

Field of Specialization:

The crystallography and spectroscopy of minerals, with emphasis on crystal chemistry, bonding, temperature and pressure effects, characterization and identification.

Contact Information:

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Education:

University of British Columbia	1986	B.S.	Mathematics
Virginia Tech	1989	M.S.	Geological Sciences
Virginia Tech	1992	Ph.D.	Geological Sciences

Graduate Advisors: G.V. Gibbs (Mineralogy) and M.B. Boisen, Jr. (Mathematics)
Carnegie Institution of Washington, Geophysical Laboratory, 1993 – 1996 Post-doc
Advisors: R.M. Hazen and L.W. Finger

Academic and Professional Appointments:

Assistant to curator Joe Nagel: M.Y. Williams Collection at University of British Columbia, 1985
Assistant to curator Gary Ansell: National Mineral Collections of Canada, 1986
Assistant to curator Susan Eriksson: Virginia Tech Museum of Geological Sciences, 1990
Graduate teaching assistant: Virginia Tech, 1988 – 1992
Pre-doctoral Fellowship: Carnegie Institution of Washington, Geophysical Laboratory, 1991
Post-doctoral Fellowship: Carnegie Institution of Washington, Geophysical Laboratory, February 1993 – July 1996
Visiting Professor, Center for the Study of Matter at Extreme Conditions, Florida International University, Miami, January 2003 – June 2003
Visiting Professor, Department of Geosciences, Virginia Tech, Blacksburg Virginia, July 2003 – September 2003
Visiting Professor, Graduate School of Human and Environmental Studies, Kyoto University, Japan. October 2003 – December 2003
Assistant Professor, Department of Geosciences, University of Arizona, August 1996 – 2002
Associate Professor, Department of Geosciences, University of Arizona, 2002 – 2008
Professor, Department of Geosciences, University of Arizona, 2008 – present

Honors and Awards:

American Federation of Mineralogical Societies Scholarship, 1990 – 1992
International Union of Crystallography Young Scientist Award, 1992
Leonard G. Berry Medal, The Mineralogical Association of Canada, 2002
Elected Fellow of the Mineralogical Society of America, 2002

Teaching:

Graduate teaching assistant Virginia Tech:

1987, Fall: Mineralogy, Geological Sciences 3505

1988, Fall: Mineralogy, Geological Sciences 3505

Winter: Instructor: Minerals Laboratory, Geological Sciences 2520

1991, Fall: X-ray Determination of Atomic Arrangements, Materials Sciences and Engineering 3044

1992, Spring: X-ray Determination of Atomic Arrangements, Materials Sciences and Engineering 3054

Visiting Professor Kyoto University, Japan:

2003, Fall: Topics in Crystallography, Graduate School of Human and Environmental Studies

University of Arizona:

1996, Fall: Earth Materials Geos206,

1997, Fall: Earth Materials Geos206; Colloquium Geos595a

1998, Spring: Advanced Mineralogy Geos418/518; Colloquium Geos595a

1998, Fall: Mineralogy Geos306; Colloquium Geos595a

1999, Spring: Colloquium Geos595a; Pyroxenes Geos596a; Natural Sciences Nats101

1999, Fall: Mineralogy Geos306; Space Groups Geos596a

2000, Spring: Natural Sciences Nats101

2000, Fall: Mineralogy Geos306

2001, Spring: Electron Density Analysis Geos596a; Natural Sciences Nats101

2001, Fall: Mineralogy Geos306; Laboratory Techniques in Geosciences Geos596a

2002, Spring: Natural Sciences Nats101

2002, Fall: Mineralogy Geos306; Introduction and Analysis of the Structure Factor Equations Geos596a

2004, Spring: Natural Sciences Nats101

2004, Fall: Mineralogy Geos306

2005, Spring: bought out teaching contract for Nats101

2005, Fall: Mineralogy Geos306

2006, Spring: Independent Study Geos399

2006, Fall: Mineralogy Geos306

2007, Spring: Characterization and Identification of Minerals Geos460/560

2007, Fall: Mineralogy Geos306

2008, Spring: Characterization and Identification of Minerals Geos460/560; Mathematical Crystallography Geos596a

Committees:

Departmental:

Chairman's Advisory 1997 – 2001

Colloquium 1997 – 1999

Graduate policy 2000 – 2002; 2007 – 2008

Lowell Chair Search 2001

Performance Evaluation 1997 – 1999; 2002; 2007 – 2008

Promotion and Tenure 2004 – 2005

Undergraduate Advisory/Policy 1997 – 2003

University:

Faculty of Science Grades Appeal Committee 1998 – 2002

University Parking Hearing Board 1999 – 2003

Rio Nuevo Scientific Steering Committee 2002 – 2004

Flandrau Science Center's Science and Technology Working Group. 2002 – 2005

Other:

Committee on Rights, Privileges, and Responsibilities of Scientific Staff at the Geophysical Laboratory, Carnegie Institution of Washington, 1996

Advisory committee, the Spallation Neutrons and Pressure project at Oak Ridge National Laboratory, 2003 – present

Executive Council, International Mineralogical Association, Treasurer, 2005 – present

National Science Foundation Advisory Panel, 2007

Mineralogical Society of America

American Geophysical Union Mineral Physics Committee, 1996 – 2006

Meetings Program Committee, 1997 – 1999

Outreach Committee, 1998 – 1999

Outreach Committee Chairman, 1999 – present

Crystallography Research Grant Committee Chairman, Award for 2006

Roebing Medal Committee Chairman, Award for 2007

Professional Service:

Coach of Virginia Tech Women's Field Hockey Team, 1987 – 1990, win-loss record: 36-18

Chair: American Geophysical Union Spring Meeting, Mineral Physics session, April 1990

Chair: American Geophysical Union Spring Meeting, Crystal Chemistry of Minerals session, May 1992

Chair: American Geophysical Union Spring Meeting, Advances in Mineralogy session, May 1994

Technical Editor (Structures): The Canadian Mineralogist, 1994 – 2005

Technical Editor, Crystal Structures: American Mineralogist, 1994 – 2005

Crystal Structure Technical Editor: European Journal of Mineralogy, 2003 – 2005

Reviewer of Abstracts: Geological Society of America's 1994 Annual Meeting in Seattle for the Mineralogy/Crystallography category

Mentor to two high school students, Aaron Andalman and Marc Hudacsko, who won the First Place Grand Award at the 1995 International Science and Engineering Fair, Hamilton, Ontario, Canada for their project titled "Determination of Bonding and Electron Density in Crystals".

Chair: American Geophysical Union Spring Meeting, Crystal Chemistry, Phase Equilibria, and Thermodynamics session, May 1995

Mineralogy Society of America Delegate to the American Geophysical Union Spring Meeting, 1995 – 1996

Chair with P. Dera: SMEC (Study of Matter at Extreme Conditions) Conference, Miami, Florida, March 2003, Session: Latest trends and future perspectives in high-pressure crystallography.

Convener of the session: "Crystal structures, crystal chemistry and topology of minerals", 19th General Assembly of the International Mineralogical Association, Kobe, Japan, July 23-28, 2006.

Mineralogical Society of America Elected Councilor, 2005 – 2007

NASA and the Jet Propulsion Laboratory 2009 Mars Rover mission Science Review board

Professional Memberships:

Mineralogical Association of Canada, 1986 – present

Mineralogical Society of America, 1988 – present

American Geophysical Union, 1997 – present

Elected member of the International Centre for Diffraction Data, 1999 – present

Deutsche Mineralogische Gesellschaft: 2002 – present

Graduate Student Supervision:

Peter Liermann 1996 – 2001 Committee member, PhD

Ryan Mathur 1996 – 2001 Committee member, PhD

Marilena Stimpfl 1997 – 2004 Committee member, PhD

Richard Thompson 1998 – 2004 Advisor, MS, PhD

Kausik Sinnaswamy 1999 – 2001 Research Advisor, MS

Marcus Origlieri 2000 – 2005 Advisor, MS, PhD

Carolyn Pommier 2000 – 2003 Committee member, PhD Chemistry

Casey Hagbo 2001 – 2003 Committee member, MS

Archana Krishnamurthy 2001 – 2004 Research Advisor, MS

Hareesh Rajan 2001 – 2004 Research Advisor, MS

Andrew McCarthy 2001 – 2004 Committee member, MS; 2004 – 2007 Advisor, PhD

Ranjini Swaminathan 2001 – 2004 Research Advisor, MS

Abigail Wasserman 2001 – 2003 Committee member, PhD Lunar and Planetary Sciences

Hinako Uchida 2002 – present Advisor, MS, PhD

Kim Tait 2003 – 2007 Advisor, PhD

Madison Barkley 2007 – present, Advisor, PhD

Rachel Henderson 2007 – present, Advisor, MS

Renata Jasinevicius 2007 – present, Advisor, MS

Abstracts from Meetings:

1. Downs, R.T., Boisen, M.B., Jr. and Gibbs, G.V. (1989) Mean-square displacements along TO bonds in framework aluminosilicates. *EOS Transactions, AGU, Spring Meeting Supplement*, 70 (15) 352
2. Downs, R.T., Gibbs, G.V. and Boisen, M.B., Jr. (1990) A study of the mean-square displacement amplitudes of Si, Al and O atoms in framework structures: Evidence for rigid bonds, order, twinning and stacking faults. *EOS Transactions, AGU, Spring Meeting Supplement*, 71 (17) 526
3. Downs, R.T., Gibbs, G.V., Bartelmehs, K.L. and Boisen, M.B., Jr. (1991) The variation of the SiO bond length with temperature. *EOS Transactions, AGU, Spring Meeting Supplement*, 72 (17) 144

4. Palmer, D.C. and Downs, R.T. (1991) High pressure behavior of cristobalite revealed by single-crystal X-ray diffraction. *EOS Transactions, AGU, Fall Meeting Supplement*, 72 (4) 478
5. Palmer, D.C., Downs, R.T. and Hemley, R.J. (1991) High-pressure phase transitions in cristobalite. *Condensed Matter and Materials Physics* Birmingham
6. Downs, R.T. and Gibbs, G.V. (1992) Aspects of the high temperature behavior of quartz. *EOS Transactions, AGU, Spring Meeting Supplement*, 73 (14) 142
7. Palmer, D.C., Finger, L.W., Hemley, R.J. and Downs, R.T. (1992) The high pressure tetragonal-triclinic phase transition in cristobalite. *EOS Transactions, AGU, Spring Meeting Supplement*, 73 (14) 301
8. Bartelmehs, K.L., Gibbs, G.V., Boisen, M.B., Jr. and Downs, R.T. (1993) Interactive computer software used in teaching and research in mineralogy at Virginia Tech. *Geological Society of America Fall Meeting*, Boston, A-347
9. Downs, R.T. (1993) The significance of thermal ellipsoids in the feldspar structures. *NATO Advanced Study Institute "Feldspars and Their Reactions"*, Edinburgh, Scotland
10. Gibbs, G.V., Boisen, M.B., Jr. and Downs, R.T. (1993) Is the space group symmetry adopted by coesite, quartz and cristobalite governed by short ranged forces? *EOS Transactions, AGU, Spring Meeting Supplement*, 74 (16) 163
11. Downs, R.T., Hazen, R.M. and Finger, L.W. (1994) The high-pressure crystal chemistry of low albite. *EOS Transactions, AGU, Spring Meeting Supplement*, 75 (16) 188
12. Downs, R.T. and Ribbe, P.H. (1994) The structure of low albite at high pressures and temperatures: comparison with alkali-substituted feldspars. *International Mineralogical Association, 16th General Meeting*, Pisa Italy, Session OS-1
13. Hazen, R.M., Downs, R.T., Finger, L.W., Conrad, P.G. and Gasparik, T. (1994) Crystal chemistry and high-pressure behavior of majorite-type garnets. *EOS Transactions, AGU, Spring Meeting Supplement*, 75 (16) 192
14. Downs, R.T., Finger, L.W. and Hazen, R.M. (1994) Rigid body refinement of the structure of quartz as a function of temperature. *Geological Society of America Annual Meeting Abstracts with Programs*, 26 A-111
15. Hazen, R.M., Downs, R.T., Finger, L.W., Gasparik, T. and Fursenko, B. (1994) Crystal chemistry of three new high-pressure silicates with octahedrally-coordinated silicon. *Geological Society of America Annual Meeting Abstracts with Programs*, 26 A-166
16. Zha, C.S., Duffy, T.S., Downs, R.T., Mao, H.K. and Hemley, R.J. (1994) Single-crystal elasticity of forsterite to 16 GPa. *EOS Transactions, AGU, Fall Meeting Supplement*, 75 (44) 633
17. Downs, R.T., Hazen, R.M. and Finger, L.W. (1995) Olivine compression mechanisms. *EOS Transactions, AGU, Spring Meeting Supplement*, 76 (17) 154
18. Andalman, A., Hudasko, M. and Downs, R.T. (1995) An electron density study of the bonding of Na and Oco in low albite. *EOS Transactions, AGU, Spring Meeting Supplement*, 76 (17) 154
19. Duffy, T.S., Zha, C.S., Downs, R.T., Mao, H.K. and Hemley, R.J. (1995) Constraints on upper mantle composition from new measurements of the elasticity of forsterite to transition zone pressures. *EOS Transactions, AGU, Spring Meeting Supplement*, 76 (17) 41
20. Hazen, R.M., Finger, L.W., and Downs R.T. (1995) High-pressure alkali and alkaline earth framework silicates with 4- and 6-coordinated silicon. *EOS Transactions, AGU, Fall Meeting Supplement*, 76 (46) F531

21. Zha, C.S., Mao, H.K., Hemley, R.J., Downs, R.T., and Duffy, T.S. (1995) Sound velocity and elasticity of b -Mg₂SiO₄ under high pressure by Brillouin scattering. *EOS Transactions, AGU, Fall Meeting Supplement*, 76 (46) F631
22. Downs, R.T., and Bartelmehs, K.L. (1996) Computer visualization of temperature and pressure effects on crystal structures. *EOS Transactions, AGU, Spring Meeting Supplement*, 77 (17) S261
23. Yang, H., Hazen, R.M., Downs, R.T., and Finger, L.W. (1996) Structural change associated with the incommensurate-normal phase transition in Akermanite, Ca₂MgSi₂O₇, at high pressure. *EOS Transactions, AGU, Spring Meeting Supplement*, 77 (17) S144
24. Downs, R.T. and Finger, L.W. (1996) Modeling the thermal motion of freely rotating molecules. *International Union of Crystallography XVII Congress and General Assembly*, Seattle Washington, C-443. ([pdf file of notes](#))
25. Hazen, R.M. and Downs, R.T. (1996) Systematic crystal chemistry of high-pressure silicates: An interactive graphics demonstration. *International Union of Crystallography XVII Congress and General Assembly*, Seattle Washington, C-543.
26. Yang, H., Finger, L.W., Hazen, R.M., Downs, R.T., and Prewitt, C.T. (1996) Compressibilities and high-pressure crystal structures of kyanite and sillimanite. *EOS Transactions, AGU, Fall Meeting Supplement*, 77 (46) F683
27. Zha, C.S., Mao, H.K., Downs, R.T., and Hemley, R.J. (1996) Single-crystal elasticity of San Carlos olivine to 32.4 GPa. *EOS Transactions, AGU, Fall Meeting Supplement*, 77 (46) F682
28. Inbar, I., Downs, R.T., Somayazulu, M., Teter, D., Hazen, R.M. (1996) High-pressure behavior of CO₂. Abstracts of the March 1996 Meeting of the American Physical Society, O27.07
29. Mazin, I.I., Fei, Y., Cohen, R.E., and Downs, R.T. (1997) New kind of polytypism: Hexagonal FeO. *The American Physical Society March Meeting*.
30. Downs, R.T., Yang, H., Hazen, R.M., and Finger, L.W. (1997) The high-pressure crystal chemistry of the alkali feldspars: New data from reedmergnerite, NaBSi₃O₈. *EOS Transactions, AGU, Spring Meeting Supplement*, 78 (17) S314
31. Cohen, R.E., Fei, Y., Mazin, I.I., Downs, R.T., and Isaak, D.G. (1997) Phase transitions in transition metal oxides and unusual polytypism in high pressure FeO. *EOS Transactions, AGU, Fall Meeting Supplement*, 78 (46) F743
32. Downs, R.T., Teter, D.M., and Gibbs, G.V. (1997) A Pro-crystal electron density analysis of potassium-oxygen bonding in microcline and KTP as a function of pressure. *EOS Transactions, AGU, Fall Meeting Supplement*, 78 (46) F754
33. Downs, R.T. (1998) Computer graphics simulation of compression mechanisms in crystals. *IUCR-HP98*, Argonne, Abstracts, 21
34. Thompson, R.M., and Downs, R.T. (1999) Quantitative analysis of the closest-packing of anions in mineral structures as a function of pressure, temperature, and compositions. *EOS Transactions, AGU, Fall Meeting Supplement*, 80 (46) F1107.
35. Downs, R.T., Gibbs, G.V., and Boisen M.B., Jr. (1999) Topological analysis of the P2₁/c to C2/c transition in pyroxenes as a function of temperature and pressure. *EOS Transactions, AGU, Fall Meeting Supplement*, 80 (46) F1140.
36. Righter, K., and Downs, R.T. (2000) Magnesioferrite spinel as the host phase for iridium and other highly siderophile elements at the cretaceous-tertiary boundary. Meteoritical Society Meeting. *Meteoritics & Planetary Science* 35: A136-A137, Supplement S Sep

2000

37. Downs, R.T., Gibbs, G.V., Giovanni, M.K., Boisen, M.B.Jr., and Rosso, K.M. (2001) A comparison of procrystal and first-principles crystal electron density distributions with application to understanding the phase changes in pyroxenes. In Eleventh Annual V.M. Goldschmidt Conference, Abstract#3902, LPI Contribution No. 1088, Lunar and Planetary Institute, Houston (CD-ROM). May 20-24, Hot Springs, VA.
38. Thompson, R.M., Downs, R.T., and Lienert, C. (2001) Ideal Pyroxene Topologies. In Eleventh Annual V.M. Goldschmidt Conference, Abstract#3149, LPI Contribution No. 1088, Lunar and Planetary Institute, Houston (CD-ROM). May 20-24, Hot Springs, VA.
39. Thompson, R.M., Downs, R.T., and Teter, D.M. (2001) Packing systematics of stishovite. *EOS Transactions, AGU, Fall Meeting Supplement*, 82 (47) F1156. ([html file](#))
40. Origlieri, M.J., Downs, R.T., and Harlow, G.E. (2001) Compression mechanism of the pyroxene kosmochlor. *EOS Transactions, AGU, Fall Meeting Supplement*, 82 (47) F1393.
41. Pommier, C.J.S., Denton, M.B., and Downs, R.T. (2002) Polarized Raman spectroscopic study of the pressure-induced phase change from C2/c to P2₁/c in spodumene. *Pittcon 1747P*, New Orleans, LA, March 17-22, 2002. ([pdf file](#))
42. Lager, G.A., Marshall, W.G., and Downs, R.T. (2002) *Keynote address*: Re-examination of the hydrogarnet structure at high pressure using neutron powder methods: Comparison with single-crystal X-ray and theoretical results. 18th General Meeting of the *International Mineralogical Association*, 1-6 Sept, 2002, Edinburgh, Scotland. Programme With Abstracts, page 82.
43. Origlieri, M.J., Thompson, R.M., Downs, R.T., and Gibbs, G.V. (2002) The relationship between compression anisotropy observed in the pyroxenes and oxide anion non-bonded repulsions. 18th General Meeting of the *International Mineralogical Association*, 1-6 Sept, 2002, Edinburgh, Scotland. Programme With Abstracts, page 71.
44. Downs, R.T., and Hall-Wallace, M. (2002) A Database of Crystal Structures Published in the American Mineralogist and The Canadian Mineralogist and It's Use as a Resource in the Classroom. 18th General Meeting of the *International Mineralogical Association*, 1-6 Sept, 2002, Edinburgh, Scotland. Programme With Abstracts, page 128.
45. Thompson, R.M., and Downs, R.T. (2002) Model Pyroxenes and Transition Pathways. 18th General Meeting of the *International Mineralogical Association*, 1-6 Sept, 2002, Edinburgh, Scotland. Programme With Abstracts, page 85.
46. Ross, N.L., and Downs, R.T. (2003) High-pressure crystal chemistry: "Stuffed" framework structures at high-pressure. *International School of Crystallography*, High Pressure Crystallography, 4-15 June. Erice, Italy
47. Pommier, C.J.S., Denton, M.B., and Downs, R.T. (2003) Raman spectroscopic study of spodumene through the pressure-induced phase change from C2/c to P2₁/c. *Pittcon 1730-3*, Orlando, FL, March 9-14, 2003.
48. Uchida, H., and Downs, R.T. (2003) Single-crystal X-ray diffraction studies on spinels from the San Carlos Volcanic Field, Arizona In *Geochimica et Cosmochimica Acta* 67, A497 Supplement, Goldschmidt Conference, Sept 7-12, Kurashiki Japan. ([pdf file](#))
49. Hazen, R.M. and Downs, R.T. (2003) Chiral mineral surfaces and their chiral index. *The Geological Society of America Annual Meeting*, Seattle Washington. November 2-5, 2003. ([pdf abstract](#))
50. Gibbs, G.V., Whitten, A., Spackman, M., Simpfl, M., Carducci, M., and Downs, R.T. (2003) The silica polymorph coesite: An exploration of the electron density. *The*

- Geological Society of America Annual Meeting*, Seattle Washington. November 2-5, 2003. ([pdf abstract](#))
51. McIntosh, B., Denton, M.B., Downs, R.T., Becker, D. (2003) Smart Raman instrument for Mars Science Laboratory. *Mars Exploration Program Assessment Group*, Sept 10-11, Jet Propulsion Laboratory, Pasadena, CA. ([pdf file](#))
 52. Tait KT, Zhao, Y., and Downs, R.T. (2004) Investigations into the stability, morphology, and crystal structure of the coexistence of s-I and s-II methane-ethane and methane-propane clathrate hydrates: occurrence and geological implications. Lab Directed Research Dollars Review at LANSCE, Los Alamos, New Mexico. March 17, 2004.
 53. McIntosh, B. Denton, M.B., and Downs, R.T. (2004) Process Raman on Earth and research Raman on Mars - How are they related? Pittcon March 11, 2004. (Session: 24300-1000). Chicago, IL.
 54. Liermann H. P., Downs R. T., Yang H. (2004) Raman spectroscopy of order/disorder in pseudobrookite (MgTi₂O₅): Implication for the determination of the thermal history of planetary materials by remote sensing. 32nd IGC - Florence 2004.
 55. Hazen, R.M., Asthagiri, A., Teng, H., and Downs, R.T. (2004) Geochemical pathways to the origin of biochemical homochirality. Division of Geochemistry, American Chemical Society National Meeting, Philadelphia, PA, Aug 22-26. ([html file](#))
 56. Downs, R.T., Liermann, H.P., and Yang, H. (2004) The analysis of Mg and Ti order/disorder in pseudobrookite by Raman spectroscopy: Implications for the geological exploration of Mars. Geological Association of Canada - Mineralogical Association of Canada Annual Meeting, St. Catherines 2004. SS01-06.
 57. Asthagiri, A., Downs, R.T., and Hazen, R.M. (2004) Density functional theory modeling of interactions between amino acids and chiral mineral surfaces. Fall GSA, Denver, 9 Nov. 2004. Geological Society of America Abstracts with Programs, Vol. 36, No. 5, p. 338. ([html file](#))
 58. Downs, R.T., Rossman, G., Drake, M.J., and Denton, M.B. (2004) A comprehensive Raman spectral library of minerals with search/match/predict capability. Fall Geological Society of America, Denver, 9 Nov, 2004.
 59. Downs, R.T., (2004) Scientific databases of the Mineralogical Society of America. GeoSciences Information Systems E-Resources Forum. Fall GSA, Denver, 7 Nov. 2004.
 60. Thompson, R.M., Downs, R.T. (2004) Volume of C2/c pyroxenes at mantle P, T, and x. EOS Transactions, AGU, 85(47), Fall Meeting Supplement, Abstract MR11A-0891.
 61. Yang H, Manoun B, Downs R T, Ganguly A, and Barsoum M W (2005) Crystal chemistry of layered carbide, Ti₃(Ge_{0.57}Si_{0.43})C₂. Study of Matter at Extreme Conditions 2005 Conference, Miami Beach. Poster 18, page 109-110.
 62. K. Tait, M. Hartl, D. Williams, C. Pantea, L.L. Daemen, Y. Zhao , & R. Downs (2005) Diffraction and spectroscopy of thorite and huttonite (ThSiO₄), Geophysical Research Abstracts, Vol. 7, 10957, European Geophysical Union, Vienna, Austria, April 24-29, 2005.
 63. Lavina, B., Polozov, A., and Downs, R.T. (2005) Mg, Al, Si, Ca - bearing magnetite from Korshunovskoe, East Siberia. XX Congress of the International Union of Crystallography, 23-31 August, Florence, Italy
 64. Tait, K.T., Zhao, Y., Downs, R.T., Stern, L.A., & Kirby, S. (2005) Investigations into the stability, morphology and the crystal structure of structure I and II methane-ethane clathrate hydrates. International Conference on Gas Hydrates, June 13-16, 2005.

65. Rajenski, K., Mogk, D., and Downs, R.T. (2005) Teaching mineralogy with crystal structure databases and visualization software: A digital resource collection. Goldschmidt Conference, Moscow, Idaho, May 20-25.
66. McCarthy, A., Domanik, K., and Downs, R.T. (2005) Determining structural chemical formulae using the American Mineralogist Crystal Structure Database. Goldschmidt Conference, Moscow, Idaho, May 20-25.
67. LeBail A, Chateigner D, Chen X, Ciriotti M, Cranswick L M D, Downs R T, Lutterotti L, Yokochi A F T (2005) COD (Crystallography Open Database) and PCOD (Predicted). Acta Crystallographica A61, C481-C481 ([pdf file](#))
68. Yang, H., Lu, R., White, A., Downs, R.T., and Ma, Y. (2005) X-ray diffraction study of marokite (CaMn₂O₄) to 40 GPa. Abstracts of the Geological Society of America Annual Fall Meeting, Salt Lake City, 16-19 October 2005.
69. Schmidt, G., Uchida H., Mooney, P., Lu, R., and Downs, R.T. (2005) Oriented crystal studies: Orienting the crystals Abstracts of the Geological Society of America Annual Fall Meeting, Salt Lake City, 16-19 October 2005.
70. Dembowski, R.F., Mooney, P.R., Laetsch, T.A., Lu, R., and Downs, R.T. (2005) Orientation in Raman spectroscopy. Abstracts of the Geological Society of America Annual Fall Meeting, Salt Lake City, 16-19 October 2005. [link](#)
71. Mooney, P.R., Dembowski, R.F., Laetsch, T.A., Zwick, J., Downs, R.T., and Lu, R. (2005) RRUFF Project: Developing an integrated database of Raman and infrared spectra, X-ray diffraction and chemistry data for minerals. Abstracts of the Geological Society of America Fall Meeting, Salt Lake City, 16-19 October 2005. ([pdf of poster](#))
72. Lu, R., Downs, R.T., Denton, M.B., and Rossman, G.R. (2005) Integrated database of Raman spectra, X-ray diffraction and chemistry data for minerals. Abstracts of the Geological Society of America Annual Fall Meeting, Salt Lake City, 16-19 October 2005.
73. Tait K T, Mao W L, Zhao Y, Trouw F R, Daemen L L, and Downs R T (2006) Gas hydrate experimental capabilities at the Los Alamos Neutron Scattering Center (LANSCE). LANSCE Basic Energy Sciences Review, Los Alamos, 21 March, 2006. [link](#)
74. Downs R T (2006) The RRUFF Project: an integrated study of the chemistry, crystallography, Raman and infrared spectroscopy of minerals. Program and Abstracts of the 19th General Meeting of the International Mineralogical Association in Kobe, Japan. O03-13 [link](#)
75. Origlieri M J, Downs R T, Carducci M D, Rosso K M, Gibbs G V (2006) Crystal structure and bonding in the new mineral AsSbO₃. Program and Abstracts of the 19th General Meeting of the International Mineralogical Association in Kobe, Japan. O08-06 [link](#)
[PowerPoint Slides](#)
76. McCarthy A C, Downs R T, Lu R, Yang H (2006) Reexamination of yedlinite, Pb₆(Cl,OH)₆Cr³⁺(OH,O)₈, using single-crystal X-ray diffraction and Raman spectroscopy, and redetermination of the chemical formula. Program and Abstracts of the 19th General Meeting of the International Mineralogical Association in Kobe, Japan. P08-12 [link](#)
77. Ikuto D, Kawame N, Banno S, Hirajima T, Ito K, Rakovan J F, Downs R T, Tamada O (2006) First in situ X-ray identification of coesite and retrogressed quartz on a glass thin section of ultrahigh-pressure metamorphic rock and their crystal structure details. Program and Abstracts of the 19th General Meeting of the International Mineralogical Association in Kobe, Japan. P08-21 [link](#)
78. Laetsch T A, Downs R T (2006) Software for identification and refinement of cell

- parameters from powder diffraction data of minerals using the RRUFF Project and American Mineralogist Crystal Structure Databases. Program and Abstracts of the 19th General Meeting of the International Mineralogical Association in Kobe, Japan. P08-25 [link](#)
79. Tait K T, Trouw F R, Hehlen M P, Shapiro A H, Zhao Y, Downs R T (2006) Inelastic neutron study of THF+D₂ clathrates. Program and Abstracts of the 19th General Meeting of the International Mineralogical Association in Kobe, Japan. P34-01 [link](#)
 80. Fong-Kee, G. (San Miguel High School), Thompson, R.M., and Downs, R.T. (2006) Mineralogy and Crystallography, Undergraduate Biology Research Program Summer Poster Session, University of Arizona.
 81. Thompson R M, Downs R T (2006) The crystal structure of diopside at pressure to 10 GPa. Eos Transactions, American Geophysical Union 87(52), Fall Meeting Supplement, Abstract MR21B-0018 [link](#)
 82. Ross N L, Gibbs G V, Downs R T, Prewitt C T, Rosso K M, Cox D F (2006) Electron density distributions for millerite, vaesite, heazlewoodite and Ni metal: A case for the importance of NiNi bond paths for electron transport. Eos Transactions, American Geophysical Union 87(52), Fall Meeting Supplement, Abstract MR43B-1086 [link](#)
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 84. Dera P, Downs R T, Liermann H, Yang W (2006) Oscillation Laue Analysis (OLA) - A new crystal structure determination method for mineral physics. Eos Transactions, American Geophysical Union 87(52), Fall Meeting Supplement, Abstract MR24A-02 [link](#)
 85. Uchida H, Downs R T, Yang H (2006) Crystal-chemical investigation of kalsilite from San Venanzo, Italy, using single-crystal X-ray diffraction and Raman spectroscopy. Goldschmidt Conference Abstracts 2006, *Geochimica et Cosmochimica Acta* 70, A677-A680 [link](#)
 86. Downs R T, Thompson R M, Pommier C J S, McCarthy A C, Yang H (2007) Crystal chemistry of pyroxene compression. Study of Matter at Extreme Conditions Conference, Miami Beach, April 15-20, 2007
 87. Lu R, Konzett J, Frost D J, Yang H, Downs R T (2007) High-pressure Raman spectroscopic study of clinopyroxenes with 6-coordinated silicon. Study of Matter at Extreme Conditions Conference, Miami Beach, April 15-20, 2007
 88. Yang H, Konzett J, Downs R T (2007) Synthesis, crystal chemistry, and compressibility of a high-pressure phase (Ti_{0.50}Zr_{0.26}Cr_{0.10}Mg_{0.14})O_{1.81} isostructural with cubic zirconia. Study of Matter at Extreme Conditions Conference, Miami Beach, April 15-20, 2007
 89. Thompson R M, McCarthy A C, Downs R T (2007) Crystal Chemical Controls on Equation of State. EOS Transactions AGU 88(52), Fall Meet. Suppl., Abstract DI44A-03 [link](#)
 90. Hazen R M, Papineau D, Bleeker W, Downs R T, Ferry J M, McCoy T J, Sverjensky D A, Yang H (2008) Mineralogical coevolution of the geo- and biospheres. Goldschmidt Conference Abstracts. *Geochimica et Cosmochimica Acta* 72, A360-A360 [link](#)

Invited Talks:

- Michigan Technological University, Department of Geological Engineering and Sciences colloquium, 24 September 1995, "Compression Mechanisms in Minerals"
- University of Arizona Geosciences colloquium, 12 October 1995, "Compression Mechanisms in Minerals"
- International Union of Crystallography XVII Congress and General Assembly, Seattle Washington, 11 August 1996, "Systematic Crystal Chemistry of High-Pressure Silicates: An Interactive Graphics Demonstration"
- International Union of Crystallography XVII Congress and General Assembly, Seattle Washington, 16 August 1996, "Modeling the thermal motion of freely rotating molecules"
- University of Arizona Geosciences colloquium, 17 April 1997, "Phase Transitions, Mechanisms and Implications"
- Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM, October 10, 1997. "Mineral Phase Transitions, Mechanisms and Geologic Implications"
- Department of Geology, Arizona State University, Tempe, AZ, January 28, 1998. "Mineral Phase Transitions, Mechanisms and Geologic Implications"
- Friends of Mineralogy Annual Meeting, Seattle/Tacoma, Washington, September 26, 1998. "Mr. Angstrom's View of the Universe"
- Tucson Gem and Mineral Society, Tucson, Arizona, November 2, 1998. "Mr. Angstrom's View of the Universe: Phosphates, Arsenates and Vanadates"
- Mineralogical Society of America Short Course, Ultrahigh-Pressure Mineralogy: Physics and Chemistry of the Earth's Deep Interior, Davis California, December 5, 1998. "High-Pressure Crystal Chemistry"
- Mineralogy at the Millenium, sponsored by The Carnegie Institution of Washington, The National Science Foundation, and The Mineralogical Society of America, April 11-13, 1999, Washington, D.C. "Visualizing Mineral Behavior".
- Caltech Geology Club, Nov 17, 1999. "Atomic Scale Response of Minerals to Pressure".
- Conference for The Study of Matter at Extreme Conditions, Miami Florida, March 30, 2001. "Change in a crystal structure at simultaneous P and T, using titanite".
- American Crystallographic Association Annual Meeting, "The analysis of bonding changes in pyroxenes at pressure and temperature using procrystal electron densities." July 21-26, 2001, Los Angeles, California.
- Geological Sciences at New Mexico State University, November 14, 2001, Las Cruces, New Mexico. " Minerals at pressure: atomic scale compression".
- Los Alamos National Laboratory, July 25, 2002, Los Alamos, New Mexico. " Minerals at pressure: atomic scale compression mechanisms".
- SMEC (Study of Matter at Extreme Conditions) Conference, Miami, Florida, March 2003, "Single-crystal studies under deviatoric conditions".
- Royal Ontario Museum, Toronto, Ontario, Canada, June 2003, "My colleagues call me a high-pressure mineral physicist..."
- Kyoto University, Kyoto, Japan, October 29, 2003. "The Effect of Pressure on Minerals Part 1. Hydrostatic Pressure".
- Kyoto University, Kyoto, Japan, December 3, 2003. "The Effect of Pressure on Minerals Part 2. Non-hydrostatic Pressure".
- Kanazawa University, Kanazawa, Japan, November 28, 2003. "The Effect of Pressure on Minerals".
- GAC-MAC Annual Meeting, St. Catherines May 2004. "The analysis of Mg and Ti

- order/disorder in pseudobrookite by Raman spectroscopy: Implications for the geological exploration of Mars."
- Study of Matter at Extreme Conditions Conference, Miami Beach, April 2007 "Crystal chemistry of pyroxene compression"
- Tucson Gem and Mineral Show, Micromount Symposium, Feb 2008 "Minerals of the RRUFF Project"
- Department of Geological Science, Indiana University, April 14, 2008 "Compression Mechanisms of Minerals"
- Compres Annual Meeting, Colorado Springs, Colorado, June, 2008. "Software from the RRUFF project databases, Raman and powder X-ray search/match routines for mineral identification."

Journal Publications:

1. Gibbs, G.V., Boisen, M.B., Jr., Downs, R.T. and Lasaga, A.C. (1988) Mathematical Modeling of the structures and bulk moduli of TX_2 quartz and cristobalite structure types, $T = C$, Si, Ge and $X = O$, S. *Materials Research Society Symposium Proceedings*, 121, 155-165. ([pdf file](#))
2. Boisen, M.B., Jr., Gibbs, G.V., Downs, R.T. and D'Arco, P. (1990) The dependence of the SiO bond length on structural parameters in coesite, the silica polymorphs and the clathrasils. *American Mineralogist*, 75, 748-754. ([pdf file](#))
3. Downs, R.T., Gibbs, G.V. and Boisen, M.B., Jr. (1990) A study of the mean-square displacement amplitudes of Si, Al and O atoms in framework structures: Evidence for rigid bonds, order, twinning and stacking faults. *American Mineralogist*, 75, 1253-1267. ([pdf file](#))
4. Gunter, M.E. and Downs, R.T. (1991) Drill: A computer program to aid in building ball and spoke crystal models. *American Mineralogist*, 76, 293-294. ([pdf file](#))
5. Bartelmehs, K.L., Bloss, F.D., Downs, R.T. and Birch, J.B. (1992) Excalibr II. *Zeitschrift für Kristallographie*, 199, 185-196. ([pdf file](#))
6. Downs, R.T., Gibbs, G.V., Bartelmehs, K.L. and Boisen, M.B., Jr. (1992) Variations of bond lengths and volumes of silicate tetrahedra with temperature. *American Mineralogist*, 77, 751-757. ([pdf file](#))
7. Palmer, D.C., Finger, L.W., Hemley, R.J. and Downs, R.T. (1992) The high pressure behavior of cristobalite. *International Union of Crystallography, High-Pressure Group Meeting*, May 30-31. ([pdf file](#))
8. Sterner, S.M., Chou, I-M., Downs, R.T. and Pitzer, K.S. (1992) Phase relations in the system NaCl-KCl-H₂O: V. Thermodynamic-PTX analysis of solid-liquid equilibria at high temperatures and pressures. *Geochimica et Cosmochimica Acta*, 56, 2295-2309. ([pdf file](#))
9. Downs, R.T., Bartelmehs, K.L., Gibbs, G.V. and Boisen, M.B., Jr. (1993) Interactive software for calculating and displaying X-ray or neutron powder diffractometer patterns of crystalline materials. *American Mineralogist*, 78, 1104-1107. ([pdf file](#))
10. Hazen, R.M., Downs, R.T., Finger, L.W. and Ko, J. (1993) Crystal chemistry of ferromagnesian silicate spinels: Evidence of Mg-Si disorder. *American Mineralogist*, 78, 1320-1323. ([pdf file](#))

11. Downs, R.T., Hazen, R.M. and Finger, L.W. (1994) The high-pressure crystal chemistry of low albite and the origin of the pressure dependency of Al/Si order-disorder. *American Mineralogist*, 79, 1042-1052. ([pdf file](#))
12. Downs, R.T. and Palmer, D.C. (1994) The pressure behavior of α cristobalite. *American Mineralogist*, 79, 9-14. ([pdf file](#))
13. Finger, L.W., Hazen, R.M., Downs, R.T., Meng, R.L. and Chu, C.W. (1994) Crystal chemistry of $\text{HgBa}_2\text{CaCu}_2\text{O}_{6+\delta}$ and $\text{HgBa}_2\text{Ca}_2\text{Cu}_3\text{O}_{8+\delta}$: Single-crystal X-ray diffraction results. *Physica C*, 226, 216-221. ([pdf file](#))
14. Hazen, R.M., Downs, R.T., Conrad, P.G. Finger, L.W., and Gasparik, T. (1994) Comparative compressibilities of majorite-type garnets. *Physics and Chemistry of Minerals*, 21, 344-349. ([pdf file](#))
15. Hazen, R.M., Downs, R.T., Finger, L.W., Conrad, P.G. and Gasparik, T. (1994) Crystal chemistry of Ca-bearing majorite. *American Mineralogist*, 79, 581-584. ([pdf file](#))
16. Nicoll, J.S., Gibbs, G.V., Boisen, M.B., Jr., Downs, R.T. and Bartelmehs, K.L. (1994) Bond length and radii variations in fluoride and oxide molecules and crystals. *Physics and Chemistry of Minerals*, 20, 617-624. ([pdf file](#))
17. Bartelmehs, K.L., Downs, R.T., Gibbs, G.V., Boisen, M.B., Jr., Birch, J.B. (1995) Tetrahedral rigid-body motion in silicates. *American Mineralogist*, 80, 680-690. ([pdf file](#))
18. Downs, R.T., Hazen, R.M., Finger, L.W. and Gasparik, T. (1995) Crystal chemistry of lead aluminosilicate hollandite: A new high-pressure synthetic phase with octahedral silicon. *American Mineralogist*, 80, 937-940. ([pdf file](#))
19. Duffy, T.S., Zha, C-S., Downs, R.T., Mao, H-K., and Hemley, R.J. (1995) Elasticity of forsterite to 16 GPa and the composition of the upper mantle. *Nature*, 378, 170-173. ([pdf file](#))
20. Downs, R.T., Zha, C.-S., Duffy, T.S. and Finger, L.W. (1996) The equation of state of forsterite to 17.2 GPa and effects of pressure media. *American Mineralogist*, 81, 51-55. ([pdf file](#))
21. Hazen, R.M., Downs, R.T. and Finger, L.W. (1996) High-pressure crystal chemistry of LiScSiO_4 , an olivine with nearly isotropic compression. *American Mineralogist*, 81, 327-334. ([pdf file](#))
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23. Zha, C-S., Duffy, T.S., Downs, R.T., Mao, H-K., and Hemley, R.J. (1996) Sound velocity and elasticity of single-crystal forsterite to 16 GPa. *Journal of Geophysical Research*, 101, 17535-17545. ([pdf file](#))
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25. Downs, R.T., Andalman, A., and Hudasko, M. (1996) The coordination numbers of Na and K atoms in low albite and microcline as determined from a procrystal electron-density distribution. *American Mineralogist*, 81, 1344-1349. ([pdf file](#))

26. Yang, H., Downs, R.T., Finger, L.W., Hazen, R.M., and Prewitt, C.T. (1997) Compressibility and crystal structure of kyanite, Al_2SiO_5 , at high pressure. *American Mineralogist*, 82, 467-474. ([pdf file](#))
27. Zha, C-S., Duffy, T.S., Mao, H.K., Downs, R.T., Hemley, R.J., and Weidner, D.J. (1997) Single-crystal elasticity of β - Mg_2SiO_4 to the pressure of the 410 km seismic discontinuity in the Earth's mantle. *Earth and Planetary Science Letters*, 147, E9-E15. ([pdf file](#))
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29. Badro, J., Teter, D.M., Downs, R.T., Gillet, P., Hemley, R.J., and Barrat, J-L. (1997) Theoretical study of a five-coordinated silica polymorph. *Physical Review B*, 56, 5797-5806. ([pdf file](#))
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32. Yang, H., Hazen, R.M., Finger, L.W., Prewitt, C.T., and Downs, R.T., (1998) Compressibility and crystal structure of sillimanite, Al_2SiO_5 , at high pressure. *Physics and Chemistry of Minerals*, 25, 39-47. ([pdf file](#))
33. Downs, R.T., and Somayazulu, M. (1998) Carbon dioxide at 1.0 GPa. *Acta Crystallographica C*54, 897-898. ([pdf file](#))
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35. Gibbs, G.V., Hill, F.C., Boisen, M.B., Jr., and Downs, R.T. (1998) Power law relationships between bond length, bond strength and electron density distributions. *Physics and Chemistry of Minerals* 25, 585-590. ([pdf file](#))
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39. Prewitt, C.T. and Downs, R.T. (1998) High-Pressure Crystal Chemistry. Reviews in Mineralogy, 37, *Ultrahigh-Pressure Mineralogy: Physics and Chemistry of the Earth's Deep Interior*, Russell J. Hemley, Editor. Mineralogical Society of America, Washington DC. ([pdf file](#))

40. Gibbs, G.V., Hill, F.C., Boisen, M.B., Jr., and Downs, R.T. (1999) Molecules as a basis for modeling the force field of silica. In *Structure and Imperfections in Amorphous and Crystalline SiO₂*. Rod Devine, editor, John Wiley and Sons, Chapter 6, 151-163. ([pdf file](#))
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42. Sprague, A.L., Roush, T.L., Downs, R.T., Richter, K. (2000) Response to comment on "Comparison of laboratory emission spectra with Mercury telescopic data" by Melissa Lane. *Icarus* 143, 409-411. ([pdf file](#))
43. Holl, C.M., Smyth, J.R., Laustsen, H.M.S., Jacobsen, S.D., and Downs, R.T. (2000) Compression of witherite to 8 GPa and the crystal structure of BaCO₃ II. *Physics and Chemistry of Minerals*, 27, 467-473. ([pdf file](#))
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45. Downs, R.T. (2000) Analysis of harmonic displacement factors. Reviews in Mineralogy and Geochemistry, 41, *High-Temperature and High-Pressure Crystal Chemistry*, Robert M. Hazen and Robert T. Downs, Editors. Mineralogical Society of America, Washington DC. ([pdf file](#))
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49. Richter, K., and Downs, R.T. (2001) The crystal structures of synthetic Re- and PGE-bearing magnesioferrite spinels: Implications for impacts, accretion and the mantle. *Geophysical Research Letters*, 28, 619-622. ([pdf file](#))
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