

## Tao Wen

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### EDUCATION

<b>University of Michigan (UM)</b>	Ann Arbor, Michigan
<b>Ph.D.</b> , Earth and Environmental Sciences Department	<i>April 2017</i>
<b>M.S.</b> , Earth and Environmental Sciences Department	<i>April 2014</i>
<b>University of Science and Technology of China (USTC)</b>	Hefei, China
<b>B.S.</b> , School of Earth and Space Science	<i>July 2011</i>

### POSITIONS HELD

- **Postdoctoral Scholar, EESI at Penn State University (February 2017 – Present)**
- **Graduate Student Researcher, Noble Gas Laboratory at University of Michigan (2011 – 2017)**
- **Undergraduate Researcher, Institute of Polar Environment at USTC (2009 – 2011)**
- **Undergraduate Researcher, Advanced Laboratory for Environmental Research and Technology at Suzhou, China (2009 Summer)**

### AWARDS AND SCHOLARSHIP

#### **Best Student Poster Presentation**

American Institute of Professional Geologists Michigan Section, December 2016

#### **Scott Turner Research Awards**

University of Michigan, Department of Earth and Environmental Sciences, Fall 2015, 2016

#### **Stewart R. Wallace Fellowship**

University of Michigan, Department of Earth and Environmental Sciences, Fall 2012

#### **Rackham Conference Travel Grant**

University of Michigan, Fall 2012, 2013, 2014, 2015, 2016

#### **Excellent Undergraduate Researcher Award**

University of Science and Technology of China, 2011

#### **Guanghua Education Scholarship**

University of Science and Technology of China, 2010

#### **Outstanding Student Scholarship**

University of Science and Technology of China, 2008, 2009

### PUBLICATIONS

#### **Peer Reviewed Publications**

15. **Wen, T.**, Liu, M., Zheng, G., Li, Z. and Brantley, S.L., Applying Machine Learning to Predict

- Missing Methane Data and Detect Anomalous Methane in Groundwater. *In preparation*.
14. Woda, J., **Wen, T.**, Oakley, D., Yoxtheimer, D., Engelder, T., Castro, M.C. and Brantley, S.L., Detecting and Explaining Why Aquifers Occasionally Become Degraded Near Hydraulically Fractured Shale Gas Wells. *Under revision*.
  13. Zheng, G., Liu, M., **Wen, T.**, Wang, H., Yao, H., Brantley, S.L. and Li, Z., Targeted Source Detection for Environmental Data. *Under review*.
  12. **Wen, T.**, Agarwal, A., Xue, L., Chen, A., Herman, A., Li, Z. and Brantley, S.L., Slight Degradation of Groundwater Quality in the Region of Longstanding Oil and Gas Development in the Marcellus Shale Area. *Submitted*.
  11. Larson, T.E., Nicot, J.P., Mickler, P., Castro, M.C., Darvari, R., **Wen, T.** and Hall, C.M., 2018. Monitoring Stray Natural Gas in Groundwater with Dissolved Nitrogen. An Example from Parker County, Texas. *Water Resources Research*.
  10. **Wen, T.**, Niu, X., Gonzales, M., Zheng, G., Li, Z. and Brantley, S.L., 2018. Big Groundwater Data Sets Reveal Possible Rare Contamination Amid Otherwise Improved Water Quality for Some Analytes in a Region of Marcellus Shale Development. *Environmental Science & Technology*.
  9. Niu, X., **Wen, T.**, Li, Z. and Brantley, S.L., 2018. One Step toward Developing Knowledge from Numbers in Regional Analysis of Water Quality. *Environmental Science & Technology*.
  8. **Wen, T.**, Pinti, D.L., Castro, M.C., López-Hernández, A., Hall, C.M., Shouakar-Stash, O. and Sandoval-Medina, F., 2018. A Noble Gas and  $^{87}\text{Sr}/^{86}\text{Sr}$  Study in Fluids of the Los Azufres Geothermal Field, Mexico – Assessing Impact of Exploitation and Constraining Heat Sources. *Chemical Geology*.
  7. Brantley, S.L., Vidic, R.D., Brasier, K., Yoxtheimer, D., Pollak, J., Wilderman, C. and **Wen, T.**, 2018. Engaging over data on fracking and water quality. *Science*, 359(6374), pp.395-397.
  6. **Wen, T.**, Castro, M.C., Nicot, J.P., Hall, C.M., Pinti, D.L., Mickler, P., Darvari, R. and Larson, T., 2017. Characterizing the noble gas isotopic composition of the Barnett Shale and Strawn group and constraining the source of stray gas in the Trinity Aquifer, north-central Texas. *Environmental Science & Technology*, 51(11), pp.6533-6541.
  5. **Wen, T.**, Castro, M.C., Nicot, J.P., Hall, C.M., Larson, T., Mickler, P. and Darvari, R., 2016. Methane Sources and Migration Mechanisms in Shallow Groundwaters in Parker and Hood Counties, Texas - A Heavy Noble Gas Analysis. *Environmental Science & Technology*, 50(21), pp.12012-12021.
  4. **Wen, T.**, Castro, M.C., Ellis, B.R., Hall, C.M. and Lohmann, K.C., 2015. Assessing compositional variability and migration of natural gas in the Antrim Shale in the Michigan Basin using noble gas geochemistry. *Chemical Geology*, 417, pp.356-370.
  3. **Wen, T.**, Castro, M.C., Hall, C.M., Pinti, D.L. and Lohmann, K.C., 2016. Constraining groundwater flow in the Glacial Drift and Saginaw aquifers in the Michigan Basin through helium concentrations and isotopic ratios. *Geofluids*, 16(1), pp.3-25.
  2. Boucher, C., Pinti, D.L., Roy, M., Castro, M.C., Cloutier, V., Blanchette, D., Larocque, M., Hall, C.M., **Wen, T.** and Sano, Y., 2015. Groundwater age investigation of eskers in the Amos region, Quebec, Canada. *Journal of Hydrology*, 524, pp.1-14.

1. Nie, Y., Liu, X., **Wen, T.**, Sun, L. and Emslie, S.D., 2014. Environmental implication of nitrogen isotopic composition in ornithogenic sediments from the Ross Sea region, East Antarctica:  $\Delta^{15}\text{N}$  as a new proxy for avian influence. *Chemical Geology*, 363, pp.91-100.

#### Non-Peer Reviewed Publications

4. **Wen, T.**, 2017. *Development of Noble Gas Techniques to Fingerprint Shale Gas and to Trace Sources of Hydrocarbons in Groundwater* (Doctoral dissertation, University of Michigan).
3. Nicot, J.P., et al., 2015. *Understanding and Managing Environmental Roadblocks to Shale Gas Development: An Analysis of Shallow Gas, NORM, and Trace Metals* (Technical Report, <http://www.rpsea.org/projects/11122-56/>).
2. **Wen, T.**, 2014. *Constraining groundwater flow in the Glacial Drift and Saginaw Aquifers in the Michigan Basin through helium concentrations and isotopic ratios* (Master thesis, University of Michigan).
1. **Wen, T.**, 2011. *Analysis on nitrogen species and isotopic composition of the ornithogenic sediments from Cape Bird, Ross Island, East Antarctica* (Bachelor thesis, University of Science and Technology of China).

#### CONFERENCE PRESENTATIONS

23. **Wen, T.**, Niu, X., Pollak, J., Brazil, L., Li, Z., and Brantley, S.L., Using Shale Network Database to Assess the Water Quality Data in Marcellus Shale Area. UCOWR-NIWR Annual Water Resources Conference, Pittsburgh, PA, 06/2018. [Invited Talk]
22. **Wen, T.**, A Multi-disciplinary and Multi-stakeholder Framework to Evaluate Environmental Impacts of Shale Gas Production. Energy Days Conference, University Park, PA, 05/2018. [Oral]
21. **Wen, T.**, Liu, M., Zheng, G., Niu, X., Gonzales, M., Woda, J., Li, Z., and Brantley, S.L., Applying machine learning in water quality data: implication for controlling factors and occurrence time of elevated methane in groundwater. Shale Network Workshop, University Park, PA, 05/2018. [Poster]
20. **Wen, T.**, Zheng, G., Liu, M., Niu, X., Gonzales, M., Woda, J., Li, Z., and Brantley, S.L., Applying Machine Learning to Detect Anomalous Methane in Groundwater. PA Groundwater Symposium, State College, PA, 05/2018. [Oral]
19. **Wen, T.**, Niu, X., Gonzales, M., Li, Z., and Brantley, S.L., Applying Data Mining Techniques to Chemical Analyses of Pre-drill Groundwater Samples within the Marcellus Formation Shale Play in Bradford County, Pennsylvania. AGU Fall Meeting, New Orleans, LA, 12/2017. [Poster]
18. Pinti, D.L., **Wen, T.**, Castro, M.C., López-Hernández, A., Hall, C.M., Shouakar-Stash, O. and Sandoval-Medina, Using noble gases and  $^{87}\text{Sr}/^{86}\text{Sr}$  to constrain heat sources and fluid evolution at the Los Azufres Geothermal Field, Mexico. AGU Fall Meeting, New Orleans, LA, 12/2017. [Poster]
17. **Wen, T.**, Castro, M.C., Nicot, J.P., Hall, C.M., Pinti, D.L., Mickler, P., Darvari, R. and Larson, T., Barnett Shale or Strawn Group: Identifying the Source of Stray Gas through Noble Gases

- in the Trinity Aquifer, North-Central Texas. AGU Fall Meeting, New Orleans, LA, 12/2017. [Oral]
16. **Wen, T.**, Niu, X., Gonzales, M., Li, Z., and Brantley, S.L., Using Data Mining Techniques to Assess Water Quality within the Marcellus Shale Play. Geochemistry Forum, State College, PA, 12/2017. [Oral]
  15. Brantley, S.L., Gonzales, M., Guarnieri, M., Niu, X., **Wen, T.** and Li, Z., Investigating Chemical Analyses of Ground Waters Sampled by Shale-gas Industry Consultants Before Gas-well Drilling in Pennsylvania. Pennsylvania Groundwater Symposium, State College, PA, 05/2017. [Oral]
  14. **Wen, T.**, Castro, M.C., Nicot, J.P., Hall, C.M., Larson, T., Mickler, P. and Darvari, R., Methane Sources and Migration Mechanisms in the Shallow Trinity Aquifer in Parker and Hood Counties, Texas – a Noble Gas Analysis. Shale Network Workshop, University Park, PA, 05/2017. [Poster]
  13. **Wen, T.**, Pinti, D.L., Castro, M.C., Hall, C.M., Shouakar-Stash, O. and López-Hernández, A., Fluids in the Los Azufres Geothermal Field, Mexico traced by noble gas isotopes and  $^{87}\text{Sr}/^{86}\text{Sr}$ . GAC-MAC Meeting, Kingston, Canada, 05/2017. [Poster]
  12. **Wen, T.**, Development of noble gas techniques to fingerprint shale gas and to trace hydrocarbons in groundwater. China University of Geosciences, Wuhan, China, 03/2017. [Invited, Oral]
  11. **Wen, T.**, Castro, M.C., Nicot, J.P., Hall, C.M., Mickler, P. and Darvari, R., Methane Sources and Migration Mechanisms in the Shallow Trinity Aquifer in Parker and Hood Counties, Texas – a Noble Gas Analysis. AGU Fall Meeting, San Francisco, CA, 12/2016. [Oral]
  10. **Wen, T.**, Castro, M.C., Nicot, J.P., Hall, C.M., Larson, T., Mickler, P. and Darvari, R., Methane Sources and Migration Mechanisms in the Shallow Trinity Aquifer in Parker and Hood Counties, Texas – a Noble Gas Analysis. AIPG Michigan Section, Ann Arbor, MI, 12/2016. [Poster]
  9. Castro, M.C., **Wen, T.**, Nicot, J.P., Hall, C.M., Mickler, P. and Darvari, R., Methane Sources in Shallow Groundwaters in Parker and Hood Counties, Texas – A Heavy Noble Gas Analysis. Goldschmidt, Yokohama, Japan, 06/2016. [Oral]
  8. **Wen, T.**, Castro, M.C., Nicot, J.P., Hall, C.M., Mickler, P. and Darvari, R., Identifying the Sources of Methane in Shallow Groundwaters in South-central Texas through Noble Gas Signatures. AAPG ACE, Calgary, Canada, 06/2016. [Oral]
  7. **Wen, T.**, Castro, M.C., Ellis, B.R., Hall, C.M. and Lohmann, K.C., Assessing Compositional Variability and Migration of Natural Gas in Antrim Shale in the Michigan Basin Using Noble Gas Geochemistry. AGU Fall Meeting, San Francisco, CA, 12/2015. [Poster]
  6. Castro, M.C., **Wen, T.**, Nicot, J.P., Hall, C.M., Mickler, P. and Darvari, R., Identifying the Sources of Methane in Shallow Groundwaters in Parker and Hood Counties, Texas through Noble Gas Signatures. AGU Fall Meeting, San Francisco, CA, 12/2015. [Oral]
  5. **Wen, T.**, Castro, M.C., Ellis, B.R. and Hall, C.M., Using Noble Gases to Assess the Compositional Variability and Sources of Natural Gas in the Antrim Shale, Michigan Basin, USA. AAPG Eastern Section Meeting, Indianapolis, IN, 09/2015. [Poster]

4. **Wen, T.**, Castro, M.C., Ellis, B.R., Hall, C.M., Lohmann, K.C. and Bouvier, L., Assessing the Compositional Variability and Migration of Natural Gas in Antrim Shale in the Michigan Basin Using Noble Gas Geochemistry. AAPG ACE, Denver, CO, 06/2015. [Oral]
3. **Wen, T.**, Castro, M.C., Ellis, B.R., Hall, C.M., Lohmann, K.C. and Bouvier, L., Noble Gas Signatures in Antrim Shale Gas in the Michigan Basin-Assessing Compositional Variability and Transport Processes. AGU Fall Meeting, San Francisco, CA, 12/2014. [Poster]
2. **Wen, T.**, Castro, M.C. and Hall, C.M., Constraining Groundwater Flow in the Michigan Basin Through Helium Concentrations and Isotopic Ratios in the Saginaw Aquifer, Southern Michigan. AGU Fall Meeting, San Francisco, CA, 12/2012. [Poster]
1. **Wen, T.**, Liu, X. and Sun, L., Variations of  $\delta^{15}\text{N}$  values in ornithogenic sediments on tropical Dongdao Island of South China Sea and their influencing factors. The 18th International Conference on Environmental Indicators, Hefei, China, 2010. [Poster]

## TEACHING

### Workshop Instructor in Shale Network Workshop, Pennsylvania State University May 2018

- *Computer module demonstration and hands-on exercise*: Created and prepared learning material; taught water chemistry about Marcellus-related spills for over 40 participants.
- *Field trip to mock spill event*: Organized and led field trip to mock spill; demonstrated sample collection from surface water.

### Interim Instructor, Pennsylvania State University

April 2017

- *GEOSC 560 – Kinetics of Geological Processes*: Taught basics of isotope geochemistry.

### Teaching Assistant, University of Michigan

September 2013 – December 2016

- *EARTH 100s – multiple introduction classes of earth sciences*.
- *EARTH 477 – Hydrogeology*: Guided 50+ students to understand the fate and transport of contaminants from Underground Storage Tanks via hands-on hydrogeological lab work and the interpretation of stratigraphic information.
- *EARTH 408 – Introduction to GIS in the Earth Sciences*: Taught 24 students to implement 2D & 3D spatial analysis in ArcGIS; received positive teaching evaluation (**rated at 4.5-5.0 out of 5.0**) from students and teachers.

## FIELD EXPERIENCE

- 2017-2018 Groundwater, surface water, natural gas, and sediment sampling in Appalachian Plateau and Ridge and Valley area (monthly)
- 2013-2014 Natural gas sampling in the Antrim Shale area (Gas & Oil Wells), MI (1 week)
- 2012 Groundwater sampling in the Glacial Drift aquifer in Michigan Basin (3 days)
- 2010 Mountain Huangshan in Anhui, China (4 days)
- 2008-2009 Tai Lake, Chao Lake, Yancheng National Natural Reserve, China (1 month)

## PUBLIC SERVICE AND PROFESSIONAL ACTIVITIES

### Public Service

- Reviewer for *Geochimica et Cosmochimica Acta*, *Water*, Geological Society of America

Today, Applied Geochemistry, Current Opinion in Environmental Science & Health, Advances in Polar Science

- Session convener and chair at Goldschmidt 2018: Using Geochemistry and Big Data to Understand the Biological-Geological Co-evolution of the Critical Zone - Including Human Impacts
- Session convener and chair at AGU 2018: (V017) Data Science and Geochemistry: Applying Data-driven Approach in Geochemistry-centric Studies
- Judge for PSU Geosciences Graduate Student Colloquium (2018)
- Committee and Instructor for Shale Network Workshop at Penn State (2018)
- President of USTC Alumni Association in Greater Detroit area (2013-2015)
- Co-founder and Vice-president of AAPG student chapter at Uni. of Michigan (2015-2016)

### Professional Affiliations

American Geophysical Union (AGU)	2012 – Present
Geological Society of America (GSA)	2014 – Present
American Association of Petroleum Geologists (AAPG)	2014 – Present
International Association of Hydrogeologists (IAH)	2014 – Present

### Professional Development

- GeoDeepDive workshop 2018, UW-Madison, Madison, WI (2018)
- Data Science in Geochemistry workshop attendee, Goldschmidt, Boston, MA (2018)
- Sequence Stratigraphy short course attendee, AAPG, Denver, CO (2015)

### SKILLS

Able to learn and understand tasks quickly while performing under pressure, both independently and as part of a team; excellent work ethic and strong ability towards detailing.

- **Expertise:** Strong hands-on experience in water chemistry, stable isotopes and noble gas labs; Proficient in ArcGIS and Microsoft Office suite; Groundwater modeling (MODFLOW); Geochemical modeling (MINEQL+ and PHREEQC); Field work planning and implementation; Collection of groundwater, surface water and shale gas samples; Geological mapping; Data synthesis and analysis; Document preparation including development of text, tables and figures for sampling and analysis plans, conference presentations and scientific papers writing
- **Programming:** Proficient in R, Python, MATLAB, LabVIEW; C, Fortran, Pascal
- **Language:** Fluent in English and Chinese

*Updated on 08/27/2018*