Board of Regents: "Acquisition of transmission electron microscope for nanotechnology investigations."

- Matching funds against an NSF-IF proposal. (with G. Pacey (PI), H. Dong, R. Edelmann, and S. Zou). 1/25/07, \$215,000 (01/03).
- 68) National Synchrotron Light Source General user proposal. Micro-EXAFS of U and Th Doped Apatite. PASS # 6045 4 days requested 1/31/2007 (6 days granted on 4/15/07, used 6/19-6/25/07). Value 10,080.
 - 69) National Synchrotron Light Source General user proposal. In-situ, Time-Resolved Studies of Apatite Formation Pathways. Pass # 3955. 5 days requested 1/31/2007 (denied).
 - 70) National Synchrotron Light Source General user proposal. Development of precursor calcium phosphate phases in the presence of secondary metal cations. PASS # 9352. 6 days requested May 31, 2007.
 - 71) National Synchrotron Light Source General user proposal. EXASAF analyses of doped apatites. PASS # 9372 4 days requested May 31, 2007.
 - 72) National Synchrotron Light Source General user proposal. Micro-EXAFS of U and Th Doped Apatite. PASS #6045. 5 days requested May 31, 2007.
 - 73) NSF Polar Programs: The Role of Environmental Nanoparticles on Heavy Metal Cycling in Aquatic Systems: A Case Study in Lake Vanda, Antarctica (with Bill Green and Hailiang Dong, June 6 2008) requested \$446,187.00
 - 75) NSF – Instrumentation and Facilities: Development of New Instrumentation and Techniques for a "Tender" X-ray Microspectroscopy Facility for Earth Sciences (joint proposal with Emma T Rasbury, SUNY at Stony Brook, Phoebe J Lam, Woods Hole Oceanographic Institution, Donald L Sparks, University of Delaware, Jay Brandes, Skidaway Institute of Oceanography 2/23/09). Requested \$711,753.00, amount to Miami = 0.
 - 80) NSF-EAR#0952298: Coprecipitation of Pb and As in apatite and applications to environmental remediation. Requested 245,682, July 16, 2009.
 - 81) NSF-EAR# Collaborative research: Investigation of Anion Incompatibility in the apatite atomic arrangement. Requested 70,159, January 6, 2010.
 - 82) NSF – EAR-IF # 1029399: Development of an Optimized 'Tender' X-ray Microspectroscopy and Imaging User Facility for Earth Sciences. (joint proposal with Paul Northrup and Emma T Rasbury, SUNY at Stony Brook, Phoebe J Lam, Woods Hole Oceanographic Institution, Donald L Sparks, University of Delaware, Jay Brandes, Skidaway Institute of Oceanography 2/10/10). Requested \$627,920.00, amount to Miami = 0.
 - 83) NSF- REU supplement to EAR#0952298. 9/8/2010, Requested \$4323.
 - 84) NSF – EAR-IF # 1128753: Development of a Tender-Energy Microspectroscopy and Imaging User Facility for Earth Sciences at NSLS and NSLS-II (joint proposal with Paul Northrup and Emma T Rasbury, SUNY at Stony Brook, Phoebe J Lam, Woods Hole Oceanographic Institution, Donald L Sparks, University of Delaware, Jay Brandes, Skidaway Institute of Oceanography 2/10/10). Requested \$646,978.00, amount to Miami = 0. Funded
 - 85) Fulbright Research Fellowship Poland. Funded \$29,500.00
 - 86) Miami CFR Proposal: Mineral replacement reactions in hydrothermal ore deposits. \$35,000 Requested 10/1/2012
 - 87) NSF – EAR #1322062: Mineral replacement reactions in hydrothermal ore deposits: implications for petrogenesis and geochronology. Submitted 1/7/2013. Requested amount \$290,058.00. Sole PI. Not funded.
 - 88) DOE : NSLS-II Partner User Proposal: The Tender Energy Microspectroscopy Consortium for the TES (Tender Energy Spatially Resolved X-ray Absorption Spectroscopy) Beamline. Submitted 10/2013.
 - 89) Miami University MRI Preproposal: Acquisition of a Microfocus Single Crystal Diffractometer for Crystallography at Miami University. Submitted to ORS 10/24/13.
 - 90) DARPA-BAA-13-20 Materials Science Research / Remote Sensing Technology. "Unique complex tagging and remote sensing system" Co-PI, joint proposal with Mark P.S. Krekeler and R. Bretz. Total requested \$5,857,184 (over three years). Submitted 3/24/14 . Denied.
 - 91) DIA-BAA-14-01. Unique complex tagging and remote sensing system" Co-PI, joint proposal with Mark P.S. Krekeler, C. Almquis and R. Bretz. Total requested \$ 13,850,000 (over three years). Submitted Fall/2014.
 - 92) USAF HPW/RHX-2014-0001. A Novel Remote Sensing Tagging System for Tracking People and Objects. Co-PI, joint proposal with Mark P.S. Krekeler, C. Almquis and R. Bretz. Total requested \$ 7,850,000 (over three years). Submitted Fall/2014.
 - 93) DURIP – DoD. A new education and academic research hyperspectral remote sensing instrumentation facility/system for Ohio. Co-PI, joint proposal with Mark P.S. Krekeler, and M. Henry. Total requested \$ 386,202.7. Submitted Fall/2014.
 - 94) Miami University: A Platform for Long Term Revenue and Student Success. First Generation Tunable Tagging System for U.S. Intelligence, Military and Law Enforcement. Co-PI, joint proposal with Mark P.S. Krekeler, C. Almquis and R. Bretz. Total requested \$250,000. Fall 2014
 - 95) NSF-EAR #1524673 Selective phosphate mineral replacement reactions in hydrothermal ore deposits: implications for petrogenesis and geochronology. Submitted 1/12/2015, Requested amount \$ 292,198.00. Sole PI.
 - 96) NSF-CHE-MRI # 1532042. MRI: Acquisition of a Microfocus Single-Crystal Diffractometer. Submitted 1/22/2015, Requested amount \$318,689.00. coPI with David Tierney.
 - 97) Ohio Board of Regents & Miami University: Acquisition of a Microfocus Single-Crystal Diffractometer. Matching funds against NSF-CHE-MRI proposal. (with David Tierney). \$136,581 (012/2014).
 - 98) Contributed to, as a major user, an NSF-MRI proposal for a LA-ICP-MS Widom, McCloud, Wolfe (co-PIs). 2-2018.
 - 99) NSF-EAR #1831014. Structural, geochemical, and computational evaluation of natural and synthetic wire silver:

- understanding the mechanisms of wire formation and Ag isotopic fractionation. Submitted 2/26/2018, Requested amount \$337,026.00. coPI with Mehdi Zanjani.
- 100) Contributed to, as a major user, an NSF-MRI proposal for a LA-ICP-MS Widom, McCloud, Wolfe (co-PIs). 2-2019.
- 101) NSF-EAR #1927703. Inverse Metal Isotope Fractionation Induced by Natural Solid-State Ion Conduction. Submitted 3/1/2019, Requested amount \$362,547.00. coPI Mehdi Zanjani.
- 102) Miami University Tech Fee proposal. Access to and training in X-ray diffraction analysis across departments and divisions. 9/23/2019, Requested amount \$75,000. Matching from Geology/Physics/Chemistry/Paper Science \$110,000.00
- 103) NSF-EAR #1927703. Collaborative Research: A New Mechanism for Metal Isotope Fractionation Induced by Natural Solid-State Ion Conduction. Submitted 2/29/2020, Requested amount \$362,036.00 (\$302,310.00. to Miami University, \$59,726 to Juniata College) coPIs Mehdi Zanjani and Ryan Mathur.
- 104) NSF-MRI#2117396. MRI: Acquisition of a High-Resolution Imaging and Analysis System for Science and Engineering Research and Teaching at Miami University. Submitted 1/19/2021, requested amount \$651,047. Ye, Z., Mechanical Engineering (PI), Rakovan, J. Geology, Jahan, M. Mechanical Engineering, Kerr, L.L. Chemical Engineering, Ren, H. Chemistry (co-PIs).
- 105) NSF-MRI#2215870. Acquisition of a High-Resolution Imaging and Analysis System for Science and Engineering Research and Teaching at Miami University. Submitted 1/19/2022, requested amount \$458,811. H. Dong, Geology (PI) Ye, Z., Mechanical Engineering (PI), Rakovan, J. Geology, Kerr, L. Chemical Engineering, Lorigan, G. Chemistry (co-PIs).
- 106) New Mexico Consortium. New Mexico Tech contribution to the NMC proposal for the Plutonium Workforce Development Initiative (PWDI): Creation of a diffraction center at NMT. Final submission June 2023. \$757,124.14 requested.

Teaching and Advising

Graduate student Committees:

Thesis/Dissertation Advisor to:

- Stephanie Bosze (M.S.) Geology
Graduation 5/2001
Thesis: Surface structurally controlled sectoral zoning in fluorite: Implications to understanding heterogeneous reactivity at the mineral-water interface. Two submitted papers. One Goldschmidt poster, 2000 GSA talk.
Awards: Society for Luminescence Microscopy and Spectroscopy (SLMS) Research Grant \$400.
Proposal Defense 4/1999
Thesis Defense 1/2001
- Steve Adams (M.A.) Geology
 Adviser 9/98-6/99
- Art Losey (M.S.) Geology
Graduation 5/2001
Thesis: Structural variation in the phosphate olivine lithiophilite-triophyllite series and characterization of light element (Li, Be, and B) mineral standards.
Awards: MSA Grant to Attend workshop on U mineralogy and geochemistry \$300
Proposal Defense 4/2000
Thesis Defense 11/2001
- Carrie Wright (M.S.) Geology
Graduation 5/2003
Thesis: Spectroscopic characterization of fluorite: Relationships between trace element zoning, defects and color. Two papers and Goldschmidt abstract.
Awards: American Federation of Mineral Societies (AFMS) Research Award \$4000
Started 8/2000
Thesis Defense 12/2002
- Frederick Partey (M.S.) Geology
Graduation 8/2004
Thesis: Source of fluorine and petrogenesis of the Rio Grande Rift type barite-fluorite-galena deposits
Awards: Awarded GSA Research Grant. 4/03. \$1600
 Awarded Society of Economic Geologists (SEG) Research Grant. 6/03. \$1000
 Awarded Sigma Xi Research Grant. 1/04. \$350.
Started 8/2002
- Ziming Yue (M.S.) Geology
Graduation Left Miami 8/2005 without finishing, for a PHD with Rona Donahoe, University of Alabama
Thesis: Heterogeneous Mn-oxide formation and the sequestration of trace metals
Started 7/2003

- Yun Liu (Ph.D.) Geology
Graduation 5/2010
Dissertation: Crystal Chemistry of U, Th and other radionuclides in apatite.
Started 8/2003
- Olaf Borkiewicz (Ph.D.) Geology
Graduation 12/2009
Dissertation: The role of precursor formation on apatite growth at low temperatures.

Awards: (\$10,900): Recipient of the 2008 Mineralogical Society of America Mineralogy/ Petrology Research Fund. \$5000
The International Centre for Diffraction Data (ICDD) 2009 Ludo Frevel Crystallography Scholarship Award. \$2500
2008 Geological Society of America Student Research grant. \$3400
2009 AAPG Jay M. McMurray Memorial Grant: \$2250
Started 1/2004
- Gregory Schmidt (M.S. 2009) Geology
Graduation 12/2009
Thesis: Triclinic $\text{Na}_3\text{AlV}_{10}\text{O}_{28} \cdot 22\text{H}_2\text{O}$, a new decavanadate mineral from the Sunday Mine, Slick Rock District, San Miguel County, Colorado, USA.
Awards: International Association for Mathematical Geology (IAMG) Student Grant, 2009. \$1000
Started 8/2006
- Tomasz Marchlewski (Ph.D.) Geology
Graduation ABD
Dissertation: Coprecipitation of Pb and As in apatite and applications to environmental remediation.
PHD Oral and written exams 9/2008
Dissertation Prospectus 12/2008
Started 1/2006
- Cynthia Tselepis (M.S.) coadvised with Mark Krekeler.
Graduated 12/2011.
Thesis: Heterogeneous oxidation of Mn(II) and oxide formation on goethite surfaces.
- Laura Crimmins (M.S.)
Graduated 8/2012.
Thesis: Structure and Chemistry of Minerals in the Ca-(As,P)-(OH,F,Cl) Apatite System: Johnbaumite, Svabite, and Turneaureite from Franklin and Sterling Hill, New Jersey, USA..
Awards: Presented and published abstract at the 2012 Rochester Mineralogical Symposium and was awarded the Mandarin Award for best graduate student talk at the meeting (\$100).
Started: 8/2010
- Alexandria Hoehner (M.S.)
Graduated: 8/2015
Thesis: Constraints on the Short-Range Structure of Amorphous Calcium Phosphate: A Precursor in the Formation of Hydroxylapatite
Start date: 8/2013
- Joshua Silverstein (M.A.)
Graduated 12/2016
Research paper: MORPHOLOGICAL EVOLUTION OF SECONDARY GOLD: AUTHIGENIC GOLD GROWTH IN A LATERITIC PLACER DEPOSIT FROM ZAPATA, VENEZUELA.
Coadvised with Mark Krekeler
Started 9/2013.
- Wladyslaw Betkowski (Ph.D.)
Graduated 5/2018.
Dissertation: Mineral replacement reactions: implications for the geochronology and petrogenesis of the Llallagua tin deposit in Bolivia.
Awards: 2017 recipient of a Miami Graduate Thesis and Dissertation Support Grant \$600
2017 recipient of a Miami Graduate Student Achievement Award \$300
Presented at the 2018 Midwest Friends of Mineralogy Symposium and won best graduate student talk at the meeting (\$100).
Start date: 8/2013
- Sean Kelly (M.S.)
Graduated 12/2016.
Thesis: Investigation Into the Column Anion Structure and Chemistry of Synthetic Apatite Along the F-OH and OH-Cl Solution Series

Awards: Best student talk at the 2014 Rochester Mineralogical Symposium. Award for giving the best student poster presentation at the American Exploration and Mining Association 2015 annual meeting in Spokane, Washington.

Start date: 8/2014

- Caleb Chappell (M.S.)
Graduated 12/2018
Thesis: Chemical and Structural Characterization of Fluorapatite from the Poudrette Pegmatite, Mont Saint Hilaire Quebec, Canada.
Start date: 8/2016
- Calvin Anderson (M.S.)
Graduation 8/2018.
Thesis: The structure, chemistry and growth mechanisms of wire silver.
Awards: Presented and published abstract at the 2017 Rochester Mineralogical Symposium and was awarded the Mandarino Award for best graduate student talk at the meeting (\$100).
Presented at the 2018 Midwest Friends of Mineralogy Symposium and won best graduate student talk at the meeting (\$100).
Start date: 8/2016
- Chris Emproto (M.S.)
Graduation: 9/2020
Thesis: Halogen and trace element chemistry of apatites from crustal silicocarbonatites of the Central Metasedimentary Belt, Grenville Province.
Awards:
Start date: 8/2017
- Calvin Anderson (Ph.D.)
Graduation 5/2023
Dissertation: Metal isotope fractionation by natural solid-state ion conduction.
Awards:
- Christian Anderkin (Ph.D.)
Start Date: 8/2020 left 3/2021 due to personal issues
- Stephanie Mounce (M.S.) Fluorite and calcite melt inclusions in apatite
Start Date: 8/2021
- Jamshid Ahmadi (Ph.D.) Source of F in the Illinois-Kentucky Fluorspar District.
Start Date: 8/2021

Courses Developed and Taught:

- GLG 111: Introductory Geology (S 98, F 98, F 00, F 01, F 04, F16, F18, F19, F20, F21)
- GLG 131: Geology and Gemstones (S 03)
- GLG 180: Gems and Gem Formation (F10, F11, F12, F16, F17) taught as GLG 111 F18 on.
- GLG 201: Mineralogy (F 04, 05, 06, 07, 08, F09, F10, F11, F12, F13, F14, F15, F16, F17, F18, F19, F20, F21)
- GLG 211: Geochemical Systems of the Earth (F 99, F 00, F 01, F 02, F03)
- GLG 280: Gems and Gem Formation (F 06, S 06, F 07, F08, S10-as 180, F10, F11 as 180)
- GLG 430/530 and 630: Mineral-Water Interface Geochemistry (S 99, S 00, S 03, S 09, S11, S19)
- GLG 432/532: Clays and Clay Mineralogy (S 01) (Revised): Clay Mineralogy & Powder X-ray Diffraction (S 07, S10, S13, S18, S20, S22)
- GLG 499/599: Geology and Mineral Deposits of the Rio Grande Rift. Field workshop (Su 99, S 03)
- GLG 699: Scanning Probe Microscopy. Summer workshop (Su 98, Su 00, Su 03, Su 08)
- GLG 720: Advanced Mineralogy Seminar: Spectroscopic Methods (S 06)
- GLG 720: Advanced Mineralogy Seminar: X-ray Crystallography (S16, S17, S21)
- GLG 499/599: Geology of Big Bend National Park and the Trans Pecos. Field workshop (S 04)
- GLG 632: X-ray methods in crystal structure analysis (S 2008)

Field Trips Conducted

- 1) 6/2023 Hansonburg Mining District, Bingham, New Mexico.
- 2) 9/2022 Bancroft Area, Ontario, Canada to study vein-dikes of the Grenville Province.
- 3) 5/2022 Southern Illinois/Kentucky Fluorspar District for my research group & Illinois Geological Survey collaborators.
- 4) 10/2021 Southern Illinois/Kentucky Fluorspar District for my research group & Illinois Geological Survey collaborators.
- 5) 8/2021 Bancroft Area, Ontario, Canada to study vein-dikes of the Grenville Province.
- 6) 8/2019 Bancroft Area, Ontario, Canada and Upstate New York to study vein-dikes of the Grenville Province.
- 7) 9/2018 Southern Illinois/Kentucky Fluorspar District for GLG 201

- 8) 3/2018 Grande Rift and adjacent geologic environments, New Mexico, Geology Department Spring Break (W/ Euan)
- 9) 9/2016 Southern Illinois/Kentucky Fluorspar District for GLG 201
- 10) 1/12/14 Volcanic features of the Jemez Mts., New Mexico. For the 10th LANSCE School on Neutron Scattering Geosciences & Materials in Extreme Environments.
- 11) 11/12-14/2011 Southern Illinois/Kentucky Fluorspar District for GLG 201
- 12) 4/10/2010 Carnegie Museum of Natural History for GLG 180
- 13) 3/10 Grande Rift, New Mexico, Geology Department Spring Break
- 14) 10/09 New Mexico Geological Society 60th Fall field conference, Chupadera Mesa Area; organized trip to Hansonburg Mining District.
- 15) 9/08 Sterling Hill Mine, NJ for GLG 201 and 280.
- 16) 10/07 Buick Mine, Viburnum Trend, and St. Francois igneous complex, MO for GLG 201 and 280.
- 17) 11/06 Smithsonian Institution for GLG 280.
- 18) 4/06 Cleveland Museum of Natural History for GLG 280.
- 19) 10/05 Brushy Creek Mine, Viburnum Trend, MO for GLG 201.
- 20) 10/04 Sterling Hill Mine, NJ for GLG 201.
- 21) 3/2004 Big Bend, TX Geology Department Spring Break Trip
- 22) 3/2003 Grande Rift, New Mexico, Geology Department Spring Break
- 23) 1999 Rio Grande Rift, New Mexico Workshop
- 24) 1998 Smithsonian Institution MUGS trip

Undergraduate Research Advised (GLG 177, 277, 377 and 477 at Miami University)

- Fall 2023 Anne Dunn (Materials and Metallurgical Engineering major and NMBGMR Bright Star Scholar) Computational (ab initio and molecular dynamics methods) study of stress corrosion in quartz. Co-advised with Deep Choudhuri (MME) and Alex Rinehart (E&ES).
- Summer 2023 Anne Dunn (Materials and Metallurgical Engineering major and NMBGMR Bright Star Scholar) Computational (ab initio and molecular dynamics methods) study of stress corrosion in quartz. Co-advised with Deep Choudhuri (MME) and Alex Rinehart (E&ES).
- Summer 2023 Elishua Shepherd (RESESS EarthScope Intern). Mineralogical differences as a function of color for Turquoise in New Mexico. Will present at Turquoise Symposium 7/8/2023, AGU Fall 2023,
- Fall 2022 Madeline Murchland, (M.S. student at University of Idaho) Mineralogy of core samples from the Hick's dome intrusion fluorite deposit.
- Spring 2022 Madeline Murchland, (no credits) Mineralogy of core samples from the Hick's dome intrusion fluorite deposit. And fluorescence spectroscopy of zoned apatite. Submitted abstracts to 2022 NC-SC GSA and MSA-FM-TGMS Symposium, Tucson.
- Fall 2021 Madeline Murchland, (no credits) Mineralogy of core samples from the Hick's dome intrusion fluorite deposit. And fluorescence spectroscopy of zoned apatite. Submitted abstracts to 2022 NC-SC GSA and MSA-FM-TGMS Symposium, Tucson.
- Summer 2021 Madeline Murchland, (no credits) Mineralogy of core samples from the Hick's dome intrusion fluorite deposit. And fluorescence spectroscopy of zoned apatite.
- Spring 2021 Stephanie Mounce, (GLG 477, 3 hrs) *Mico-mineral inclusions in fluorite-melt inclusions in apatite from Grenville crustal silicocarbonatites*. Presented work at the 1) Geological Society of America Joint North-Central & South-Central Section Meeting 2) Miami University Undergraduate Research Forum (UR 21) 3) Dept. of Geology Undergraduate Research Forum. Proposals submitted 1) Geological Society of America; awarded \$300 2) Mineralogical Society of America.
- Spring 2021 Madeline Murchland, (GLG 377) Mineralogy of core samples from the Hick's dome intrusion fluorite deposit. Granted Miami Undergraduate Research Award, \$900 (with Makenzie Rutherford). Presented work at the 1) Geological Society of America Joint North-Central & South-Central Section Meeting 2) Rochester Mineralogical Symposium.
- Spring 2021 Makenzie Rutherford, (GLG 377) Mineralogy of core samples from the Hick's dome intrusion fluorite deposit. Granted Miami Undergraduate Research Award, \$900 (with Madeline Murchland). Presented work at the 1) Miami University Undergraduate Research Forum (UR 21) 2) Dept. of Geology Undergraduate Research Forum. 3) She was a presenter and panelist in the Crystallography mini-Workshop at Rochester Mineralogical Symposium 4/17/2021.
- Fall 2020 Stephanie Mounce, (GLG 477, 3 hrs) *Mico-mineral inclusions in fluorite-melt inclusions in apatite from Grenville crustal silicocarbonatites*. Coadvised by Christian Anderkin.
- Fall 2020 Madeline Murchland, (GLG 377, 3 hrs) Mineralogy of core samples from the Hick's dome intrusion fluorite deposit. Submitted joint proposal for Miami Undergraduate Research Award
- Fall 2020 Makenzie Rutherford, (GLG 377, hrs) Mineralogy of core samples from the Hick's dome intrusion fluorite deposit. Submitted joint proposal for Miami Undergraduate Research Award
- Spring 2020 Madeline Murchland *Optical anomalies in crystals; flattened garnet and gahnite inclusions in mica*. Submitted abstracts to the Forty-seventh Rochester Mineralogical Symposium and Friends of Mineralogy Midwest Chapter 8th annual symposium, Miami University.

- Spring 2020 Makenzie Rutherford, *Optical anomalies in crystals; flattened garnet and gahnite inclusions in mica*. Submitted abstracts to the Forty-seventh Rochester Mineralogical Symposium and Friends of Mineralogy Midwest Chapter 8th annual symposium, Miami University.
- Spring 2020 John Fink (GLG 477, 3hrs) *Crystal structure analysis and column anion quantification in apatite from Grenville crustal silicocarbonatites*. Submitted abstracts to the Forty-seventh Rochester Mineralogical Symposium and Friends of Mineralogy Midwest Chapter 8th annual symposium, Miami University.
- Spring 2020 Mounce, Stephanie (GLG 377, 3 hrs) *Mico-mineral inclusions in fluorite-melt inclusions in apatite from Grenville crustal silicocarbonatites*. Coadvised by Chris Emproto. Submitted abstracts to the Forty-seventh Rochester Mineralogical Symposium and Friends of Mineralogy Midwest Chapter 8th annual symposium, Miami University. Submitted Mineralogical Society of America Grant for Student Research in Mineralogy and Petrology Proposal (3/1/2020) Mounce, S. and Emproto, C., Immiscible halide and carbonate melts from the Schickler Occurrence, ON, Canada.
- Spring 2020 Austin Alvarez. *Evaluation of metamictization in betafite and fluorapatite included in betafite from the Grenville metamorphic belt by single crystal and powder X-ray diffraction*. Published paper Emproto, C., Alvarez, A., Anderkin, C., Rakovan, J. (2020) The Crystallinity of Apatite in Contact with Metamict Pyrochlore from the Silver Crater Mine, ON, Canada. *Minerals*, 10, 244.
- Fall 2019 Mounce, Stephanie (GLG 377) *Mico-mineral inclusions in fluorite-melt inclusions in apatite from Grenville crustal silicocarbonatites*. Coadvised by Chris Emproto.
- Fall 2019 John Fink (GLG 477) *Crystal structure analysis and column anion quantification in apatite from Grenville crustal silicocarbonatites*.
- Fall 2019 Austin Alvarez (GLG 477) *Evaluation of metamictization in betafite and fluorapatite included in betafite from the Grenville metamorphic belt by single crystal and powder X-ray diffraction*.
- Spring 2019 Elizabeth O'Brien & Sam Smiley: Crystal structures of synthetic decavanadates.
- Spring 2019 John Fink (GLG 377) *Crystal structure analysis of minerals from the Neoproterozoic Metamorphic Mozambique Belt, apatite and muscovite*. Presented at the 2019 Friends of Mineralogy Midwest Chapter Symposium, 3/9/2019. Won second best student talk award. Presented to the 2019 Rochester Symposium.
- Spring 2019 Austin Alvarez (GLG 377) *Evaluation of metamictization in betafite and fluorapatite included in betafite from the Grenville metamorphic belt by single crystal and powder X-ray diffraction*.
- Fall 2018 John Fink (GLG 377) *Crystal structure analysis of minerals from the Neoproterozoic Metamorphic Mozambique Belt, apatite and muscovite*.
- Fall 2018 Austin Alvarez (GLG 377) *Evaluation of metamictization in betafite and fluorapatite included in betafite from the Grenville metamorphic belt by single crystal and powder X-ray diffraction*.
- Spring 2018 John Fink (GLG 377) *Fairbankite and other tellurite minerals from Tombstone, AZ, chemistry and structure determinations*.
- Spring 2018 Austin Alvarez (277) *Crystal Healing: annealing experiments with partially metamict Th-rich fluorapatite*.
- Spring 2017-2018 Elizabeth O'Brien & Sam Smiley: Crystal structures of synthetic decavanadates. Poster at the Miami University Undergraduate Research Forum "The Use of 51V-NMR to Study the Intermolecular Changes of Decavanadates in Solution Over Time" Samuel Smiley, David Tierney, John Rakovan.
- Spring 2017 David Ziga: Crystal structures of synthetic decavanadates. Presented and published abstract at the 2017 Rochester Mineralogical Symposium on his Raman spectroscopy of the Ferberite FeWO₄ – Hübnerite MnWO₄ solid Solution.
- Spring 2017 Haleigh Richards: structure and chemistry of zoned hydroxylapatite from the Sapo Mine, Brazil. Presented and published abstract at the 2017 Rochester Mineralogical Symposium and was awarded the Mandarin Award for best undergraduate student talk at the meeting (\$100).
- Spring 2016 Haleigh Richards structure and chemistry of zoned hydroxylapatite from the Sapo Mine, Brazil.
- Spring 2015 David Ziga (GLG 177) FYRE. Raman spectroscopy of the Ferberite FeWO₄ – Hübnerite MnWO₄ solid solution series: Characterization for potential identification of conflict minerals.
- Spring 2015 Samuel Smiley (GLG 177) FYRE. Origin of color change in gem apatite from crustal silicocarbonatite, Madagascar.
- Spring 2013-Spring 2014 (GLG 277, 377, 477) Sean Kelly and Joe Merrill: Crystal structure refinements of apatite solid solutions in the F-OH-Cl system for precise determination of halogen content. In collaboration with Dan Harlov GFZ Potsdam and John Hughes, UVT. The results of their work have been submitted as abstracts for presentation at the 2014 Southeast Regional Geological Society of America Meeting in Blacksburg, VA (Kelly first author) and the 2014 Rochester Mineralogical Symposium (Merrill first author). A manuscript to be submitted to a peer reviewed journal is in progress.
- Fall 2010-Spring 2012 (GLG 377, 477) Jena Long: Optical properties and fluid inclusions in a unique apatite from the Merelani Hills, Tanzania. Presented and published abstract at the 2012 Rochester Mineralogical Symposium and was awarded the Mandarin Award for best undergraduate student talk at the meeting (\$100).
- Spring 2010 –Spring 2011 (GLG 277, 377) Christiaan Bon: Formational history of smythite in epithermal deposits of the

- Harrodsburg Limestone, Central Indiana. Presented results at the Miami University Undergraduate Research Conference, 4/2010. Presented work and published abstract at the 2011 Rochester Mineralogical Symposium. Given the Mandarinino Award for best student talk at the meeting (\$100).
- Fall 2009 – Fall 2010 (GLG 277, 377) Agnes Taylor: Formation and crystal chemistry of apatite group minerals in the system Ca-Pb-PO₄-AsO₄-OH-Cl. Presented results at the Miami University Undergraduate Research Conference, 4/2010. Presented work and published abstract at the 2010 Goldschmidt Conference, Knoxville, TN. New Project began in Spring 2011: Pseudomorphic replacement of schulltenite by hydroxylmimetite. Presented this work and published abstract at the 2011 Rochester Mineralogical Symposium.
 - Fall 2007 - Spring 2008: (3 hrs GLG 177) Nina Marie Gasbarro: The effects of compressional and shear stresses on the surface atomic structure of gold crystals: applications to materials behavior and placer deposits. This work has resulted in Nina being awarded experimental spallation neutron time at Oakridge and Los Alamos National Laboratories in 2008. This work was presented at the 2007 and 2008 Miami Undergraduate Research Conference and at the Spring 2009 American Geophysical union meeting. It also resulted in the publication: *Rakovan, J., Gasbarro*, N., Nakotte, H., Kothapalli, K. and Vogel, S. C. (2009) Characterization of Gold Crystallinity by Diffraction Methods. Rocks & Minerals, 84:54-61.*
Funding Source: Undergraduate Research Fund in Mineralogy. Cincinnati Mineral Society.
 - Spring 2008 (1 hrs GLG 477) Kati Feldman: Advanced studies in Gemology: GIA colored stones and diamonds courses.
 - Fall 2004: Jason McDonald: Origin of iridescence on fluorites from the Findley Arch, Ohio, and As-Pb contamination of sediments from Jacksonville, FL. Laboratory based study utilizing several advanced analytical techniques including X-ray photoelectron spectroscopy at Ohio State University. This work resulted in an invited publication in *ExtraLapis* special issue on fluorite.
McDonald, J. (2006) Iridescent Fluorites from Ohio's Findlay Arch District. FLUORITE. Lithographie, LLC Natural History Publications. East Hamton, CT. p66-68.*
 - Spring 2004: Mariana Huerta: Optical and structural study of dissymmetrised apatites from Llallagua, Bolivia. Research presented at the Rochester Mineralogical Symposium. Abstract published in *Rocks & Minerals*. Given the Mandarinino Award for best student talk at the meeting (\$100).
Huerta, M. and Rakovan, J. (2007) Growth induced dissymmetrization of fluorapatite from Llallagua, Bolivia: The relationship between compositional and optical zoning. 2004 Rochester Mineralogical Symposium Program and Abstracts and Rocks & Minerals, 82,143.*
 - Fall 2003: Mariana Huerta: Optical and structural study of dissymmetrised apatites from Llallagua, Bolivia.
 - Spring 2003: Mariana Huerta: Optical and structural study of dissymmetrised apatites from Llallagua, Bolivia. Awarded Miami CAS Deans Scholar grant for this work (\$1500).
 - Spring 2003: George-Paul Richmann: Single crystal X-ray diffraction study of the ganophyllite group minerals.
 - Fall 2002: Amanda Klingensmith: Structural response of fluorite to trivalent REE substituents.
This work has led to a poster presentation "Lanthanide Doped Fluorite crystal Structures: Placement of Fluorine in REE/Ca Substituted Fluorite" at the Miami Undergraduate Summer Scholars Research Symposium. Coadvised with John Hughes.
 - Fall 2002: Amanda Klingensmith: Structural response of fluorite to trivalent REE substituents. Summer Scholars Award (\$2500) Coadvised with John Hughes.
 - Spring 2002: Adam Wolf: Crystal chemistry and structure of axinite, Limecrest Quarry, NJ. GLG 477, 3hrs.
This study has led to a peer reviewed publication of which Adam is first author.
Wolf, A., Rakovan, J. and Cahill, C. (2003) Ferroaxinite From Lime Crest Quarry, Sparta, New Jersey. Rocks and Minerals. 78, 252-256*
 - Fall 2001: Adam Wolf: Crystal chemistry and structure of axinite, Limecrest Quarry, NJ. GLG 477, 3hrs.
 - Spring 2001: Eric Hammerly: AFM of clay minerals. 477, 3hrs.
AFM study of the palygorskite-sepiolite to smectite transformation.
This work has led to the submission of an abstract to and presentation at the 2001 Goldschmidt Conference and a paper in a leading journal in the field of mineralogy.
Krekeler, K., Hammerly, E., Rakovan, J. and Guggenheim, S. (2005) Microscopy Studies of the Palygorskite to Smectite Transformation. Clay and Clay Minerals, 53, 92-99.
 - Fall 2000: Eric Hammerly: AFM of clay minerals. 477, 3hrs.
 - Fall 2000: Matt Spansky: Trace element chemistry of fluorites from the Hansonburg Mining district, Bingham, NM. 377, 3 hrs. This work lead to an abstract and talk at the 2000 Butler University Undergraduate Research Conference.
 - Fall 2000: Rebecca Witherow: Trace element chemistry of fluorites from the Hansonburg Mining district, Bingham, NM. 377, 3 hrs. This work lead to an abstract and talk at the 2000 Butler University Undergraduate Research Conference
 - Spring 2000 : Matt Spansky: Trace element chemistry of fluorites from the Hansonburg Mining district, Bingham, NM. 377, 3 hrs.
 - Fall 1999: Kasey McCall: AFM study of the surface microtopography and growth mechanisms of

graphite. 377, 3hrs. This work led to the Mineralogical Society Undergraduate Research Award, a poster presentation at the 1999 annual Geological Society of America meeting, and an abstract and talk at the 2000 Butler University Undergraduate Research Conference.

- Fall 1999: Kasey McCall: AFM study of the surface microtopography and growth mechanisms of graphite. 377, 3hrs.
- Fall 1998: Seth Horstmeyer: Development of dissolution rate experiments and AFM study of calcite surface microtopography.

Advised NSF funded Research Experience for Undergraduates (REU)

- Spring 2001: Eric Hammerly: AFM study of the palygorskite-sepiolite to smectite transformation.
- Summer 1999 Rebecca Witherow: Use of the trace element chemistry of fluorites from the Hansonburg Mining district in the study of its hydrothermal genesis.
- Summer 1999: Matt Spansky: Use of the trace element chemistry of fluorites from the Hansonburg Mining district in the study of its hydrothermal genesis.

Service Activities

Outreach and Community Education

Outreach to the mineral enthusiast community and the general public has been a very important part of my teaching activities. To this end I have been very active in outreach through the Mineralogical Society of America; in giving presentations (3-5 a year) to mineral clubs and sponsored Mineralogical symposia (i.e. Rochester, New Mexico, Tucson); and development of a Miami University sponsored mineral education center for the annual Cincinnati Mineral Society show. I also strive to bring modern mineralogical research and ideas to the collecting community through publications. This effort includes contributing articles on topics such as crystal growth and luminescence to journals such as the *Mineralogical Record* and *Rocks & Minerals*. I also have made other major contributions to *Rocks & Minerals*.

Starting September 1 2022 my outreach and education efforts in the mineral enthusiast community changed significantly with starting my new job as State Mineralogist and senior mineral museum curator in the New Mexico Bureau of Geology and Mineral Resources; a research division of the New Mexico School of Mining and Technology.

NMBGMR Mineral Museum

New Museum Displays

- Personal Guest Exhibit 10/2022
- Phillip Simmons Guest Exhibit 10/2023

Remote Displays (creation, travel to, for setup, teardown and return)

- Two displays at the Denver Mineral Show (Hardrock Summit); 1) Coronado's Treasure Chest: The Best of NM Minerals, and 2) Colorado Minerals. 9/2022
- Two displays at the Los Alamos Mineral Show; 1) Not all that glitters is gold: Pyrite from Peru, and 2) Palygorskite: Mountain Leather. 12/2022
- Two displays for the Tucson Gem and Mineral Society Show. 1) New Mexico Quartz 2) Sheet silicates, won the Friends of Mineralogy best educational display award. 2/2023
- Spring 2023 Albuquerque Gem and Mineral Society Show. 3/2023 (discussions with Paul Hlava, Phil Bove, Ray DeMark, Mike Sanders, Phil Simmons, Nancy Attaway, and others about donations; met to arrange an annual additional feature to the NMM Symposium: Micromounters Playroom)
- Turquoise United 2nd Annual Symposium, Albuquerque, NM included research poster from summer scholar Eli 8/2023.
- Two displays at the Denver Mineral Show (Hardrock Summit); 1) Major New Fluorite Fine Blanchard Mine, and 2) New Mexico Gems. 9/2022

Donation Development and Procurement

- Helped develop Claire Schaffer donations of minerals to the museum. 10/2022
- Developed donation of minerals and tools from Kippur Flax to the museum and Bureau. 10/2022
- Developed donation of minerals from Marty Zinn to the museum, two visits to see his collection. 11/2022
- Developed donation of minerals and gems from Bruce Moffitt to the museum.
- Developed donation of minerals from Rod Woodcock to the museum. Traveled to Tucson to pack and move the collection. Also visited Jim McGassin for the development of a future donation.

- Developed donation of minerals from Richard (in Chandler AZ), 200+ specimens.
- Developed donation of minerals from Brandon Chafey, fluorite specimens.
- Developed donation of minerals from Nancy Attaway, topaz, beryl, and tanzanite specimens.

Purchased Specimen Procurement

- Acquired (purchase) Congo Smithsonite for Museum Display (from Spirifer Minerals at Denver show)
 - Acquired (purchase) major Chino copper specimen (from Phil Persson) with development funds (\$20,000) and developed donation from Nancy Attaway (\$20,000).
-
- Weekly interactions with museum visitors for tours (for VIPs), mineral ID, development, etc.
 - Coauthored the Fall 2022 Mineralogical Cabinet (museum newsletter)
 - Diagnosed and Repaired PXR; replaced detector fan. Saved \$6000-7000 in service costs.
 - Updated Museums Procedures Document.
 - Wrote postcards from the field
 - Started Development of Policy for Curator's personal collections.
 - Developed Museum slogan for outreach; Minerals! Inspire a love of science [and other STEM fields].
 - Developed NMT alumni reception, 2/6/2023 in Tucson, with Megan Schwingle Associate Director Office for Advancement and Alumni Relations. Approximately 50 attendees.
 - Developed proposal for legislation to adopt a New Mexico State Minerals – Kelly Mine Smithsonite.
 - Expert witness testimony to House Committee 2/17/2023
 - Developed Museum outreach table for Jan 2023 Earth Day Event at the State Capital Round House.
 - Hosted MSA distinguished lecturer Matt McInnis
 - Coordinated Phil Simmons collection loan, visited his collection, moved donation
 - Wrote contribution the NSF MRI proposal for new EPMA, Nels Iverson PI.
 - PHD student, Jamshid Ahmadi, qualifying exams (written and oral)
 - PXR analyses for external/internal clients
-
- Frequent problem-solving and modification of systems. An example; museum patron tried to make a donation via the Bureau website resulting in an error message. In trying to resolve this I discovered a series of issues with the online system that took a full day of work with Adam, Connie, Brenda and others to solve the problems and update our online donation system.
 - Graduated Ph.D. student Calvin Anderson (dissertation review, final defense, work towards publication(s) submission)
 - Advising of three graduate students Calvin Anderson (Ph.D.), Jamshid Ahmadi (Ph.D.) and Stephanie Mounse (M.S.)
 - Edited articles for Rocks & Mineral Magazine, coordinated issue layouts and solicited content, worked with authors in the development of their article.
 - Co-advised summer undergraduate Bright Star Scholar Anne Dunn
 - Co-advised summer undergraduate student intern, Elishua Shepherd, as part of the NSF EarthScope Consortium / RESESS Program. Lead fieldtrips to Turquoise museum, Hansonburg Mining District. Developed turquoise mineralogy research project.
 - LANSCE Neutron beam time proposal: Textural analysis of turquoise group minerals in turquoise samples from New Mexico 5/28/2023
 - Lead development of team proposal comparing RGR and IKFD tectonics and fluorite deposits. Local fieldtrips with Liz Widom, Troy Raspberry, et. al
 - Coauthored the Spring 2023 Mineralogical Cabinet (museum newsletter)

Rocks & Minerals

- Executive Editor of Rocks and Minerals (5/01 – present)
- Regular columnist of: *Word to the Wise* (1/03-present)
- Regular contributor of articles, news stories, letters to the editor, etc.
- While in Japan, 2005, wrote a series of four articles on Mineralogy in Japan for Rocks & Minerals. These are the first and only extensive articles on minerals and mineralogy of Japan in modern (20th and 21st century) popular western literature.
- Coordinated and help produce and market special reprint issue with my series of 5 articles on Japan including “sakura ishi”.

- Nominated Marie Huizing for and organized the presentation of the Mineralogical Society of America distinguished public service medal.
- Conceived of and initiated the Supplemental Materials webpage for *Rocks & Minerals*.
- Brokered and organized the scanning of *Rocks & Minerals* by Robert Downs and the RRUFF project.

New Mexico Bureau of Geology and Mineral Resources and New Mexico Tech

- NMT Radiation Safety Committee member 9/2022-present

Department of Geology and Miami University

- Search Committee for CAMI Director. January 2021 – December 2021.
- Chair of ad hoc committee for student grievance (GLG 244) Spring, 2021
- Organized purchase and installation of new powder X-ray diffractometer for the Department of Geology and others. 11/2019-2/2020.
- Department APIEP committee and Chair of Net Resources (Revenue vs. Expenses) subcommittee 9/2020-2/2021.
- Sole PI on Miami University Tech Fee proposal to acquire new powder X-ray diffractometer for the Department of Geology and others. Matching from Geology/Physics/Chemistry/Paper Science \$110,000.00. 9/2019
- Participated in search for new lecturer for the Department of Geology. Fall 2019 - Spring 2020.
- Acting Chair, frequently during the summer and intermittently during the semesters 2015-present
- Department of Geology Lab Manager Search Committee Fall 2019
- Department of Geology Graduate Director 1/2014-present.
- Department of Geology Promotion and Tenure Committee 2004-present.
- Department of Geology Graduate Student Admission Committee 9/1/10-present
- Department of Geology Limper Museum advising committee 1998-present.
 - Helped with development of centennial bronze sculpture 2021
 - Helped with specimen acquisitions 2020 and 2021
 - Helped in acquisition of Green River fossil fish plate for the museum
 - Acquired amethyst geode for the museum
 - Helped in development through alumnus Sandy Ludlum, which lead to a major donation to the museum.
 - Help procure donations to the collection from Lance Hample and 2019
 - Advised in display layout and construction.
- Geology Dept. representative to the Divisional Appeals Committee 2015-present..
- College of Arts and Science Promotion and Tenure Committee 9/2011 – 12/1012, 9/2019-12/2020
- Department of Geology Chief Academic Advisor. 7/2009-7/2010.
- Chair Miami University Radiation Safety Committee (8/1/08 – present).
- Assistant Chair Miami University Radiation Safety Committee 2006 – 2008.
- Member Miami University Radiation Safety Committee 2006 – 2008.
- Geology Department International programs liaison 2005-2008
 - In 2007 made a second trip to Krakow during which we formalized a joint degree mechanism.
- Hosted Miami Valley Mineral and Gem Club visit to Miami University September 9, 2007.
 - Gave a talk on sakura ishi and designed and built two Special exhibits in the Limper Museum
 - 1) Minerals of Tanakamiyama, Japan from the Harvard Mineral Museum Collection.
 - 2) Sakura Ishi from Kameoka, Japan
- Prepared poster on *o-hanami* for Miami University's Library *Ohanashi* program (Nov. 18, 2006): <http://staff.lib.muohio.edu/ohanashi/index.html>
- Organized 2006 Baldwin Frontiers in Geology Lecture and Hosted Speaker, Dr. Jeffrey Post.
- Miami University Committee on Faculty Research. 8/04-8/07. Chair ANS subcommittee 2006-07.
- Miami University Natural and Applied Science Area Subcommittee of Graduate Council. 8/04-8/06.
- Geology Department Committee for TA allocations. 4/2004-4/2006.
- Miami Representative to the Central States Universities Inc. (10/03-2006)
- Moderator for the Miami University Undergraduate Research Conference (2002, 2004).
- Coordinator of the Miami University education center at the Cincinnati Mineral Society show (2000-2004).
- Geology Department Library Liaison (5/99-present)
- Geology Department Committee for Benchmarking, Chair (2000-present)
- Geology Department Committee for Peer Evaluation of Teaching (2000-present)
- Geology Department advisor to honors students and coordinator of special programs for honors students 9/99-present.
- Miami University Summer Reading Program Discussion Leader (1998-2003)
- Geology Department Curriculum Committee, 5/99-present
- Undergraduate student adviser (1998-present)

- Museum Manager Search Committee (Fall 2005)
- Coorganized and cohosted the Miami University Nanotechnology Symposium (11/13-14/03)
- Miami Instrumentation Laboratory Advisory Committee member (2000-2004)
- Upgraded Geology Department's Powder Diffraction System
- Organized and ran Minorities in Math and Science Education field trip (1998, 1999, 2000, 2001). Featured on Ch. 5 News 6/27/2000.
- Held Scanning Probe Microscopy Laboratory open house for Alumni Weekend (6/17/2000).
- Miami University Geology Society (MUGS) faculty representative, 5/99-2003.
- Developed and wrote a proposal for PhD enhancement "Mineral-Microbe Interactions in Environmental Geochemistry"
- Developed a presentation on the Dept.s graduate program for recruiting talks. Fall 2000
- 1999 Faculty search committee for Sed/Strat position in Department of Geology
- 1999 Helped to organize the Geology Seminar Series. Organized visits by Dr. John Jaszczak, Dr. Steve Guggenheim, Dr. Don Weidener, and Laurie Benton.
- Guided a 4 day Geology department field trip to Washington, DC and the Smithsonian. 5/10/99.
- Graduate Recruitment: Helped develop and produce Geology department recruitment poster
- Gave Nov. 20, 1999 Geology Limper Lecture "Amethyst scepters from Hopkinton, RI.

Community

- National Science Foundation panel member in lead of the Advanced Photon Source Facility Review and funding (Spring/2006).

Mineralogical Society of America (MSA)

- Associate Editor of the American Mineralogist, 5/99-5/02
- MSA Arts Council, Chair, and MSA Outreach Committee: In charge of development and implementation of outreach program as well as other responsibilities (1993-present).
 - MSA liaison to the TGMS annual show 1995-1998
 - Developed and produced the MSA 25 and 50 year member commemorative pins
 - Developed and produced the MSA garnet necktie
 - Developed and produced the first MSA mineralogical calendar for 1998
- MSA Benefactors Committee, Chair (2008-2010)
- MSA Nominating Committee for Officers (2019-present)
- MSA liaison to the TGMS annual show (1995-present)
- MSA Ambassador 2019-2021

The MSA Ambassador Program was established as part of MSA's Centennial the celebration in 2019. It recognized MSA members offering public presentations about mineralogy and petrology as part of MSA's 100th anniversary.

- **Euhedra for teaching symmetry and more:** Development of teaching resource and distribution to the international mineralogy community (Summer/Fall/Spring 2020-2021).

Because of the lack of an adequate resource for virtual teaching of crystallography and symmetry I teamed up with Bill Tislar to develop and distribute this resource. Euhedra is a crystal shape drawing program written by Bill Tislar, of T&T Technology. Bill has created a lite version, Euhedra-L, that can open and manipulate crystal models that have already been created but will not allow access to the information used to create those models (e.g. symmetry, Miller indices of forms, etc.). This was developed with me based on my teaching requirements. Students at Miami University (Christian Anderkin, Stephanie Mounce and Madeline Murchland) and I created a library of crystal shape models for use in Euhedra Lite. These include crystals with individual forms and form combinations from all crystal systems. Windows and Mac versions of both the standard and lite versions along with the Miami models were distributed (to the world) via the Mineralogical Society of America Website: <http://www.minsocam.org/msa/Euhedra.html>. Announcements of the project were made through MSA-Talk and mineralogypedagogy.slack.com . Demonstrations were given to open audiences via Mineral Talks Live, <https://www.facebook.com/pages/category/Community/Mineral-Talks-LIVE-106986071038407/> , and the Ohio Department of Higher Education, <https://oh-tech.webex.com/recordingservice/sites/oh-tech/recording/play/e3766033decc4aebbd9e1d1565655d08>

International Mineralogical Association (IMA)

- IMA Commission on New Minerals, Nomenclature and Classification Subgroup on Apatite Nomenclature (3/08-2010).
- Secretary of the International Mineralogical Association (IMA) Commission on Mineral Growth and Interface Processes (2002-2006).

Cincinnati Mineral Society (CMS)

- Member of the Education Award Committee 2019-present
- Judge of competitive displays in mineralogy Cincinnati Mineral Society show (1999-2015).
- Vice President of the Cincinnati Mineral Society (2001 and 2002)
- Cincinnati Mineral Society Show Committee. 1999-2003.
- Led a joint field trip of the Cincinnati, Dayton, and Fort Hamilton Mineral Societies in the Department of Geology and the Limper Museum at Miami University on Saturday, November 17, 2001. I gave a tour of the mineralogical research facilities housed in Shideler and Hughes Hall. Roughly 25 people attended the tour.
- 5/12/2000 Judged competitive and educational displays for Cincinnati Mineral Society show. Contributed 3 displays for Miami University.
- 5/1/99 Helped develop an educational display on MVT deposits for the 1999 Cincinnati Mineral Society show.
- 5/1/99 Judged competitive and educational displays for Cincinnati Mineral Society show.

Invited Talks:

- 1) 1994: Battelle, North West Pacific Laboratory, Molecular Science Research Center. *Surface structural controls on trace element incorporation and ordering in apatite.*
- 2) 1994: Materials Science Research Center, Hong Kong University of Science and Technology . *Surface structural controls on trace element incorporation and ordering in apatite*
- 3) 1996: Chinese University of Hong Kong Department of Chemistry. *Mineralogic Applications of Surface Science.*
- 4) 1998: Arizona State University Departments of Geology and Chemistry. *Surface structural controls on trace element incorporation in apatite during growth.*
- 5) 1998: Microscopy Society of America Meeting, Atlanta, GA. *Heterogeneous oxidation and precipitation of aqueous Mn(II) at the goethite surface: An SPM study.*
- 6) 1998: Miami University Department of Chemistry. *Mineralogic Applications of Scanning Probe Microscopy.*
- 7) 2/3/99: Miami University Department of Physics: *Scanning Probe Microscopy and its applications in the Earth Sciences*
- 8) 1999 *Sceptered amethyst, Hopkinton, RI.* Miami University K.E. Limper Lecture.
- 9) 1999 *Sceptered amethyst, Hopkinton, RI.* Cincinnati Mineral Society
- 10) 4/5/2000 *Fluorite Mineralization of the Hansonburg Mining District, Bingham, NM.* Dept. Geology, Miami University.
- 11) 4/14/2000 *Fluorite Mineralization of the Hansonburg Mining District, Bingham, NM.* Cincinnati Mineral Society.
- 12) 5/5/2000 *Heterogeneous reactivity at the mineral-water interface.* Dept. of Geology, University of Cincinnati.
- 13) 5/20/2000 *Luminescence and Zoning in Minerals: Phenomena of Beauty and Illumination.* Dept. of Geology, Penn State.
- 14) 6/1/2000 *Sceptered amethyst, Hopkinton, RI.* Brukner Center Gem and Mineral Club, Troy, OH.
- 15) 2/2001 *Heterogeneous reactivity at the mineral-water interface.* Dept. of Geology, Indiana/Perdue University in Indianapolis.
- 16) 3/2001 *Surface structural controls on trace element incorporation into minerals during growth.* Dept. of Geology, Michigan Technological University.
- 17) 3/2001 *Fluorite Mineralization of the Hansonburg Mining District, Bingham, NM.* Seaman Mineralogical Museum, Michigan Technological University.
- 18) 5/2001 *Luminescence and Zoning in Minerals.* Society of Cosmetic Chemists, New York, New York.
- 19) 5/2001 *Calcite Luminescence:* Midwest Mineral Symposium. Cincinnati, OH.
- 20) 10/2001 *A Research Trip to Antarctica: Mineral-Microbe Interactions in the Dry Valleys:* Miami University K.E. Limper Lecture.
- 21) 12/2001 *A Research Trip to Antarctica: Mineral-Microbe Interactions in the Dry Valleys:* Cincinnati Mineral Society.
- 22) 4/5/2002 *Surface structural controls on trace element incorporation into minerals during growth.* Dept. of Geology and Geological Engineering, Notre Dame.
- 23) 6/6/02 *Fluorite Mineralization of the Hansonburg Mining District, Bingham, NM.* Brukner Center Gem and Mineral Club, Troy, OH.
- 24) 6/20/2002 *How and Why Minerals form Beautifully Faceted Crystals.* Midwest Friends of Mineralogy Mineral Symposium. Bloomington, IN.
- 25) 10/2/2002 *Heterogeneous reactivity at the mineral-water interface. Surface structural controls on trace element incorporation into minerals during growth.* Dept. of Geology, Oberline College.
- 26) 10/4/2002 *Heterogeneous reactivity at the mineral-water interface. Surface structural controls on trace element incorporation into minerals during growth.* Dept. of Geology, Ohio University.
- 27) 1/10/2003 *Luminescence and Zoning in Minerals.* Cincinnati Mineral Society.
- 28) 1/29/2003 *Reflections on Phosphates: Geochemical, Geobiological and Materials Importance* Invited speaker at the Miami University Authors' Reception.
- 29) 9/12/03 The causes of color in minerals and recent results from studies of fluorites from Bingham, NM. Cincinnati Mineral Society.
- 30) 11/8/03 The causes of color in minerals and recent results from studies of fluorites from Bingham, NM. Key Note

- Speaker, 24th Annual New Mexico Mineral Symposium, New Mexico Tech.
- 31) 12/2/03 Lanthanides in Fluorite (REE:CaF₂): Probes of Crystal Surface Structure and Association in Color Centers. Materials Research Society National Meeting, Boston, MA.
 - 32) 1/9/04 Apatite: Ca₅(PO₄)₃(F,Cl,OH). Cincinnati Mineral Society.
 - 33) 4/15/04 Apatite: Truly an interdisciplinary mineral. Rochester Mineralogical Symposium. Rochester. NY.
 - 34) 4/13/04 Apatite: Geochemical, Geobiological and Materials Importance. Dayton Mineral Society.
 - 35) 12/5/04 Luminescence and Zoning in Minerals. New York State Museum, Mineralogy Month Celebration.
 - 36) 4/12/05 Apatite: Geochemical, Geobiological and Materials Importance. Kyoto University Graduate School of Human and Environmental Studies.
 - 37) 4/19/05 Source of fluorine and petrogenesis of the RioGrande Rift type barite-fluorite-galena deposits. Kyoto University Department of Geology and Mineralogy.
 - 38) 6/1/05 Tokyo University, Department of Chemistry,
 - 39) 9/10/05 Mineralogical Meanderings in Japan. Friends of Mineralogy Midwest Chapter Meeting. Indiana
 - 40) 10/15/05 Rio Grande Rift barite-fluorite-galena deposits of southern, New Mexico: An MVT subclass. Northwest Friends of Mineralogy Symposium.
 - 41) 10/16/05 The Causes of color in Minerals. Northwest Friends of Mineralogy Symposium.
 - 42) 12/12/05 Japan 2005: Mineral, Fossils and Cherry Blossoms. Cincinnati Mineral Society Christmas Dinner and Meeting.
 - 43) 2/9/06 Advances in Mineral Identification Techniques. Society of Mineral Museum Professionals. Tucson, AZ.
 - 44) 4/15/06 Mineralogy of the Hansonburg Mining District, Bingham New Mexico and related Rio Grande Rift Barite-Fluorite-Galena Deposits. Rochester Mineralogical Symposium. Rochester. NY.
 - 45) 4/17/06 *Sakura Ishi* from Kameoka Japan: Mica pseudomorphs of complex cordierite-indialite intergrowths. Rochester Mineralogical Symposium. Rochester. NY.
 - 46) 7/20/2006 Luminescence and Zoning in Minerals. Mineralogy Society of Hong Kong. Hong Kong.
 - 47) 11/3/06 Mineralogical Meanderings in Japan. Cleveland Museum of Natural History.
 - 48) 11/4/06 *Sakura Ishi* from Kameoka Japan: Mica pseudomorphs of complex cordierite-indialite intergrowths. Cleveland Micromineral Society and Cleveland Museum of Natural History Mineralogical Symposium.
 - 49) 11/14/06 *Sakura Ishi* from Kameoka Japan: Mica pseudomorphs of complex cordierite-indialite intergrowths. Dayton Mineral Society.
 - 50) 3/8/07 Environmental Mineralogy of Apatite. Department of Geology, University of Kentucky.
 - 51) 3/22/07 REE incorporation in apatite: Surface structural controls and crystal chemistry Department of Geology, Michigan State University.
 - 52) 9/15/07 Synchrotron Microanalytical Methods in the Study of Trace and Minor Elements in Apatite. At Jagiellonian University workshop: Accessory minerals in-situ: microanalytical methods and petrological applications Kraków, Poland, 15-16 September 2007
 - 53) 11/8/07 Environmental Mineralogy of Apatite. University of Texas El Paso.
11/8/07 Source of fluorine and petrogenesis of the RioGrande Rift type barite-fluorite-galena deposits. University of Texas El Paso.
 - 54) 11/10/07 *Sakura Ishi* from Kameoka Japan: Mica pseudomorphs of complex cordierite-indialite intergrowths. 28th Annual New Mexico Mineral Symposium, New Mexico Tech.
 - 55) 11/07 Key Note Speaker; Mineralogical Meanderings in Japan, 28th Annual New Mexico Mineral Symposium, New Mexico Tech.
 - 56) 1/9/09 Characterization of Gold Crystallinity by Diffraction methods. Cincinnati Mineral Society.
 - 57) 2/14/09 *Sakura Ishi* from Kameoka, Japan: Mica pseudomorphs of complex cordierite-indialite intergrowths. The 30th Annual FM-MSA-TGMS Tucson Mineralogical Symposium.
 - 58) 5/15/09 Source of fluorine and petrogenesis of the Rio Grande Rift type barite-fluorite-galena deposits. Hong Kong University, Department of Earth Sciences.
 - 59) 5/15/09 Homoeptaxy: amethyst overgrowth on milky quartz Hopkinton, RI. Mineralogy Society of Hong Kong. Hong Kong.
 - 60) 10/8/09 Mineralization of the Hansonburg Mining District. New Mexico Geological Society 60th Fall field Conference, Chupadera Mesa Area.
 - 61) 11/7/09 Geology and mineralogy of the Hansonburg District, New Mexico. Cleveland Micromineral Society and Cleveland Museum of Natural History Mineralogical Symposium.
 - 62) 4/10 Crystallinity of Placer Gold and Testing the Authenticity of Large Gold Crystals. Rochester Mineralogical Symposium. Rochester. NY.
 - 63) 9/22/10 Geology and mineralogy of the Hansonburg District, New Mexico. New Mexico State University.
 - 64) 10/30/10 Precursor evolution and metal uptake in apatite formation from aqueous solutions. Geological Society of America annual meeting Denver, CO.
 - 65) 3/11/11 Hoedown at Hansonburg: Fun and mineralogy of the Bingham fluorite deposits. Cincinnati Mineral Society.
 - 66) 3/25/11 Famous Mineral locations of Japan. Columbus Rock & Mineral Society, Columbus, OH.
 - 67) 4/8/11 Gold, crystal chemistry and crystallography. Innovations in Art and Culture conference: Gold – Substance, Significance and Symbol. New York, NY.
 - 68) 8/20/11 Luminescence: A phenomenon of Beauty and Illumination. Mineral Symposium 2011 Fluorescent Minerals.

- Tellus Science Museum is a Cartersville, GA.
- 69) 9/12/11 Pegmatites of the Hirukawa area, Nakastugawa, Gifu Prefecture, Japan. Cincinnati Mineral Society.
 - 70) 2/14/12 Unusual crystal chemistry of Llallagua apatite: implications for geochronology of the Bolivian Tin Belt. Institute of Geological Sciences, Polish Academy of Science, Krakow.
 - 71) 3/2/12. Joint Polish – American Research on in situ remediation of heavy metal contamination in soils. Fulbright Research and Scholarship Day, Krakow Poland.
 - 72) 5/14/12. The Llallagua Tin Deposit, Bolivia: new ideas about its petrogenesis from apatite, monazite and zircon geochronology. GFZ German Research Centre for Geosciences, Helmholtz Centre Potsdam.
 - 72) 5/31/12. Sediment hosted U-V deposits and decavanadates of the Colorado Plateau. Mineralogical Society of Poland. Krakow.
 - 73) 12/8/12 Eight Months in Central Europe - People, Places, Museums and Minerals. Cincinnati Mineral Society.
 - 74) 1/21/13 Recent developments in geochronology of the Llallagua Tin Deposit, Bolivia. Indiana University chapter of the Society for Economic Geology.
 - 75) 3/16/13 Mineral Localities of Poland and Museums in Eastern Europe. Friends of Mineralogy, Midwest Chapter.
 - 76) 4/20/13 Apatite and other phosphates from Llallagua, Bolivia: An interesting story of hydrothermal mineralization and pseudomorphism. Rochester Mineralogical Symposium.
 - 77) 1/10/2014 Characterization of Gold Crystallinity By Diffraction Methods. 10th LANSCE School on Neutron Scattering Geosciences & Materials in Extreme Environments. Los Alamos, NM.
 - 78) 11/8/2014 Geological and Cultural History of the Naegi Pegmatite District, Gifu Prefecture, Japan, at the ExplorASIAN Miami faculty forum– STEM (Science, Technology, Engineering and Mathematics) in Asia titled
 - 78) 10/10/2015 Amethyst, Ashaway Village Hopkinton, Rhode Island. Michigan Mineralogical Society. Detroit, MI.
 - 79) 1/13/2015 Apatite and other phosphates from Llallagua, Bolivia: Beautiful Complexities and contradictions in geochronology. The Natural History Museum of Los Angeles County, CA.
 - 80) 5/2/2015 Apatite and other phosphates from Llallagua, Bolivia: Beautiful complexities! And Contradictions in geochronology. Brock University, St. Catharines, (Niagara) Ontario, Canada.
 - 81) 5/2/2015 Geological and Cultural History of the Naegi Pegmatite District, Gifu Prefecture, Japan. Brock University, St. Catharines, (Niagara) Ontario, Canada.
 - 82) 5/9/2015 A lifetime of mineralogy. Cincinnati Mineral Society. Cincinnati, OH.
 - 82) 10/13/2015 Apatite – A Mineral for All Seasons. Michigan Mineralogical Society. Detroit, MI.
 - 83) 1/8/16 Decavanadates of the Colorado Plateau. Cincinnati Mineral Society. Cincinnati, OH.
 - 84) 4/16 Selective mineral replacement reactions Llallagua Bolivia: Geochronologic and materials implications. Notre Dame University.
 - 85) 8/9/16 How Beautiful Crystals Form: An Introduction to Crystal Growth. Dayton Gem and Mineral Society, Dayton, OH.
 - 86) 8/2016 How Beautiful Crystals Form: An Introduction to Crystal Growth. Dallas Mineral Collecting Symposium, Dallas, TX. The talk was recorded and distributed to 5000+ subscribers to the Mineralogical Record.
 - 87) 10/21/16 How Beautiful Crystals Form: An Introduction to Crystal Growth. Cincinnati Mineral Society, Cincinnati, OH.
 - 88) 1/13/17 Environmental applications of the mineral apatite. Department of Earth Resources and Environment, Ho Chi Minh City University of Technology, Vietnam National University. 268 Ly Thuong Kiet St., Dist. 10, Ho Chi Minh City, Vietnam.
 - 89) 1/17/17 Environmental applications of the mineral apatite. Department of Earth and Environment Sciences, Wright State University. Dayton, OH.
 - 90) 7/15/17 How Beautiful Crystals Form: An Introduction to Crystal Growth. International Mindat Conference and Crystal Days, Lwowek Slaski, Poland
 - 91) 9/15/17 Selective mineral replacement reactions Llallagua Bolivia: Geochronologic and materials implications. Virginia Tech.
 - 92) 11/5/17 Gem Crystal Formation: An Introduction to Crystal Growth. Gemmological Association of Great Britain, London.
 - 93) 2/10/18 Crystals and Crystal Forms. 39th Annual FM-MSA-TGMS Tucson Mineral Symposium.
 - 94) 5/8/18 Crystals and Crystal Forms. Dayton Gem and Mineral Society, Dayton OH.
 - 95) 10/12/18 Gem Crystal Formation: An Introduction to Crystal Growth. Cincinnati Mineral Society
 - 96) 2/9/2019 Neutron studies of the Harvard “Ram”’s Horn” gold, Ground Hog Mine, Colorado. Harvard University Mineralogical & Geological Museum reception, Westward Look, Tucson, AZ.
 - 97) 3/9/2019 Forensic Mineralogy: Examples in Silver and Gold. Friends of Mineralogy Midwest Chapter 7th Annual mineral symposium. Miami University, Oxford, OH.
 - 98) 4/11/2019 Crystal Growth, A Primer. 46th Rochester Mineralogical Symposium
 - 99) 4/16/2019 Forensic Mineralogy: Examples in Silver and Gold. Columbus Rock and Mineral Society. Columbus, OH.
 - 100) 4/19/2019 McCrone Associates, Inc. Westmont, Illinois. Forensic Mineralogy: New Insights into the Nature of wire Silver and Gold.
 - 100) 5/11/2019 Forensic Mineralogy: Examples in Silver and Gold. Cincinnati Mineral Society.
 - 101) 5/24/2019 Silver & Gold New Insights to Wire Formation. Sorbonne Université, Paris, France.
 - 102) 5/29/2019 Silver & Gold New Insights to Wire Formation. Natural History Museum, London, England.

- 103) 6/4/2019 Silver & Gold New Insights to Wire Formation. TU Bergakademie, Freiberg, Germany.
- 104) 10/19/2019 Silver & Gold New Insights to Wire Formation. 2019 Yale Mineral and Gem Symposium, New Haven CT.
- 105) 1/16/2020 Silver & Gold New Insights to Wire Formation. American Society of Metallurgists joint Dayton/Cincinnati chapter meeting.
- 106) 2/14/2020 Forensic Mineralogy: New Insights into the Nature of wire Silver and Gold. 2020 Tucson Gem and Mineral Society Show Symposium.
- 107) 5/15/2020 Apatite and Society: A case study. Co-presented with John Hughes on-line to the Eastern Federation of Mineralogical and Lapidary Societies.
- 108) 6/1/2020 Silver & Gold New Insights to Wire Formation. Lapidary and Mineral Society of Central Connecticut online presentation.
- 109) 7/22/2020 Mineral Talks Live Interview. https://youtu.be/8YytT2L_oBo
- 110) 10/14/2020 New Insights into Wire Silver and Gold Formation. AGI –MSA 'Earth Materials Frontiers' Webinar Series for Earth Week. <https://www.earthsciweek.org/webinars/wiresilvergold.html>
- 111) 2/12/2021 Mosaic and Split Crystals. Cincinnati Mineral Society (remote presentation).
- 112) 3/12/2021 New insights into the structure and formation of wire silver and gold. Mineralogical Society of Southern California (remote presentation).
- 113) 4/17/2021 CRYSTALLOGRAPHY TUTORIALS FOR COLLECTORS: CRYSTAL SYSTEMS. 48th ROCHESTER MINERALOGICAL SYMPOSIUM: THE ERMS 2021!
- 114) 9/10/2021 The Sauberg Mine, type locality of fluorapatite, and the recognition of apatite as a distinct mineral species. Cincinnati Mineral Society.
- 115) 9/24/2021 New Insights into Wire Silver and Gold Formation. University of Michigan Department of Geology Seminar.
- 116) 1/20/2022 New Insights into Wire Silver and Gold Formation. New Mexico Bureau of Geology and Mineral Resources, New Mexico Tech.
- 117) 2/11/2022 Fluorescence Zoning in Apatite. TGMS Show Symposium: Apatite Supergroup Minerals and Fluorescence.
- 118) 8/20/2022 Crystal Faces and Crystal Forms: An introduction to Crystallography for mineral collectors. 12th annual Dallas Mineral Collecting Symposium. Abstract online https://www.dallassymposium.org/2022_dmcs/
- 119) 4/1/2023 The Discovery of the Rhode Island Amethyst Scepters. The 30th Flagg Mineral Foundation Minerals of Arizona Symposium.
- 120) 4/22/2023 What is New from the New Mexico Mineral Museum. 50th Annual Rochester Mineralogical Symposium. The ERMS 2023.
- 121) 4/27/2023 Hopkinton Rhode Island Amethyst Scepters. Albuquerque Gem & Mineral Club meeting.
- 122) 5/18/2023 Morphologic and structural Crystallography of some of the world's finest gold specimens. Gold Prospectors Association of New Mexico.
- 123) 12/9/2020 The New Mexico Mineral Museum. Cincinnati Mineral Society – Cincinnati Dry Dredgers annual joint Christmas meeting.
- 124) 2/9/2024 Mosaic and Split Crystals. Tucson Gem and Mineral Society - Arthur Roe Memorial Micromount Symposium. Tucson, AZ

Community Activism

- Organized a letter campaign to preserve the only known exposure of Cumberlandite, which resulted in the purchase of the site by the Town of Cumberland, Rhode Island and the formation of a Geologic Park.
- Organized a letter campaign among the Science faculty at Miami University to fight the inclusion of intelligent design in the Ohio State K-12 science curriculum. I was interviewed for a Ch. 15 news piece on this subject.