EarthScope

Exploring the structure and evolution of the North American Continent, and the physical properties that control earthquakes and volcanoes.

Kaye M. Shedlock
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Integrated observational system of systems - $197.43 million
PBO is 1200 geodetic and 78 strain/seismic stations
SAFOD is an instrumented 3.1 km borehole into the San Andreas Fault
USArray is 2605 seismic and 27 magnetotelluric stations
- 40+ m; ~ 1 ton
- Core/samples requests semi-annually
  - 28 Proposals
  - 98 Principal Investigators
  - 790 Requests
USArray Science Highlights

**USArray Seismic Data**
- Acquiring ~4.9 GB/day
- ~ 8.0 TB in archive
- Availability (uptime) Performance Metric = 85%
- Consistently > 90%

Magnetotellurics
- Resistivity - 2006 Oregon Transportable Experiment: Mickus, et al

Seismic wavefield:
- Ammon and Lay

Rayleigh wave group velocity @ 8 s:
- Moschetti, Ritzwoller, et al

Body wave tomography:
- Burdick et al

Topography of UM discontinuities:
- Schmerr and Garnero

Folded Slab and Post-perovskite phase imaging:
- Hutko, et al
PBO Science Questions

- What are the forces and processes driving deformation at plate boundaries and in plate interiors?
- What is the rheological structure of the lithosphere and where is its strength?
- What drives strain release on active faults (e.g. earthquake and/or aseismic slip events)?
- How is magma transported within the crust and to the surface?
- How can we reduce the hazards of earthquakes and volcanic eruptions?
- Is there long-term transient deformation within the plate boundary zone, and if so, what are the characteristic temporal scales and underlying causes?
- How is magma transported within the crust and to the surface?
- How can we reduce the hazards of earthquakes and volcanic eruptions?
Why GPS and Strainmeters

- Instruments chosen for PBO Observatory cover broad frequency range
- Allow the study of the four-dimensional strain field
PBO Instrumentation

**GPS:**
- 1100 permanent
- 880 PBO
- 11 USArray joint
- 209 Nucleus
- 100 campaign

**Strain:**
- 73

**Seismic:**
- 78

**Tilt:**
- 26
InSAR Imagery

ERS-2

ENVISAT

ERS-1

RADARSAT-1
QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

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Envisat Results from Wells Earthquake

Expected horizontal displacement from Wells, NV quake
(model based on seismic data)

Hammond and Kreemer

Envisat Track 127 Frame 2781 Descending Orbits 28738-31744
Rapid uplift of the Yellowstone caldera revealed by GPS and InSAR data (2004-2007).

Chang, et al., 2007
Western US Deformation

Velocity field (kinematic)
GPS, Fault slip

Stress field (dynamic)
Lithospheric density
Kinematic constraints

Smith, et al., in press
The COSMIC program is now routinely including approximately 80 stations from the Plate Boundary Observatory (PBO) in our near real-time analysis of GPS data within the continental United States.
Plume Tracking

Retrieval of clear anomaly in GPS phase delay modeling residuals (5 - 10 cm of equivalent pseudorange delay)

Anomalies compatible with eastward lateral drift (confirmed via ground and air reports)

GPS data can be used to detect and quantify volcano plumes.
High-Rate GPS

Almost evenly split between academia, government and private sector.

Support GPS positioning of airborne/mobile instrument platforms (for lidar, photogrammetry, bathymetry, etc.).

Research for hazard, early...
The End
of the construction

The continued growth of unprecedented
Science....