# Alexander P.. Bump

# **Professional Summary**

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# **Professional Preparation**

## Academic Background

Doctor of Philosophy, Dissertation: Kinematics, Dynamics, and Mechanics of Laramide Deformation, Colorado Plateau, Utah and Colorado, Geology, University of Arizona, 2001

Non-degree Student, Geology, University of Vermont, 1996

Bachelor of Arts, Cum Laude, Physics, Williams College, 1993

Junior Year Abroad, University of Graz, 1992

#### **Professional Appointments**

Research Scientist Associate, Bureau of Economic Geology, The University of Texas at Austin (2019-Present)

Defining research program to apply hydrocarbon exploration and risking to exploration for and description of carbon storage sites. Working with industry partners and government regulators to create a strategic view of storage resources to prove and develop specific sites.

Head of Discipline, Exploration Structural Geology; Exploration Advisor, BP (2016-2018) Responsible for delivery of high-value projects, post-well structural analysis, development of structural geology capability, technology development and external engagement with the broader industrial and academic structural geology community.

Senior Exploration Geologist, Basin Analysis Team, BP (2015-2016)

Screened the globe for new access opportunities, with focused projects on North Atlantic and East African margins. Created play catalog from over 100 basins, grouped by tectonic settings. Led project to define play characteristics of distal passive margins.

Senior Exploration Geologist, Angola Exploration Team, BP (2012-2015) Defined play fairways and prospects, and drilled 3 wells, including the Katambi discovery. Worked extensively with Cambridge and Oxford to understand thermal evolution of margin and de-risk previously unidentified controls on distal margin heat flow.

Exploration Geologist, Exploration Access Group, BP (2009-2012) Integrated large and diverse datasets to define new plays and evaluate exploration opportunities for the Middle East and onshore China.

Exploration Geologist, Global Unconventional Resources Group, BP (2008-2009) Defined heavy oil play types, screened the globe for exploration opportunities and identified three new regions with potential for >100Bnbbl OIP. Co-developed CRS methodology for heavy oil development and ranked available blocks for Venezuelan bid round.

Structural Geologist, Exploration & Production Technology Group, BP (2005-2008) Consulted for business units across the value chain from South American new ventures to Gulf of Mexico exploration and onshore US production. Structural Geologist, Gulf of Mexico Shelf Exploration, BP (2005)

Structural Geologist, Gulf of Mexico Deepwater Exploration, BP (2002-2004) Mapped salt and interpreted salt body architecture and growth history for frontier exploration areas in Keathley Canyon. Contributed to the initial identification of and access for 4 super-giant Paleogene discoveries.

#### Research Associate, University of Arizona (2001-2002)

Applied newly developed trishear fold models to investigation of subsurface structure of basement-cored uplifts. Developed quantitative strain modeling technique to test theoretical trishear fold models against strain observed and mapped in the field.

#### Research Assistant, University of Arizona (2000-2001)

Mapped reservoir-scale structures in the field to interpret kinematics of basement-cored uplifts. Applied mining industry software to model observed strains and define regional stress state at time of deformation. Integrated results with contemporaneous tectonics.

#### Intern Geologist, Prudhoe Bay Production Team, BP (2000)

Remapped oil-water contact in Prudhoe Bay, based on recent well logs. Noticed large disparities in well performance, examined wide range of possible causes and ultimately proved critical differences in drive mechanisms that allowed better well placement.

#### Teaching Assistant, University of Arizona (1996-2000)

Wrote and taught undergraduate structural geology labs and field camp. Studied teaching methods and improved personal teaching evaluations from "Should get out of teaching and into research as fast as possible" to consistently "Excellent."

Intern Geologist, Gulf of Mexico Deepwater Exploration Team, Mobil Oil (1998) Defined and mapped megasequences in a GoM mini-basin and described the structural and depositional history to lay the foundation for detailed prospect description.

## Dissertations

Kinematics, dynamics, and mechanics of Laramide deformation, Colorado Plateau, Utah and Colorado, University of Arizona, 2001.

## Continuing Education Courses Taken

Integrated Petroleum Exploration: BP, 2017-2018

Integrated Basin Dynamics: BP, 2011-2018

## <u>Awards</u>

# Awards and Honorary Societies

2024 Tinker Family BEG Publication Award, Exemplary Publication of Scientific or Economic Impact, for timely and foundational work toward CO2 storage security, 2024

21 Spot Bonuses for Technical Contributions, Leadership, Mentoring, and Teaching, 2003-2018

Coach of the Year, Ful-on Tri Club, 2017

Keynote speaker, AAPG Hedberg Conference on Deepwater Foldbelts, 2009

Speaker of the Month, Arizona Geological Society, 2001

Outstanding Student Paper Award, Tectonophysics Division, AGU, 2000

## <u>Service</u>

## **External Committees Participation**

Internship Mentor for Oliver Roberts, Prospectivity of the Pinda Carbonate Play, Block 24, Angola, BP, 2012

Internship Mentor for Jennie Cook, Conditions for deformation band formation, Holstein Field, Gulf of Mexico, BP, 2008

Internship Mentor for Cyrus Gillett, Regional structure of the greater Green River Basin, Wyoming, BP, 2007

Internship Mentor for Serkan Arka, Structure and Prospectivity of the Ene Basin, Peru, BP, 2007

Internship Mentor for Shundong He, Geometry and structure of collapsed salt stocks: strain partitioning and potential reservoir compartmentalization, BP, 2006

Internship Mentor for Subho Banerjee, Strain modeling of the Atlantis Anticline, Gulf of Mexico, and implications for sub-seismic fault prediction, BP, 2006

Internship Mentor for Laura Chiaramonte, Regional structure of the Perdido Fold Belt, western Gulf of Mexico, BP, 2005

#### Teaching and Advising

## University Courses Taught

Learning from Experience: Post-Project Analysis: presented to Royal Holloway University of London, 2018.

Seismic Interpretation: Constructing Multiple Models: presented to Royal Holloway University of London, 2018.

Basin Analysis: presented to Texas A&M University, 2009.

Crustal rheology graduate seminar: presented to University of Arizona, 2002.

Structural Geology Undergraduate Laboratory: presented to University of Arizona, 1996-2000.

Field Geology: presented to University of Arizona, 1997-1999.

Introductory Geology Laboratory: presented to University of Arizona, 1996.

#### Continuing Education Courses Taught

Rifting, subsidence and heat flow: 2018.

Structural Geology 101: Subsidence Analysis and Basin Fill: 2018.

Integrated Petroleum Exploration: presented to BP, 2017-2018.

Integrated Basin Dynamics: presented to BP, 2011-2018.

Architecture and Prospectivity of Distal Passive Margins: 2017.

Structural Geology 101: Assessing Structural Timing: 2017.

Structural Geology 101: Quick-look Restoration Techniques to Aid Interpretation: 2017.

Structural Geology 101: Rules of Thumb for Fault Interpretation and QC: 2017.

Seismic Interpretation and Developing Multiple Models: presented to BP, 2016-2017.

Passive Margin Zonation and Characteristic Plays: presented to BP, 2016.

Salt Stock Deformation and Potential Traps: presented to BP, 2016.

Salt Tectonics: presented to BP, 2016.

Thrust Belts and Foreland Basins: presented to BP, 2015.

21st Century Structural Geology: presented to BP, 2003-2013.

Stage T: Exploration Geoscience: presented to BP, 2009-2011.

Subsidence and Heat Flow of Cratonic Basins: presented to BP, 2010.

## Student Committee Supervision

Master's Thesis, Thesis Committee, Melianna Ulfah, Plume Migration and Pressure Evolution Analyses for Recommendations in Offshore CO2 Storage Acreage Leasing Policy, The University of Texas at Austin, Austin, Texas, 2021

Senior Independent Project, Undergraduate Student Mentor, Bilinski, G. E. and Sanders, A. E., The Structural Evolution of the Zone of Deformation Near the Comb Ridge, Utah, University of Arizona, 1999

## Presentations

**Invited Presentations** 

The Role of Salt Tectonics in the Energy Transition: An Overview and Future Challenges: presented to Salt as Store, Seal, Trap, and Repository Session, presented at Energy Geoscience Conference, Aberdeen, UK, May 16-18, 2023.

The Role of Salt Tectonics on Underground Storage: presented to SPE RWTH Aachen, presented at Online, April 14, 2023.

Geology of the 2015 Nepal Earthquake: presented to Ullens School, Kathmandu, 2018.

BP Exploration Geology: presented to Guild of Tallow Chandlers, London, 2017.

BP Exploration Geology: presented to BP Board of Directors, London, 2016.

Ride Across America: presented to Fulham Prep School, London, 2013.

The Role of Salt Tectonics in the Energy Transition: An Overview and Future Challenges: presented to Multi-scale Laboratories Seminars, presented at Online, March 14, 2023-Present.

## Presentations

Using multiphase sand tank experiments to investigate the effect of heterogeneities on CO2 capillary trapping (eLightening): presented at AGU Fall Meeting, San Francisco, Calif., December 11-15, 2023.

Teaching Teamwork: Project-based Learning in an Interdisciplinary Course Delivered by an Interdisciplinary Teaching Team (poster): presented at Earth Educators Rendezvous, Pasadena, Calif., July 10-14, 2023.

Sandbox model results & implications for CO2 migration and trapping: presented at 2023 Joint Annual GoMCarb - SECARB Offshore Partnerships' Meeting, Austin, Tex., April 5-7, 2023.

The Role of Salt Tectonics in the Energy Transition: An Overview and Future Challenges: presented to Applied Geodynamics Laboratory Consortium Members, presented at Applied Geodynamics Laboratory Consortium Annual Meeting 2022, Austin, Texas, November 10-11, 2022.

Progress in the Gulf of Mexico: presented at 5th University of Texas Conference on Carbon Capture and Storage (UTCCS-5), UT J. J. Pickle Research Campus, Austin, Tex., January 28, 2020.

The Thermal History of Benguela Basin: Observations and Effects: presented to The Geological Society, presented at Heat Flow, Subsidence and Continental Break-Up: A Case-Study Workshop, 2018.

Benguela Basin and the Prospectivity of Hyper-Extended Margins: presented to American Association of Petroleum Geologists, presented at AAPG International Conference and Exhibition, 2017.

Rifting, Subsidence and Evolution of the Benguela Basin, Angola: presented to The Geological Society, presented at Rifts 3 conference, 2016.

Thermal Evolution of the Benguela Basin, Angola: presented to Royal Holloway University of London, presented at The Roberts Conference, Passive Margins 2016, 2016.

Tectonic History of the Arabian Plate and the Distribution of Hydrocarbons: Passive Margins and Petroleum Systems: presented to Royal Holloway University of London, presented at The David Roberts Memorial Symposium, 2014.

Tectonics of Rifting and Break-up in the Central Segment of the South Atlantic, Angola and Brazil: presented to The Geological Society, presented at Petroleum Geoscience of the West Africa Margin, 2014.

Subsidence History of the Arabian Plate: Setting the Stage for the World's Largest Hydrocarbon Province: presented to The Geological Society, presented at Industrial Structural Geology Conference, 2012.

Detrital zircon U/Pb dating of sandstones in Peru: Implications for provenance and paleogeography: presented at 15th Peruvian Geological Congress, 2010.

The Atwater Foldbelt and its place in the global spectrum of deepwater fold and thrust belts: presented to American Association of Petroleum Geologists, presented at AAPG Hedberg Research Conference, 2009.

A pseudo-3D model of the Llanos foothills thrust belt, Colombia: presented to The Geological Society, presented at Fold-Thrust Belt Exploration Conference, 2008.

Deformation history of the Andean foreland, Peru, and its impact on present-day structure: presented to American Association of Petroleum Geologists, presented at AAPG Annual Meeting, 2008.

Integrating multi-disciplinary reservoir description to characterize connectivity in a complex minibasin fill: Holstein Field: presented to American Association of Petroleum Geologists, presented at AAPG Annual Meeting, 2007.

Reverse faults, topography, and the mechanics of foreland basement-cored uplifts: presented to American Association of Petroleum Geologists, presented at AAPG Annual Meeting, 2007.

Tectono-structural evolution of the Colorado Plateau: Backbone of the Americas: presented to Geological Society of America, presented at A global meeting presented by The Association Geologica Argentina and The Geological Society of America, 2006.

An informal survey of structural geology in the major oil companies: presented to American Association of Petroleum Geologists, presented at AAPG Reservoir Deformation Research Group Annual Meeting, 2005.

Laramide deformation of the Colorado Plateau and the evolution of ancient fault arrays: presented to Geological Society of America, 2005.

Forward and inverse trishear modeling of the San Rafael and Waterpocket monoclines, Colorado Plateau, Utah: presented to Geological Society of America, 2002.

Kinematics, Dynamics, and Mechanics of Laramide Deformation, Colorado Plateau, Utah and Colorado: presented to Arizona Geological Society, Tucson, Arizona, 2002.

Kinematics, Dynamics, and Mechanics of Laramide Deformation, Colorado Plateau, Utah and Colorado: presented to Southwest Research Institute, San Antonio, Tex., 2002.

Kinematics, Dynamics, and Mechanics of Laramide Deformation, Colorado Plateau, Utah and Colorado: presented to University of Rochester, Rochester, New York, 2002.

Preliminary (U-Th)/He thermochronological constraints on timing and magnitude of Tertiary denudation of the Colorado Plateau: presented to Geological Society of America, 2002.

The Colorado Plateau and its role in the Laramide Orogeny: presented to American Geophysical Union, presented at Eos (Transactions of the American Geophysical Union), 2001.

Three-dimensional Laramide deformation of the Colorado Plateau: competing influences of the Sevier thrust belt and the flat Farallon slab: presented to Geological Society of America, 2001.

Laramide deformation on the northern Colorado Plateau: Complex patterns from simple controls: presented to Geological Society of America, 2000.

Progressive development of brittle and semi-brittle structures on the monument uplift, Utah, and their implications for regional strain: presented to Geological Society of America Rocky Mountain Section, 2000.

Reverse faults, topography, and the mechanics of foreland basement-cored uplifts: presented to American Geophysical Union, presented at Eos (Transactions of the American Geophysical Union), 2000.

Late Cretaceous to Eocene integrated structural and geodynamic analysis of five Colorado Plateau uplifts, Utah: presented to American Association of Petroleum Geologists, presented at AAPG Bulletin, 1999.

Strain analysis of the San Rafael Swell, Utah, and its implications for the development of Colorado Plateau uplifts: presented to Geological Society of America, 1999.

Detailed internal structure of a conjugate strike-slip deformation band shear zone system in Navajo sandstone at a salient in the Waterpocket Fold, Capitol Reef National Park, Utah: presented to American Geophysical Union, presented at Eos (Transactions of the American Geophysical Union), 1997.

The Waterpocket Fold, a tale of two uplifts, Capitol Reef National Park, Utah: presented to American Geophysical Union, presented at Eos (Transactions of the American Geophysical Union), 1997.

The Role of Salt Tectonics in the Energy Transition: An Overview and Future Challenges: presented to GeoH2 Consortium Members, presented at GeoH2 Annual Consortium Meeting, Austin, Texas, October 18, 2022-Present.

## Activities of a Professional Nature

# **Professional Societies**

American Association of Petroleum Geologists

Geological Society of America

Geological Society of London

#### Activities of a Professional Nature

Co-convenor, "Heat Flow, Subsidence and Continental Break-up: A Case-study Workshop," Geological Society of London (2018)

Advisory Board member, Royal Holloway University of London, Petroleum MSc program (2016-2018)

Committee member, Geological Society of London Library Users Group (2016-2018)

Coach, Ful-On Triathlon Club (2015-2018)

BP project manager, BP-Cambridge Margins Project, a joint research program with Cambridge University (2014-2018)

Coach, BP run club (2011-2018)

Co-designer of high-tech collaborative workspaces for new Sunbury exploration building, BP (2013)

Designer and presenter of BP exploration workflows for basin analysis, play evaluation and prospect description (2013)

Technical interviewer for geoscience recruiting, BP (2010-2013)

Internship Mentor for Oliver Roberts, Prospectivity of the Pinda Carbonate Play, Block 24, Angola, BP, 2012 (2012)

Cycled John O'Groats to Land's End in nine days, raised £1000 for Paralympics GB (2010)

MA committee member, University of Houston (2010)

Reviewer for Tectonics, Geophysical Research Letters, Journal of Geoscience Education, Journal of Structural Geology (1998-2010)

Chair, AAPG Reservoir Deformation Research Group (2009)

Co-Chair, AAPG Reservoir Deformation Research Group (2008)

Internship Mentor for Jennie Cook, Conditions for deformation band formation, Holstein Field, Gulf of Mexico, BP (2008)

Global Course Custodian, 21st Century Structural Geology, BP (2005-2008)

Leader, BP Houston Exploration and Production Technology Structural Geology Group (2005-2008)

Transition Area Director, Jeff and Brede's Intergalactic Triathlon (2004-2008)

Contributor, Design workshop for BP Houston Integrated Learning Center (2007)

Internship Mentor for Serkan Arka, Structure and Prospectivity of the Ene Basin, Peru, BP (2007)

Internship Mentor for Shundong He, Geometry and structure of collapsed salt stocks: strain partitioning and potential reservoir compartmentalization, BP (2006)

Internship Mentor for Subho Banerjee, Strain modeling of the Atlantis Anticline, Gulf of Mexico, and implications for sub-seismic fault prediction, BP (2006)

Panelist, Careers in Geoscience, Williams College (2006)

Contributor, Design workshop for BP Structure and Geomechanics Research Program (2005)

Internship Mentor for Laura Chiaramonte, Regional structure of the Perdido Fold Belt, western Gulf of Mexico, BP (2005)

President, Houston Racing Triathlon Club (2005)

Board member, Houston Racing Triathlon Club (2004)

Coordinator, Structure/Tectonics Group meetings, University of Arizona (2000-2001)

Organizer, seminar on selling a graduate degree in Geosciences, University of Arizona (1999)

Graduate Representative, Tectonics Search Committee, University of Arizona (1998-1999)

Cycled across U.S.: 4262 miles in 54 days, self-supported (1994)

Furniture construction: Home now approximately half furnished in hand-made, self-designed pieces (1996-Present)

Endurance sports: Over 350 races completed in cross-country skiing, running, rowing, mountain biking, road cycling, swimming and triathlon with individual wins in five different sports. Finishes include three Ironmans, three ultra-marathons, two 24-hour races and many 100+ mile cycle races. (1984-Present)

## <u>Funding</u>

## Research Support

Research Author, co-authored with Nicky White from Cambridge University: BP-Cambridge

Margins Phase IV: Dynamic Topography Through Space and Time, BP (2018-2022; £500,000).

Research Author, co-authored with George H. Davis: Inverse and Forward Modeling of the Utah System of Colorado Plateau Basement-Cored Uplifts, NSF (2000-2002; \$161,005).

Research Author: Strain analysis and thermochronology of the Monument uplift, northern Arizona, H. Wesley Pierce scholarship, administered by the H. W. Pierce Foundation (2000-2001; \$3,200).

Research Author: Thermochronologic constraints on the Late Cretaceous tectonics of the Colorado Plateau, Geological Society of America Penrose Grant (2000-2001; \$3175).

Research Author: Late Cretaceous to Eocene integrated structural and geodynamic evolution of five Colorado Plateau uplifts, Utah, Geological Society of America Penrose Grant (1999-2000; \$1950).

Research Author: Late Cretaceous to Eocene integrated structural and geodynamic evolution of five Colorado Plateau uplifts, Utah, L. Austin Weeks AAPG Grant-in-Aid (1999-2000; \$2000).

Research Author: Laramide and Sevier: comparative strain analysis of the San Rafael Swell and the Pavant thrust, central Utah, Geostructure Partnership, University of Arizona (1998-1999; \$5000).

Research Author: Laramide and Sevier: comparative strain analysis of the San Rafael Swell and the Pavant thrust, central Utah, Mobil Exploration and Producing U.S. (1998-1999; \$3000).

Research Author: Laramide and Sevier: comparative strain analysis of the San Rafael Swell and the Pavant thrust, central Utah, AMOCO (through Department of Geosciences, University of Arizona) (1998; \$2000).

#### **Publications**

#### Peer Reviewed Authored Books

Bump, A., Bakhshian, S., Hovorka, S. D., and Rhodes, J., 2022, Criteria for depleted reservoirs to be developed for CO2 storage: Cheltenham, UK, IEA Environmental Projects Ltd., IEAGHG Technical Report, v. 2022-01, 114 p.

# Peer Reviewed Book Chapters

Davis, G. H., and Bump, A. P., 2009, Structural geologic evolution of the Colorado Plateau, in Kay, S. M., Ramos, V. A., and Dickinson, W. R., eds., Backbone of the Americas: shallow subduction, plateau uplift, and ridge and terrane collision: Boulder, Colo., Geological Society of America, Memoir, v. 204, p. 99-124, http://doi.org/10.1130/2009.1204(05).

#### Peer Reviewed Journal Articles

Bump, A. P., and Hovorka, S. D., 2024, Pressure space: the key subsurface commodity for CCS: International Journal of Greenhouse Gas Control, v. 136, no. 104174, 16 p., http://doi.org/10.1016/j.ijggc.2024.104174.

Leng, J., Bump, A., Hosseini, S. A., Meckel, T. A., Wang, Z., and Wang, H., 2024, A comprehensive review of efficient capacity estimation for large-scale CO2 geological storage: Gas Science and Engineering, v. 126, no. 205339, 19 p., http://doi.org/10.1016/j.jgsce.2024.205339.

Ni, H., Bump, A. P., and Bakhshian, S., 2024, An experimental investigation on the CO2 storage capacity of the composite confining system: International Journal of Greenhouse Gas Control, v. 134, no. 104125, 10 p., http://doi.org/10.1016/j.ijggc.2024.104125.

Bakhshian, S., Bump, A. P., Pandey, S., Ni, H., and Hovorka, S. D., 2023, Assessing the potential of composite confining systems for secure and long-term CO2 retention in geosequestration: Scientific Reports, v. 13, no. 21022, 14 p., http://doi.org/10.1038/s41598-023-47481-2.

Bump, A. P., and Hovorka, S. D., 2023, Fetch-trap pairs: exploring definition of carbon storage prospects to increase capacity and flexibility in areas with competing uses: International Journal of Greenhouse Gas Control, v. 122, no. 103817, 10 p., http://doi.org/10.1016/j.ijggc.2022.103817.

Bump, A. P., and Hovorka, S. D., 2023, Minimizing exposure to legacy wells and avoiding conflict between storage projects: exploring area of review as a screening tool: International Journal of Greenhouse Gas Control, v. 129, no. 103967, 13 p., http://doi.org/10.1016/j.ijggc.2023.103967.

Bump, A. P., Bakhshian, S., Ni, H., Hovorka, S. D., Olariu, M. I., Dunlap, D., Hosseini, S. A., and Meckel, T. A., 2023, Composite confining systems: Rethinking geologic seals for permanent CO2 sequestration: International Journal of Greenhouse Gas Control, v. 126, no. 103908, 12 p., http://doi.org/10.1016/j.ijggc.2023.103908.

Duffy, O. B., Hudec, M. R., Peel, F., Apps, G., Bump, A., Moscardelli, L., Dooley, T. P., Fernandez, N., Bhattacharya, S., Wisian, K., and Shuster, M. W., 2023, The role of salt tectonics in the energy transition: an overview and future challenges: Tektonika, v. 1, no. 1, p. 18-48, http://doi.org/10.55575/tektonika2023.1.1.11.

Meckel, T. A., Treviño, R. H., Hovorka, S. D., and Bump, A. P., 2023, Mapping existing wellbore locations to compare technical risks between onshore and offshore CCS activities in Texas: Greenhouse Gases: Science and Technology, v. 13, no. 3, p. 493-504, http://doi.org/10.1002/ghg.2220.

Ulfah, M., Hosseini, S., Hovorka, S., Bump, A., Bakhshian, S., and Dunlap, D., 2022, Assessing impacts on pressure stabilization and leasing acreage for CO2 storage utilizing oil migration concepts: International Journal of Greenhouse Gas Control, v. 115, no. 103612, 13 p., http://doi.org/10.1016/j.ijggc.2022.103612.

Bump, A. P., Hovorka, S. D., and Meckel, T. A., 2021, Common risk segment mapping: streamlining exploration for carbon storage sites, with application to coastal Texas and Louisiana: International Journal of Greenhouse Gas Control, v. 111, no. 103457, 13 p., http://doi.org/10.1016/j.ijggc.2021.103457.

Meckel, T. A., Bump, A. P., Hovorka, S. D., and Treviño, R. H., 2021, Carbon capture, utilization, and storage hub development on the Gulf Coast: Greenhouse Gases: Science and Technology, v. 11, no. 4, p. 619-632, http://doi.org/10.1002/ghg.2082.

Bump, A. P., 2004, Three-dimensional Laramide deformation of the Colorado Plateau: competing influences of the Sevier thrust belt and the flat Farallon slab: Tectonics, v. 23, no. 1, article no. TC1008, 15 p., http://doi.org/10.1029/2002TC001424.

Bump, A. P., 2003, Reactivation, trishear modeling, and folded basement in Laramide uplifts: implications for the origins of intra-continental faults: GSA Today, v. 13, no. 3, p. 4-10, http://doi.org/http://dx.doi.org/10.1130/1052-5173(2003)013%3C0004:RTMAFB%3E2.0.CO;2.

Bump, A. P., and Davis, G. H., 2003, Late Cretaceous-early Tertiary Laramide deformation of the northern Colorado Plateau, Utah and Colorado: Journal of Structural Geology, v. 25, no. 3, p. 421-440, http://doi.org/10.1016/S0191-8141(02)00033-0.

Davis, G. H., Bump, A. P., Garcia, P. E., and Ahlgren, S. G., 2000, Conjugate Riedel deformation band shear zones: Journal of Structural Geology, v. 22, no. 2, p. 169-190, http://doi.org/10.1016/S0191-8141(99)00140-6.

## Non Peer Reviewed Journal Articles

Rodriguez, E., Bump, A., and Hovorka, S. D., 2024, Estimating CO2 Storage Capacity, Injectivity, and Storage Costs for Large Scale CCS Deployment & Carbon Dioxide Removal Goals: Social Science Research Network, GHGT-17 conference proceedings, 11 p., http://doi.org/10.2139/ssrn.5022393.

Bump, A., Bakhshian, S., Ni, H., Hovorka, S. D., Dunlap, D. B., Olariu, M. I., Hosseini, S. A., and Meckel, T., 2022, Composite confining systems: rethinking geologic seals for permanent CO2 sequestration: 16th Greenhouse Gas Control Technologies Conference, 23-27 October, Lyon, France, http://doi.org/10.2139/ssrn.4286411.

Bump, A. P., Hovorka, S. D., Meckel, T. J., Nuñez-López, V., Olariu, M. I., and Treviño, R. H., 2020, Carbon capture and storage potential in southern Louisiana: a new business opportunity: GeoGulf Transactions, v. 70, p. 73-84.

## Guidebooks

Bump, A., and Ahlgren, S. G., 2001, Regional to reservoir-scale structure and tectonics of the Colorado Plateau, in University of Arizona Geostructure Partnership 2nd Annual Field Conference Guidebook: 44 p.

# Conference Proceedings

Rodriguez Calzado, E., Hovorka, S. D., and Bump, A., 2022, Mapping CO2 Injectivity Potential Within Available CO2 Underground Storage Window in Sedimentary Rocks Across the United States, AGU Fall Meeting.

Bump, A., Kennan, L., and Fallon, J., 2008, Deformation history of the Andean Foreland, Peru, and its impact on present day structure, AAPG Annual Convention, San Antonio, Tex., 11 p.

# Published Reports

Jennifer Pett-Ridge, Sara Kuebbing, Allegra C. Mayer, Hovorka, S. D., Hélène Pilorgé, Sarah E. Baker, Simon H. Pang, Corinne D. Scown, Kimberly K. Mayfield, Andrew A. Wong, Roger D. Aines, Hamed Ziad Ammar, Alvin Aui, Mark Ashton, Bruno Basso, Mikel Bradford, Bump, A., Ingrid Busch, Rodriguez, E., Jackson W. Chirigotis, Nicolas Clauser, Sinead Crotty, Nicholas Dahl, Tao Dai, Mark Ducey, Jerome Dumortier, Nathan C. Ellebracht, Gil-Egui, R., Ames Fowler, Katerina Georgiou, Diamantoula Giannopolous, Hannah M. Goldstein, Thomas Harris, Dermot Hayes, Chad Hellwinckel, Alina Ho, Mu Hong, Elwin Hunter-Sellars, Whitney Kirkendall, Matthew Langholtz, Mark Layer, Ian Lee, Reid Lewis, Wengin Li, Weier Liu, Jimena Terrazas Lozano, Abby Lunstrum, Wilson McNeil, Peter Nico, Anastasia O'Rourke, K. Paustian, George Peridas, Maxwell Pisciotta, Lydia Price, Peter Psarras, G. Phillip Robertson, William Joe Sagues, Daniel L. Sanchez, Briana Mordick Schmidt, Eric W. Slessarev, Noah Sokol, Alexander J. Stanley, Amy Swan, Crystal Toureene, Mark Mba Wright, Yuan Yao, Bingquan Zhang, and Yao Zhang, 2023, Roads to Removal: Options for Carbon Dioxide Removal in the United States: Lawrence Livermore National Laboratory, v. 1, no. LLNL-TR-852901; 1080440, 559 p.