

Field of Specialization:

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

Contact Information:

Dr Robert T Downs

Department of Geosciences

Gould-Simpson Building

University of Arizona

Tucson Arizona 85721-0077

Voice: 520-626-8092

Lab: 520-626-3845

Fax: 520-621-2672

rdowns@email.arizona.edu

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 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  
Assistant to curator Joe Nagel: 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: CIW, 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  
Director and Curator of the University of Arizona Mineral Museum, 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  
Fellow of the Mineralogical Society of America, 2002  
Fellow of the American Association for the Advancement of Science, AAAS, 2009 ([Link](#))  
Tait K T, Barkley M C, Thompson R M, Origlieri M J, Evans S H, Prewitt C T, Yang H (2011)

Bobdownsite, a new mineral species from Big Fish River, Yukon, Canada, and its structural relationship with whitlockite-type compounds. *The Canadian Mineralogist* 49, 1065-1078 ([pdf](#))

### 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

2010, Fall: Mineralogy Geos306; Spring: Characterization and Identification of Minerals Geos460/560

### Committees:

Departmental:

Chairman's Advisory 1997 – 2001  
Colloquium 1997 – 1999  
Graduate policy 2000 – 2002; 2007 – 2009  
Lowell Chair Search 2001  
Performance Evaluation 1997 – 1999; 2002; 2007 – 2008  
Promotion and Tenure 2004 – 2005; 2009  
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 – 2009  
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

American Association for the Advancement of Science: 2007 – 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 – 2009 Advisor, MS, PhD

Kim Tait 2003 – 2007 Advisor, PhD

Rachel Henderson 2007 – 2009, Advisor, MS

Renata Jasinevicius 2007 – 2009, Advisor, MS

Madison Barkley 2007 – 2011, Advisor, PhD

Greg Schmidt 2009 – 2010, Advisor, PhD

Menezes Filho L A D 2010 - 2014, Committee member, Federal de Minas Gerais, Brazil

Shaunna Morrison, 2012 – 2017, Advisor, MS, PhD

Ben Schumer, 2013 – 2017, Advisor and Committee member, PhD

Barbara Lafuente, 2014 – 2016, Advisor, PhD

Kim Fendrich, 2014 – 2016, Advisor, MS

Cherie Achilles, 2016 – present, Advisor PhD

Josh Golden, 2016 – 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, 16<sup>th</sup> 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  $\beta$ - $\text{Mg}_2\text{SiO}_4$  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,  $\text{Ca}_2\text{MgSi}_2\text{O}_7$ , 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  $\text{CO}_2$ . 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,  $\text{NaBSi}_3\text{O}_8$ . *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  $P2_1/c$  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  $P2_1/c$  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 (MgTi<sub>2</sub>O<sub>5</sub>): 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,  $Ti_3(Ge_{0.57}Si_{0.43})C_2$ . 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 ( $ThSiO_4$ ), 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 ( $CaMn_2O_4$ ) 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 AsSbO<sub>3</sub>. 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 yedlinitite, Pb<sub>6</sub>(Cl,OH)<sub>6</sub>Cr<sup>3+</sup>(OH,O)<sub>8</sub>, 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](#)
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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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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
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92. Barkley M C, Dera P, Downs R T, Miletich R (2010) The structure determination of the high-pressure analog of behoite,  $\text{Be}(\text{OH})_2$ . 2010 Stewardship Science Academic Alliances Symposium, Carnegie Institution of Washington, Washington, D.C., January 20, 2010.
93. Barkley M C, Dera P, Downs R T (2010) Reversible displacive phase transitions of  $\text{SiO}_2$ -cristobalite and behoite,  $\text{Be}(\text{OH})_2$ . GSA Abstracts with Programs Vol. 42 No. 5: Geological Society of America Annual Meeting, 31 October – 3 November, 2010.
94. Grazulis S, Butkus J, Downs R T, Quiros Olozabal M, LeBail A (2010) Software for maintaining and expanding the Crystallography Open Database. 26th European Crystallographic Meeting, ECM 26, Darmstadt, 2010. *Acta Crystallographica* A66, s313. [link](#)
95. McMillan M M, Downs R T, Stein H J, Zimmerman A, Beitscher B, Sverjensky D A, Papineau D, Armstrong J, Hazen R M (2010) Molybdenite mineral evolution: A study of trace elements through time. Geological Society of America Abstracts with Programs 42, 93-93
96. Origlieri M J, Yang H, Downs R T (2010) Bartelkeite: Revision of chemical formula and structural relationship with lawsonite. 20th General Meeting of IMA (IMA2010) August 21 – 27, 2010, poster
97. Barkley M C, Downs R T (2011) Classification and topology of hydrogen environments in hydrous minerals: An Update. 2011 Stewardship Science Academic Alliances Symposium, Carnegie Institution of Washington, Washington, D.C., February 15, 2011.
98. Downs R T (2013) National Science Foundation EarthCube End-User Domain Workshop for Rock Deformation and Mineral Physics Research, November 14, 2013. "Future

- directions in mineralogy and crystallography: Computational methods for crystal structure and education"
99. Rampe E B, Bish D L, Chipera S K, Morris R V, Achilles C N, Ming D W, Blake D F, Anderson R C, Bristow T F, Crisp J A, Des Marais D J, Downs R T, Farmer J D, Morookian J M, Morrison S M, Sarrazin P, Spanovich N, Stolper E M, Treiman A H, Vaniman D T, Yen A S, and the MSL Science Team (2013) Detecting nanophase weathering products with CheMin: Reference intensity ratios of allophane, aluminosilicate Gel, and ferrihydrite. *44th Lunar and Planetary Science conference*, [link](#)
  100. Morrison S M, Downs R T, Blake D F, Bish D L, Ming D W, Morris R V, Yen A S, Chipera S J, Treiman A H, Vaniman D T, Gellert R, Achilles C N, Rampe E B, Bristow T F, Crisp J A, Sarrazin P C, Farmer J D, Des Marais D J, Stolper E M, Morookian J M, Wilson M A, Spanovich N, Anderson R C, and the MSL Science Team (2013) Crystal-chemical analysis of soil at Rocknest, Gale Crater *44th Lunar and Planetary Science conference*, Abstract #1831 [link](#)
  101. Morris R V, Ming D W, Blake D F, Vaniman D T, Bish D L, Chipera S J, Downs R T, Gellert R, Treiman A H, Yen A S, Achilles C N, Anderson R C, Bristow T F, Crisp J A, Des Marais D J, Farmer J D, Grotzinger J P, Leshin L A, McAdam A C, Morookian J M, Morrison S M, Rampe E B, Sarrazin P C, Spanovich N, Stolper E M, and the MSL Science Team (2013) The amorphous component in Martian basaltic soil in global perspective from MSL and MER missions *44th Lunar and Planetary Science conference*, Abstract #1653 [link](#)
  102. Vaniman D T, Blake D F, Yen A S, Ming D W, Morris R V, Achilles C N, Bish D L, Chipera S J, Morrison S M, Downs R T, Rampe E B, Morookian J M, Sarrazin P C, Treiman A H, Anderson R C, Bristow T F, Crisp J A, Des Marais D J, Farmer J D, Spanovich N, Stolper E M, and Wilson M A (2013) Data from the Mars Science Laboratory CheMin XRD/XRF instrument, European Geophysical Union Conference, EGU2013-6272
  103. Morrison S M, Downs R T, Blake D F, Bish D L, Ming D W, Morris R V, Yen A S, Chipera S J, Treiman A H, Vaniman D T, Gellert R, Achilles C N, Rampe E B, Bristow T F, Crisp J A, Sarrazin P C, Morookian J M and the MSL Science Team (2013) Crystal-Chemical Analyses of Soil and Drilled Rock in Gale Crater, Mars, *Mineralogical Magazine (Goldschmidt)*, 77(5), 1794
  104. Morrison S M and the MSL Science Team (2013) Crystal-Chemistry of Mars Minerals at Rocknest, John Klein and Cumberland, Geological Society of America Annual Meeting, 228708
  105. Rampe E B, Morris R V, Ming D W, Archer P D, Bish D L, Chipera S J, Vaniman D T, Blake D F, Bristow T F, Sutter B, Farmer J D, Downs R T, Leveilles R, Achilles C N, Crisp J A, Des Marais D J, Morookian J M, Morrison S M, Sarrazin P C, Spanovich N, Treiman A H, Yen A S, and the MSL Science Team (2014) Characterizing the phyllosilicate component of the Sheepbed mudstone in Gale Crater, Mars using laboratory XRD and EGA, *45th Lunar and Planetary Science conference*, Abstract #1890
  106. R V, Ming D W, Gellert R, Vaniman D T, Bish D L, Blake D F, Chipera S J, Downs R T, Treiman A H, Yen A S, Achilles C N, Archer P D, Bristow T F, Crisp J A, Des Marais D J, Farmer J D, Grotzinger J P, Mahaffy P R, McAdam A C, Morookian J M, Morrison S M, Rampe E B, and the MSL Science Team (2014) Chemical composition of crystalline, smectite, and amorphous components for Rocknest soil and John Klein and Cumberland

- mudstone drill fines using APXS, CheMin, and SAM datasets from Gale crater, Mars, 45th Lunar and Planetary Science conference, Abstract #1319
107. Lafuente B, Bishop J L, Fenton L K, King S J, Blake D F, Sarrazin P C, Downs R T, Horgan B H, Garcia G C (2014) Mineralogical characterization by XRD of gypsum dunes at White Sands National Monument and application to gypsum detection on Mars, 45th Lunar and Planetary Science conference, Abstract #2578
  108. Lafuente B, Downs R T, Blake D, Stone N, Pires A (2014) The planetary materials database. 21st General Meeting of the International Mineralogical Association, 1-5 September, 2014, Gauteng South Africa, 383-383 ([pdf file](#))
  109. Farmer J D, Blake D, Klug S L, Boonstra D, Ming D W, Lavery D, Lafuente B, Manfredi L, Swann J, Downs R T (2014) Using earth/mars comparisons to assess habitability in the field: Educator symposium and field trip for K-12 educators 2014 GSA Annual Meeting in Vancouver, British Columbia (19-22 October 2014) Paper 258-7 ([link](#))
  110. Morrison S M, Downs R T, Blake D F, Bish D L, Vaniman D T, Ming D W, Morris R V, Morookian J M, Rampe E B, Bristow T F, Chipera S J, Treiman A H, Gellert R, Achilles C N, Crisp J A, Sarrazin P C, Farmer J D, Des Marais D J, Stolper E M, Yen A S, Wilson M A, Spanovich N, Anderson R C and the MSL Science Team (2014) Crystal-chemical analyses of Martian minerals in Gale crater, 21st General Meeting of the International Mineralogical Association, Session PC1, 384
  111. Cavanagh P D, Bish D L, Blake D F, Vaniman D T, Morris R V, Ming D W, Rampe E B, Achilles C N, Chipera S J, Treiman A H, Downs R T, Morrison S M, Fendrich K V, Yen A S, Grotzinger J, Crisp J A, Bristow T F, Sarrazin P C, Farmer J D, Des Marais D J, Stolper E M, Morookian J M, Wilson M A, Spanovich N, Anderson R C, and the MSL Science Team (2015) Confidence Hills mineralogy and CheMin results from base of Mt. Sharp, Pahrump Hills, Gale crater, Mars, *Lunar and Planetary Science Conference* 46, Abstract #2735
  112. Farmer, JD, Bish DL, Blake DF, Ming DW, Morris RV, Vaniman DT, Achilles CN, R C Anderson, Bristow TF, Cavanagh PD, Chipera SJ, Crisp JA, Downs RT, Des Marais DJ, Fendrich KV, Grotzinger JP, Morookian JM, Morrison SM, Rampe EB, Treiman AH, Sarrazin PC, Spanovich N, Stolper EM, and Yen AS (2015) Iron and sulfur mineralogy of Gale crater sediments signals changes in habitable conditions during diagenesis, *AbSciCon*, Abstract #7267
  113. Fendrich K V, Rampe E B, Vaniman D T, Bish D L, Blake D F, Treiman A H, Ming D W, Morris R V, Bristow T F, Cavanagh P D, Downs R T, Morrison S M, Chipera S J, Achilles C N, Crisp J A, Farmer J D, Des Marais D J, Morookian J M, Sarrazin P, Grotzinger J P, Spanovich N, Yen A S, Anderson R C, Stolper E M, Gellert R, and the MSL Team (2015) Curiosity Rover's CheMin Instrument Investigates Mineralogy of Gale Crater and Implications for Diagenesis, *European Geophysical Union Conference*, EGU2015-7730
  114. Morris R V, Ming D W, Gellert R, Vaniman D T, Bish D L, Blake D F, Chipera S J, Morrison S M, Downs R T, Rampe E B, Treiman A H, Yen A S, Achilles C N, Archer P D, Bristow T F, Cavanagh P, Fendrich K, Crisp J A, Des Marais D J, Farmer J D, Grotzinger J P, Mahaffy P R, McAdam A C, Morookian J M, and the MSL Science Team (2015) Update on the chemical composition of crystalline, smectite, and amorphous components for Rocknest soil and John Klein and Cumberland mudstone drill fines at Gale crater, Mars, *Lunar and Planetary Science Conference* 46, Abstract #2622

115. Morrison S M, Downs R T, Blake D F, Bish D L, Morris R V, Vaniman D T, Rampe E B, Achilles C N, Ming D W, Chipera S J, Treiman A H, Gellert R, Bristow T F, Crisp J A, Morookian J M, Sarrazin P C, Farmer J D, Yen A S, Des Marais D J, Grotzinger J P, Stolper E M, Wilson M A, Spanovich N, Anderson R C, and the MSL Science Team (2015) Crystal-chemical analysis of Martian minerals in Gale crater, *Lunar and Planetary Science Conference* 46, Abstract #2506
116. Rampe E B, Morris R V, Bish D L, Chipera S J, Ming D W, Blake D F, Vaniman D T, Bristow T F, Cavanagh P, Farmer J D, Morrison S M, Treiman A H, Achilles C N, Crisp J A, Des Marais D J, Downs R T, Fendrich K, Morookian J M, Sarrazin P, Spanovich N, Yen A S, and the MSL Science Team (2015) Potential cement phases in sedimentary rocks drilled by curiosity at Gale crater, Mars, *Lunar and Planetary Science Conference* 46, Abstract #2038
117. Rampe, EB, Ming DW, Vaniman DT, Blake DF, Chipera SJ, Morris RV, Bish DL, Cavanagh PD, Achilles CN, Bristow TF, Morrison SM, Treiman AH, Crisp JA, Downs RT, Farmer JD, Fendrich KV, Morookian JM (2015) Evidence for Acid-Sulfate Alteration in the Pahrump Hills Region, Gale Crater, Mars, *AGU Fall meeting*, Abstract #P53F-04
118. Treiman A H, Bish D, Ming D W, Grotzinger J, Vaniman D T, Baker M B, Farmer J, Chipera S, Downs R T, Morris R V, Rampe E, Blake D F, Berger J, Cavanagh P D, Gellert R, Glazner A F, Schmidt M, Yen A S, Filiberto J and the rest of the APXS and CheMin teams (2015) Mineralogy and genesis of the Windjana sandstone, Kimberley area, Gale crater, Mars, *Lunar and Planetary Science Conference* 46, Abstract #2620
- 119.
120. Achilles C N, Vaniman D T, Blake D F, Bristow T F, Rampe E B, Ming D W, Chipera R V, Morris R V, Morrison S M, Downs R T, Fendrich K V, Ehlmann B L, Yen A S, Sarrazin P C, Treiman A H, Craig P I, Lapotre M G A, Edgett K S, Gellert R, Crisp J A, Morookian J M, Grotzinger J P, De Marais D J, Farmer J D (2016) Mineralogy of eolian sands at Gale Crater. *Lunar and Planetary Science Conference* 47, Abstract #2532 [link](#)
121. Achilles, CN, Downs RT, Vaniman DT, Yen AS, Blake DF, Morris RV, Ming DW, Rampe EB, Morrison SM, Bristow TF, Chipera SJ, Ehlmann BL, Lapotre MGA, Edgett KS, Gellert R, Treiman AH, Fendrich KV, Sarrazin PC, Craig PI, Crisp JA, Grotzinger JP, Des Marais DJ, Farmer JD and Morookian JM (2016) Mineralogy of Eolian Sands at Gale Crater, Mars, *Goldschmidt*, Abstract #2639
122. Hazen RT, Hummer DR, Liu C, Hystad G, Downs RT, Golden JJ, Morrison SM (2016) Mineral ecology and evolution of first-row transition elements, *Goldschmidt*, Abstract #1083
123. Morris R V, Vaniman D T, Blake D F, Gellert R, Chipera S J, Rampe E B, Ming D W, Morrison S M, Downs R T, Treiman A H, Yen A S, Achilles C N, Bristow T F, Crisp J A, Des Marais D J, Farmer J D, Fendrich K V, Frydenvang J, Graff T J, Grotzinger J P, Morookian J M, Schwenzer S P (2016) High-temperature, perhaps silicic, volcanism on Mars evidenced by tridymite detection in high SiO<sub>2</sub> sedimentary rock at Gale Crater, Mars. *Lunar and Planetary Science Conference* 47, Abstract #2581 [link](#)
124. Rampe E B, Ming D W, Morris R V, Blake D F, Bristow T F, Chipera S J, Vaniman D T, Yen, A S, Grotzinger J P, Downs R T, Morrison S M, Peretyazhko T, Achilles C N, Bish D L, Cavanagh P D, Craig P D, Crisp J A, Fairen A G, Des Marais D J, Farmer J D, Fendrich K V, Morookian J M, Treiman A H (2016) Diagenesis in the Murray

- Formation, Gale Crater, Mars. *Lunar and Planetary Science Conference 47*, Abstract #2543 [link](#)
125. Rampe, EB, Ming DW, R Morris, Blake DF, Vaniman DT, Bristow TF, Chipera SJ, Yen AS, Grotzinger JP, Farmer JD, Des Marais DJ, Morrison SM, Gellert R, Achilles CN, Downs RT, Treiman AH, Craig PI, Fendrich KV, Fairen AG (2016) Mineralogical and Geochemical Trends in a Fluvio-lacustrine Sequence in Gale Crater, Mars, *Goldschmidt*, Abstract #2582
  126. Achilles, C N, Downs RT, Blake DF, Vaniman DT, Ming DW, Rampe EB, Morris RV, Morrison SM, Treiman AH, Chipera SJ, Yen AS, Bristow TF, Craig PI, Hazen RM, Crisp JA, Grotzinger JP, Des Marais DJ, Farmer JD, Sarrazin PC, and Morookian JM (2017) Mineralogy of Rocks and Sediments at Gale Crater, Mars, *European Geophysical Union Conference*, EGU2017-10808
  127. Achilles, CN, Downs RT Ming DW, Rampe EB, Morris RV, Treiman AH, Morrison SM, Blake DF, Vaniman DT, Ewing RC, Chipera SJ Yen AS, Bristow TF, Ehlmann BL, Lapotre MGA, Gellert R, and Hazen RM (2017) Ground Truth Mineralogy vs. Orbital Observations at the Bagnold Dune Field, *Lunar and Planetary Science Conference 48*, Abstract # 2889
  128. Bristow, TF, Blake DF, Vaniman DT, Chipera SJ, Rampe EB, Grotzinger JP, McAdam AC, Ming DW, Morrison SM, Yen AS, Morris RV, Downs RT, Treiman AH, Achilles CN, Des Marais DJ (2017) Surveying Clay Mineral Diversity in the Murray Formation, Gale Crater, Mar, *Lunar and Planetary Science Conference 48*, Abstract #2642
  129. Rampe EB, Ming DW, Grotzinger JP, Morris RV, Blake DF, Vaniman DT, Bristow TF, Morrison SM, Yen AS, Chipera SJ, Downs RT, Achilles CN, Hazen RM, Peretyazhko TS, Sutter B, Treiman AH, Craig PI, Farmer JD, Des Marais DJ, and Fairen AG (2017) Mineral trends in early Hesperian lacustrine mudstone at Gale crater, Mars, *Lunar and Planetary Science Conference 48*, Abstract #2821
  130. Vaniman, DT, Martínez GM, Rampe EB, Bristow TF, Blake DF, Yen AS, Ming DW, Rapin W, Meslin P-Y, Morookian JM, Downs RT, Chipera SJ, Morris RV, Morrison SM, Treiman AH, Achilles CN, Grotzinger JP, Hazen RM, Crisp JA (2017) Calcium Sulfates at Gale Crater and Limitations on Gypsum Stability, *Lunar and Planetary Science Conference 48*, Abstract #1661

#### 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."  
Tucson Gem and Mineral Show, February 2013. "Curiosity: Results from the Mars Science



## Laboratory"

Arizona Senior Academy, April 2013. "Curiosity: Results from the Mars Science Laboratory"  
National Science Foundation EarthCube End-User Domain Workshop for Rock Deformation  
and Mineral Physics Research, November 14, 2013. "Future directions in mineralogy and  
crystallography: Computational methods for crystal structure and education"

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-H<sub>2</sub>O: V. Thermodynamic-PTX analysis of solid-liquid equilibria at high temperatures and pressures. *Geochimica et Cosmochimica Acta*, 56, 2295-2309. ([pdf file](#))
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#### Funding:

- Capitalization, University of Arizona, (1996) \$240,000.
- A device to apply hydrostatic high-pressure to crystals (1999–2001) Faculty Small Grants Program, University of Arizona Foundation, \$5000.
- Compression mechanisms of upper mantle minerals (1999–2002) National Science Foundation, grant No. EAR-9903104, \$186,997.
- Advancing Computational and Visualization Skills in Geosciences (2000-2002) National Science Foundation, \$52,148. Joint, with M. Hall-Wallace (P.I.), R. F. Butler, P. Kresan, J. Pelletier.
- Compression mechanisms of upper mantle minerals, Research Experience for Undergraduates (2000-2002) National Science Foundation, \$12,500.
- The crystal structure database and analysis tools project (2001-2004) National Science Foundation, \$350,000.

- University of Nevada, Las Vegas subcontract - Development of Windows-based single-crystal diffractometer software (2002) Department of Energy, \$34,815.
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- A high performance Raman spectroscopy system for Mars surface studies. (2003-2005) Co-PI: B. McIntosh (Hamilton Sundstrand Sensor Systems), M.B. Denton (U of Arizona), R.T. Downs (UofA) and W. Doyle (Axiom Analytical, Inc.) NASA, \$1,491,770.
- Clathrate Hydrates Science and Technology. (2003-2005) PI: Yusheng Zhao (Los Alamos) Co-PI: D.L. Bish, L.L. Daemen, A. Migliori, R.P. Currier, L.R. Pratt, P.C. Lichtner, D.D. Hickmott. Collaborators: H-K Mao, R. Hemley, J. Parise, R.T. Downs. Department of Energy \$4,350,000.
- Combination of private funding and matching funds from the College of Science for a new Bruker X8Apex single-crystal diffractometer and a Bruker D8Advance powder diffractometer plus laboratory renovations, \$450,000.
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- The RRUFF project: An integrated database of Raman and IR spectra, X-ray diffraction and chemistry data for minerals. (2004-2008) Private funding. \$3.5M. PIs: R T Downs, M B Denton, G R Rossman.
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- Hybrid powder-single crystal X-ray diffraction instrument for planetary mineralogical analysis of unprepared samples. (2008) NASA SBIR Phase 1, \$100,000. PIs: P Sarrazin, W Bruner, P C Dera, R T Downs
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- Characterization of Sulfosalts and Copper Sulfides (2010-2011) Newmont Mining Corporation \$200,000
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- Fundamentals of Rare Earth Element Mineralogy (2013-2015) National Science Foundation's Graduate Research Fellowship Program, \$132,000. Student: Shaunna Morrison
- The Co-Evolution of the Geo- and Biosphere: An Internal Program for Data-Driven Abductive Discovery in the Earth Sciences (2015-2017) Keck Foundation, \$1.4M. Co-Is: Robert Downs (\$168K), Paul Falkowski, Peter Fox, Robert Hazen, Andrew Knoll, Dimitri Sverjensky
- Understanding Amorphous and Poorly Ordered Analogs of Martian Global Soil (6/14/2016-8/31/2017) NASA Earth and Space Science Fellowship Program, \$43,614. Student: Cherie Achilles
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