Cooperative Institute for Dynamic Earth Research

2019 CIDER Summer Program

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Understanding the Earth’s interior structure, dynamics and evolution

Geodynamics,

Chemistry and Mineral Physics,

Seismology,

Rheology and Material Properties,

Geochemistry/cosmochemistry

Anchored in observations at the Earth’s surface and remote sensing using satellites
Parable of the blind men and the elephant
Recognizing the need for more effective communication and understanding between the different disciplines, CIDER’s goal is to provide:

• An intellectual framework for integrated multi-disciplinary research in the geosciences

• An essential complement to growing infrastructure for data gathering and distribution

• A cross-disciplinary educational environment to prepare the next generation of earth scientists
2002 – Visit KITP

To define the scope and format of CIDER
Resulted in proposal to NSF/CSEDI->
co- funded 1st summer program with KITP (2004)
Funded summer at KITP in 2006, 2008, 2010

2009 – Marconi Center Community Workshop

• To review past activities,
• To define the scope of CIDER-II
  -> “D” changed from “Deep” to “Dynamic”
• Resulted in:
  • proposal to FESD- 2011
  • -> 5 years of funding with expanded scope.

2003 – Marconi Center Community Workshop

2016 – Marconi Center Community Workshop

• To review CIDER accomplishments
• To define the scope of CIDER beyond 2017 and start planning for future funding model
CIDER Summer Programs

- At KITP, U.C. Santa Barbara

  - 2004: “Relating seismological and geochemical heterogeneity in the earth’s mantle”
  - 2006: “The earth’s transition zone”
  - 2008: “Boundary layers in the Earth”
  - 2010: “Fluids and volatiles in the Earth’s mantle and core”
  - 2012: “Deep time: how the early Earth became the modern world”
  - 2014: “Dynamics of planetary interiors”
  - 2016: “Flow in the deep Earth”
  - 2018: “Relating seismological and geochemical heterogeneity in the earth’s mantle”
  - 2020: “Earth’s evolution as an inhabited world”
CIDER Summer Programs

- At UC Berkeley
  - 2011: "Dynamics of mountain building"
  - 2013: "From mantle to crust: continental formation and destruction"
  - 2015: "Solid Earth and climate"
  - 2017: "Subduction zone structure and dynamics"
  - 2019: "Volcanoes"
CIDER “Burnman group” in action, Summer 2012

CIDER poster session
Summer 2014
New activities starting in 2012 (FESD):

• Post or pre-AGU CIDER workshops:

• Support for research projects initiated during summer program

• Support for “working groups”:
  - Reference Earth Model (led by V. Lekic)
  - Attenuation (led by D. Wiens)
  - Geoneutrinos (led by W. McDonough)
  - Geomagnetic prediction (led by D. Lathrop)
  - Dynamic topography (led by S. Zhong)
CIDER wiki

- **Open to the public** (www.deep-earth.org)
  - Summer program lecture slides and video-recording
    - CIDER Lecture Collection
  - Reports of Working Groups

- Other Activities
  - CIDER publications, presentations, proposals
  - Wiki-topic pages
    - E.g. “Seismic Reference Earth Models”
    - “Dynamic topography” ...

- **Open only to CIDER participants**
  - Student Research Group pages
CIDER Summer Program Products

- Research groups formed during the summer program continue to function after the end of the summer program (AGU posters, publications)

- More generally, new collaborations lead to publications and/or proposals

- Networking among participants.
  - Post-doc and faculty positions
From 2013 Summer Program:

**RESEARCH ARTICLE**  
10.1002/2015GC005943  
G-Cubed 2015

**Characterization and Petrological Constraints of the Midlithospheric Discontinuity**

Erika Rader¹, Erica Emry², Nicholas Schmerr³, Daniel Frost⁴, Cheng Cheng⁵, Julie Menard¹, Chun-Quan Yu⁶, and Dennis Geist⁷

From 2014 Summer Program:

**RESEARCH LETTER**  
10.1002/2016GL068560  
GRL., 2016

**Primordial metallic melt in the deep mantle**

Zhou Zhang¹, Susannah M. Dorfman²,³, Jabrane Labidi⁴, Shuai Zhang⁵, Mingming Li⁶,⁷, Michael Manga⁵, Lars Stixrude⁸, William F. McDonough⁹, and Quentin Williams¹⁰

From 2016 Summer Program:

**RESEARCH ARTICLE**  
10.1029/2018GC007534  
G-Cubed 2018

**Multidisciplinary Constraints on the Abundance of Diamond and Eclogite in the Cratonic Lithosphere**

Joshua M. Garber¹,², Satish Maurya³,⁴, Jean-Alexis Hernandez⁵, Megan S. Duncan⁶,⁷, Li Zeng⁸, Li, Honguo L. Zhang⁹, Ulrich Faui¹⁰,¹, Catherine McCammon¹¹,¹, Jean-Paul Montagner¹², Louis Moresi¹², Barbara A. Romanowicz⁴,¹³,¹, Roberta L. Rudnick¹, and Lars Stixrude¹⁴

From 2017 Summer Program

The causes of spatiotemporal variations in erupted fluxes and compositions along a volcanic arc

C.B. Till¹, A.J.R. Kent², G.A. Abers³, H.A. Janiszewski⁴,⁵, J.B. Gaherty⁴ & B.W. Pitcher²,⁶  
Nature Comm., 2019
VOLCANIC ERUPTIONS AND THEIR REPOSE, UNREST, PRECURSORS, AND TIMING
Summary of the ERUPT report

Grand Challenges

• Forecast the onset, size, duration and hazard of eruptions by integrating observations with quantitative models of magma dynamics

• Quantify the life cycles of volcanoes globally and overcome our current biased understanding

• Develop a coordinated volcano science community to maximize scientific returns from any volcanic event
5. Strengthening volcano science

Requirements for an effective volcano science community

- **Support for interdisciplinary collaboration and training**, which is essential to making discoveries and integrating models and measurements
- **Shared community infrastructure**, which is necessary for state-of-the-art modeling, analytical facilities, monitoring and field experiments
- **Databases that preserve and facilitate open exchange of information** and hence enable exploration of the life cycle of volcanoes and improve forecasting
- **New technology and instruments** that permit new detection, measurements and sampling, including previously inaccessible parts of ongoing eruptions
- **A coordinated response by the research community** to eruptions globally to overcome observational bias
- **Observatory-academic partnerships**, which will accelerate the translation of basic science to applications and monitoring
6. Grand challenges in volcano science

3. Develop a coordinated volcano science community to maximize scientific returns from any volcanic event

The research community needs to be prepared to monitor and respond to eruptions globally

Requires multidisciplinary research, USGS-academic partnerships, training networks
Logistics

- Lectures:
  - Recording
  - Microphones
  - Lecturers post lecture ppt/pdfs on the wiki
    - https://seismo.berkeley.edu/wiki_cider/2019_Summer_Program_Agenda
    - Assistance from Dan Frost
    - Login:CIDER.2019
    - Password:summer2019
- Poster Sessions
  - Wed. June 19th: A-Mi
  - Wed. June 26th: Mu-Z
- Wear badges at all times
- Lunch cards
- The University of California indoors AND outdoors is non-smoking campus
- Group dinners (Wednesdays on campus, volunteers)
- Group photo (Tuesday during morning coffee break)
- Reimbursements (students and post-docs by June 28, senior participants by July 7)
Clear Lake volcanic field

Late-Pliocene to early Holocene

~100 km³ since 2.1 Ma

Mean interval between eruptions is 1800 years (USGS)

Basalt to rhyolite

Supports world’s largest geothermal facility (“The Geysers”)

Sarna-Wojcicki et al., *Geosphere* (2011)