

Curriculum Vitae

CHRISTINE SMITH SIDDOWAY

Professor of Geology
Department of Geology, The Colorado College
Colorado Springs, Colorado 80903 U.S.A.
Tel. 719-389-6717(6621) FAX: 719-389-6910
<http://sites.coloradocollege.edu/csiddoway/>
ORCID: 0000-0003-0478-6138

ACADEMIC BACKGROUND

- 1995 Ph.D., University of California-Santa Barbara.
1989 M.S., University of Arizona, Tucson.
1984 B.A., Carleton College, Northfield, Minnesota.

RESEARCH INTERESTS: *Tectonic development of West Antarctica, Subglacial bedrock geology of the Ross Ice Shelf and Marie Byrd Land (Antarctica), Rocky Mountains structures, Precambrian geology of western North America, Geodesign for urban environmentalism*

TEACHING EMPHASES: *Structural geology and tectonics, Geological field methods, Geodesign*

Research metrics: [Research Gate](#) [Google Scholar](#) [OrCID iD](#)
Media coverage: [Nature Careers](#) [Science News](#) [ArsTechnica](#) [Wikipedia](#)

PROFESSIONAL APPOINTMENTS

- 2019-23 Chair, Department of Geology, Colorado College
2009- Professor of Geology, Colorado College
2001-2007 Associate professor of Geology, Colorado College, Colorado Springs, CO.
2006 (5 mo.) Visiting Scientist, Lamont-Doherty Earth Observatory, Columbia University
2002-2003 Visiting professor, Department of Geosciences, University of Minnesota.
1996-2001 Assistant professor, Colorado College, Colorado Springs, CO.
1995-96 Fulbright Post-doctoral Research Fellow, Università di Siena, Italy.

FIELD AND RESEARCH EXPERIENCE, PAST 10 YRS.

- 2019 - 21 International Ocean Discovery Program (IODP) Amundsen Sea West Antarctic Expedition 379
Ongoing: Principal investigator, U.S. Antarctic Program, investigations funded by grants from the Office of Polar Programs, National Science Foundation.

HONORS

- 2021 Sigma Xi Scientific Research Honor Society, elected June 2021.
2021 UC Santa Barbara Earth Sciences Distinguished Alumna, recognized June 2021.
2016-19 Thomas M. McKee Professorship in the Natural Sciences, Colorado College.
2009 Fellow, Geological Society of America

Selected Professional Activities, past 10 years

- 2019- Research scientist Exp 379 and Exp 382, International Ocean Discovery Program
- 2017-20 Deputy Chair, SCAR GeoMAP Action Group (Antarctica)
- 2016-19 Member-at-Large, GSA Penrose / Thompson Field Forums Committee
- 2012–14 Joint Technical Program Committee, Structural Geology & Tectonics Division of the Geological Society of America
- 2009-2012 Associate editor, Geological Society of America Bulletin

Professional Affiliations:

American Geophysical Union; Colorado Scientific Society; Geological Society of America; Earth Science Womens Network; Sigma Xi; American Association for the Advancement of Science; United States Antarctic Program.

EXTRAMURAL RESEARCH GRANTS SINCE 2010.

- 2020 Collaborative Research: [Testing the linchpin of WAIS collapse](#) with diatoms and IRD in Pleistocene and Late Pliocene strata of the Resolution Drift, Amundsen Sea, Antarctica, \$55,449, NSF 1939146, Antarctic Science.
- 2019 Collaborative Research: Ice sheet erosional Interaction with Hot geotherm ([ICI-Hot](#)) in West Antarctica, \$219,571, NSF 1917176, Antarctic Science.
- 2018 IODP 379 Amundsen Sea West Antarctic Ice Sheet History, \$67,390, Subaward GG009393 FROM OCE 14-50528, LDEO, Columbia University.
- 2015 Collaborative Research: A systems approach to understanding the **R**oss **O**cean and ice **S**helf **E**nvironment, and **T**ectonic setting **T**hrough **A**erogeophysical surveys and modeling (ROSETTA-ICE), \$ 164,441, 36 mo. Funded by NSF Antarctic Integrated Systems Science, www.nsf.gov/awardsearch/showAward?AWD_ID=1443497 .
- 2013 ACM Seminar in Advanced Interdisciplinary Learning: “Mediterranean Trivium: Earth, Sea & Culture.” With S. Ashley & S. Thakur, \$106,000. <http://sites.coloradocollege.edu/sail/>
- 2010 Collaborative research: Polyphase orogenesis and crustal differentiation in West Antarctica, \$145,260. With M. Brown, University of Maryland. NSF-AES-0944600.
- 2010 Research at Undergraduate Institutions: Development of an on-line GIS repository of geological data from the Ford Ranges, Marie Byrd Land, and application to Cenozoic paleogeography reconstruction, \$49,545, 24 months. NSF-OPP-0944777.

REFEREED PUBLICATIONS, PAST 10 YRS.

- Tankersley, M., Horgan, H., **Siddoway, C.**, Caratori Tontini, F., and Tinto K., 2022, Basement topography and sediment thickness beneath Antarctica's Ross Ice Shelf, *Geophysical Research Letters*, doi: 10.1029/2021GL097371 .
- Tikoff, B., **Siddoway, C.**, Sokoutis, D., and Willingshofer, E., 2022, The lithospheric folding model applied to the Bighorn uplift during the Laramide orogeny, in Craddock, J.P. et al., eds., *Tectonic Evolution of the Sevier-Laramide Hinterland: Geol. Soc. America Special Paper 555*, [https://doi.org/10.1130/2021.2555\(08\)](https://doi.org/10.1130/2021.2555(08))
- Siddoway, C.**, 2021, Geology of West Antarctica (Chapter 3, *invited*), in Kleinschmidt, G., ed., [Geology of the Antarctic Continent](#); pp. 87-131. Stuttgart: *Schweizerbart Science Publishers*, ISBN 978-3-443-11034-5.
- Siddoway, C.**, 2020, Antarctica, in Scott Elias, S. and Alderton, D. (eds.), *Encyclopedia of Geology*, 2nd edition; 17 pages. Amsterdam: Academic Press, 10.1016/B978-0-08-102908-4.00136-3.

- Flowers, R. M., Macdonald, F.A., **Siddoway, C.S.**, and Havranek, R., 2020, Diachronous development of the Great Unconformity prior to Snowball Earth, *Proceedings of the National Academy of Sciences*, doi: [10.1073/pnas.1913131117](https://doi.org/10.1073/pnas.1913131117).
- Jordan, T.A., Riley, T.R. and **Siddoway, C.**, 2020, Geology of West Antarctica, *Nature Reviews Earth and Environment*, doi:10.1038/s43017-019-0013-6.
- Das, Indrani, L. Padman, R.E. Bell, H.A. Fricker, K.J. Tinto, C.L. Hulbe, **C.S. Siddoway**, T. Dhakal, N.P. Frearson, C. Mosbeux, S. I. Cordero, M.R. Siegfried, 2020, Multi-decadal basal melt rates and structure of the Ross Ice Shelf, Antarctica using airborne ice penetrating radar, *Journal of Geophys. Research-Earth Surface*, doi: 10.1029/2019JF005241.
- Siddoway, C.**, Palladino, G., Prosser, G., Freedman, D., and Duckworth, W. C., 2019, Basement-hosted sand injectites: Use of field examples to advance understanding of hydrocarbon reservoirs in fractured crystalline basement rocks, in Bowman, M. (ed.), *Subsurface Sand Remobilization and Injection*, Geological Society of London Special Publication 493, doi: 10.1144/SP493-2018-140.
- Tinto, K. J., Padman, L., **Siddoway, C.S.**, and 15 others, 2019, Ross Ice Shelf response to climate driven by the tectonic imprint on seafloor bathymetry, *Nature Geoscience*, 12, 441–449.
- Jensen, J.L., **Siddoway, C. S.**, Reiners, P.W., Ault, A.K., Thomson, S.N. and Steele-MacInnis, M., 2018, Single-crystal hematite (U-Th)/He dates and fluid inclusions document widespread Cryogenian sand injection in crystalline basement, *Earth and Planetary Science Letters*, v. 500, 145–155, 10.1016/j.epsl.2018.08.021.
- Colleoni, F., De Santis, L., **Siddoway, C.S.**, Bergamasco, A., Golledge, N., Lohmann, G., Passchier, S. and Siegert, M., 2018, Spatio-temporal variability of processes across Antarctic ice-bed-ocean interfaces, *Nature Communications*, v. 9, 2289, <https://rdcu.be/ZLBI>.
- Langridge, R.M. Ries, W., Dolan, J., Schermer, E. and **Siddoway, C.**, 2017, Geologic slip rate estimates for the Alpine Fault at Maruia River (Calf Paddock), New Zealand, *New Zealand Journal of Geology & Geophysics*, 10.1080/00288306.2016.1275707.
- Brown, C., Yakymchuk, C., Brown, M., Fanning, C.M. Korhonen, F.J., and **Siddoway, C.S.**, 2016, From source to sink: Petrogenesis of Cretaceous anatectic granites from the Fosdick migmatite–granite complex, West Antarctica, *Journal of Petrology*, 10.1093/petrology/egw039.
- McFadden, R.R., Teyssier, C., **Siddoway, C.S.**, Cosca, M., and Fanning, C.M., 2015, Mid-Cretaceous oblique rifting of West Antarctica: emplacement and rapid cooling of the Fosdick Mountains migmatite-cored gneiss dome, *Lithos*, doi:10.1016/j.lithos.2015.07.005
- Yakymchuk, C., Brown, C.R., Brown, M., **Siddoway, C.S.**, Fanning, C.M. and Korhonen, F.J., 2015, Paleozoic evolution of West Marie Byrd Land, West Antarctica: *Geological Society of America Bulletin*, doi:10.1130/B31136.1.
- Siddoway, C.S.** and Gehrels, G.E., 2014, Basement-hosted sandstone injectites of Colorado: A vestige of the Neoproterozoic revealed through detrital zircon provenance analysis, *Lithosphere*, v. 6, p. 403-408, <http://dx.doi.org/10.1130/L390.1>.
- Yakymchuk, C.; Brown, M., Korhonen, F., Piccoli, P., **Siddoway, C.**, and Vervoort, J.D., 2014, Decoding polyphase migmatites using geochronology and phase equilibria modeling, *Journal of Metamorphic Geology*, v. 33 (2), p. 203–230, doi: 10.1111/jmg.12117.
- Yeck, W., et al., 2014, Structure of the Bighorn Mountain Region, Wyoming, from Teleseismic Receiver Function Analysis: Implications for the Kinematics of Laramide Shortening, *Journal of Geophysical Research – Solid Earth*. 2013JB010769RR.
- Siddoway, C.S.**, Myrow P. and Fitz Díaz, E., 2013, Strata, structures and enduring enigmas: A 125th Anniversary appraisal of Colorado Springs geology, in Abbott, L. and Hancock, G.S. (eds.), *Geological Society of America Field Guides*, v. 33, Ch. 13, doi:10.1130/2013.0033(13).

- Yakymchuk, C., **Siddoway, C.S.**, Brown, M., and Fanning, C.M., 2013, Anatectic reworking and differentiation of continental crust along the active margin of Gondwana: a zircon Hf–O perspective from West Antarctica, in Harley et al. (eds.), *Antarctica and Supercontinent Evolution*, Geological Society of London Special Publication 383, doi: 10.1144/SP383.7.
- Levine, Jamie S.F., Mosher, Sharon and **Siddoway, C.S.**, 2013, Relationship between syndeformational partial melting and crustal-scale magmatism and tectonism across the Wet Mountains, central Colorado, *Lithosphere*, v. 5 (5), p. 456-476, doi: 10.1130/L287.1.
- Saito, S., Brown, M., Korhonen, F.J., McFadden, R.R., and **Siddoway, C.S.**, 2012, Evidence for melting of metasomatised sub-continental arc mantle beneath the mid-Cretaceous proto-Pacific Gondwana margin from mafic intrusive rocks in the Fosdick Mountains, West Antarctica, *Gondwana Research*, v. 23 (4), p. 1567–1580, [dx.doi.org/10.1016/j.gr.2012.08.002](https://doi.org/10.1016/j.gr.2012.08.002)
- Carreras, J., Druguet, E., & **Siddoway C.**, 2012, Geological Heritage beyond Natural Spaces: The Red Rocks Amphitheatre (Morrison, Colorado, U.S.A.), an example of syncretism between Between Urban Development and Geoconservation, *GeoHeritage Journal* (Springer Verlag), DOI10.1007/s12371-012-0062-4.

INVITED LECTURES // PAST 5 YEARS

- University of Arizona**, Feb. 9 and 16, Bedrock Geology of Antarctica, and hypotheses about cross-Ross Ice Shelf sedimentary connections (Lectures presented to “CURE” students, course taught by Martin Pepper)
- Colorado Scientific Society** [Denver, CO], Jan. 22, 2022, Antarctica at the juncture of bedrock geology and dynamic ice sheet
- Northern Illinois University**, Nov. 20, 2020, From Cores to Continent: Use of detrital minerals and a volcanic ash bed to expand knowledge of West Antarctica’s bedrock and neotectonics
- SCAR-COMNAP Open Science Conference**, Aug. 6, 2020, Updated tectonic framework of West Antarctica and legacy of formation upon Gondwana’s complex convergent margin
- Café Scientifique – Univ. Colorado/Colorado Springs**, Nov. 12, 2019, Tavakaiv Quartzite: An uncommon rock record of ‘Snowball Earth’ times, preserved on the flanks of Pikes Peak.
- Lamont-Doherty Earth Observatory**, Nov. 6, 2019 [Geochemistry Seminar], Subglacial geology and its influence on icesheet origins and processes, West Antarctica.
- University of Minnesota**, Oct. 4, 2018, A “rosetta stone” for Antarctic tectonics: New gravity and magnetics data for the Ross Ice Shelf region, *and* **ICI-Hot** : **IC**e sheet erosional **I**nter- action with **Hot** geotherm beneath an Ice Sheet
- K-12 Earth Science Teachers Field Workshop**, July 31 and Aug. 2, 2018, On the trail of Tavakaiv Quartzite: Colorado’s newest/oldest sedimentary formation (a scientific research real roller coaster!).
- Colorado State University**, Nov. 2, 2017, Ross Ice Shelf, Antarctica: Airborne Geophysical Data for Bathymetry, Crustal Structure and sub-Shelf Ocean Circulation.

ACADEMIC / PROFESSIONAL SERVICE, 2012 TO PRESENT

Professional Service since 2012

- 2022- Career Contributions Committee, Structural Geology & Tectonics Division of the Geological Society of America
- ongoing Peer review for publications and National Science Foundation proposals
- 2017-20 Deputy Chair, SCAR International GeoMAP Action Group (Antarctica)
- 2016 – 19 Member-at-Large, GSA Penrose Conferences and Thompson Field Forums Committee; *and* Fellowships and Membership Committee
- 2016 Review Panel, NSF Antarctic Geoscience

Colorado College – administrative appointments and committee service

- 2022 Faculty Executive Committee (Governance Subcommittee)
- 2020- Chair, Department of Geology, Colorado College
- 2019-20 Natural Sciences Division Executive Committee
- 2017-18 Design Review Board
- 2015 - 16 Advancement Advisory Committee (Chair); Watson Fellowship Committee

CONFERENCE PRESENTATIONS, 2018 to present. (Includes only those not represented by published articles)

- Siddoway, C., Thomson, S.T., Hemming, S., Buchband, H., Quigley, C., Furlong, H., Hilderman, R., and 6 others, 2021, U-Pb zircon geochronology of dropstones and IRD in the Amundsen Sea, applied to the question of bedrock provenance and Pliocene ice sheet extent in West Antarctica, European Geophysical Union v-Meeting, [Abstract EGU21-9151](#), session CR1.1.
- Iverson, N., Siddoway C., Zimmerer M., Smellie J., Dunbar N., Gohl K. and IODP Exp. 379 scientists, 2021, Rhyolite volcanism in the Marie Byrd Land volcanic province, Antarctica: New evidence for pyroclastic eruptions during latest Pliocene icesheet expansion, European Geophysical Union v-Meeting, [Abstract EGU21-9003](#), session GMPV9.4.
- Siddoway, C., Riley, T., Jordan, T.A., Tinto, K.J. and Tankersley, M., 2020 (invited), Updated tectonic framework of West Antarctica and legacy of formation upon the complex convergent margin of the Gondwana supercontinent, SCAR 2020 Online, [Session 13, Abstract 920](#).
- Siddoway, C., Cavosie, A., Bohaty, S., Hillenbrand, C.D. and IODP Expedition 379 scientists, 2020, Origin of detrital and diagenetic minerals in a terrigenous sand layer, Resolution Drift, northern Amundsen Sea (Site U1533, IODP Expedition 379), Scientific Committee on Antarctic Research Open Science Conference, Hobart, Tasmania.
- Siddoway, CS, SN Thomson, JM Taylor, C Teyssier, C Kinney, 2019, ICI-Hot project: Timing of development of West Antarctica's subglacial topography evaluated using apatite and zircon double/triple-dating, AGU Fall Meeting 2019.
- Padman, L., RE Bell, I Das, C Mosbeux, DF Porter, CS Siddoway, et al., 2018, Ice Shelf Vulnerability to Increased Seasonal Upper Ocean Warming AGU Fall Meeting Abstracts.
- Siddoway, C., 2018, Geodesign in the Undergraduate Classroom: An avenue to urban environmentalism. GIS in Higher Ed Summit, Colorado Springs (15 March).
- Siddoway C.S., Cox S.C., Burton-Johnson, A., Millikin, A., Smith Lyttle B., Elkind S., and SCAR Geomap Initiative, West Antarctica Digital Geological Dataset for Cross-discipline Use, POLAR2018 Open Science Conference (June 15-26, Davos, Switzerland) Abstract A- 938-0073-01410.

Education Activities, past 5 years

GRADUATE AND POST-DOCTORAL RESEARCH MENTORING

- Jacque Baughmann, PhD 2018, University of Colorado, Boulder, Bridging high and low temperature thermal histories across the Kaapvaal craton, southern Africa, from advances in titanite & zircon (U-Th)/He thermochronology. PhD Committee advised by R. Flowers.
- Cailey Condit, PhD 2017, University of Colorado, Boulder, Zircon and monazite geochronology and trace element geochemistry of tectonites that record the Big Sky orogeny (N. Madison range, SW Montana). PhD committee advised by Kevin Mahan.

TEACHING AND RESEARCH MENTORING AT COLORADO COLLEGE, 2016 TO PRESENT

Courses taught

- CC 120 First Year Program: Writing in the Disciplines
- GY 140 Introduction to Earth Systems
- GY 212 Earth as a Physical System
- GY 250 Topics in Geology: Explore Antarctica / Experience STEM (course-based undergrad research)
- GY 315 Structural Geology
- GY 316 Field analysis of Geological Structures
- GY 400 Senior Research Seminar: Antarctic ice sheet evolution and subglacial landscape (2020), Digital mapping in Geology (2015),
- GY 445 Regional Studies in Geology (2017): Mojave region, Pacific Plate to Colorado Plateau

STUDENT RESEARCH ADVISING, past 5 years:

Senior Research Advising [GY405]:

- Roat, Abby, 2022, Characterizing changes in 21st century subglacial hydrology at Humboldt Glacier, N. Greenland
- Swope, Fiona, 2022, Glacial Exhumation History of the DeVicq Region in West Antarctica
- Haddad, Helen, 2022, Developing Geology Curriculum in Collaboration with Concrete Couch (local non-profit)
- Brandhorst, Claire, 2021, Primary observation and development of online educational resource for the Sutherland Creek / Bear Creek segment of the Ute Pass fault, Colorado Front Range
- Norwine, Jonny, 2021, Comparison of geostatistical vs. machine learning workflows applied to a geologic modeling problem
- Bering, Liza, 2020, Geological review of notable features surrounding the Stabler Gilmore Cabin
- Meyer, Ellie, 2019, Brittle kinematic analysis of transcurrent deformation, Mosca Creek (CO)
- Krauss, Zoe, 2019, Magnetics and Gravity modeling of Ross Ice Shelf
- Rundquist, Will, 2019, Geodesign for rehabilitation of campus-creek relationship
- Sachs, David, 2019, Geologically Influenced Design (Interdisciplinary Major)
- Vick, Jordan, 2019, GIS development and Geodesign for educational use of Monument Park 'duck pond' (post graduation internship for Environmental major)
- Patterson, Kevin, 2019, Matrix analysis of sillimanite quartz pods in a high strain zone
- Keeshin, Skye, 2018, Analysis of Shallow Ice Radar for the North-Western Ross Ice Shelf: Quantifying Ocean-Cryosphere Interaction
- Thompson, Cole, 2018, Mode of Emplacement of Tava Sandstone Injectites Using Dike Geometries and Detrital Zircon Provenance Analysis
- Tankersley, Matt, 2018, Investigating the Crustal Structure of the Ross Ice Shelf Region from Aerogeophysical Data
- Culver, Mason, 2018, Multi-scaled Geometric and Textural Analysis to Determine the Transport and Emplacement Mechanisms of the Tava Sandstone
- Culver, Ian, 2018, Oxygen Isotope Analysis of Hematite and Quartz in the Neoproterozoic Tava Sandstone as a Proxy for Paleoenvironment
- Jozef, Gina, 2018, Analyzing Radar Profiles of Kamb Ice Stream to Identify Zones of Basal Melt for the Ross Ice Shelf, Antarctica
- Lockett, Alec, 2017, Use of potential fields data for geological characterization of the crust beneath Ross Ice Shelf investigation using Potential Fields data acquired by LC130 airborne survey, Antarctica

Meeting presentations arising from collaborations with students, past 5 yrs

*Undergraduate students in boldface type, * indicates graduate student.*

*Levenstein, Brandon M., Schaen, A., Siddoway, C., Kirk, J., Reiners, P. and Quade, J., 2022, Using clay dating to constrain the ages of paleoweathering environments: a case study from weathered granite beneath the Great Unconformity in Manitou Springs, Colorado, Goldschmidt Conference (Hawai'i), <https://conf.goldschmidt.info/goldschmidt/2022/meetingapp.cgi/Paper/12318>.

*Taylor, J., **Swope, F.**, Siddoway, C., Thomson, S.N., Teyssier, C., 2021, Development of Glacial Topography over a Hot Geotherm: Insights from Low-Temperature Thermochronology and Thermo-Kinematic Modeling in Marie Byrd Land, West Antarctica, AGU Fall meeting (11-15 December 2021), Abstract EP15A-02.

Sachs D., Rundquist W., Cooney M., Hines C., and Siddoway C., 2018, Geodesign applied to an urban campus and its river reach: Colorado College and Monument Creek, GIS in the Rockies, Denver, CO (27-28 September).
Undergraduate poster session: 3rd Place award

Keeshin, S., Robin E. Bell, Christine Siddoway, **Gina Jozef**, Kirsty Tinto, S. Isabel Cordero, Nick Frierman, Indrani Das, and ROSETTA Ice Team, 2017, Shallow Ice Radar Expression of TAM glaciers within Ross Ice Shelf, and a new method to distinguish mechanisms of ice sheet thinning. [24th Annual WAIS Workshop](#). Camp Casey Conference Center, Coupeville, WA.

Jozef, Gina, R.E. Bell, C. Siddoway, **Skye Keeshin**, Kirsty Tinto, N. Frearson, S. Isabel Cordero, Indrani Das, and ROSETTA Ice Team, 2017, Analyzing Kamb Ice Stream Flow Line from Grounding Line to Front of Ross Ice Shelf for Evidence of Basal Melt. [24th Annual WAIS Workshop](#). Camp Casey Conference Center, Coupeville, WA.

Siddoway, C., **Millikin, Alexis, White, T., Elkind, S.**, Cox, S.C., Smith Lyttle, B.P., 2017, New geological dataset of Marie Byrd Land & the Ellsworth Mountains: a milestone in the SCAR GeoMAP initiative, New Zealand Antarctic Science (NZARI) Conference, Dunedin, New Zealand (26 - 28 June).

Elkind S., Siddoway, C., Cox, S., Morin, P. and Smith Lyttle B., 2016, First digital geological map dataset of Marie Byrd Land: A product of the SCAR GeoMap project, XXXIV SCAR Biennial Meeting and Open Science Conference, Kuala Lumpur, Malaysia (22-26 August).

Collaborators/current, and during the past 5 years:

Rebecca Flowers, University of Colorado

Nels Iverson, New Mexico Tech

Johann Klages, Alfred Wegener Institut, Bremen, Germany

Francis Macdonald, UC Santa Barbara

Peter Reiners, University of Arizona

Reed Scherer, Northern Illinois University

Matt Tankersley, Victoria University, Wellington, New Zealand

Christian Teyssier, University of Minnesota

Basil Tikoff, University of Wisconsin

Kirsty Tinto, Lamont Doherty Earth Institute, Columbia University

Stuart Thompson, University of Arizona