



**Thomas H. Darrah, Ph.D.**

School of Earth Science

Divisions of Solid Earth Dynamics; Water, Climate and the Environment

275 Mendenhall Laboratory

The Ohio State University, Columbus, OH 43210

EDUCATION

B.S. Geology, 2004, Dept. of Earth and Environmental Sciences, University of Rochester

Senior Research Thesis: Noble Gas and Mineralogical Tracers of Meteorite Impacts and Interplanetary Dust Particles

M.S. Geology, 2006, Dept. of Earth and Environmental Sciences, University of Rochester

Thesis: Noble Gas and Stable Isotope Chemistry of Geothermal Springs within the Kinematically Active East African Rift (Afar, Ethiopia)

Ph.D. Geochemistry, 2009, Dept. of Earth and Environmental Sciences, University of Rochester

Thesis: Inorganic Trace Element and Isotopic Composition of Modern Human Bones: Relation to Bone Pathology, Osteotoxicity, and Geographical Provenance Identification

Post-Doctoral Medical and Environmental Geochemistry of Human Biomineralization, Dept. of Environmental, Earth, and Ocean Sciences, University of Massachusetts Boston



## PROFESSIONAL APPOINTMENTS

2011-2013	Research Scientist, Division of Earth and Ocean Sciences, Nicholas School of the Environment, Duke University
2010-Present	CLIA/EPA Certified Laboratory Director, GeoMed Analytical, LLC
2010-Present	Geological Hazards Mitigations Expert: Limnological and Volcanic Risk Assessment, United Nations OPS, Virunga Volcanic Province, D.R.C.
2009-Present	Associate Member Dana-Farber/Harvard Cancer Center, Programs for Cancer Cell Biology and Cancer Survivorship
2009-Present	Chief Research Officer/Founding Partner, GeoMed Analytical, LLC
2009-2011	Post-Doctoral Fellow, EEOS Dept, University of Massachusetts Boston
2004-2009	Research Assistant, Noble Gas and ICP-MS Laboratories, Dept of Earth and Environmental Sciences, University of Rochester
2002-2003	Geological Engineer and Exploration Geologist, Blaschak Coal Corp, Mahanoy City, PA

## HONORS AND AWARDS

- Department of Earth Sciences, Lattimore Fellow Award for Excellence in Undergraduate Field Research, 2003
- Distinction and High Honors in Research in Geological Sciences, 2004
- *Metallomics* Journal Top 10 Most Accessed Publication of 2009
- Elected Vice President of Geological Society of America- Geology and Health Division

## RESEARCH GRANTS

### National Institute of Health:

- NCS-NIH NO1-HD-5-3422 RFP 18 Main: National Children's Study (PI: Darrah): Trace metal environmental analysis of cord bloods and placental tissue (\$143,456) (2010-2013)
- NCS-NIH Pilot (PI: Darrah): Placental Studies, Trace Metal Environmental Analyses, National Children's Study, (\$47,400) (2010)
- NIH NICHD RO3 HD059027. (PI: RK Miller) (sub-award) Biokinetics of Au



nanoparticles in placental perfusates (\$22,110) (2009-2012)

**National Science Foundation:**

- NSF EAGER: Award Number: 1249255 (PI: Darrah): Geochemical fingerprinting for risk assessment of shale gas development and hydraulic fracturing (\$100,000) (awarded)
- NSF Biology Major Research Instrumentation Program: Acquisition of a stable isotope ratio mass spectrometry and GC-MS/ECD (PD: R. Hannigan), (\$869,000) (2009-2011)
- NIH: Quantification of Pt in the serum, tissues, and bone of patients treated with Pt-based chemotherapy drugs, (\$29,800) (2009-2010)

**Department of Defense:**

- Nanotoxicology AOSR (PI: Oberdorster) (sub-award) Quantification of gold nanoparticles in biological tissue and fluids (\$83,250) (2010-2012)

**Foundation:**

- UMass-Boston Healey Grant Research: (PD: Darrah) Metallomic impacts of metals in human bone biomineralization, (\$19,650) (2009-2011)
- Petroleum Research Fund (PD: G. Mitra): Geochemical techniques to investigate geological fracture fluid flow (\$75,000) (2011-2012)

Publications

***Journal Articles***

**Environmental and Geological Chemistry:**

Jackson, R.B., Vengosh, A., **Darrah, T.H.**, Warner, N.R., Down, A., Poreda, R.J., Osborn, S.G., Zhao, K., Karr, J.D., 2013. Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction. *Proceedings of the National Academy of Sciences of the United States of America* 110, 11250-11255.

**Darrah TH**, D.Tedesco, F. Tassi, O.Vaselli, R.J. Poreda. (2012). Gas chemistry of the Dallol Geothermal Field of the Danakil Depression in the Afar region of the northern most East African Rift (in press *Chemical Geology* DOI: 10.1016/j.chemgeo.2012.10.036).

Hunt AG, **Darrah TH**, & Poreda RJ. (2012). Determining the source and genetic fingerprint of natural gases using noble gas geochemistry: A northern Appalachian Basin case study. *AAPG* 96(10):1785-1811.

**Darrah TH** and RJ Poreda. (2012). Noble Gas and Mineralogical Tracers of Meteoritic Debris and Interplanetary Dust Particles in GPC-3 Sediment Core. *Geochimica et Cosmochimica Acta*,(2012), doi:10.1016/j.gca.2012.01.030.

NR Warner, RB Jackson, **TH Darrah**, SG Osborn, A Down, K Zhao, A White, A Vengosh. (2012). Geochemical evidence for possible natural migration of Marcellus Formation brine to shallow aquifers in Pennsylvania. *Proceedings of the National Academy of Sciences of the United States of America* 109(30):11961-11966.



Aguilera, F., Tassi, F., **Darrah, T.**, RJ Poreda, Moune, S., Vaselli, O. (2011). Hydrothermal-magmatic activity at the Lastarria volcano, northern Chile: insights on ground deformation episodes from fluid geochemistry. (*Bulletin of Volcanology*. (2011) DOI 10.1007/s00445-011-0489-5 Vol 70, Is 5 1-16).

Burgi F, **TH Darrah**, D Tedesco, RJ Poreda, K Sims. (2011) Geological Hazard Assessment of the Mt. Nyiragongo Volcano, Virunga Volcanic Province, D.R. of Congo. *Smithsonian Magazine*.

Tassi F, F. Aguilera; **T. Darrah**, O. Vaselli, B. Capaccioni, RJ Poreda; AD Huertas. (2010). Fluid geochemistry of hydrothermal systems in the Arica-Parinacota, Tarapacá and Antofagasta regions (northern Chile)". *Journal of Volcanology and Geothermal Research* Volume. 2010 Vol 192 1-15.

Tassi, F., O. Vaselli, D. Tedesco, G. Montegrossi, **T. Darrah**, E. Cuoco, M. Y. Mapendano, R. Poreda, and A. Delgado Huertas. (2009). Water and gas chemistry at Lake Kivu (DRC): Geochemical evidence of vertical and horizontal heterogeneities in a multi-basin structure. *Geochem. Geophys. Geosyst.*, 10, Q02005, doi:10.1029/2008GC002191.

D. Tedesco, F. Tassi, O. Vaselli, **T. Darrah**, R.J. Poreda, E. Cuoco, and M.M. Yalire (2009). Gas Isotopic Signatures (He, C and Ar) in the Lake Kivu Region (Western Branch of the East African Rift System): Geodynamic and Volcanological Implications. *Journal of Geophysical Research*, 115:B01205.

R. B. Firestone, A. West, J. P. Kennett, L. Becker, T. E. Bunch, Z. S. Revay, P. H. Schultz, T. Belgya, D. J. Kennett, J. M. Erlandson, O. J. Dickenson, A. C. Goodyear, R. S. Harris, G. A. Howard, J. B. Kloosterman, P. Lechler, P. A. Mayewski, J. Montgomery, R. Poreda, **T. Darrah**, S. S. Que Hee, A. R. Smith, A. Stich, W. Topping, J. H. Wittke, and W. S. Wolbach (2007). Evidence for an extraterrestrial impact 12,900 years ago that contributed to the megafaunal extinctions and the Younger Dryas cooling. *PNAS*, 104:16016-16021.

### **Medical Chemistry/Medical Geochemistry:**

**Darrah TH**, White AM, Campbell ME, Miller RK, Stodgell CJ, Katzman PJ, Ruffolo L, Weidenborner P, Culhane J, Wadlinger S, Landrigan P, Littman L, Thiex N, Specker B, Swanson, J, Dole N, Eucker B, Clark EB, Varner M, Taggart E, Moye J, 2013b. Understanding the Trace Metal Composition of Human Placenta from the National Children's Study (NCS). *Birth Defects Part A-Clinical and Molecular Teratology* 97(5): 332. Dean G, 1950. Seven cases of barium carbonate poisoning *Br Med J* 250: 817-818.



E Cuoco\*, D Tedesco, RJ Poreda, **TH Darrah**. (2012). Toxic metal contamination of drinking water following the 2010 Nyamulargira Eruption (*Journal of Hazardous Materials*, accepted and in press). (\* mentored student paper)

**Darrah TH**, Campbell ME, Rinderknecht AL, et al, 2012. Validation of ICP-MS for the quantitative analysis of traditional and emerging environmental toxic and nutritional metals in human placenta from the National Children's Study. Birth Defects Research, Part A: Clinical and Molecular Teratology 94(SI):384.

P Censi, E Tamburo, LA Randazzo, P Zuddas, A Cuttita, **TH Darrah** (2012). Investigating human aerosol inhalation using trace element bronchoalveolar lavages (Book chapter in an *Introduction to Medical Geochemistry*).

**Darrah TH** and RE Hannigan, The trace element composition of modern human bone (2012). (Book chapter in an *Introduction to Medical Geochemistry*)

Sprauten M, **T.H. Darrah**, M.E. Campbell, R. Hannigan, M. Cvancarova, C. Beard, H. Haugnes, D. Peterson, S.D. Fossa, J. Oldenburg, L.B. Travis. (2011). Impact of long-term serum Platinum concentrations on neuro- and ototoxicity in cisplatin-treated survivors of testicular cancer. *Journal of Clinical Oncology*, 2012, Vol 30, Issue 3, 300-307.

McLaughlin M.P., **T.H. Darrah**, P.L. Holland. (2011). Palladium and Platinum derivatives of a blue copper protein [dx.doi.org/10.1021/ic2017648](https://doi.org/10.1021/ic2017648) *J Inorganic Chemistry*. 2011, 50, 11294–11296

**Darrah TH**, **JJ Prutsman-Pfeiffer**, RJ Poreda, ME Campbell, PV Hauschka and RE Hannigan. (2009). Incorporation of excess gadolinium into human bone from medical contrast agents, *Metallomics*, Vol 1, Issue 6 479-488. DOI: 10.1039/b905145g.

### ***Manuscripts Submitted***

**Darrah TH**, RB Jackson, A Vengosh, NR Warner, RJ Poreda. (2012). The evolution and migration of Devonian hydrocarbons and brines in the Appalachian Basin: insights from integrating noble gas geochemistry. (*Geochimica et Cosmochimica Acta*).

**Darrah TH**, A Vengosh, RB Jackson, RJ Poreda (2012). Differentiating 'natural' and anthropogenic origins of combustible gases in shallow aquifers within zones of active shale gas development in the Appalachian Basin

### ***Textbooks***

P Censi, **TH Darrah**, Y Erel (eds) (February, 2013) *Medical geochemistry: Geological Materials and Health*. Springer. ISBN 978-94-007-4371-7



*Invited Presentations*

**Darrah, TH\* (2013)** Recent advances in noble gas geochemistry: unconventional approaches for economic extraction from unconventional resources

**Darrah, TH\***, A Vengosh, RB Jackson, RJ Poreda (2012). Noble gas geochemistry: A novel approach for resolving the source and mechanism of deep fluid and natural gas migration. Geological Society of America Annual Meeting: Pardee Keynote Symposia.

**Darrah, TH\***, ME Campbell, C Walker, RK Miller (2012). Pt and Gd: Emerging Environmental Toxic Metals in Human Placenta from the National Children's Study (NCS)). Teratology Society of America, 2012 Annual Meeting.

**Darrah, TH\***, A Vengosh, RB Jackson, RJ Poreda (2012). Noble gas geochemistry of groundwaters in northeastern PA. National Science Foundation Hydraulic Fracturing Workshop.

**Darrah, TH\***, ME Campbell, M Horton, and RE Hannigan (2011). The Development and Application of Cryogenic Laser Ablation ICP-MS (CLA-ICP-MS) for Trace Elemental Analysis of Biological Tissues. Geophysical Research Abstracts Vol. 13, EGU2011-13128, 2011, EGU General Assembly.

**Darrah, TH\***, A Carey, ME Campbell, RJ Poreda (2011). The Effects of Coal-Fired Power Plant Emissions And Fly Ash On A Regional Watershed. Geophysical Research Abstracts Vol. 13, EGU2011-13172, 2011 EGU General Assembly 2011.

**Darrah, TH\***, T Walsh, G Mitra, and RJ Poreda (2011). American Institute of Professional Geologist Meeting: Marcellus Shale: Energy Development and Enhancement by Hydraulic Fracturing Conference 2011. Talk: Using Noble Gas Geochemistry to Evaluate the Genetic Fingerprint, Migration, and Thermal History of Natural Gases in the Appalachian Basin.

**Darrah, TH\*** (2010) Invited Speaker/Instructor. Summer school on Medical Geochemistry. Effects on Health of Geological Material Exposure: The Geochemical Approach. Metal inputs and interactions from geological and anthropogenic sources in human biominerals, tissues, and fluids: Understanding the metal composition of modern human bones.

**Darrah, TH\*** (2009). Long-term Fate of Platinum in Testicular Cancer Survivors: Analysis of Platinum in Biological Tissues, Fluids, and Bone. International Testicular Cancer Survivorship Conference. University of Rochester.



## ENTREPRENEURIAL ACTIVITY

### **GeoMed Analytical, LLC:**

Chief Technical Officer, Founding Partner, and Director of Analytical Operations and Instrumentation Development, 2009 to present. General Partners - Robyn Hannigan (Chief Science Officer) entrepreneurial

Highlights: Founded the first CLIA laboratory certified for the analysis of non-traditional metals (e.g. Gd, Pt, Pd, etc.). CLIA License Number: 3078/ #22D1102787. Developed and patented the cryogenic laser ablation platform for the analysis of metal in organic-rich and biological materials.

## Professional Service to the Community

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| 2012-2013 | Organizing Committee for the GEOMED 2013 Medical Geology Conference in Washington, DC   |
| 2011-2013 | Vice President, Geological Society of America: Geology and Health Division  |
| 2011-2012 | Session Chair, European Geological Union: Medical Geochemistry  |
| 2010      | Organizing Committee for the 1 <sup>st</sup> annual Summer School of Medical Geochemistry, University of Palermo, Italy                       |
| 2010      | United Nations OPS. Limnological and Volcanic Hazards Mitigation Expert, Virunga Volcanic Province D.R. Congo.                                |
| 2010      | Visiting Lecturer, University of Naples, Italy: Analytical Methods for Metallomic and Trace Element Analysis in Biological Fluids and Tissues |
| 2009      | Visiting Lecturer, University of Naples, Italy: ICP-MS  |

## TEACHING EXPERIENCE

### GRADUATE STUDENTS MENTORED

Amanda Carey, M.S. Student, Department of Earth and Environmental Sciences, University of Rochester

Emilio Cuoco, M.S. Student, Department of Earth and the Environmental, University of Naples, Italy



### UNDERGRADUATE STUDENTS MENTORED

Amanda F. Carey (University of Rochester; Presently a consultant at Dakota Environmental Consulting)

Zoe R. Harrold (University of Rochester; Now a PhD student at U. Washington)

Ann Dunlea (University of Rochester; Now a PhD student at Boston University)

Diego Vasquez (University of Rochester; Now a PhD student at University of Southern California)

Jennifer Geldart (Univ. of Massachusetts-Boston, McNair Scholar; Now a PhD student at Tufts Univ.)

Melika Uter (University of Massachusetts-Boston, McNair Scholar; Now senior undergraduate)

Tia Wheeler (University of Massachusetts-Boston, McNair Scholar; Now senior undergraduate)

### CONTINUING PROFESSIONAL DEVELOPMENT

- Introduction to Reproductive Toxicology and Teratology, University of Rochester, 2012
- Entrepreneurship and Business Management Development. College of Management University of Massachusetts Boston, 2010
- Collaborative Institutional Training Initiative (CITI) CR# 4273249. Group 1. Social and Behavioral Research Investigators and Key Personnel. Human Research Subject Protection Training, University of Massachusetts Boston, 2010
- National Institute of Health Information Security Awareness Program Training, 2010
- National Institute of Health Information Privacy Awareness Program Training, 2010
- Center for Medicare and Medicaid Services Clinical Laboratory Certification (ID #22D1102787) 2009

### MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

American Chemical Society

American Association for the Advancement of Science

American Association of Petroleum Geologists





**THE OHIO STATE UNIVERSITY**

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American Institute of Professional Geologists

American Geophysical Union, Geochemistry

Dana Farber/Harvard Cancer Center Member

International Medical Geology Association

Geological Society of America, Geology and Health Division

Geochemical Society

National Children's Study URMC-Mount Sinai Consortium