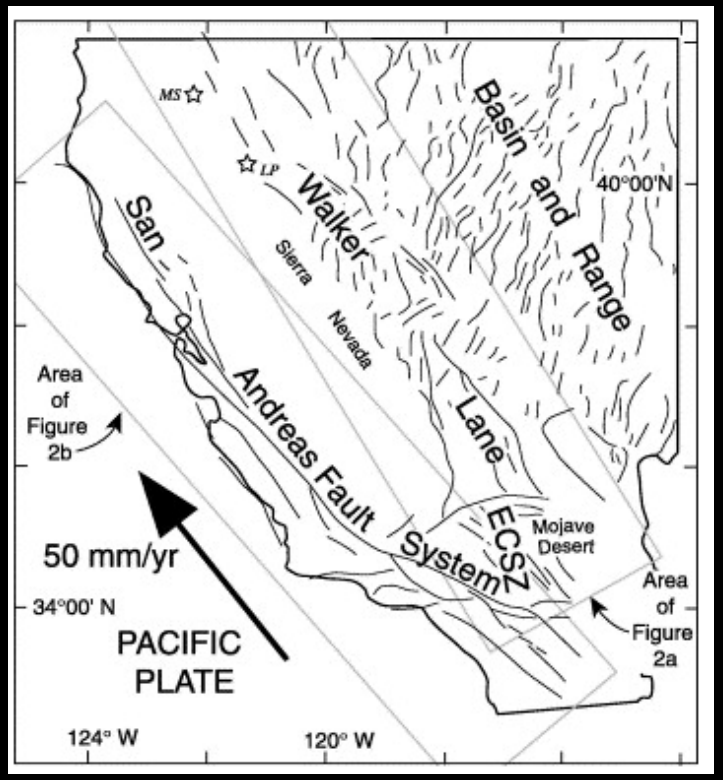
The Walker Lane RIFT SYSTEM:

A Natural Laboratory to Study Rift Initiation that Culminated in Seafloor Spreading

(in the Gulf of California)



Why am I in charge of this pitch? Because I am representing everyone who was at the Penrose I ran in Walker Lane last August (but heard about this meeting too late to apply)…..

As well as the people who are here…….Cathy Busby (UCSB), Graham Kent (UNR), Neal Driscoll (SIO), Chris Henry (UNR), Jim Faulds (UNR) Glenn Biasi (UNR), Ken Smith (UNR), John Louie (UNR), Bill Hammond (UNR), Alistair Harding (SIO), Geoff Blewitt (UNR), Corne Kreemer (UNR), Danny Brothers (USGS), Fred Phillips (NMIT), Jared Kluesner (SIO), Peter Lonsdale (SIO), Keith Putirka (Fresno St.), Debi Kilb (SIO), Pat Cashman (UNR), Paul Umhoefer (NAU), Gary Fuis (USGS), Dan Lizarralde (WHOI), Jeff Babcock (SIO), Kathie Marsaglia (CSUN)

Modern Tectonic Context

Walker Lane rift system - currently accommodates 20-25% of the plate motion between the Pacific and the North American plates

Provides a clear record of rift initiation…

and a time-transgressive view of

processes involved in strain localization.

Sierra Nevada microplate - Walker Lane system:
Global importance because of the many important concepts developed there and exported to other parts of the world (see below).

It remains, however, to integrate disparate geologic, geochemical, and geophysical discoveries into a comprehensive physically based process model for continental rifting.

This requires a long-term program that brings many different types of workers together.

listric normal faults, detachment faults and metamorphic core complexes, "chaos" (large-scale landslide deposits), calderas and geothermal fields (e.g. Long Valley), maar volcanoes and Pluvial lake deposits, vertical axis rotations of crustal blocks, strain partitioning, thermochronologic dating of ancient landscape surfaces and tectonic tilting events, root delamination, and the emplacement of huge

Attributes of Walker Lane-Gulf of California rift system

IMMEDIATE

GLOBALLY APPLICABLE SCIENTIFIC RESULTS

AT RELATIVELY LOW COST,

WITH MAJOR SOCIETAL IMPACT.

Including an amphibious approach

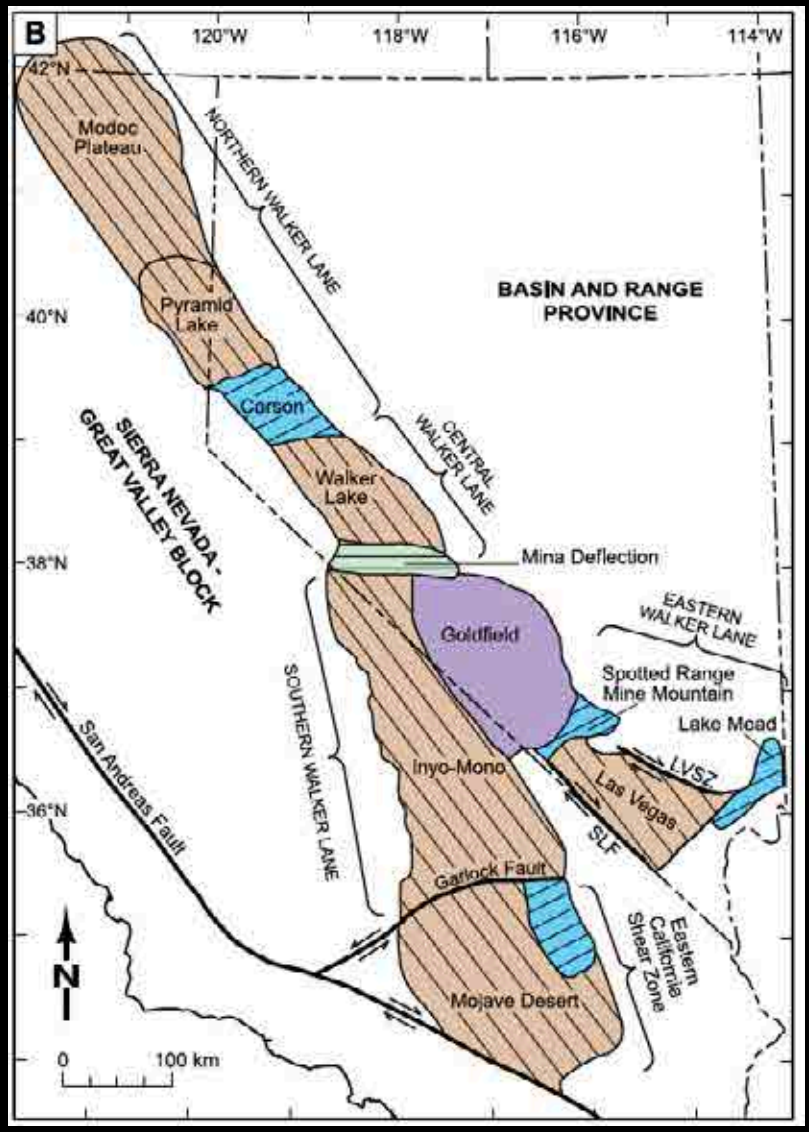
e.g. Pyramid Lake

Attributes…..

(1) Data infrastructure (e.g., geologic mapping, digital topography, seismic and geodetic studies)

Integrate disparate geologic maps and analytical data into a single user-friendly database in Google Earth - IMMEDIATE public impact.

Rifting studies can focus immediately on the KEY QUESTIONS.



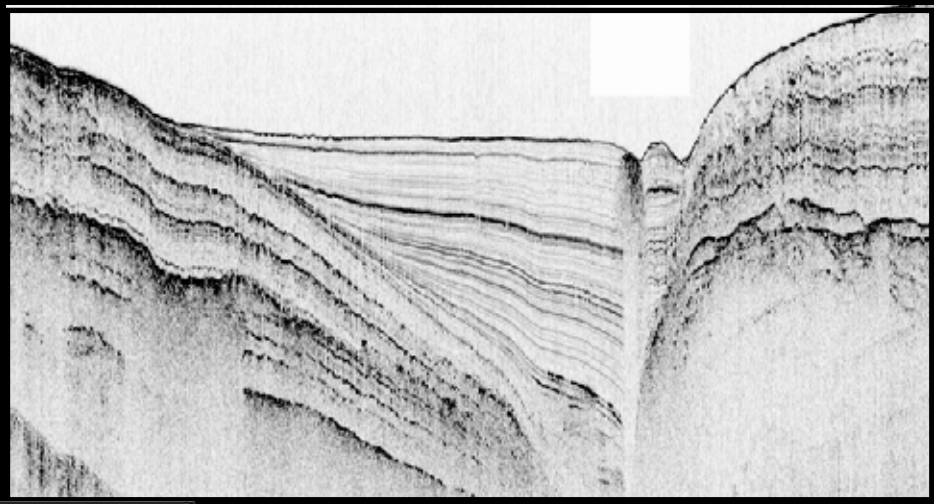
Attributes, continued:

(2) Ease and safety of physical access - THE POLITICAL REALITY - cost-effective experimentation and data acquisition - Improved scientific return with student and community access.

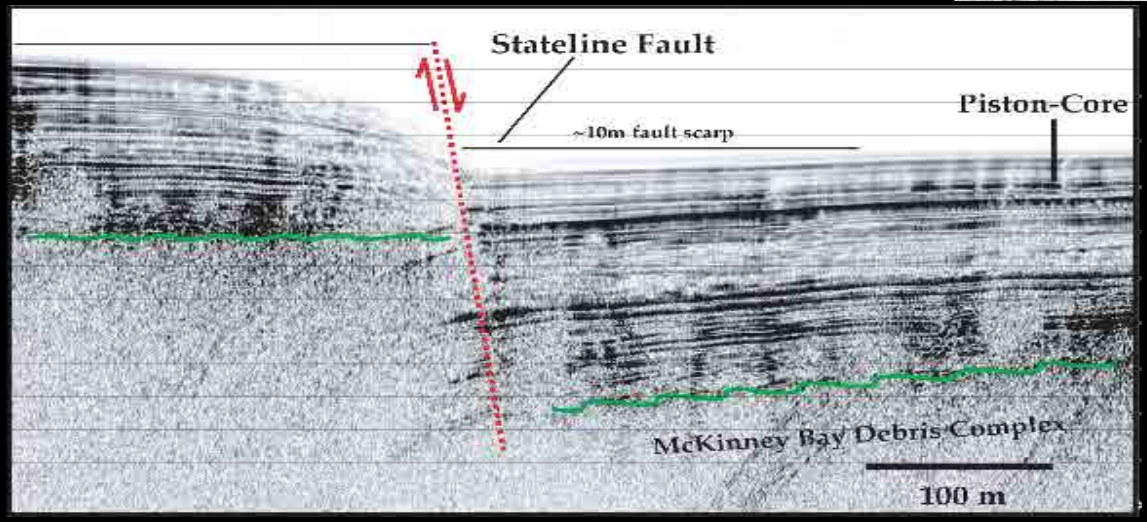
BROADER IMPACT - Students!!!!

Attributes, continued:

(3) Study sites that require access to ocean-going vessels may not begin until 2014 or later, whereas data collection on lakes can begin immediately.



Pyramid Lake, Walker Lane Rift System

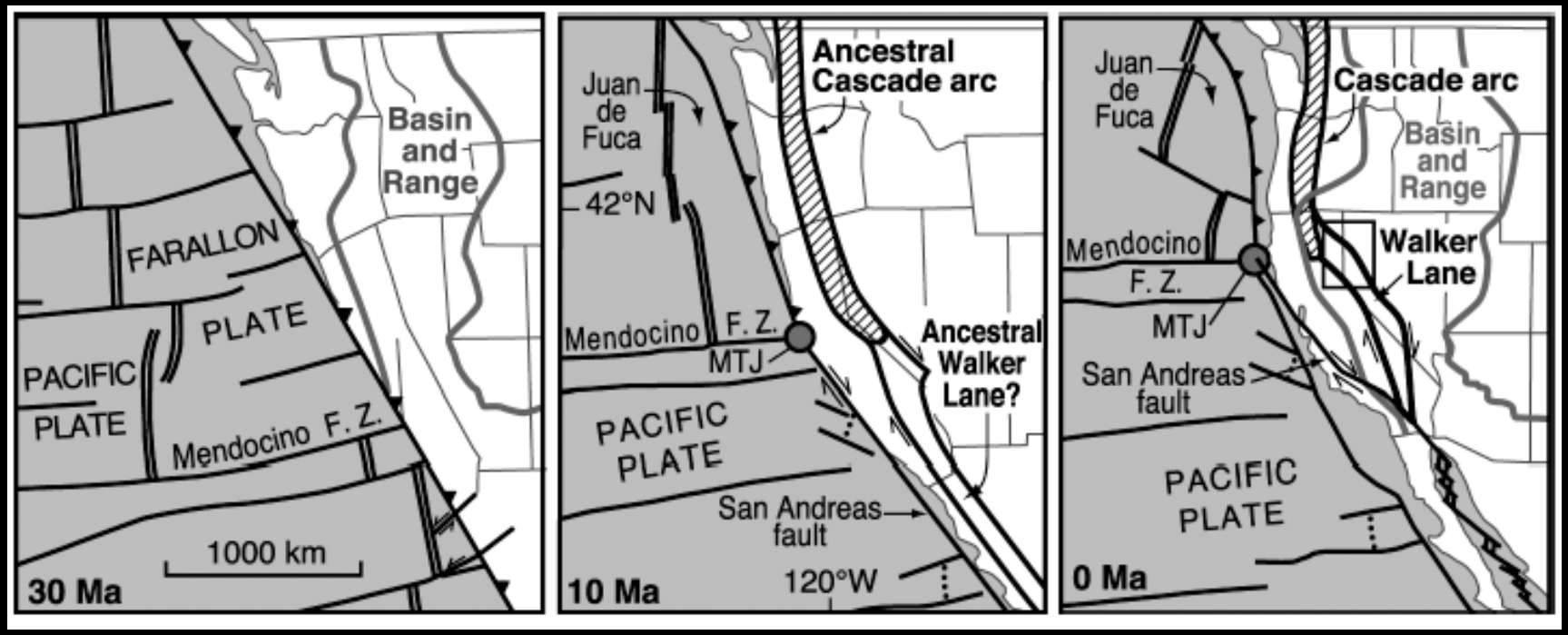


Lake Tahoe, Walker Lane Rift System

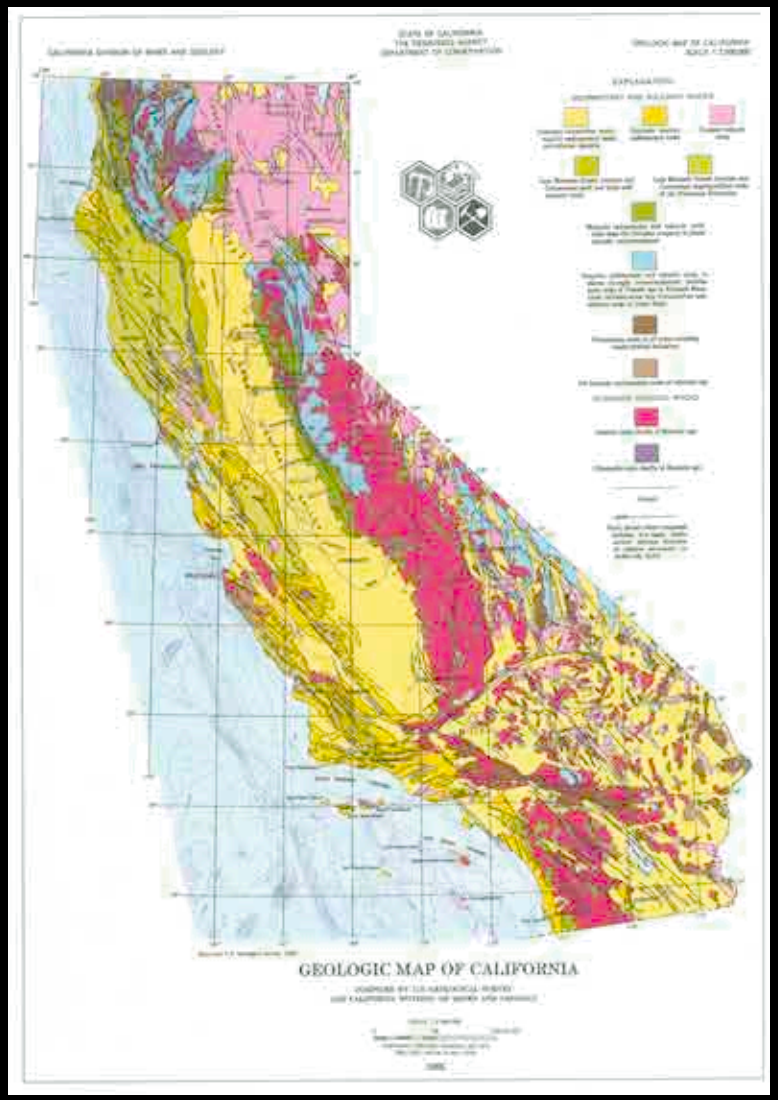
(4) Due to an on-going history of active rifting from southern Gulf of Ca to northern Walker Lane,

time and space transgressive processes can be observed -

Post breakup (Gulf) to new rift (Salton Trough) to rift initiation (Walker Lane)……..



…….across an array of continental crustal types with a variety of prior magmatic-tectonic histories.



Including Precambrian craton, Paleozoic passive margin, Paleozoic accreted terranes, Mesozoic to Cenozoic subduction margin.

(5) Outstanding exposure and preservation at the FULL RANGE OF STRUCTURAL LEVELS promoting interaction of a…

******Multidisciplinary team*******

that will be assembled and interact closely

in an

INTEGRATED AMPHIBIOUS APPROACH

e.g. volcanic and sedimentary basins, structural analysis, igneous and metamorphic petrology, deep-level magmatic processes, geochronology and isotope geochemistry,geophysical surveys of crust and mantle features, seismology, geodetics, active tectonics and surface dating, hyperspectral mapping of geology and alteration, economic geology, geothermal exploration, etc

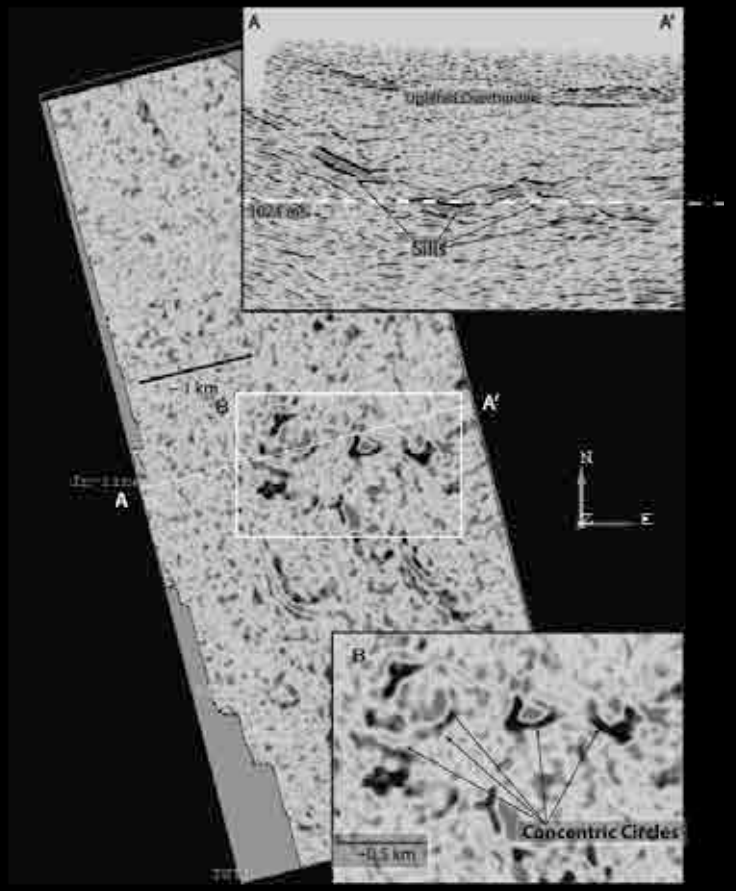
****THIS is what distinguishes us from core NSF*******

Attributes, continued:

(6) Active magmatism - evaluate volatile fluxes and sources; use new geochronologic techniques to date very young volcanic rocks and associated structures.

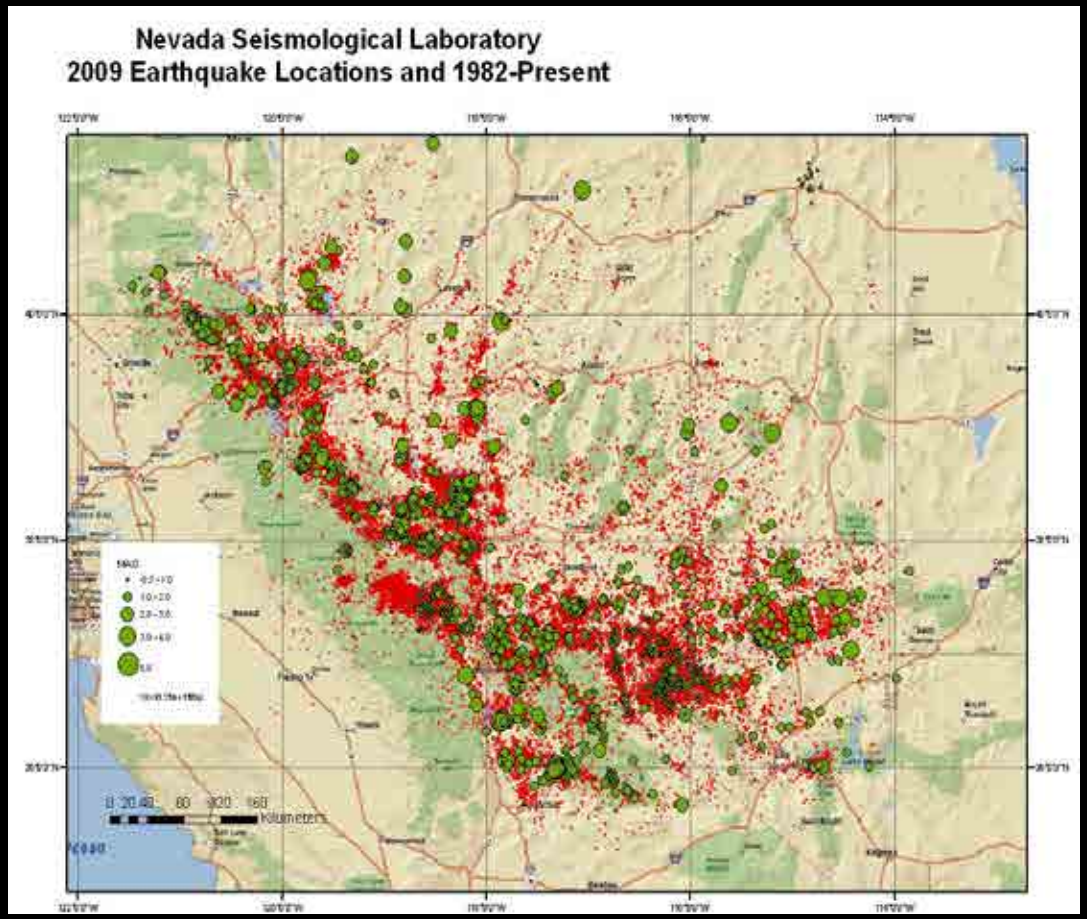
e.g. seismic reflection imaging

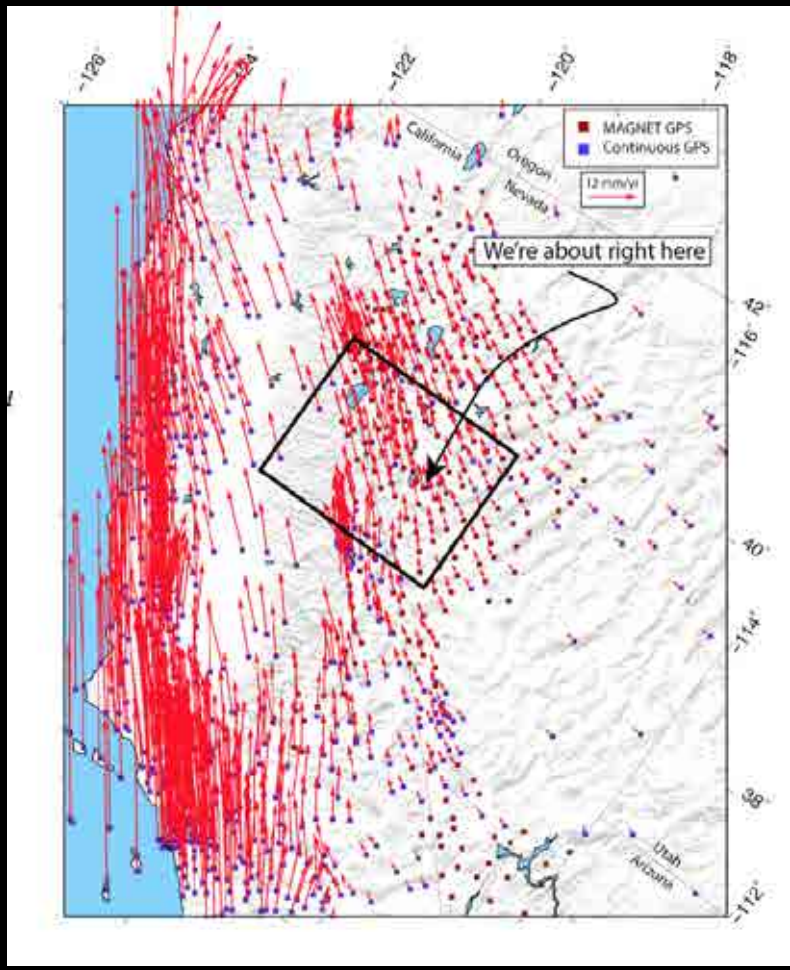
of mafic sills



(7) Magmatism over past >26 Ma - can determine longer-term fault motion rates with dateable volcanic stratigraphy.

(8) Active tectonism - real-time measurements with GPS and seismic monitoring, discovery of previously unmapped faults with LIDAR, dating of very young fault surfaces with new cosmogenic techniques.





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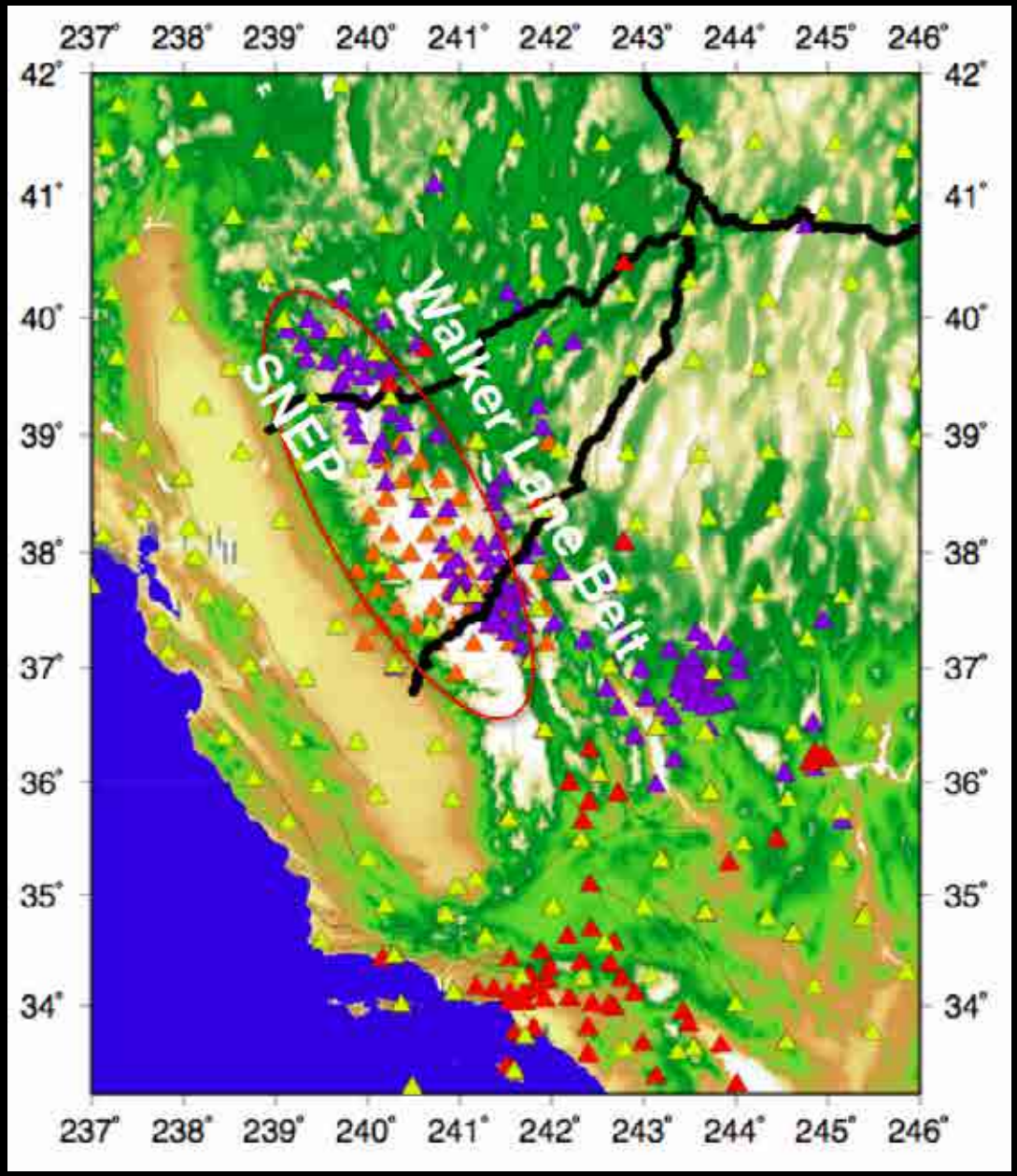


(9) Portable array data already available from Sierra Nevada -

need to

EXTEND THIS TO WALKER LANE RIFT SYSTEM

To determine the structure of the lower crust and upper mantle.

Attributes, continued:

(10) Intense geothermal exploration - $300 MILLION from DOE and Industry in Nevada over next 5 years - $20 MILLION in seismic alone -

societal impact (green energy) and leveraging from other funding agencies.

Coso Geothermal Field

MATRIX ITEM 1: Why does rifting occur - specifically, how do extensional forces exceed the yield strength of the lithosphere?

Determine relative importance of:

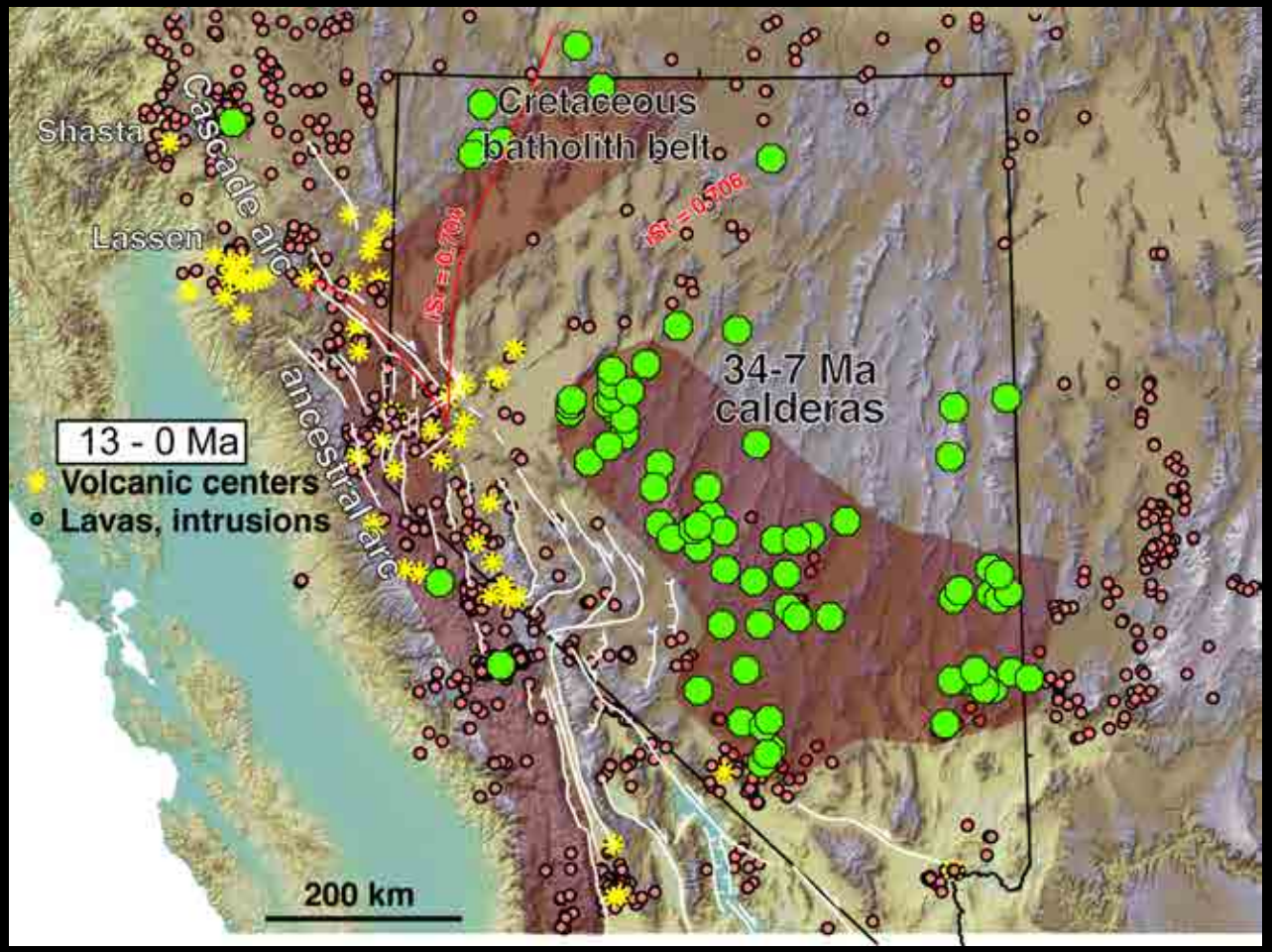
Regional forces:

1. Gravitational collapse of crust thickened in Sevier and Laramide orogenies (Paleocene)
2. Eocene to Miocene extension caused by slab rollback (Eocene to Miocene)
3. Change from subduciton margin to transform margin
4. Basin and Range extension due to growth of the San Andreas fault boundary (16 Ma-present)
5. Onset of transtension at ~12 Ma (due to change in Pacific plate motion)

Local body forces:

1. Positive and negative contributions of mantle buoyancy (e.g. root delamination, asthensopheric upwelling)

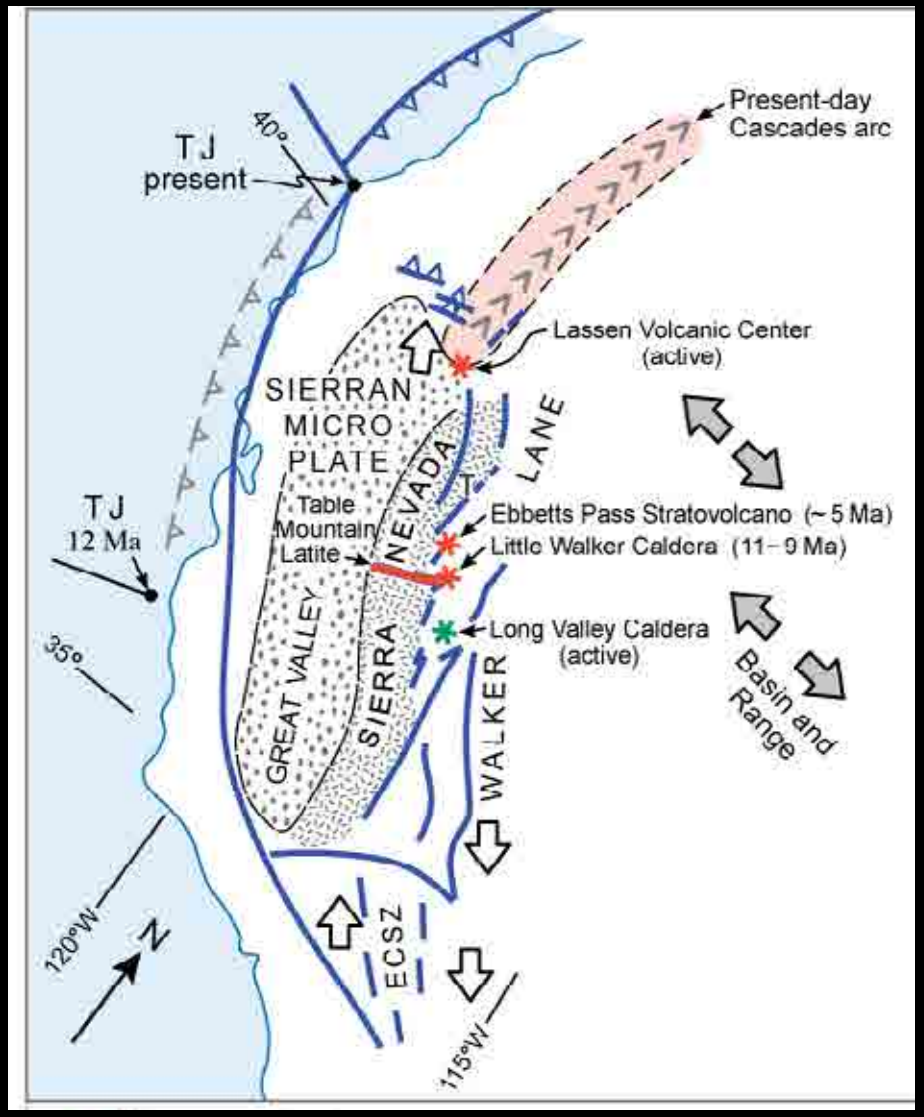
HYPOTHESIS: Walker Lane rift system formed between Cretaceous and mid-Cenozoic caldera batholithic belts (browns) - and cut through the Cretaceous batholith belt along the Ancestral Cascade Arc axis (orange dots).



Link with Cascadia

We are still discovering major volcanic centers and determining their tectonic controls…….

…but large volcanic centers appear to be located on transtensional stepovers:



ACTIVE:

Lassen arc stratovolcanic center

Long Valley rift caldera

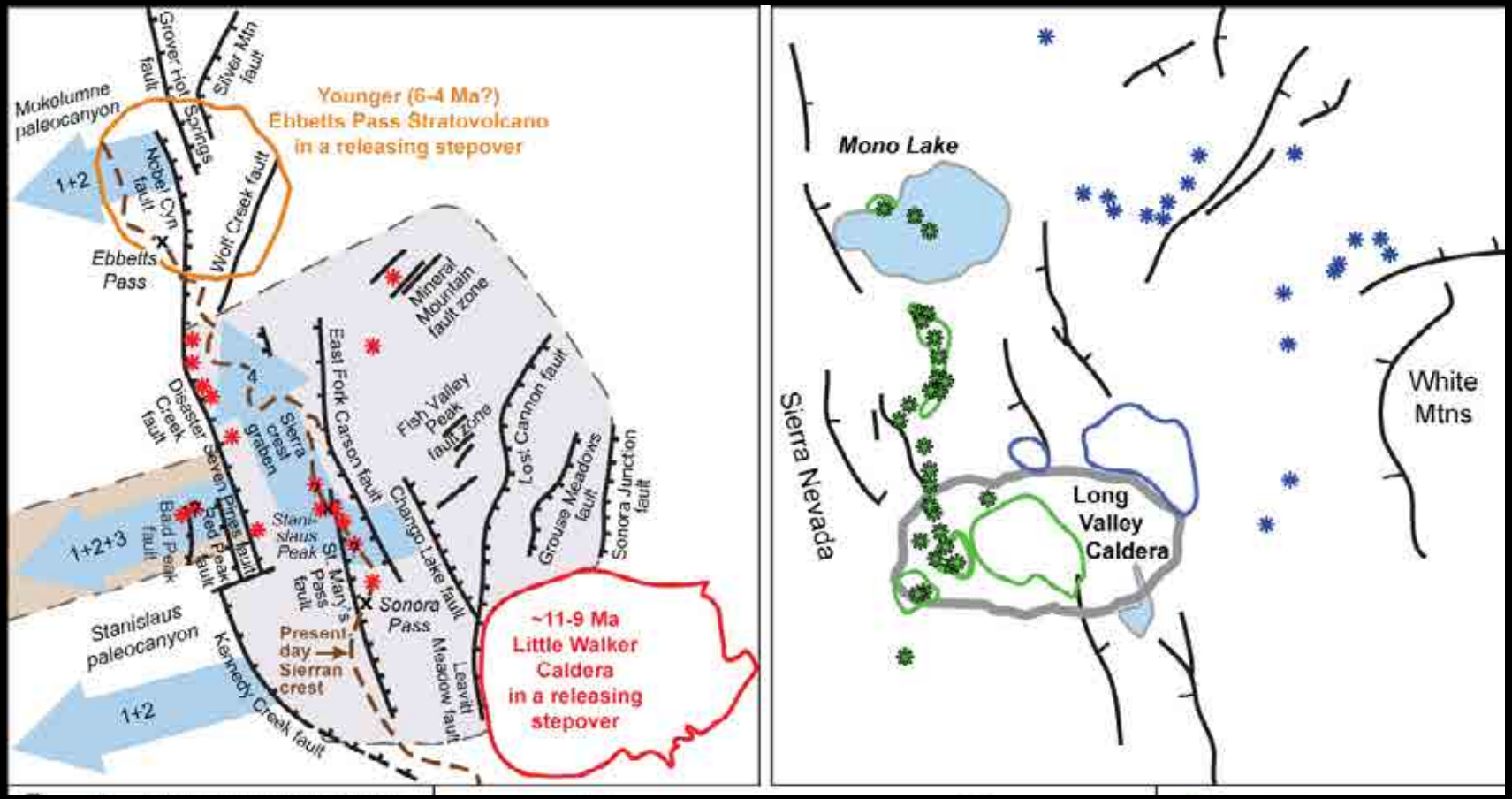
CENTERS NEWLY DISCOVERED:

Sierra Crest Graben Andesite Flood Lava Complex beneath Little Walker arc caldera (11 - 9 Ma)

Ebbetts Pass arc stratovolcanic center (5 Ma)

Miocene Little Walker Caldera (left) built atop grabens filled with fissure-fed flood andesite (lavender)

shown at same scale as the active Long Valley caldera (right)



NNW-SSE faults right transtensional, ENE-WSW faults left transtensional. Stars = vents.

STRATIGRAPHIC EXPRESSION OF RIFT INITATION

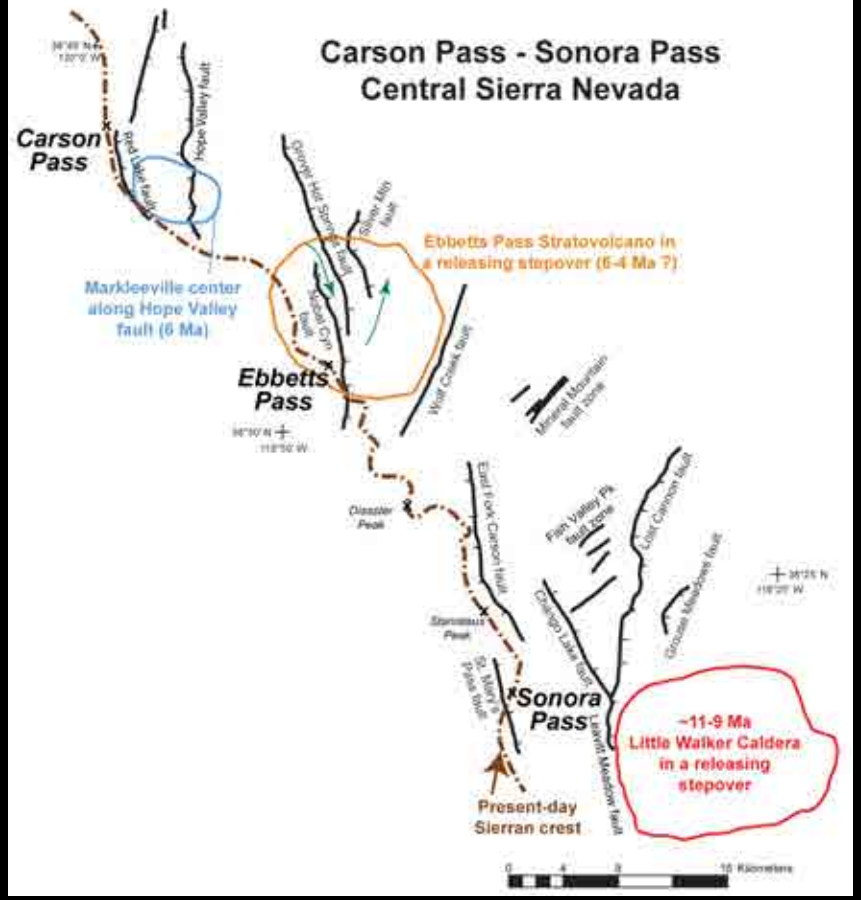
at ~12 Ma:

Extreme effusive eruptions of “flood andesite”

and

unusually large-volume, widespread landslide deposits

(Busby et al. in review)



Another major volcanic center sited on transtensional stepover:

Newly-discovered

5 Ma

Ebbetts Pass Stratovolcano

(Busby et al., unpublished data)

MATRIX ITEM 3: What controls the architecture of rifts and rift margins? SEDIMENTARY BASIN Outcrop and Lake Studies

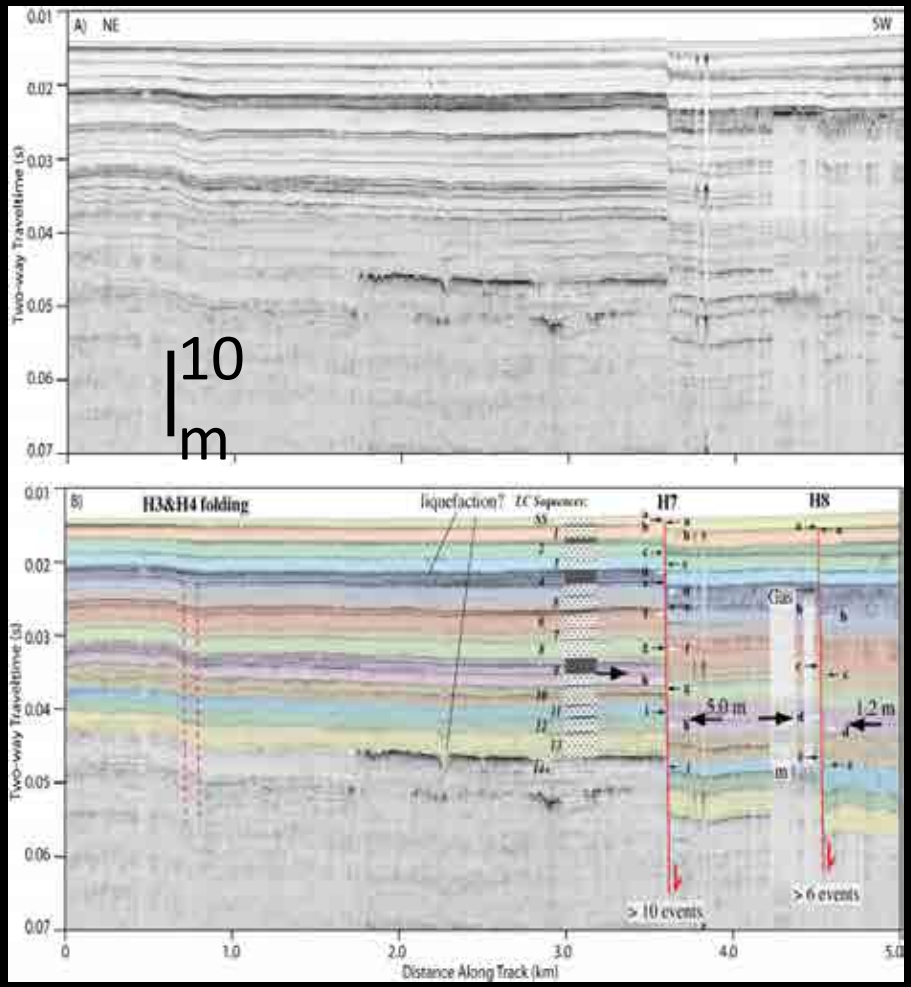
Great variety in:

drainage area sizes/bedrock geology/erosional processes

basin ages, sizes and structures, sedimentation rates, fault movement histories and paleoseismicity records

hazards record from landslides and seiches

paleoclimate record from outcrop and dill core



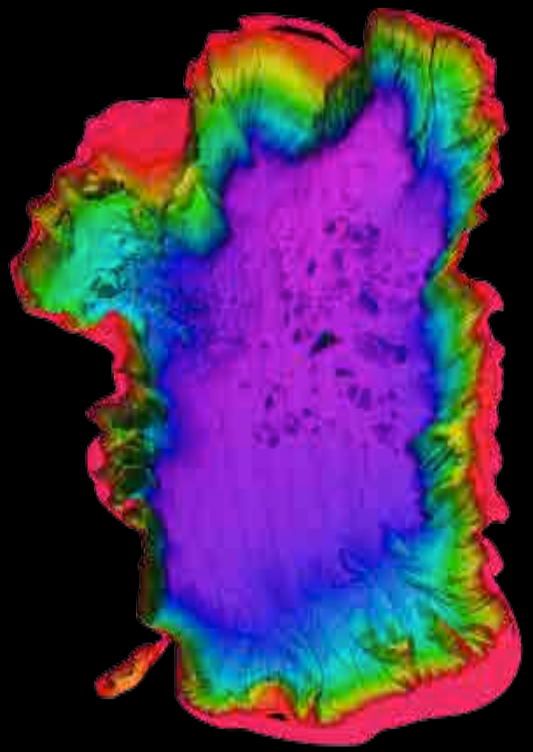
Salton Sea

Lake Tahoe/Pyramid Lake to Salton Sea to Gulf of CA:

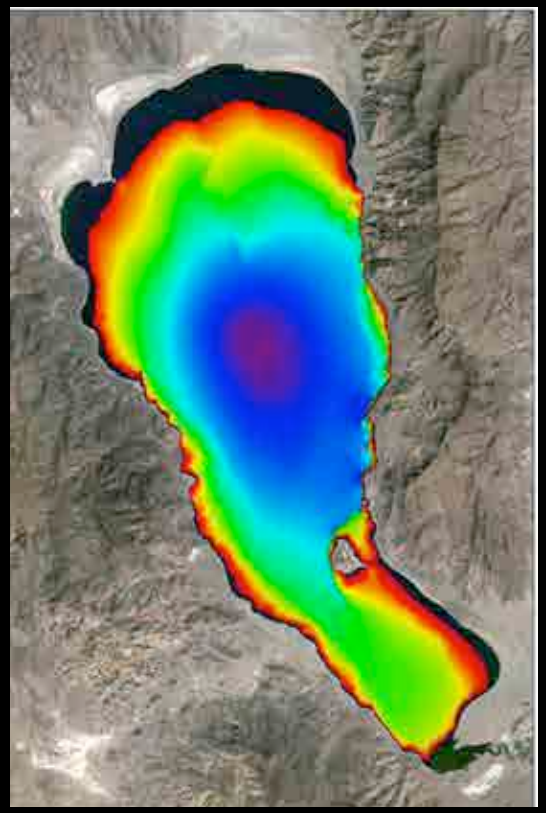
High resolution studies of modern lakes and the dissected deposits of Pleistocene pluvial lakes

Influence of Sedimentation on Rift Development

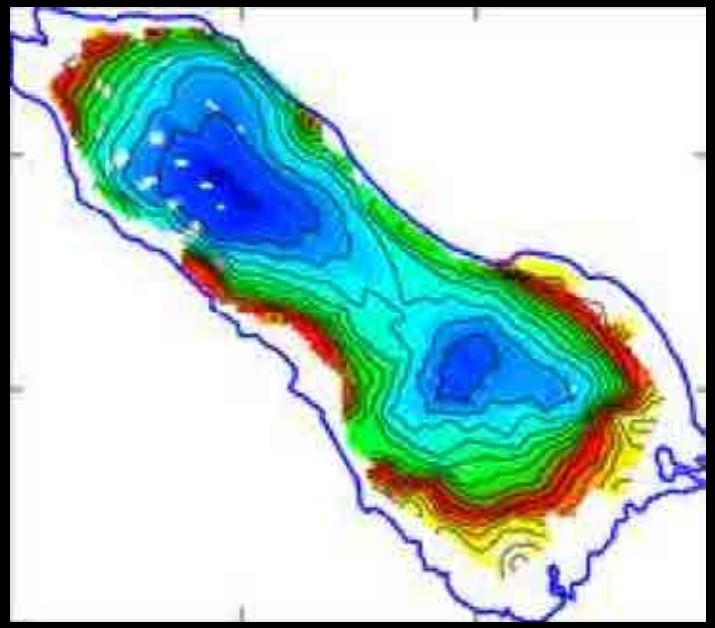
Lake Tahoe



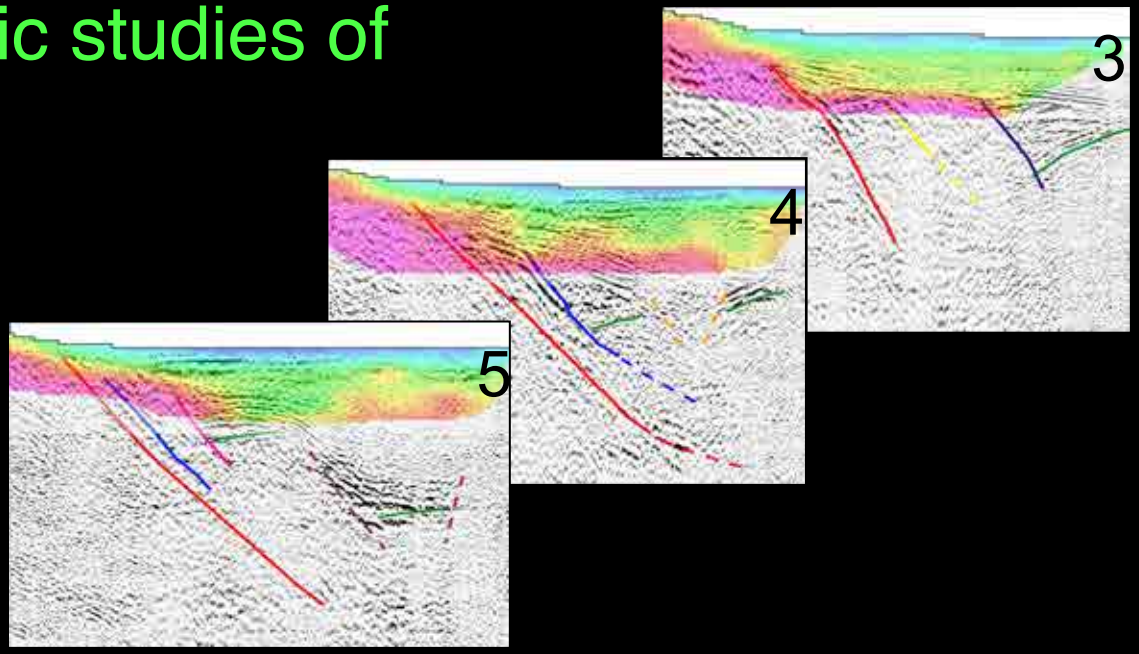
Pyramid Lake



Salton Sea

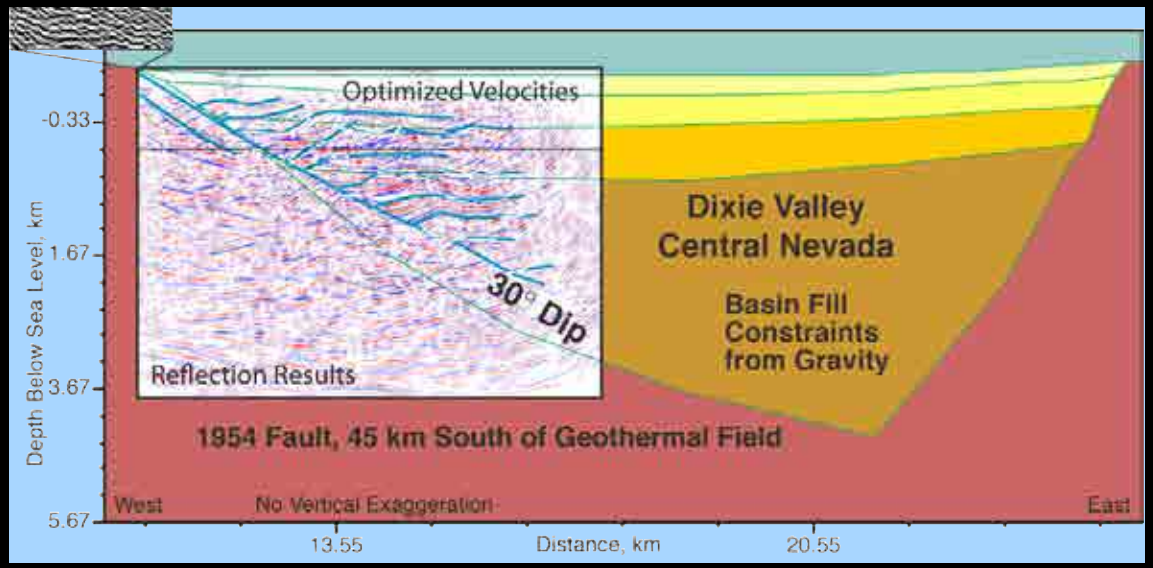


Examples of Seismic studies of basin architecture



Only the range-front fault breaks the surface

A fault that has been active at low angle since 23 Ma



WE PROPOSE A

U.S. RIFT PROGRAM

to interface with Cascadia

By comparing rift initiation in the Walker Lane and Rio Grande rift systems

with the successful Gulf of CA rift

and the Mississippi Valley failed rift and the "mature" East Coast rift