Tuesday, December 13

8:10 – 9:40 ***Climate Detectives: Solving a Climate Mystery on the JOIDES Resolution***– Dr. Sean Gulick (UT- Austin), Alison Mote (UT- Austin), Sharon Cooper (Lamont- Doherty Earth Observatory), and Dr. Katherine Elliins (UT- Austin).

Climate Detectives Team

Sean Gulick, PhD
Research Professor
Institute for Geophysics, Jackson School of Geosciences
The University of Texas at Austin

Sean is interested in tectonic-climate interactions, the role of catastrophism in the geologic record and marine geophysical imaging at nested resolutions. His current projects include tectonic and climate interactions in the St. Elias Mountains and Surveyor submarine fan, geohazards and margin evolution of subduction and transform faulting in Alaska, Sumatra, and Japan, and the geologic processes and environmental effects of the Cretaceous-Paleogene Chicxulub meteor impact.

Alison Mote, M.S.
Geoscience Course Coordinator
OnRamps Dual Enrollment Program, Office of Strategy and Policy
The University of Texas at Austin

Prior to working with the OnRamps program at UT, Alison served as a public school educator for 9 years, most recently at the Ann Richards School for Young Women Leaders in Austin, TX. With a passion for geoscience and education, Alison often integrated concepts related to earth sciences into her Physics and Chemistry courses, and also taught AP Environmental Science and OnRamps Geoscience. The EarthLabs Climate Detectives module was born from her experience as an Education Officer on board Expedition 341 with the *JOIDES Resolution.* In her current role at UT, Alison works on curriculum development and provides support and training to OnRamps Geoscience instructors across the state of Texas.

Sharon Cooper
Manager, Education and Outreach,
International Ocean Discovery Program (IODP)
Lamont-Doherty Earth Observatory

Sharon is the manager of Education and Outreach for the International Ocean Discovery Program (IODP), where she develops and oversees a wide range of programs designed to get out the word about the exciting and groundbreaking science being uncovered by the scientific drilling program. These include the Onboard Education and Outreach program and the School of Rock, through which we place educators on expeditions of the scientific drilling vessel, *JOIDES Resolution*.

Kathy Ellins, PhD
Program Director of Geoscience Education
Office of Outreach and Diversity, Jackson School of Geosciences
The University of Texas at Austin
Fulbright Scholar

Kathy is a geoscience educator who strives to improve science learning and to reach the public through: (1) curriculum development for the Earth/ocean/climate sciences; (2) teacher professional development; (3) multi-institutional collaboration to promote diversity in the geosciences at the K-12 and undergraduate levels; and (4) interdisciplinary projects that explore the intersection between geoscience and the visual arts.

EarthLabs for Educators and Policy Makers

a National Model for Earth Science Lab Courses

Climate Detectives: Solving a Climate Mystery on the *JOIDES Resolution*

American Geophysical Union

AGU GIFT Workshop, December 13th, 2016

8:10 am – 9:40 am

Dr. Sean Gulick, University of Texas at Austin, Jackson School of Geosciences

Alison Mote, University of Texas at Austin, OnRamps Dual Enrollment Program

Sharon Cooper, Lamont-Doherty Earth Observatory

Dr. Kathy Ellins, University of Texas at Austin, Jackson School of Geosciences

The University of Texas at Austin OnRamps

TEXAS Geosciences The University of Texas at Austin Jackson School of Geosciences

JOIDES RESOLUTION Science in search of Earth's secrets

INSTITUTE FOR GEOPHYSICS Understanding How Worlds Work UTIG

IODP INTERNATIONAL OCEAN DISCOVERY PROGRAM Exploring the Earth Under the Sea

NSF

DIG Texas BLUEPRINTS

Diversity & Innovation in Geoscience

DIG Texas Instructional Blueprints for Teaching Earth And Space Science

EarthLabs Climate Project

Acknowledgements

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1. **DIG Texas Blueprints:** NSF GEO-1203021, GEO-1202745, GEO-1202920, and GEO-1202920
2. *EarthLabs* Climate Project (NSF-DRK12) DUE1019721, DUE1019703, and DUE1019815

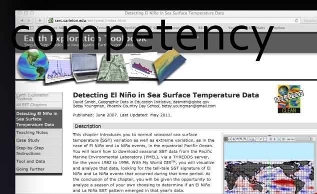
Any opinions, findings, and conclusions or recommendations expressed in these materials are those of the presenters and do not necessarily reflect the view of the NSF.

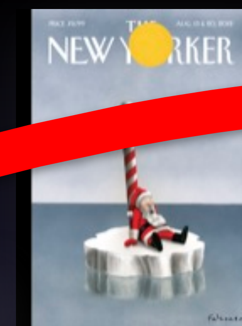
Blueprint: A Coherent Pathway for an Entire Earth Science Course (27 - 30 weeks)

EARTH AND SPACE SCIENCE TEKS

Use authentic data
Focus on inquiry and process of science (SEPs)

competency





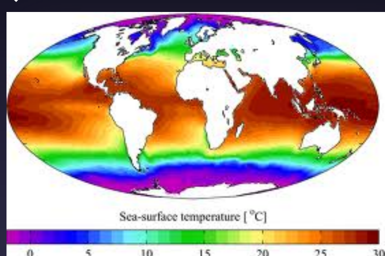
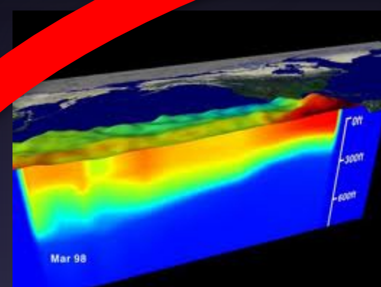


Plate Tectonics



Stratigraphic Principles

NEXT GENERATION SCIENCE STANDARDS

DIGTexas BLUEPRINTS
Diversity& Innovation in Geoscience

Documenting Past Climate

Time required to complete this unit:

This page is under development and may be edited at any time. Some resources have not been cataloged, pending project approval.

3 weeks, or 12.5 hours, or 750 minutes (estimated)

Earth Science Content:
Key Terms: paleoclimate, glacial cycles, Milankovich Cycles, sediment, sedimentology, paleomagnetism, paleontology, proxy data, dropstone, tectonics, microfossil, diatoms, foraminifera, iceberg, isotope, sediment drilling and coring, drillship. scientific ocean drilling

▶ **Standards: ESS TEKS:** 1.A, 2.E, 2.F, 3.E, 7.A, 7.C, 8.B, 11.A, 13.E, 15.B **ES Literacy:** 1.2, 1.3, 1.5, 1.7, 2.1, 3.6, 3.7, 4.1, 4.8, 4.9, 5.6, 5.7, 6.1, 6.4, 6.5, 6.8, 9.2

Unit Storyline

Earth's climate has changed, sometimes dramatically, in the past. If you had lived on the island of Manhattan about 20,000 years ago, you would have found yourself living during an ice age on top of a 4-kilometer thick slab of ice. Does it matter? Is it important to understand Earth's climate history? Can knowledge about past climate help us understand how Earth's Earth's climate http://serc.carleton.edu/dig_blueprints/units/document_past_climate.html

Activities

The activities we have selected are congruent with the Next Generation Science Standards (NGSS), and are arranged to build upon one another. Therefore, to follow the storyline we recommend that teachers complete the activities in the order provided.

Climate Detectives

View Activity

http://serc.carleton.edu/earthlabs/climatedetectives/index.html

In this module of six lessons from the EarthLabs series, learners assume the role of participants on the International Ocean Discovery Program's drillship, the JOIDES Resolution. Using data collected from Expedition 341, students will explore how climatic changes are recorded in the rock record, learn about careers associated with the IODP, and gain an appreciation for the ocean drilling process, and data collection methods.

Instructional Strategies: Inquiry

Resource Type: Laboratory investigation, experiment or demonstration

Time Required: 750 minutes

▸ **Standards: ESS TEKS:** 1.A, 2.E, 2.F, 3.E, 7.A, 7.C, 8.B, 11.A, 13.E, 15.B **ES Literacy:** 1.2, 1.3, 1.5, 1.7, 2.1, 3.6, 3.7, 4.1, 4.8, 4.9, 5.6, 5.7, 6.1, 6.4, 6.5, 6.8, 9.2

The linked titles are directed to the teacher pages. Lab activities that are contained within this module are as follows:

Alison Mote

Education Officer IODP Expedition 341

The Challenge

- You are a young scientist with a passion for understanding how Earth's climate has changed over the past 7 million years. To help with your research you will join an international team of scientists and crew on the drillship, the *Joides Resolution*, and spend a summer at sea in the Gulf of Alaska collecting sediment cores from beneath the seafloor.
- This modern-day expedition (IODP Expedition 341) will help you answer a series of questions about about past climate in the region.

Using a section of **Core U1417B** students work in teams to analyze different types of data to answer the following questions:

1 **Change Over Time.** How have environmental conditions in in the Gulf of Alaska changed during the time when the sediments in this section of core were deposited?

2 **Glacial Cycle**s. What does the occurrence of different types of diatoms (plants) and their abundance in the core reveal about the timing of the cycles of the advance and retreat of glaciation?

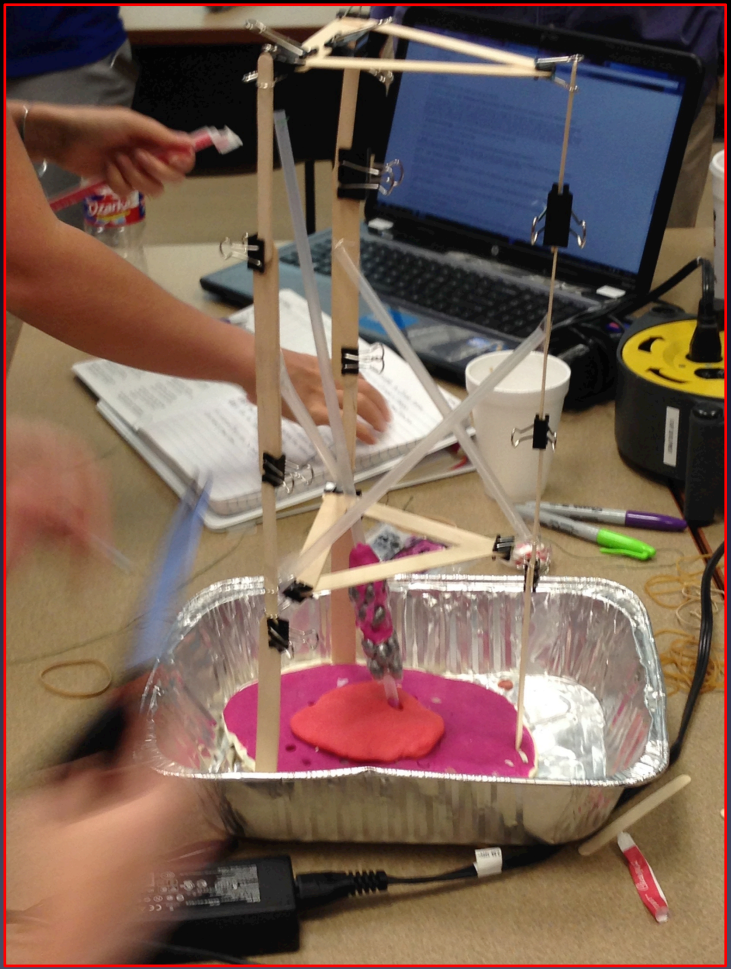
3 **Measurement of Time**. What is the timeline represented by the section of core you are investigating and how do we know?

To answer these questions and satisfy the challenge, students …

1. **Gather background information** about
   - the goals of the expedition
   - the ship, labs, and drilling/ coring technology
   - the scientists, engineers and crew, their special expertise and how they collaborate
2. **Obtain knowledge** about **tectonic setting**, glaciation, glacial cycles, marine sedimentation, ice rafted debris, geologic time, and proxy data
3. **Conduct investigations**, using **data** and **evidence** that give clues about past climate
4. **Construct answers** to the challenge
5. C**ommunicate results**

Lab 2: Coring is Not Boring

A - Build a Model Drill



IODP

International Ocean Discovery Program

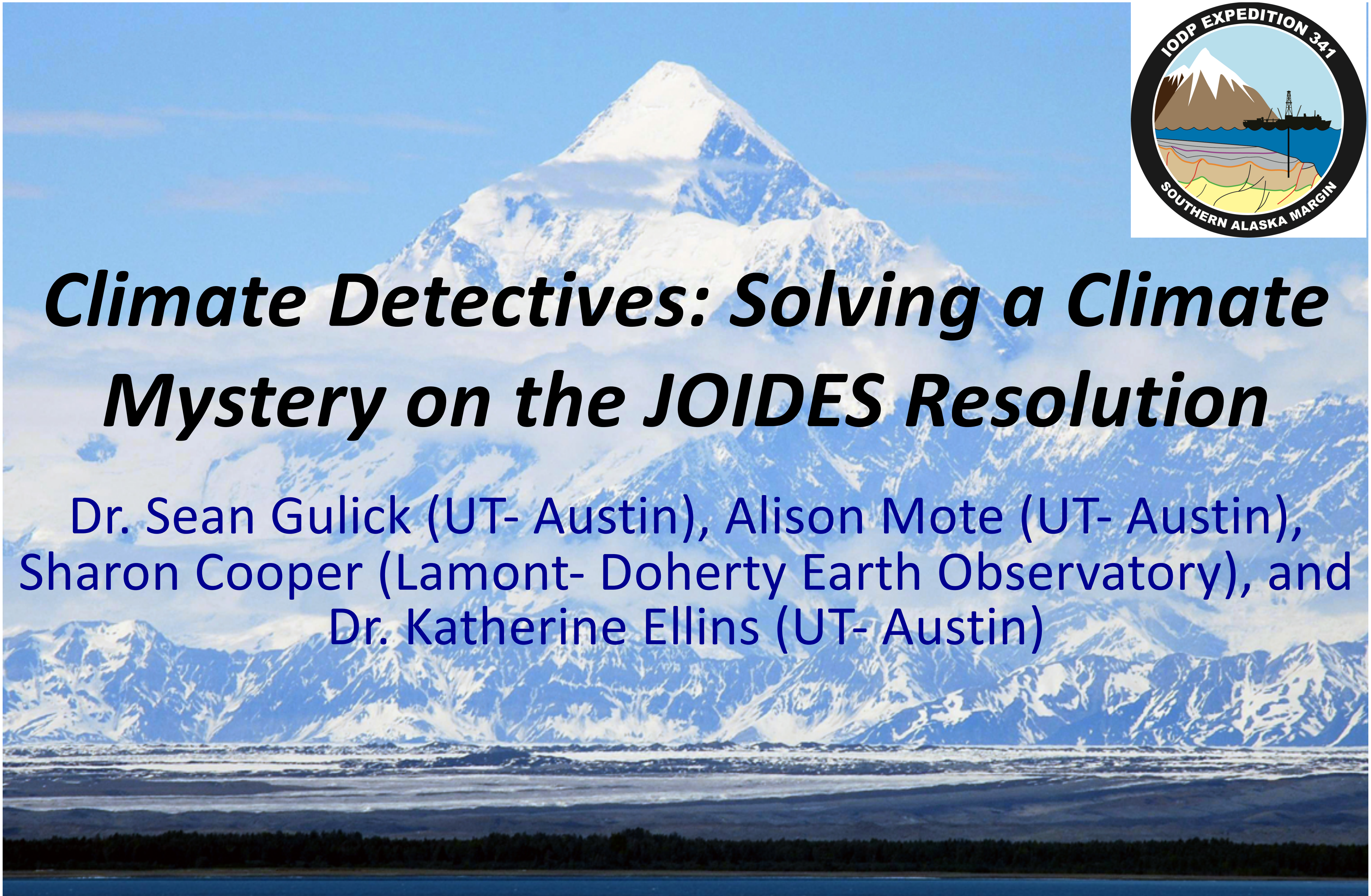
Leah Schneider LeVay, IODP TAMU

Sean Gulick, UTIG, UT Austin

John Jaeger, U. of Florida, USAC Chair

http://serc.carleton.edu/earthlabs/climatedetectives/index.html

Co-Chief Sean Gulick

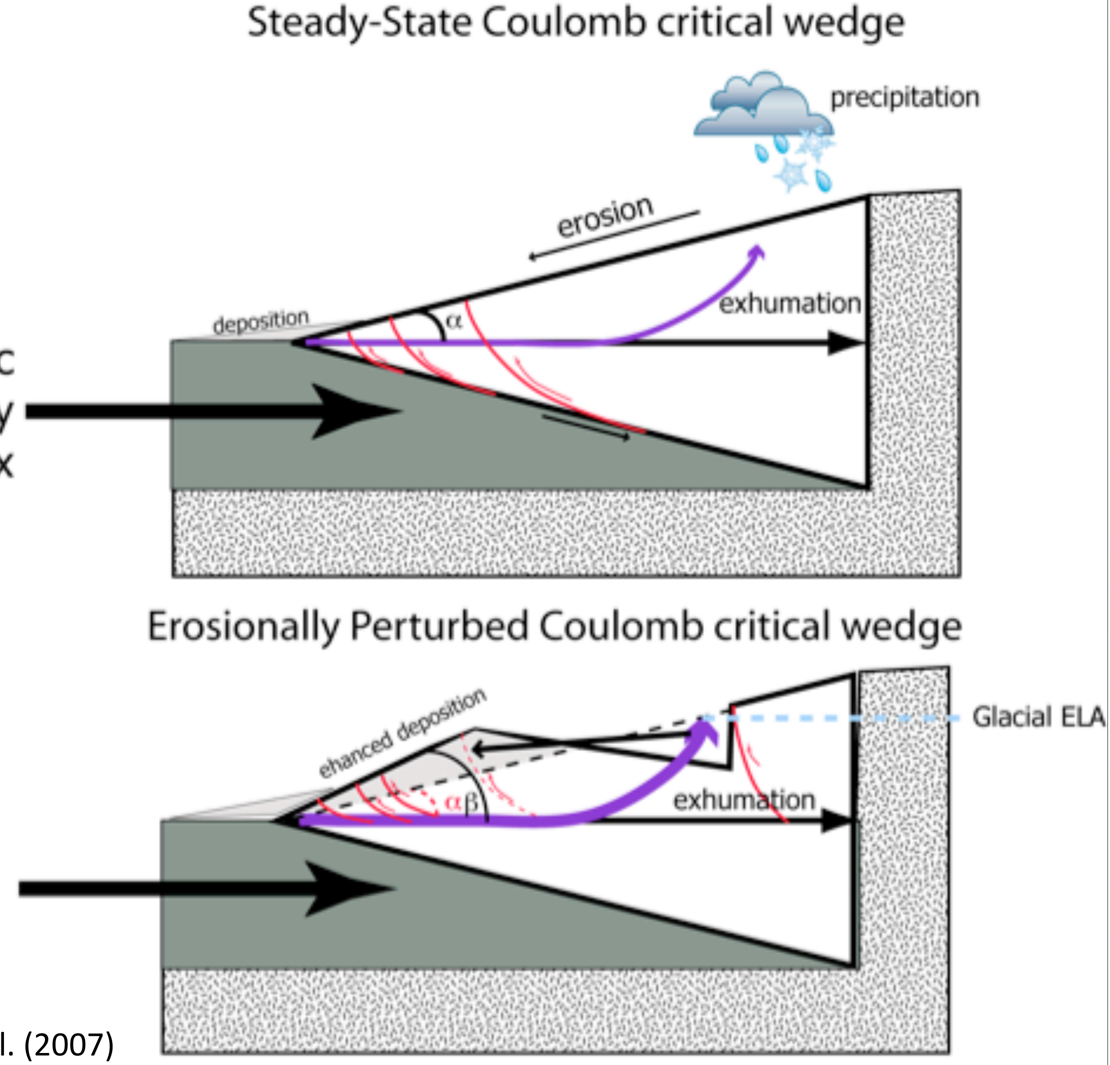


Climate Detectives: Solving a Climate Mystery on the JOIDES Resolution

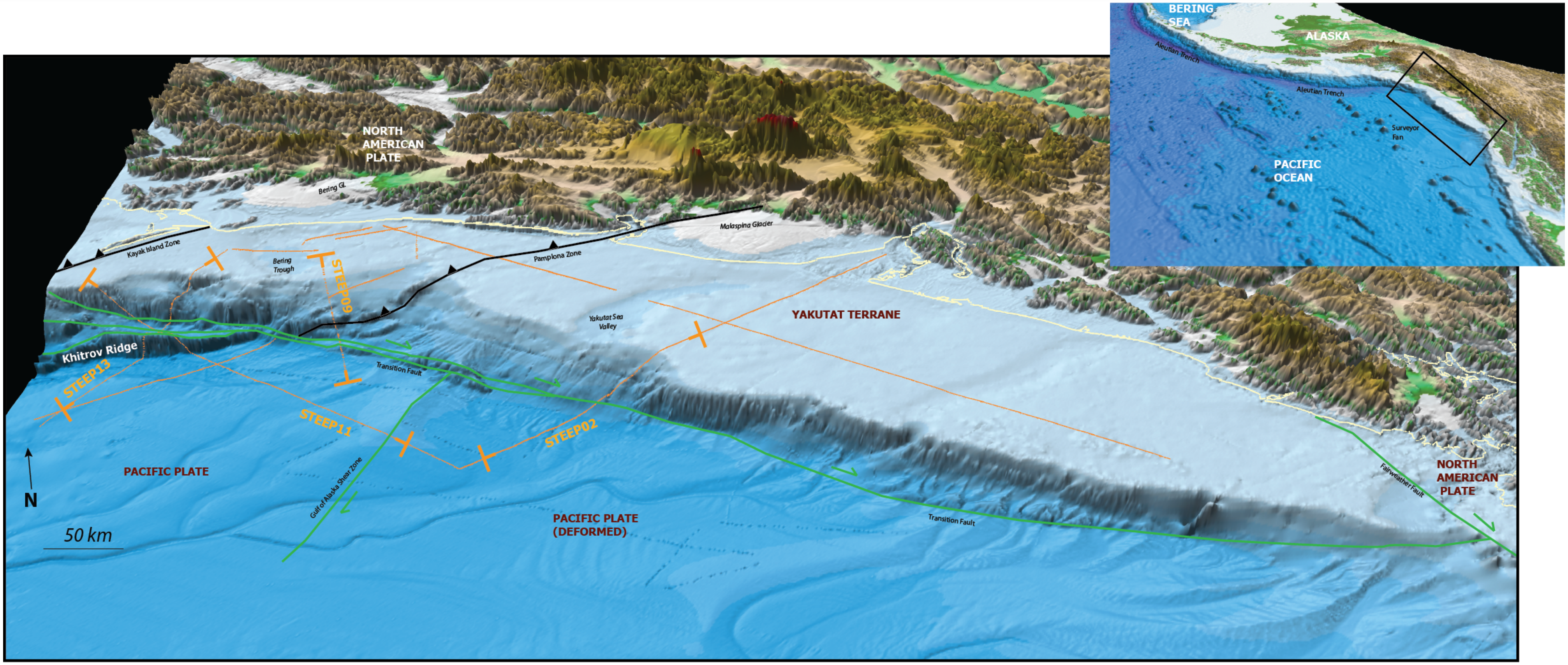
Dr. Sean Gulick (UT- Austin), Alison Mote (UT- Austin), Sharon Cooper (Lamont- Doherty Earth Observatory), and Dr. Katherine Ellins (UT- Austin)

Hypothesis

-Mountain building fundamentally altered by erosion resulting in a measurable tectonic response and a significantly increased sediment flux to the ocean basins



After Roe et al. (2007)



Gulick et al., Geology, 2013

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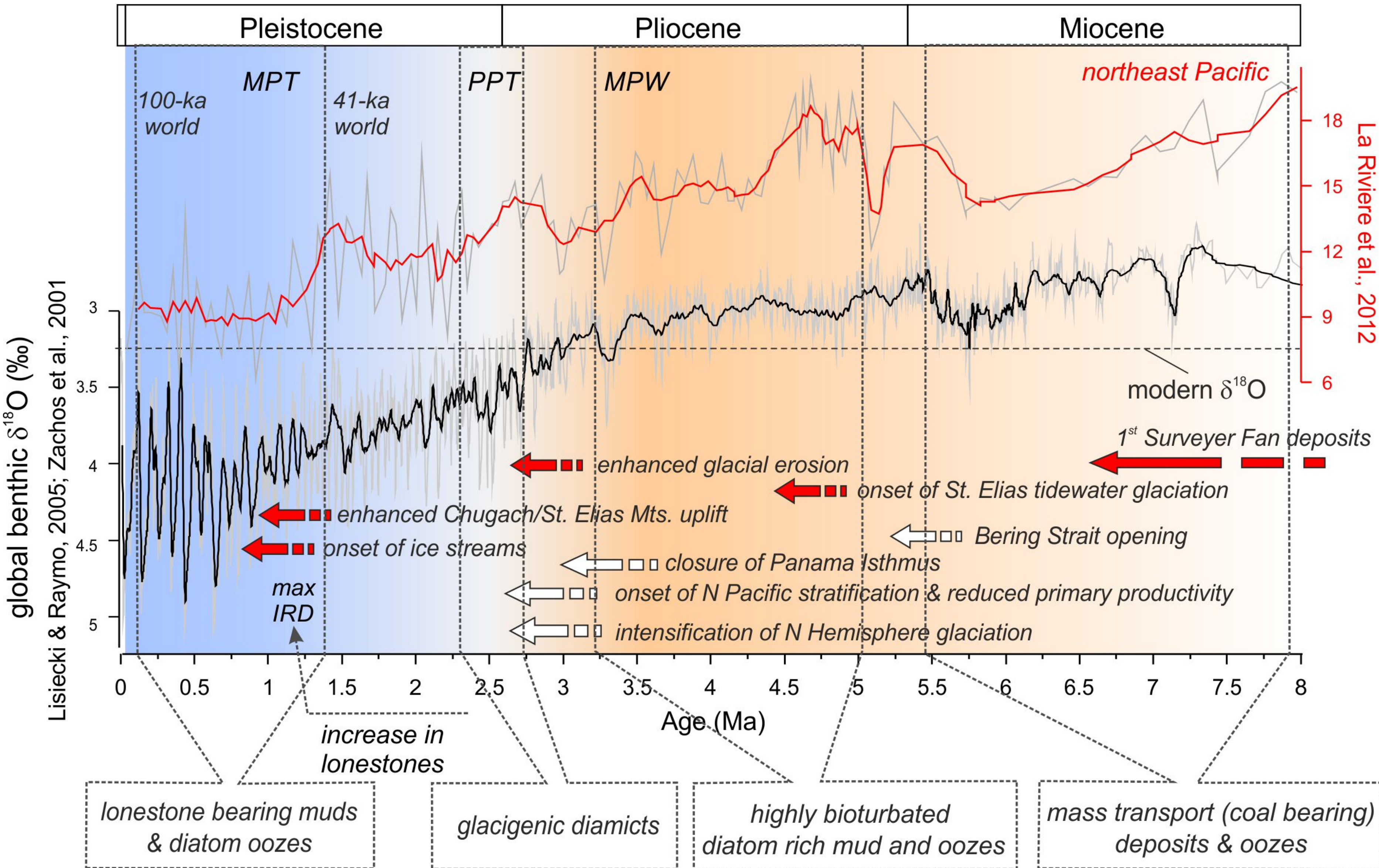

INSTITUTE FOR GEOPHYSICS

JACKSON SCHOOL OF GEOSCIENCES

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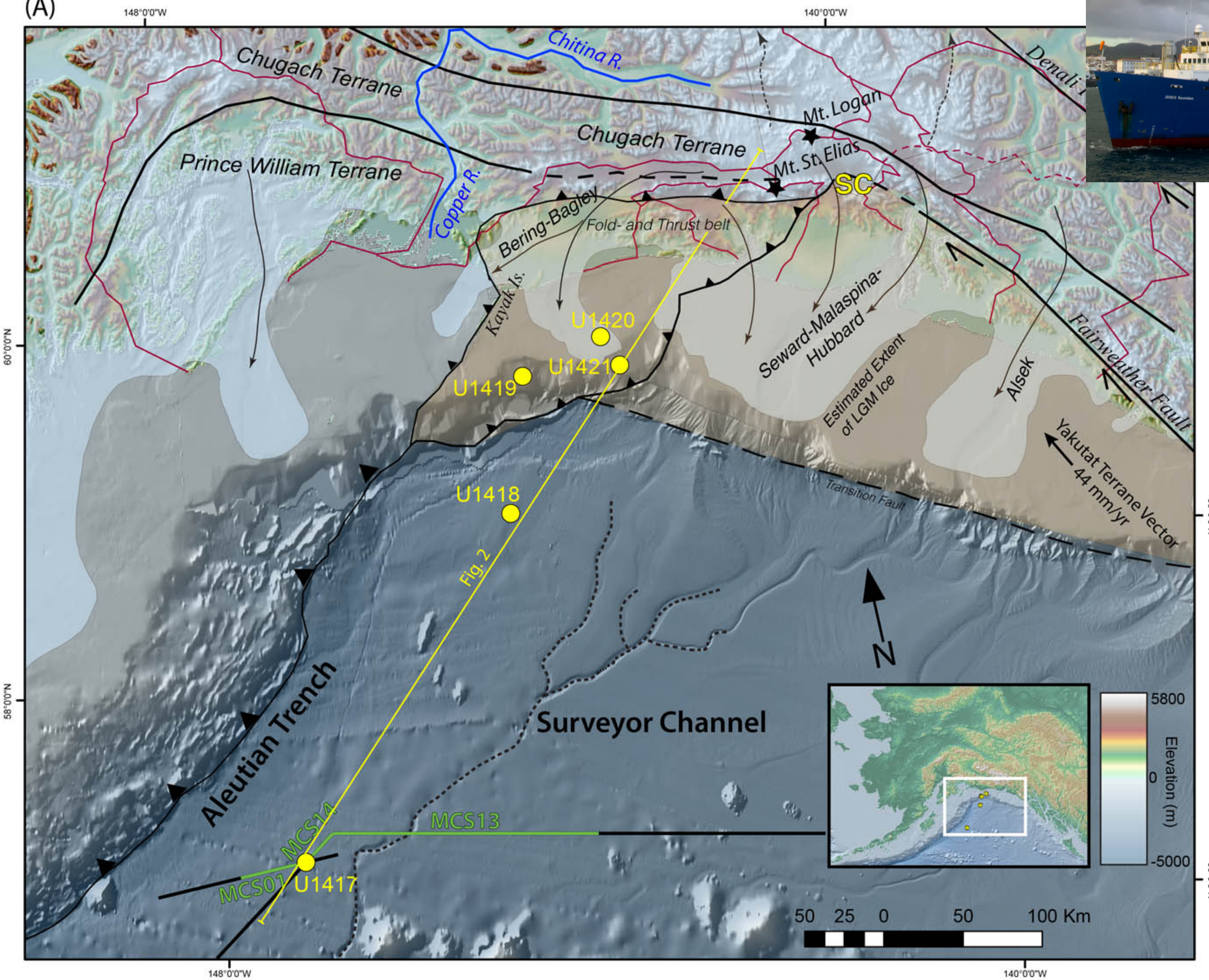
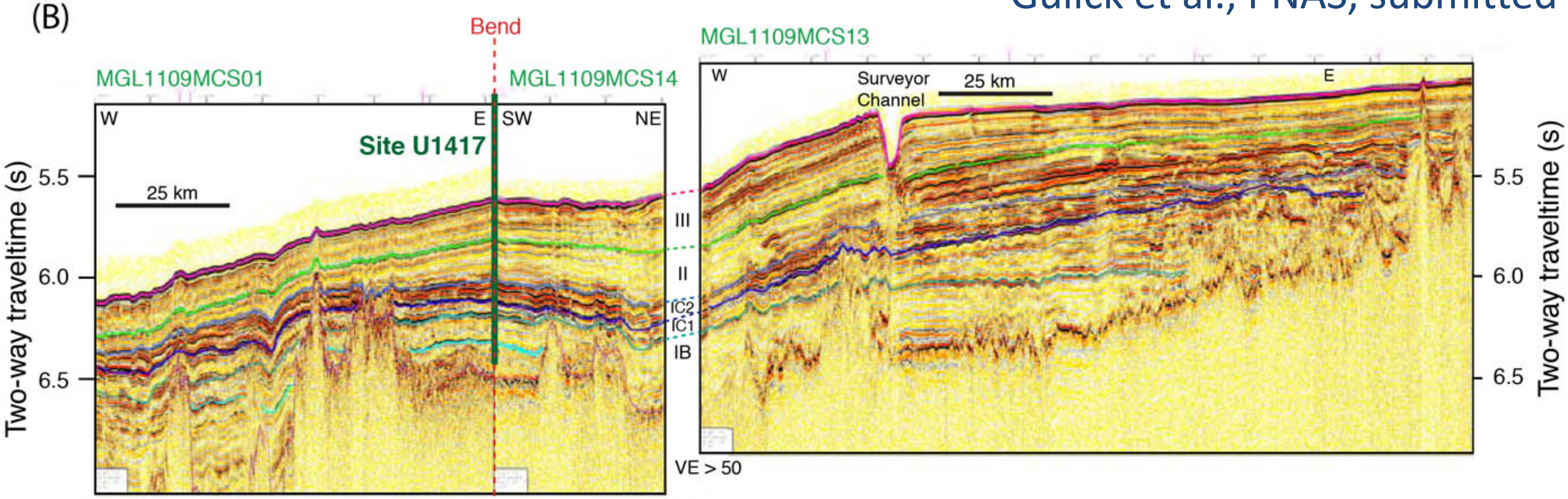
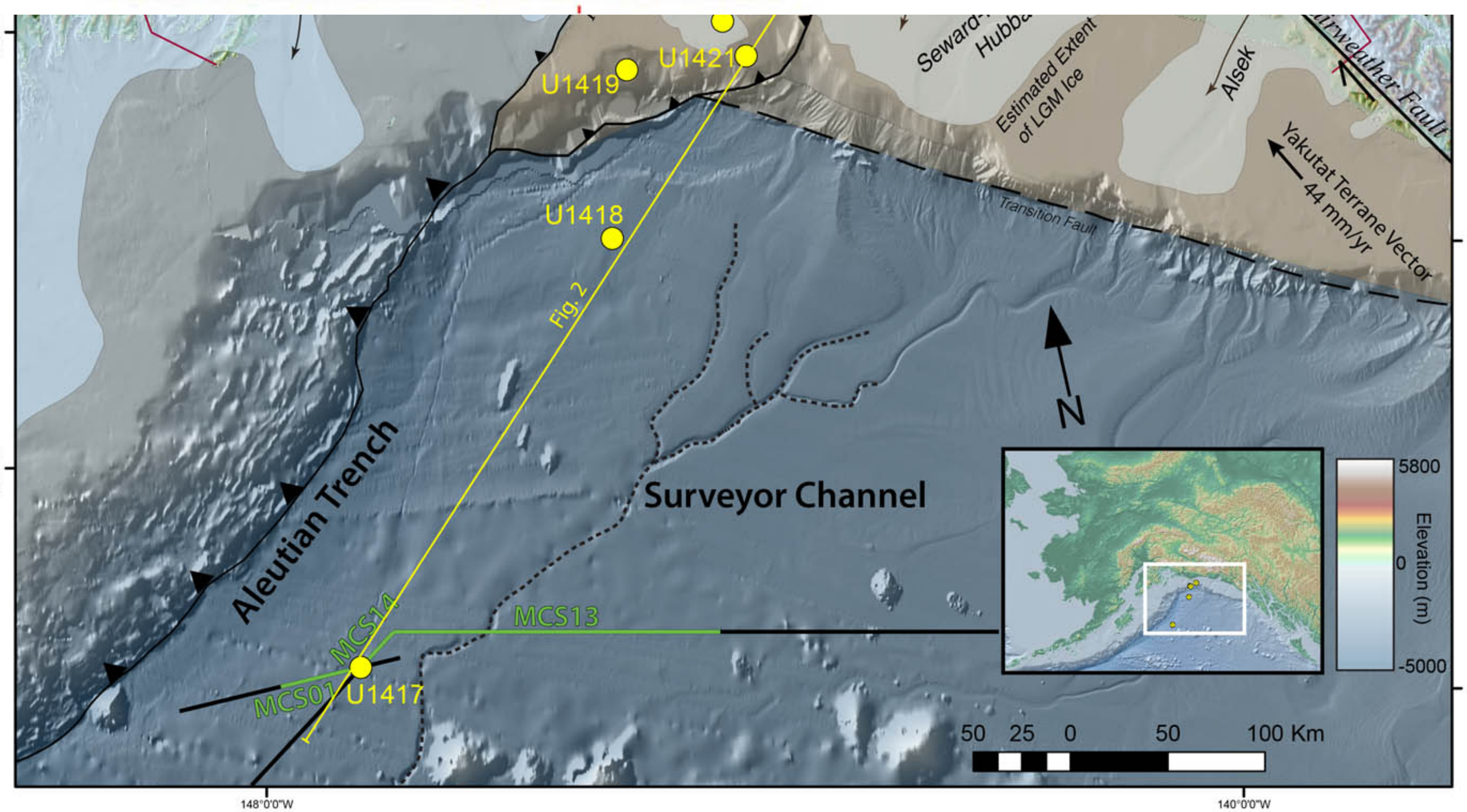


2013 IODP Expedition 341: Gulf of Alaska

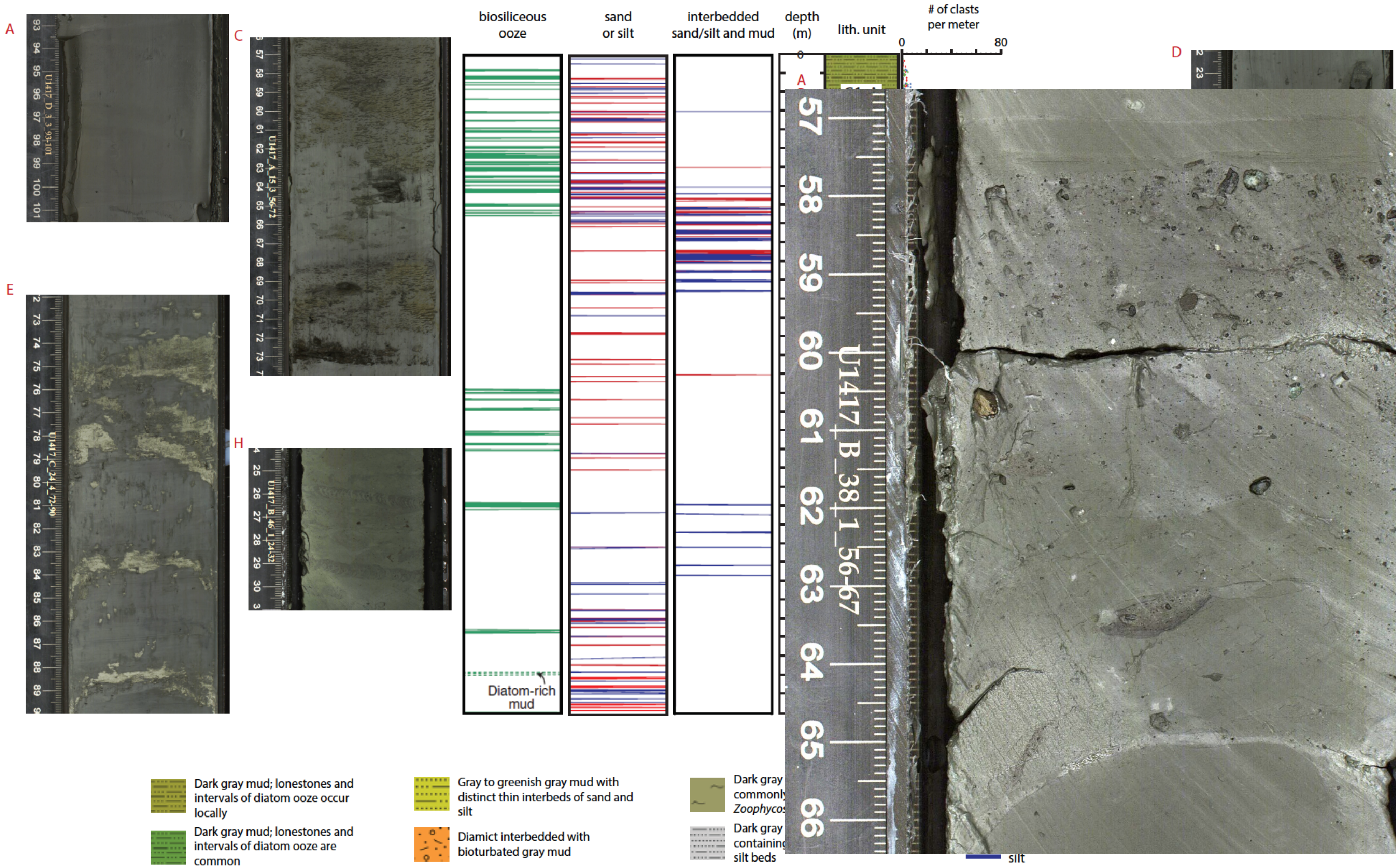
CORE ON DECK!

Gulick et al., PNAS, submitted





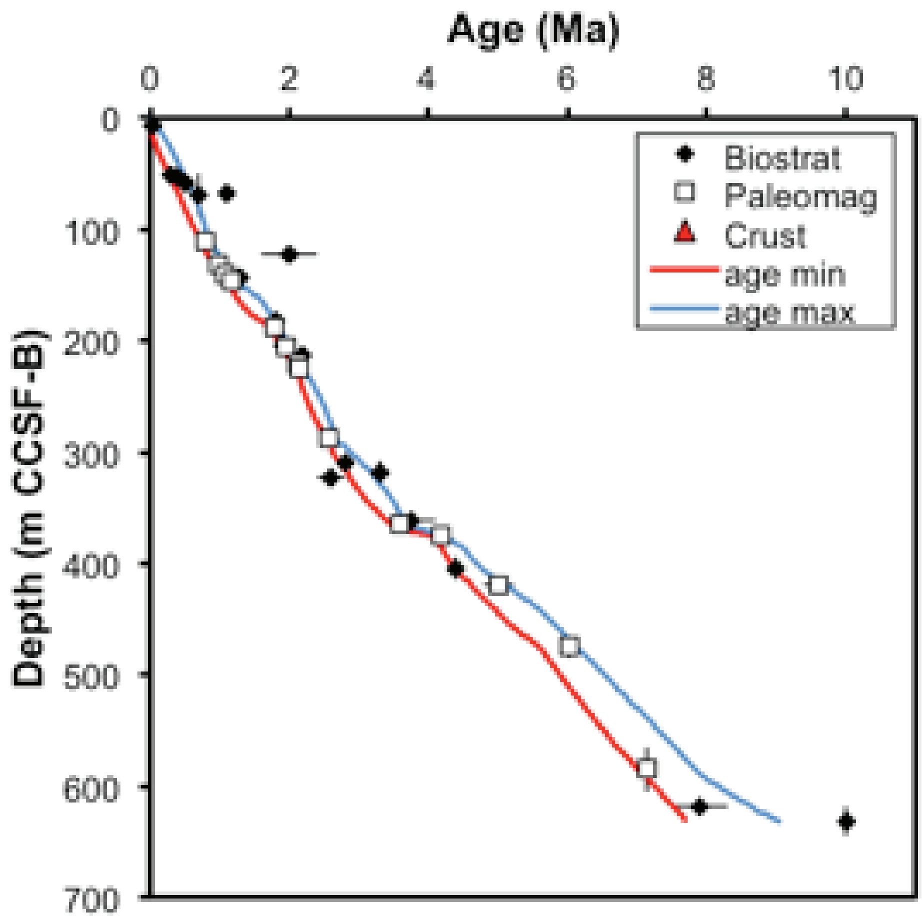
Expedition 341: Gulf of Alaska



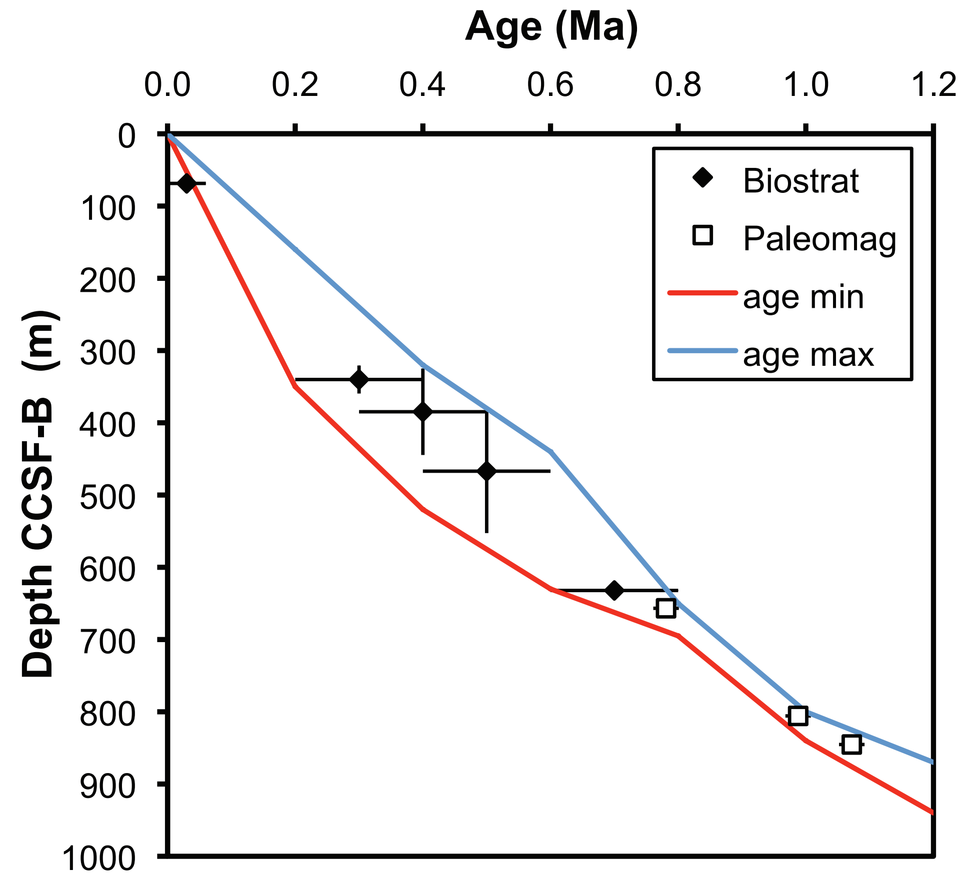
Morey et al., in prep; modified from Jaeger et al., Exp Rpts, 2014

Age-Depth Model- U1417 & U1418

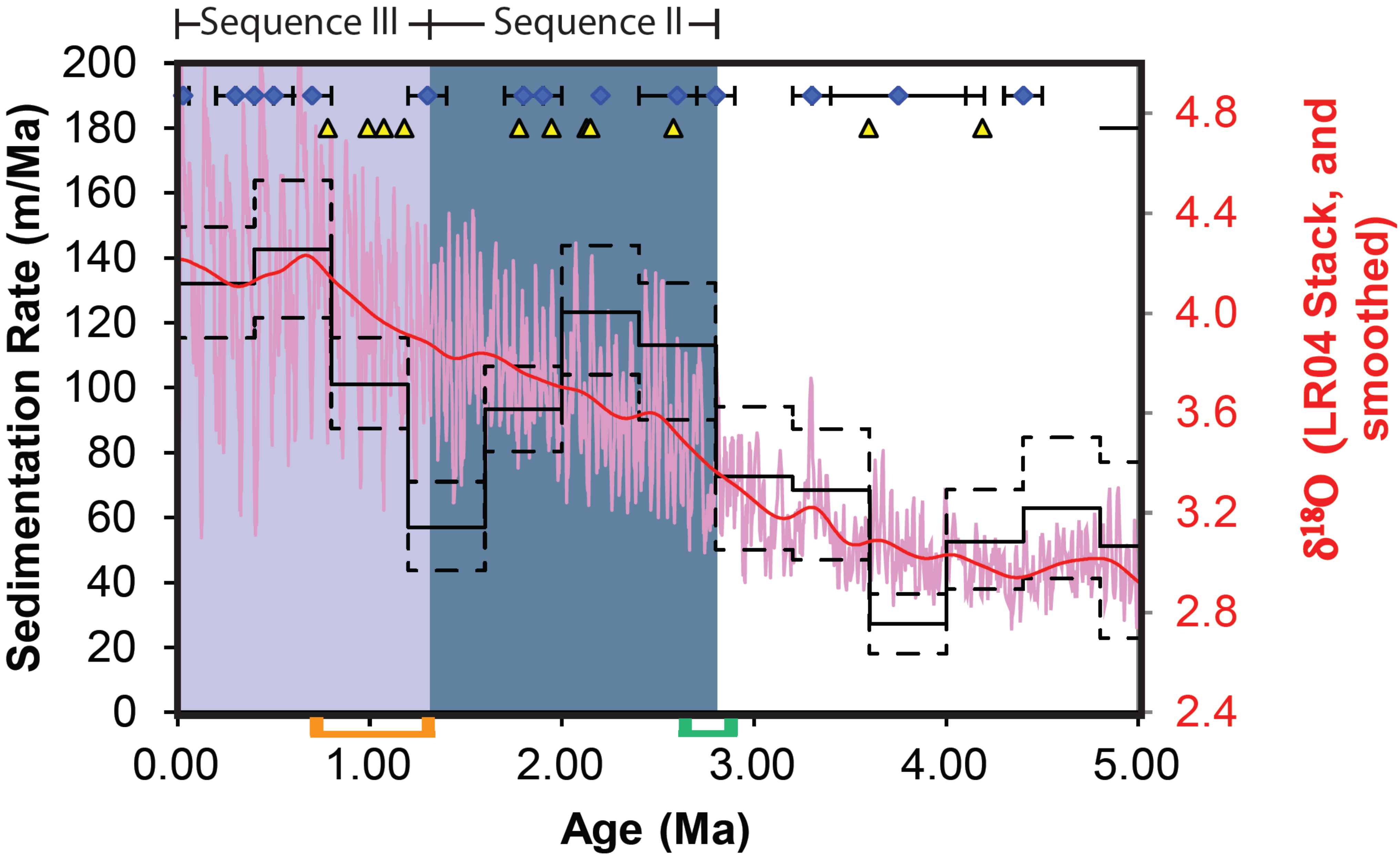
Site U1417



Site U1418

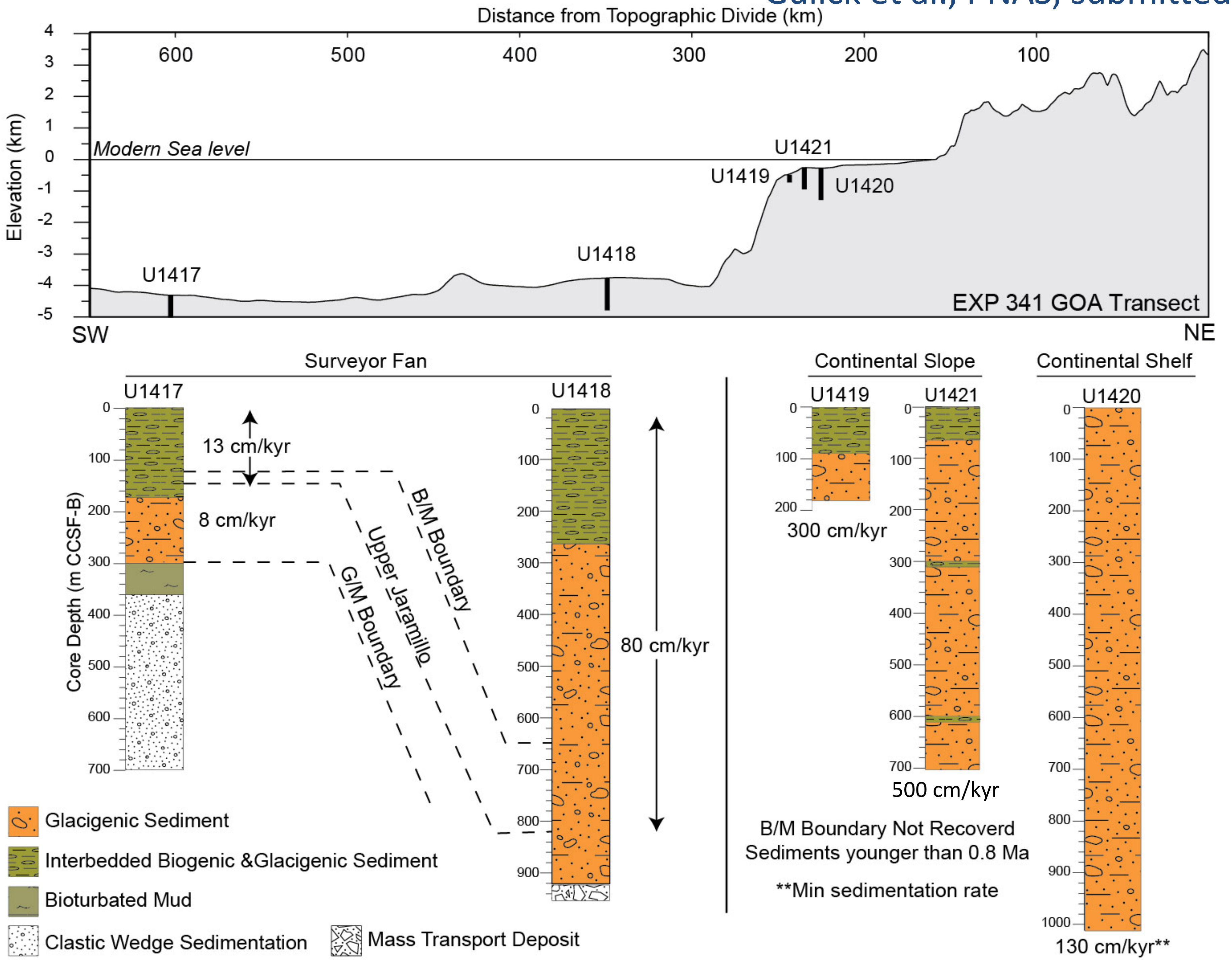


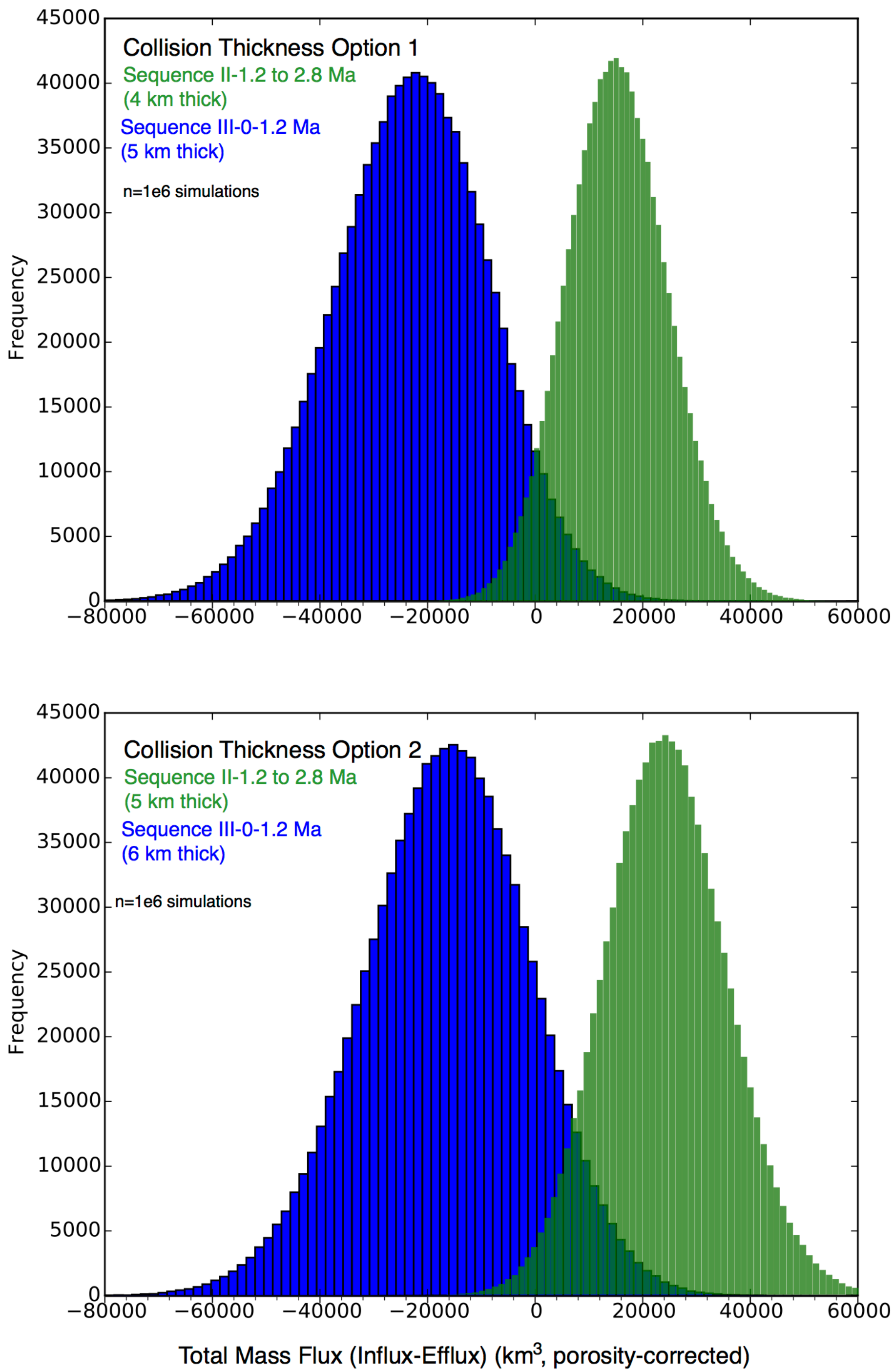
Jaeger, Gulick, Levay et al., IODP, 2014; Gulick et al., 2015



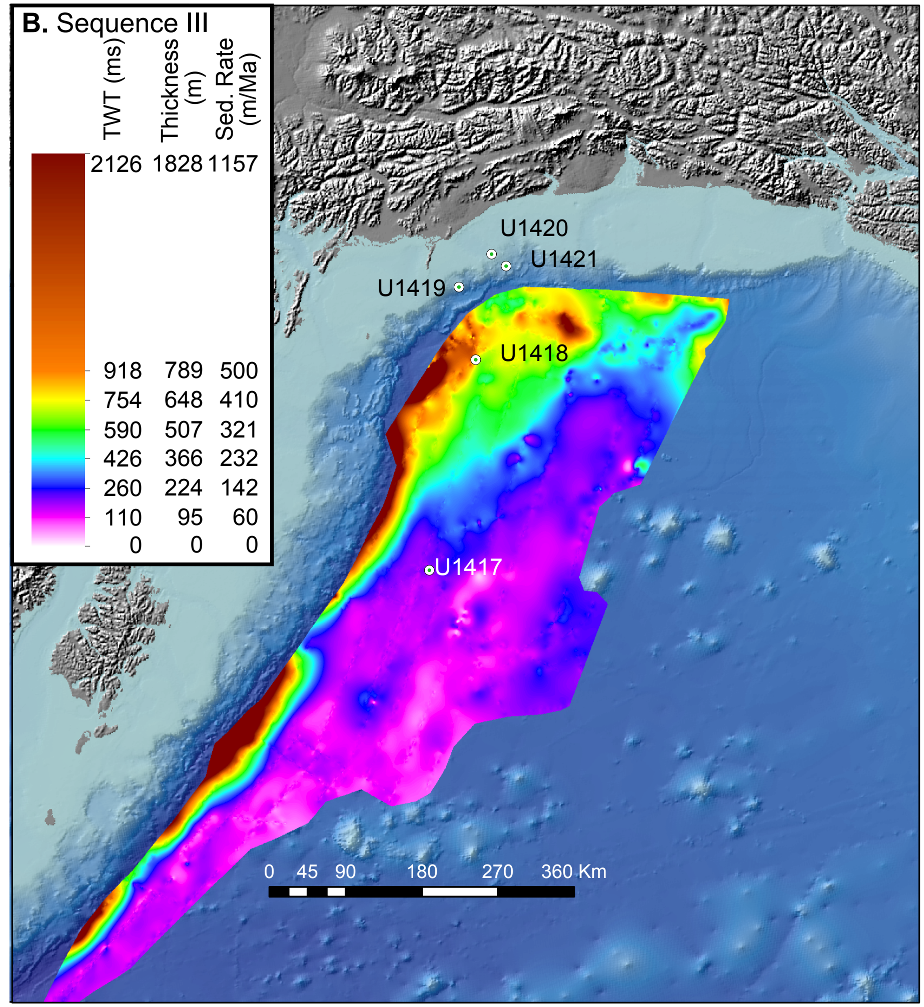
Morey et al. in prep; modified from Gulick et al., 2015

Gulick et al., PNAS, submitted





THE UNIVERSITY OF TEXAS AT AUSTIN



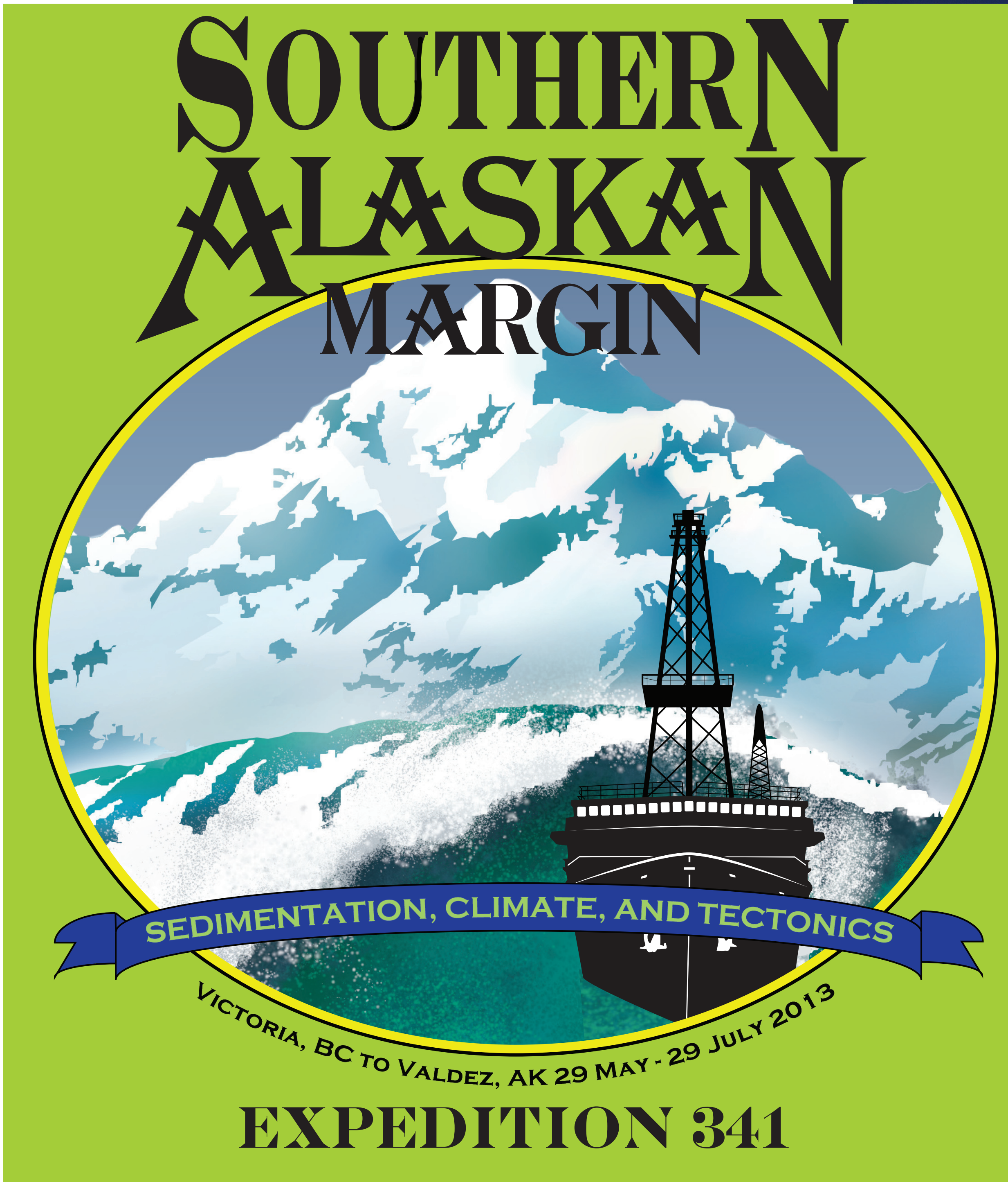
Gulick et al., PNAS, 2015

Conclusions

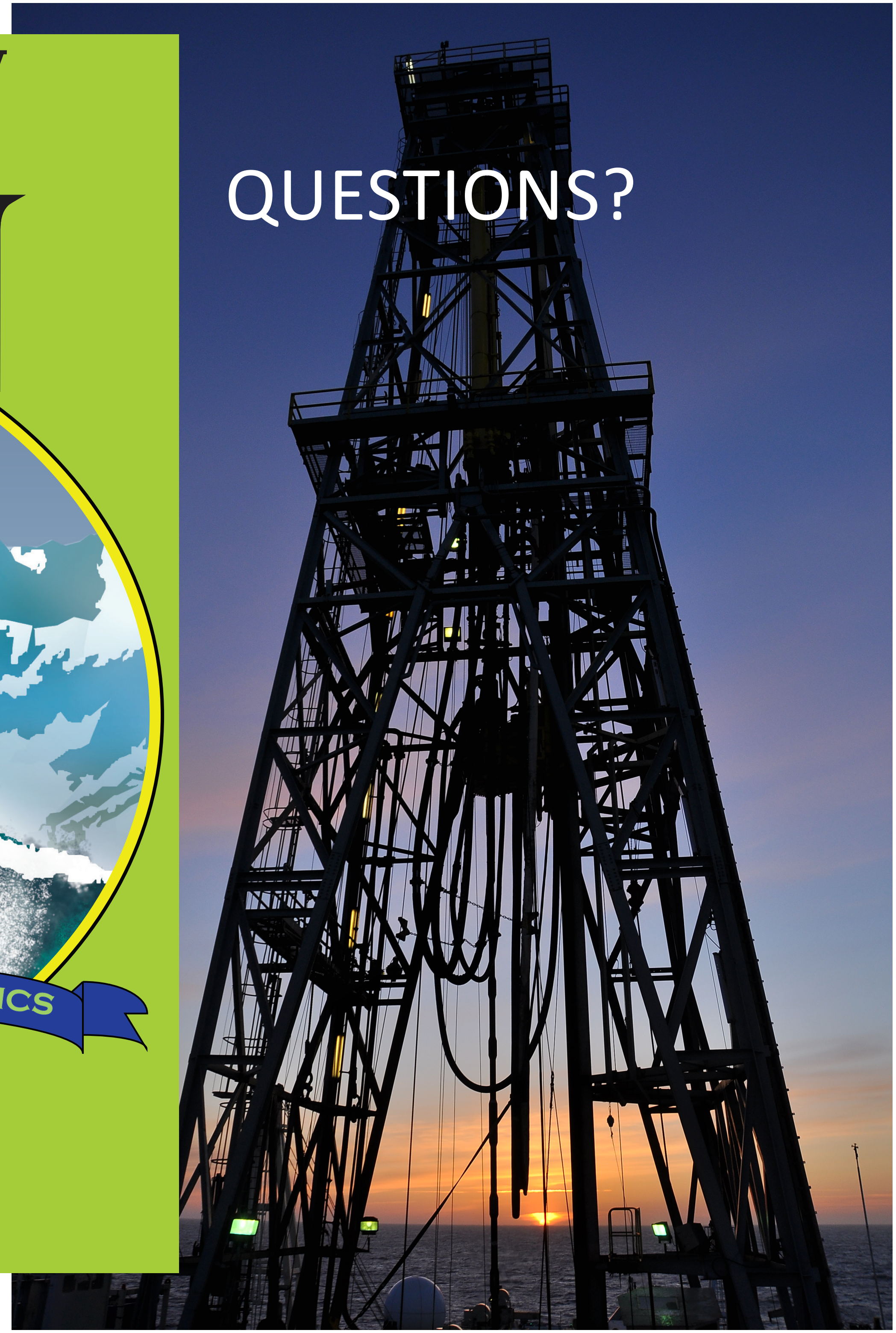
Erosion accelerated in response to Northern Hemisphere glacial intensification (~2.7 Ma) and that the 900-km long Surveyor Channel inception appears to correlate with this event. However, tectonic influx exceeded integrated sediment efflux over the interval 2.8-1.2 Ma. Volumetric erosion accelerated following the onset of quasi-periodic (~100-kyr) glacial cycles in the mid-Pleistocene climate transition (1.2-0.7 Ma). Since then erosion and transport of material out of the orogen has outpaced tectonic influx by 50-80%.

Significance

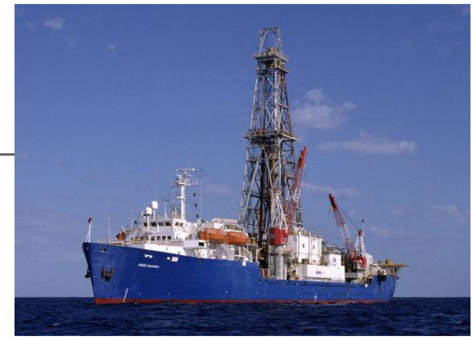
In coastal Alaska and the St. Elias orogen, over the past 1.2 million years integrated erosion has outpaced plate tectonic mountain building. This finding underscores the power of climate in driving erosion rates, the potential for feedback mechanisms linking climate, erosion, and tectonics, and the complex nature of climate-tectonic coupling in transient responses toward longer-term dynamic equilibration of landscapes with ever-changing environments.


SOUTHERN
ALASKAN
MARGIN
SEDIMENTATION, CLIMATE, AND TECTONICS
VICTORIA, BC TO VALDEZ, AK 29 MAY - 29 JULY 2013
EXPEDITION 341

QUESTIONS?



Climate Detectives: Module Overview



The R/V *JOIDES Resolution* (above) has state of the art research laboratories and collects sediment cores from all over the world to learn about earth processes.

The following text is excerpted from the EarthLabs website:

serc.carleton.edu/earthlabs/climatedetectives/index.html

Presenters

Dr. Sean Gulick, Jackson School of Geosciences, UT Austin (sean@ig.utexas.edu)
Alison Mote, OnRamps Dual Enrollment Program, UT Austin (alison.mote@austin.utexas.edu)
Sharon Cooper, Lamont-Doherty Earth Observatory (scooper@ldeo.columbia.edu)
Dr. Katherine Ellins, Jackson School of Geosciences, UT Austin (kellins@jsg.utexas.edu)

Acknowledgements

This lab activity was developed by Jeff Lockwood of TERC and Alison Mote of the University of Texas at Austin for the EarthLabs project. Special thanks to Dr. Tamara Ledley, EarthLabs PI, TERC; and Nick Haddad, EarthLabs Project Director, TERC; Dr. Katherine Ellins, UT Austin; Sharon Cooper, IODP; Expedition 341 Chief Scientists Dr. Sean Gulick (UT Austin) and Dr. John Jaeger (University of Florida), and the Expedition 341 Science Party.

Pedagogical Approach

The Climate Detectives module takes a challenge-based approach to learning about the earth's past climate. Learners are presented with a set of research questions and are challenged to explore and investigate these questions as members of the Expedition 341 science party onboard the *JOIDES Resolution* (see challenge on p. 3). In the process, students learn about careers in geoscience, engineering, and related fields and explore the nature of scientific discovery through the lens of the International Ocean Discovery Program (IODP). This challenge-based approach ties into the Next Generation Science Standards Performance Expectations in a variety of ways. For more information on the NGSS connections, visit the Educator Information pages, which outline the Engineering Practices and Crosscutting Concepts for each lab.

Why teach about past climate?

Earth's climate has changed, sometimes dramatically, in the past. If you had lived on the island of Manhattan about 20,000 years ago, you would have found yourself living during an ice age. You would see nothing but an expanse of ice as you pitch your tent on a 4,000-foot thick slab of ice that covers the island and extends for miles in all directions. But what does it matter? Why is it important to understand Earth's climate history?

Understanding the influence of humans on the climate system

The paleoclimatic record also allows us to examine the causes of past climate change. Looking into Earth's climate history can help scientists determine how much of the 20th century warming may be explained by natural causes, such as solar variability, and how much may be explained by human influences.

Improving the ability of climate models to simulate future climate change

Most state of the art climate prediction is accomplished using large sophisticated computer models of the climate system. A great deal of research has been focused on ensuring that these models can simulate most aspects of the modern, present-day, climate. It is also important to know how these same models simulate climate change. This can be accomplished by comparing simulations of past climate change with observations from paleoclimatic records. So in a real sense, paleoclimatology helps us improve the ability of computer models predict what future changes in climate we might expect.

Why use this set of lessons?

The ultimate question for students regarding events that have occurred throughout the Earth's history is "How do we know?" Students will discover how we know what we know about the Earth's past climate through a series of learning activities in which they will work collaboratively, mimicking scientific research groups on the *JOIDES Resolution*. Using data collected from Expedition 341, students will explore how climatic changes are recorded in the rock record, learn about careers associated with the IODP, and gain an appreciation for the ocean drilling process, and data collection methods. Ultimately, students will assume the role of scientists on board the *JOIDES Resolution* as they support their ideas with evidence.

In this unit, students analyze sediment cores and search for clues about Earth's past climate history. Every effort has been made to have students experience what it's like to join a scientific expedition and work collaboratively to do an investigation that focuses on uncovering clues to past climate change. They travel along with a group of scientists who extracted sediment cores from several locations along the south coast of Alaska in the summer of 2013. Students conduct hands-on lab activities, watch videos, analyze the actual data from the expedition, consult maps and graphs, explore online interactives, all of which will help them gather evidence to determine when major climate events occurred in the past, and how these events connect with changes in climate today, and in the future.

Key Questions addressed by this module include:

- What are some of the specific types of evidence that scientists gather as they examine marine sediment cores?
- What Earth processes combine to produce sequences of sediments on the ocean floor?
- Why is it important to understand climate history?
- How does the advance and retreat of glaciers affect rates of deposition and other Earth processes?
- What are climate cycles and what causes them?
- What is proxy data and how is it used to reveal past climate history?

Before starting this module

1. Read the **Lab Overviews** section, which identifies all of the materials you'll need to gather and provides a quick scope and sequence of the unit.
2. If you have not already done so, please read the Climate Series Introduction.

Assessments

Several options for assessing student understanding are provided throughout this module. **Stop and Think** questions can be used to assess student understanding at key points within each lab. These questions are available on the Instructor Page for each lab, under the Printable Materials heading. Short written tests to assess student understanding of material covered by each lab can be found on the corresponding Instructor Pages, under the Assessment heading. A full list of lab-level assessments as well as a cumulative end-of-module test can also be found on the Assessments page.

The Challenge

You are a young scientist with a passion for understanding how the Earth's climate has changed over the past 7 million years. To help with your research you will board the *JOIDES Resolution* to spend a summer at sea in the Gulf of Alaska collecting sediments from beneath the ocean floor with an international team of scientists and crew. This modern day expedition will help you answer a series of questions about what the climatic conditions on Earth were like millions of years ago.

Using a section of *sediment core* from Expedition 341, you will work collaboratively with members of the science party (in reality, party = team) and use different types of science data from the expedition to answer the following questions related to past climate in south Alaska:

- What is the present geologic setting in this region?
- How have environmental conditions in in the Gulf of Alaska changed during the time when the sediments in this core were deposited?
- What does the presence of types of diatoms (plants) and their abundance in the core reveal about the timing of the cycles of the advance and retreat of glaciers and ice sheets?
- What is the timeline represented by this section of sediment core?

And, as a team you'll need to develop background knowledge in several key areas. Over the next two weeks (7 hours for the workshop!) you will conduct a number of investigations and work alongside *Joides Resolution* scientists to learn:

- How scientists from many different countries and with different expertise collaborate as a team to examine a science problem.
- How sedimentary cores are retrieved from beneath the seafloor.
- What kinds of information can be extracted from the features of sediment cores to give clues to climate change.
- About the different types of data, including proxy data, used to detect changes in Earth's climate.
- Methods used to determine when changes in climate occurred in sediment cores.

Well, grab your gear and get ready to board the *Joides Resolution* for a voyage of discovery. What will you and your collaborators uncover about dynamic changes in our past climate and what caused those changes?

2A: Building a Model Core Drill

serc.carleton.edu/eslabs/climatedetectives/2a.html

Coring Is Not Boring!

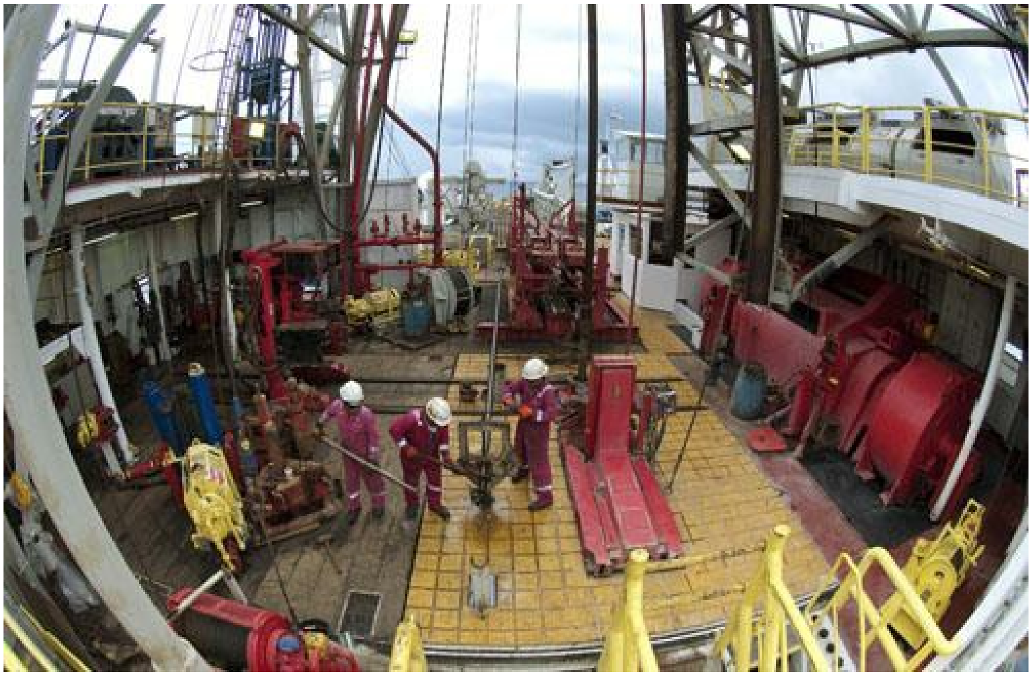
How Does the *JOIDES Resolution* Obtain Sediment Cores?

The *JOIDES Resolution* is one of the premier science research vessels in the world. Unlike other ocean-going ships, it is outfitted with a huge 62 meter tall derrick to support its core drilling function. When the *JOIDES Resolution* reaches the drilling site, the crew keeps the vessel over the precise location of the site using 12 computer-controlled thrusters as well as a main propulsion system. When assembled, the rig can suspend up to 9,150 m (over 5.5 miles!) of drill pipe in ocean depths as great as 8,235 m (about 5 miles).

Watch JR in a Minute: The Derrick

The *JOIDES Resolution* is a very big ship. It measures 471 feet long by 70 feet wide. It has travelled over 67,000 miles and has recovered almost 7,000 individual cores. Source: IODP

Near the center of the research vessel is the "moon pool," a 7m (23 ft.) wide hole through which the assembled string of drilling pipe is lowered into the ocean. Each piece of pipe is about 28 m (93 ft.) and weighs about 874 kg (1925 lb.). A massive drill bit is affixed to the end of the first piece of pipe.



Workers feed pipe down a hole in the center of the moon pool. Source: IODP

The drill crew uses the draw works to thread each piece of pipe together to form the drill string. After they have assembled the string, which can be up to six miles in length, it is lowered through to depths ranging from a 100 to thousands of meters of ocean water over a period of twelve hours. To core through the seafloor, the crew uses a motorized system to rotate the entire drill string. The thrusters keep the massive vessel itself from rotating along with the drill pipe. This ship moves to several sites during each expedition and drills operate continuously once in place.

Watch JR in a Minute: Core Drilling

Pieces of pipe are stitched together and then are lowered to the ocean bottom. Source IODP

The drill crew can use two different types of drills to bring up cores. If the sediment layers are fine grained (mud) or sand, a piston corer is used. It uses a piston-like action to shoot the hollow drill pipe through the layers of sediment in a matter of seconds. The pipe, now filled with sediment is then slowly brought up to the surface. On the other hand, if the crew has to drill through denser sediments or layers of rock, a rotary core barrel is used. The drill string has a bit and outer core barrel attached to it. The bit rotates with the drill string while the inner core barrel stays remains stationary. The bit trims a 2.3 meter core. When the inner barrel holds about 10 m of core, it is brought to the surface.

The piston core drill collects 100 m of sediment in a single thrust. Source IODP

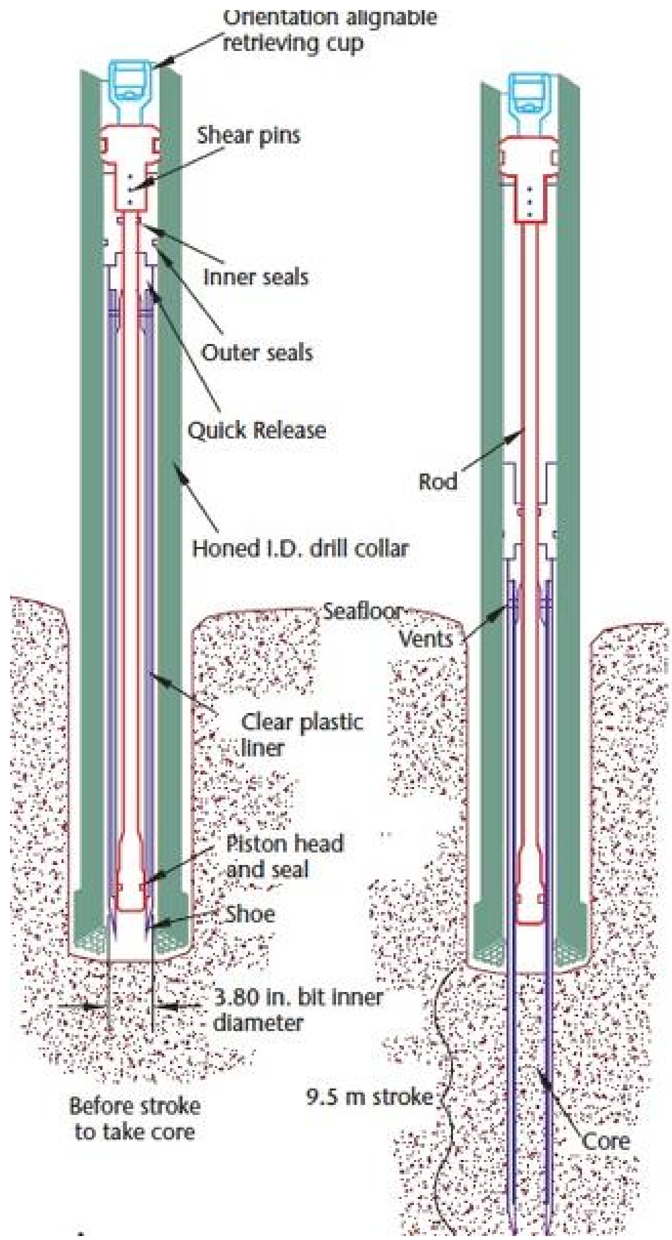
The rotary core barrel drill slowly cuts its way through dense sediment or rock. Source IODP

Lab Procedure

Part A - Build a Model Drill

In this part of the activity, you will build a simple model of the *JOIDES Resolution* coring apparatus. Your goal is to recover a core sample from a model of the ocean floor composed of different layers of clay. The following are the materials you will use to build your model:

- Popsicle sticks
- Small binder clamps
- Spool of thread
- Clear straws
- Transparent tape
- Rubber bands
- PlayDoh
- A model of sediments on the ocean floor (see your teacher)



1. Look at the animation called Explanation of Deep Sea Coring. It illustrates how cores are gathered by the *JOIDES Resolution*.

2. Your model will also use a hollow pipe or tube (clear straw) to sample the sedimentary layers at the test site. Instead of using the force of pressurized water to force your coring device through the sediment, you will use extra weight(s) on your coring drill to sample at least two layers. You are not allowed to lower or push your coring apparatus down into the sediment layers by hand. In this model, your device represents the coring drill on the *JOIDES Resolution*, the foot of air it passes through represents the ocean, and the PlayDoh layers at the test site represents the sediment layers the expedition will explore at each of the sites it visits.

3. **Brainstorm and Design** - Look at the materials you were given to build the drill.

- How will you construct a frame to surround the "moon pool" opening on the deck of the ship?
- How will you assemble a series of pipes to send the drill to the bottom of the ocean floor (PlayDoh)?
- How will you lower the drill through the ocean (air) and penetrate the sedimentary layers (PlayDoh)?

4. **Build** - Use the materials provided to build a device that can lower a drill string and take a core sample of at least two layers below. If you have difficulty in the design process, see your teacher for a picture of a sample model.

Part B - Test, Evaluate, and Redesign

Now that you have built an initial model drill, you will need to test your drill's effectiveness in drilling though several layers of sediment (PlayDoh).

4. Obtain a small amount of two different colors of PlayDoh. Knead the clay into two flat disks about 10 cm across. Place the two layers on top of each other.

5. **Test and Evaluate -** Position your drill about 1 foot above the two layers. Release the drill. Watch how it interacts with the PlayDoh layers.

· Did your drill penetrate to the bottom of all the layers?

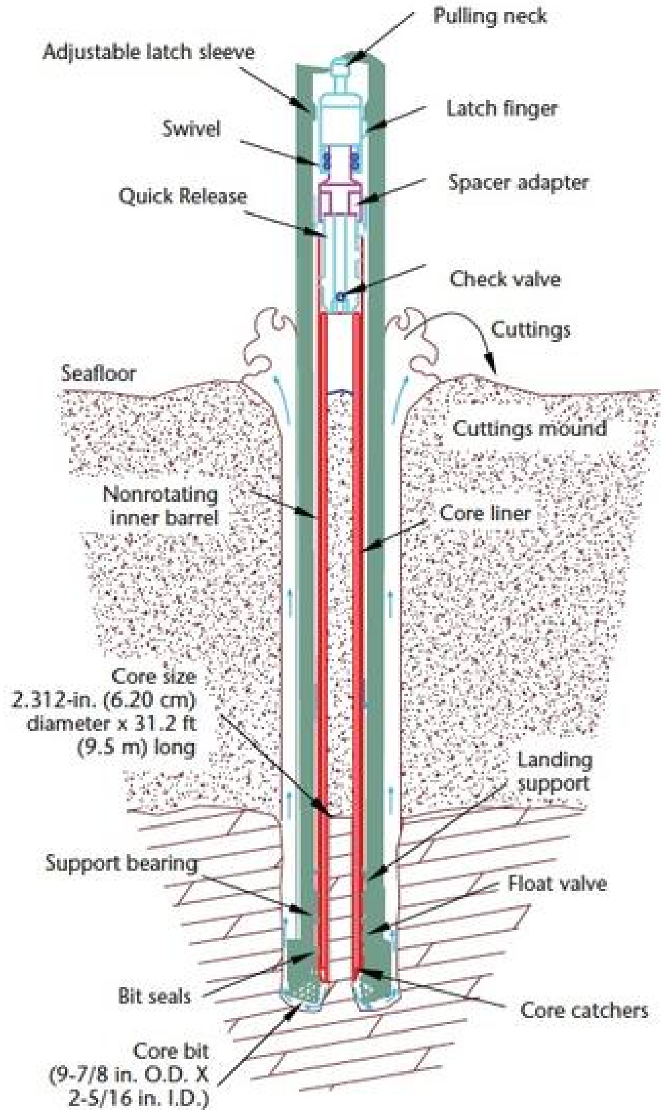
· Did your drill capture a core sample?

6. Make several other trials and think of changes that you can make to make your drill more efficient at taking cores samples.

7. You may have found that your prototype needs a redesign. Remember that the design process is all about "If at first you don't succeed, then try, try again." Study any problems and then redesign.

8. **Final Test** – Your teacher will show you the testing area and instruct your group where your core should be taken. You will add your core to the rest of those gathered from other groups to determine what lies under the surface of this model seabed.

9. **Analyze Results** – Your teacher will assemble the class results. As a class, answer the following questions.



Schematic of the RCB coring system in coring mode.

Stop and Think

1. How many sedimentary layers (called **strata** distinct horizontal layers in geological deposits. Each layer may differ from adjacent layers in terms of texture, grain size, chemical composition, or other geological criteria.) are present in the test area?

2. Trace out the approximate outline of the second layer (called a lens of sedimentary material) with a dotted line on a separate piece of paper. Use the coordinates of the test area to sketch the layer in as close to true scale as you can.

3. Assuming that the test area sediment layers were laid down by a river emptying into a bay or ocean, what kind of event in the Earth system might be responsible for depositing the lens of material?

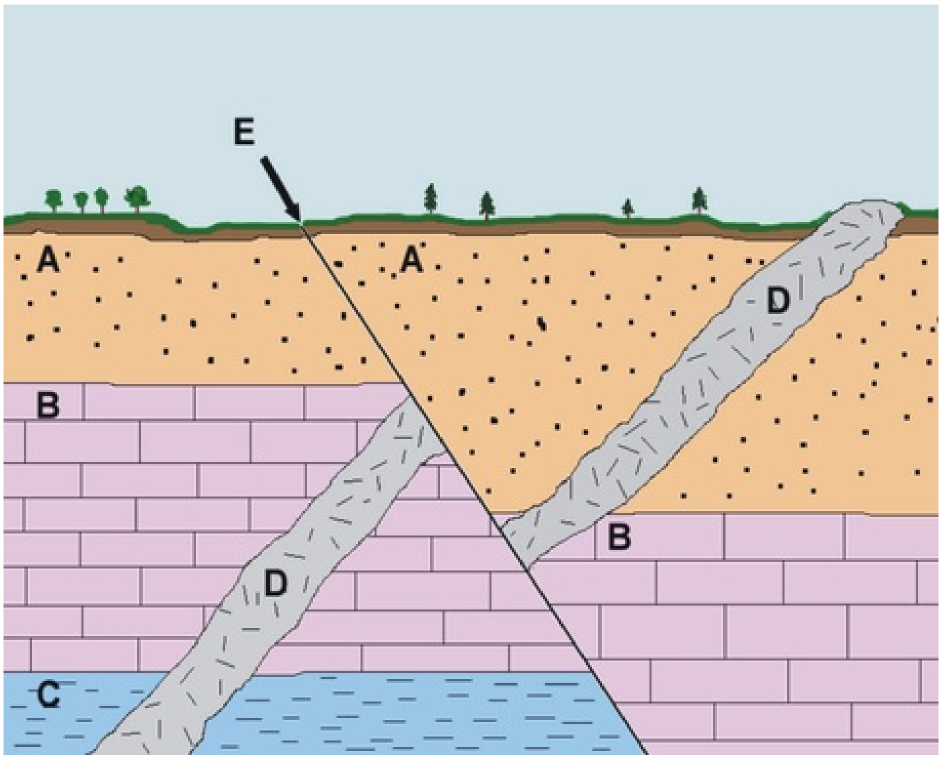
4. If the PlayDoh layers were replaced by a stack of graham crackers, how would have to modify the design of your drill?

Going Further

Draw a Cross Section of Sediment Beds

Procedure

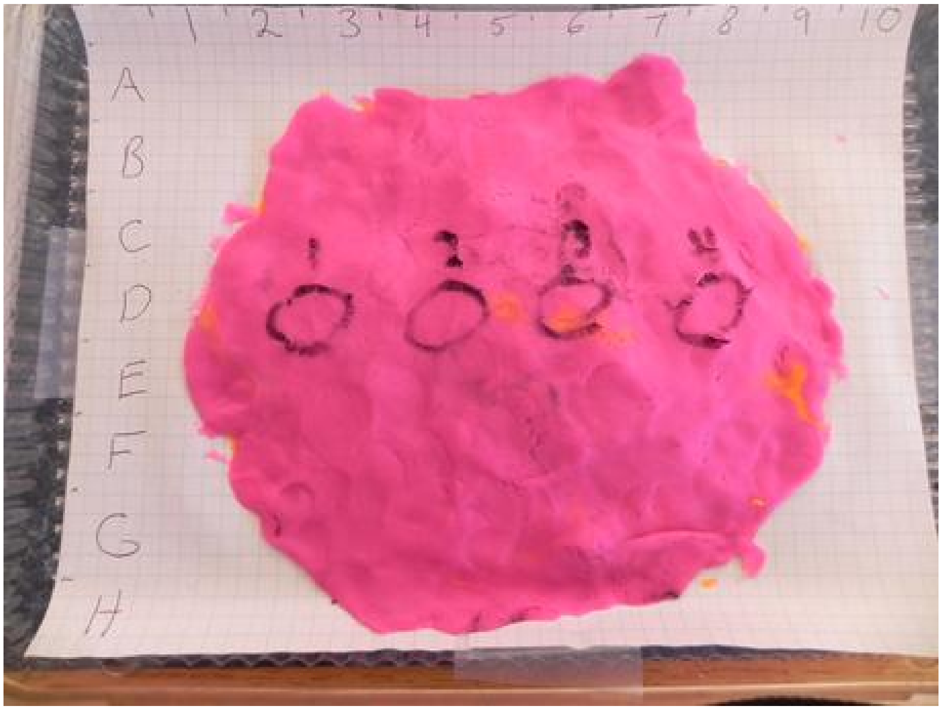
1. Geologists usually construct a cross-section of rock strata to help them understand the rock record, the geologic history of a region.



Cross sections of strata show both rock type (letters or symbols) and their orientation and relationship with layers above or below. In this drawing, a fault is shown displacing the layers on the right side of the diagram. Source: TERC

You can draw a cross section of the layers in your PlayDoh model by making a set of measurements, and then drawing a graph.

Note: Your core sections must be taken along a straight line across the PlayDoh.



1. Mark 4 or 5 possible drilling sites aligned across the PlayDoh sediment beds. The left edge of the beds represents O on the distance scale.

2. Measure the distance (in mm) of the core sample positions, starting with zero on the right hand. Record in a table.

3. For each core site/position, measure the thickness of each colored clay layer. Record these numbers. Also note the total thickness of layers at each site. Note: You may want to multiply these numbers by 10 to make them easier to plot.

4. Since you are drawing a picture of what lies below the surface, draw a horizontal line on a set of axes near the top of the graph.

5. Label the x-axis "Distance (mm)" and number it (using equal increments) from 0 to your the value of the location of your last drilling site.

6. Label the y-axis "Depth (mm)" and number it from 0 (the surface) to the maximum thickness of sediment at your coring sites.

7. At site 1 on your graph, mark the thickness of layers beginning at the top (surface) toward the x-axis. Remember to measure the second layer thickness from the bottom of the first layer and so on. Repeat for each site.

8. Draw a line that connects each point at the bottom of layer 1, layer 2, and so on.

9. Color in each of the layers to produce a finished diagram. Compare your results with others from your class.

Stop and Think Questions Lab 2: Coring Is Not Boring!

Part A – Building a Model Core Drill

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2. Trace out the approximate outline of the second layer (called a lens of sedimentary material) with a dotted line on a separate piece of paper. Use the coordinates of the test area to sketch the layer in as close to true scale as you can.

3. Assuming that the test area sediment layers were laid down by a river emptying into a bay or ocean, what kind of event in the Earth system might be responsible for depositing the lens of material?

4. If the Playdoh layers were replaced by a stack of graham crackers, how would have to modify the design of your drill?

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