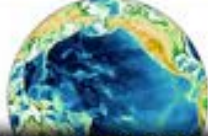




MARGINS Mini-Lessons – Phase 1....

- **2006-2009**
- **PIs:** Abers Manduca, Reed, Ryan
- **Activities:** several workshops, aimed at “producing” Mini-Lessons from MARGINS synthesis resources (TEI presentations, and other MARGINS managed content – but what happened was that most of the participants wanted to work with GeoMapApp on interactive content!
- **Products:** 34 Mini-Lessons of various sorts across the four MARGINS initiatives – targeting introductory through Senior-level courses.
- **Since then:**
 - Some of these original Mini-Lessons have been augmented by user-created contributions (assessments, etc.)
 - Others have been updated with updates to GeoMapApp
 - All have been reviewed by Cutting Edge via multiple protocols, with a number being designated as **Exemplary Teaching Activities**.



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[A tour of the Mariana Subduction System](#)

This lesson presents a brief tour of the Mariana subduction system, an active continental margin in the west Pacific.

On the Cutting Edge Exemplary Collection



[Online Investigation of an Island Arc Volcano: Anatahan, Mariana Arc](#)

This activity is a Web investigation and research exercise starting with the 2003-present Anatahan volcanic eruptions in the Mariana arc, and concluding with a petrologic examination of published Mariana arc lavas data sets.

On the Cutting Edge Exemplary Collection



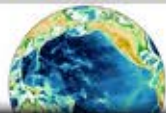
[The spectrum of fault slip](#)

Introduction to the different types of slip behaviors that can occur on subduction thrust, and comparative analysis of data sets derived from earthquakes and slow slip events to learn to discriminate among events.



[Central American Arc Volcanoes, Petrology, and Geochemistry](#)

This module teaches basic concepts in igneous petrology through relating hand specimen identification of lavas to major element geochemistry, using the Central American volcanic arc as an example.



to understand the complex interplay of processes that govern the evolution of continental margins

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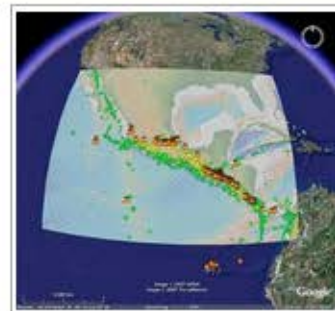
Plate Tectonics as Expressed in Geological Landforms and Events

Jeffrey G. Ryan, Department of Geology, University of South Florida [Author Profile](#)

► [This activity is part of the On the Cutting Edge Exemplary Teaching Activities collection and has been reviewed by 1 other review process](#)

Summary

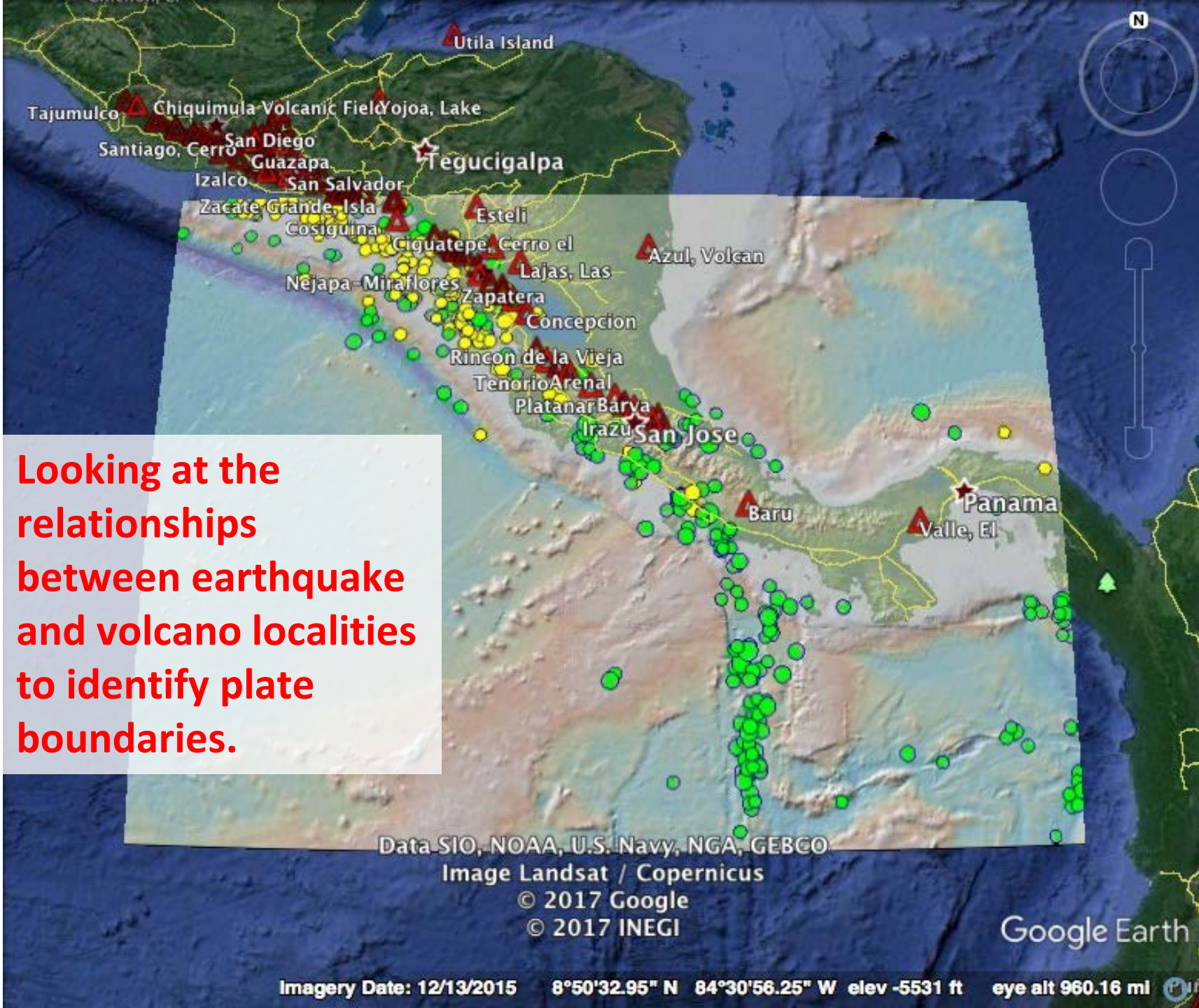
This activity seeks to have students analyze global data sets on earthquake and volcano distributions toward identifying major plate boundary types in different regions on the Earth. While the focus of the activity as written is on two NSF-MARGINS focus areas, any region of the Earth for which this data is available can be targeted. A secondary objective of the activity is to familiarize students with two publicly available resources for viewing and manipulating geologically-relevant geospatial data: Google Earth(TM) and GeoMapApp, a Java-based marine geoscience data resource and visualization tool maintained by the Marine Geoscience Data Systems at Lamont-Doherty Earth Observatory.



Learning Goals

Through this activity, students should become familiar with the concepts of plate boundaries and plate interactions, and the principles tacit in the theory of Plate Tectonics that most major geologic events occur during plate boundary interactions. Students should also become able to connect major geologic phenomena (volcanism, earthquake activity) to tectonic plate geometries, and recognize the "slop" in this relationship (i.e., phenomena often occur proximal to plate boundaries, but often not at the boundaries). Depending on how the activity is used, one can also have students model the kinds of data analysis skills that were necessary to the geoscientists in the 1960's who first looked at these kinds of global datasets.

Looking at the relationships between earthquake and volcano localities to identify plate boundaries.





Online Investigation of an Island Arc Volcano: Anatahan, Mariana Arc

Jeff Ryan,
Department of
Geology
University of
South Florida

Current students have access online to nearly unlimited information in an entirely unfiltered state. What students need to establish library resources, guidance and training in assessing information quality, and in identifying high-quality resources for educational and research use. In this activity, students will conduct a directed Web surf/search effort for information on and datasets from the Anatahan arc volcano in the Mariana volcanic arc, which they will use in an interpretive study of recent magmatic activity in the Mariana arc. Students should have been exposed to concepts related to magma genesis and the nature of subduction zone magmatism before conducting this activity. As well, a rudimentary knowledge of trace element geochemistry and its application to the study of igneous rocks is expected, or should be prepared for if this activity is used.

The activity is designed for a Junior-level petrology course as an extended homework exercise that complements hands-on laboratory work in volcanic rock description and analysis. An intent of the activity is to help students connect the volcanic rock samples they see in the lab to a real volcanic event that they discover through their own research efforts.

2003-2005 Anatahan Eruptions

- MARGINS-SubFac "event": Successful event responses
- Generous Web- and journal-published information resources, including comprehensive geochemical datasets, are available on its eruptive products.
- Anatahan is a "typical" arc volcano erupting a "typical" suite of arc lavas in a "typical" (and well-documented) island arc setting = a good starting point for an investigation of subduction-related volcanism.

Geospatial/Descriptive data resources

Map of EM800 multibeam sonar bathymetry around Anatahan island, collected during the 2003 Ring of Fire expedition.

Anatahan caldera (J.R. Lockwood)

GIS applications: Google Earth, GeoMapApp, etc.
Eruptive history and style: MARGINS pages and linked websites

Activity Learning Goals:

Web Research skills (Why? Undergraduates desperately need training in Information Quality Assessment, as they are bombarded with data, and don't know how to filter it.)

Geochemical Data Interpretation: Learning basics of elemental partitioning and variations in lava compositions w/ varying degrees of crystallization/melting, as observed on simple x-y plots (e.g.: Hanson, 1989).

Geospatial Information access and Manipulation: Use of GIS tools (i.e. Google Earth, GeoMapApp).

Starting Place:
<http://www.nsf-margins.org/SF/Anatahan/Anatahan2003.html> (Anatahan pages on NSF-MARGINS website) **NOT Google!**

Links here are to Source Reference websites and published literature (like searching the stacks in the library...)

Do the comparisons (i.e., "Where do these links appear in a Google search for Anatahan?") to explain Web search engines and their limitations

Direct students to seek both basic information (geography, history), and geologically relevant data, especially bulk-rock chemical analyses and trace element results.

Extended Searching: Refereed literature online

GeoRef (JVGR special issues, etc.)
GERM (reservoir and partitioning data)

Student Examination of Anatahan lavas: Bulk Composition and Trace Element Abundance Variations

The published Anatahan geochemical datasets are both extensive and consistent in terms of elemental coverage (i.e., full ICP-MS elemental datasets are available for all analyzed lavas).

As such, the Anatahan sample suites provide an excellent dataset for introducing students to the various graphical presentations of geochemical data and their uses in studying igneous petrogenesis.

Hanson (1989) provides a basic explanation of elemental systematics in igneous rocks on x-y covariation diagrams. Many undergraduate petrology texts discuss the common uses of Harker variation diagrams, the TAS classification diagrams, and "igneous" AFM plots. The Anatahan datasets are good suites for teaching the uses of the various geochemical plots, as well as a good venue for a guided student investigation of volcanic petrogenesis.

Assessment Strategies:

- Students generate a report, responding to the questions posed.
- Includes all diagrams generated, and data tables compiled, as well as a complete list of references used, Web and otherwise.
- Evaluate based both on understanding of petrology/geochemistry principles, but also on the quality and of their searches.
- Consider both the sources used, and how they are used (are they cited properly, are they source references, is there adequate breadth of research?)

References and Resources

Nakada, S., Matsushita, T., Yoshimori, M., Sugimoto, T., Kato, T., Morimoto, T., Ohno, R. and Camacho, J. (2008) Geological aspects of the 2002-2004 eruption of Anatahan volcano, northern Mariana Islands. J. Volc. Geotherm. Res., 144, 206-243.

Pullinger, J., Truesdell, F., Brownfield, J., Sims, D., Boudaha, J., and Barkley, B. (2002) The 2003 phreatomagmatic eruption of Anatahan volcano: historical and petrologic features of decadal at an emergent island arc volcano. J. Volc. Geotherm. Res., 144, 208-224.

Wada, J., Plank, T., Stern, R., Takahashi, D., Gib, J. O'Leary, J., Elmer, J., Moore, R., Woodhead, J., Truesdell, F., Fischer, T., and Hirose, D. (2005) The May 2003 eruption of Anatahan Volcano, Mariana Islands: geochemical overviews of a 4000 arc volcano. J. Volc. Geotherm. Res., 144, 129-170.

Geochemical Earth Reference Model (<http://www.earthchem.org/earthchem/GERM-SubFac.asp>)

Maria Seawatch Data System (<http://www.maria-sea.org/mariasea/index.html>)

GeoMapApp (<http://www.earth.google.com/earth/>)
Google Earth (<http://earth.google.com/>)
EarthChem (<http://www.earthchem.org/earthchem/GERM-SubFac.asp>)

Student research exercise into both MARGINS website content, literature/IEDA data, and GE/GeoMapApp data.

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this activity is used.

The activity is designed as an extended homework exercise that complements hands-on laboratory work in volcanic rock description and analysis. An intent of the activity is to help students connect the volcanic event that they discover through their own research efforts.

Hanson, et al (1989) An Approach to Trace Element Modeling Using a Simple Igneous System as an Example: RAG-21: Cosmogeny and Mineralogy of the Ring of Fire Domain