Sean G. Polun Ph.D.

Education

Doctoral Degree	Doctor of Philosophy in Geology	August 2018
University of Missouri		Columbia, MO

- Dissertation Title: Structural Geology, Tectonic Geomorphology, and Neotectonics of the Central Afar rift, Ethiopia and Djibouti
- Dissertation Advisor: Francisco Gomez, Ph.D.

Master's Degree	Master of Science in Geology	2011
Idaho State University		Pocatello, ID
Bachelor's Degree	Bachelor of Science in Geology	2009
University of Pittsburgh	GIS Certificate	Pittsburgh, PA

Research Appointments

Postdoctoral Research Fellow	June 2019 - Present
University of Missouri	Columbia, MO

Supervisors: Tandis Bidgoli, Ph.D. and Francisco Gomez, Ph.D.

- Contributed to a US Department of Energy project that characterized the suitability of a site in western Kansas for CO2 sequestration
  - Mapped faults within a 3D seismic volume acquired for the area
  - Developed a tool, pyFaultSlip, to assess the hazard of induced slip in the region if the site were to be developed into a CO2 repository
- Contributed to an American Chemical Society Petroleum Research Fund Project to investigate the neotectonic history of faulting within the Wind River Basin of Wyoming
  - Directed students during fieldwork and managed shallow seismic data acquisition
- Played a key role in developing several grant proposals to USGS, NASA, and NSF
- This work was funded via a DOE subcontract (Bidgoli) and ACS PRF grant (Gomez)

Research Associate	November 2018 – June 2019
University of Missouri	Columbia, MO

Supervisors: Francisco Gomez, Ph.D. and Samson Tesfaye, Ph.D.

- Examine the structural, tectonic, and geomorphic evolution of the Afar Triple Junction.
- Process InSAR data for the Afar Triple Junction and examine for signs of deformation
- Develop tools and workflows to relate deformation to observations from sUAS and satellite based DEMs.
- This work was funded via a NSF grant (Gomez and Tesfaye)

Doctoral Research	2013 – July 2018
University of Missouri	Columbia, MO

Supervisor: Francisco Gomez, Ph.D.

- Examine the structural, tectonic, and geomorphic evolution of the Afar Triple Junction.
- Conducted field research in the winters of 2015 and 2016, leading the 2016 field expedition.
- Conducted comprehensive study of fault population and scaling statistics in region.
- Analyzed geologic slip rates (determined with fault scarp morphometry and Cl^{36} TCN dating) and compared to geodetic extension rates.
- This work was funded via a NSF grant (Gomez and Tesfaye)

Master's Research	2009 - 2011
Idaho State University	Pocatello, ID

Supervisor: David Rodgers, Ph.D.

- Examine the structural evolution of the Blackfoot Volcanic Field in Caribou County, ID, and relate that evolution to the broader regional tectonic setting (Eastern Snake River Plain).
- Use GIS mapping and field observations to characterize structural geology of volcanic field.

Research Intern June – August 2007
Ruhr – University Bochum Bochum, Germany

Research Emphasis: Collaborate with researchers in the department of Geophysics to run forward seismic models to evaluate the effect of partial melting beneath the island of Santorini on seismic wave scattering. Wrote MATLAB scripts to automate workflow and initialization of model.

Research Grants

Contributions to Ongoing and Pending Funded Research

Pending **Investigation of paleoliquefaction of the Grand River Tectonic Zone (central Missouri)**
USGS – Earthquake Hazards Program, $89,360
Principal Investigators: Francisco Gomez, Ph.D. and Tandis Bidgoli, Ph.D.
University of Missouri, Columbia, MO
Role: Co-Investigator. Wrote the proposal with Gomez and Bidgoli. If funded (as of writing is panel approved), I will be the responsible for mapping of liquefaction deposits throughout the Grand River Valley, coordination of soil test pits and limited trenching, and managing the acquisition of a shallow seismic reflection / refraction profile.

2022 – **EAGER: Using machine learning to develop a calibrated, remote sensing-based age model to improve late Quaternary slip-rate estimates in arid environments**
NSF - Early-concept Grants for Exploratory Research, $173,272
P.I.s: Tandis Bidgoli, Ph.D., Francisco Gomez, Ph.D., Sean Polun, Ph.D
University of Missouri, Columbia, MO
Role: Co-Principal Investigator. Wrote the proposal with Bidgoli and Gomez. If funded, will be key personnel for developing machine learning model to relate surface properties from remote sensing to surface age. I provided preliminary data to form the basis of this proposal.

2020 – 2022 **Geophysical and geological investigation of Quaternary faulting in the petroliferous Wind River Basin (Wyoming)**
American Chemical Society – Petroleum Research Fund (New Directions), $110,000
P.I.s: Francisco Gomez, Ph.D. and Eric Sandvol, Ph.D.
University of Missouri, Columbia, MO
Role: Key personnel. Directed students during fieldwork and managed shallow seismic data acquisition. Assessing kinematic history of Chicken Springs Fault System in central Wyoming.

Contributions to Previously Funded Research

2019 – 2020 **Midcontinent Stacked Carbon Storage Hub: ICKan Phase II**
U.S. Department of Energy, $243,866
P.I.s: Tandis Bidgoli, Ph.D.
University of Kansas, Lawrence, KS and University of Missouri, Columbia, MO
Role: Key personnel. Mapped faults within a 3D seismic volume acquired for the area. Developed a tool, pyFaultSlip, to assess the hazard of induced slip in the region if the site were to be developed into a CO2 repository. Assisted writing final reports.

2014 – 2019 **Collaborative Research: Structure and Quaternary Kinematics of Amagmatic Rifting in the Central Afar Triple Junction**
National Science Foundation, $318,184
P.I.s: Francisco Gomez, Ph.D., Samson Tesfaye, Ph.D.
University of Missouri, Columbia, MO and Lincoln University, Jefferson City, MO
Role: Key personnel. Conducted field research in the winters of 2015 and 2016, leading the 2016 field expedition. Conducted comprehensive study of fault population and scaling statistics in region. Analyzed geologic slip rates (determined with fault scarp morphometry

and Cl^{36} TCN dating) and compared to geodetic extension rates. Helped develop concept of determining faulting initiation from knickpoint retreat for initial grant proposal.

Contributions to Submitted Grants

2020 **Establishing the link between deep fluid injection, surface deformation, and induced earthquakes in the US midcontinent through application of C- and L-band InSAR**
NASA – Research Opportunities in Space and Earth Science, $146,192
P.I.s: Tandis Bidgoli, Ph.D., Francisco Gomez, Ph.D., Sean Polun, Ph.D.
University of Missouri, Columbia, MO
Role: Co-P.I. Wrote the proposal with Bidgoli and Gomez. Conducted initial interferometry to demonstrate preliminary results. If funded, would have been responsible for most data handling, processing, and analysis.

2020 **Assessing slip partitioning between inaccessible portions of the eastern Garlock fault and the Eastern California shear zone using airborne and satellite remote sensing**
USGS – Earthquake Hazards Program, $60,214
P.I.s: Tandis Bidgoli, Ph.D., Francisco Gomez, Ph.D., Sean Polun, Ph.D.
University of Missouri, Columbia, MO
Role: Co-Principal Investigator. Wrote the proposal with Bidgoli and Gomez. If funded, would be key personnel for developing machine learning model to relate surface properties from remote sensing to surface age. I provided preliminary data to form the basis of this proposal.

2019, 2020 **Assessing slip partitioning between inaccessible portions of the eastern Garlock fault and the Eastern California shear zone using airborne and satellite remote sensing**
NASA – Research Opportunities in Space and Earth Science, $193,264
P.I.s: Tandis Bidgoli, Ph.D., Francisco Gomez, Ph.D., Sean Polun, Ph.D.
University of Missouri, Columbia, MO
Role: Co-Principal Investigator. Wrote the proposal with Bidgoli and Gomez. If funded, would be key personnel for developing machine learning model to relate surface properties from remote sensing to surface age. I provided preliminary data to form the basis of this proposal. Also contributed to resubmission (2020).

2019, 2021 **Investigating injection-induced earthquake hazards in the US midcontinent using InSAR**
USGS – Earthquake Hazards Program, $78,013
P.I.s: Francisco Gomez, Ph.D., Tandis Bidgoli, Ph.D., Sean Polun, Ph.D.
University of Missouri, Columbia, MO
Role: Co-P.I. Wrote the proposal with Gomez and Bidgoli. Conducted initial interferometry to demonstrate preliminary results. If funded, would have been responsible for most data handling, processing, and analysis. Also contributed to resubmission (2021).

2014 **Structure, kinematics, and stratigraphy of a tectonically controlled basin from shallow seismic reflection surveying in Dobe graben, Ethiopia**
American Chemical Society – Petroleum Research Fund (New Directions), $110,000
P.I.s: Francisco Gomez, Ph.D. and Eric Sandvol, Ph.D.
University of Missouri, Columbia, MO
Role: Key personnel. Wrote proposal with Gomez. Helped develop concept for proposal and research plan.

Teaching Experience

Graduate Teaching Assistant		**2013 – Present**
University of Missouri		Columbia, MO
Courses Taught:		Semester:
GEOL 1100 (Lab)	Principles of Geology (Lab)	F13, S17, S18
GEOL 1150 (Lab)	Principles of Geology for Scientists and Engineers (Lab)	S14
GEOL 2400 (Lab)	Surficial Processes and Products (Lab)	F13, F14
GEOL 4002 / 7002 (Lab)	Geoscience Remote Sensing (Lab)	S16
GEOL 3650 (Lab)	Structural Geology (Lab)	F15, F16
GEOL 4120 / 7120 (TA)	Engineering Geology (TA)	S17

Graduate Teaching Assistant		**2009 – 2011**
Idaho State University		Pocatello, ID
Courses Taught:		Semester:
GEOL 4421L	Structural Geology Lab	S10, S11
GEOL 1100L	Principles of Geology Lab	F09, F10
GEOL 2210L	Earth in Space and Time	F10

Honors, Awards, and Recognition

James Stitt Teaching Award — U. Missouri Dept. of Geological Sciences — 4/2016

Recognition by the Geological Sciences faculty for excellence by a graduate teaching assistant

Other Certification and Licensure

FAA Remote Pilot Certificate (sUAS Rating) — Effective 2018 - 2022

Publications

Polun, S., and Bidgoli, T., Introducing PyFaultSlip: A free and open-source tool for the assessment of induced fault slip hazards from deep fluid injection, *Computers and* Geoscience (Submitted)

Polun, S., Gomez, F., and Tesfaye, S., Spatial evolution of the central Afar Depression (Ethiopia and Djibouti): Insights from stream incision models, Geology (Submission pending acceptance of Geomorphology paper)

Polun S., Gomez, F., and Tesfaye, S., Characterization of late Quaternary extension rates across the amagmatic central Afar rift (Ethiopia and Djibouti) from uplift rates and GPS geodesy, Tectonics (Submission pending acceptance of Geomorphology paper)

Polun, S., D. Horrell, S. Tesfaye, & F. Gomez,. Fluvial re-entrenchment as a constraint on graben formation in the central Afar (Ethiopia & Djibouti). *Geomorphology*, Submitted.

Polun, S., 2018, Structural Geology, Tectonic Geomorphology, and Neotectonics of the Central Afar rift, Ethiopia and Djibouti, Ph.D. Dissertation, University of Missouri, Columbia, MO, 107p.

Polun, S., Gomez, F., and Tesfaye, S., 2018, Scaling properties of normal faults in the central Afar, Ethiopia and Djibouti: Implications for strain partitioning during the final stages of continental breakup, Journal of Structural Geology 115, p 178 – 189, doi: 10.1016/j.jsg.2018.07.018.

Polun, S., 2011, Kinematic analysis of late Pleistocene faulting in the Blackfoot Lava Field, Caribou County, Idaho. M.S. Thesis, Idaho State University, Pocatello, ID. 86 p.

Conference Talks

Polun, S., and Bidgoli, T., 2021, Enabling safe and efficient deep fluid injection with new open-source tools: Application of pyFaultSlip for assessing induced slip risks and CO2 storage in Oklahoma and Kansas, AGU Fall Meeting, New Orleans, LA.

Polun, S., Gomez, F., Potter, M., Altunas, G., Heins, J., and Ludwig, K., 2021, Geometric and kinematic analysis of the Chicken Springs fault system, a diffuse Holocene fault system in the Great Divide Basin, Wyoming

Polun, S., Horrell, D., Tesfaye, S., and Gomez, F., 2017, New kinematic constraints on the Quaternary tectonic evolution of the Afar triple junction, GSA Annual Meeting, Seattle, WA.

Polun, S., Hickcox, K., Tesfaye, S., and Gomez, F., 2016, Quantifying strain partitioning between magmatic and amagmatic portions of the Afar triple junction of Ethiopia and Djibouti through use of contemporary and late Quaternary extension rates, AGU Fall Meeting, San Francisco, CA

Conference Posters as Presenting Author

Polun, S., Bidgoli, T., and Gomez, F., 2021, Developing an integrated surface-age — remote sensing spectral property model to enable slip rate studies in inaccessible regions: Examples and challenges from the Mojave Desert. AGU Fall Meeting, New Orleans, LA.

Polun, S., and Bidgoli, T., 2020, Assessing slip tendency of cryptic faults in southern Kansas with a new open source, extensible tool: Introducing pyFaultSlip. AGU Fall Meeting, San Francisco, CA

Polun, S., Bidgoli, T., and Gomez, F., 2020. Determining ages of faulted surfaces along inaccessible portions of the eastern Garlock Fault using radiometric assessments of surface character: Applications for slip rate studies. GSA Connects Online, Montreal, Canada

Polun, S., Bidgoli, T., and Jennings, J., 2019. Slip tendency on cryptic faults in the Patterson Storage Site, a proposed CO_2 repository in SW Kansas: Quantifying potential injection-induced seismicity hazards. AGU Fall Meeting, San Francisco, CA

Gomez, F., **Polun, S**., and Bidgoli, T., 2019. Injection-induced surface deformation in central Kansas observed with Sentinel 1 interferometric SAR (InSAR): Tools for rapid and independent monitoring. AGU Fall Meeting, San Francisco, CA

Polun, S., Bidgoli, T., Gomez, F., and Ansari, E., 2019. Observing injection-induced surface deformation in the US midcontinent with interferometric SAR (InSAR): New methods for monitoring induced seismicity. GSA Annual Meeting, Phoenix, AZ

Polun, S., Bidgoli, T., and Gomez, F. 2019. Assessing alluvial fan surface ages along inaccessible portions of the eastern Garlock Fault, southeastern California, with aerial LiDAR, SAR Backscatter, and multispectral data: Implications for slip rate studies. GSA Annual Meeting, Phoenix, AZ

Polun, S., Stockman, M., Hickcox, K., Horrell, D., Tesfaye, S., and Gomez, F., 2015, Assessment of late Quaternary strain partitioning in the Afar Triple Junction: Dobe and Hanle grabens, Ethiopia and Djibouti, AGU Fall Meeting, San Francisco, CA

Polun, S., Tesfaye, S., and Gomez, F., 2015, Fault scaling in an incipient rift: Example from the Afar Triple Junction, Ethiopia and Djibouti, AAPG Annual Convention and Expo, Denver, CO (Poster)

Polun, S., Rodgers, D., and McCurry, M., 2010, Kinematic analysis of late Pleistocene faulting in the bimodal Blackfoot Volcanic Field, Idaho, USA: Evidence of dike-induced faulting?, GSA Annual Meeting, Denver, CO (Poster)