

Dr. Elizabeth J. Cassel

Jackson Postdoctoral Fellow

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EDUCATION

Ph.D. Stanford University, Geological and Environmental Sciences June 2010
Dissertation: "Cenozoic Landscape Evolution of the Northern Sierra Nevada and Western Basin and Range: Implications for Tectonics, Climate, and Topography"
Advisor: Professor Stephan A. Graham
Committee: C. Page Chamberlain, Donald Lowe, George Hilley, and Christopher Henry

B.A. Carleton College, Geology, *Magna Cum Laude* June 2003
Senior Thesis: "The Sedimentary Succession and its Evolution at Morgan Beach, Cape Liptrap, Australia"

RESEARCH AND TEACHING INTERESTS

The interactions between tectonics, climate, and erosion; basin analysis; sedimentology; stratigraphy; tectonics and crustal dynamics in high elevation plateaus; Earth surface processes; stable isotope geochemistry and its applications to paleo-elevation, -climate, and -hydrology; sediment provenance and drainage evolution through detrital mineral geochronology; (U-Th)/(He-Pb) double dating; fluvial and alluvial depositional environments.

Potential Courses: Introductory Geology; Environmental Geology; Sedimentology and Stratigraphy; Tectonics; Sedimentary Basin Analysis; Sedimentary Processes; Sedimentary Petrography; Geochronology; Stable Isotope Geochemistry; Field Methods; Geology Field School; Depositional Environments; Marine Sedimentation; Climate, Tectonics, and Topography; Mountains of the Cenozoic; Methods in Palealtimetry; Geologic and Historical Aspects of the California Gold Rush; Geology of the North American Cordillera.

RESEARCH EXPERIENCE

Jackson Postdoctoral Fellow, School of Geosciences, The University of Texas at Austin:
Geological Sciences Department, Austin, TX September 2011-present

Understanding past drainage morphology and elevations of mountain ranges, especially records of plateau evolution, is critical for reconstructing the tectonic processes controlling orogenic development and the climatic history of the region. I combine sedimentologic, geomorphic, geochemical, and geochronologic data to track changes in surface topography, hydrology, geomorphology, and exhumation patterns. I am currently focusing on the Cenozoic history of the region of the proposed 'Nevadaplano' (including northern Nevada and northeastern California), the progression of uplift of the Andean Altiplano in southern Peru and northern Chile, and laboratory methods in stable isotope geochemistry.

Current research projects:

1. Drivers for basin formation and lacustrine evolution through the Eocene sedimentary record in eastern Nevada and the implications for the timing and magnitude of Basin and Range extension, using basin stratigraphy, $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology, stable isotope analysis, and detrital zircon (U-Th)/(He-Pb) double dating.

2. Paleogene drainage morphology and fluvial system evolution of the western US through detailed sedimentologic and stratigraphic analysis, detrital zircon sediment provenance and stable isotope and geochemical analyses of rhyolitic ignimbrites.
3. History of Cenozoic uplift and forearc basin evolution in the southern Peruvian and northern Chilean Andes, using sedimentologic and stratigraphic characterization of forearc sediments, detrital zircon geochronology, and stable isotope analysis of rhyolitic ignimbrites.
4. Testing the durability and stability of the volcanic glass proxy and improving methods of application for stable isotope analysis.
5. Estimation of fluvial and alluvial conglomerate paleoslopes, based on sedimentology, paleogeomorphology, and LIDAR-based analysis of outcrops.

Dissertation, Stanford University:

Geological and Environmental Science Department, Stanford, CA 2004-2010

My dissertation research addressed the controversial issues of Eocene-Oligocene topography and climate of Sierra Nevada, the timing of uplift of the range, and the existence of a high-elevation plateau to the east by reconstructing the history of fluvial incision and aggradation, sedimentary provenance, and the isotopic record of paleo-elevation. Gained a new understanding of fluvial system evolution through detailed documentation of the stratigraphy, sedimentary architecture, contact relationships, and the pattern of paleo-valley incision and basin aggradation, as well as laboratory research including stable isotope and TREE geochemistry, GIS surface mapping, $^{40}\text{Ar}/^{39}\text{Ar}$ radiometric dating, and detrital zircon geochronology.

Intern, ExxonMobil Upstream Research:

Sources and Seals Team, New Play Concepts, Houston, TX 2008

This project included two weeks of field work in Wyoming and northern Utah studying the Mowry Shale, followed by producing a prospect-scale geologic timescale hydrocarbon flow model, based on well-log and core data, as well as field observations and interpretations. The geologic model was built in PETREL and simulations were run in MPath (UNIX-based, from Permedia). Supervisor: Dr. Rene Jonk, New Play Concepts, ExxonMobil Upstream Research.

Field Researcher, Stanford University

Sedimentary Research Group, Stanford, CA 2005-2009

1. Four weeks in Patagonia, Southern Chile to study the Mesozoic Magallanes Basin turbidite deposits in outcrop. Fieldwork involved compiling both vertically and laterally extensive and detailed stratigraphic records of vast exposures, as well as gathering lithologic, paleocurrent and paleobiologic data, to gain insights into deep-water depositional architecture.

2. Six weeks in Western China to study the provenance and depositional history of sediments in the Songpan-Ganzi, a complex of highly deformed and folded Mesozoic turbidite deposits. Fieldwork involved sampling of sediments for sandstone QFL, REE, and detrital zircon analysis, collecting paleocurrent data, facies analyses, and photo documentation, to determine provenance and basin evolution. Thin sections from a potential sedimentary unroofing sequence in the Northeast Sichuan Basin provide a possible follow-up project.

3. Two weeks to southwest Montana to study the Paleocene to the Pliocene climatic and sedimentary record based on oxygen stable isotope analysis of paleosol carbonate from intermontane basins in southwestern Montana and eastern Idaho. This work contributed to the landscape evolution group's research on the Cenozoic topographic history of the western US.

4. Two weeks in the Taranaki Basin on the north island of New Zealand to study the stratigraphic architecture and depositional history of a Miocene deep-water slope succession now exposed along the coast. This work contributed to the sedimentary group's ongoing research.

Geographic Information Systems Analyst, University of Washington

Earth & Space Sciences and Marine Sciences Departments, Seattle, WA 2003-2004

At UW, I performed GIS analyses for both The Puget Sound River History Project and The Near Shore Project division of the Puget Sound Regional Synthesis Model. Work included georeferencing, digitizing and interpreting USCGS topographic sheets to establish the character of the Puget Sound near shore pre-settlement; also interpreting and trimming LIDAR topographic imagery to construct an accurate map of the modern shoreline. Supervisors: Amir Sheikh, Dr. David Finlayson, and Prof. David Montgomery, University of Washington.

Australia Program, Researcher:

KECK Consortium Project, Melbourne, Australia and Carleton College, MN 2002-2003

This work included four weeks of independent field research: mapping, sampling for OSL dating, and constructing a detailed stratigraphic record of beach exposures in Southeastern Australia, followed up by interpretation of that record and geochronology to determine the timing and evolution of a coastal alluvial fan system, and further understanding of the tectonic evolution of the area. Culminated in senior thesis and co-authored publication. Advisor: Prof. Thomas Gardner, Trinity University.

Southeast Alaska Pluton Emplacement, Project Researcher:

National Science Foundation Research Project, Southeast AK 2002

This project included two weeks of GPS mapping, studying field relationships, and sample collection from plutons within the Alexander Terrane and Western Metamorphic Belt. Used Al-in-hornblende barometry and phase equilibria, based on data from electron microprobe analysis, to reconstruct the Cretaceous pluton intrusion and crystallization history for the region.

TEACHING EXPERIENCE

Visiting Assistant Professor of Geosciences, Franklin & Marshall College:

Department of Earth & Environment 2010-2011

Course load included Earth, Environment, and Humanity, an introductory environmental geology course with a lab, Geologic and Historical Aspects of the California Gold Rush, a writing-intensive first-year seminar, and a field-intensive Sedimentology and Stratigraphy course with a lab. In addition to my teaching responsibilities, I was able to collaborate with other faculty and students, to contribute to independent student research projects, and to supervise a student first-year seminar preceptor and teaching assistants. I also co-lead the department spring field trip to Death Valley with 18 Earth & Environment students.

Hoagland Teaching Assistant, Stanford University:

School of Earth Sciences 2008-2009

This yearlong appointed teaching assistantship involved improving introductory undergraduate courses within the Earth Sciences by working one-on-one with faculty members and developing new activities, labs, lectures, and field trips. Developed activities for Introductory Geology and a K/T extinction-focused introductory course; continued work and class lectures in the undergraduate Sedimentology course last year. Supervisor: Anne Egger, Undergraduate Program Coordinator, Stanford University.

Field Course Supervisor, Stanford University:

Geological and Environmental Sciences Department 2007-2009

One-on-one mentoring of three undergraduate students in the field for up to three weeks, including teaching field sedimentology, stratigraphy, geomorphology, GPS mapping, detrital zircon

and stable isotope proxy sampling methods, and creating and advising a final field course project for the Stanford undergraduate Geology major field requirement.

Teaching and Laboratory Assistant, Stanford University and Carleton College:

Geological and Environmental Sciences Dept., Geology Dept. 2006-2010; 2002-2003

Courses: Sedimentology and Stratigraphy, Mineralogy, Petrology.

GRANTS AND AWARDS

2011- --- Jackson Postdoctoral Fellowship, Jackson School of Geosciences, UT Austin
2007-2008 Hoagland Teaching Assistantship, School of Earth Sciences, Stanford University
2005-2007 Stanford Graduate Fellowship, Stanford University
2006-2007 American Association of Petroleum Geologists Grant-in-Aid
2006-2007 Geological Society of America Student Grant
2006-2008 McGee Research Grant, School of Earth Sciences, Stanford University
2006-2007 Northern California Geological Society Graduate Research Grant
2002-2003 Duncan Stewart Fellowship, Geology Department, Carleton College
2003 Distinction in Geology (exemplary work on senior thesis), Carleton College
2003 Phi Beta Kappa
2003 Sigma Xi Scientific Society Member

UNIVERSITY AND PROFESSIONAL SERVICE

2009- --- Reviewer: National Science Foundation – Division of Earth Sciences; Geology; Geological Society of America Bulletin; Geosphere; Journal of Structural Geology; Journal of Sedimentary Research
2013 Judge: Jackson School of Geosciences Research Symposium
2012-2013 Independent project advisor: Amanda Wilson '15 and Nikki Seymour '13, UT-A
2011 Co-Leader, Earth & Environment Department Field Trip to Death Valley, F&M
2011 Committee Member, Honors Defense: Katherine Datin '11, F&M
2010-2011 Coach, Code Blue, F&M Women's Ultimate Frisbee Team
2009-2010 GES Department Seminar Committee, Stanford University
2007-2008 Geochronology Faculty Search Student Committee, Stanford University
2007-2008 Co-Organizer, "Brown Bag" Student Research Seminar, Stanford University
2007 Organizer, "Convergent Margins" Department Field Trip, Stanford University
2006 Co-Organizer, Silicic Volcanism Seminar, Stanford University

PUBLICATIONS

Peer-reviewed articles:

Cassel, E.J., Grove, M., and Graham, S.A., 2012, Eocene drainage evolution and erosion of the Sierra Nevada batholith across northern California and Nevada, *American Journal of Science*, v. 312, no. 2, p. 117-144.

Cassel, E.J., Graham, S.A., Chamberlain, C.P., and Henry, C.D., 2012, Early Cenozoic Topography, Morphology, and Tectonics of the Northern Sierra Nevada and Western Basin and Range, *Geosphere*, April 2012, v. 8, no. 2, p. 229-249.

Henry, C.D., Hinz, N.H., Faults, J.E., Colgan, J.P., John, D.A., Brooks, E.R., Cassel, E.J., Garside, L.J., Davis, D.A., and Castor, S.B., 2012, Eocene–Early Miocene paleotopography of the Sierra Nevada–Great Basin–Nevadaplano based on widespread ash-flow tuffs and paleovalleys, *Geosphere*, v. 8, no. 1, p. 1-27.

Cassel, E.J., and Graham, S.A., 2011, Paleovalley morphology and fluvial system evolution of Eocene-Oligocene sediments ('auriferous gravels'), northern Sierra Nevada, California: Implications for climate, tectonics, and topography, *Geological Society of America Bulletin*, v. 123, no. 9/10, p. 1699-1719.

Cassel, E.J., Graham, S.A., and Chamberlain, P.C., 2009, Cenozoic tectonic and topographic evolution of the northern Sierra Nevada, California, through stable isotope paleoaltimetry in volcanic glass: *Geology*, v. 37, no. 6, p. 547-550.

Cassel, E.J., Calvert, A.T., and Graham, S.A., 2009, Age, geochemical composition, and distribution of Oligocene ignimbrites in the northern Sierra Nevada, California: implications for landscape morphology, elevation, and drainage divide geography of the Nevadaplano: *International Geology Review*, v. 51, no. 7, p. 723-742.

Gardner, T.W., Webb, J., Davis, A.G., Cassel, E.J., Pezzia, C., Merritts, D.J., and Smith, B., 2006, Late Pleistocene landscape response to climate change: eolian and alluvial fan deposition, Cape Liptrap, southeastern Australia: *Quaternary Science Reviews*, v. 25, p. 1552-1569.

Cassel, E., 2003, The Late Quaternary Sedimentary Succession and its Evolution at Morgan Beach, Cape Liptrap, Australia: *KECK Proceedings*, v. 16.

In review/in preparation:

National Science Foundation – Tectonics Collaborative Research Proposal:

Lead PI: Cassel, E.J., Co-PIs: Smith, M.E., Stockli, D.F., Singer, B.S., and Jicha, B., *in review*, Collaborative Research: Paleogeographic record of contractional to extensional tectonics in the Cordilleran hinterland, Nevada, US.

Long, S.P., Henry, C.D., Muntean, J.L., Edmondo, G.P., and Cassel, E.J., *in review*, Early Cretaceous construction and pre-Late Eocene extensional collapse of a structural culmination, Eureka, Nevada, U.S.A.: implications for out-of-sequence deformation in the Sevier hinterland, Geosphere.

Cassel, E.J., and Brecker, D.O., *in prep*, Hydrogen isotopic compositions of hydrated felsic volcanic glass: stability and preservation on geologic timescales.

Cassel, E.J., Henry, C.D., Brecker, D.O. and Stockli, D.F., *in prep*, Paleogene topography and drainage morphology across Nevada: Evidence from depositional systems, sediment provenance, and δD of ancient waters in volcanic glass.

National Science Foundation – Tectonics Research Proposal:

PIs: Cassel, E.J., Horton, B.K., Shanahan, T.M., and Brecker, D.O., *in prep*, Uplift and basin evolution of the central Andean Western Cordillera, to be submitted July 2013.

Cassel, E.J., Stockli, D.F., and Henry, C.D., *in prep*, Sediment transport in ancient river systems across the Cordillera of the western U.S.

Cassel, E.J., Smith, M.E., Stockli, D.F., Jicha, B., and Singer, B.S., *in prep*, Lacustrine basin evolution at the crest of the Cordilleran hinterland during the Eocene transition from contractional to extensional tectonics in eastern Nevada.

Conference Presentations:

Cassel, E.J., Henry, C.D., and Larson, T.E., 2012, Paleogene topography and drainage morphology across Nevada: Evidence from depositional systems, sediment provenance, and δD of ancient waters in volcanic glass, American Geophysical Union, Fall Meeting, Abstract T31F-05, December 2012.

Cassel, E.J., Henry, C.D., Graham, S.A., and Chamberlain, C.P., 2011, Oligocene Provenance, Drainage Morphology, and Topography of the Nevadaplano: American Geophysical Union, Fall Meeting, Abstract T23H-06, December 2011.

Cassel, E.J., Henry, C.D., Graham, S.A., and Chamberlain, C.P., 2010, Determining Oligocene Topography and Tectonism across the Northern Sierra Nevada and Western Basin and Range using Stable Isotope Palealtimetry in Volcanic Glass: Abstracts with Programs – 2010 Annual Meeting, The Geological Society of America.

Cassel, E.J., Henry, C.D., Grove, M., Graham, S.A., and Chamberlain, C.P., 2010, Cenozoic Landscape Evolution of the Northern Sierra Nevada and Western Basin and Range: Implications for Tectonics and Topography: Origin and Uplift of the Sierra Nevada, The Geological Society of America Penrose Conference, Bridgeport, CA, August 16-20, 2010.

Cassel, E.J., Grove, M., and Graham, S.A., 2010, Depositional Ages, Provenance, and Paleo-drainage Patterns from Detrital Zircon Geochronology of Eocene-Oligocene Fluvial Sediments ('auriferous gravels') in the Northern Sierra Nevada, CA: Abstracts with Programs – 2010 Cordilleran Section Meeting, The Geological Society of America, Anaheim, CA, May 28-30, 2010.

Cassel, E.J., and Graham, S.A., 2009, Eocene-Oligocene paleovalley characterization and fluvial system evolution in the northern Sierra Nevada, California: Abstracts with Programs – 2009 Annual Meeting, The Geological Society of America.

Cassel, E.J., and Graham, S.A., 2008, Geochemical Composition and Correlation of Oligocene Ash-flow Tuffs in the Northern Sierra Nevada of California: Eos, Transactions, American Geophysical Union, Fall Meeting Suppl., Abstract V21C-2126, December 2008.

Cassel, E.J., and Graham, S.A., 2007, The Eocene to Oligocene Landscape of the Northern Sierra Nevada: Eos, Transactions, American Geophysical Union, Fall Meeting Suppl., Abstract T33A-1141, December 2007.

Cassel, E.J., Graham, S.A., and Chamberlain, P.C., 2007, Palealtimetry of the northern Sierra Nevada in the Oligocene using hydrogen isotopes in hydrated volcanic glass: Abstracts with Programs – 2007 Annual Meeting, The Geological Society of America.

Cassel, E. and Davidson, C., 2003, Crystallization Depths of Cretaceous Plutons along the Wrangell Transect, Southeast Alaska: Abstracts with Programs – 2003 Annual Meeting, The Geological Society of America.

Bohacs, K., Cassel, E., Hemmesch, N., Jonk, R., Lazar, R., and MacQuaker, J., 2009, Significant variations in hydrocarbon source and mudstone-reservoir character at the parasequence scale: counter-intuitive trends, systematic relations, and economic implications: AAPG Annual Mtg., June 2009.

Jonk, R., Cassel, E., and Barboza, S., 2009, Modeling Hydrocarbon Migration and Retention in Fine-Grained Clastic Successions: Conventional Approaches to Evaluating Unconventional Resources: AAPG Hedberg Research Conference, May 3-7, 2009.

Gardner, T., Merritts, D., Davis, A., Cassel, E., Pezzia, C., Webb, J. and Smith, B., 2003, Late Pleistocene Calcareous and Siliceous Aeolian and Alluvial Fan Deposits, Cape Liptrap, Southeastern Victoria, Australia: Abstracts with Programs – 2003 Annual Meeting, The Geological Society of America.

REFERENCES

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