SSIP: Salton Seismic Imaging Project

A Joint GeoPRISMS + EarthScope + USGS Investigation of

Rift Initiation and Evolution

SSIP

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Wet-SSIP

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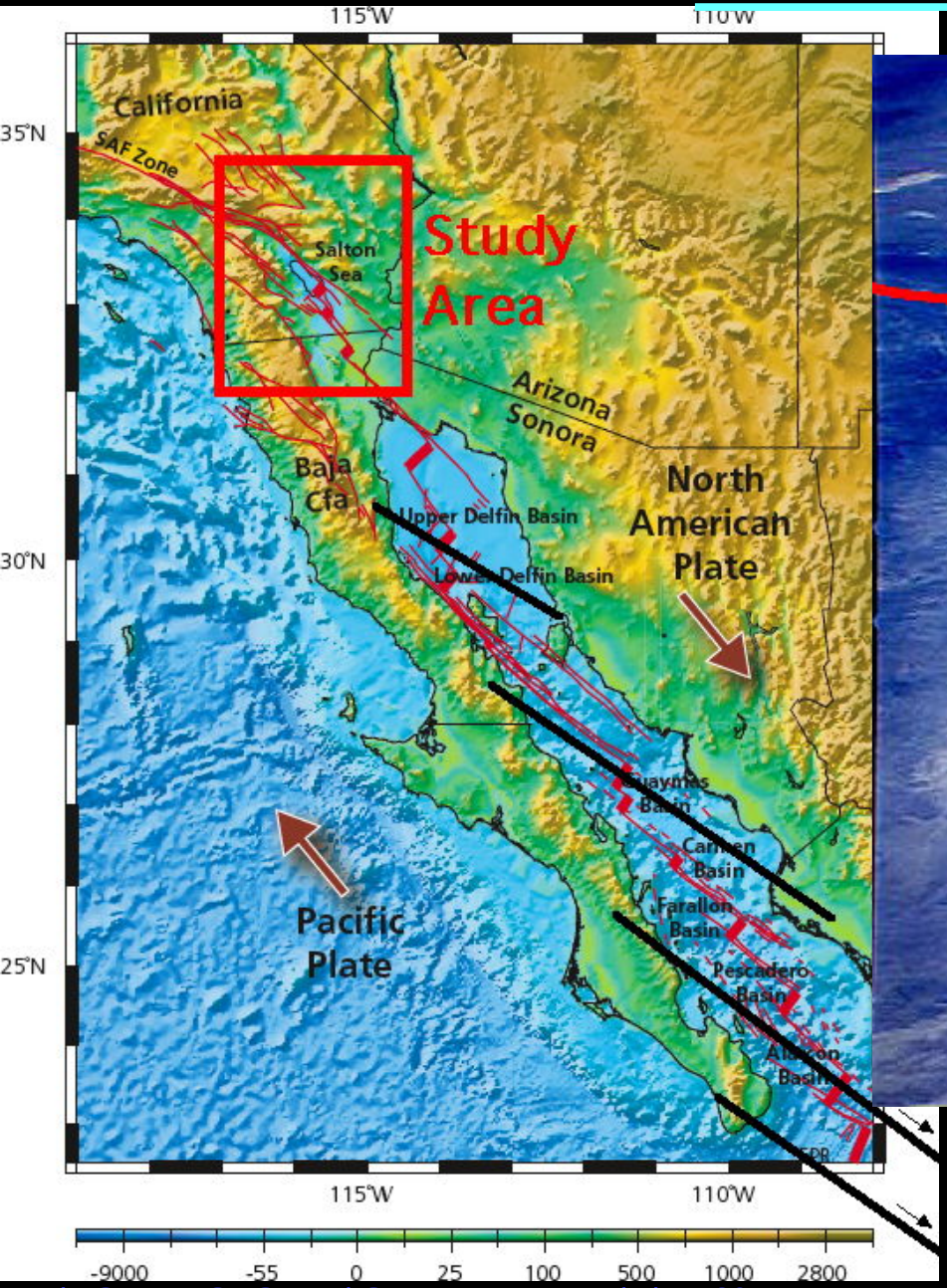
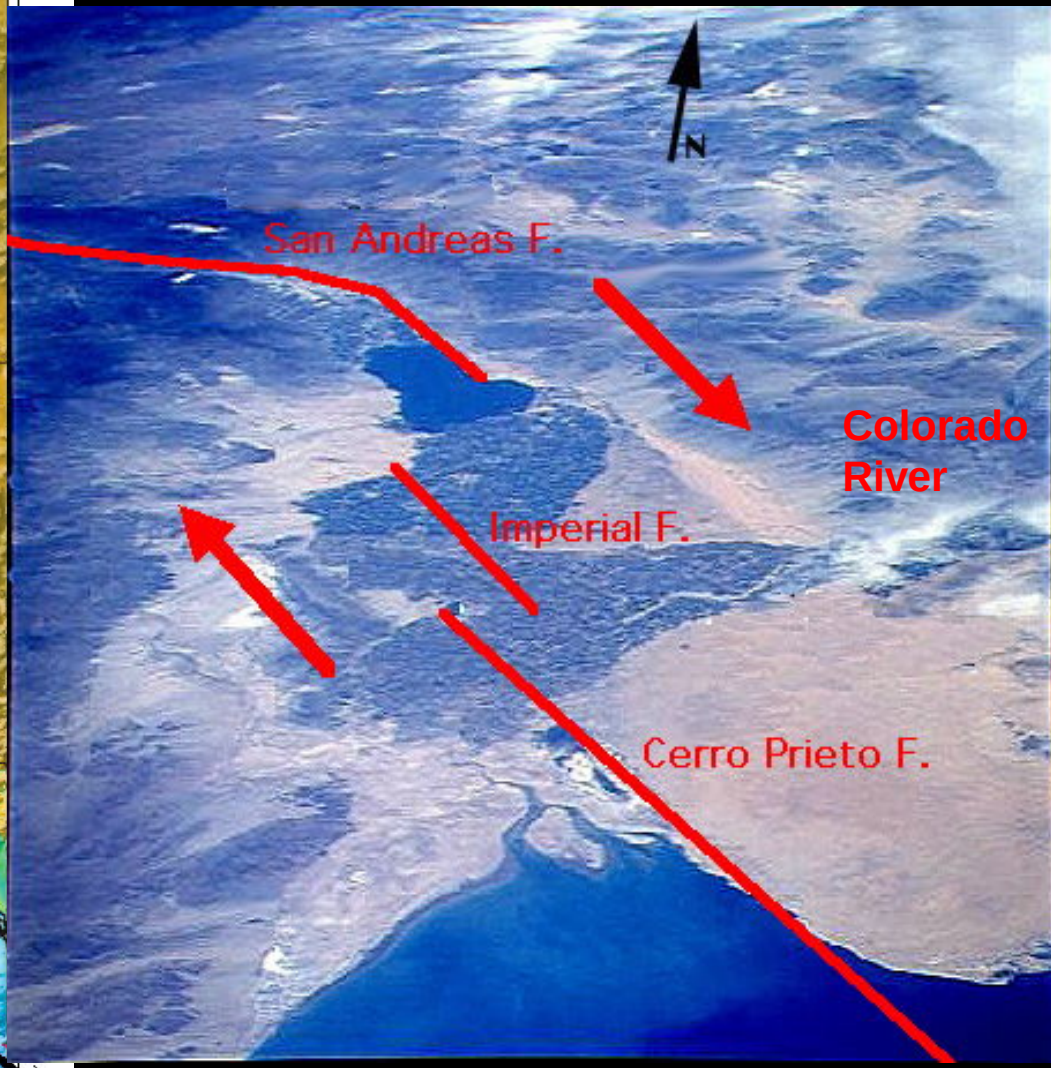
Broadband-SSIP

Simon Klemperer, Stanford

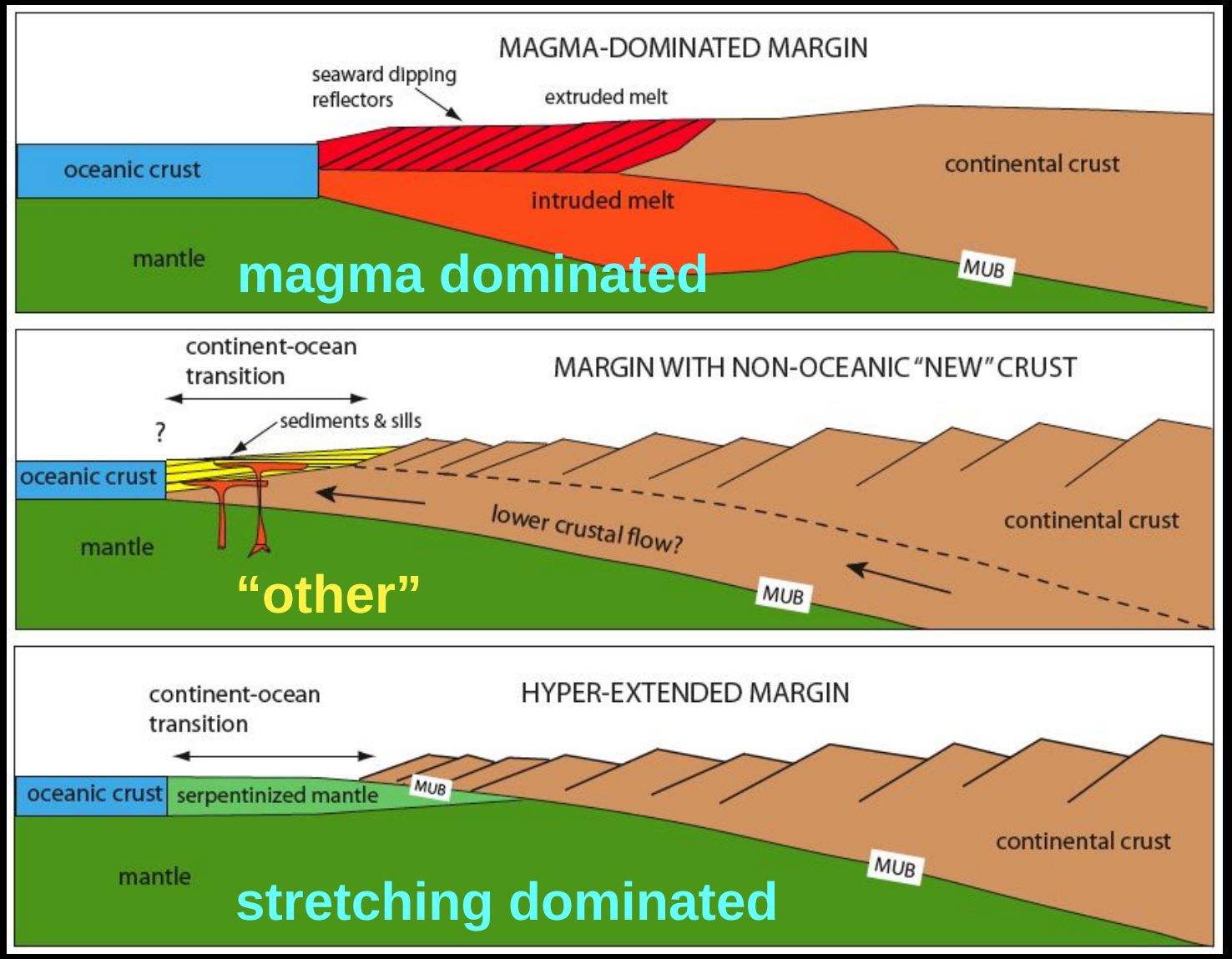
Salton Trough





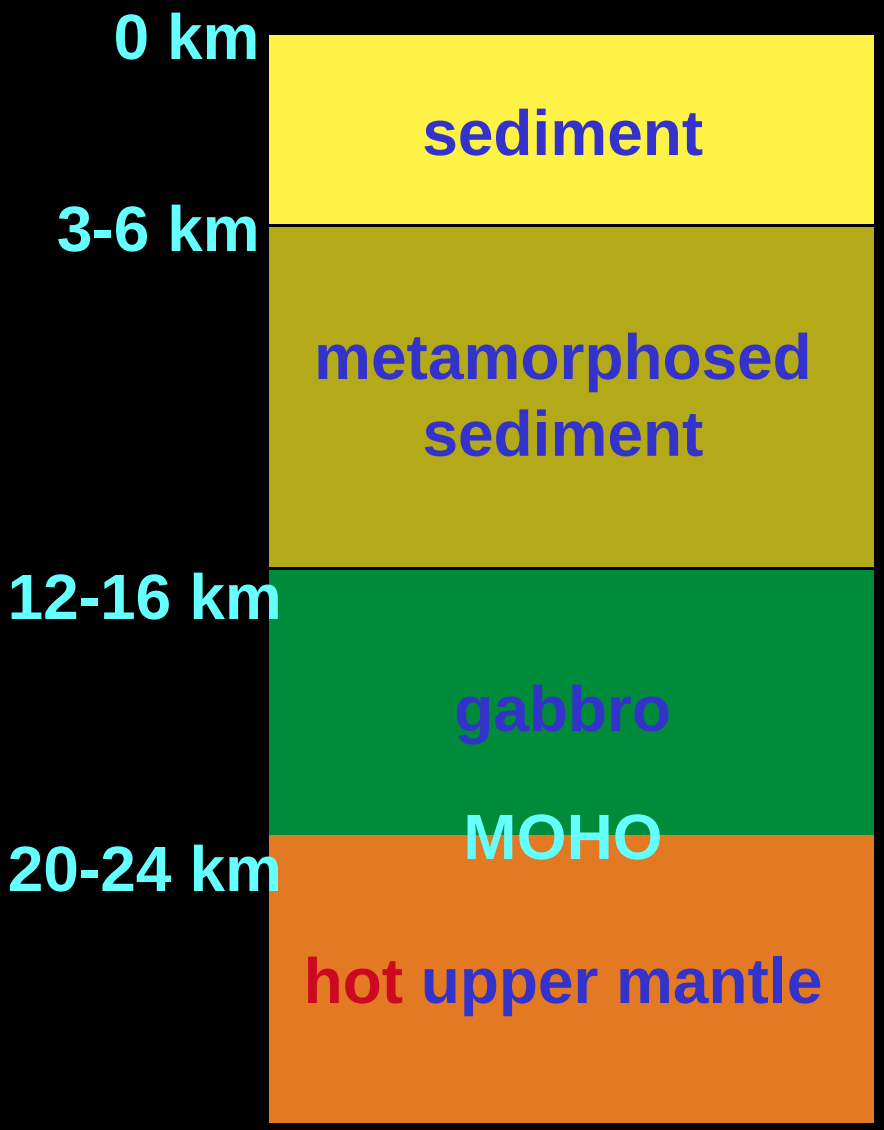
same amount of extension along entire length of Gulf

Transitional Crust at Rifted Continental Margins



Lithosphere in Imperial Valley

entirely new crust, <6 Myr old

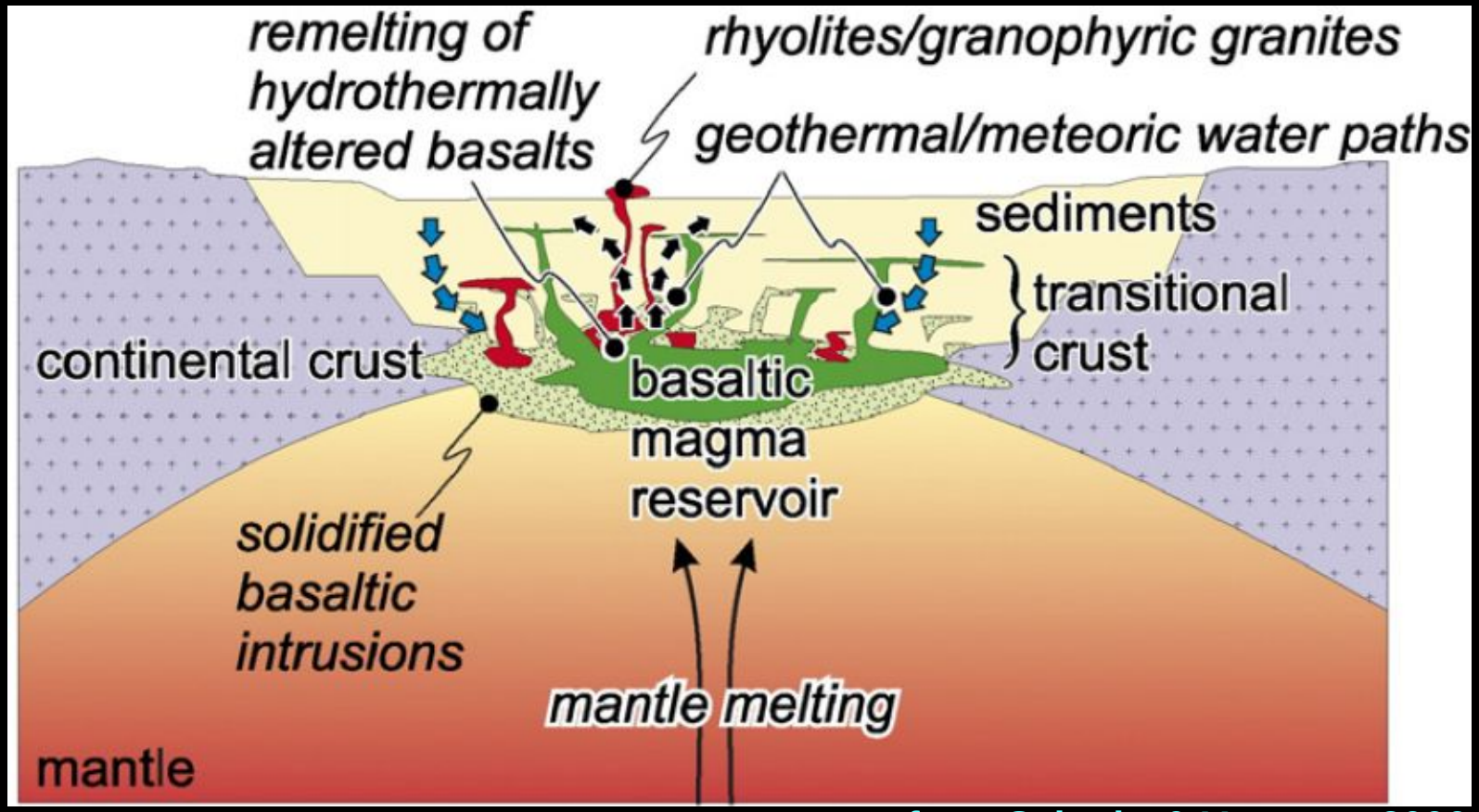


sedimentation from Colorado River

magmatism from mantle

➔ future continental margin

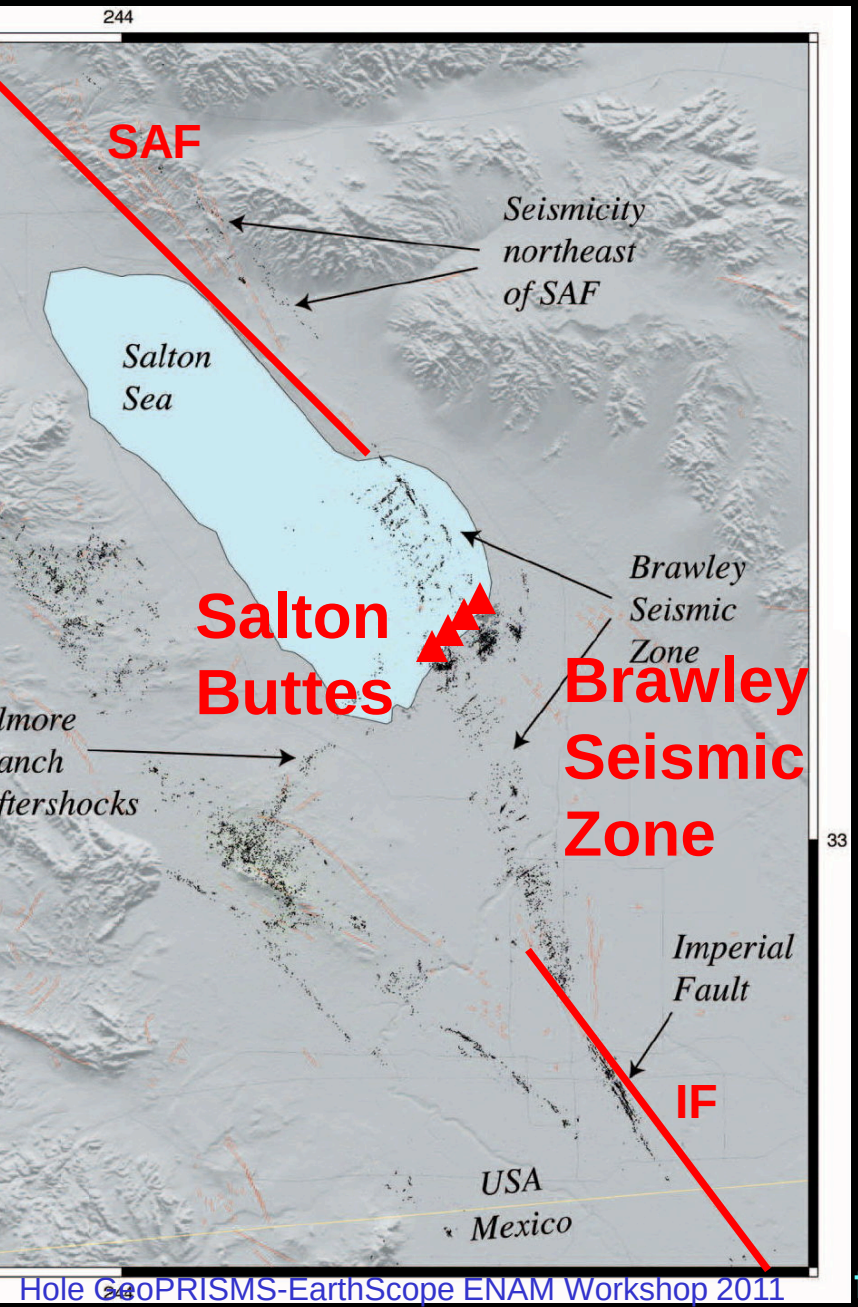
Sedimentation & Magmatism



from Schmitt & Vazquez, 2006

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:

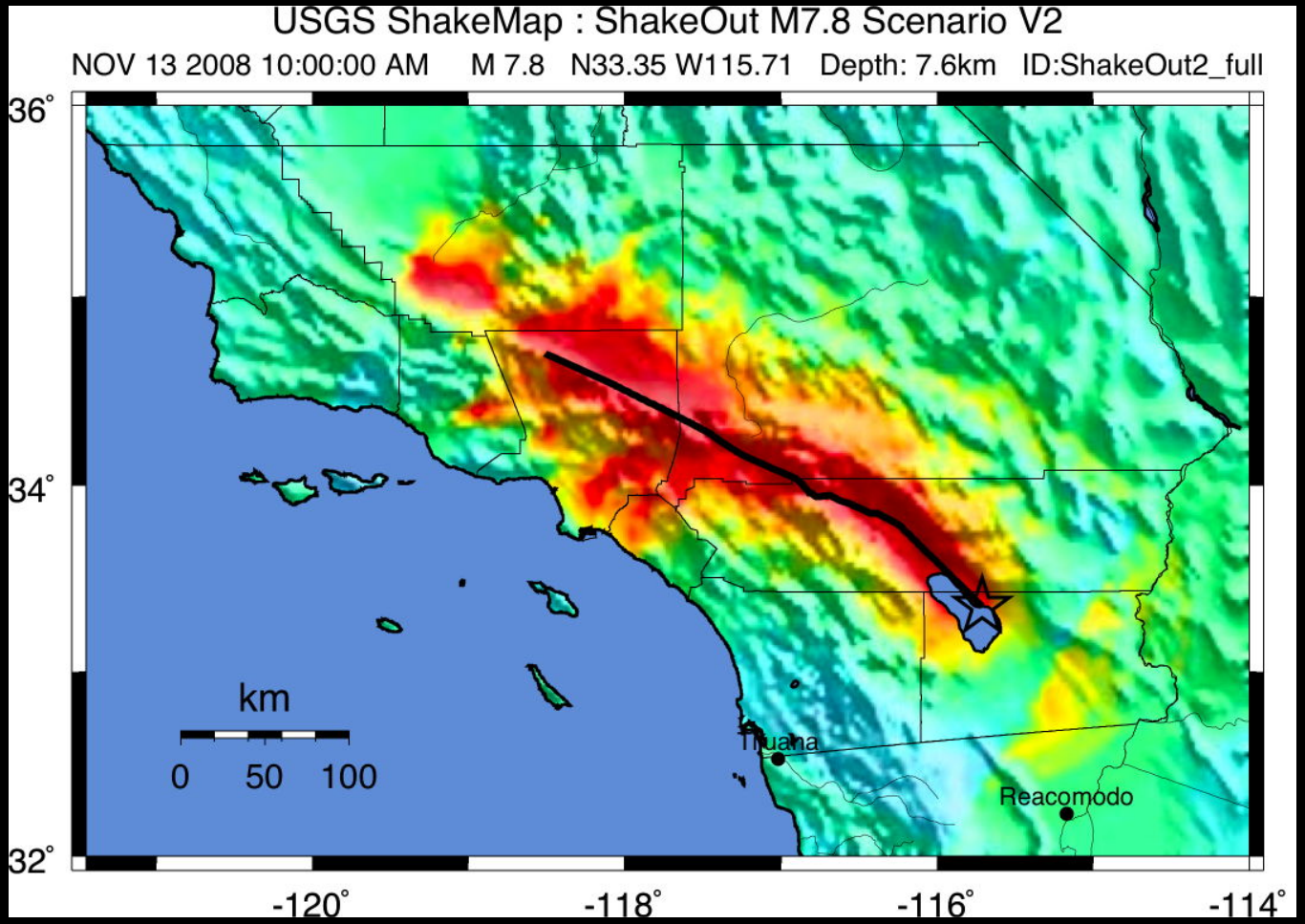
- continental stretching (brittle & ductile)

- magmatism

- sedimentation

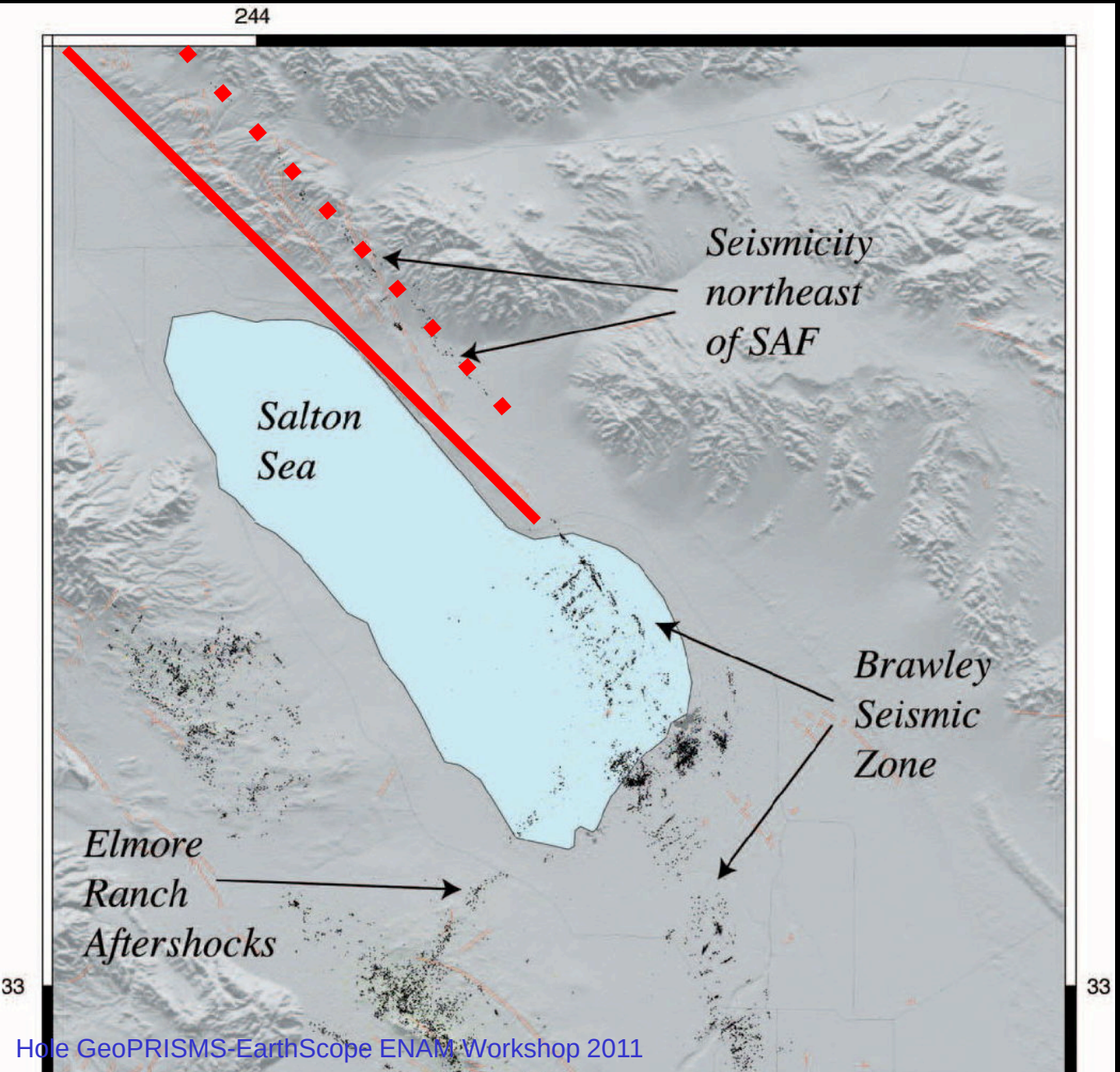
partitioning of strain during continental breakup

Earthquake Hazards



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

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)
  - magmatism
  - sedimentation
- partitioning of strain during continental breakup

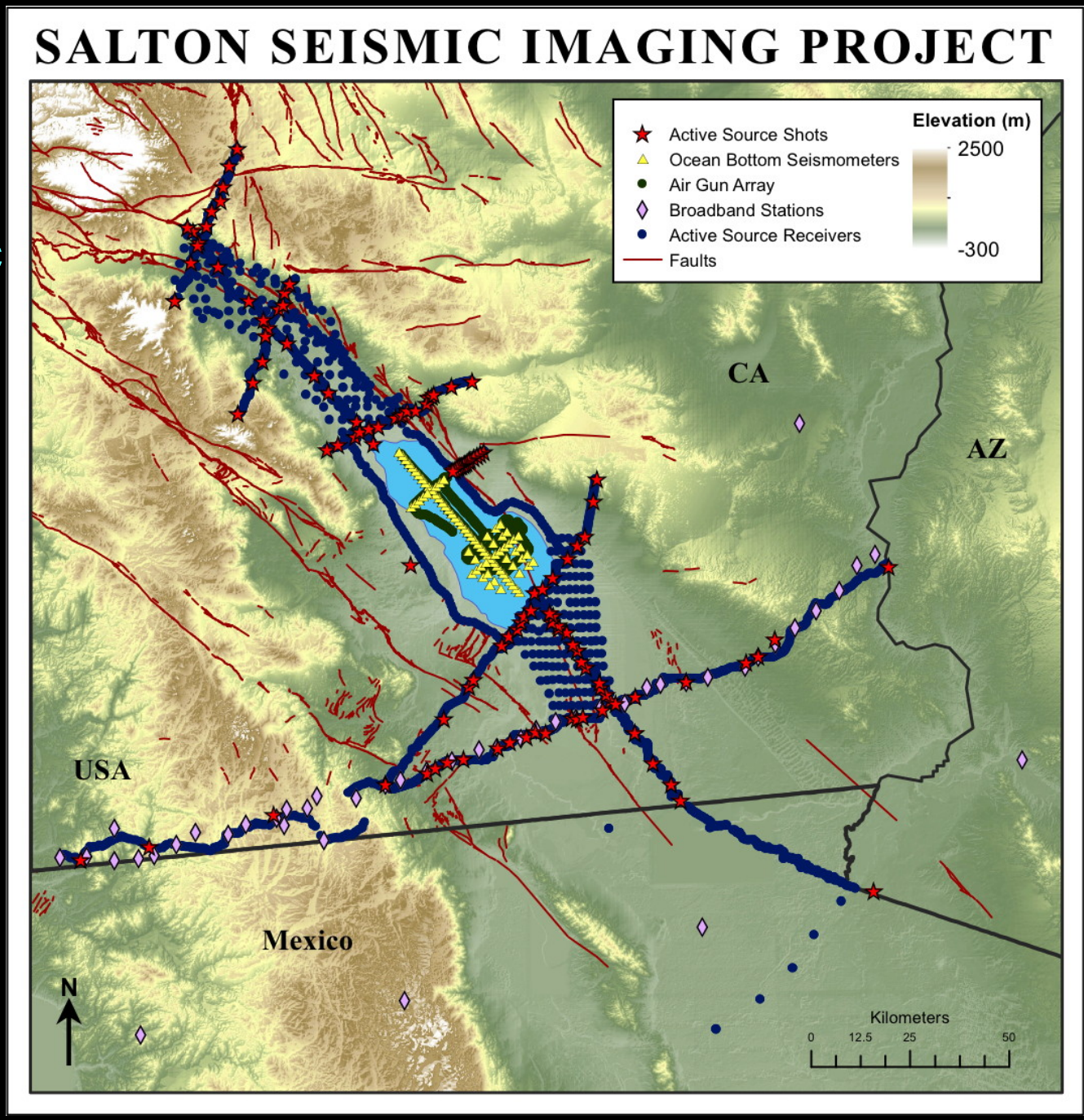
earthquake hazards

- 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



SALTON SEISMIC IMAGING PROJECT

SSIP
- onshore seismic
  - refraction
  - & reflection

Wet-SSIP
- marine seismic
  - refraction
  - & reflection

Broadband-SSIP
- onshore
  - broadband
  - teleseismic

Geodynamic Processes at Rifting and Subducting Margins

Marine Geology & Geophysics

Geophysics

Broadband-SSIP

January 2011 – June 2012

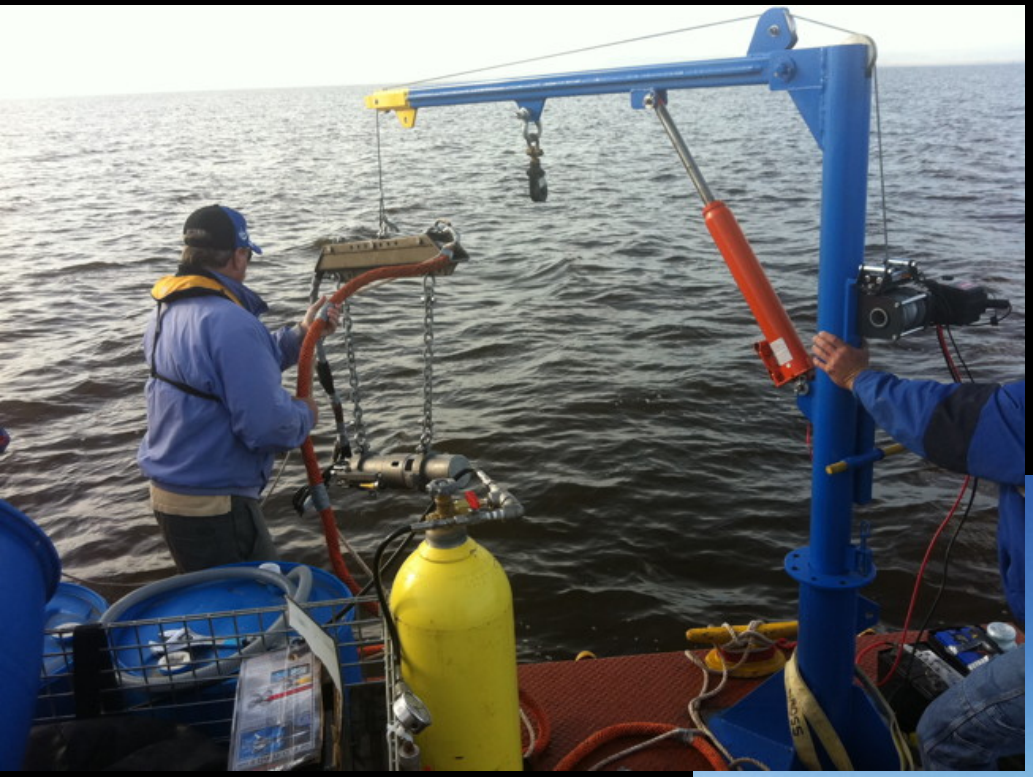
42 broadband seismic
16 personnel,
5 universities

SSIP

March 2011

explosive shots
126 shots
total 33,329 kg
median 115 kg

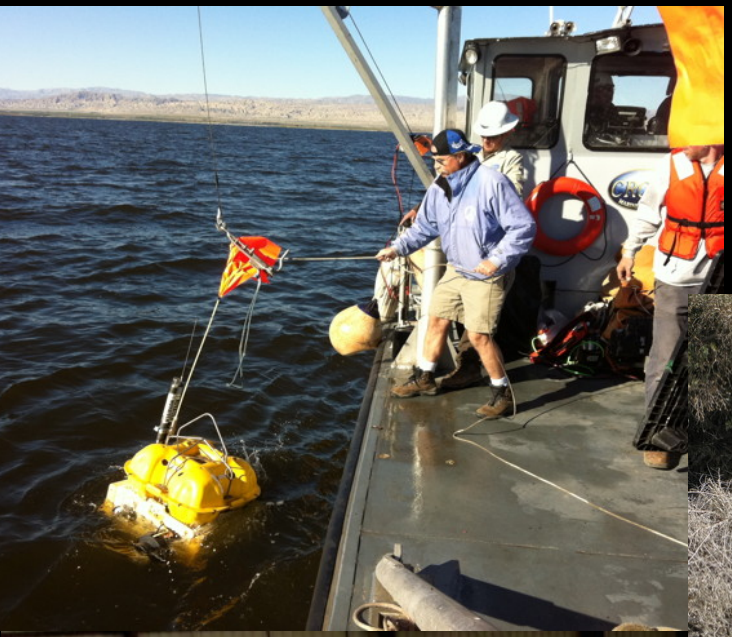
Wet-SSIP



March 2011

airgun shots
2330 shots
~100 m spacing

SSIP+Wet-SSIP

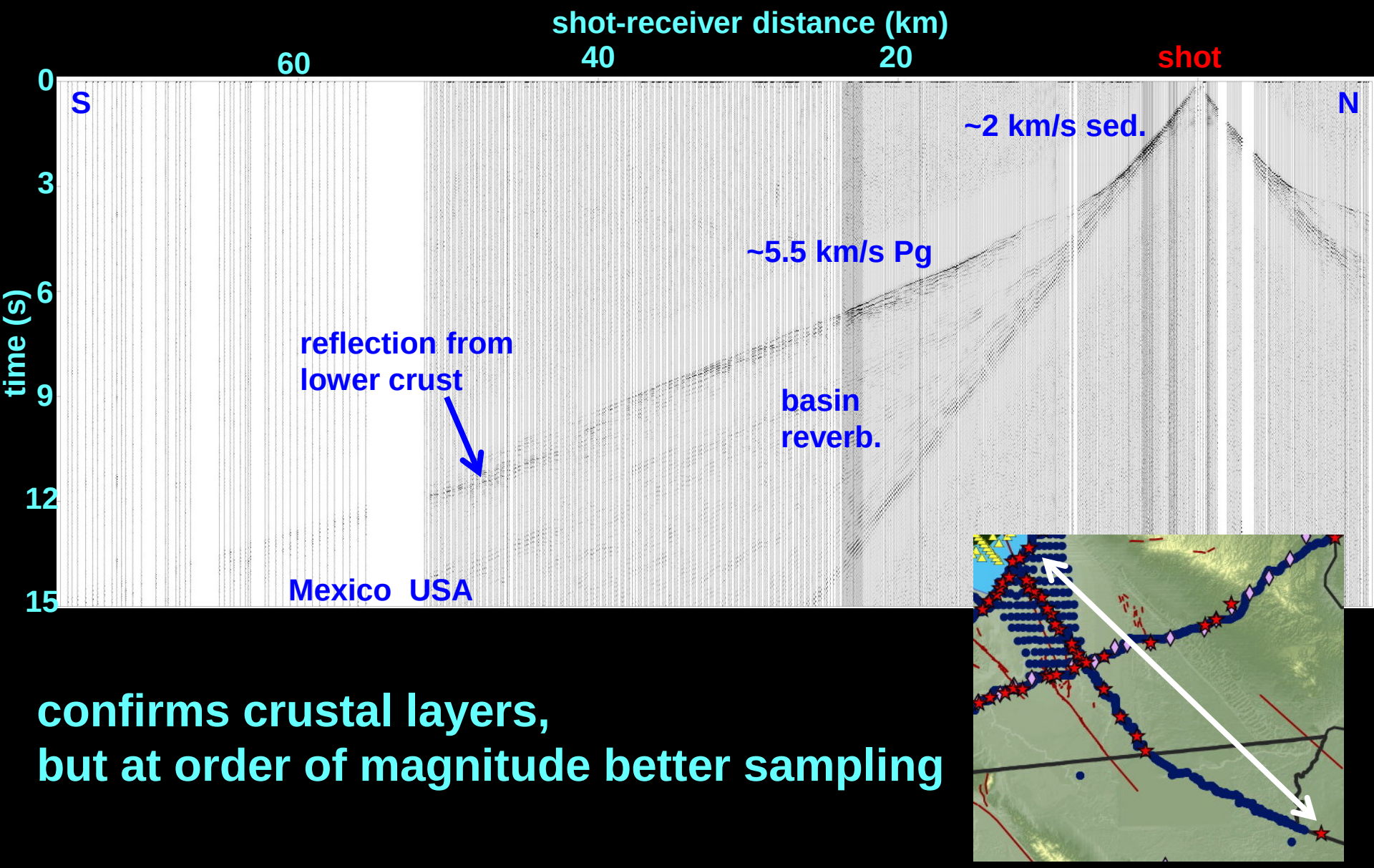


March 2011
(<3 weeks)
seismometers:
3958 1-component
Texan sites
277 3-component
RT130 sites
78 3-component
OBS sites

SSIP+Wet-SSIP

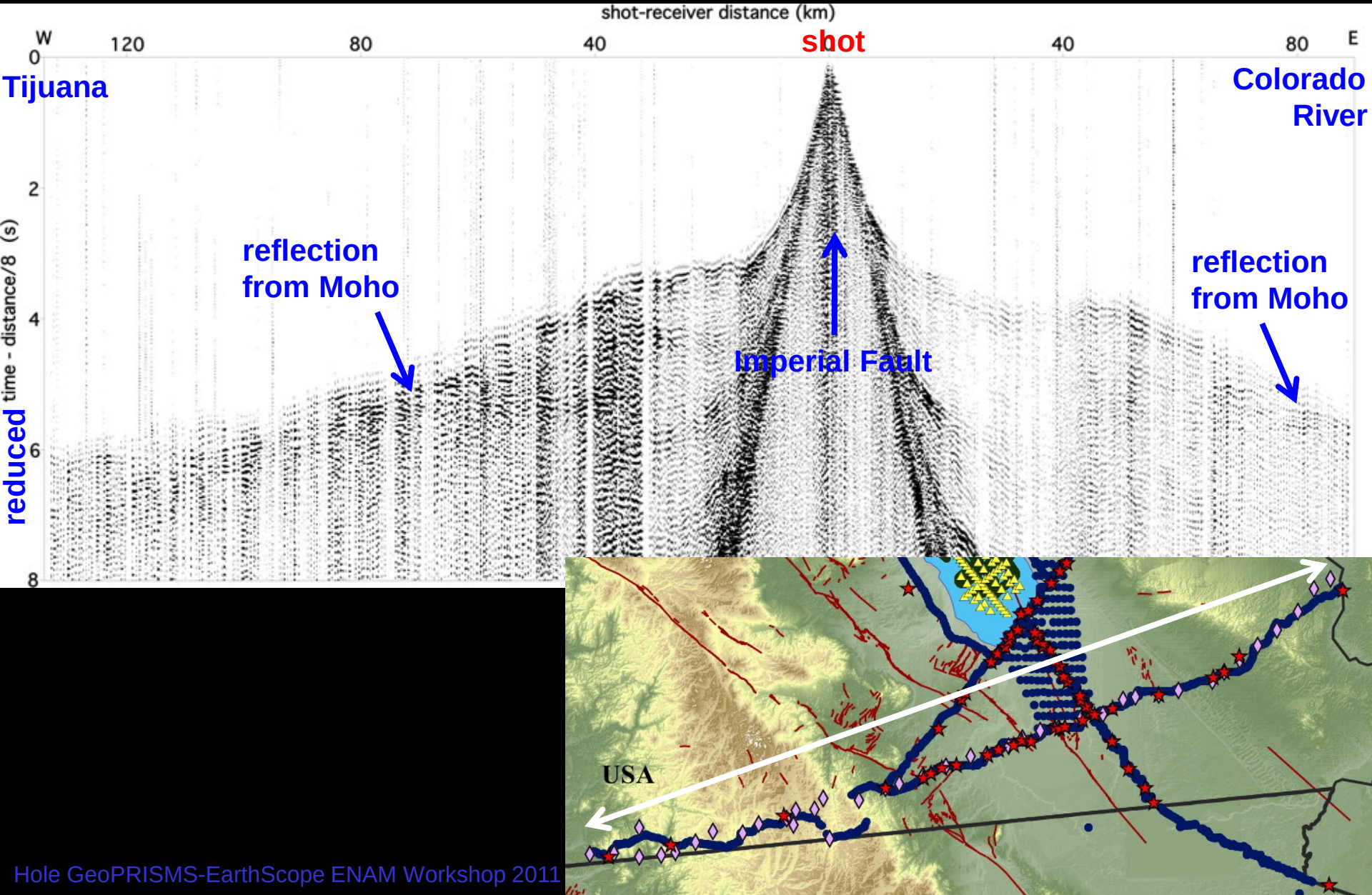
March 2011
(<3 weeks)
~120 personnel
> 50 students
31 colleges/universities

Imperial Valley Shot Gather



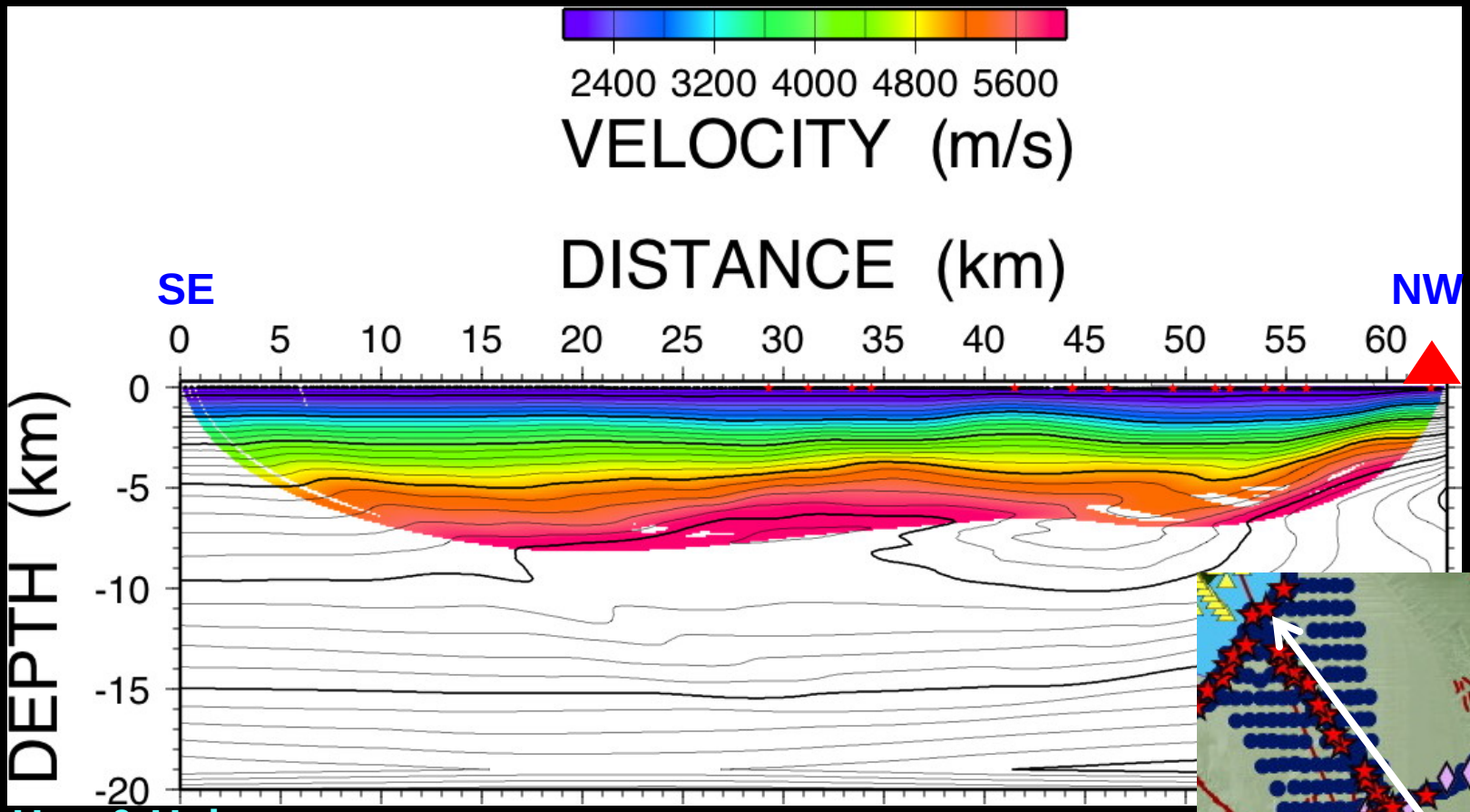
confirms crustal layers,
but at order of magnitude better sampling

Shot Gather Across Salton Trough

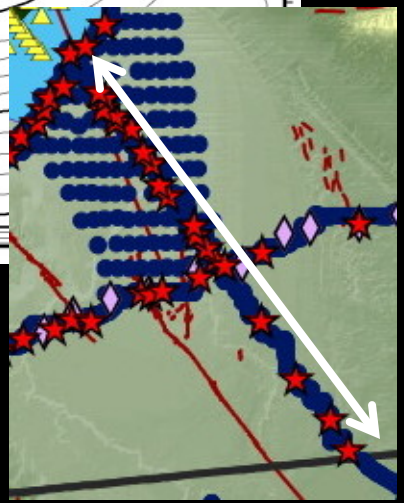


Velocity Model: Along Imperial Valley

slow “basement” = metamorphosed sediment

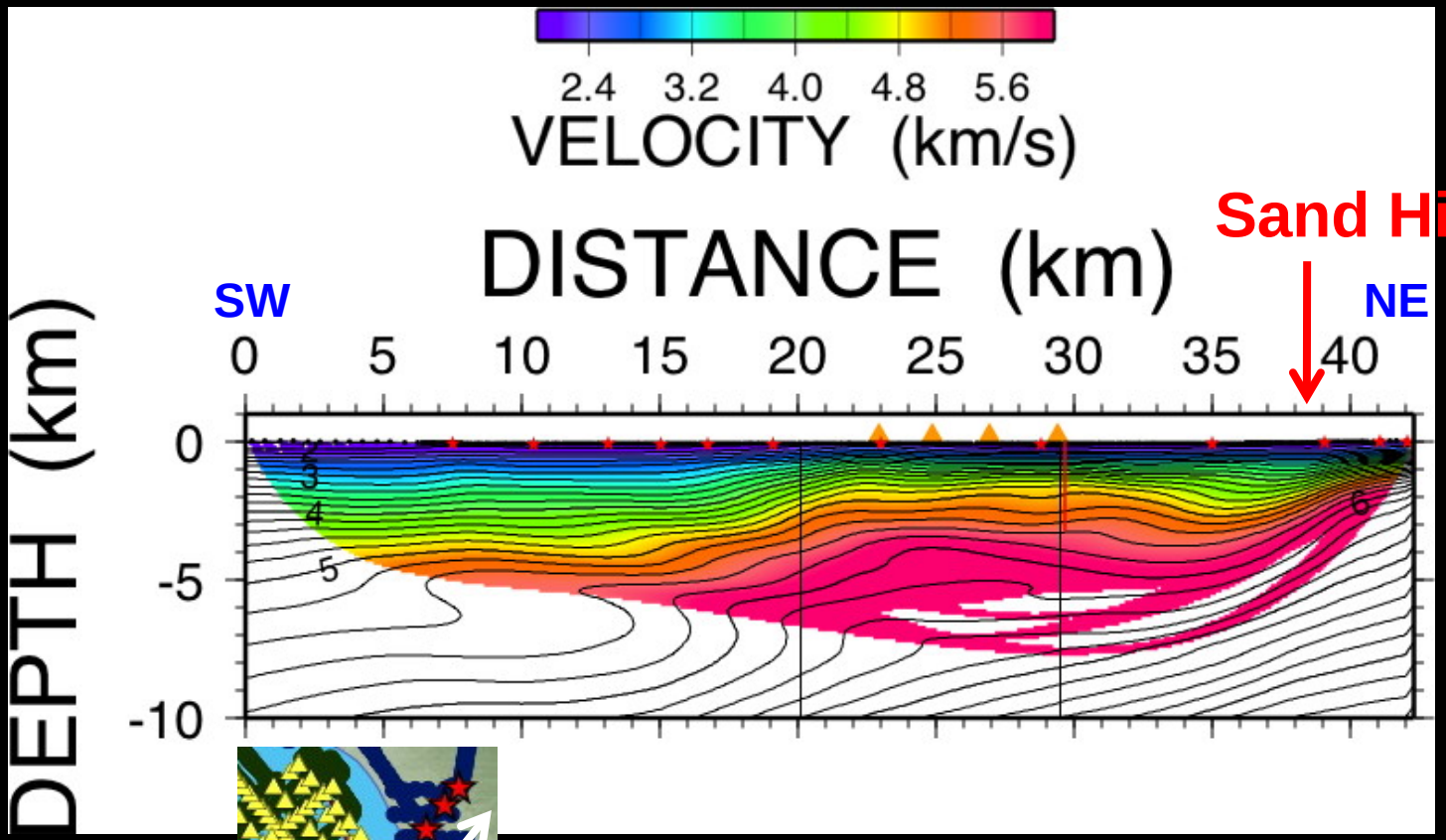


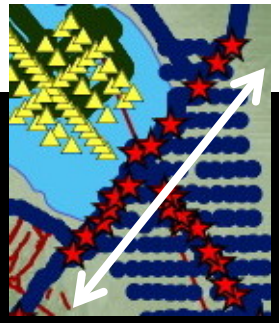
Han & Hole



Velocity Model: Along S. Shore of Salton Sea

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





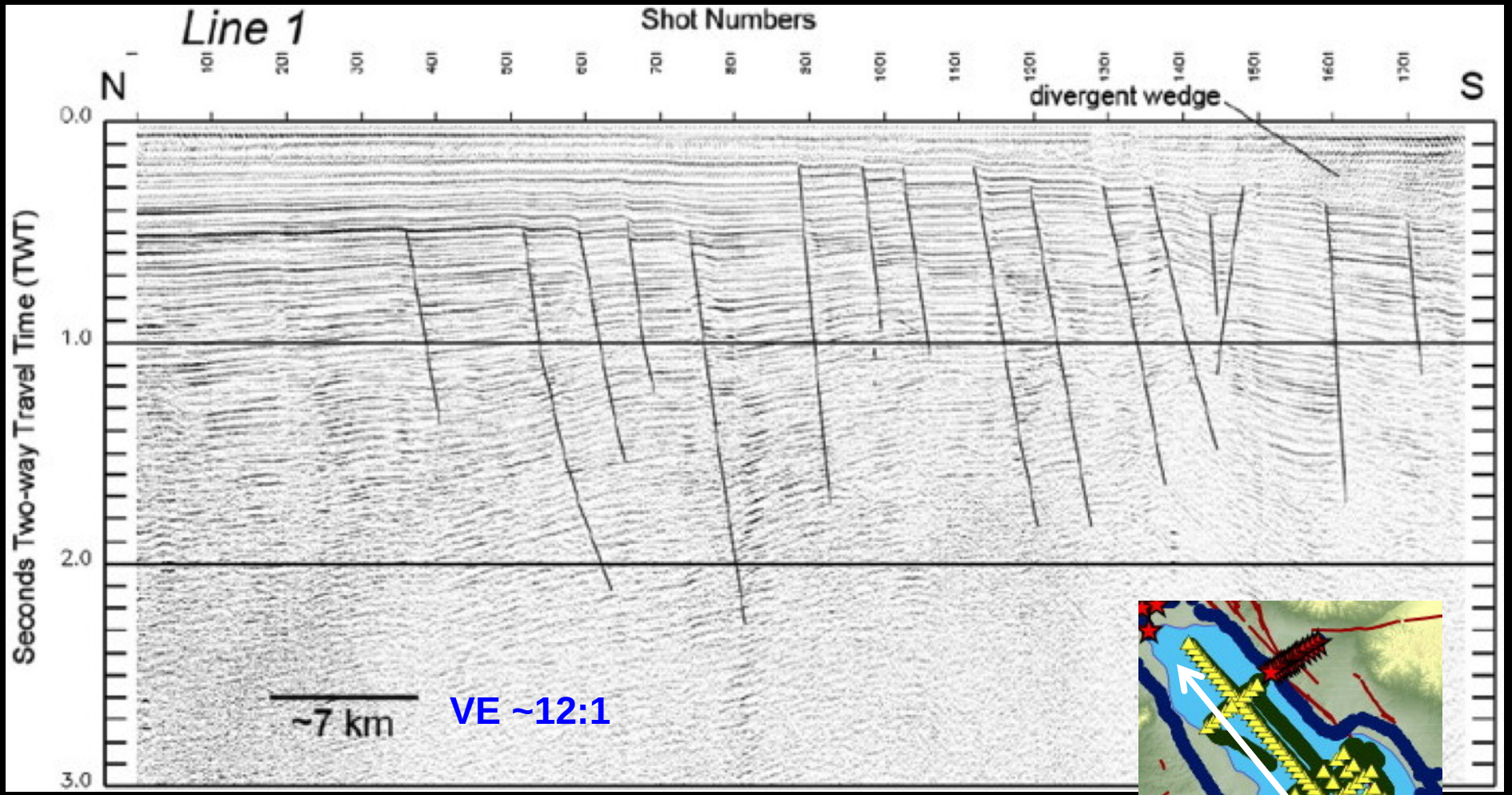
Sand Hill Fault

Delph & Hole

IRIS undergrad intern

Reflection Image: Along Salton Sea

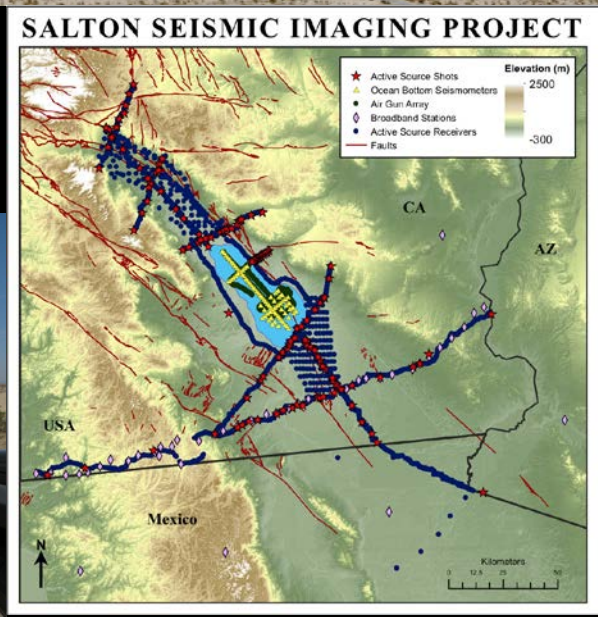
normal faults in sediments **rapid subsidence in south**



Driscoll, Kent, Harding, Kell, & Babcock

SSIP has barely begun analysis

rift processes
earthquake hazards



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