

PETER J. HEANEY

Contact:

Department of Geosciences
540 Deike Building
Penn State University
University Park, PA 16802
Tel: (814) 865-6821
Fax: (814) 863-7823
email: pjheaney@psu.edu

EDUCATION

Harvard University, Cambridge, MA	History and Science	A.B. 1984
A.B. Thesis: "Smiting the edge of luckless rock: Geological stagnation in early nineteenth-century Boston"		
The Johns Hopkins University, Baltimore, MD	Geology	M.A. 1988
The Johns Hopkins University, Baltimore, MD	Geology	Ph.D. 1989
Ph.D. Dissertation: "Transmission electron microscopy of phase transitions and microstructures in minerals". Advisor: D.R. Veblen		

AREAS OF SPECIALIZATION:

Fields of Interest:

Crystal structure analysis of minerals
Environmental geochemistry
Phase transitions in rock-forming minerals

Primary Techniques:

Powder X-ray and neutron diffraction
Transmission electron microscopy

PROFESSIONAL EXPERIENCE:

6/05 to present: Professor of Geosciences, Department of Geosciences, Penn State University.

6/12 to 6/16: Associate Head for Undergraduate Programs, Department of Geosciences, Penn State University.

8/04-6/05 and 8/11-6/12: Visiting Research Scientist, Department of Mineral Sciences, Smithsonian Institution.

9/98-6/05: Associate Professor of Geosciences, Department of Geosciences, Penn State University.

9/91-8/98: Assistant Professor of Mineralogy, Department of Geosciences, Princeton University.

8/90-8/91: NSF-NATO Postdoctoral Fellow, Department of Earth Sciences, Cambridge University, with Dr. Michael Carpenter.

7/89-7/90: Smithsonian Postdoctoral Fellow, Department of Mineral Sciences, National Museum of Natural History, with Dr. Jeffrey Post.

HONORS and AWARDS

George W. Atherton Award for Excellence in Teaching, Penn State University, 2023.
Friends of Mineralogy Best Article Award for *Rocks & Minerals* in 2023: "Mastering the Art of Silicate Mineralogy"
Honorary Award, American Federation of Mineral Societies, Eastern Division, 2023 & 2007
Miller Faculty Research Fellowship, College of Earth and Mineral Sciences, Penn State University, 2017.
Faculty Advising Award, College of Earth and Mineral Sciences, Penn State University, 2016
Distinguished Honors Faculty Member, Schreyer Honors College, Penn State University, 2011-2013
Wilson Award for Excellence in Teaching, College of Earth and Mineral Sciences, Penn State University, 2011
G. Montgomery and Marion Hall Mitchell Award for Innovative Teaching, College of Earth and Mineral Sciences, Penn State University, 2008
Fellow, Geological Society of America, 2006
Faculty Mentoring Award, College of Earth and Mineral Sciences, Penn State University, 2006
Excellence in Teaching Award, Princeton Undergraduate Engineering Council, Princeton University, 1998
Fellow, Mineralogical Society of America, 1997
Distinguished Lecturer, Mineralogical Society of America, 1994-1995
NSF-NATO Postdoctoral Fellowship, Visiting Scholar, Wolfson College, Cambridge University, 1990-1991
Smithsonian Institution Postdoctoral Fellowship, 1989-1990

PROFESSIONAL SOCIETIES

Mineralogical Society of America
American Geophysical Union
American Association for the Advancement of Science

Geological Society of America
American Chemical Society
Clay Minerals Society

PROFESSIONAL SERVICE (Selected)

Gems and Gemology Editorial Review Board (2021-present)
Steering Committee, Synchrotron Earth and Environmental Science (SEES) (2020-2022)

Coordinator, International Travel Grants and Awards Program, Geological Society of America (2019-2021)
Chair, MSA Centennial Committee, Mineralogical Society of America (2015-2019)
Chair, Distinguished Public Service Award Committee, Mineralogical Society of America, (2010-2016)
Vice-President/President/Past President, Mineralogical Society of America (2007-2009)
Associate Editor, *Clays and Clay Minerals* (1998-2007)
Editor of "Triple Point," *Elements* (2004 to 2007)
Chair, Minerals Subcommittee, International Centre for Diffraction Data (2004-2005)
MSA Award Committee, Chair, Mineralogical Society of America (2002-2003)
Meetings Coordinator, Mineralogical Society of America (2001-2004)

SESSIONS and SYMPOSIA ORGANIZED:

Charting Soils at the Atomic Scale: A Tribute to the Careers of David L. Bish and Jeffrey E. Post. P.J. Heaney and S. Wilson. Geological Society of America Annual Meeting., Oct. 9-10, 2022.

Synchrotrons and Geochemistry: A Workshop for Novices and Experts. P.J. Heaney, A. Lanzirotti, J. Stubbs, P. Fenter, S.C. Myneni, B. Gilbert, T. Duffy. University of Chicago, June 28-29, 2021.

MSA Centennial Symposium: The Next 100 Years of Mineral Sciences. P.J. Heaney and Steven Shirey. Carnegie Institute for Science, June 20-21, 2019.

Mineralogy Writ Small: A Tribute to the Distinguished Career of David R. Veblen. P.J. Heaney, J. Stubbs, D. Elbert, Geological Society of America Annual Meeting. Nov. 2, 2015.

Environmental Mineralogy. P.J. Heaney and J.E. Post, Fall Meeting, Geological Society of America. Oct. 5, 2008.

Environmental Mineralogy. J.E. Post and P.J. Heaney, Spring Meeting, American Geophysical Union. Mar. 23, 2006.

Advanced Characterization of the Structures and Behaviors of Minerals. P.J. Heaney, J.E. Post, and M.A. Carpenter, Geological Society of America Annual Meeting. Nov. 7, 2004.

Electronic Student Response Technology in the Geoscience Classroom: Is it a Valuable Teaching Tool? L. Greer and P.J. Heaney. Geological Society of America Annual Meeting. Nov. 10, 2004.

The Science of Gem Materials. P.J. Heaney, T. Moses, and J.E. Post. Fall Meeting, Materials Research Society. Dec. 2-3, 2003.

Determining Diamond Provenance. P.J. Heaney and E.P. Vicenzi, Spring Meeting, American Geophysical Union. May 29, 2002.

The Geochemistry and Mineralogy of Gemstones. P.J. Heaney and G. Harlow. Eleventh Annual Goldschmidt Conference. May 21, 2001.

Rietveld Analysis Workshop. J.E. Post, P.J. Heaney, C.T. Prewitt. MSA-sponsored workshop at the Carnegie Institute of Washington. May 30, 2000.

Advances in Mineral Structure Analysis. J.E. Post, P.J. Heaney, C.T. Prewitt. Symposium at the Spring Meeting of the American Geophysical Union. Washington, D.C. May 31, 2000.

Advances in Silica Geochemistry. P.J. Heaney and P. Dove. Oct. 24, 1994. MSA-sponsored symposium at the Annual Meeting of the Geological Society of America. Seattle, WA.

Interactions between the Geosphere and the Biosphere: A Symposium in Honor of David A. Crerar. S.L. Brantley and P.J. Heaney. May 21-22, 1993. Department of Geological and Geophysical Sciences, Princeton University.

PUBLICATIONS

Articles published in refereed journals

- 1) Veblen, D.R., Heaney, P.J., Angel, R.J., Finger, L.W., Hazen, R.M., Prewitt, C.T., Ross, N.L., Chu, C.W., Hor, P.H., and Meng, R.L. (1988) Crystallography, chemistry, and structural disorder in the new high- T_c Bi-Ca-Sr-Cu-O superconductor. *Nature*, 332, 334-337.
<https://doi.org/10.1038/332334a0>
- 2) Hazen, R.M., Finger, L.W., Angel, R.J., Prewitt, C.T., Ross, N.L., Hadidiacos, C.G., Heaney, P.J., Veblen, D.R., Sheng, Z.Z., El Ali, A., and Hermann, A.M. (1988) 100 K superconducting phases in the Ti-Ca-Ba-Cu-O system. *Physical Review Letters*, 60, 1657-1660.
<https://doi.org/10.1103/PhysRevLett.60.1657>
- 3) Hazen, R.M., Prewitt, C.T., Angel, R.J., Ross, N.L., Finger, L.W., Hadidiacos, C.G., Veblen, D.R., Heaney, P.J., Hor, P.H., Meng, R.L., Sun, Y.Y., Wang, Y.Q., Xue, Y.Y., Huang, Z.J., Gao, L., Bechtold, J., and Chu, C.W. (1988) Superconductivity in the very high T_c Bi-Ca-Sr-Cu-O system: Phase identification. *Physical Review Letters*, 60, 1174-1177.
<https://doi.org/10.1103/PhysRevLett.60.1174>
- 4) Morris, D.E., Nickel, J.N., Wei, J.Y.T., Asmar, N.G., Scott, J.S., Scheven, U.M., Hultgren, C.T., Markelz, A.G., Post, J.E., Heaney, P.J., Veblen, D.R., and Hazen, R.M. (1989) Eight new high-temperature superconductors with the 1:2:4 structure. *Physical Review B*, 39, 7347-7350. <https://doi.org/10.1103/PhysRevB.39.7347>
- 5) Heaney, P.J. and Veblen, D.R. (1990) A high-temperature study of the low-high leucite phase transition using the transmission electron microscope. *American Mineralogist*, 75, 464-476.

- 6) Heaney, P. J. and Veblen, D. R. (1991) An examination of spherulitic dubiomicrofossils in Precambrian banded iron formations using the transmission electron microscope. *Precambrian Research*, 49, 355-372.
- 7) Heaney, P.J. and Veblen, D.R. (1991) Observations of the α - β phase transition in quartz: A review of imaging and diffraction studies and some new results. *American Mineralogist*, 76, 1018-1032.
- 8) Heaney, P.J. and Veblen, D.R. (1991) Observation and analysis of a memory effect at the α - β quartz transition. *American Mineralogist*, 76, 1459-1466.
- 9) Heaney, P.J., Post, J.E., and Evans, H.T., Jr. (1992) The crystal structure of bannisterite. *Clays and Clay Minerals*, 40, 129-144.
- 10) Heaney, P.J. and Post, J.E. (1992) The widespread distribution of a novel silica polymorph in microcrystalline quartz varieties. *Science*, 255, 441-443. DOI: [10.1126/science.255.5043.441](https://doi.org/10.1126/science.255.5043.441)
- 11) Cellai, D., Carpenter, M.A., and Heaney, P.J. (1992) Phase transitions and defect microstructures in natural kaliophyllite. *European Journal of Mineralogy*, 4, 1209-1220.
- 12) Veblen, D.R., Banfield, J.F., Guthrie, G.D., Jr., Heaney, P.J., Ilton, E.S., Livi, K.J.T., and Smelik, E.A. (1993) High-resolution and analytical transmission electron microscopy of mineral disorder and reactions. *Science*, 260, 1465-1472. DOI: [10.1126/science.260.5113.1465](https://doi.org/10.1126/science.260.5113.1465)
- 13) Guthrie, G.D., Jr. and Heaney, P.J. (1993) Mineralogical characteristics of the silica polymorphs in relation to their biological activities. Notes of the Second International Conference on Silica, Silicosis, and Cancer, pp. 128-135.
- 14) Gislason, S.R., Heaney, P.J., Veblen, D.R., and Livi, K.J.T. (1993) The difference between the solubility of quartz and chalcedony: The cause? *Chemical Geology*, 107, 363-366. [https://doi.org/10.1016/0009-2541\(93\)90210-A](https://doi.org/10.1016/0009-2541(93)90210-A)
- 15) Heaney, P.J. (1993) A proposed mechanism for the growth of chalcedony. *Contributions to Mineralogy and Petrology*, 115, 66-74. <https://doi.org/10.1007/BF00712979>
- 16) Mehta, A. and Heaney, P.J. (1994) Structure of $\text{La}_2\text{NiO}_{4.18}$. *Physical Review B*, 49, 563-571. <https://doi.org/10.1103/PhysRevB.49.563>
- 17) Heaney, P.J., Veblen, D.R., and Post (1994) Structural disparities between chalcedony and macrocrystalline quartz. *American Mineralogist*, 79, 452-460. <https://pubs.geoscienceworld.org/msa/ammin/article/79/5-6/452/105263/Structural-disparities-between-chalcedony-and>

- 18) Heaney, P.J. (1995) Moganite as an indicator for vanished evaporites: A testament reborn? *Journal of Sedimentary Research*, A65, 633-638. <https://doi.org/10.1306/D4268180-2B26-11D7-8648000102C1865D>
- 19) Tseng, H.-Y., Heaney, P.J., and Onstott, T.C. (1995) Characterization of defects induced by neutron irradiation using powder X-ray diffraction. *Physics and Chemistry of Minerals*, 22, 399-405. <https://doi.org/10.1007/BF00213338>
- 20) Heaney, P.J. and Davis, A.M. (1995) Observation and origin of self-organized textures in agates. *Science*, 269, 1562-1565. [10.1126/science.269.5230.1562](https://doi.org/10.1126/science.269.5230.1562)
- 21) Guthrie, G.D., Jr. and Heaney, P.J. (1995) Mineralogical characteristics of the silica polymorphs in relation to their biological activities. *Scandinavian Journal of Work, Environment, and Health*, 21, Supp. 2, 5-8. <https://ezaccess.libraries.psu.edu/login?url=https://www.jstor.org/stable/40966463>
- 22) Petrovic, I., Heaney, P.J., and Navrotsky, A. (1996) Thermochemistry of the new silica polymorph moganite. *Physics and Chemistry of Minerals*, 23, 119-126. <https://doi.org/10.1007/BF00202307>
- 23) Gislason, S.R., Heaney, P.J., Oelkers, E.H., and Schott, J. (1997) Kinetic and thermodynamic properties of moganite, a novel silica polymorph. *Geochimica et Cosmochimica Acta*, 61, 1193-1204. [https://doi.org/10.1016/S0016-7037\(96\)00409-7](https://doi.org/10.1016/S0016-7037(96)00409-7)
- 24) Xu, H. and Heaney, P.J. (1997) Memory effects of domain structures during displacive phase transitions: A high-temperature TEM study of quartz and anorthite. *American Mineralogist*, 82, 99-108. <https://doi.org/10.2138/am-1997-1-212>
- 25) Kim, C.S., Yates, D.M., and Heaney, P.J. (1997) Layered Na-silicate: An analog to smectite for benzene sorption from water. *Clays and Clay Minerals*, 45, 881-885. https://www.researchgate.net/profile/Christopher-Kim/publication/237737100_The_Layered_Sodium_Silicate_Magadiite_An_Analog_to_Smectite_for_Benzene_Sorption_from_Water/links/0f3175335ae9add120000000/The-Layered-Sodium-Silicate-Magadiite-An-Analog-to-Smectite-for-Benzene-Sorption-from-Water.pdf
- 26) Yates, D.M., Joyce, K.J., and Heaney, P.J. (1998) Complexation of copper with polymeric silica in aqueous solution. *Applied Geochemistry*, 13, 235-241. [https://doi.org/10.1016/S0883-2927\(97\)00062-0](https://doi.org/10.1016/S0883-2927(97)00062-0)
- 27) Heaney, P.J., Mehta, A., Sarosi, G., Lamberti, V.E., and Navrotsky, A. (1998) Structural effects of Sr-substitution in $\text{La}_{2-x}\text{Sr}_x\text{NiO}_{4+\delta}$. *Physical Review B*, 57, 10370-10378. <https://doi.org/10.1103/PhysRevB.57.10370>

- 28) Lichtenstein, A.I., Jones, R.O., Xu, H. and Heaney, P.J. (1998) Anisotropic thermal expansion in the silicate β -eucryptite: A neutron diffraction and density functional study. *Physical Review B*, 58, 6219-6223. <https://doi.org/10.1103/PhysRevB.58.6219>
- 29) De, S., Heaney, P.J., Hargraves, R.B., Vicenzi, E.P., and Taylor, P.T. (1998) Microstructural observations of polycrystalline diamond: A contribution to the carbonado conundrum. *Earth and Planetary Science Letters*, 164, 421-433. [https://doi.org/10.1016/S0012-821X\(98\)00229-5](https://doi.org/10.1016/S0012-821X(98)00229-5)
- 30) Xu, H., Heaney, P.J., Yates, D.M., Von Dreele, R.B., and Bourke, M.A. (1999) Structural mechanisms underlying near-zero thermal expansion in β -eucryptite: A combined synchrotron X-ray and neutron Rietveld analysis. *Journal of Materials Research*, 14, 3138-3151. <https://doi.org/10.1557/JMR.1999.0421>
- 31) Xu, H., Heaney, P.J., Navrotsky, A., Topor, L., and Liu, J. (1999) Thermochemistry of stuffed quartz-derivative phases along the join LiAlSiO_4 – SiO_2 . *American Mineralogist*, 84, 1360-1369. <https://doi.org/10.2138/am-1999-0913>
- 32) Xu, H., Heaney, P.J., and Böhm, H. (1999) Structural modulations and phase transitions in β -eucryptite: An in-situ TEM study. *Physics and Chemistry of Minerals*, 26, 633-643. <https://doi.org/10.1007/s002690050228>
- 33) Phillips, B.L., Xu, H., Heaney, P.J., and Navrotsky, A. (2000) ^{29}Si and ^{27}Al MAS-NMR spectroscopy of β -eucryptite (LiAlSiO_4): The enthalpy of Si,Al ordering. *American Mineralogist*, 85, 181-188. <https://doi.org/10.2138/am-2000-0117>
- 34) Xu, H., Heaney, P.J., and Beall, G.H. (2000) Phase transitions induced by solid solution in stuffed derivatives of quartz: A powder synchrotron XRD study of the LiAlSiO_4 -- SiO_2 join. *American Mineralogist*, 85, 971-979. <https://doi.org/10.2138/am-2000-0711>
- 35) De, S., Heaney, P.J., Vicenzi, E.P., and Wang, J. (2001) Chemical heterogeneity in carbonado, an enigmatic polycrystalline diamond. *Earth and Planetary Science Letters*, 185, 315-330. [https://doi.org/10.1016/S0012-821X\(00\)00369-1](https://doi.org/10.1016/S0012-821X(00)00369-1)
- 36) Xu, H., Heaney, P.J., and Navrotsky, A. (2001) Thermal expansion and structural transformations of stuffed derivatives of quartz along the LiAlSiO_4 join: A variable temperature powder synchrotron XRD study. *Physics and Chemistry of Minerals*, 28, 302-312. <https://doi.org/10.1007/s002690100165>
- 37) Heaney, P.J., Vicenzi, E.P., Giannuzzi, L.A., and Livi, K.J.T. (2001) Focused ion beam milling: A method of site-specific sample extraction for microanalysis of Earth materials. *American Mineralogist*, 86, 1094-1099. <https://doi.org/10.2138/am-2001-8-917>
- 38) Gulians V.V., Holmes S.A., Benziger J.B., Heaney P., Yates D., Wachs I.E. (2001) In situ studies of atomic, nano- and macroscale order during $\text{VOHPO}_4 \cdot 0.5\text{H}_2\text{O}$ transformation

- to (VO)₂P₂O₇. *Journal of Molecular Catalysis A*, 172, 265-276.
[https://doi.org/10.1016/S1381-1169\(01\)00162-5](https://doi.org/10.1016/S1381-1169(01)00162-5)
- 39) Heaney, P.J. and Post, J.E. (2001) Evidence for an *I2/a* to *Imab* phase transition in the silica polymorph moganite at ~570 K. *American Mineralogist*, 86, 1358-1366.
<https://doi.org/10.2138/am-2001-11-1204>
- 40) Zhang, J., Celestian, A., Parise, J.B., Xu, H., and Heaney, P.J. (2002) A new polymorph of eucryptite (LiAlSiO₄), ε-eucryptite, and thermal expansion of α- and ε-eucryptite at high pressure. *American Mineralogist*, 87, 566-571. <https://doi.org/10.2138/am-2002-0421>
- 41) Post, J.E., Heaney, P.J., and Hanson, J. (2002) Rietveld refinement of a triclinic structure for synthetic Na-birnessite using synchrotron powder diffraction data. *Powder Diffraction*, 17, 218-221. <https://doi.org/10.1154/1.1498279>
- 42) Post, J.E., Heaney, P.J. and Hanson, J. (2003) A synchrotron X-ray diffraction study of the structure and dehydration behavior of todorokite. *American Mineralogist*, 88, 142-150.
<https://doi.org/10.2138/am-2003-0117>
- 43) Heaney, P.J. and Fisher, D.M. (2003) A new interpretation of the origin of tiger's-eye. *Geology*, 31, 323-326. [https://doi.org/10.1130/0091-7613\(2003\)031<0323:NIOTOO>2.0.CO;2](https://doi.org/10.1130/0091-7613(2003)031<0323:NIOTOO>2.0.CO;2)
- 44) Post, J.E., Heaney, P.J., Von Dreele, R., Hanson, J. (2003) Neutron and temperature-resolved synchrotron X-ray powder diffraction study of akaganéite. *American Mineralogist*, 88, 782-788. <https://doi.org/10.2138/am-2003-5-607>
- 45) Zhang, M., Xu, H., Salje, E.K.H., and Heaney, P.J. Vibrational spectroscopy of beta-eucryptite (LiAlSiO₄): Optical phonons and phase transitions. (2003) *Physics and Chemistry of Minerals*, 30, 457-462. <https://doi.org/10.1007/s00269-003-0337-z>
- 46) Kubicki, J.D. and Heaney, P.J. (2003) Molecular orbital modeling of aqueous organosilicon complexes: Implications for silica biomineralization. *Geochimica et Cosmochimica Acta*, 67, 4113-4121. [https://doi.org/10.1016/S0016-7037\(03\)00093-0](https://doi.org/10.1016/S0016-7037(03)00093-0)
- 47) Post, J.E., Heaney, P.J., Cahill, C.L., and Finger, L. (2003) Woodruffite: A new Mn oxide structure with 3x4 tunnels. *American Mineralogist*, 88, 1697-1702.
<https://doi.org/10.2138/am-2003-11-1209>
- 48) Komarneni, S., Newalkar, B.L., Li, D., Gheyi, T., Lopano, C.L., Heaney, P.J., and Post, J.E. (2003) Anionic clays as potential slow-release fertilizers: Nitrate ion exchange. *Journal of Porous Materials*, 10, 243-248. <https://doi.org/10.1023/B:JOPO.0000011385.19108.49>
- 49) De, S., Heaney, P.J., Fei, Y., and Vicenzi, E.P. (2004) Microstructural study of synthetic sintered diamond and comparison with carbonado, a natural polycrystalline diamond. *American Mineralogist*, 89, 438-445. <https://doi.org/10.2138/am-2004-2-325>

- 50) Post, J.E. and Heaney, P.J. (2004) Neutron and synchrotron X-ray diffraction study of the structure and dehydration behavior of ramsdellite and groutellite. *American Mineralogist*, 89, 969-975. <https://doi.org/10.2138/am-2004-0706>
- 51) Greer, L. and Heaney, P.J. (2004) Real-time analysis of student comprehension: An assessment of electronic student response technology in an introductory Earth science course. *Journal of Geoscience Education*, 52, 345-351. <https://doi.org/10.5408/1089-9995-52.4.345>
- 52) Heaney, P.J. and Fisher, D.M. (2004) New interpretation of the origin of tiger's-eye: Reply to Comment of J. Gutzmer, N.J. Beukes, and B. Cairncross. <https://doi.org/10.1130/0091-7613-32.1.e45>
- 53) Icopini, G., Brantley, S.L., and Heaney, P.J. (2005) Kinetics of silica oligomerization and nanocolloid formation as a function of pH and ionic strength at 25 °C. *Geochimica et Cosmochimica Acta*, 69, 293-303. <https://doi.org/10.1016/j.gca.2004.06.038>
- 54) Heaney, P.J., Vicenzi, E.P., and De, S. (2005) Strange diamonds: The mysterious origins of carbonado and framesite. *Elements*, 1, 85-89. <https://doi.org/10.2113/gselements.1.2.85>
- 55) McConnell, D.A., Steer, D.N., & Owens, K., Borowski, W., Dick, J., Foos, A., Knott, J.R., Malone, M., McGrew, H., Van Horn, S., Greer, L., and Heaney, P.J., (2006) Using Conceptests to Assess and Improve Student Conceptual Understanding in Introductory Geoscience Courses, *Journal of Geoscience Education*, 54, 61-68. <https://doi.org/10.5408/1089-9995-54.1.61>
- 56) Post, J.E., Bish, D.L. and Heaney, P.J. (2007) Synchrotron powder X-ray diffraction study of the structure and dehydration behavior of sepiolite. *American Mineralogist*, 92, 91-97. <https://doi.org/10.2138/am.2007.2134>
- 57) Lopano, C.L., Heaney, P.J., Post, J.E., Hanson, J., and Komarneni, S. (2007) Time-resolved structural analysis of K- and Ba-exchange reactions with synthetic Na-birnessite using synchrotron X-ray diffraction. *American Mineralogist*, 92, 380-387. <https://doi.org/10.2138/am.2007.2242>
- 58) Conrad, C.F., Icopini, G.A., Yasuhara, H., Bandstra, J., Brantley, S.L., Heaney, P.J. (2007) Modeling the kinetics of silica nanocolloid formation and precipitation in environmentally relevant aqueous solutions. *Geochimica et Cosmochimica Acta*, 71, 531-542. <https://doi.org/10.1016/j.gca.2006.10.001>
- 59) Heaney, P.J., Post, J.E., and McKeown, D.A. (2007) Anomalous behavior at the *I2/a* to *Imab* phase transition in SiO₂-moganite: An analysis using hard-mode Raman spectroscopy. *American Mineralogist*, 92, 631-639. <https://doi.org/10.2138/am.2007.2184>

- 60) Hummer, D.R., Heaney, P.J., and Post, J.E. (2007) Thermal expansion of anatase and rutile between 300 and 575 K using synchrotron powder X-ray diffraction. *Powder Diffraction*, 22, 352-357. <https://doi.org/10.1154/1.2790965>
- 61) Eaton-Magaña, S., Post, J.E., Heaney, P.J., Walters, R.A., Breeding, C.M., and Butler, J.E. (2007) Fluorescence spectra of colored diamonds using a rapid, mobile spectrometer. *Gems and Gemology*, 43, 332-351.
- 62) Eaton-Magaña S., Post J.E., Heaney P.J., Freitas J.A. Jr., Klein P.B., Walters R.A., Butler J.E. (2008) Using phosphorescence as a fingerprint for the Hope and other blue diamonds. *Geology*, 36, 83-86. <https://doi.org/10.1130/G24170A.1>
- 63) Post, J.E. and Heaney, P.J. (2008) Synchrotron powder X-ray diffraction study of the structure and dehydration behavior of palygorskite. *American Mineralogist*, 93, 667-675. <https://doi.org/10.2138/am.2008.2590>
- 64) Post, J.E., Heaney, P.J., and Ertl, A. (2008) Rietveld refinement of the ranciéite structure using synchrotron powder diffraction data. *Powder Diffraction*, 23, 10-14. <https://doi.org/10.1154/1.2836477>
- 65) Heaney, P.J., Post, J.E., Fischer, T.B., Hummer, D.R., Lopano, C.L., and Wall, A.J. (2008) Applications of time-resolved synchrotron X-ray diffraction to cation exchange, crystal growth and biomineralization reactions. *Mineralogical Magazine*, 72, 179-184. <https://doi.org/10.1180/minmag.2008.072.1.179>
- 66) Fischer, T.B., Heaney, P.J., Jang, J.-H., Ross, D.E., Brantley, S.L., Post, J.E., and Tien, M. (2008) Continuous time-resolved X-ray diffraction of the biocatalyzed reduction of Mn oxide. *American Mineralogist*, 1929-1932. <https://doi.org/10.2138/am.2008.3038>
- 67) Lopano, C.L., Heaney, P.J., and Post, J.E. (2009) Cs-exchange in birnessite: Reaction mechanisms inferred from time-resolved X-ray diffraction and transmission electron microscopy. *American Mineralogist*, 94, 816-826. <https://doi.org/10.2138/am.2009.3068>
- 68) Hummer, D.R., Kubicki, J.D., Kent, P.R.C., Post, J.E., and Heaney, P.J. (2009) The origin of nanoscale phase stability reversals in titanium oxide polymorphs. *Journal of Physical Chemistry C*, 4240-4245. <https://doi.org/10.1021/jp811332w>
- 69) Tan, H., Zhang, G., Heaney, P.J., Webb, S.M., and Burgos, W.D. (2010) Characterization of manganese precipitates from Appalachian coal mine drainage treatment systems. *Chemical Geology*, 25, 389-399. <https://doi.org/10.1016/j.apgeochem.2009.12.006>
- 70) Stubbs, J.E., Post, J.E., Elbert, D.C., Heaney, P.J., and Veblen, D.R. (2010) Uranyl phosphate sheet reconstruction during dehydration of metatorbernite [Cu(UO₂)₂(PO₄)₂ • 8H₂O]. *American Mineralogist*, 95, 1132-1140. <https://doi.org/10.2138/am.2010.3439>

- 71) Hu, K. and Heaney, P.J. (2010) Serpentine doublets, sold as “pietersite.” *Gems and Gemology*, 46, 157-158.
- 72) Hu, K. and Heaney, P.J. (2010) A microstructural study of pietersite from Namibia and China. *Gems and Gemology*, 46, 280-286. <https://www.gia.edu/doc/A-Microstructural-Study-of-Pietersite-from-Namibia-and-China.pdf>
- 73) Jin, L., Ravello R., Ketchum, B., Bierman, P.R., Heaney, P.J., White, T., and Brantley, S.L. (2010) Mineral weathering and hillslope evolution at Shale Hills catchment: a Critical Zone Observatory in central Pennsylvania, USA. *Geochemistry and Cosmochimistry Acta*, 74, 3669-3691. <https://doi.org/10.1016/j.gca.2010.03.036>
- 74) Post, J.E., Heaney, P.J., and Cho, Y. (2011) Neutron diffraction study of hydrogen in birnessite structures. *American Mineralogist*, 96, 534-540. <https://doi.org/10.2138/am.2011.3629>
- 75) Wall, A.J., Heaney, P.J., Mathur, R., Post, J.E., Hanson, J.C., and Eng, P.J. (2011) A flow-through reaction cell that couples time-resolved X-ray diffraction with stable isotope analysis. *Journal of Applied Crystallography*, 44, 429-432. <https://doi.org/10.1107/S0021889811000525>
- 76) Lopano, C.L., Heaney, P.J., Bandstra, J.Z., Post, J.E., and Brantley, S.L. (2011) Kinetic analysis of cation exchange in birnessite using time-resolved synchrotron X-ray diffraction. *Geochimica et Cosmochimica Acta*, 75, 3973-3981. <https://doi.org/10.1016/j.gca.2011.04.021>
- 77) Wall, A.J., Mathur, R., Heaney, P.J., Post, J.E. (2011) Cu isotope fractionation during bornite dissolution: *in situ* X-ray diffraction analysis. *Ore Geology Reviews*, 42, 62-70. <https://doi.org/10.1016/j.oregeorev.2011.01.001>
- 78) Cygan, R.T., Post, J.E., Heaney, P.J., and Kubicki, J.D. (2012) Molecular models of birnessite and related hydrated layered minerals. *American Mineralogist*, 97, 1505-1514. <https://doi.org/10.2138/am.2012.3957>
- 79) Hummer, D.R., Heaney, P.J., and Post, J.E. (2012) In situ observations of particle size evolution during the hydrothermal crystallization of TiO₂: A time-resolved synchrotron SAXS and WAXS study. *Journal of Crystal Growth*, 344, 51-58. <https://doi.org/10.1016/j.jcrysgro.2012.01.044>
- 80) Fleeger, C.R., Heaney, P.J., and Post, J.E. (2013) A time-resolved X-ray diffraction study of Cs exchange into hexagonal H-birnessite. *American Mineralogist*, 98, 671-679. <https://doi.org/10.2138/am.2013.4287>
- 81) Hummer, D.R., Kubicki, J.D., Kent, P.R.C., and Heaney, P.J. (2013) Single-site and monolayer surface hydration energy of anatase and rutile nanoparticles using density functional theory. *Journal of Physical Chemistry B*, 49, 26,084-26,090. <https://doi.org/10.1021/jp408345v>

- 82) Post, J.E. and Heaney, P.J. (2014) Time-resolved synchrotron X-ray diffraction study of the dehydration behavior of chalcophanite. *American Mineralogist*, 99, 1956-1961. <https://doi.org/10.2138/am-2014-4760>
- 83) Peterson, K.M., Heaney, P.J., Post, J.E., and Eng, P.J. (2015) A refined monoclinic structure for a variety of "hydrohematite". *American Mineralogist*, 100, 570-579. <https://doi.org/10.2138/am-2015-4807>
- 84) Hummer, D.R. and Heaney, P.J. (2015) MinKin: A kinetic modeling program for the precipitation, dissolution, and phase transformation of minerals in aqueous solution. *Chemical Geology*, 405, 112-122. <https://doi.org/10.1016/j.chemgeo.2015.03.019>
- 85) Xu, H., Heaney, P.J., Yu, P., and Xu, H. (2015) Synthesis and structure of a stuffed derivative of α -quartz, $\text{Mg}_{0.5}\text{AlSiO}_4$. *American Mineralogist*, 100, 2191-2198. <https://doi.org/10.2138/am-2015-5303>
- 86) Ling, F.T., Heaney, P.J., Post, J.E. and Gao, X. (2015) Transformations from triclinic to hexagonal birnessite at circumneutral pH induced by common biological buffers. *Chemical Geology*, 416, 1-10. <https://doi.org/10.1016/j.chemgeo.2015.10.007>
- 87) Post, J.E., Thomas, E., and Heaney, P.J. (2016) Jianshuiite in oceanic manganese nodules at the Paleocene-Eocene boundary. *American Mineralogist*, 101, 407-414. <https://doi.org/10.2138/am-2016-5347>
- 88) Ilton, E.S., Post, J.E., Heaney, P.J., Ling, F.T. and Kerisit, S.N. (2016) XPS determination of Mn oxidation states in Mn (hydr)oxides. *Applied Surface Science*, 366, 475-485. <https://doi.org/10.1016/j.apsusc.2015.12.159>
- 89) Heaney, P.J. (2016) Time's arrow in the trees of life and minerals. *American Mineralogist*, 101, 1027-1035. *Invited MSA Centennial article*. <https://doi.org/10.2138/am-2016-5419>
- 90) Magee, C.W. Jr., Teles, G., Vicenzi, E.P., Taylor, W., Heaney, P.J. (2016) Uranium irradiation history of carbonado diamond, and implications for Paleoproterozoic oxidation in the São Francisco Craton. *Geology*, 44, 527-530. <https://doi.org/10.1130/G37749.1>
- 91) Peterson, K.M., Heaney, P.J., and Post, J.E. (2016) A kinetic analysis of the transformation from akaganeite to hematite: An in situ time-resolved X-ray diffraction study. *Chemical Geology*, 444, 27-36. <https://doi.org/10.1016/j.chemgeo.2016.09.017>
- 92) Lin, X. and Heaney, P.J. (2017) Causes of iridescence in natural quartz. *Gems and Gemology*, 53, 68-81. <https://doi.org/10.5741/GEMS.53.1.68>
- 93) Ling, F.T., Post, J.E., Heaney, P.J., Kubicki, J.D., Santelli, C.M. (2017) Fourier transform spectroscopy (FTIR) analysis of triclinic and hexagonal birnessites. *Spectrochimica Acta*, 178, 32-46. <https://doi.org/10.1016/j.saa.2017.01.032>

- 94) Fischer, T.B., Heaney, P.J., and Post, J.E. (2018) Changes in the structure of birnessite during siderophore-assisted dissolution: A time-resolved synchrotron X-ray diffraction study. *Chemical Geology*, 476, 46-58. <https://doi.org/10.1016/j.chemgeo.2017.11.003>
- 95) Lin, X., Heaney, P.J. and Post, J.E. (2018) Iridescence in metamorphic “rainbow” hematite. *Gems and Gemology*, 54, 28-39. <https://doi.org/10.5741/GEMS.54.1.28>
- 96) Ling, F.T., Post, J.E., Heaney, P.J., and Ilton, E.S. (2018) The relationship between Mn oxidation state and structure in triclinic and hexagonal birnessites. *Chemical Geology*, 479, 216-227. <https://doi.org/10.1016/j.chemgeo.2018.01.011>
- 97) Peterson, K.M., Heaney, P.J. and Post, J.E. (2018) Evolution in the structure of akaganeite and hematite during hydrothermal growth: An *in situ* synchrotron X-ray diffraction analysis. *Powder Diffraction*, 33, 287-297. <https://doi.org/10.1017/S0885715618000623>
- 98) Xu, H., Lu, X., Heaney, P.J., and Ren, Y. (2019) Structural behavior of a stuffed derivative of α -quartz, $\text{Mg}_{0.5}\text{AlSiO}_4$, at high temperature: An *in situ* synchrotron XRD study. *Physics and Chemistry of Minerals*, 46, 717-725. <https://doi.org/10.1007/s00269-019-01033-1>
- 99) Kong, K.P., Fischer, T.B., Heaney, P.J., Post, J.E., Stubbs, J.E., and Eng, P.J. (2019) Mineralogical and geochemical constraints on chromium oxidation induced by birnessite. *Applied Geochemistry*, 108, 104365 (14 pp). <https://doi.org/10.1016/j.apgeochem.2019.104365>
- 100) Heaney, P.J. (2020) Heirs of the revolution: X-ray diffraction and the birth of the Mineralogical Society of America. *American Mineralogist*, 105, 3-21. <https://doi.org/10.2138/am-2020-7205>
- 101) Heaney, P.J., Oxman, M.J. and Chen, S.A. (2020) A structural study of size-dependent lattice expansion: *In situ* X-ray diffraction of the growth of goethite nanoparticles from 2-line ferrihydrite. *American Mineralogist*, 105, 652-663. <https://doi.org/10.2138/am-2020-7217>
- 102) Ling, F.T., Post, J.E., Heaney, P.J., Santelli, C., Ilton, E.S., Burgos, W.D., and Rose, A. (2020) A multi-method characterization of natural terrestrial birnessites. *American Mineralogist*, 105, 833-847. <https://doi.org/10.2138/am-2020-7303>
- 103) Bralower, T.J., Cosmidis, J., Heaney, P.J., Kump, L.R., Morgan, J.V., Harper, D.T., Lyons, S.L., Freeman, K.H., Grice, K., Wendler, J.E., Zachos, J.C., Artemieva, N., Chen, S.A., Gulick, S.P.S., House, C.H., Jones, H.L., Lowery, C.M., Nims, C., Schaefer, B., Thomas, E., Vajda, V. (2020) Origin of a global carbonate layer deposited in the aftermath of the Cretaceous-Paleogene boundary impact. *Earth and Planetary Science Letters*, 548, 116476 (17 pp). <https://doi.org/10.1016/j.epsl.2020.116476>
- 104) Post, J.E., McKeown, D.A., and Heaney, P.J. (2020) Raman spectroscopy study of manganese oxides – Tunnel structures. *American Mineralogist*, 105, 1175-1190. <https://doi.org/10.2138/am-2020-7390>

- 105) Gu, X., Heaney, P.J., Reis, F.D.A.A., and Brantley, S.L. (2020) Deep abiotic weathering of pyrite. *Science*, 370, 425. <https://doi.org/10.1126/science.abb8092>
- 106) Bralower, T.J., Cosmidis, J., Fantle, M.S., Lowery, C.M., Passey, B.H., Gulick, S.P.S., Morgan, J.V., Vajda, V., Whalen, M.T., Wittmann, A., Artemieva, N., Farley, K., Goderis, S., Hajek, E., Heaney, P.J., Kring, D.A., Lyons, S.L., Rasmussen, C., Siber, E., Rodriguez Tovar, F.J., Turner-Walker, G., Zachos, J.C., Carte, J., Chen, S.A., Cockell, C., Coolen, M., Freeman, K.H., Garber, J., Gonzalez, M., Gray, J.L., Grice, K., Jones, H.L., Schaefer, B., Smit, J., and Tikoo, S.M. (2020). The habitat of the nascent Chicxulub crater. *AGU Advances*, 1(4), e2020AV000208. <https://doi.org/10.1029/2020AV000208>
- 107) Elmi, C., Post, J.E., Heaney, P.J., and Ilton, E.S. Effects of pH and Ca exchange on the structure and redox state of synthetic Na-birnessite. (2021) *American Mineralogist*, 106, 15-27. <https://doi.org/10.2138/am-2020-7112>
- 108) Post, J.E., McKeown, D.A., and Heaney, P.J. (2021) Raman spectroscopy study of manganese oxides – Layer structures. *American Mineralogist*, 106, 351–366. <https://doi.org/10.2138/am-2021-7666>
- 109) Chen, S.A., Heaney, P.J., Post, J.E., Fischer, T.B., Eng, P.J., and Stubbs, J.E. (2021). Superhydrous hematite and goethite: A potential water reservoir in the red dust of Mars? *Geology*, 49, 1343-1347. <https://doi.org/10.1130/G48929.1>
- 110) Post, J.E., Heaney, P.J., Fischer, T., and Ilton, E. (2022) Manjiroite or hydrous hollandite? *American Mineralogist*, 107, 564-571. <https://doi.org/10.2138/am-2021-7848>.
- 111) Chen, S.A., Heaney, P.J., Post, J.E., Eng, P.J., and Stubbs, J.E. (2022) Hematite/goethite ratios at pH 2-13 and 25-170 °C: A time-resolved synchrotron X-ray diffraction study. *Chemical Geology*, 606, 120995. <https://doi.org/10.1016/j.chemgeo.2022.120995>
- 112) Chen, S.A., Heaney, P.J., Post, J.E., Eng, P.J., and Stubbs, J.E. (2023) Vacancy infilling during the crystallization of Fe-deficient hematite: An in situ synchrotron X-ray diffraction study of non-classical crystal growth. *American Mineralogist*, 108, 1720-1731. <https://doi.org/10.2138/am-2022-8379>
- 113) Chung, D.Y., Heaney, P.J., Post, J.E., Stubbs, J.E., and Eng, P.J. (2023) Synchrotron X-ray diffraction of pyrolusite (MnO₂) and rutile (TiO₂) during heating to ~1000 °C. *Journal of the Physics and Chemistry of Solids*, 177, 111284. <https://doi.org/10.1016/j.jpcs.2023.111284>
- 114) Post, J.E., Heaney, P.J., Ilton, E.S., and Elzinga, E. (2023) The crystal structure of feitknechtite (β-MnOOH) and a new MnOOH polymorph. *American Mineralogist*, 108, 2031-2141. <https://doi.org/10.2138/am-2022-8729>

- 115) Wang, C., Shen, A.H., Heaney, P.J., Palke, A., Wang, K., Wang, H., Kiefert, L. Cu nanoparticle geometry as the key to bicolor behavior in Oregon sunstones -- an application of LSPR theory in nanomineralogy. *American Mineralogist*, in press. <https://doi.org/10.2138/am-2023-9141>

Books Edited

- 1) Heaney, P.J., Prewitt, C.T., and Gibbs, G.V., Eds. (1994) *Silica: Physical behavior, geochemistry and materials applications*. *Reviews in Mineralogy*, vol. 29, 606 p.

Chapters in Books

- 1) Heaney, P.J. and Banfield, J.F. (1993) Structure and chemistry of silica, metal oxide, and phosphate minerals. In: Guthrie, G.D., Jr. and Mossman, B.T., Eds. *Health Effects of Mineral Dusts*. *MSA Reviews in Mineralogy*, 28, 185-233.
- 2) Heaney, P.J. (1994) Structure and chemistry of the low-pressure silica polymorphs. In: P.J. Heaney, C.T. Prewitt, G.V. Gibbs, Eds., *Silica: Physical behavior, geochemistry and materials applications*. *Reviews in Mineralogy*, vol. 29, 1-40.
- 3) Heaney, P.J. (1997) Crystal Growth Fast and Slow. In: J.B. Brady, D.W. Mogk, and D. Perkins, Eds. *Teaching Mineralogy*. Mineralogical Society of America, Washington, D.C. pp. 67-78.
- 4) Heaney, P.J. (2000) Phase transformations induced by solid solution. In: Redfern, S.A.T. and Carpenter, M.A., Eds., *Transformation Processes in Minerals*. *Reviews in Mineralogy and Geochemistry*, 43, 135-174.
- 5) Heaney, P.J. (2021) Iris agates and Cantor dusts: The textural complexity of agates. In: Thoresen, L. and Overlin, S. Eds., *Seventeenth Annual Sinkankis Symposium Book – Agate and Chalcedony*. Pala International, Inc. Fallbrook, CA. pp. 28-39.
- 6) Heaney, P.J. The Complex Mineralogy of Agates. In: Staebler, G., Ed. *Agates*. *Lithographie*, in press.

Government Reports

- 1) Smelik, E.A. and Heaney, P.J. (1995) Optical and X-ray diffraction examination of selected concrete aggregates for moganite content. Federal Highway Administration Report FHWA-RD-95-XXX.

Conference Programs

- 1) Heaney, P.J. (2019) MSA Centennial Symposium: The Next 100 Years of Mineral Sciences. Mineralogical Society of America.

Other Published Contributions

- 1) Heaney, P.J. (1992) What future, mineralogy? *The Lattice*, 8, 4-5.
- 2) Heaney, P.J. (1993) Bragg, William Lawrence and William Henry. *MacMillan Encyclopedia of the Earth Sciences*, Simon and Schuster, New York, pp. 57-59.
- 3) Heaney, P.J. (1996) Book Review: *Handbook of Mineralogy, Vol. II: Silica, Silicates*. By Anthony, J.W. et al., Eds. (Mineral Data Publishing, Tucson, 1995, 904 p.), *American Mineralogist*, 81, 524.
- 4) Heaney, P.J. (1997) Quartz. *McGraw-Hill Encyclopedia of Science and Technology*, 8th ed., vol. 14, McGraw-Hill, New York, pp. 709-710.
- 5) Heaney, P.J. (1997) Oscillatory Banding in Minerals. *McGraw-Hill Yearbook of Science and Technology 1998*, McGraw Hill, New York, pp. 253-255.
- 6) Heaney, P.J. (1998) Living in a Material World. *The Lattice*, 14, 6-7.
- 7) Heaney, P.J. (2002) Presentation of MSA's Distinguished Public Service Award to Jeffrey Post. *American Mineralogist*, 87, 796-797.
- 8) Heaney, P.J. (2005) Triple Point. *Elements*, 1, 7.
http://www.elementsmagazine.org/archives/e1_1/e1_1_dep_triplepoint.pdf
- 9) Heaney, P.J. (2005) Science Societies and the Democratic Process. *Elements*, 1, 61.
http://www.elementsmagazine.org/archives/e1_2/e1_2_dep_triplepoint.pdf
- 10) Heaney, P.J. (2005) Voices from our Past. *Elements*, 1, 133-134.
http://www.elementsmagazine.org/archives/e1_3/e1_3_dep_triplepoint.pdf
- 11) Heaney, P.J. (2005) Searching for Geodiversity. *Elements*, 1, 191.
http://www.elementsmagazine.org/archives/e1_4/e1_4_dep_triplepoint.pdf
- 12) Heaney, P.J. (2006) Reflections on Bragg's Law. *Elements*, 2, 69-70.
http://www.elementsmagazine.org/archives/e2_2/e2_2_dep_triplepoint.pdf
- 13) Heaney, P.J. (2006) Grace under Pressure: A Challenge to the Modern Reviewer. *Elements*, 2, 261-262. http://www.elementsmagazine.org/archives/e2_5/e2_5_dep_triplepoint.pdf

- 14) Heaney, P.J. (2006) Sorry, Levi, but Thanks for the Memories: An Elegy for a Historic Mineral Collection. *Elements*, 2, 327-328.
http://www.elementsmagazine.org/archives/e2_6/e2_6_dep_triplepoint.pdf
- 15) Heaney, P.J. (2007) Mineralogy and the Composition of an American Science. *Elements*, 3, 7.
http://www.elementsmagazine.org/archives/e3_1/e3_1_dep_triplepoint.pdf
- 16) Heaney, P.J. (2007) Caught in the Web of Virtual Education. *Elements*, 3, 87.
http://www.elementsmagazine.org/archives/e3_2/e3_2_dep_triplepoint.pdf
- 17) Heaney, P.J. (2007) What's Your *h*-Index? *Elements*, 3, 229-230.
http://www.elementsmagazine.org/archives/e3_4/e3_4_dep_triplepoint.pdf
- 18) Dong, H., Heaney, P.J., and Rakovan, J. (2007) Who's Who in Mineral Names: Donald R. Peacor. *Rocks and Minerals*, 81, 34-35.
- 19) Heaney, P.J. (2007) The Extinction of Geology. *Elements*, 3, 301-302.
http://www.elementsmagazine.org/archives/e3_5/e3_5_dep_triplepoint.pdf
- 20) Heaney, P.J. (2012) Celestine for State Mineral! A Sabbatical Project. *Elements*, 8, 325.
http://www.elementsmagazine.org/archives/e8_5/e8_5_dep_triplepoint.pdf
- 21) Heaney, P.J. (2013) Quartz. *Encyclopedia of Scientific Dating Methods*. Springer, Dordrecht. DOI 10.1007/978-94-007-6326-5_78-2. 3 pages.
- 22) Heaney, P.J. (2015) At the blurry edge of mineralogy. *American Mineralogist*, 100, 3.
<https://doi.org/10.2138/am-2015-5147>
- 23) Heaney, P.J. (2016) Presentation of MSA's Distinguished Public Service Award to J. Alexander Speer. *American Mineralogist*, 101, 1005.
- 24) Heaney, P.J. (2017) Animal, Vegetable, or Mineral? *Natural History Magazine*, February issue, 32-37.
- 25) Heaney, P.J. (2017) Defining minerals in the Age of Humans. *American Mineralogist*, 102, 925-926. <https://doi.org/10.2138/am-2017-6045>
- 26) Heaney, P.J. (2018) Endpaper: The Gemstone Analogy. [What Gems Tell Us About Climate Change]. *Natural History Magazine*, November issue, 48.
- 27) Heaney, P.J., and Gunter, M.E. (2019), The Mineralogical Society of America turns 100, *Eos*, 100, <https://doi.org/10.1029/2019EO125537>.
- 28) Heaney, P.J. and Shirey, S. (2019) The MSA Centennial Symposium: Meeting Summary, *Elements*, 15, 285.
- 29) Heaney, P.J. and Kaliwoda, M. (2020) Walter Friedrich Unplugged: His 1963 Interview in East Berlin. Annotated Translation (German) with Preface. *IUCr Newsletter*, vol 28, no. 3

https://www.iucr.org/news/newsletter/etc/articles?issue=149786&result_138339_result_page=25

-Excerpted in AIP History Newsletter (2021) vol. 53, pp. 26-28.

-Reproduced on website of American Crystallographic Association

30) Heaney, P.J. (2022) Minerals, Magic, and Science: IMA Designates 2022 as the Year of Mineralogy. *Rocks & Minerals*, 97, 130-133.

<https://doi.org/10.1080/00357529.2022.2004511>

31) Lanzirotti, A., Heaney, P.J., Stubbs, J., Fenter, P., Myneni, S., Gilbert, B., and Duffy, T. (2022) Meeting Report: Synchrotrons and Geochemistry: A Workshop for Novices and Experts. *Synchrotron Radiation News.*, 34, 41-42. [10.1080/08940886.2021.2022403](https://doi.org/10.1080/08940886.2021.2022403)

32) Heaney, P.J. (2023) Mastering the art of silicate mineralogy. *Rocks & Minerals*, 98, 8-27.

<https://doi.org/10.1080/00357529.2023.2126697>

GRANTS and CONTRACTS -- Funded

NSF #EAR-9206031: Microstructural investigations of phase transitions in rock-forming minerals. 6/15/92-12/1/94. Principal Investigator. \$123,429.

NSF #EAR-9304438: Acquisition of an analytical transmission electron microscope for geological research. Instrumentation. Principal Investigator. \$385,000.

-In conjunction with Division of Materials Research

NSF #EAR-9408031: Microstructural analysis of evaporitic silica. 3/15/95-2/28/97. Principal Investigator. \$140,000.

Unocal Corp.: Chromatographic analysis of silica polymerization in aqueous fluids. 8/01/96-8/31/98. Principal Investigator. \$98,871.

NSF #EAR-9706143: The formation of polycrystalline diamond: A microstructural and microanalytical study of carbonado. 7/1/97-6/30/99. Principal Investigator. \$149,559.

DOE #DE-FG07-00ID13954: A geochemical and microanalytical study of silica scale deposition in geothermal brines. 8/1/00-7/1/03. Principal Investigator. \$210,490.

NSF #EAR-0073862: A mantle or crustal origin for carbonado? Synthesis and microanalytical studies of polycrystalline diamond. 7/15/00-7/14/03. Principal Investigator. \$149,767.

Pennsylvania State University Center for Environmental Chemistry and Geochemistry: Real-time structural analysis of heavy metal cation exchange reactions in anionic clays and manganese oxides. 6/01/01-5/31/03. Principal Investigator. \$10,000.

NSF #EAR-0125908: Time-resolved structural analysis of heavy metal cation exchange reactions in anionic clay and manganese oxide nanoparticles. 01/01/02-12/31/04. Principal Investigator. \$225,957.

NSF #EAR-0417714: Time-resolved diffraction studies of cation exchange reactions and hydrothermal synthesis of minerals. 09/01/04-08/31/07. Principal Investigator. \$334,930.

NSF DMR-0420744: MRI: Acquisition of focused ion beam instrument for interdisciplinary research and education. 07/01/04-06/30/05. Co-Principal Investigator with E.C. Dickey (P.I.) and J.M. Catchmark. \$482,888.

NSF CHE-0431328: EMSI: Center for environmental kinetic synthesis. 09/01/04 – 08/31/09. S.L. Brantley (P.I.). One of 12 co-P.I.s. \$6.7 million from NSF and \$2.5 million from DOE.

NSF EAR-0745374: Time-resolved diffraction studies of soil-forming mineral reactions. 08/15/08-08/14/11. Principal Investigator. \$280,000.

DOE-NETL: 9.3.2 Mineralogical and Geochemical Impacts of Leaked CO₂-enriched Fluids. 01/15/10-11/14/10. Co-Principal Investigator with William Burgos (P.I.). \$131,377.

DOE-NETL: 9.3.2 Mineralogical and Geochemical Impacts of Leaked CO₂-enriched Fluids. 11/15/10-11/14/11. Co-Principal Investigator with William Burgos (P.I.). \$162,101.

DOE-NETL: 9.3.2 Mineralogical and Geochemical Impacts of Leaked CO₂-enriched Fluids. 11/15/11-11/14/12. Co-Principal Investigator with William Burgos (P.I.). \$105,000.

NSF EAR-1147728: Mechanisms of mineral dissolution: Time-resolved synchrotron X-ray diffraction of Fe- and Mn-oxides with dissolved organic ligands. 02/15/12-02/14/15. Principal Investigator. \$350,349.

2014/2015 PSIEE Seed Grant: Chromium fate in groundwater systems: In situ investigation of chromium oxidation by manganese oxide using electrochemical and synchrotron diffraction analyses. 03/15/15-07/31/16. C. Gorski and P.J. Heaney. \$25,000.

NSF EAR-1552211: In situ synchrotron X-ray diffraction of Fe oxide transformations in aqueous solutions. 02/15/16-01/31/20. P.J. Heaney, J.E. Post, J.D. Kubicki. \$408,616

Dept. Geosciences, Penn State University: Blue Sky Proposal: Exploring Earth's History through Mineral Evolution: Constructing an Interactive, Web-based Mineralogy Tree. 01/15/19-07/14/20. P.J. Heaney. \$15,000.

Penn State Center for Global Studies: Career Development Award. April-May 2019. P.J. Heaney. \$2,500.

NSF EAR-1925903: Structural controls on Fe oxide formation: A crystallographic analysis of the growth of hematite versus goethite. P.J. Heaney, J.E. Post, J.D. Kubicki. 8/15/2019 to 7/31/2024. \$474,916

MRI PSIEE Seed Grant 2020: Characterizing structural changes in sodium-ion battery electrodes in real time. 2/25/20-2/24/21. C.A. Gorski and P.J. Heaney. \$30,000.

NSF CHE-2304711: Thermodynamics and Redox Reactivity of Birnessite. C.A. Gorski and P.J. Heaney, 8/1/2023-7/31/2026. \$425,346

EDUCATION -- Advising

Postdoctoral Researchers

Douglas M. Yates -- Analysis of polynuclear species by gel filtration chromatography: Controls on crystallization and adsorption in low-temperature fluids. 6/94 - 8/98

Gary Icopini -- A geochemical and microanalytical study of silica scale deposition in geothermal brines. 8/00 to 8/03.

Charles Magee -- Microanalysis of inclusions in natural polycrystalline diamonds. 8/02 to 1/03.

Christine Conrad -- Kinetics of silica polymerization. 9/05 to 12/06.

Lachlan MacLean -- Time-resolved X-ray diffraction of dissolution processes. 9/07 to 8/08.

Graduate Students

Graduate Theses and Projects Supervised

Hongwu Xu -- Ph.D. in Geosciences, 1998. *Structural effects of atomic substitutions in silicates*. Princeton University

Subarnarekha De -- Ph.D. in Geosciences, 2000. *Microanalytical studies of carbonado and synthetic polycrystalline diamond*. Princeton University

Song Yang -- Non-Degree, 2000. *Microstructural characterization of tiger's-eye*. Pennsylvania State University. Non-degree.

Vivian Schatz -- M.A. in Geological Education, 2001. *Mechanisms of silicification of fossil stromatolites*. Pennsylvania State University

Christina Lopano -- Ph.D. in Geosciences, 2007. *Synthesis of Mn oxide cation exchange agents*. Pennsylvania State University

Yunchul Cho, Ph.D. in Soil Sciences, 2008. *Analysis of H speciation in Mn oxides*. Pennsylvania State University. Primary Advisor: Sridhar Komarneni.

Daniel Hummer, Ph.D. in Geosciences, 2010. *Mechanisms of Aqueous Crystallization and Phase Transformation in Titanium Oxide Minerals*. Pennsylvania State University

Timothy Fischer, Ph.D. in Geosciences, 2010. *Structural Transformations of Birnessite (MnO_2) during Biological and Abiological Reduction*. Pennsylvania State University

Andrew Wall, Ph.D. in Geosciences, 2011. *Abiotic Controls on Copper Isotope Fractionation during the Dissolution of Copper Sulfide Minerals*. Pennsylvania State University

Claire Fleeger, Ph.D. in Geosciences, 2011. *Contaminant Sequestration and Phase Transformation Properties of Birnessite-like Phases (MnO_2)*. Pennsylvania State University

Kaifan Hu, Ph.D. in Gemology, 2011. *Microanalysis of chatoyant silica gem materials*. Visiting student from China University of Geosciences-Wuhan, 2008-2010. China Scholarship Council Postgraduate Program.

Kristina Peterson, Ph.D. in Geosciences, 2014. *Nucleation, growth and phase transformation mechanisms of the iron (oxy)hydroxides*. Pennsylvania State University

Matthew Oxman, M.S. in Geosciences, 2015. *A time-resolved synchrotron X-ray diffraction study of the in situ, hydrothermal synthesis of goethite from 2-line ferrihydrite*. Pennsylvania State University

Xiayang (Sunny) Lin, M.S. in Geosciences, 2015. *Causes of iridescence in natural gem materials*. Pennsylvania State University

Kimberly Foecke, M.S. in Geosciences, 2016. *Analysis of exterior stains on fossil bone and taphonomic implications*. Co-advisor with Russell Graham and Tim White. Pennsylvania State University

Florence Ling, Ph.D. in Geosciences, 2016. *Mineralogical and geochemical analysis of synthetic and natural birnessite*. Pennsylvania State University

Kyeong Pil (Phil) Kong, M.S. in Geosciences, 2017. *Mineralogical and geochemical constraints on the chromium oxidation induced by birnessite*. Pennsylvania State University

Si (Athena) Chen, Ph.D. in Geosciences, 2021. *The formation of iron (hydr)oxides in surface environments: A crystallographic and kinetic study*. Pennsylvania State University

Chengsi Wang, Ph.D. in Gemology, 2021. *Influence of metal-semiconductor nanoparticles on the optical properties of minerals as determined by TEM/FIB*. Visiting student from China University of Geosciences-Wuhan, 2019. China Scholarship Council Postgraduate Program.

Yu Yan, Ph.D. in Geosciences, 2022. *Microanalysis of chatoyant silica gem materials*. Visiting student from Peking University, 2019-2020. China Scholarship Council Postgraduate Program.

Dongyoun Chung, M.S. in Geosciences, 2022. Changes in crystal structures of metal oxide/hydroxide minerals during dissolution and heating: an in situ synchrotron X-ray diffraction study. Pennsylvania State University.

Dongyoun Chung, Ph.D. in Geosciences, in progress. *Mechanisms of growth and dissolution in soil-forming minerals*. Pennsylvania State University.