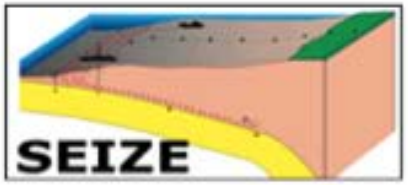
DUE TUES

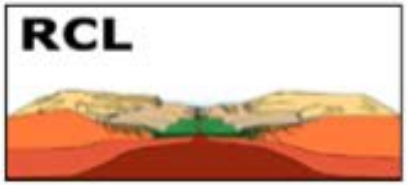
OCE & EAR

Geodynamic Processes at Rifting and Subducting Margins

Incorporating Cutting Edge Scientific Results from the MARGINS-GeoPRISMS Program into the Undergraduate Curriculum: An Overview

Julia Morgan, August Costa, Andrew Goodliffe, Jeff Marshall, Ellen Iverson & MARGINS Mini-Lesson Development Team





MARGINS

Website: http://serc.carleton.edu/margins

E-mail: morganj@rice.edu

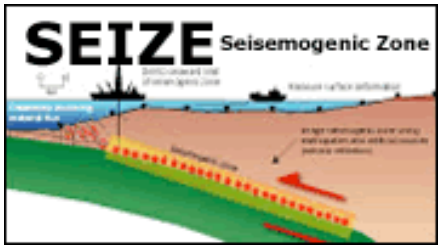
NSF MARGINS Program (<2000-2010)

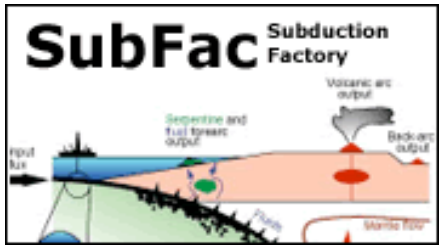
- *"to understand the complex interplay of processes that govern continental margin evolution globally"*
- **Main Principles**
  - *Focus on rifts and subduction zones*
  - *Cross the shoreline (& NSF divisions)*
  - *Explore active processes & margins*
  - *Interdisciplinary investigations*
  - *Integrate field lab, theory & modeling*
  - *Concentrate resources at Focus Sites*

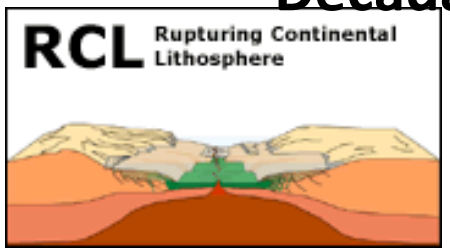
MARGINS

www.nsf-margins.org

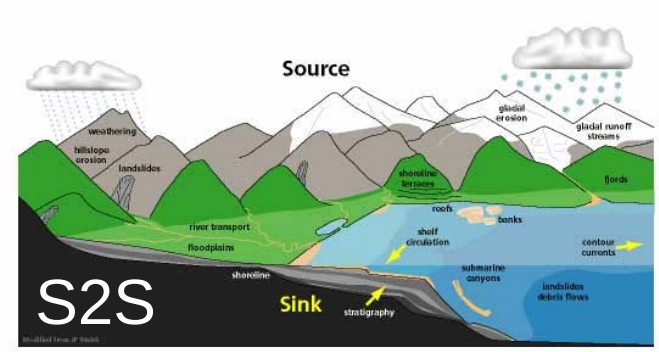
- **Four interdisciplinary initiatives.**
- **Science questions based on community workshops.**
- **MARGINS Science Plan**
- **Decadal Review (2009)**







MARGINS Initiatives & Focus Sites

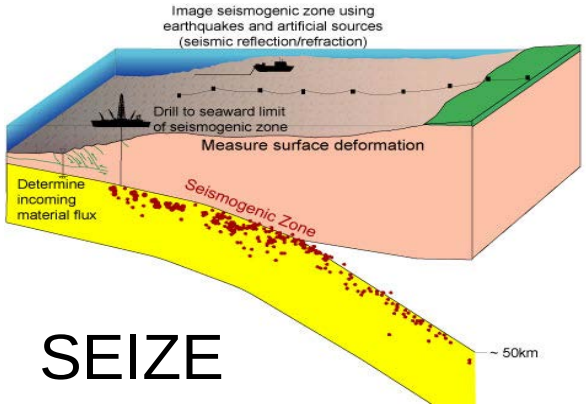


Sediment Source-to-SInk

- Production, transport & storage of sediments & solutes from source to sink

Gulf of Papua

Waipaoa, N.Z.



SEIZE

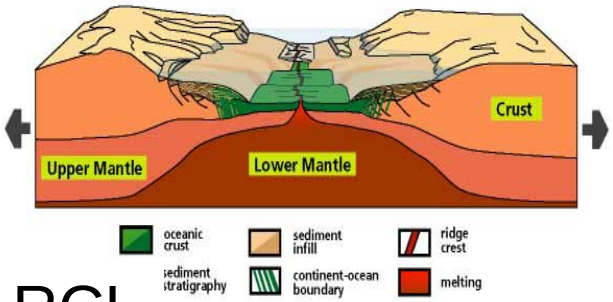
Seismogenic Zone

- Nature and genesis of large subduction-zone thrust earthquakes and the faults that make them

Nankai

Central America

MARGINS Initiatives & Focus Sites



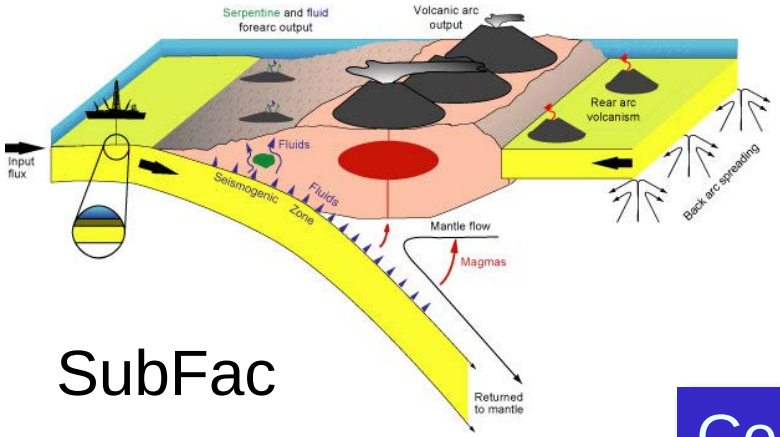
RCL

Rupturing Continental Lithosphere

- Driving forces for rift initiation, propagation and evolution, from continent to ocean basin

Gulf of California/Salton Trough

Allied: Red Sea



SubFac

Subduction Factory

- The cycling of material, fluids, and energy from trench to arc and deep earth; growth of continents

Central America

Izu-Bonin-Mariana

Allied: Cascadia, Aleutians

Pre-Existing MARGINS Mini-Lessons

(http://serc.carleton.edu/margins/collection.html)

2006 NSF CCLI (Abers)

- **Train undergraduates using cutting edge scientific results.**
- **Yielded ~30 ready-to-use mini-lessons spanning MARGINS science.**
- **Issues:**
  - *Levels of completion, review, testing, etc.*
  - *Gaps in content.*

2012 NSF TUES (Morgan)

- **Opportunity to expand the collection & synthesize MARGINS results.**

Motivation for this Project

- **Strong support from the Decadal Review Committee**
  - ***Enhance upper-level undergraduate education.***
- **Unique opportunity/obligation to synthesize and bring the landmark science of the last decade into the undergraduate curriculum using state of the art teaching practices.**
  - ***Review highlights of a decade+ of MARGINS results in four initiatives;*** *how they have* ***changed our understanding*** *of continental margins.*
  - *Enable* ***student encounters*** *with scientific data & research results.*
  - *Teach* ***critical thinking*** *and the* ***scientific process****.*
- **Combine the best science with the best educational practice**
  - *Scientific expertise of* ***MARGINS*** *(and* ***GeoPRISMS****).*
  - *Educational expertise of* ***On the Cutting Edge****.*
- **Team-based curriculum development process**
- **Explicit plan for field testing, refinement, and assessment**

MARGINS Mini-Lesson Project Leads

MARGINS Mini-Lesson Project Team

- *Julia Morgan, Former GeoPRISMS Chair & GEAC Member (Rice University)*
- *August Costa, GeoPRISMS Education & Outreach Coordinator (Rice University)*
- *Ellen Iverson [and Cathy Manduca, GEAC Member] (SERC, Carleton College)*
- *Andrew Goodliffe, Former GEAC Member (University of Alabama)*
- *Jeff Marshall, GEAC Member (Cal Poly Pomona)*
- *Jenn Beck (EvalArts Consulting)*

Geo PRISMS Geodynamic Processes at Rifting and Subducting Margins

Science Team Leads

- *SubFac: Bob Stern (U. Texas Dallas)*
- *SEIZE: Casey Moore (UCSC)*
- *RCL: Becky Dorsey (U. Oregon) > Scott Bennett (USGS)*
- *S2S: Steve Kuehl (VIMS) & Lonnie Leithold (NCSU)*

MARGINS

MARGINS Mini-Lesson Devpmt Teams

Applications solicited from MARGINS, GeoPRISMS, & On the Cutting Edge

- **Subduction Factory (SubFac): Chemical cycling in subduction zones**
  - ***Robert Stern <rjstern@utdallas.edu> (U. Texas, Dallas) - Science Team Lead***
  - *Ben Edwards <edwardsb@dickinson.edu> (Dickinson College) - Curr. Specialist*
  - *Sarah Penniston-Dorland <sarahpd@mail.umd.edu> (U. Maryland) – GEAC & GSOC member*
  - *Chris Kincaid <kincaid@gso.uri.edu> (U. Rhode Island)*
- **Seismogenic Zone Experiment (SEIZE): Seismogenic zone processes at subd. zones**
  - ***Casey Moore <casey@ucsc.edu> (UC Santa Cruz) - Science Team Lead***
  - *Jeff Marshall <marshall@csupomona.edu> (Cal Poly Pomona) - Curr. Specialist (and Project Team)*
  - *Eliza Richardson <eur10@psu.edu> (Penn State University)*
  - *David Pearson <peardavi@isu.edu> (Idaho State University)*

- **Rupturing continental lithosphere (RCL): Rifting processes and feedbacks**
  - ***Rebecca Dorsey (U Oregon) > Scott Bennett (USGS) - Science Team Leads***
  - *Andrew Goodliffe <amg@ua.edu> (U. Alabama) - Curr. Specialist (and Project Team)*
  - *Jack Loveless <jloveles@smith.edu> (Smith College)*
  - *Lisa Lamb <malamb@stthomas.edu> (University of St. Thomas)*
- **Source to sink sediment cycling (S2S): Sediment erosion, transfer, and deposition**
  - ***Steve Kuehl <kuehl@vims.edu> (Virginia Inst. Marine Science) - Co-Science Team Lead***
  - ***Lonnie Leithold <elleitho@ncsu.edu> (N. Carolina State University) - Co-Science Team Lead***
  - *Kathleen Surpless <ksurples@trinity.edu> (Trinity University) - Curr. Specialist*
  - *Adam Hoffman <AHoffman@dbq.edu> (University of Dubuque)*

MARGINS Mini-Lesson Devpmt Teams

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- **Subduction Factory (SubFac): Chemical cycling in subduction zones**

  - *Adam Hoffman <AHoffman@dbq.edu> (University of Dubuque)*

MARGINS Highlights Webinars

(*http://serc.carleton.edu/margins*)

- February 28, 2013 - **Rebecca J. Dorsey** (University of Oregon), *A Decade of Research Findings about Rupturing Continental Lithosphere (RCL)*
- March 4, 2013 - **Lonnie Leithold** (North Carolina State University), *A Decade of Research Findings about Source to Sink Research (S2S)*
- March 5, 2013 - **J. Casey Moore** (University California, Santa Cruz), *A Decade of Research Findings about the Seismogenic Zone Experiment (SEIZE)*
- March 13, 2013 - **Robert J. Stern** (University of Texas at Dallas), *A Decade of Research Findings about Subduction Factory Studies (SubFac)*

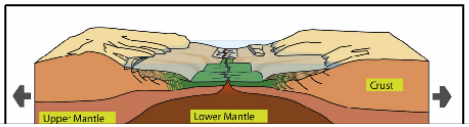
MARGINS Highlights Webinars

(Feb-Mar 2013)

Science Highlights of the RCL Initiative

RCL

Rupturing Continental Lithosph



GAME CHANGI
about continenta

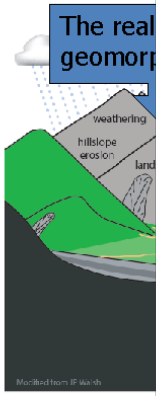
1. Structural Evolution
collision); (b) micro
2. Pre-Rift Magmatic
magmatism. Less n
(not localized). This
3. Role of Sediments
control on rift proce
Includes critical link
4. New Type of Crust
heavily sedimented
Fundamentally diffe

The overriding accomplishment

S2S

Brought together expertise typically held in different communities of scientists to build unprecedented understandi

Broadcast a
margin sedi



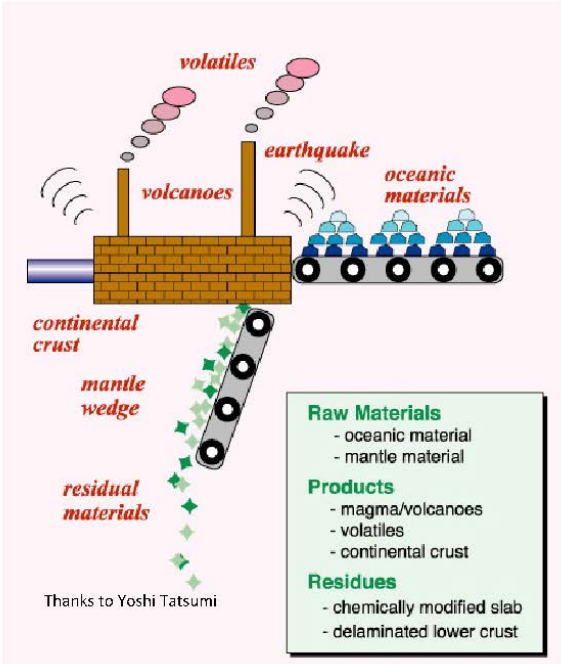
Chester et al.,
Nature, submitted

IODP Rapid Response: JFAST Exp. 343

SEIZE

Very Large Slip

The Subduction Factory



The MARGINS "Subduction Factory" experiment addressed 3 questions:

1. How do important variables (e.g., convergence rate, sediment thickness, age of subducted plate) control arc magma compositions?
2. How are volatiles (such as H_2O and CO_2) cycled through subduction zones?
3. What are the processes and rates by which subduction zones generate new continental crust?

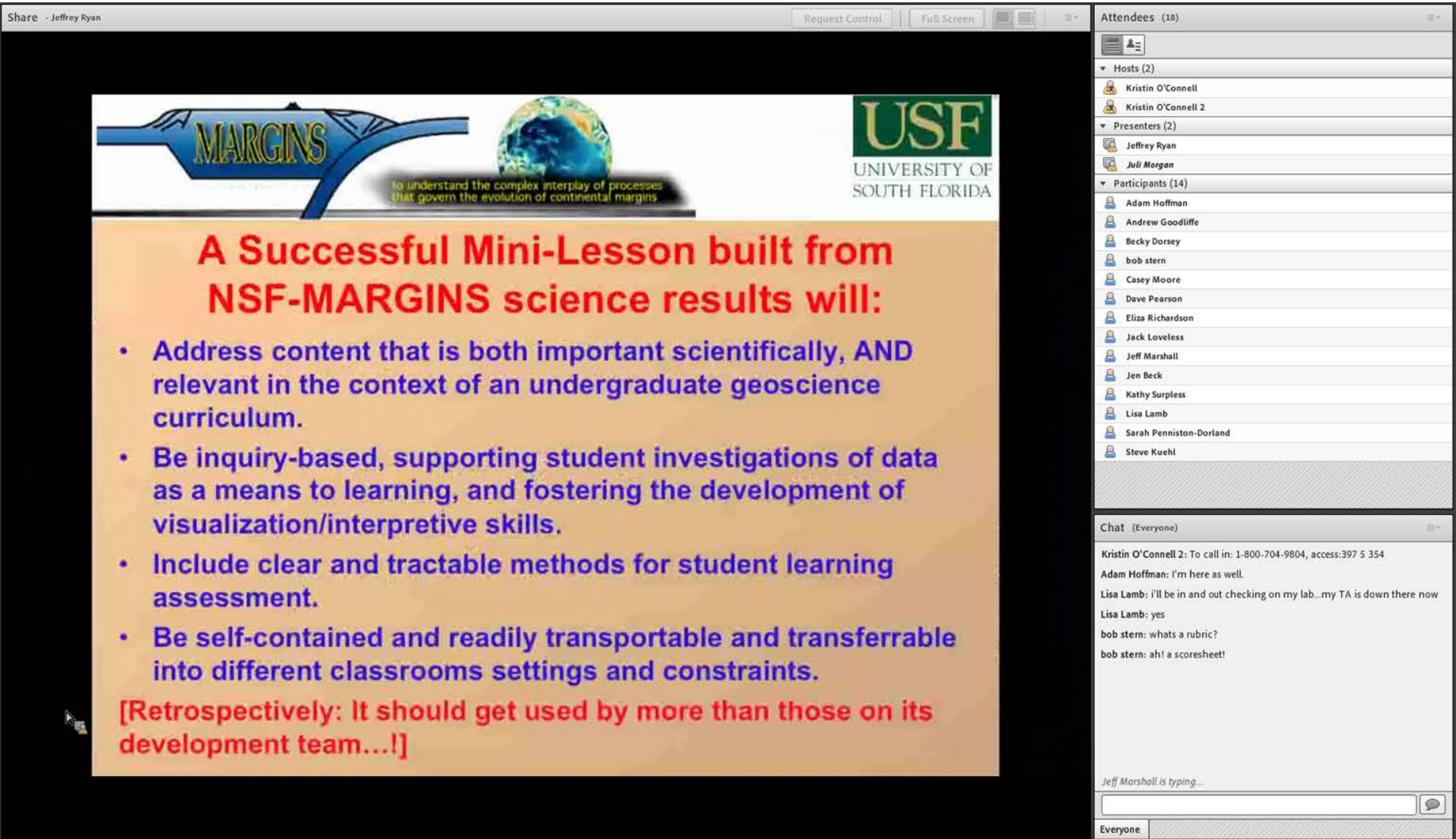
SubFac

- **Up to 45 attendees each**
- **Undergrad classes & International participants**
- **Now available as webcasts**

http://serc.carleton.edu/margins

Virtual Workshop 1

Jeff Ryan (USF, former MEAC, MSC, NSF) on "Effective Mini-Lesson Design"

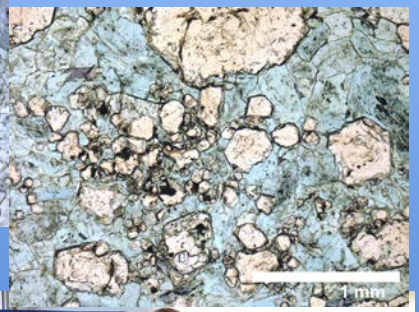


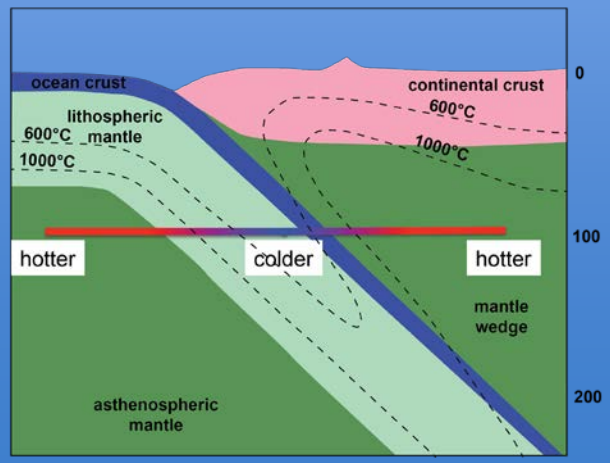
Mini-Lessons Suites

http://serc.carleton.edu/margins/lesson_descript.html

SubFac

- Subduction zone metamorphism
- Central American arc volcanoes: Petrology and geochemistry
- Slab temperature controls on melting in subduction zones
  - Part I. Conductive heat transfer
  - Part II. Advective heat transfer





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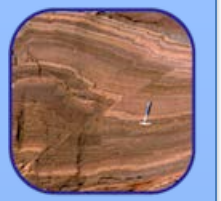
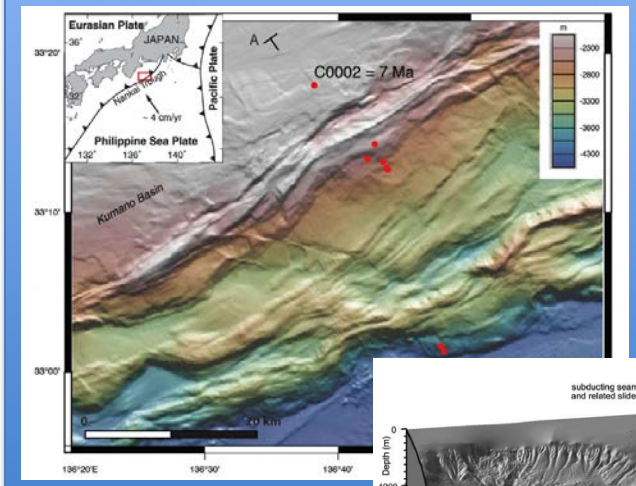
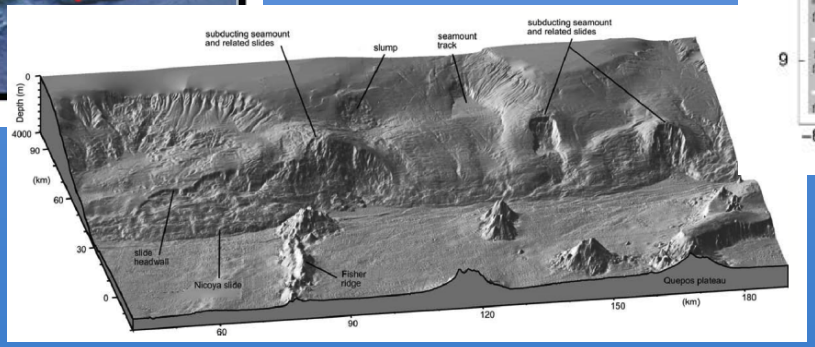
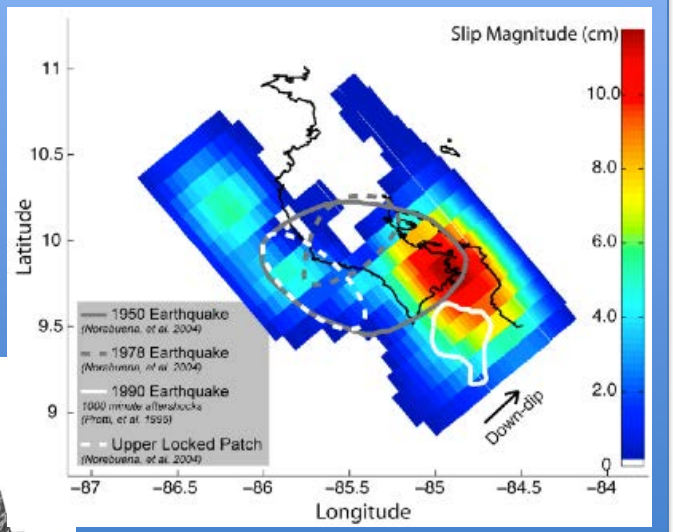


- Overview and Context
- Accretionary vs. Erosive Subduction Margins
- The Spectrum of Fault Slip
- The Plate Boundary Fault of the 2011 Tohoku Earthquake: Oceanic Provenance and Earthquake Genesis





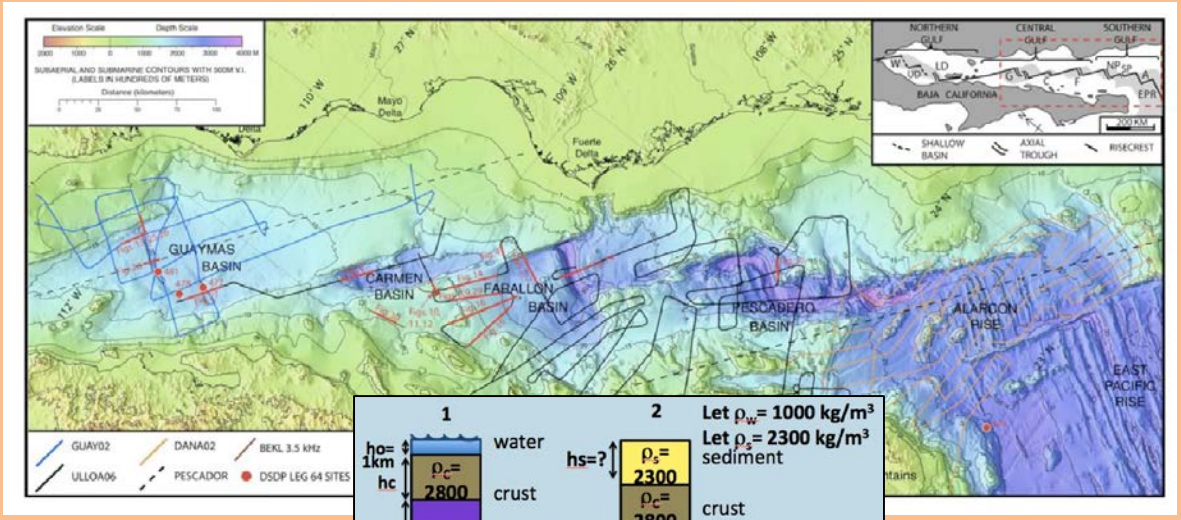


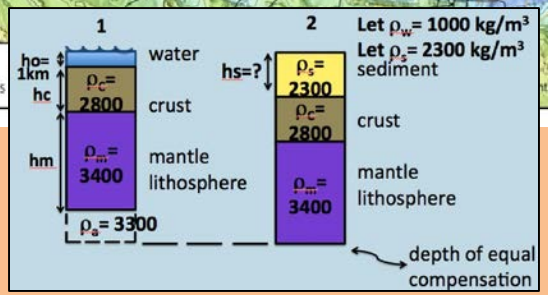
Mini-Lessons Suites

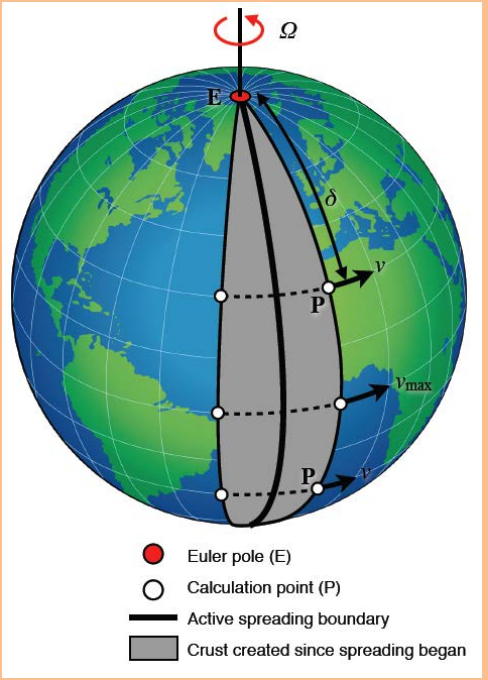
http://serc.carleton.edu/margins/lesson_descript.html

RCL

- Introduction - Overview & context
- Bathymetry of rifted margins
- Exploring styles of extension in the Gulf of California
- Interactions between tectonics and sedimentation
- Oblique spreading and rift morphology





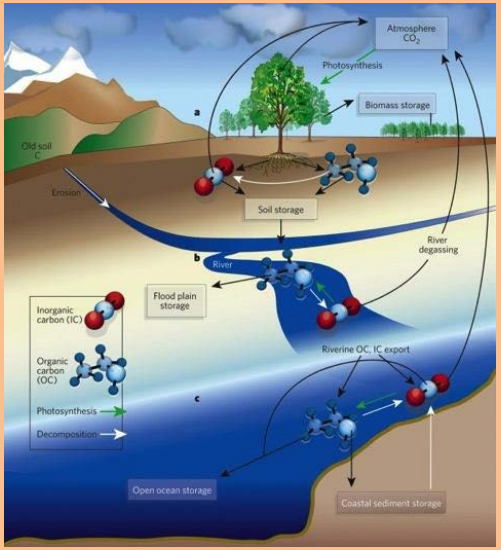


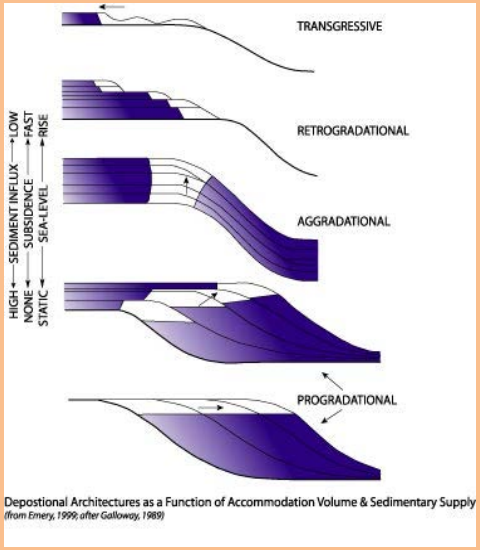
Mini-Lessons Suites

http://serc.carleton.edu/margins/lesson_descript.html

S2S

- Overview & Context: From source to sink: How sediment reflects the journey from the mountains to the sea
- Sediment dispersal and continental margin stratigraphy
- Contemporary climate oscillations: ENSO & case study of Huanghe River
- Holocene Optimum: A time of massively increased sediment discharge for Asian Rivers
- Sediments and carbon burial on the continental margins





Finally ....

Many, many heartfelt thanks to the entire MARGINS Mini-Lesson Development Team!
As well as all users!

(Let us know what you think, and if you want to contribute to the collection.)

Process & Timeline (2013-2014)

- **Construct initiative-based development teams - 2 yr terms**
  - ***Science team lead*** *and* ***curriculum expert*** *on each team.*
  - *Applications from MARGIN / GeoPRISMS & On the Cutting Edge.*
  - ***Breadth in expertise****, some overlapping interests among teams.*
  - *Balance of research and education roles.*
  - *Oversight by* ***project team*** *(PIs and SERC advisers).*
- **Two year (and a bit) timeline**
  - ***Introductory Webinar Series*** *(Feb-Mar 2013)*
  - ***Virtual Workshop*** *for initial development phase (Mar-Apr 2013)*
  - *Outline & scope out potential mini-lessons; virtual check-in (Sum 2013)*
  - ***Workshop*** *to solidify mini-lessons, intro to pedagogy (Sept 2013)*
  - *Initial development of mini-lessons (Fall 2013)*
  - ***Classroom testing*** *& assessment (AY 2013-2014 and beyond)*
  - *Cross-team* ***mini-lesson reviews***
  - *Refinement of mini-lessons (concurrent with field testing)*
  - ***Workshop*** *to complete mini-lessons, define steps forward (Sep 2014)*
  - *Mini-lesson finalization & dissemination (Oct-Dec 2014)*