Rebecca M. Flowers
Curriculum Vitae

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Appointments

2014-present	Associate Professor, University of Colorado, Boulder, USA
2016-17	Humboldt Research Fellow and Visiting Professor, University of Tuebingen, Germany
2007-2014	Assistant Professor, University of Colorado, Boulder, USA
2005-2007	Postdoctoral Scholar, Division of Geological and Planetary Sciences, Caltech
2000-2005	Research/Teaching Asst, Dept. of Earth, Atmospheric and Planetary Sciences, MIT

Professional Preparation

2005-07	Postdoc	California Institute of Technology, Geology and Geochemistry
2005	PhD	Massachusetts Institute of Technology, Geology and Geochemistry
2000	MSc	University of Utah, Geology
1998	BSc	College of William & Mary, Geology

Honors and Recognition

2019	CU ASSETT Faculty Fellow
2018	CU Research & Innovation (RIO) Faculty Fellow
2017-2018	EarthScope Distinguished Speaker
2016-2017	Alexander von Humboldt Research Fellowship
2015-2016	Mineralogical Society of America Distinguished Lecturer
2010-2015	NSF CAREER award
1999-2003	NSF Graduate Fellowship

----------RESEARCH----------

Research Interests

I use thermochronology, geochronology, and geologic observations to address problems in continental tectonics and mantle dynamics. Over the last decade, I have particularly focused on applying "deep-time" (U-Th)/He thermochronology to better understand the coupling of deeper Earth and surface processes over extended (10s-100s Ma) timescales. I also direct a (U-Th)/He geochronology lab, containing an Alphachron He extraction line and Agilent 7900 quadrupole ICPMS, in which we emphasize the development and refinement of both conventional (e.g., apatite, zircon) and novel (e.g., conodonts, perovskite, garnet) He thermochronometers. My group especially seeks creative, collaborative applications of (U-Th)/He data to problems in fields in which the technique has not typically been used (e.g., to constrain lunar impact histories, calibrate mantle dynamic models, date kimberlite emplacement). Our goal is to consistently be open-minded to new ways of thinking about the interpretation and significance of our results.

Publications, peer-reviewed *(except where otherwise noted)*

author denotes student mentored by Flowers; * denotes senior lab member

51. Collett, C., Duvall, A.R., **Flowers, R.M.,** Tucker, G.E., and Upton, P., in review, The timing and style of oblique deformation within New Zealand's Kaikoura Ranges and Marlborough Fault system

from low-temperature thermochronology: *Tectonics.*

50. **Flowers, R.M.,** Arrowsmith, R., McConnell, V., Metcalf, J.R., Rittenour, T., and Schoene, B.S. in press, The AGeS2 (Awards for Geochronology Student research) Program: Supporting community geochronology needs and interdisciplinary science: *GSA Today, Groundworks article*.
49. **Flowers, R.M.** and Ehlers, T.E., 2018, Influence of rock erodibility on the interpretation of thermochronologic data: *Earth and Planetary Science Letters*, v. 482, p. 312-323, doi: 10.1016/j.epsl.2017.11.018.
48. Baughman, J.S. and **Flowers, R.M.,** 2018, Deciphering a 2 Gyr-long thermal history from a multichronometer (U-Th)/He study of the Phalaborwa carbonatite, South Africa: *Geochem. Geophys. Geosyst.*, v. 19, https://doi.org/10.1029/2017GC007198.
47. Kelly, N.M.*, **Flowers, R.M.,** Metcalf, J.R.*, and Mojzsis, S.J., 2018, Late accretion to the Moon recorded in zircon (U-Th)/He thermochronometry: *Earth and Planetary Science Letters,* doi: 10.1016/j.epsl.2017.11.009, v. 482, p. 222-235.
46. Weisberg, W.R., Metcalf, J.R.*, Flowers, R.M., 2018, Response to comment on "Distinguishing slow cooling versus multiphase cooling and heating in zircon and apatite (U-Th)/He datasets: the case of the McClure Mountain syenite standard": *Chemical Geology*, v. 498, p. 153-156.
45. Weisberg, W.R., Metcalf, J.R.*, Flowers, R.M., 2018, Distinguishing slow cooling versus multiphase cooling and heating in zircon and apatite (U-Th)/He datasets: the case of the McClure Mountain syenite standard: *Chemical Geology*, v. 485, p. 90-99.
44. Powell, J., Schneider, D., Desrochers, A., **Flowers, R.M.,** Metcalf, J.R.*, Gaidies, F., and Stockli, D.F., 2018, Low-temperature thermochronology of Anticosti Island: A case study on the application of conodont (U-Th)/He thermochronology to carbonate basin analysis: *Marine and Petroleum Geology*, v. 96, p. 441-456.
43. Baughman, J.S., **Flowers, R.M.,** Metcalf, J.R.*, and Dhansay, T., 2017, Influence of radiation damage on titanite He diffusion kinetics: Geochimica et Cosmochimica Acta, v. 205, p. 50-64.
42. Johnson, J.E., **Flowers, R.M.,** Baird, G.B., and Mahan, K.H., 2017, "Inverted" zircon and apatite (U-Th)/He dates from the Front Range, Colorado: High-damage zircon as a low temperature (<50°C) thermochronometer: *Earth and Planetary Science Letters*, v. 466, p. 80-90.
41. **Flowers, R.M.,** Farley, K.A., and Ketcham, R.A., 2016, Response to comment on: "A reporting protocol for thermochronologic modeling illustrated with data from the Grand Canyon": *Earth and Planetary Science Letters,* v. 441, p. 213.
40. Landman, R.L., **Flowers, R.M.,** Rosenau, N.A., and Powell, J., 2016, Conodont (U-Th)/He thermochronology: A case study from the Illinois Basin: *Earth and Planetary Science Letters*, v. 56, p. 55-65.
39. Stanley, J.R. and **Flowers, R.M.,** 2016, Dating kimberlite emplacement with zircon and perovskite (U-Th)/He geochronology: *Geochem. Geophys. Geosyst.* doi: 10.1002/2016GC006519, v. 17, p. 4517-4533.
38. **Flowers, R.M.,** Farley, K.A., and Ketcham, R.A., 2015, A reporting protocol for thermochronologic modeling illustrated with data from the Grand Canyon: *Earth and Planetary Science Letters,* v. 432, p. 425-435.
37. Ault, A.K., **Flowers, R.M.,** and Bowring, S.A., 2015, Synchroneity of cratonic burial phases and gaps in the kimberlite record: Episodic magmatism or preservational bias?: *Earth and Planetary Science Letters,* v. 410, p. 97-104.
36. Stanley, J.R., **Flowers, R.M.,** and Bell, D.R., 2015, Erosion patterns and mantle sources of topographic change across the southern African Plateau derived from the shallow and deep records of kimberlites, *Geochem. Geophys. Geosyst.* v. 16, p. 3235-3256, doi:10.1002/2015GC005969.
35. Condit, C.B., Mahan, K.H., Ault, A.K., and **Flowers, R.M.,** 2015, Foreland-directed propagation of high-grade tectonism in the deep roots of a Paleoproterozoic collisional orogen, SW Montana, USA: *Lithosphere*, doi:10.1130/L460.1.
34. **Flowers, R.M.**, 2014, News & Views, Geomorphology: Tales of Topography: Nature Geoscience, v. 7, p. 483-485. *(Invited contribution, not peer-reviewed)*

33. **Flowers, R.M.** and Farley, K.A., 2013, Response to Comments on "Apatite $^{4}He/^{3}He$ and (U-Th)/He evidence for an ancient Grand Canyon: *Science*, v. 340, p. 143-c. *(Not peer-reviewed)*
32. Ault, A.K., **Flowers, R.M.,** and Bowring, S.A., 2013, Phanerozoic surface history of the Slave craton: *Tectonics*, v. 32, p. 1-18.
31. Landman, R.L. and **Flowers, R.M.,** 2013, (U-Th)/He thermochronologic constraints on the evolution of the northern Rio Grande rift, Gore Range, Colorado and implications for rift propagation models: *Geosphere*, v. 9, p. 170-187.
30. Stanley, J.R., **Flowers, R.M.,** and Bell, D.R., 2013, Kimberlite (U-Th)/He dating links surface erosion with lithospheric heating, thinning, and metasomatism in the southern African Plateau: *Geology*, v. 14, p. 1243-1246, doi:10.1130/G34797.1.
29. **Flowers, R.M.** and Farley, K.A., 2012, Apatite $^{4}He/^{3}He$ and (U-Th)/He evidence for an ancient Grand Canyon, *Science*, v. 338, p. 1616-1619.
28. **Flowers, R.M.,** Ault, A.K., Kelley, S.A., Zhang, N., and Zhong, S., 2012, Epeirogeny or eustasy? Paleozoic-Mesozoic vertical motion of the North American continental interior from thermochronometry and implications for mantle dynamics: *Earth and Planetary Science Letters*, v. 317-318, p. 436-445.
27. Ault, A.K. and **Flowers, R.M.,** 2012, Is apatite U-Th zonation information necessary for accurate interpretation of apatite (U-Th)/He thermochronometry data?: *Geochimica et Cosmochimica Acta*, v. 79, p. 60-78.
26. Ault, A.K., **Flowers, R.M.,** and Mahan, K.H., 2012, Quartz shielding of sub-10 um zircons from radiation damage-enhanced Pb loss: an example from a metamorphosed mafic dike, northwestern Wyoming craton: *Earth and Planetary Science Letters*, v. 339-340, p. 57-66.
25. Farley, K.A. and **Flowers, R.M.,** 2012, (U-Th)/Ne and multidomain (U-Th)/He systematics of a hydrothermal hematite from eastern Grand Canyon: *Earth and Planetary Science Letters,* v. 359-360, p. 131-140.
24. Moser, D.E., Cupelli, C.L., Barker, I., **Flowers, R.M.,** Bowman, J.R, Wooden, J., and Hart, R.J., 2012, Reply to the discussion by Rajesh and Knoper on "New shock phenomena for dating and reconstruction of large impact basins revealed by zircon microstructural (EBSD, CL), U-Pb and (U-Th)/He analysis of the Vredefort dome": *Canadian Journal of Earth Sciences*,v. 49, p. 863-864. *(Not peer-reviewed)*
23. Zhang, N., Zhong, S., and **Flowers, R.M.,** 2012, Predicting and testing continental vertical motion histories since the Paleozoic: *Earth and Planetary Science Letters*, v. 317-318, p. 426-435.
22. **Flowers, R.M.** and Kelley, S.A., 2011, Interpreting data dispersion and "inverted" dates in apatite (U-Th)/He and fission-track datasets: An example from the U.S. midcontinent: *Geochimica et Cosmochimica Acta,* v. 75, p. 5169-5186.
21. Moser, D.E., Cupelli, C.L., Barker, I., **Flowers, R.M.,** Bowman, J.R, Wooden, J., and Hart, R.J., 2011, New shock phenomena for dating and reconstruction of large impact basins revealed by zircon microstructural (EBSD, CL), U-Pb and (U-Th)/He analysis of the Vredefort dome: *Canadian Journal of Earth Sciences*, Special Issue on the theme of *Geochronology* in honor of Tom Krogh, v. 48, p. 117-139.
20. **Flowers, R.M.** and Schoene, B., 2010, (U-Th)/He thermochronometry constraints on unroofing of the eastern Kaapvaal craton and significance for uplift of the southern African Plateau: *Geology*, v. 38, p. 827-830.
19. **Flowers, R.M.,** 2010, The enigmatic rise of the Colorado Plateau, Research Focus: *Geology*, v. 38, p. 671-672. *(Invited contribution, not peer-reviewed)*
18. **Flowers, R.M.,** Schmitt, A., and Grove, M., 2010, Decoupling of U-Pb dates from chemical and crystallographic domains in granulite-facies zircon: *Chemical Geology*, v. 270, p. 20-30.
17. **Flowers, R.M.,** 2009, Exploiting radiation damage control on apatite (U-Th)/He dates in cratonic regions: *Earth and Planetary Science Letters,* v. 277, p. 148-155.
16. **Flowers, R.M.,** Ketcham, R.A., Shuster, D.L., and Farley, K.A., 2009, Apatite (U-Th)/He thermochronometry using a radiation damage accumulation and annealing model: *Geochimica et Cosmochimica Acta*, v. 73, p. 2347-2365.

15. Ault, A.K., **Flowers, R.M.,** and Bowring, S.A., 2009, Phanerozoic burial and unroofing history of the western Slave craton and Wopmay orogen from apatite (U-Th)/He thermochronometry, *Earth and Planetary Science Letters*, v. 284, p. 1-11.
14. **Flowers, R.M.,** Bowring, S.A., Mahan, K.H., Williams, M.L., and Williams, I.S., 2008, Stabilization and reactivation of cratonic lithosphere from the lower crustal record in the western Canadian shield: C*ontributions to Mineralogy and Petrology*, v. 156, p. 529-549.
13. **Flowers, R.M.**, Wernicke, B.P., and Farley, K.A., 2008, Unroofing, incision and uplift history of the southwestern Colorado Plateau from apatite (U-Th)/He thermochronometry: *GSA Bulletin*, v. 120, p. 571-587.
12. Mahan, K., Goncalves, P., **Flowers, R.M.,** Williams, M.L., and Hoffman-Setka, D., 2008, The role of heterogeneous strain in the development and preservation of a polymetamorphic record in high-P granulites, western Canadian shield: *Journal of Metamorphic Geology,* v. 26, p. 669-694.
11. **Flowers, R.M.,** Shuster, D.L., Wernicke, B.P., and Farley, K.A., 2007, Radiation damage control on apatite (U-Th)/He dates from the Grand Canyon region, Colorado Plateau: *Geology*, v. 35, p. 447-450.
10. **Flowers, R.M.,** Bowring, S.A., and Reiners, P.W., 2006, Low long-term erosion rates and extreme continental stability documented by ancient (U-Th)/He dates: *Geology*, v. 34, p. 925-928.
9. **Flowers, R.M.,** Bowring, S.A., and Williams, M.L., 2006, Timescales of high-pressure, high-temperature metamorphism and mafic dike anatexis, Snowbird tectonic zone, Canada: *Contributions to Mineralogy and Petrology*, v. 151, p. 558-581.
8. **Flowers, R.M.,** Mahan, K.H., Bowring, S.A., Williams, M.L., Pringle, M.S., and Hodges, K.V., 2006, Multistage exhumation and juxtaposition of lower continental crust in the western Canadian Shield: Linking high-resolution U-Pb and $^{40}Ar/^{39}Ar$ thermochronometry with P-T-D paths: *Tectonics*, 25, TC4003, doi:10.1029/2005TC001912.
7. Mahan, K.H., Williams, M.L., **Flowers, R.M.,** Jercinovic, M.J., Baldwin, J.A., and Bowring, S.A., 2006, Geochronological constraints on the Legs Lake shear zone with implications for regional exhumation of lower crust, western Churchill Province, Canadian Shield, Canada: *Contributions to Mineralogy and Petrology*, v. 152, p. 223-242.
6. Shuster, D.L., **Flowers, R.M.**, and Farley, K.A., 2006, The influence of natural radiation damage on helium diffusion kinetics in apatite: *Earth and Planetary Science Letters*, v. 249, p. 148-161.
5. **Flowers, R.M.,** Bowring, S.A., Tulloch, A.J., and Klepeis, K.A., 2005, Tempo of burial and exhumation within the deep roots of a magmatic arc, Fiordland, New Zealand: *Geology*, v. 33, p. 17-20.
4. **Flowers, R.M.,** Royden, L.H., and Bowring, S.A., 2005, Isostatic constraints on lithospheric thermal evolution: Application to the Proterozoic orogen of the southwestern United States, *in* Karlstrom, K.E. and Keller, R.G., eds., The Rocky Mountain region – An evolving lithosphere: Tectonics, geochemistry and geophysics: *American Geophysical Union Monograph 154,* p. 125-138.
3. **Flowers, R.M.,** Royden, L.H., and Bowring, S.A., 2004, Isostatic constraints on the assembly,stabilization, and preservation of cratonic lithosphere: *Geology*, v. 32, p. 321-324.
2. **Flowers, R.M.,** Moser, D.E. and Hart, R.J., 2003, Evolution of the amphibolite- granulite facies transition exposed by the Vredefort impact structure, Kaapvaal Craton, South Africa: *Journal of Geology*, v. 111, p. 455-470.
1. Moser, D.E., **Flowers, R.M.** and Hart, R.J., 2001, Birth of the Kaapvaal tectosphere 3.08 billion years ago: *Science*, v. 291, p. 465-468.

Other Publications

2. **Flowers, R.M.,** Arrowsmith, R., Metcalf, J.R., Rittenour, T., and Schoene, B.S., 2014, New EarthScope Geochronology Graduate Student Research and Training Program, *inSights the EarthScope Newsletter,* Fall 2014, p. 3. Reviewed internally by EarthScope personnel.
1. **Flowers, R.M.,** 2009, Pushing back the Age of the Grand Canyon: *OUTCROP*, Newsletter of the Rocky Mountain Association of Geologists, v. 58, no. 9, p. 8, 12-13. Reviewed internally by RMAG personnel.

External Grant Funding

Current

17. **NSF Sedimentary Geology and Paleobiology,** EAR-1759200, "Collaborative Research: Did the formation of the Great Unconformity trigger oxygenation and the Cambrian explosion?", **lead PI** (co-PI: F. Macdonald), **$229,950,** 9/1/18-8/31/20.
16. **NSF Tectonics, Petrology & Geochemistry,** EAR-1759200, *"Collaborative Research: AGeS2 (Awards for Geochronology Student research) Program: Democratizing access to geochronology and promoting interdisciplinary science*", **lead PI** (co-PIs: R. Arrowsmith, V. McConnell), **$850,400,** 9/1/18-7/31/21.
15. **NSF Tectonics Program,** EAR-1450181, "Hypsometric history of the North American continental interior and implications for mantle dynamics", **lead PI** (with co-PI S. Zhong), **$296,833**, 8/1/15-7/31/18, on no-cost extension.

Past

14. **NSF Instrumentation and Facilities Program,** EAR-1559306, "Acquisition of a quadrupole ICPMS system for (U-Th)/He thermochronology and trace element analysis at the University of Colorado Boulder", **lead PI** (with co-PI J. Metcalf), **$183,646,** 8/1/16-7/31/18 with no-cost extension.
13. **NSF EarthScope,** Supplement to "Collaborative Research: Earthscope geochronology: A student research and training program and EarthScope Institute", **lead PI** (with co-PIs R. Arrowsmith, J. Metcalf, T. Rittenour, B. Schoene), **$69,681** supplement ($11,369 to CU), 8/1/17-7/31/18.
12. **Alexander von Humboldt Fellowship for Experienced Researchers,** "Influence of rock strength variations on the exhumation history of cratons", **sole PI, $39,550 EUR,** 7/10/16-7/9/17.
11. **NSF EarthScope Program, EAR-1358514,** "Collaborative Research: Earthscope geochronology: A student research and training program and EarthScope Institute", **lead PI** (with co-PIs R. Arrowsmith, J. Metcalf, T. Rittenour, B. Schoene), **$348,407** ($56,845 to CU), 8/1/14-7/31/17.
10. **NASA Cosmochemistry Program,** NNX14AG31G, "Coupled U-Pb and (U-Th)/He geochronology of lunar zircons", **co-PI** (with lead PI S. Mojzsis and co-PI J. Metcalf), **$390,001,** 1/1/14-12/31/16.
9. **NSF CIDER program,** funds to convene workshop in spring 2015 entitled "Integrating Dynamic Topography with Surface and Geological Processes" in Boulder, CO, with Shijie Zhong and Thorsten Becker, **$18,750,** 2014-2015.
8. **ACS Petroleum Research Fund, New Directions Grant 53526-ND8,** "Quantitative constraints on thermal histories in carbonates and marine shales: Conodont (U-Th)/He thermochronometry", **sole PI, $100,000,** 6/1/13-8/31/15.
7. **NSF Tectonics Program,** EAR-1321735, "Collaborative Research: Tracing the geomorphic signature of strike-slip faulting in Marlborough Hill Country, South Island, NZ", **co-PI** (with lead PI A. Duvall and co-PI G. Tucker), **$419,519,** 9/1/13-8/31/17, with no-cost extension.
6. **NSF Instrumentation and Facilities Program,** EAR-1126991, "Early Career: Acquisition of a He system for (U-Th)/He thermochronology at the University of Colorado, Boulder", **sole PI, $320,000,** 9/15/11-8/31/15 with no-cost extension.
5. **NSF Directorate for Education and Human Resources,** Enhanced Experience Supplement to "CAREER: Evolution of the southern African Plateau using advances in (U-Th)/He thermochronometry, and enhancing student critical thinking in science", **sole PI, $35,000**, 6/15/16-7/31/17.
4. **NSF Tectonics Program,** EAR-0951518, "CAREER: Evolution of the southern African Plateau using advances in (U-Th)/He thermochronometry, and enhancing student critical thinking in science", **sole PI, $531,933**, 6/15/10-6/14/16, with no-cost extension.
3. **ACS Petroleum Research Fund, New Investigator Grant 47476-G8,** "Evolution of the Rio Grande Rift in the heart of the southern Rockies: Cooling and unroofing history of the Gore Range, Colorado", **sole PI, $50,000,** 3/1/08-2/28/10

2. **NSF Tectonics Program,** EAR-071145, "Quantifying the stability of continents using advances in apatite (U-Th)/He, $^{4}He/^{3}He$ and U/Pb thermochronometry", **sole PI, $193,144,** 9/1/07-8/31/12 with no-cost extension.

Internal Grant Funding

1. **CU Renovation and Infrastructure Improvement,** (U-Th)/He lab renovation, **lead faculty member** (with J. Metcalf)**, $62,688,** 8/1/16-7/31/17

Invited Talks in Departmental Seminars (65 during last 13 years)

2018 Yale University, Dept of Geology & Geophysics; College of William & Mary, Geology Dept, 100 years of Women Geoscience Celebration; University of Puerto Rico, Dept of Geology; Appalachian State University, Dept of Geological and Environmental Sciences; Lawrence University, Dept of Geology

2017 Harvard University, Earth & Planetary Sciences; University of Alberta, Dept of Earth and Atmospheric Sciences – Grace Anne Stewart speaker selected by graduate students; Montana State University, Dept of Geology; Southern Methodist University, Roy Huffington Dept of Earth Sciences; University of Potsdam, Institute of Earth and Environmental Science; GFZ German Research Center, Earth Surface Process Modeling Group; University of Bristol, School of Earth Sciences; Cardiff University, School of Earth and Ocean Sciences; University of Franche-Compte, Institute of the Environment

2016 University of Tuebingen, Dept of Geologie and Geodynamik; University of Illinois Champaign-Urbana, Dept of Geology; Grand Valley State University, Dept of Geology; Bowling Green State University, Dept of Geology; University of Arizona, Dept of Geosciences; New Mexico State University, Dept of Geological Sciences; Texas Tech, Dept of Geosciences

2015 University of Idaho, Dept of Geological Sciences; Idaho State University, Dept of Geosciences; University of Montana, Dept of Geosciences

2014 Rice University, Dept of Earth Sciences; University of Houston, Dept of Earth and Atmospheric Sciences – brownbag seminar; Utah State University, Dept of Geology; UNAVCO, Boulder, CO; University of North Carolina Chapel Hill, Dept. of Geological Sciences; University of Northern Colorado, Dept of Earth and Atmospheric Sciences

2013 University of Utah, Dept. of Geology and Geophysics; Princeton University, Dept. of Geosciences; University of Oregon, Dept. of Geological Sciences (two talks); New Mexico Tech, Dept. of Earth and Environmental Science (two talks); U.S. Geological Survey, Lakewood, CO; University of the Witwatersrand, School of Geosciences, South Africa

2012 University of Wyoming, Dept. of Geology and Geophysics; Southern Methodist University, Dept. of Earth Sciences; Colorado State University, Dept. of Geosciences; Colorado College, Geology Department; Colorado Scientific Society, Lakewood, Colorado

2011 University of Nevada, Las Vegas, Dept. of Geoscience; The University of the Free State, Dept. of Geology, Bloemfontein, South Africa; Nelson Mandela Metro University, Dept. of Geosciences, Port Elizabeth, South Africa

2010 Stanford University, Dept. of Geological and Environmental Sciences

2009 University of Texas, Austin, Jackson School of Geological Sciences (two talks); Boston University, Dept. of Earth Sciences; Colorado School of Mines, Dept. of Geology and Geological Engineering; Four Corners Geological Society, Colorado

2008 University of New Mexico, Dept. of Earth and Planetary Sciences; University of Florida, Dept. of Geological Sciences; University of Montana, Dept. of Geosciences; University of Wyoming, Dept. of Geology and Geophysics; Colorado State University, Dept. of Geosciences

2007 University of Colorado, Boulder, Dept. of Geological Sciences; University of California, Davis, Dept. of Geology; California Institute of Technology, Geoclub Seminar

2006 University of North Dakota, Dept. of Geology and Geological Engineering; North Dakota State University, Dept. of Geosciences; University of Colorado, Boulder, Dept. of Geological Sciences;

University of Arizona, Dept. of Geosciences; University of Tennessee, Knoxville, Dept. of Earth and Planetary Sciences; University of Texas, El Paso, Dept. of Geological Sciences

2005 University of Calgary, Dept. of Geology and Geophysics; California Institute of Technology, Geoclub Seminar; University of California, Los Angeles, Dept. of Earth and Space Sciences; University of California, Santa Cruz, Dept of Earth Sciences; University of Texas, El Paso, Dept. of Geological Sciences' Vanderbilt University, Dept. of Earth and Environmental Sciences

Invited Talks to Public Groups

2014 Collegiate Peaks Forum Series, Buena Vista, CO; Southwest Seminars, Santa Fe, NM
2013 Café Scientifique, University of Colorado, Colorado Springs
2012 Academy for Lifelong Learning, Denver, CO

Other Invited Talks

2017 National Science Foundation Headquarters, Arlington, VA – Future of the AGeS (Awards for Geochronology Student research) program

Invited or Keynote Talks at Meetings

author denotes student supervised by Flowers
GSA – Geological Society of America; AGU – American Geophysical Union; GAC-MAC – Geological Association of Canada-Mineralogical Association of Canada

16. **Flowers, R.M.,** Baughman, J.S., Robinson, K.H., and Metcalf, J.R., 2018, Titanite and rutile (U-Th)/He thermochronology: Diffusion kinetics, radiation damage effects, and utility: 2018 International Conference on Thermochronology, Quedlinburg, Germany. Scheduled for September, 2018.
    Session: "Noble gas diffusion applied to thermochronology"
15. **Flowers, R.M.,** Baughman, J.S., Johnson, J.E., and Metcalf, J.R., 2017, The expanding temperature sensitivity range of (U-Th)/He thermochronology from improved understanding of the "big three" (apatite, zircon and titanite): approaches and examples: National GSA meeting, Seattle, WA, October, 2017.
    Session: "Improvements and Challenges in Geochronology: Organizing the Past while Planning for the Future"
14. **Flowers, R.M.,** Arrowsmith, R., Metcalf, J.R., Rittenour, T., Schoene, B.S., Hole, J., Pavlis, T., Wagner, L., Whitmeyer, S., and Williams, M.L., 2015, Geology, Geochronology, and EarthScope: The EarthScope AGeS program and a new idea for a 4D-Earth initiative: Fall AGU meeting, San Francisco, CA, December 2015.
    Session: "Crustal structure and evolution across the continental US from 10 years of Earthscope investigations: What have we learned and what are the open questions?"
13. **Flowers, R.M.,** Baughman, J.S., Johnson, J.E., Landman, R.L., Stanley, J.R., Weisberg, W.R., and Metcalf, J.R., 2015, Expanding the temperature sensitivity range and applicability of the (U-Th)/He system: some examples National GSA meeting, Baltimore, MD, November 2015.
    Session: "Novel Methods, Applications, and Data Interpretations in Thermochronology"
12. **Flowers, R.M.,** Ault, A.K., Zhong, S., and Bowring, S.A., 2015, Exploring relationships between kimberlite distributions, mantle dynamics, and the hypsometric history of the North American cratonic interior: Spring
    AGU/GAC-MAC Joint Assembly meeting, Montreal, Canada, May, 2015.
    Session: "Origin of cratonic mantle lithosphere, diamonds, and deeply sourced volatile-rich melts: Processes and timescales"
11. **Flowers, R.M.** and Farley, K.A., 2014, Grand Canyon, models, and the interpretation of thermochronology data: Thermo2014, 14th International Conference on Thermochronology, Chamonix, France, September 2014.
    Session: "Landscape evolution on different timescales"

10. **Flowers, R.M.,** 2013, Kimberlites, thermochronology, and the Phanerozoic elevation change histories of cratons: Keynote speaker, post-AGU Cooperative Institute for Dynamic Earth Research symposium, Berkeley, CA, December 2013.
9. **Flowers, R.M.,** Blackburn, T.J., Kelley, S.A., and Ault, A.K., 2013, Evidence for post-100 Ma deposition, erosion and vertical motion of North American interior regions lacking preserved Cretaceous cover: Invited Speaker, Fall AGU meeting, San Francisco, CA, December 2013.
   Session: "Origin, evolution, and impacts of high topography in continental interiors"
8. **Flowers, R.M.** and Farley, K.A., 2013, Constraints on an ancient Grand Canyon and the topographic evolution of the southwestern Colorado Plateau from thermochronometry: Invited Speaker, National GSA meeting, Denver CO, October 2013.
   Session: "Paleotopography"
7. **Flowers, R.M.,** Ault, A.K., Kelley, S.K., Zhang, N., and Zhong, S., 2011, Deciphering the history and causes of the cryptic rise and fall of continental interiors using low temperature thermochronology: Invited Speaker, Fall AGU meeting, San Francisco, CA, December 2011.
   Session: "The long road to flat – Towards understanding the drivers and quantifying change in 'dead' orogens"
6. **Flowers, R.M.,** Ault, A.K., Kelley, S.A., Zhang, N., and Zhong, S., 2011, Testing mantle dynamic models from thermochronology constraints on the rise and fall of continental interiors: Invited Speaker, Special meeting on Dynamic Topography organized by the Royal Astronomical Society, Geological Society and the British Geophysical Association, September 2011.
5. **Flowers, R.M.,** 2010, Interpretation of apatite (U-Th)/He thermochronometry data from cratonic rocks: Invited speaker, Thermo2010, 12th International Conference on Thermochronology, Glasgow, Scotland, August 2010.
   Session: "Interpretation of thermochronology data: Limitations and potential"
4. **Flowers, R.M.,** 2010, Deciphering unroofing, paleotopography and elevation gain of cratonic plateaus using (U-Th)/He thermochronometry: case studies from the Colorado Plateau and southern Africa: Keynote speaker, Structural Geology and Tectonics Forum, Madison, WI, May 2010.
   Session: "Exhumation and large scale tectonics"
3. **Flowers, R.M.,** Wernicke, B.P., and Farley, K.A., 2009, Constraints on Early Tertiary incision and uplift of the Grand Canyon region of the Colorado Plateau from apatite (U-Th)/He thermochronometry: Invited speaker, AGU Joint Assembly, Toronto, Canada, May 2009.
   Session: "Surface geological and tectonic constraints on time-dependent mantle convection"
2. **Flowers, R.M.,** 2008, High to low temperature geo- and thermochronology and the reactivation and stability of continental lithosphere, western Canadian shield: Keynote speaker, Goldschmidt international geochemistry meeting, Vancouver, Canada, July 2008.
   Session: "4D structure of the continental crust: greenstones to granulites",
1. **Flowers, R.M.** and Kelley, S., 2008, Thermal histories in sedimentary basins from integrated low-temperature thermochronometry: An example from the High Plains of New Mexico and western Texas: Invited speaker, Goldschmidt international geochemistry meeting, Vancouver, Canada, July 2008.
   Session: "Sedimentary basin development and evolution"

I am an author on 12-15 abstracts per year submitted to national and international meetings for each of the last few years.

----------TEACHING----------

Advisees

Current Graduate Students:

Katherine Robinson, MSc, 2017-present, Development of rutile (U-Th)/He thermochronology.

Colin Sturrock, PhD, 2015-present, Deciphering burial and erosion histories across the interior of the Canadian shield and implications for mantle dynamics.

Past Graduate Students:

Jaclyn Baughman, PhD, 2013-2018, Bridging high and low temperature thermal histories across the Kaapvaal craton, southern Africa from advances in titanite and zircon (U-Th)/He thermochronology. Now visiting assistant professor at Bowdoin College.

Rachel Havranek, MSc, 2015-2017, Coupling vertical transect zircon (U-Th)/He and Raman spectroscopy data to constrain Colorado Front Range evolution. Now PhD student at CU Boulder.

Jessica Stanley, PhD, 2010-2015, Discerning erosion patterns and mantle sources of topography across the southern African Plateau from the shallow and deep records of kimberlites. Now Assistant Professor at University of Idaho.

Josh Johnson, MSc, 2013-2015, "Inverted" zircon and apatite (U-Th)/He dates and interpretation of high-damage zircon from the southern Rocky Mountains, Front Range, Colorado. Now at Idaho Conservation League, Ketchum, Idaho.

Rachel Landman, PhD 2011-2015, Thermochronologic investigations of Cenozoic unroofing and surface uplift in the southern Rocky Mountains and High Plains.

Rachel Landman, MSc, 2008-2010, Tertiary cooling history of the Gore Range: a northern Rio Grande Rift flank uplift, central Colorado.

Alexis Ault, PhD, 2007-2012, Constraints on craton stability from thermochronologic and geochronologic studies of the Slave and Wyoming cratons. Now Assistant Professor at Utah State University.

Current and Past Research Associates in Lab Group:

Dr. James Metcalf, 2012-present

Dr. Nigel Kelly, 2014-2017

Geochronology Mentor for AGeS Students

Mariana Bonich, Syracuse University PhD student with Scott Samson, 2015 AGeS project entitled: "Deciphering novel methods to link source rock to sediment sink: Overcoming the 'stepladder effect'"

Matthew Morriss, University of Oregon PhD student with Eugene Humphreys, 2016 AGeS project entitled:"Thermochronometric constraints on the age of Hells Canyon, testing lithospheric foundering in NE Oregon".

Past Undergraduates working in (U-Th)/He Lab

Lane Daigle, 2018, Geological Sciences mentoring program in collaboration with Dr. Ben Johnson

Haley May, 2018, RESESS summer intern

Noah McCorkel, 2017, Honors thesis in collaboration with Dr. Lon Abbott and Dr. Jim Metcalf

Fatima Niazy, 2017, RESESS summer intern in collaboration with Dr. Lon Abbott and Dr. Jim Metcalf

Jamie Glass, 2015-17, UROP and Geological Sciences mentoring program

Coleman Hiett, 2015-17, Honors thesis in collaboration with Dr. Lon Abbott and Dr. Jim Metcalf

Ryan Stoner, 2015-16, UROP and Geological Sciences mentoring program, Honors thesis

Wes Weisberg, 2014-2016, RESESS summer intern

Brandt Scott, 2015, RESESS summer intern

David Liefert, 2014-15, Honors thesis

Melissa Lowe, 2014, Geological Sciences mentoring program

Brenda Kessenich, 2012-2014, UROP and Geological Sciences mentoring program

Connor Simmons, 2013-2014, CU UROP and CU work-study programs
Matthew Tello, 2012- 2013, CU UROP and Geological Sciences mentoring programs
Keith Bowhan, 2012- 2013
Cristina Lugo-Centeno, 2012, RESESS summer intern
Ryan Nell, 2009-2010, CU UROP and Geological Sciences mentoring program
Emily Gregonis (now Wolin), 2008-2009, CU UROP and Geological Sciences mentoring program
Katherine Anarde, 2009, Geological Sciences mentoring program
Marc Serravezza, 2008, Geological Sciences mentoring program
Brian Meyer, 2008, CU Summer undergraduate research experience (SURE) program

Teaching Experience (since 2007)

GEOL 1010, Introduction to Geology, 3 credits. Taught 7x, 75-169 students. Introductory geology for majors and nonmajors.

GEOL 2005, Introduction to Earth Materials, 4 credits including 2-hr lab. Co-developed. Taught 5x, 42-75 students, Introduces the classification, origin, and use of solid earth materials. Is part of the required core curriculum for all GEOL majors.

GEOL 3090, Developing Scientific Writing Skills, 3 credits. Developed. Taught 3x, 18-20 students. Develops scientific writing and communication skills by reading scientific papers, writing and revising, and peer review. Satisfies the Arts & Sciences upper-division core curriculum writing requirement.

GEOL 4500, Critical Thinking, 3 credits. Developed. Taught 1x, 21 students. Focused on developing critical thinking skills through reading and analysis of scientific papers. Now replaced by GEOL 3090. Satisfied now-defunct Arts & Sciences critical thinking core curriculum requirement.

GEOL 4960, Writing in Geosciences, 1 credit. Developed. Taught 1x, 16 students. Now replaced by GEOL 3090.

GEOL 5215/4215, Geochronology and Thermochronology, 3 credits. Developed. Taught 4x, 7-14 students. Provides an overview of geochronologic and thermochronologic methods used to constrain tectonic, magmatic, metamorphic, sedimentary, and geomorphic processes. Mix of lecture and discussion.

GEOL 5700, Graduate Writing, 2 credits. Developed in S18 in response to graduate student demand. Taught 1x, 9 students. Aimed at improving writing, editing, and reviewing skills, while meeting student writing goals. Discussion of materials about effective writing, along with peer-editing of text that students are producing for their graduate research endeavors.

GEOL 5703, Tectonics reading seminar, 1 credit. Taught 1x, 7 students. Focuses on discussing recent literature on diverse tectonic problems.

GEOL 5700/4700, Problems in the Rockies, co-taught, 3 credits. Co-developed. Taught 1x, 11 students. Seminar discussion of a range of classic and recent literature to understand the evolution of the Rocky Mountain region.

Science Education Activities

Participant, Science Education Initiative (SEI) in the Dept of Geological Sciences, GEOL 4500, GEOL 1010 2x

Participant, multi-institutional NSF-funded GARNET Project, GEOL 1010 2x

Participant, NAGT Temporal Journal Learning Club, monthly virtual discussions of readings that explored the cognitive underpinnings of understanding geologic time, 2011

----------SERVICE----------

Synergistic Activities

National and International Service

Lead PI, co-founder, and co-director of the AGeS (Awards for Geochronology Student research) Program, 2014-Present. Multi-year educational initiative aimed at broadening access to geochronology data and expertise by offering graduate students up to $10k to visit geochronology

labs for a week or more to acquire data and be mentored by geochronologists on a project of joint interest. Initially implemented within the framework of the NSF EarthScope program, now funded by cross-programmatic NSF support.

International Steering Committee, EARTHTIME initiative, 2017-present

Standing Committee for the International Thermochronology Conferences, 2014-present

Member, GSA position statement panel on "Removing Barriers to Career Progression for Women in the Geosciences", 2017

Secretary, GSA Structural Geology and Tectonics Division, 2015-2017

NSF PIRE Site Visit Review Panel Member, September 2017

Member, GSA Student Research Grant Committee, 2015-2018

NSF EarthScope Steering Committee, 2012-2015

Associate Editor, *Geosphere,* 2013-2014

Instructor at CIDER (Cooperative Institute for Dynamic Earth Research) Summer Program at UC Berkeley, 2013

AGU Tectonophysics Program Committee, one of 3 members, responsible for organizing the Tectonophysics sessions (~1500 abstracts) at the 2011 and 2012 Fall AGU Meetings.

Colorado Scientific Society, Counselor, 2012-2014

NSF Tectonics Panel Member, September 2008

Workshop, Short Course, and Session Organization

Co-organizer, NSF CIDER workshop "Integrating Dynamic Topography with Surface and Geological Processes" in the Dept of Geological Sciences at CU-Boulder, with Shijie Zhong and Thorsten Becker, April 2015

Co-organizer of 2-day GSA short course "EarthScope Institute: Geochronology and the Earth Sciences", Vancouver, Canada, October 2014

Organizer of 1.25-day short course "An introduction to low temperature thermochronology", at the African Earth Observatory Network, Port Elizabeth, South Africa, attended by 19 diverse African graduate students and postdocs, August 2013

Co-organizer of 1-day GSA short course at the CU-Boulder He lab "An introduction to the theory and methods of (U-Th)/He thermochronology", October 2013

Organizing committee, NSF EarthCube Geochronology workshop, aimed at developing new ways to organize geochronology data in an accessible cyber-infrastructure, October 2013

Session convener: Fall AGU Meetings (2014, 2009, 2007), National GSA Meetings (2013, 2010), Goldschmidt Conferences (2013, 2011, 2010)

Panelist Activities

Panelist, two separate round tables on "Diffusion" and "Reproducibility" at the 16th International Conference on Thermochronology, Quedlinburg, Germany, 2018.

Panelist, "'Insights into the Writing & Publishing Process" at the Career Development Workshop for NSF Geoscience Postdoctoral Researchers, NOAA, Boulder, CO, 2016.

Panelist, "Developing synergies between disciplines" at the Challenges and Opportunities in Geochronology Workshop, pre-Goldschmidt Meeting, 2014

Panelist, two separate round tables on "Diffusion" and "Databases" at the 14th International Conference on Thermochronology, Chamonix, France, 2014

Public Outreach

Science Coach in American Chemical Society, American Association of Chemistry Teachers program. Serve as mentor for high school science teacher Susan Kelly, 2018-19 academic year.

Presentation on Geologic Time to all first and second graders at Flatirons Elementary School (~55 students). Fall 2017.

Extensive interaction with the media in Nov-Dec 2012 following publication of manuscript by Flowers and Farley (2012) in *Science* arguing for a more ancient age of the Grand Canyon. This work

received coverage from hundreds of media outlets, including on the front page of the *NY Times*, *Washington Post*, and *LA Times*, as well as reports on *NPR* and *PBS NewsHour*.

Filmed for National Geographic "Naked Science" documentary on the origin and evolution of the Grand Canyon, June 2010.

Flowers et al. (2008) results included in a short annual review for the 2009 Britannica Book of the Year in Geology & Geochemistry

Flowers et al. (2008) received coverage from Earth Magazine, Science, Nature, MSNBC, National Geographic.com, Xinhua News Agency, China Economic Net, a variety of blogs, and an earth-science theme issue of Science Spin, a Weekly Reader magazine for 4th and 5th graders

Referee for Journals, Proposals, and Books

Referee for academic journals (26 different journals, 8-12 manuscript reviews/year): American Journal of Science, Analytical Chemistry, Chemical Geology, Contributions to Mineralogy and Petrology, Earth and Planetary Science Letters, Earth Surface Processes and Landforms, G-cubed, Geological Society of America Bulletin, Geochimica et Cosmochimica Acta, Geology, Geomorphology, Geophysical Research Letters, Geosphere, Journal of the Geological Society, Journal of Geophysical Research-Surface Processes, Journal of Metamorphic Geology, Journal of Geology, Journal of Structural Geology, Lithos, Lithosphere, Mountain Geologist, Precambrian Research, Science Advances, Tectonics, Tectonophysics, Terra Nova

Referee for National Science Foundation proposals (14 different NSF programs, 6-8 NSF reviews/year): Antarctic Earth Sciences, EarthCube, EarthScope, Frontiers in Earth Science Research, Geomorphology, Geophysics, Instrumentation and Facilities, Integrated Earth Systems; Major Research Instrumentation, Marine Geology and Geophysics, Petrology and Geochemistry, Postdoctoral Fellowship, Sedimentary Geology and Paleobiology, Tectonics

Referee for other programs (1-3 proposals/year): American Chemical Society Petroleum Research Fund, Canadian NSERC program, Department of Energy, Dutch Council for Earth and Life Sciences, W.M. Keck Foundation proposals

Referee for books: "Geochronology and Thermochronology" by Reiners, Carlson, et al.

University and Department Service

CU Arts & Sciences Search Committee for Post-Award Administrator: 2018-19
CU Arts & Sciences Council, 2015-16
CU Arts & Sciences curriculum committee, 2015-16
Analytical facilities and space committee – Spring 2011, 2011-12
Colloquium organizer - 2009
Curriculum committee, graduate – 2007-08; 2013-14; 2014-15
Curriculum committee, undergraduate – 2012-13
Executive committee - 2008-09; 2014-15; 2017-18
Futures committee – 2017-18
New chair committee – 2012-13; 2018-19
Rock shop committee – chair, 2017-18; chair, 2018-19
Salary equity and grievance committee – 2012-13, 2017-18; chair 2018-19
Search committee, Geobiology faculty member – 2015-16

Memberships: Geological Society of America, American Geophysical Union, Mineralogical Society of America