

FRANCESCA AVRIL SMITH

Department of Earth & Planetary Sciences
Northwestern University
1850 Campus Drive
Locy Hall, Rm 200A/B
Evanston, IL 60208

cesca@earth.northwestern.edu
PHONE: 847-491-3459
FAX: 847-491-8060

EDUCATION

- Ph.D. 2002 University of Chicago, Geophysical Sciences. Dissertation: *The Carbon Isotope Signature of Fossil Phytoliths: The Dynamics of C₃ and C₄ Grasses in the Neogene*. Susan Kidwell and James W.C. White (INSTAAR), Advisors.
- M.S. 1996 University of Chicago, Geophysical Sciences. Thesis: *The Evolution and Paleoecology of Photosynthetic Pathways in Grasses: Estimates of the Number of Originations of C₄ Grasses and Methods for Inferring Photosynthetic Pathways in Paleocommunities using Carbon Isotopic Signatures of Fossil Phytoliths*. Susan Kidwell, Advisor.
- B.A. 1992 Yale University, Geology and Studies in the Environment double major. Senior Thesis: *What is a wetland? I. The use of Depth Profiles of ²²⁶Ra and ²¹⁰Pb as Indicators of Wetland Hydrology; II. Wetland Delineation: Interaction of Science and Policy*. Karl Turekian, Advisor

EMPLOYMENT

- 7/2006-present Assistant professor, Department of Earth and Planetary Sciences, Northwestern University.
- 7/2004-7/2006 Postdoctoral Fellow, Department of Paleobiology, Smithsonian Institution. Compound-specific carbon isotope ratios of terrestrial biomarkers across the Paleocene-Eocene Boundary in collaboration with Scott Wing (Smithsonian) and Kate Freeman (PSU).
- 8/2002- 7/2004 Postdoctoral Research Associate, Department of Geosciences and Biogeochemical Research Initiative for Education (BRIE) at Pennsylvania State University. Postdoctoral research with Katherine Freeman developing novel terrestrial paleoclimate proxy using compound-specific hydrogen isotope ratios of plant compounds.

GRANTS, AWARDS AND FELLOWSHIPS

- NSF-EAR collaborative research grant: *Paleohydrology of the Paleocene-Eocene Thermal Maximum: A multiple proxy reconstruction*. Collaborators: S. Wing, J. Block and M. Kraus 2007-2010
- Hutchinson Fellowship, University of Chicago, Committee on Evolutionary Biology 2000-2001
- STAR Graduate Fellowship, U.S. Environmental Protection Agency 1996-1999
- Sigma Xi Research Grant (for Field and Laboratory Pilot Study) 1995
- Hinds Fund Research Grant, University of Chicago, Committee on Evolutionary Biology 1995
- McCormick Fellow, University of Chicago, Physical Sciences Division 1993-1996
- Distinction in the Studies in the Environment Major, Yale University 1992
- Conoco Scholarship to Yellowstone-Bighorn Research Association Field Camp 1991
- Summer Undergraduate Research Fellow, Scripps Institution of Oceanography 1990

RESEARCH INTERESTS AND EXPERTISE

- Development and application of geochemical tools to examine large scale biotic-abiotic interactions over geologic time
- Responses of ancient ecosystems to climate change and analogs for ecosystem response to future global change
- Analytical expertise in organic geochemistry, and bulk and molecular isotopic techniques

PUBLICATIONS

- Smith, F.A., Wing, S.L. and K.H. Freeman. 2007. Magnitude of the carbon isotope excursion at the Paleocene-Eocene Thermal Maximum: The role of plant community change. *Earth and Planetary Science Letters* 262: 50–65.
- Smith, F.A., and K.H. Freeman. 2006. Influence of physiology and climate on δD of leaf wax *n*-alkanes from C₃ and C₄ grasses. *Geochimica et Cosmochimica Acta* 70: 1172-1187.
- Wing S.L., G.J. Harrington, F.A. Smith, J.I. Bloch, D.M. Boyer, and K.H. Freeman. 2005. Transient Floral Change and Rapid Global Warming at the Paleocene-Eocene Boundary. *Science* 310: 993-996.
- Smith, F.A., and J.W.C. White. 2004. Modern calibration of phytolith carbon isotope signatures for C₃/C₄ paleograssland reconstruction. *Palaeogeography, Palaeoclimatology, Palaeoecology* 207: 277-304.
- Smith, F.A. and K.B. Anderson. 2001. Characterization of organic compounds in phytoliths: Improving the resolving power of phytolith $\delta^{13}C$ as a tool for paleoecological reconstruction of C₃ and C₄ grasses. In: *Phytoliths: Applications in Earth Science and Human History*, J.D., Meunier, F. Colin, Eds. A.A. Balkema Publishers, Rotterdam, Netherlands. pp. 317-327.

ABSTRACTS

- Smith, F.A., Wing, S.L. and K.H. Freeman. 2007. Plant community change and the magnitude of the carbon isotope excursion at the Paleocene-Eocene Thermal Maximum. *Geological Society of America Abstracts with Programs* 39 (Denver, CO).
- Smith, F.A., S.L. Wing, and K.H. Freeman. 2007. How large was the “true” carbon isotope excursion at the PETM? *23rd International Meeting on Organic Geochemistry* (Torquay, England).
- Smith, F.A., K.H. Freeman and B. Helliker. 2007. Hydrologic and taxonomic controls on leaf wax lipid hydrogen isotope ratios. Invited Keynote address at the *American Chemical Society meeting* (Boston MA).
- Smith, F.A., S. Wing, and K.H. Freeman. 2006. Plant biomarker signatures of floral change across the PETM. Oral presentation. *Climates and Biota of the Early Paleogene (Bilbao, Spain)*.
- Smith, F.A., S. Wing, and K.H. Freeman. 2005. Increased carbon isotope discrimination by plants during the PETM: Reconciling terrestrial and marine carbon isotope excursion. Oral presentation. *Geological Society of America Abstracts with Programs* 37 (Salt Lake City, UT).
- Smith, F.A., S. Wing, and K.H. Freeman. 2005. Using carbon and hydrogen isotope ratios of terrestrial organic matter to understand climate change at the PETM. Invited talk. *Goldschmidt Geochemistry Conference (Moscow, ID)*.
- Smith F.A., K.H. Freeman, B. Helliker, and J.R. Ehleringer. 2004. Hydrogen Isotope Ratios of Leaf Waxes in C₃ and C₄ Grasses Record Meteoric Water and Aridity Signatures. Oral presentation. *Fall Meeting of the American Geophysical Union (San Francisco, CA)*.
- Freeman, K H., F. A. Smith, P.P. Polissar, C.A. Turich and N. Pedentchouk. 2004. Molecular Proxy Approaches for Paleohydrology. Oral presentation by K.H. Freeman at *Fall Meeting of the American Geophysical Union (San Francisco, CA)*.
- Wing, S. L., G.J. Harrington, J.I. Bloch, D.M. Boyer, and F. Smith. 2004. Major Transient Floral Change During the Paleocene-Eocene Thermal Maximum. Oral presentation by S. Wing. *Fall Meeting of the American Geophysical Union (San Francisco, CA)*.
- Smith, F.A. and K.H. Freeman. 2004. Compound-specific hydrogen isotope ratios of leaf wax *n*-alkanes from C₃ and C₄ grasses. Invited “Hot Topic” oral presentation. *Organic Geochemistry Gordon Research Conference (Holderness School, NH)*.
- Smith, F.A. and K.H. Freeman. 2003. Rainfall and the Miocene expansion of C₄ grasses: A leaf wax hydrogen isotope paleohydrologic proxy. Oral presentation. *Geological Society of America Abstracts with Programs* 35 (Seattle, WA).

- Smith, F.A., N. Pedentchouk and K.H. Freeman. 2003. Hydrogen isotope ratios of lipid biomarkers (*n*-alkanes) as paleohydrologic proxies: Aquatic vs. terrestrial archives. Oral presentation. *Joint Assembly of EGS-AGU-EUG (Nice, France)*.
- Smith, F.A. 2002. Miocene and Pliocene Grasslands: Relative Abundance of C₃ and C₄ Grasses Recorded in the Carbon Isotope Signature of Fossil Phytoliths. Oral presentation. *Paleograsslands-2002 (St. Cloud, MN)*.
- Smith, F.A. 2001. The Neogene Record of Grass Photosynthetic Pathway from the Carbon Isotope Signature of Fossil Phytoliths. Poster presentation. *A History of Atmospheric CO₂ and Its Effects on Plant, Animals and Ecosystems (Snowbird, UT)*.
- Smith, F.A. 2001. Phytolith Carbon Isotope Records of Neogene Grasses. Oral presentation. *Geological Society of America Abstracts with Programs 33:68 (Boston, MA)*.
- Smith, F.A. 2001. Fossil phytolith carbon isotope records of grass photosynthetic pathways. Oral presentation. *North American Paleontological Convention 2001 (Berkeley, CA)*.
- Smith, F.A. and J.W.C. White. 2000. Reconstructing Neogene Grasslands Using Carbon Isotope Ratios of Fossil Phytoliths. Oral Presentation. *Paleo-Grassland Research 2000 (Westbrook, CT)*.
- Smith, F.A. and J.W.C. White. 2000. Carbon Isotope Ratios of Phytoliths: Modern versus Fossil. Oral presentation. *Third International Meeting on Phytolith Research (Brussels, Belgium)*.
- Smith, F.A. and J.W.C. White. 2000. Phytolith carbon isotope evidence of Neogene grassland composition, climate and CO₂. Oral presentation. *Geological Society of America Abstracts with Programs 32: 196 (Reno, NV)*.
- Smith, F.A. and J.W.C. White. 1999. Carbon Isotope Signatures of Fossil Phytoliths: Exploring the Influence of CO₂ and Temperature on C₃/C₄ Grass Biogeography. Poster Presentation. *Eos, Transactions, AGU Vol. 80, Number 46, p. F99 (San Francisco, CA)*.
- Smith, F.A., and K.B. Anderson. 1998. Characterization of Organic Material in Phytoliths from a C₃ and a C₄ grass. Oral presentation. *Second International Meeting on Phytolith Research (Aix en Provence, France)*.
- Smith, F.A. and K.B. Anderson. 1998. Characterization of organic compounds in phytoliths: toward a reconstruction of C₃ and C₄ grasses in Neogene grasslands of the Great Plains. Oral presentation. *Geological Society of America Abstracts with Programs 30: 37 (Toronto, Canada)*.
- Smith, F.A. 1998. Paleoecological reconstructions of Neogene grasslands. Poster presentation. *Science to Achieve Results (STAR) Graduate Fellowship Program Technical Conference (Arlington VA)*.
- Smith, F.A. 1996. Carbon Isotopic values of Miocene grass phytoliths and the origin of hypsodonty in North American horses. Oral presentation. *Geological Society of America Abstracts with Programs 28: 106 (Denver, CO)*.
- Smith, F.A. 1996. The carbon isotope signature of fossil grass phytoliths: C₃ grasslands and horses with tall teeth. *Expo: a Student Conference at the Department of Geophysical Sciences, University of Chicago (Chicago, IL)*.

INVITED LECTURES

- 10/2007 Benedictine University, ACCA Biogeography Seminar, *Climate change impacts on terrestrial ecosystems in the geologic past*.
- 5/2007 Northwestern University, Department of Civil and Environmental Engineering, *Ecological effects of past global warming recorded in plant lipid isotope ratios*.
- 2/2007 Harvard University, Earth and Planetary Sciences and Organismic and Evolutionary Biology Departments'. *Paleoecological and isotopic consequences of global warming during the Paleocene-Eocene Thermal Maximum*.
- 2/2007 Northwestern University, Interdisciplinary Committee on Evolutionary Processes. *Plant lipid isotope signatures as molecular fossils and paleoclimate proxies*. 2/8/07.
- 11/2006 University of Chicago, Department of Geophysical Sciences. *Plant lipids record increased carbon isotope discrimination during the Paleocene-Eocene Thermal Maximum*.

- 3/2006 Yale University, Department of Geology and Geophysics. *Increased carbon isotope discrimination by plants during the PETM: Reconciling terrestrial and marine carbon isotope excursion.*
- 4/2005 University of Arizona, Department of Geosciences. *Useful grass clippings? Hydrologic records in leaf wax hydrogen isotope ratios.*
- 4/2005 Brown University, Department of Geological Sciences. *Paleohydrologic proxy calibration: Hydrogen isotope ratios of grass leaf waxes.*
- 3/2005 Boise State University, Department of Geosciences. *Paleohydrologic proxy calibration: Hydrogen isotope ratios of grass leaf waxes.*
- 3/2005 Northwestern University, Department of Geological Sciences. *Paleohydrologic proxy calibration: Climatic and physiological controls on D/H ratios of grass leaf waxes.*
- 2/2005 Purdue University, Department of Earth and Atmospheric Sciences. *Useful grass clippings? Paleocological and paleoclimate records from carbon and hydrogen isotope ratios of grasses.*
- 2/2005 Pennsylvania State University, Department of Geosciences. *Climate signals in hydrogen isotope ratios of leaf waxes.*
- 3/2004 University of Missouri, Columbia, Department of Geological Sciences. *Plants as hydrologic recorders: Leaf wax hydrogen isotope ratios.*
- 5/2002 Pennsylvania State University, Department of Geosciences and the Biogeochemical Research Initiative for Education. *The carbon isotope signature of fossil phytoliths: Neogene grassland biogeography in relation to climate and atmospheric CO₂.*
- 4/2002 McGill University, Earth and Planetary Sciences. *The Carbon Isotope Signature of Fossil Phytoliths: The Dynamics of C₃ and C₄ grasses in the Neogene.*

RESEARCH EXPERIENCE

Stable Isotope and Organic Geochemistry:

- 8/2002- 7/2006 Pennsylvania State University, Department of Geosciences, Molecular and Isotope Biogeochemistry Laboratory. Postdoctoral research on compound-specific δD and $\delta^{13}C$ of lipids from plants, Neogene and Paleocene/Eocene paleosols with Katherine Freeman (PSU) and Scott Wing (Smithsonian).
- 10/1996-6/2002 INSTAAR, University of Colorado at Boulder, Stable Isotope Lab. Dissertation research using vacuum extraction lines, dual inlet and continuous flow mass spectrometry to analyze organic carbon in phytoliths, plant tissue and soils.
- 3/1998-7/1998 Argonne National Lab, Coal Chemistry Group. Dissertation research with Ken Anderson characterizing the organic compounds in phytoliths using TMAH thermochemolysis and gas-chromatograph mass spectrometry.
- 8/1996-10/1996 INSTAAR, University of Colorado at Boulder, Stable Isotope Lab. Technician for James White. δD , $\delta^{18}O$ of ice core samples, $\delta^{13}C$ of NOAA flask network air samples, mass spectrometer maintenance and repair.
- 6/1995-10/1995 Colorado State University, Department of Soil Sciences. Visiting graduate with Eugene Kelly. Phytolith extraction from Tertiary sediments, and preparation for $\delta^{13}C$ analysis.
- 9/1992-9/1993 Harvard University, Stable Isotope Lab. Lab Assistant. Bruno Marino and Michael McElroy, supervisors. $\delta^{13}C$ of maize cellulose, carbonate and tooth enamel.

Radioisotope and Sedimentary Geochemistry:

- 10/1991-4/1992 Yale University, Radiogenic Isotope Laboratory. Senior thesis research with Karl Turekian on using ^{210}Pb and ^{226}Ra as indicators of long term wetland saturation depths.
- 1/1991-5/1991 Yale University, Sedimentary Geochemistry Lab. Undergraduate Laboratory Assistant. Tim Lyons and Robert Berner, supervisors. Analyzed manganese concentrations from Black Sea sediments on atomic absorption spectrophotometer.

Biomechanics, Biogeography and Growth Patterns of Molluscs:

- 1/1994-6/1994 University of Chicago, Biomechanics Laboratory. Research project with Michael LaBarbera on the safety factor of *Mytilus edulis*. Measured strain in shells of living mussels during opening and closing as well as when crushed.
- 6/1990-8/1990 Scripps Institution of Oceanography, Center for Coastal Studies. Summer Undergraduate Research Fellowship with Reinhard Flick. Preservation of 14 year tidal cycles in mussel shell growth bands.
- 11/1989-1/1990 Sea Education Association Semester Program, Woods Hole, MA. Field study on biogeographic variation of pteropods (planktonic molluscs) in the Caribbean.

TEACHING EXPERIENCE/TRAINING

- Professor, “Global Warming: The Scientific Evidence”, Spring & Fall 2007, Freshman seminar, Northwestern University.
- Professor, “Paleobiology”, Winter 2007, Earth and Planetary Sciences, Northwestern University.
- Co-advisor for Undergraduate Senior Thesis by David Beausang, Geography Major at Penn State University, Spring 2005. Thesis: Spatial associations between climate and leaf wax *n*-alkanes from C₃ and C₄ grasses.
- Facilitator for PETM faculty/student discussion group, Penn State University, Spring 2005.
- NAGT Training Workshop: Preparing for an Academic Career in the Geosciences; Minneapolis, MN, July 29-August 1, 2004.
- Co-teacher, Penn State University, *Stable Isotopes in Terrestrial Ecosystems*, Graduate Seminar taught with K. Freeman, in the Department of Geosciences (GEO SC 597D), Spring, 2004.
- Course coordinator, Penn State University, *Biogeochemical Analysis* (GEO SC 597B), Fall, 2002 & 2003. Cross-college interdisciplinary team-taught field/laboratory graduate course.
- Co-teacher, Penn State University, *Paleoclimate Proxies*, Upward Bound Math and Science Summer Program course for minority high school students. Taught 2 weeks of an intensive 6 week research focused course with Dana Royer. Summer, 2003.
- Teaching Assistant, University of Chicago, Department of Geophysical Sciences, 1/94-6/96.
Responsibilities: lecturing, leading labs, grading, and facilitating discussions. Courses:
- | | | | |
|--|------------|--------|------|
| <i>Global Warming: Understanding the Forecast</i> | PhySci 134 | Spring | 1996 |
| <i>Introduction to Paleontology</i> | GeoSci 223 | Winter | 1996 |
| <i>Biological Evolution</i> | NatSci 104 | Autumn | 1995 |
| <i>Environmental History of the Earth</i> | PhySci 110 | Spring | 1995 |
| <i>Evolution of the Solar System and the Earth</i> | NatSci 102 | Winter | 1995 |
| <i>Biological Evolution</i> | NatSci 104 | Autumn | 1994 |
| <i>Field Course to Northern California</i> | GeoSci 228 | Summer | 1994 |
| <i>Environmental History of the Earth</i> | PhySci 110 | Spring | 1994 |
| <i>The Earth</i> | PhySci 108 | Winter | 1994 |

FIELD RESEARCH EXPERIENCE

- Bighorn Basin, WY*: Postdoctoral research on isotope signature of organic matter from paleosols from across the Paleocene-Eocene. 2004 (4 weeks), 2005 (4 weeks), 2007 (1 week).
- Great Plains*: Masters and Ph.D. research on $\delta^{13}\text{C}$ of fossil phytoliths from Miocene and Pliocene paleosols and modern phytoliths from grasses and soils. 1995 (2 weeks), 1997 (3 months).
- Connecticut wetlands*: Undergraduate senior thesis research on radioisotopes in sediments from a salt marsh (Pataganset) and a fresh water wetland (North Madison). 1991 (2 weeks).
- La Jolla intertidal zone*: Summer Undergraduate Research Fellow field experiment suspending mussels off of pier at Scripps Institution of Oceanography and collecting wild mussels. 1990 (4 weeks).
- Caribbean Sea*: Sea Education Association Semester oceanographic cruise on R/V Corwith Cramer, 134 ft. schooner, (6 weeks) as part of semester program (12 weeks).

Field Courses/ Field Trips

Cretaceous Stratigraphy, ND, SD, MT	1998	University of Chicago Field Trip (1 wk)
Structure/Stratigraphy, Big Bend N.P.	1998	University of Chicago Field Trip (1 wk)
Modern Carbonate Env., St. Lucia	1995	University of Chicago Field Trip (1 wk)
Marine Invertebrate Zoo., San Juan Is.	1994	Friday Harbor Laboratories, U. WA (6 wks)
Grand Canyon and Book Cliffs Geology	1993	University of Chicago Field Trip (2 wks)
Glacier N.P. and surroundings, MT	1992	Sampling with T. Lyons, G. Ravizza (3 wks)
Geology Field Camp, MT, WY	1991	Yellowstone-Bighorn Res. Assoc. (6 wks)

FOREIGN LANGUAGE

Near Fluent French (verbal and written).

PROFESSIONAL AFFILIATIONS

American Geophysical Union. Geological Society of America. Geochemical Society. American Chemical Society.