SSIP: Salton Seismic Imaging Project
A Joint GeoPRISMS + EarthScope + USGS Investigation of Rift Initiation and Evolution

SSIP
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Hole GeoPRISMS-EarthScope ENAM Workshop 2011
Salton Trough

same amount of extension along entire length of Gulf
Transitional Crust at Rifted Continental Margins

- Magma-dominated Margin
  - Magma-dominated crust
  - Seaward dipping reflectors
  - Extruded melt

- Margin with Non-Oceanic "New" Crust
  - Continent-ocean transition
  - Sediments & sills
  - Lower crustal flow?

- Hyper-Extended Margin
  - Continent-ocean transition
  - Serpentinized mantle

Hole GeoPRISMS-EarthScope ENAM Workshop 2011
entirely new crust, <6 Myr old

- 0 km
  - sediment
- 3-6 km
  - metamorphosed sediment
- 12-16 km
  - gabbro
- 20-24 km
  - MOHO
  - hot upper mantle

- sedimentation from Colorado River
- magmatism from mantle

→ future continental margin
Sedimentation & Magmatism

thick sediment affects magmatism, heat flow
magmatism affects sediment (metamorphism)
role of hydrothermal circulation

⇒ together create brand-new crystalline crust
Oblique Rifting

strain partitioning

rift ↔ transform

brittle ↔ ductile ↔ magmatic

from Shearer et al. 2005
SSIP Goals

rift initiation and evolution
roles of and interactions between:
  - continental stretching (brittle & ductile)
  - magmatism
  - sedimentation
partitioning of strain during continental breakup
Earthquake Hazards

San Andreas Fault
+ at least 4 faults in Imperial & Mexicali Valleys with historic magnitude 6-7 earthquakes

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Fault Dip

Earthquakes not under San Andreas Fault trace

from Shearer et al. 2005
SSIP Goals

rift initiation and evolution
roles of and interactions between:
- continental stretching (brittle & ductile)
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partitioning of strain during continental breakup

earthquake hazards
parameters for fault-earthquake models and
for strong ground motion simulation
- subsurface geometry of faults
- geometry & velocity of sedimentary basins
- regional 3D velocity model
SSIP
onshore seismic refraction & reflection

Wet-SSIP
marine seismic refraction & reflection

Broadband-SSIP
onshore broadband teleseismic
SSIP
  onshore seismic refraction & reflection

Wet-SSIP
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  onshore broadband teleseismic

Marine Geology & Geophysics

Geophysics
Broadband-SSIP

January 2011 – June 2012

42 broadband seismic
16 personnel,
5 universities
SSIP

March 2011

explosive shots
126 shots
total 33,329 kg
median 115 kg
Wet-SSIP

March 2011

airgun shots
2330 shots
~100 m spacing
**SSIP+Wet-SSIP**

March 2011
(<3 weeks)

seismometers:

- 3958 1-component Texan sites
- 277 3-component RT130 sites
- 78 3-component OBS sites
SSIP+Wet-SSIP

March 2011
(<3 weeks)
~120 personnel
> 50 students
31 colleges/universities
Imperial Valley Shot Gather

confirms crustal layers, but at order of magnitude better sampling

Hole GeoPRISMS-EarthScope ENAM Workshop 2011
Shot Gather Across Salton Trough

Tijuana

reflection from Moho

reflected Boulder Fault

Colorado River

reflection from Moho

USA
Velocity Model: Along Imperial Valley

slow “basement” = metamorphosed sediment
Velocity Model: Along S. Shore of Salton Sea

slow “basement” = metamorphosed sediment
much shallower under geothermal & volcanic field

Sand Hill Fault

Delph & Hole

IRIS undergrad intern
Reflection Image: Along Salton Sea

normal faults in sediments  rapid subsidence in south

Driscoll, Kent, Harding, Kell, & Babcock
SSIP has barely begun analysis

rift processes
earthquake hazards

http://www.geophys.geos.vt.edu/hole/salton/