



# The Galápagos as a Laboratory for the Earth Sciences



**American Geophysical Union Chapman Conference**

Puerto Ayora, Galápagos, Ecuador

25 – 30 July 2011

# AGU Chapman Conference on The Galápagos as a Laboratory for the Earth Sciences

Puerto Ayora, Galápagos, Ecuador  
25 - 30 July 2011

## Conveners

**Mark Richards**, University of California Berkeley  
**Dennis Geist**, University of Idaho

## Program Committee

**Gordon Grant**, USDA Forest Service  
**Patricio Ramon**, Escuela Politecnica National  
**Karen Harpp**, Colgate University  
**Doug Toomey**, University of Oregon  
**Garrett Ito**, University of Hawaii  
**Cynthia Ebinger**, University of Rochester

## Co-Sponsor

The conference organizers acknowledge the generous support of the following organizations:



## Cover photo

Top left: Galapagos tortoises at the Charles Darwin Research Station. Top right: Rounded olivine and plagioclase crystals from a northern Floreana beach. Bottom left: A blue-footed booby on Espanola Island. Bottom right: View up a clastogenic flow during the 2005 Sierra Negra eruption.

# AGU Chapman Conference on The Galápagos as a Laboratory for the Earth Sciences

## Meeting At A Glance

### Saturday, 23 July 2011

0630h–1830h Sierra Negra Pre-Meeting Field Trip

### Sunday, 24 July 2011

0730h–1530h Sierra Negra Pre-Meeting Field Trip (continued)

1830h–2000h Icebreaker

### Monday, 25 July 2011

0830h–0900h Welcome and Introduction

0900h–1000h Surface Processes at Ocean Islands

1000h–1015h Break

1015h–1215h Surface Processes at Ocean Islands (continued)

1215h–1345h Lunch

1345h–1545h Active Processes at Ocean Islands

1800h–2000h Evening Plenary and Poster Session I

### Tuesday, 26 July 2011

0830h–0930h Mantle Processes at Ocean Islands

0930h–0945h Break

0945h–1145h Mantle Processes at Ocean Islands (continued)

1145h–1315h Lunch

1315h–1515h Surface Processes in the Galapagos

1730h–1930h Evening Plenary and Poster Session II

### Wednesday, 27 July 2011

0830h–0930h Plume-Ridge Interaction in the Galapagos

0930h–0945h Break

0945h–1145h Plume-Ridge Interaction in the Galapagos (continued)

1145h–1315h Lunch

1315h–1515h Active Processes in the Galapagos

1730h–1930h Evening Plenary and Poster Session III

### Thursday, 28 July 2011

0800h–1700h Santa Cruz Field Trip

### Friday, 29 July 2011

0830h–0930h Future Directions: Active Processes

0930h–0945h Break

0945h–1200h Future Directions: Active Processes (continued)

1200h–1330h Lunch

1330h–1615h Future Directions: Deep Earth Processes

1800h–2000h Evening Plenary and Poster Session IV

**Saturday, 30 July 2011**

0830h-0915h	Future Directions of Surface Processes
0915h-0930h	Break
0930h-1110h	Future Directions of Surface Processes (continued)
1110h-1200h	Perspectives on Collaborative Projects
1200h-1330h	Lunch
1330h-1700h	Key Scientific Questions and Strategies
1930h-2130h	Conference Banquet

# SCIENTIFIC PROGRAM

## SATURDAY, 23 JULY

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0630h – 1830h **Sierra Negra Pre-Meeting Field Trip - Saturday**

## SUNDAY, 24 JULY

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0730h – 1530h **Sierra Negra Pre-Meeting Field Trip - Sunday**

1830h – 2000h **Conference Icebreaker**

## MONDAY, 25 JULY

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0830h – 900h **Welcome and Introduction**  
Presiding: Mark A. Richards, Dennis Geist  
Municipal Hall

**Surface Processes at Ocean Islands**  
Municipal Hall

0900h – 0940h **William Dietrich** | The Coevolution of Geomorphology and Biology of Ocean Islands

0940h – 1000h Discussion by Taylor Perron

1000h – 1015h Break

1015h – 1055h **Anne J. Jefferson** | Top down or bottom up? Volcanic history, climate, and the hydrologic evolution of volcanic landscapes

1055h – 1115h Discussion by Kathy Cashman

1115h – 1155h **Suzanne P. Anderson** | Rock into Regolith: Earth's Critical Zone on Volcanic Ocean Islands

1155h – 1215h Discussion by Gordon Grant

1215h – 1345h Lunch

## Active Processes at Ocean Islands

Municipal Hall

- 1345h – 1425h **Paul Segall** | Insights into magmatic processes from deformation and seismicity
- 1425h – 1445h Discussion by Cindy Ebinger
- 1445h – 1525h **Katharine V. Cashman** | The Hazards and Benefits of Volcanic Eruptions on Oceanic Islands
- 1525h – 1545h Discussion by Jonathan Lees
- 1800h – 2000h **Evening Plenary and Poster Session I**  
Adjoining Room, Municipal Hall
- 1800h – 1830h Presentation by GNP/INOCAR
- M-1 **Anne E. Carey** | Climate, dust, and soil biogeochemistry on volcanic islands
- M-2 **Andrés González** | A hydro-ecological cross-section of Santa Cruz Island, Galapagos Archipelago
- M-3 **Russell Yost** | Potential role of soil calcium and phosphorus on Galapagos tortoise growth and well-being
- M-4 **Taylor Perron** | Origin of morphologic variability among Pleistocene coral reefs
- M-5 **Kenneth H. Rubin** | Using Geochronology of Shoreline and Coral Reef Deposits to Study Uplift and Subsidence at Tropical Volcanic Ocean Islands: Examples from Hawaii with Applications to the Galapagos
- M-6 **Oliver C. Shorttle** | Asymmetry of plume-ridge interaction around The Galápagos and Iceland controlled by spreading-ridge geometry
- M-7 **Karen S. Harpp** | Plume-Ridge Interaction in the Galápagos I: Lithospheric Control on Volcanic Lineament Generation in the Northern Galápagos Province
- M-8 **Katrina A. Garman** | Investigating Plume-ridge Interaction and its Tectonic Implications: Insights from the Distal Ends of the Galápagos Spreading Center at 86°W and 97.5°W
- M-9 **Eric Mittelstaedt** | Plume-ridge interaction at the Galapagos: Insights provided by new gravity and magnetic observations
- M-10 **Adam Soule** | Evaluating ridge-hotspot interaction models through crustal stress indicators in the Northern Galápagos Volcanic Province
- M-11 **Jeffrey Karson** | Subaerial Seafloor Spreading in Iceland: Manifestations of Ridge-Hot Spot Interactions
- M-12 **Emily L. Wilson** | Plume-Ridge Interaction in the Galápagos II: Volcanic Evolution of the Northern Galápagos Islands

- M-13 **Bryndis Brandsdottir** | Plume-Ridge Interactions in Iceland and Galapagos, Crustal Buildup and Volcanism
- M-14 **William Schlitzer** | Plume-Ridge Interaction in the Galápagos III: The Origins of Pinta, Marchena, and Genovesa Islands
- M-15 **Kaj Hoernle** | Temporal and Spatial Variations in Galapagos Plume-Ridge Interaction
- M-16 **Alice Colman** | Influence of Magma Supply on Galápagos Spreading Center Magmatic and Eruptive Processes
- M-17 **Gordon E. Grant** | A framework for understanding landscape development of volcanic ocean islands

## TUESDAY, 26 JULY

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### Mantle Processes at Ocean Islands

Presiding: Mark A. Richards

Municipal Hall

- 0830h – 0910h **Matthew G. Jackson** | Ocean Islands and mantle plumes: Outstanding geochemical and petrological questions
- 0910h – 0930h Discussion by Rajdeep Dasgupta
- 0930h – 0945h Break
- 0945h – 1005h **Yang Shen** | Geophysical constraints on oceanic islands, mantle dynamics and mantle heterogeneity: Part I
- 1005h – 1025h **Yang Shen** | Geophysical constraints on oceanic islands, mantle dynamics and mantle heterogeneity: Part II
- 1025h – 1045h Discussion by Gabi Laske
- 1045h – 1125h **Mark Jellinek** | The Plume-Hotspot Connection, Plate Tectonics and the Remarkable Character of the CMB Region
- 1125h – 1145h Discussion by Shijie Zhong
- 1145h – 1315h Lunch

### Surface Processes in the Galapagos

Municipal Hall

- 1315h – 1355h **Taylor Perron** | Problems in the geomorphology of the Galápagos and other ocean islands
- 1355h – 1415h Discussion by Dennis Geist
- 1415h – 1455h **Noémi d'Ozouville** | The Galapagos Islands as a Laboratory for Hydrological Processes
- 1455h – 1515h Discussion by Anne Jefferson

- 1730h – 1930h **Evening Plenary and Poster Session II**  
Adjoining Room, Municipal Hall
- 1730h – 1800h Presentation by National Science Foundation
- T-1 **Robert A. Duncan** | How Did the Galápagos Hotspot Begin?
- T-2 **Eduardo Contreras-Reyes** | Magmatic processes beneath the Louisville and Juan Fernández hotspot tracks from wide angle seismic data
- T-3 **Christopher A. Vidito** | Galápagos Plume Source Lithology: Inferences from Olivine Phenocryst Compositions
- T-4 **Millard F. Coffin** | Deep structural images of the Ontong Java Plateau deduced from an active source seismic experiment
- T-5 **Sally A. Gibson** | Constraints on the transition from active plume upwelling to lateral mantle flow beneath Galápagos: Geochemical evidence from Isla Santiago
- T-6 **Mark A. Richards** | Petrological Interpretation of Deep Crustal Intrusive Bodies Beneath Oceanic Hotspot Provinces
- T-7 **Paula M. Manriquez** | A flexure study beneath the Juan Fernandez Hotspot track
- T-8 **Todd A. Bianco** | Geochemical Variations at Hotspots Caused by Variable Melting of Veined Mantle Plumes
- T-9 **Gabi Laske** | The Hawaiian PLUME OBS deployment: Lessons learned and recommendations for a Galapagos deployment
- T-10 **Deborah E. Eason** | Insights into melt and chemical transport rates in the mantle from the volcanic response to glacial unloading in Iceland
- T-11 **Emilie E. Hooft** | Seismic Constraints on the Formation of the Galápagos and Iceland Platforms
- T-12 **Dennis Geist** | A Petrologic Model of the Galapagos Plume
- T-13 **Rajdeep Dasgupta** | Constraining pyroxenite component in OIB source through melt-rock reaction experiments in pyroxenite-peridotite system and partitioning of first-row transition elements during mantle melting
- T-14 **Alejandro Gallego** | Analysis of surface wave azimuthal anisotropy with geodynamic models and application to the Iceland hotspot
- T-15 **Shijie Zhong** | Mantle Plumes, Oceanic Islands and Their Induced Surface Vertical Motions
- T-16 **Cinzia G. Farnetani** | Origin of hotspot lavas geochemical zoning: a geodynamics perspective



## WEDNESDAY, 27 JULY

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### Plume-Ridge Interaction in the Galápagos

Municipal Hall

- 0830h – 0910h **Kaj Hoernle** | Petrology/Geochemistry of the Galapagos Hotspot and Hotspot-Ridge Interaction
- 0910h – 0930h Discussion by Sally Gibson
- 0930h – 0945h Break
- 0945h – 1025h **Douglas R. Toomey** | Upper mantle structure beneath the Galápagos Archipelago from joint inversion of body and surface waves
- 1025h – 1045h Discussion by Mike Coffin
- 1045h – 1125h **Garrett Ito** | Dynamics of Plume-Plate Interaction
- 1125h – 1145h Discussion by Cinzia Farnetani
- 1145h – 1315h Lunch

### Active Processes in the Galápagos

Municipal Hall

- 1315h – 1355h **John M. Sinton** | Magma Migration, Storage and Evolution in the Galápagos Region
- 1355h – 1415h Discussion by John MacLennan
- 1415h – 1455h **Michael P. Poland** | Capitalizing on the Galápagos archipelago as a high-visibility natural laboratory for volcanology
- 1455h – 1515h Discussion by Patricio Ramon

### Evening Plenary and Poster Session III

Adjoining Room, Municipal Hall

- 1730h – 1800h Talk on State of Galapagos
- W-1 **James T. McClinton** | Neuro-fuzzy classification of submarine lava flow morphology on the Galapagos Spreading Center, 92°W
- W-2 **Omar E. Marcillo** | Infrasound produced by degassing of shield-volcanos: Hawaii and Galapagos
- W-3 **Peter M. Shearer** | Characterizing fault zones at Kilauea and Mauna Loa volcanoes by large-scale mapping of earthquake stress drops and high precision relocations
- W-4 **Mark Jellinek** | The influence of diffusive convection on the longevity of hydrothermal plumes

- W-5 **Helge M. Gonnermann** | Modeling the dynamics of magma flow from mantle to surface at Mauna Loa and Kilauea, Hawai'i
- W-6 **Mary E. Peterson** | Volatile budget of the mantle sources of the Galapagos plume
- W-7 **Michael P. Poland** | Magma Supply to Basaltic Shields: An Example from Hawaii and an Opportunity for the Galapagos
- W-8 **Marco Bagnardi** | Time series of volcanic deformation in the Galapagos: A perspective from InSAR, GPS, and seismic data
- W-9 **Rachel L. Walters** | Time-dependent geochemical modeling of the rift cycle applied to rift relocations at Iceland
- W-10 **Andrés G. Ruiz Paspuel** | Seismic and ground deformation patterns at Sierra Negra Volcano, Galapagos- Ecuador
- W-11 **Cynthia J. Ebinger** | Magmatism and faulting on Isabela Island, Galapagos interpreted from seismicity and InSAR patterns
- W-12 **Patrick J. McGovern** | Structure and evolution of Galapagos volcanic edifices: Insights from lithospheric flexure models and comparisons with planetary analogs
- W-13 **George W. Bergantz** | Magma Systems in the Galapagos Islands: The Dynamics of and Evidence for the Transition Between Crystal Rich and Crystal Poor Conditions
- W-14 **Ricardo Ramalho** | Episodic swell growth inferred from variable uplift of the Cape Verde hotspot islands

## THURSDAY, 28 JULY

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0800h – 1700h **Santa Cruz Field Trip**

## FRIDAY, 29 JULY

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### **Future Directions: Active Processes**

Municipal Hall

- 0830h – 0845h Orientation
- 0845h – 0900h Summary Presentation
- 0900h – 0930h Panel Discussion
- 0930h – 0945h Break

- 0945h – 1130h Breakout Groups
- 1130h – 1200h Summary (reconvene)
- 1200h – 1330h Lunch

## **Future Directions: Deep Earth Processes**

Municipal Hall

- 1330h – 1345h Presentation
- 1345h – 1415h Panel and breakout charges
- 1415h – 1545h Breakout Groups: Surface Processes
- 1545h – 1615h Reconvene in Plenary

## **Evening Plenary and Poster Session IV**

Adjoining Room, Municipal Hall

- 1800h – 1830h Presentation: Hazard Mitigation in the Galápagos
- F-1 **Ricardo Ramalho** | Why have the old Cape Verde Islands remained above sea-level? Insights from field data and wave erosion modeling
- F-2 **Marco Bagnardi** | Evidence of multiple magma reservoirs at Fernandina volcano
- F-3 **Marco Bagnardi** | The April 2009 eruption of Fernandina volcano: onset and effects observed by Satellite Radar Interferometry
- F-4 **Dennis Geist** | An Evolutionary Model of Galapagos Magma Chambers
- F-5 **Patricio Ramon** | April 2009 Fernandina volcano eruption, Galápagos Islands, Ecuador: thermal mapping of the lava flows emitted
- F-6 **Douglas R. Toomey** | Crustal structure beneath the Galápagos Archipelago from ambient noise tomography and its implications for plume-lithosphere interactions
- F-7 **Mario C. Ruiz** | Seismic Activity and Seismic Monitoring at Galapagos Islands
- F-8 **Jonathan M. Lees** | Search for Harmonic tremor in the Galapagos
- F-9 **Leif Karlstrom** | Mechanical controls on the longevity and magnitude of large volcanic eruptions
- F-10 **John MacLennan** | Petrological Constraints on Magma Transport and Storage under Iceland

## SATURDAY, 30 JULY

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### **Future Directions of Surface Processes**

Municipal Hall

- 0830h – 0845h Presentation
- 0845h – 0915h Discussion
- 0915h – 0930h Break
- 0930h – 1040h Breakout Groups
- 1040h – 1110h Reconvene for Discussion

### **Perspectives on Collaborative Projects**

Municipal Hall

- 1110h – 1140h Plenary Talk
- 1140h – 1200h Discussion
- 1200h – 1330h Lunch

### **Key Scientific Questions and Strategies**

Municipal Hall

- 1330h – 1400h Plenary Discussion on Project Ideas
- 1400h – 1600h Planning Group Discussions
- 1600h – 1700h Summary Discussion

- 1930h – 2130h **Conference Banquet**