

# **Richard Styron, PhD, LG**

*Field and Computational Geoscience*

## **Contact**

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## **Current Position**

Active Fault Scientist  
Global Earthquake Model Foundation  
Portland, OR / Pavia, Italy

## **Primary Research Interests:**

- Active tectonics, earthquake processes and seismic hazard
- Scientific computing
- Innovation in quantitative geoscience

## **Education**

*University of Kansas*, PhD, Geology, 2012  
Thesis: Estimating fault slip rates in the Indo-Asian Collision Zone over 10-10<sup>6</sup> yr timescales  
Primary advisor: Michael Taylor

*University of Arkansas*, MS, Geology, 2008  
Thesis: Kinematics of the western margin of Nicaragua from GPS geodesy  
Primary advisor: Glen Mattioli

*University of Arkansas*, BS, Geology, 2005

## **Certifications**

Licensed geologist in Washington State (License #3190)

## Experience:

### *Roles:*

- 2016-present: Active Fault Specialist, *Global Earthquake Model Foundation*. Major projects include the creation and maintenance of the GEM Global Active Fault Database, the first public, comprehensive global dataset of active fault traces and associated attributes; the development of *Hamlet*, an application for statistical testing of seismic hazard models; development of computational tools and workflows for fault and rupture modeling in seismic hazard; and the development of the GEM Global Block Model.
- 2016-present: Adjunct Researcher, University of Kansas
- 2014-present: Principal, *Earth Analysis*. Geophysical consulting, academic and governmental scientific collaboration.
- 2013-2014: Post-doctoral scholar, *University of Michigan, Ann Arbor*. Developed coupled physical and statistical computational model for topographic and tectonic stress calculations, with Eric Hetland.
- 2012-2014: Consultant, *Instituto Colombiano del Petroleo*. Worked with the ICP on thermal and kinematic modeling of the development of the Colombian Andes. Performed modeling, geologic cross-section construction, and software development (including HPC cluster and cloud software).
- 2008-2012: Patterson Fellow, Teaching Assistant, *University of Kansas*. PhD research into active faulting and fault evolution in south Tibet and the Himalaya, additional research on northern Andes faults, taught variety of geology field and lab courses.
- 2006-2008: Research Assistant, Teaching Assistant, *University of Arkansas, Fayetteville*. MS research in GPS tectonic geodesy in Nicaragua, and ancillary research in Caribbean volcano deformation, taught upper and lower-level geology lab courses.

### *Leadership, Logistics and Service:*

- Extensive research collaboration with academics (professors, graduate and undergraduate students, laboratories), nonprofits, government researchers, and energy companies.
- 8 semesters (classroom) and 3 summers (field) teaching experience. Courses taught include Intro Geology, Petrology, Structure, Environmental Geology, Natural Hazards, Earth History, Field Camp, Advanced Field Methods
- Lead or co-lead 8 international field campaigns (Nicaragua, Dominica, Tibet, Mexico, Peru), several domestic field trips; whitewater raft, kayak and mountain bike guide.
- Organized and judged student research symposia, all officer roles in student geology clubs, founded undergraduate mentor program (grad students mentoring undergrads).
- Peer reviewer for *Geophysical Research Letters*, *G-Cubed*, *Tectonics*, *Journal of Geophysical Research*
- Creator/maintainer of active fault databases in Caribbean and Central America, North Africa, Northeastern Asia, Tibet/Himalaya and the Andes; also the GEM Global Active Fault Database

### *Fieldwork:*

- 5x GPS geodetic field campaigns in Nicaragua and Dominica, 2x tectonic (mapping, thermochronology, cosmogenic nuclide) field campaigns in Tibet, 2x mapping projects on/near Garlock fault (CA), stratigraphic section measuring in Peruvian Andes, LiDAR survey in Sierra El Mayor/ Cucapah (Mexico), 3x Teaching Assistant, KU Geology Field Camp, CO

### *Computational work:*

- Wrote programs for calculating crustal and fault stresses, Monte Carlo simulations of earthquake rupture histories, cosmogenic nuclide depth profilers, statistical (Bayesian) and 'cloud computing' wrappers for thermochronology models, and many others
- Significant use of pre-existing modeling software for thermochronology and cosmogenic nuclide dating, GIS

- Familiarity with web development, and progressing on making scientific web applications for data visualization, statistical analysis, and mapping

#### *Consulting:*

- Modeling (and model software construction) of thermochronologic and structural geologic cross sections in the Colombian Andes
- Analysis of the effects of topographic stresses on the 2015 Gorkha, Nepal earthquake
- Analysis of the stresses produced by magma chamber inflation, topography and tectonics at the Newberry, Oregon enhanced geothermal site
- Statistical characterization of paleo-earthquake magnitudes and recurrence intervals in the Puget Lowland, WA

#### *Laboratory work*

- Geochronology: Zircon and apatite (U-Th)/He mineral separation, picking, noble gas and ICP mass-spectrometry,  $^{10}\text{Be}$  and  $^{36}\text{Cl}$  TCN sample preparation and isolation
- Dendrochronology: Tree-ring specimen preparation, ring width measurements, chronology development

## Computing Skills and Interests

#### *Programming Languages:*

- Extensive use of Python (daily use for years), proficient with Matlab
- Some experience with C++, Mathematica, Lisp (Racket), R, SQL, JavaScript, Julia

#### *Software:*

- Very comfortable with Linux, OS X, Windows
- Amazon AWS, GMT, ArcGIS, QGIS, Envi
- Adobe Creative Suite, MS Office Suite, LaTeX
- Many geoscientific finite element modeling codes

#### *Computing interests:*

- Scientific Computing: Physical and statistical (esp. Bayesian) modeling, open-source scientific tools and application development
- Web development, learning new programming languages and frameworks

## Scientific Output

#### **Publications:**

1. Fang, J., Wright, T., Johnson, K., Ou, Q., **Styron, R.**, Craig, T., Elliott, J., Hooper, A., Zheng, G., 2024, Strain Partitioning in the Southeastern Tibetan Plateau from Kinematic Modeling of High-Resolution Sentinel-1 InSAR and GNSS, *Geophysical Research Letters*, doi: 10.1029/2024GL111199, *in press*.
2. Johnson, K., Chartier, T., Pagani, M., Perez, Y., Guzmán, V., Roque de Medina, M. B., **Styron, R.**, Yopez-Estrada, C., 2024, Probabilistic seismic hazard analysis for the Dominican Republic, *Earthquake Spectra*, doi: 10.1177/87552930241263618, *in press*.
3. Saxena, R., Dannberg, J., Gassmüller, R., Fraters, M., Heister, T., **Styron, R.**, 2023, High-resolution mantle flow models reveal importance of plate boundary geometry and slab pull forces on generating tectonic plate motions, *Journal of Geophysical Research: Solid Earth*, vol. no. 8, e2022JB025877. doi: 10.1029/2022JB025877
4. **Styron, R.** and Sherrod, B, 2021, Improving paleoseismic magnitude estimates with rupture length information: application to the Puget Lowland, WA USA, *Bulletin of the Seismological Society of America*, vol. 111, no. 2, p. 1139-1153. doi: 10.1785/0120200193.

5. Johnson, K., Pagani, M., and **Styron, R.**, 2021, PSHA of the southern Pacific Islands, *Geophysical Journal International*, vol. 224, no. 3, p. 2149-2172. doi: 10.1093/gji/ggaa530.
6. Morell, K., **Styron, R.**, Stirling, M., Griffin, J., Archuleta, R., and Onur, T., 2020, Seismic Hazard Analyses from Geologic and Geomorphic Data: Current and future challenges, *Tectonics*, vol. 39, no. 10. doi: 10.1029/2018TC005365.
7. **Styron, R.** and Pagani, M. 2020, The GEM Global Active Faults Database (GAF-DB), *Earthquake Spectra*, vol 36. , no. 1\_suppl, doi: 10.1177/8755293020944182.
8. **Styron, R.**, García-Pelaez, J., and Pagani, M., 2020, CCAF-DB: The Caribbean and Central American Active Fault Database, *Natural Hazards and Earth System Science*, vol. 20, p.831-857, doi:10.5195/nhess-200-831-2020.
9. Pagani, Marco, García-Pelaez, Julio, Gee, Robin, Johnson, Kendra L., Silva, Vitor, Simionato, Michele, **Styron, R.**, et al., 2020, The 2018 version of the Global Earthquake Model: Hazard component, *Earthquake Spectra*, in press.
10. Poggi, V., Garcia-Peláez, J., **Styron, R.**, Pagani, M., and Gee, R., 2020, A Probabilistic Seismic Hazard Model for North Africa, *Bulletin of Earthquake Engineering*, in press. DOI: 10.1007/s10518-020-00820-4
11. Henremagne C. Peñarubia, Johnson, Kendra L., **Styron, R.**, Bacolcol, T. C., Sevilla, W. I. G., Perez, J. S., et al., 2020, Probabilistic Seismic Hazard Analysis model for the Philippines, *Earthquake Spectra*, DOI: 10.1177/8755293019900521, in press.
12. **Styron, R.**, 2019, The impact of earthquake cycle variability on neotectonic and paleoseismic slip rate estimates, *Solid Earth*, vol. 10, p.15-25, doi: 10.5194/se-2019-10.
13. Sundell, K., Saylor, J., Lapen, T., **Styron, R.**, Villareal, D., Usnayo, P., and Cárdenas, J., 2018, Peruvian Altiplano stratigraphy highlights along-strike variability in foreland basin evolution of the Cenozoic central Andes, *Tectonics*, vol. 37, no. 6, p. 1876-1904, doi: 10.1029/2017TC004775.
14. Staisch, L., Blakely, R., Kelsey, H., **Styron, R.**, and Sherrod, B., 2018, Miocene to present-day deformation rates in central Washington, USA, Revealed by stream profiles, potential-field geophysics, and structural geology of the Yakima folds, *Tectonics*, vol. 37, no. 6, p. 1750-1770, doi: 10.1029/2017TC004916.
15. Staisch, L., Kelsey, K., Sherrod, B., Möller, A., Paces, J., and **Styron, R.**, 2017, Miocene-Pleistocene deformation of the Saddle Mountains: implications for seismic hazard in central Washington, USA. *Geological Society of America Bulletin*, vol. 130, no. 3-4, p. 411-437, doi:10.1130/B31783.1.
16. Evans, S. L., **Styron, R. H.**, Soest, M. C., Hodges, K. V., and Hanson, A. D., 2015, Zircon and apatite (U-Th)/He evidence for Paleogene and Neogene extension in the Southern Snake Range, Nevada, USA. *Tectonics*, vol. 34, no. 10, 2142-2164. doi: 10.1002/2015TC003913.
17. **Styron, R.** and Hetland, E., 2015, The weight of the mountains: Constraints on tectonic stress, friction, and fluid pressure in the 2008 Wenchuan earthquake from estimates of topographic loading, *Journal of Geophysical Research: Solid Earth*, vol. 120, no. 4, 2697-2716. doi: 10.1002/2014JB011338.
18. **Styron, R.**, Taylor, M., and Sundell, K., 2015, Accelerated extension of the Tibetan plateau linked to the northward underthrusting of Indian crust, *Nature Geoscience*, vol. 8, no. 2, p. 131-134. doi: 10.1038/ngeo2336.
19. **Styron, R.** and Hetland, E., 2014, Estimated likelihood of observing a large earthquake on a continental low-angle normal fault and implications for low-angle normal fault activity, *Geophysical Research Letters*, vol. 41, no. 7, doi: 10.1002/2014GL059335.
20. McCallister, A., Taylor, M., Murphy, M., **Styron, R.**, Stockli, D., 2014, Thermochronologic constraints on the late Cenozoic exhumation history of the Gurla Mandhata metamorphic core complex, Southwestern Tibet, *Tectonics*, vol. 33, p. 27-52, doi: 10.1002/2013TC003302.
21. Sundell, K., Taylor, M., **Styron, R.**, Stockli, D., Kapp, P., Hager, C., Liu, D., Ding, L., 2013, Evidence for constriction and Pliocene acceleration of east-west extension in the North Lunggar rift region of west-central Tibet, *Tectonics*, vol. 32, no. 5, p. 1454-1479, doi: 10.1002/tect.20086.

22. **Styron, R.**, Taylor, M., Sundell, K., Stockli, D., Oalman, J., Möller, A., McCallister, A., Liu, D., Ding, L., 2013, Miocene initiation and acceleration of extension in the the South Lunggar rift, western Tibet: Rates, timing and magnitude of deformation of an active detachment system, *Tectonics*, vol. 32, no. 4, p. 880-907, doi: 10.1002/tect.20053.
23. Veloza, G., **Styron, R.**, Taylor, M., Mora, A., 2012, Active Tectonics of the Andes: An open-source archive for active faults in northwestern South America, *GSA Today*, vol. 22, no. 10, p. 4-10, doi: 10.1130/GSAT-G156A.1.
24. **Styron, R.**, Taylor, M., Murphy, M., 2011, Oblique convergence, arc-parallel extension, and strike-slip faulting in the High Himalaya, *Geosphere*, vol. 7, no. 2, 587-596, doi: 10.1130/GES00606.1.
25. **Styron, R.**, Taylor, M., and Okoronkwo, K., 2010, *HimaTibetMap-1.0*: new 'web-2.0' online database of active structures from the Indo-Asian collision, *Eos*, vol. 91 no. 20. doi: 10.1029/2010EO200001.

#### **Publications in revision**

1. King, T., Elliott, A., Gruetzner, C., **Styron, R.**, Walker, R., The Tien Shan Active Fault Database: a multi-tiered multi-purpose active fault database, *Nature: Scientific Data*, *in revision*
2. **Styron, R.**, *in revision*, Contemporary Slip Rates of All Active Faults in the Indo-Asian Collision Zone, *Seismica*. Pre-print DOI: 10.10512747.1.

#### **Publications in review**

1. Sundell, K., Eden, **Styron, R.**, Villarreal, D. P., Usnayo, P., Saylor, J. E., Göğüş, O. H., Lapen, T. J., Finney, B., Cardenas, J., Carlotto, V., Tectonic and climatic controls on late Cenozoic intra-arc basin development in the central Andes of Peru, *Earth and Planetary Science Letters*, *in review*.