Observations of the February 27, 2010 M8.8 Chile Earthquake

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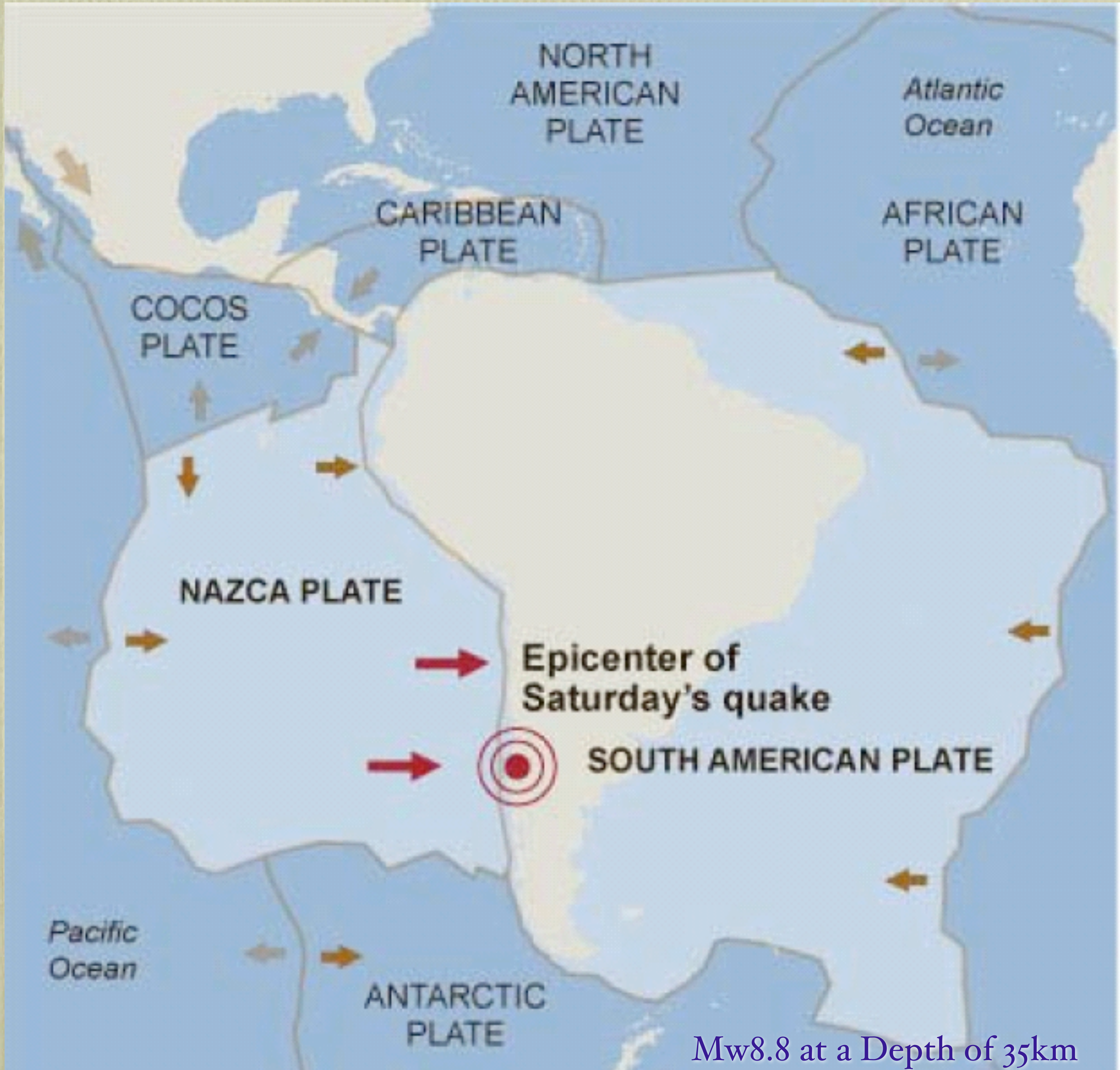
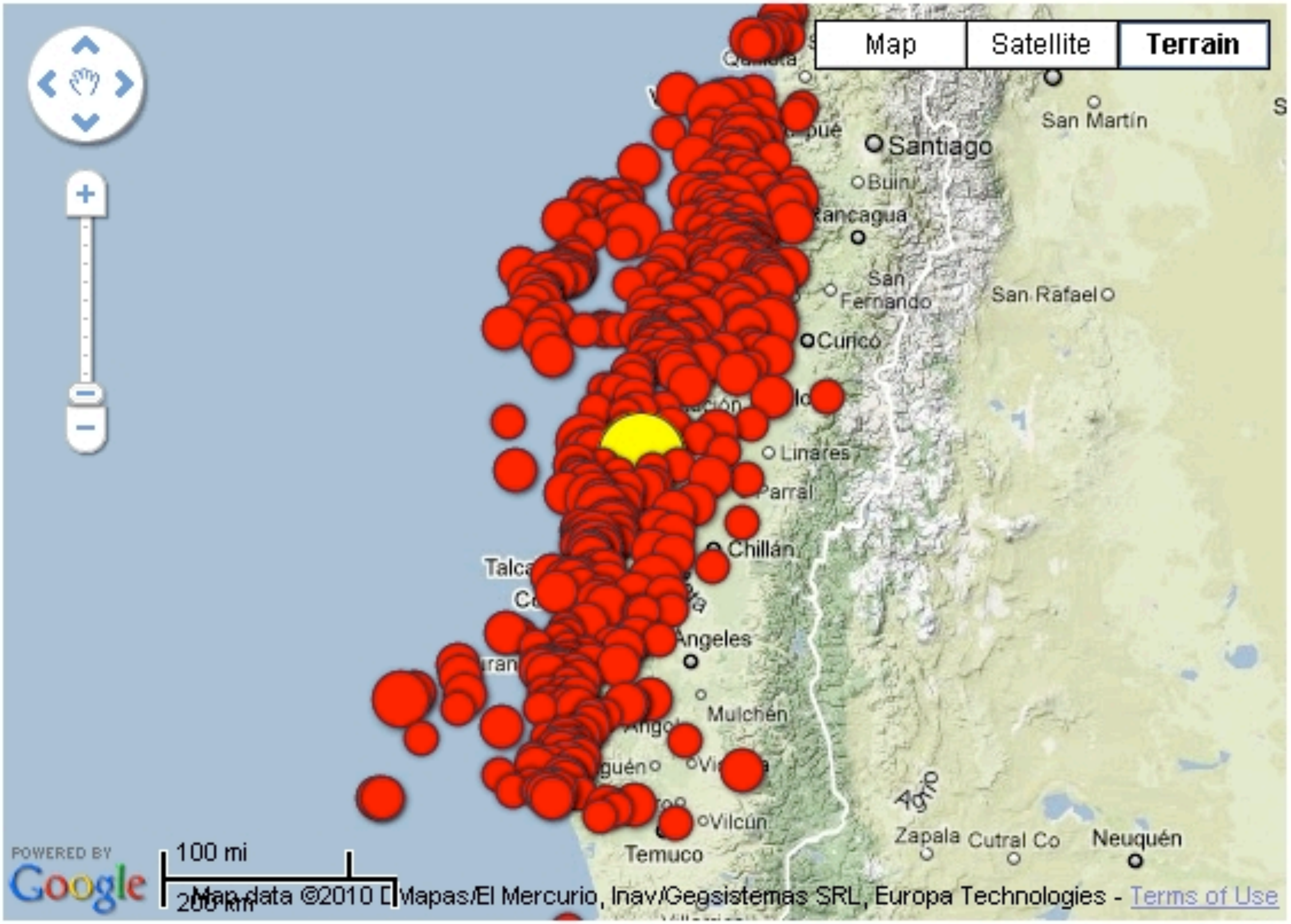
Keith I. Kelson, Fugro-WLA (primary author)

Updated March 31, 2010


NORTH AMERICAN PLATE
Atlantic Ocean
CARIBBEAN PLATE
AFRICAN PLATE
COCOS PLATE
NAZCA PLATE
Epicenter of Saturday's quake
SOUTH AMERICAN PLATE
Pacific Ocean
ANTARCTIC PLATE
Mw8.8 at a Depth of 35km

Aftershock Map - Mainshock and 421 Aftershocks

Last Updated: 18 March 2010, 20:57:06 UTC




```
 Best Double Couple:Mo=1.8*10**22
  NP1:Strike= 14 Dip=19 Slip= 104
  NP2:        179     71        85

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```

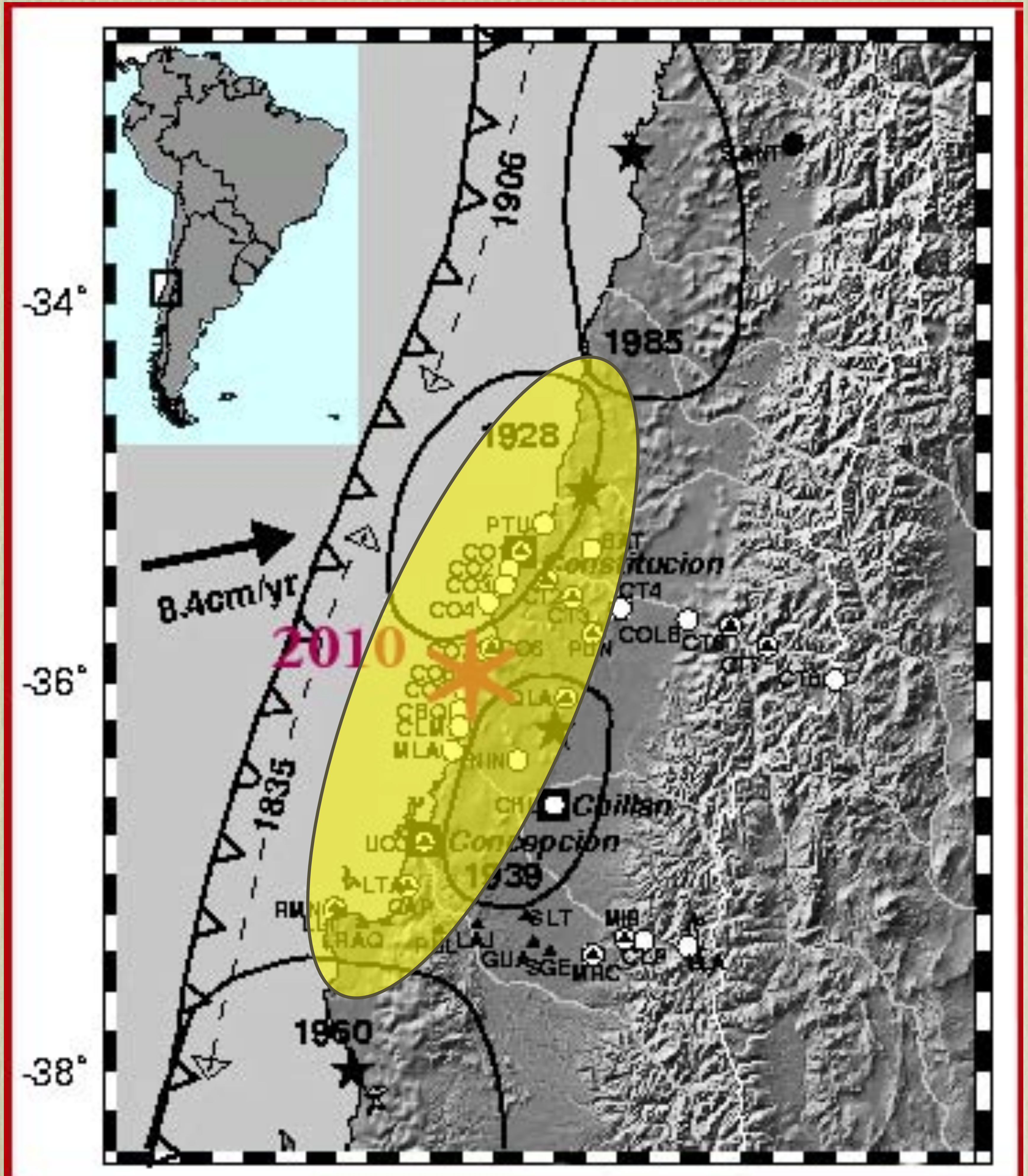
Legend

This aftershock map was manually generated for the event. It includes the mainshock and aftershocks at the time of the las
information may be out of date.

1985-M8.0

Previous Events - Seismic Gap

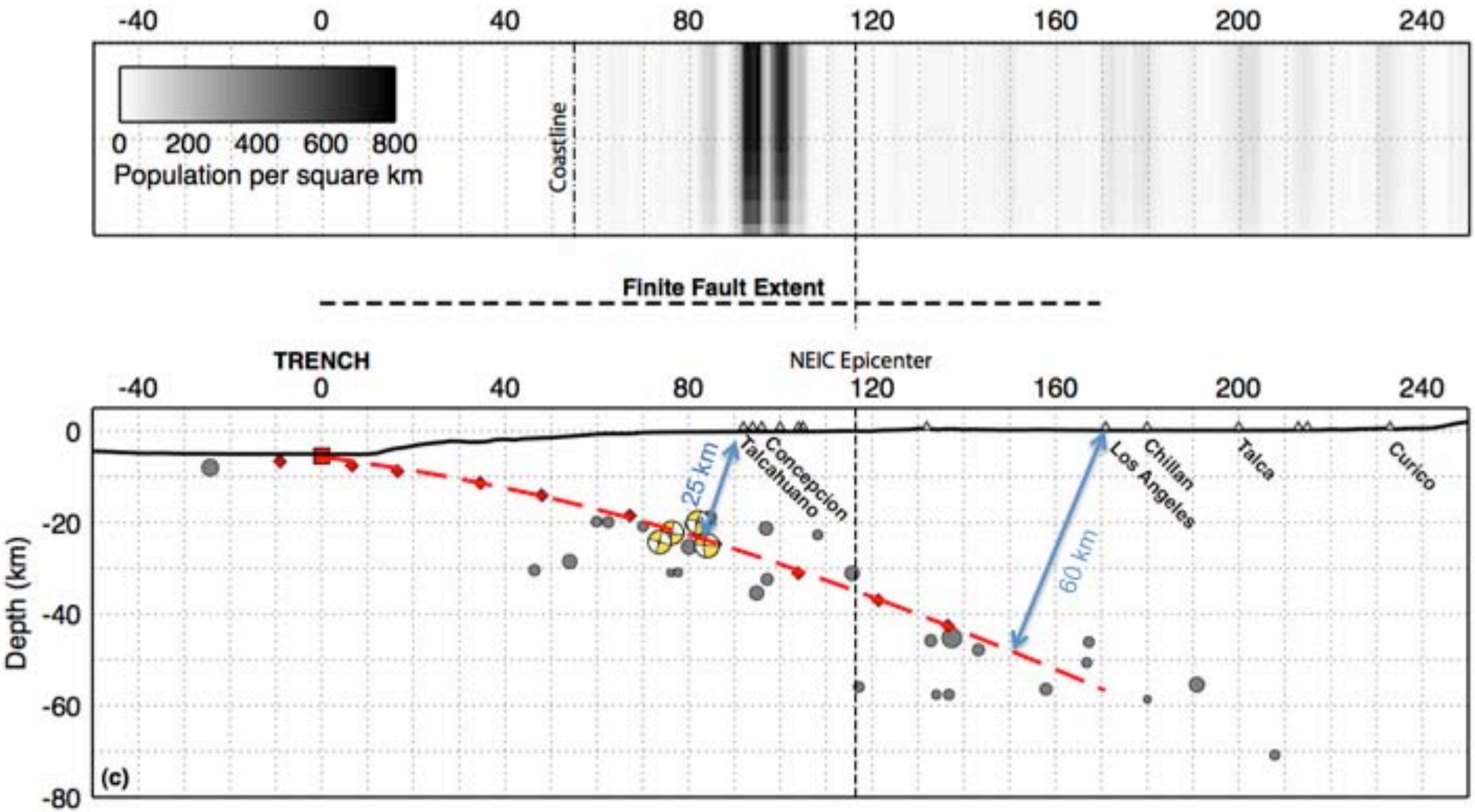
1960-M9.5



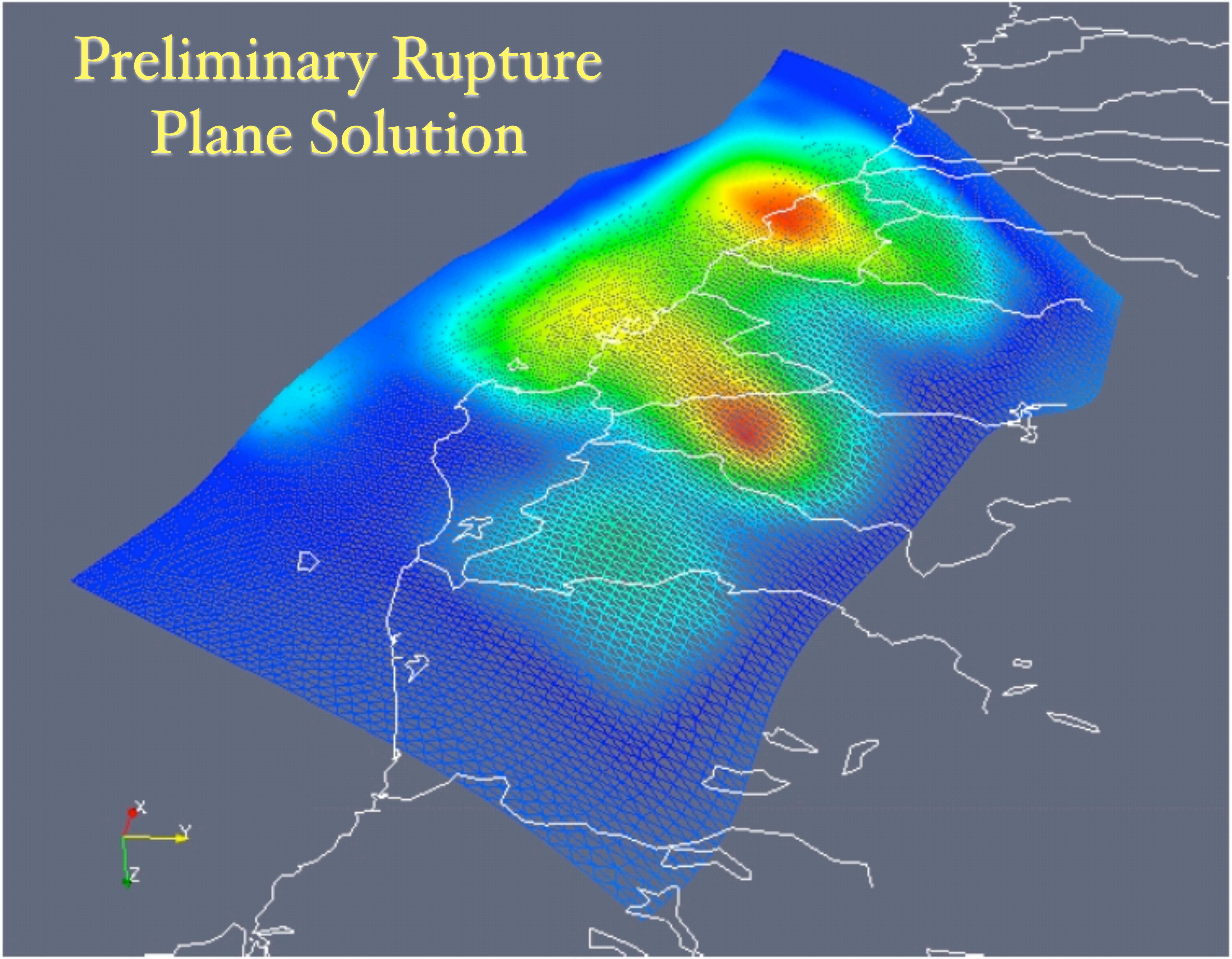
USGS

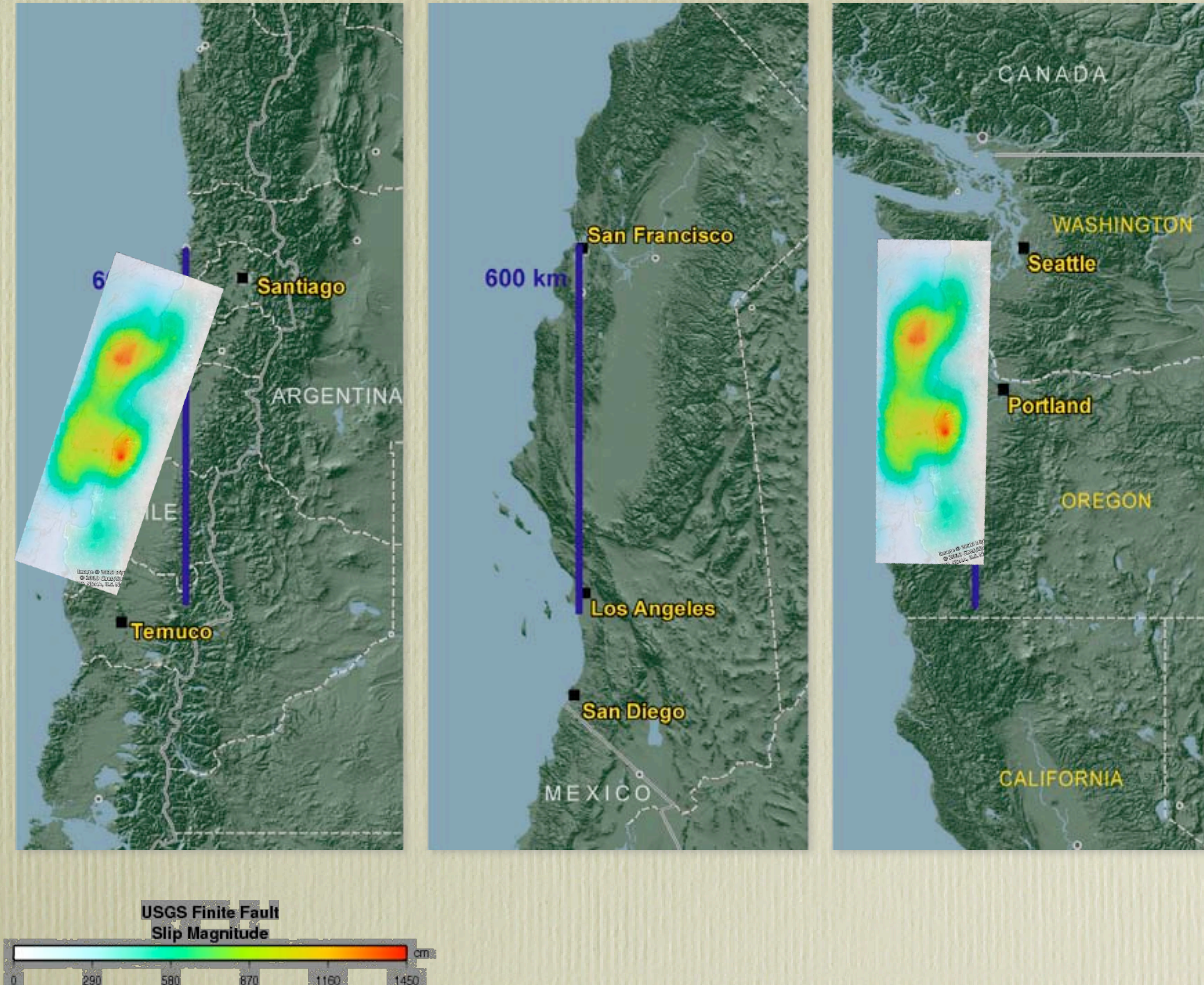
Chile Earthquake: Depth extent of faulting

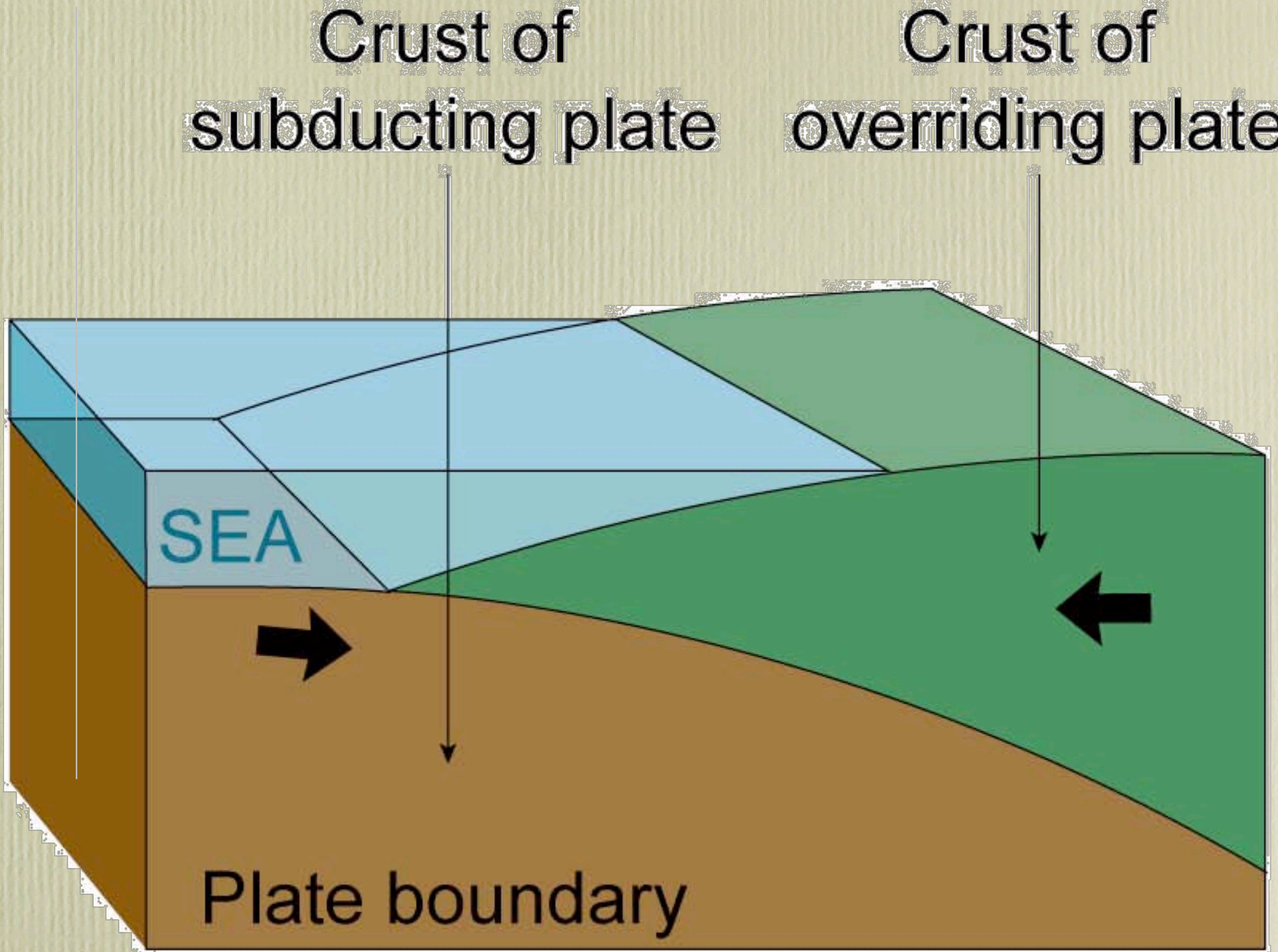
Closest cities to fault that slipped is about 25 km:



Preliminary Rupture Plane Solution

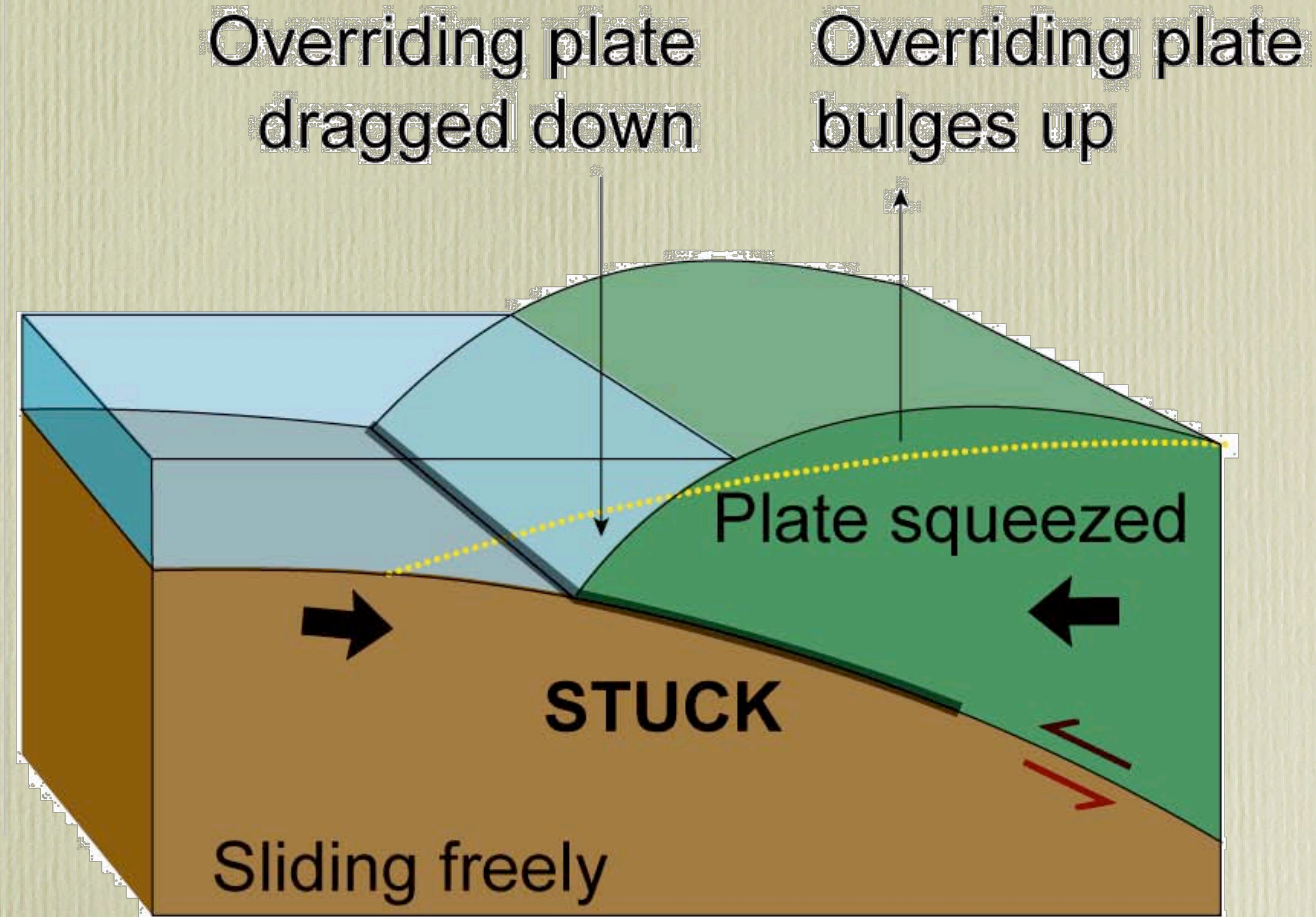



Santiago
ARGENTINA
Temuco
San Francisco
600 km
Los Angeles
San Diego
MEXICO
CANADA
WASHINGTON
Seattle
Portland
OREGON
CALIFORNIA
USGS Finite Fault
Slip Magnitude
cm
0
290
580
870
1160
1450



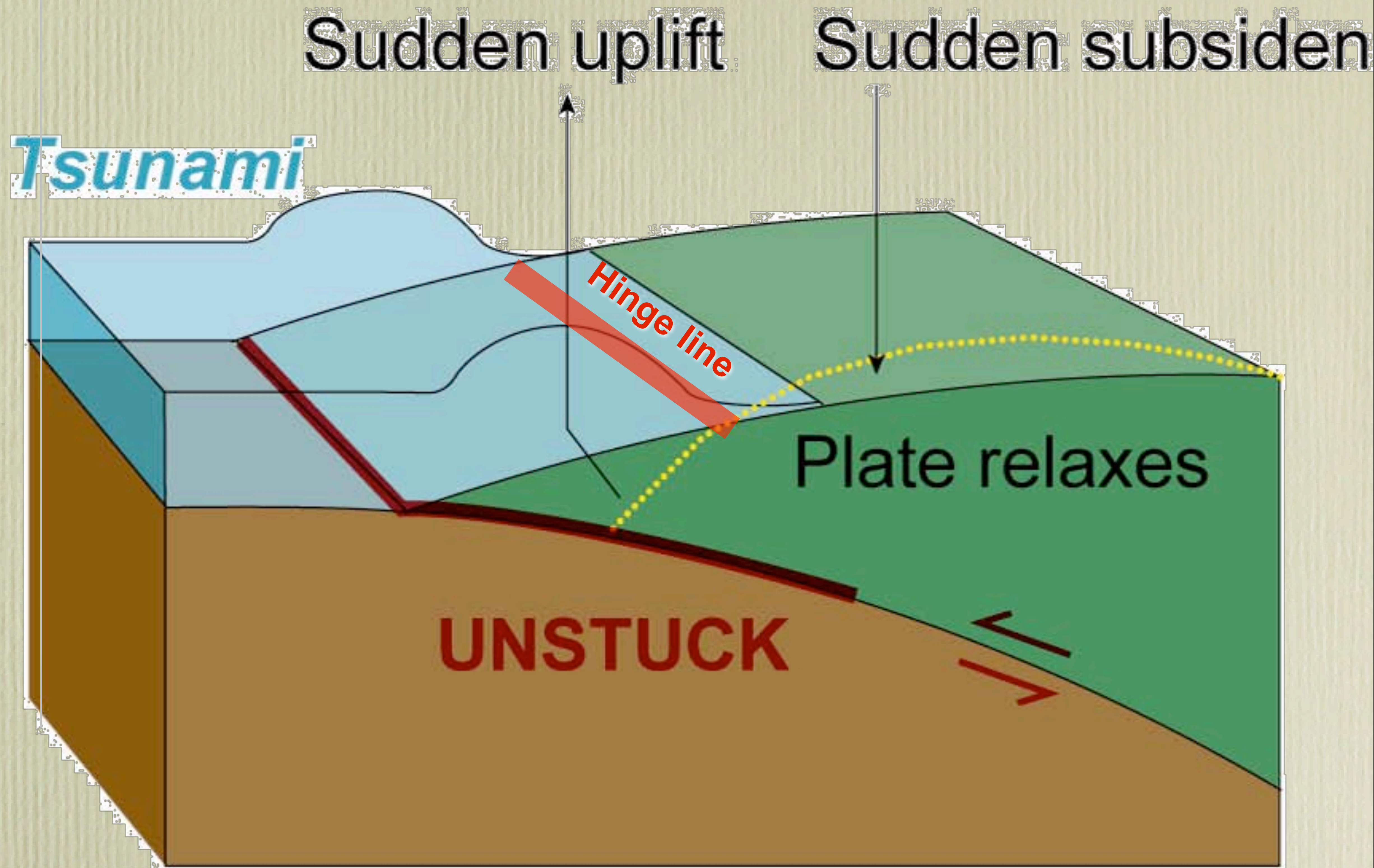
OVERALL, a tectonic plate descends, or "subducts," beneath an adjoining plate. But it does so in a stick-slip fashion.

After Atwater et al. (2005)



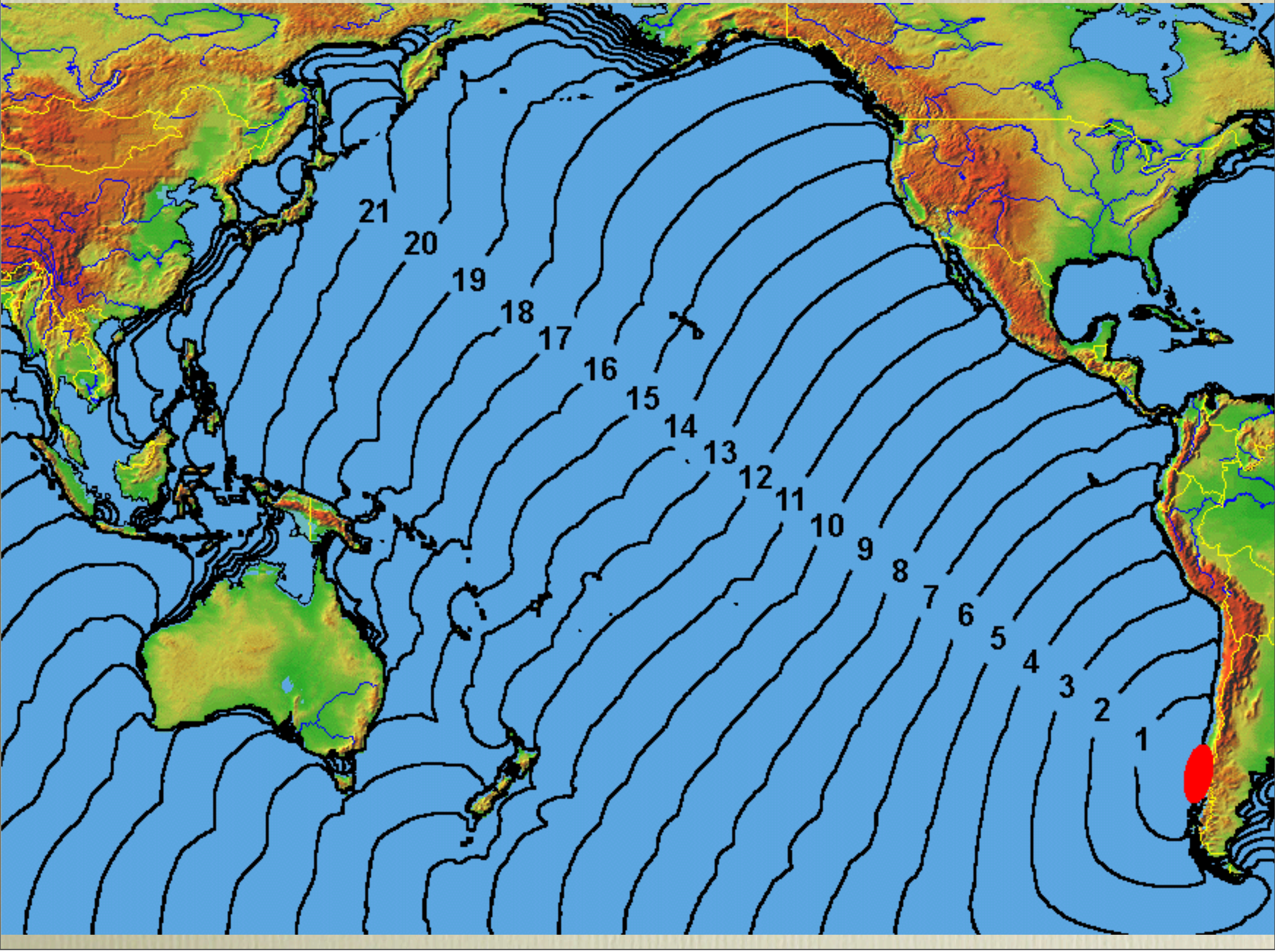
BETWEEN EARTHQUAKES the plates slide freely at great depth, where hot and ductile. But at shallow depth, where cool and brittle, they stick together. Slowly squeezed, the overriding plate thickens.

After Atwater et al. (2005)



DURING AN EARTHQUAKE the leading edge of the overriding plate breaks free, springing seaward and upward. Behind, the plate stretches; its surface fails. The vertical displacements set off a tsunami.

After Atwater et al. (2005)


21
20
19
18
17
16
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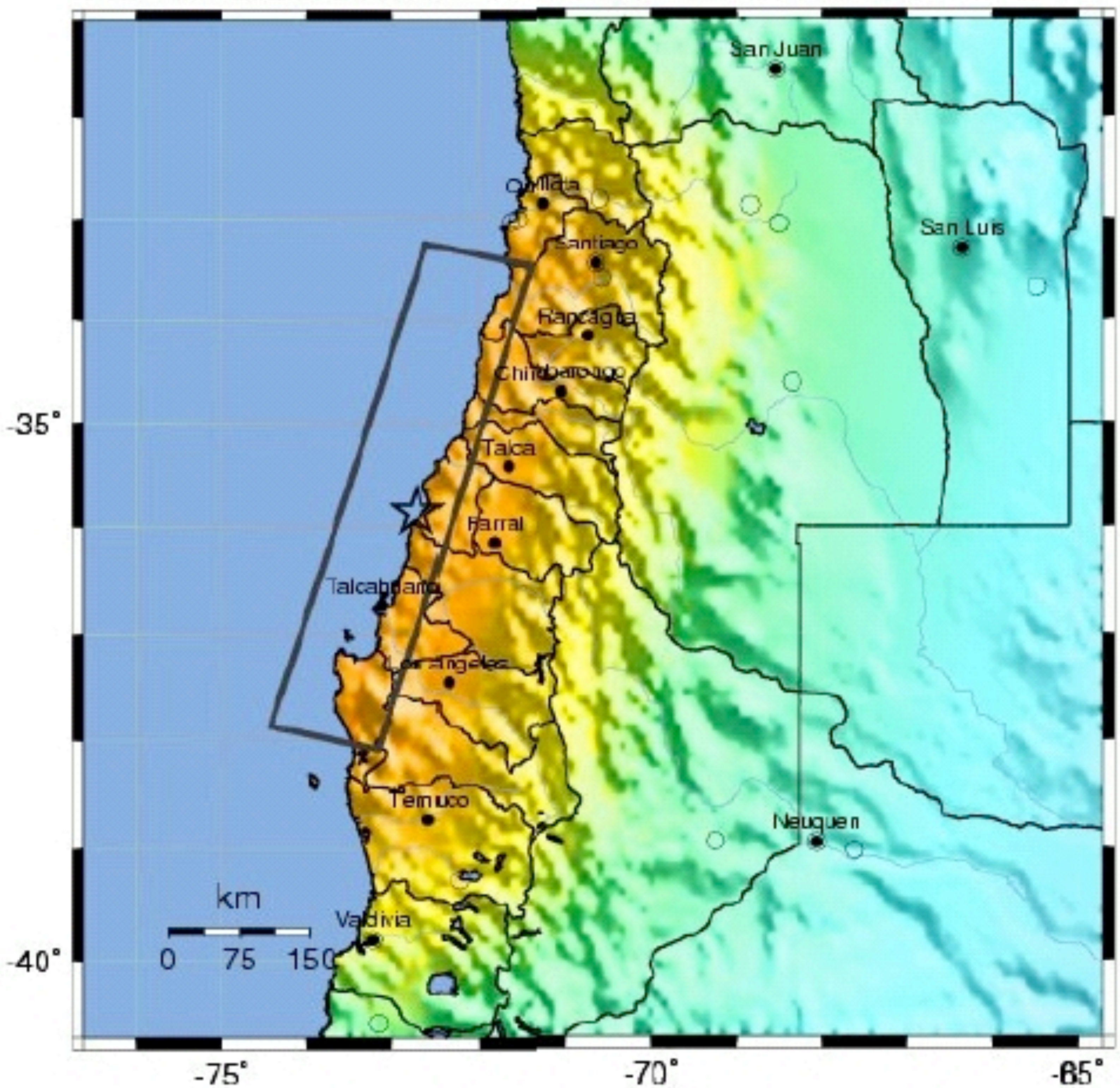
12
11
10
9
8
7
6
5
4
3
2
1

USGS ShakeMap : OFFSHORE MAULE, CHILE

Sat Feb 27, 2010 06:34:14 GMT M 8.8 S35.85 W72.72 Depth: 35.0km ID:2010tfan



Map Version 6 Processed Sat Feb 27, 2010 01:40:36 PM MST -- NOT REVIEWED BY HUMAN

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

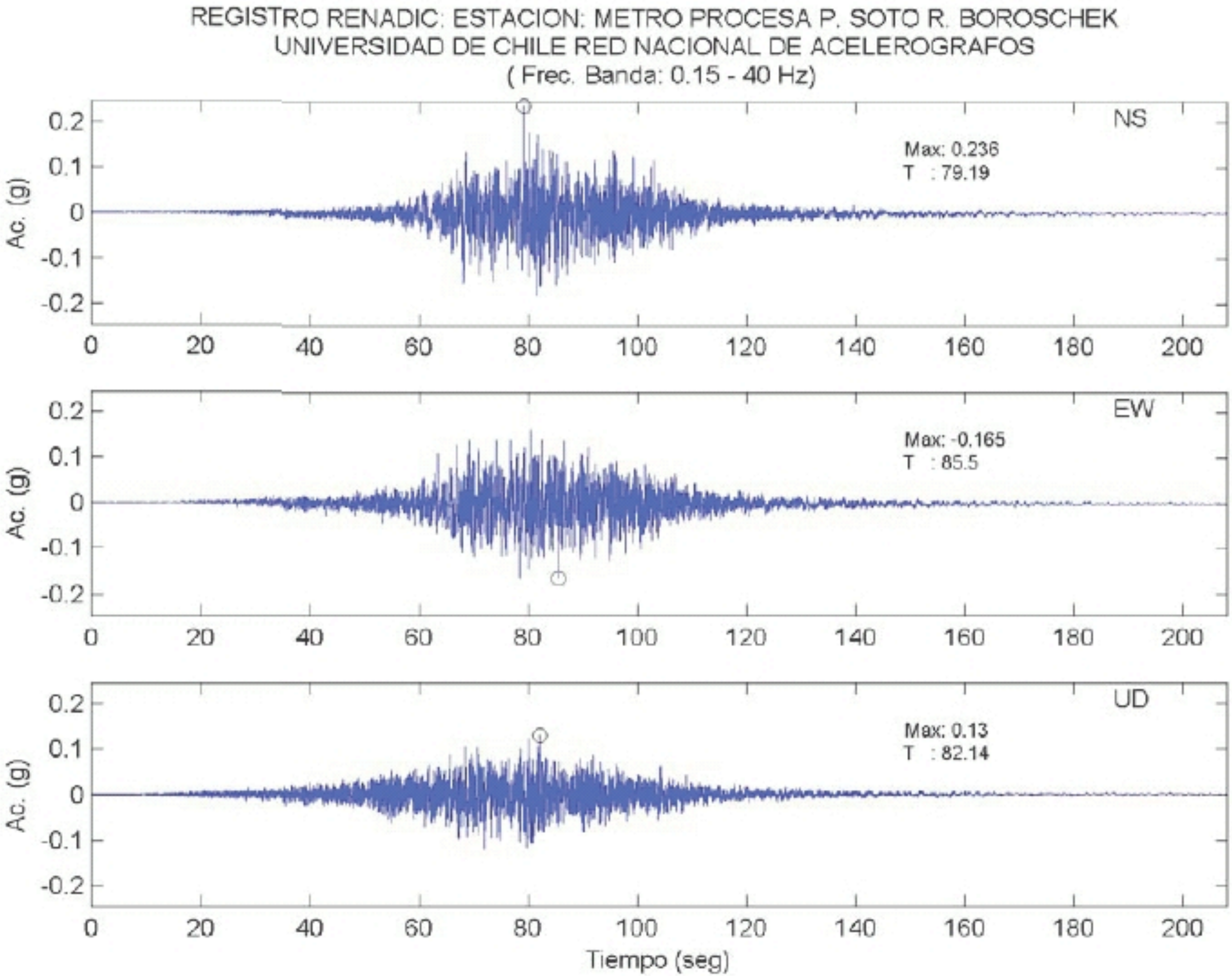


Figura 4 **Registro de Aceleraciones Estación Metro Mirador Santiago.**

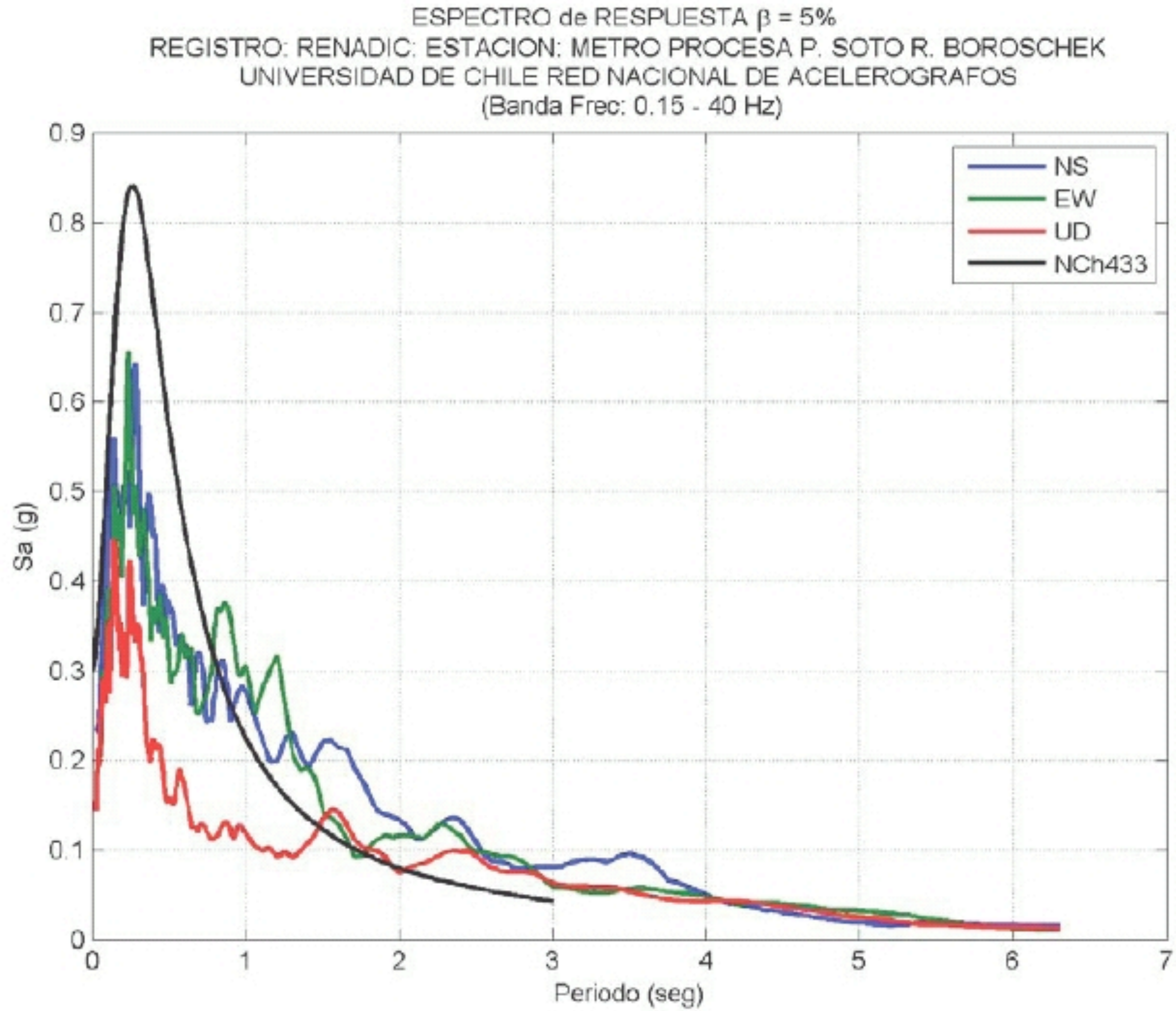


Figura 6 **Comparación Espectro de Diseño Norma Chilena NCh433 – Estación Metro Mirador Santiago.**

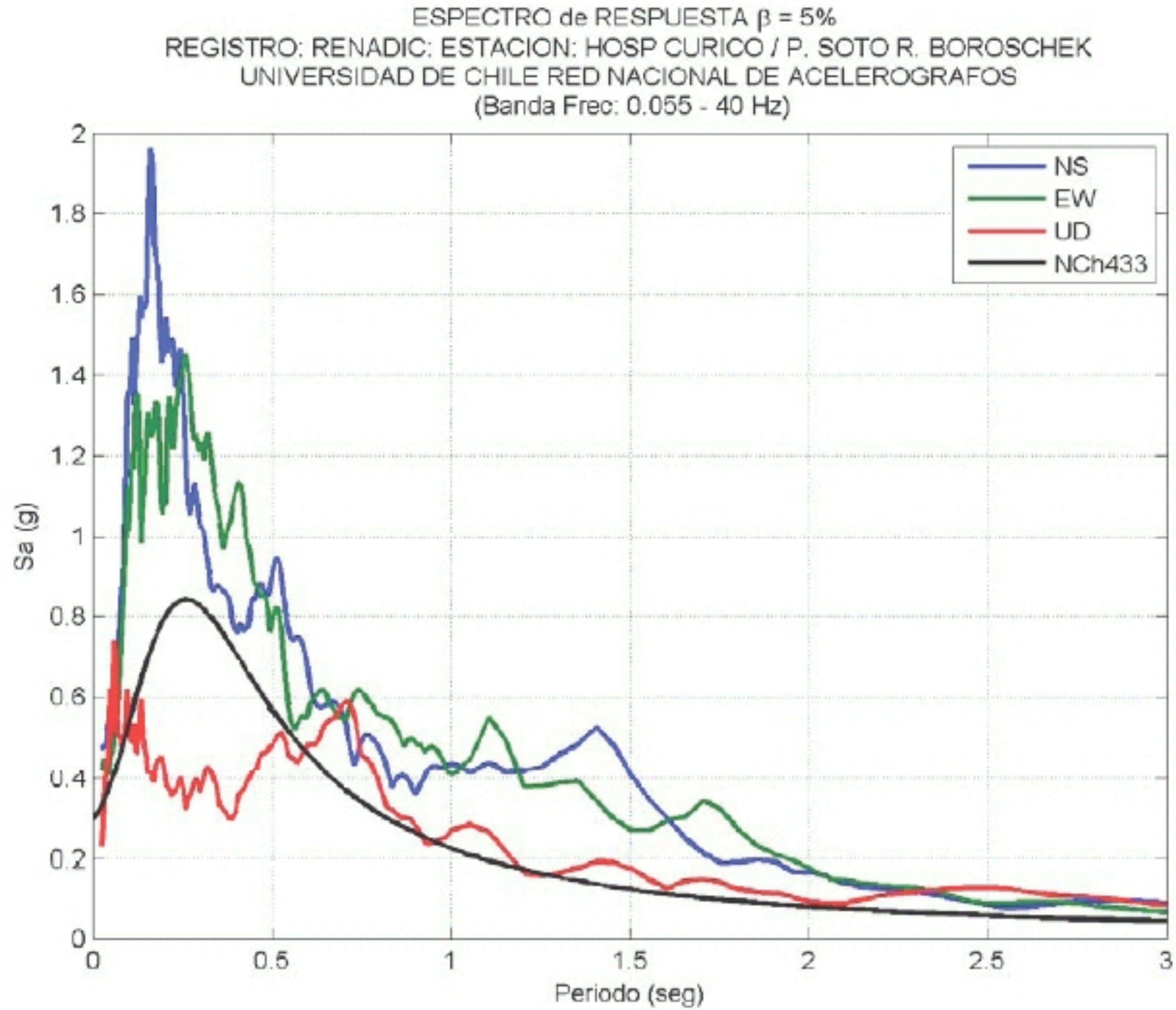
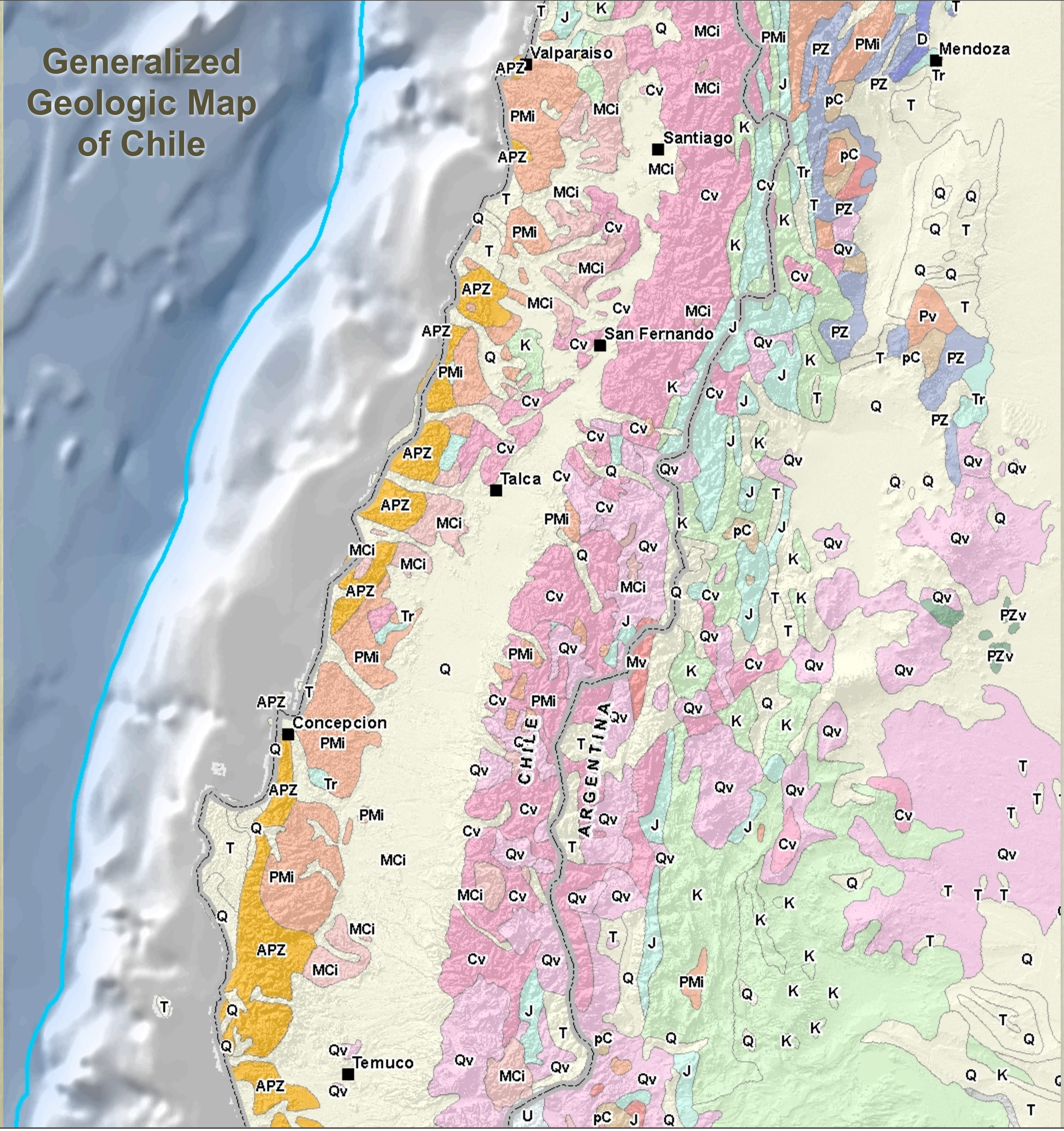
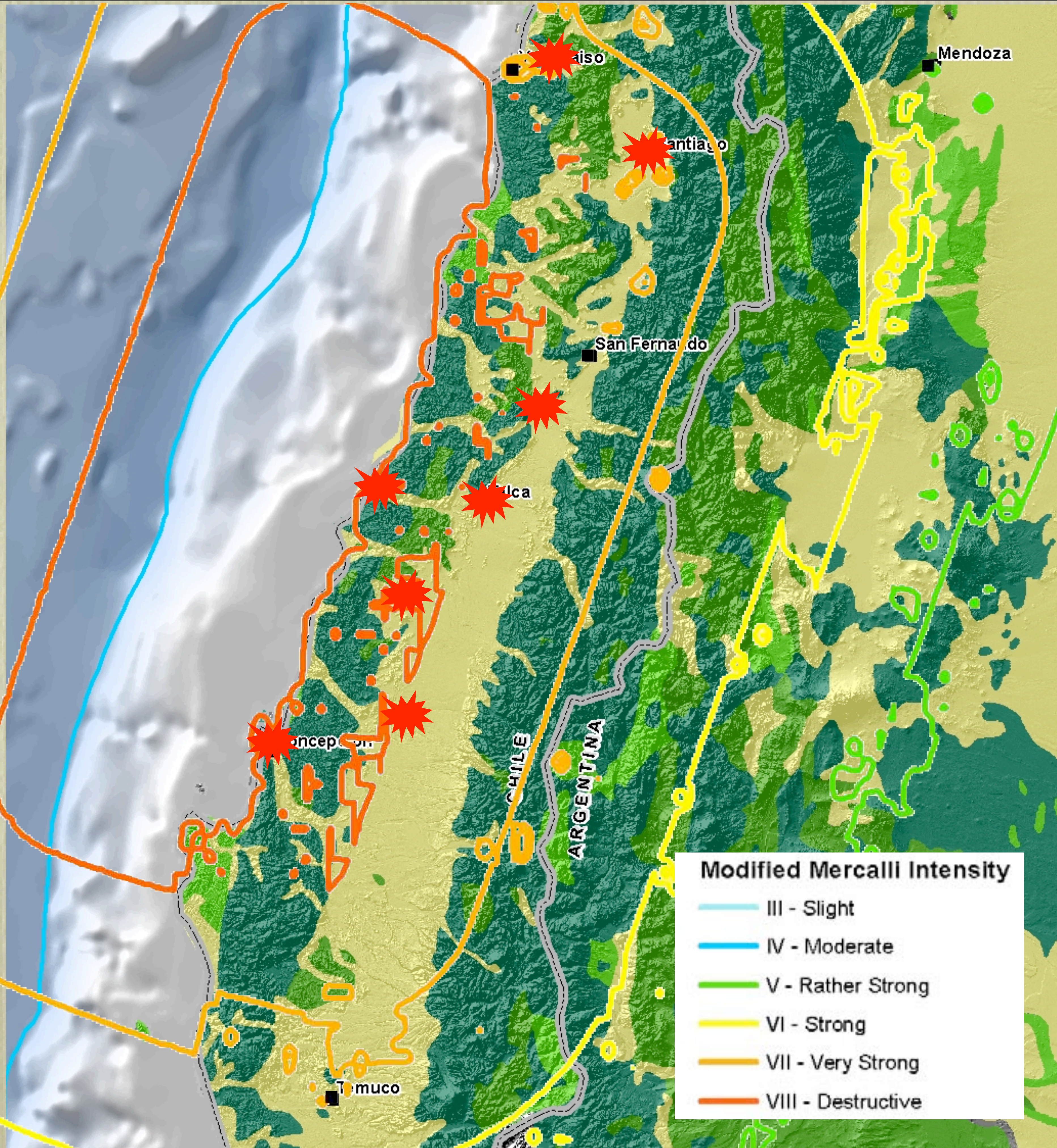


Figura 18 **Comparación Espectro de Diseño Norma Chilena NCh433 – Estación Hospital Curico.**

Generalized Geologic Map of Chile

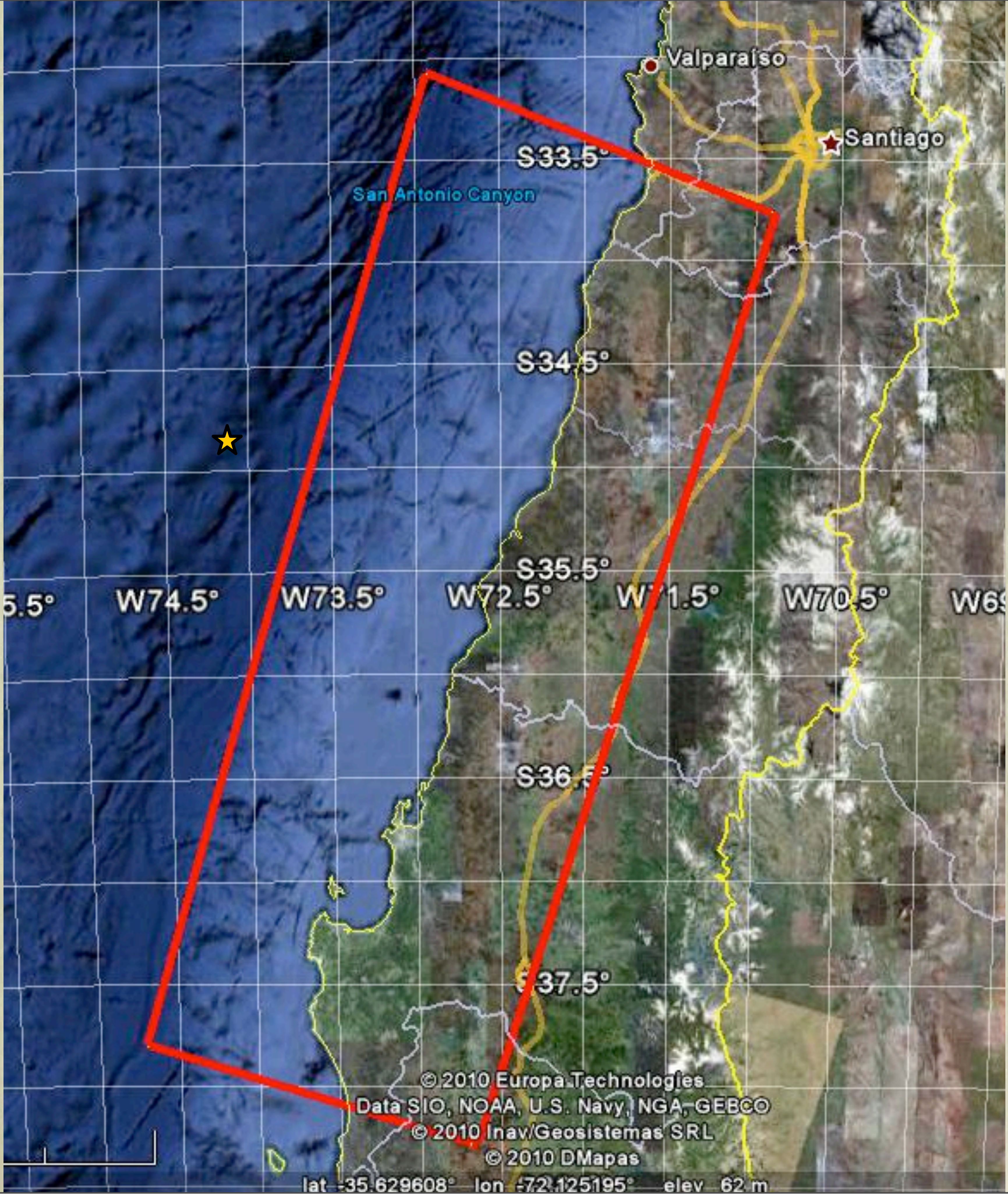



Mendoza
CHILE
ARGENTINA
Modified Mercalli Intensity
III - Slight
IV - Moderate
V - Rather Strong
VI - Strong
VII - Very Strong
VIII - Destructive

GEER Reconnaissance

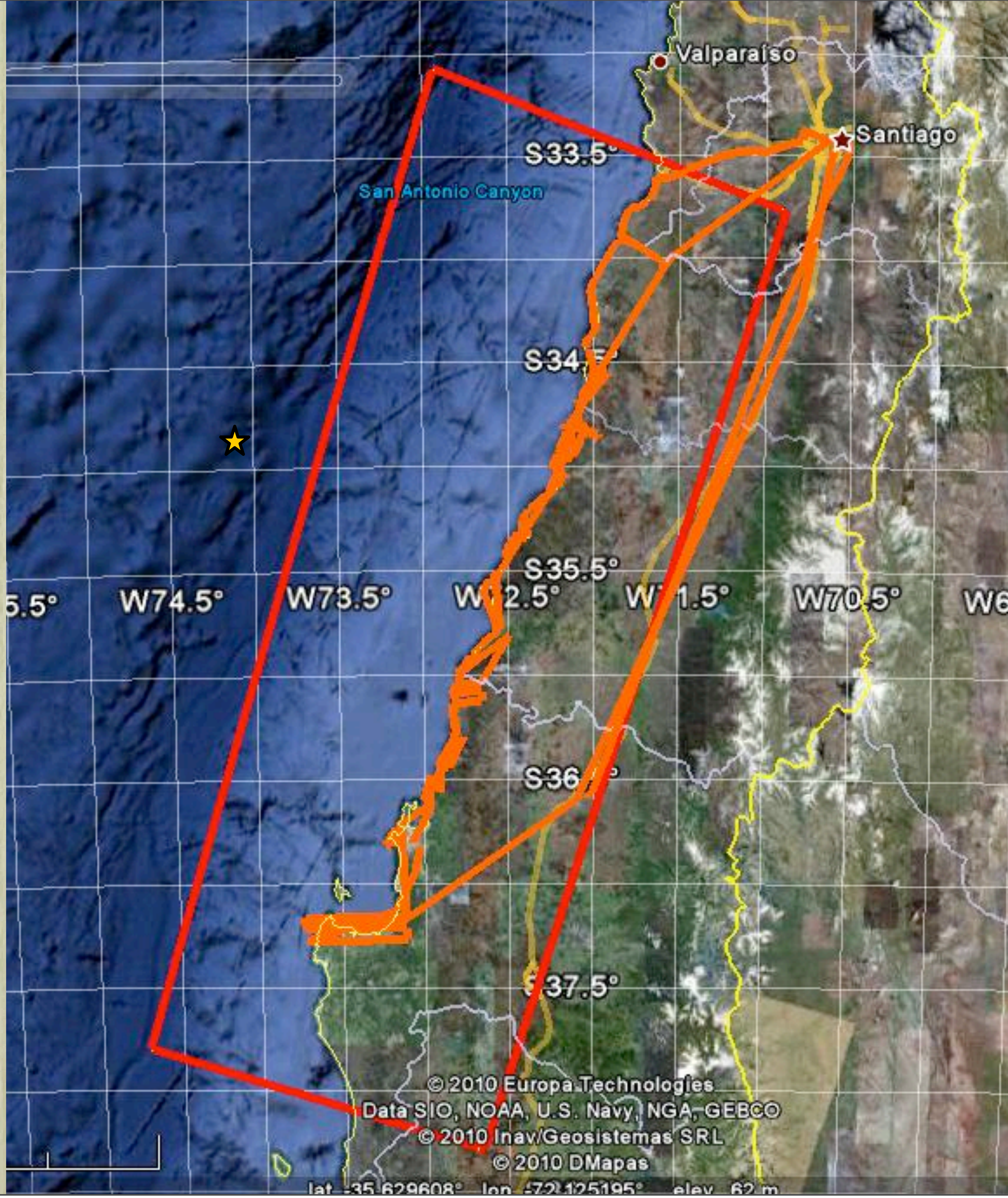
- Joint US/Chile effort seed-funded by NSF
- Expert Group of >30 academics and professionals
- Goal: acquire perishable data for immediate and future use
- Teams (A, B, and C) staggered over weeks/months
- Information freely shared and openly published

Rupture Plane



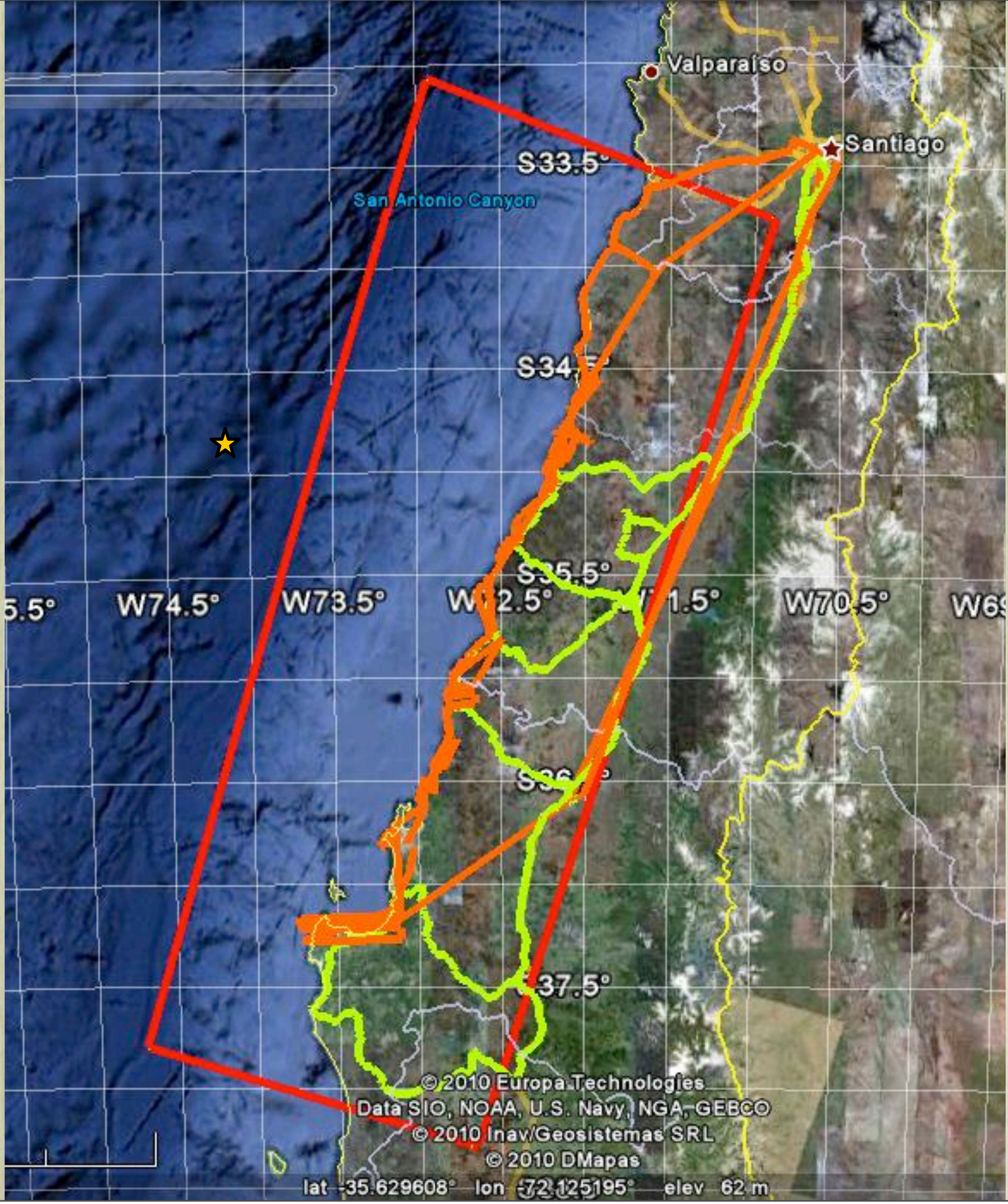
Rupture Plane

Strong Motion Stations



Rupture Plane

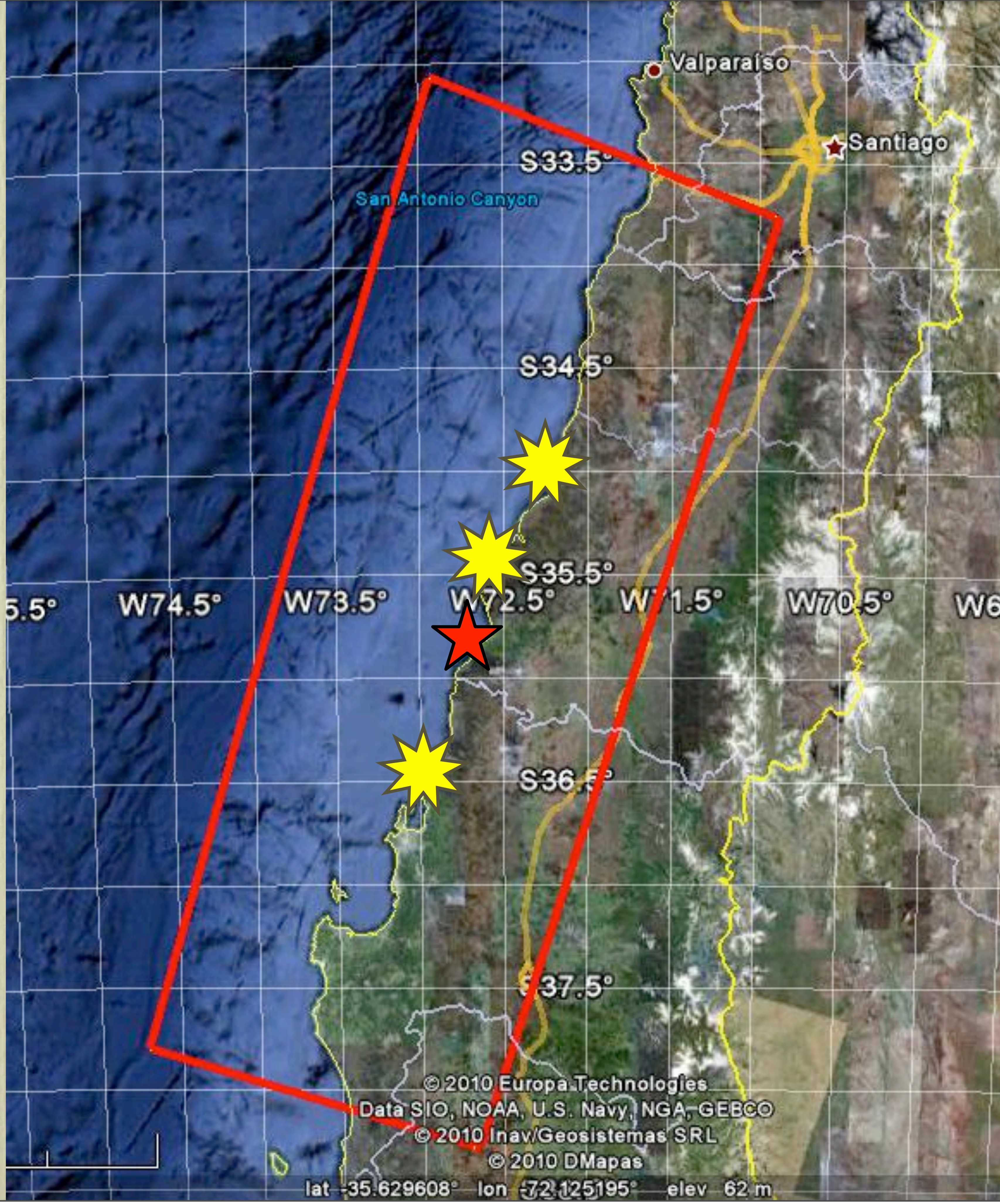
Aerial Recon



Rupture Plane

Aerial Recon

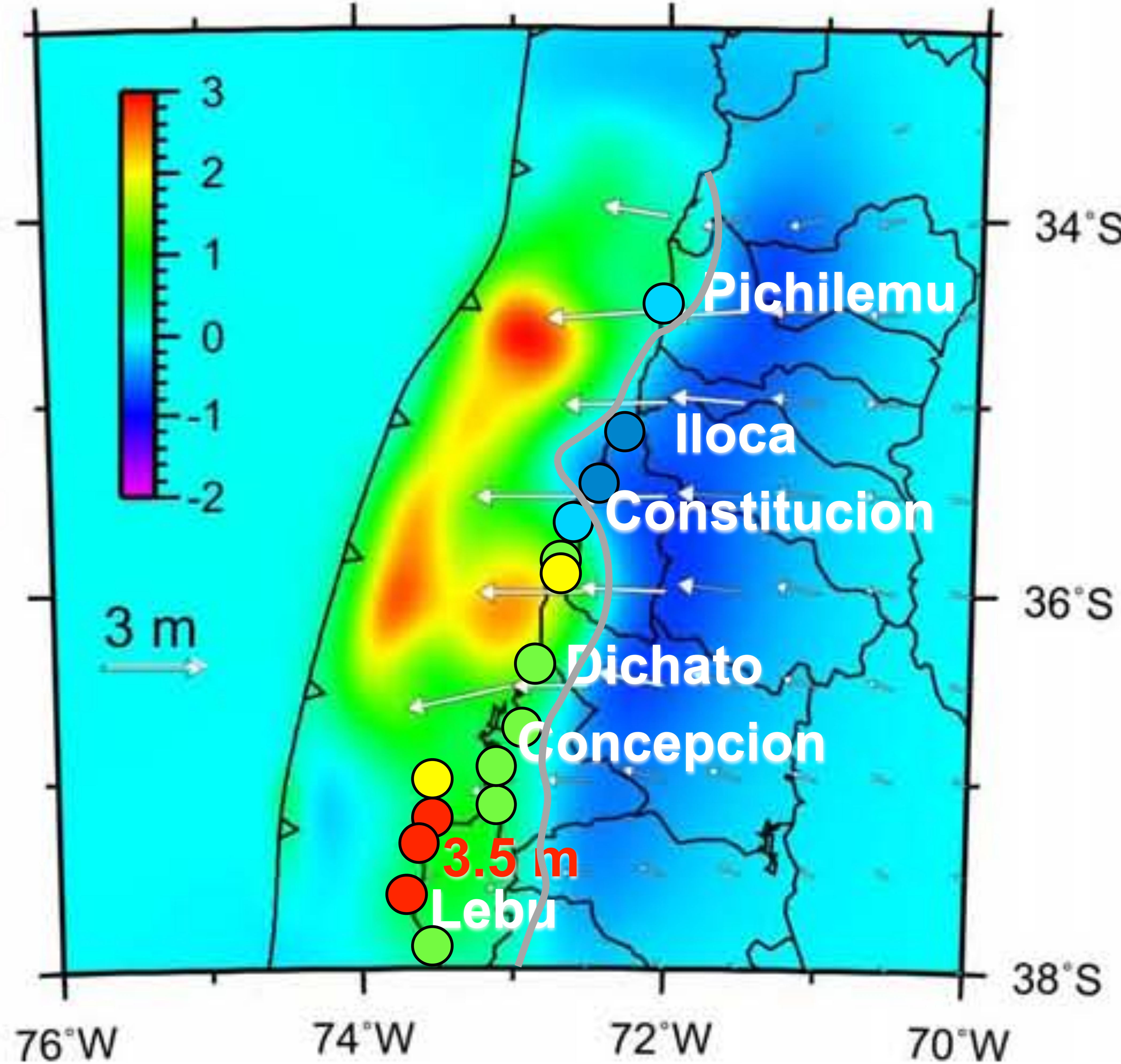
Ground Recon



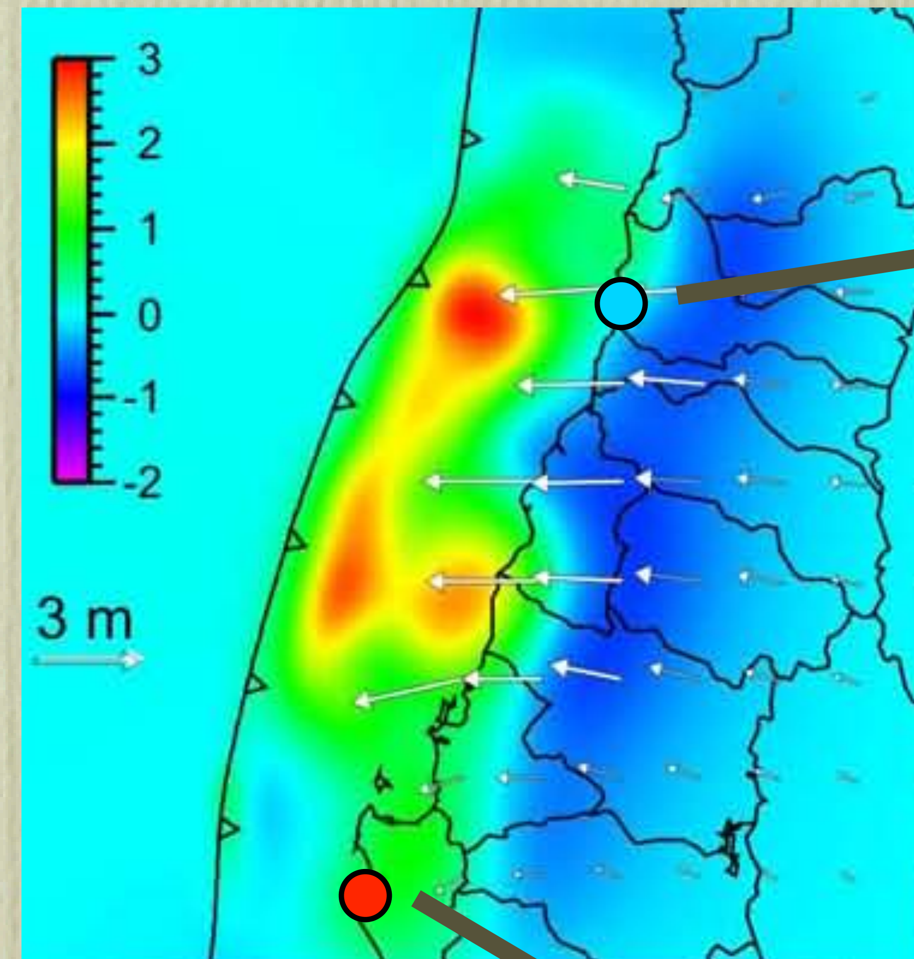
Major Tsunami Damage

Epicenter

Estimated Coseismic Vertical Displacements



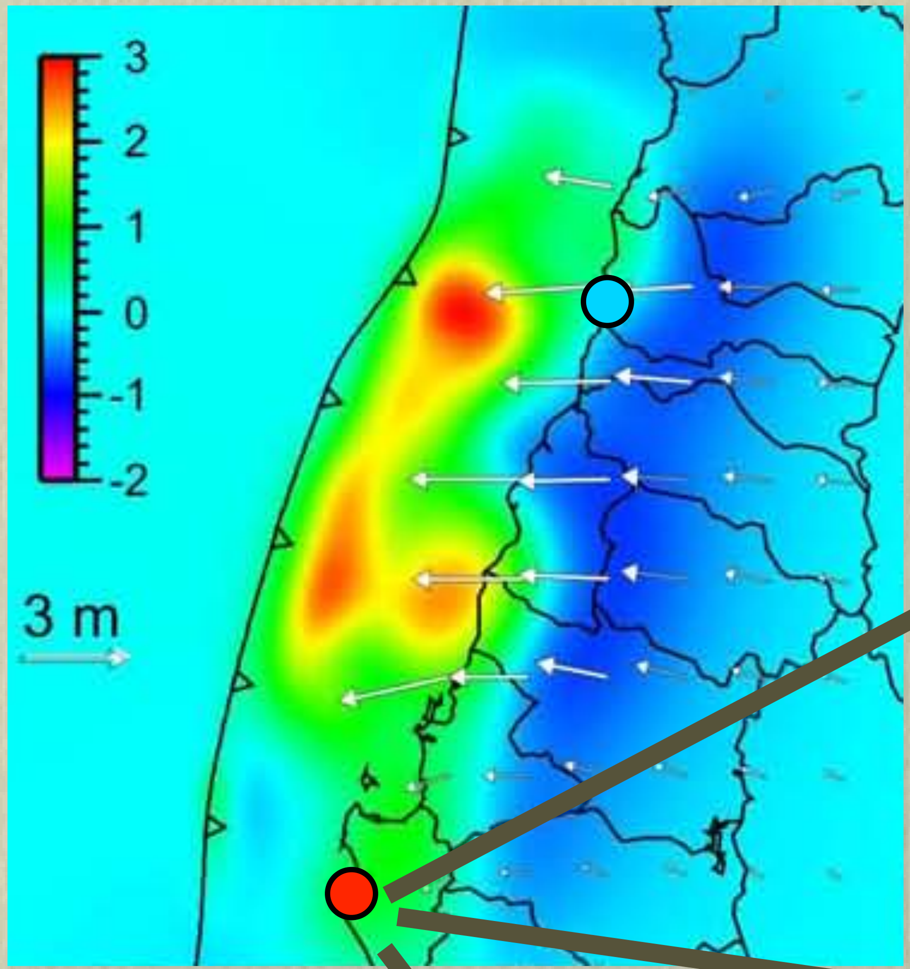
Tectonic Uplift and Subsidence



0 m

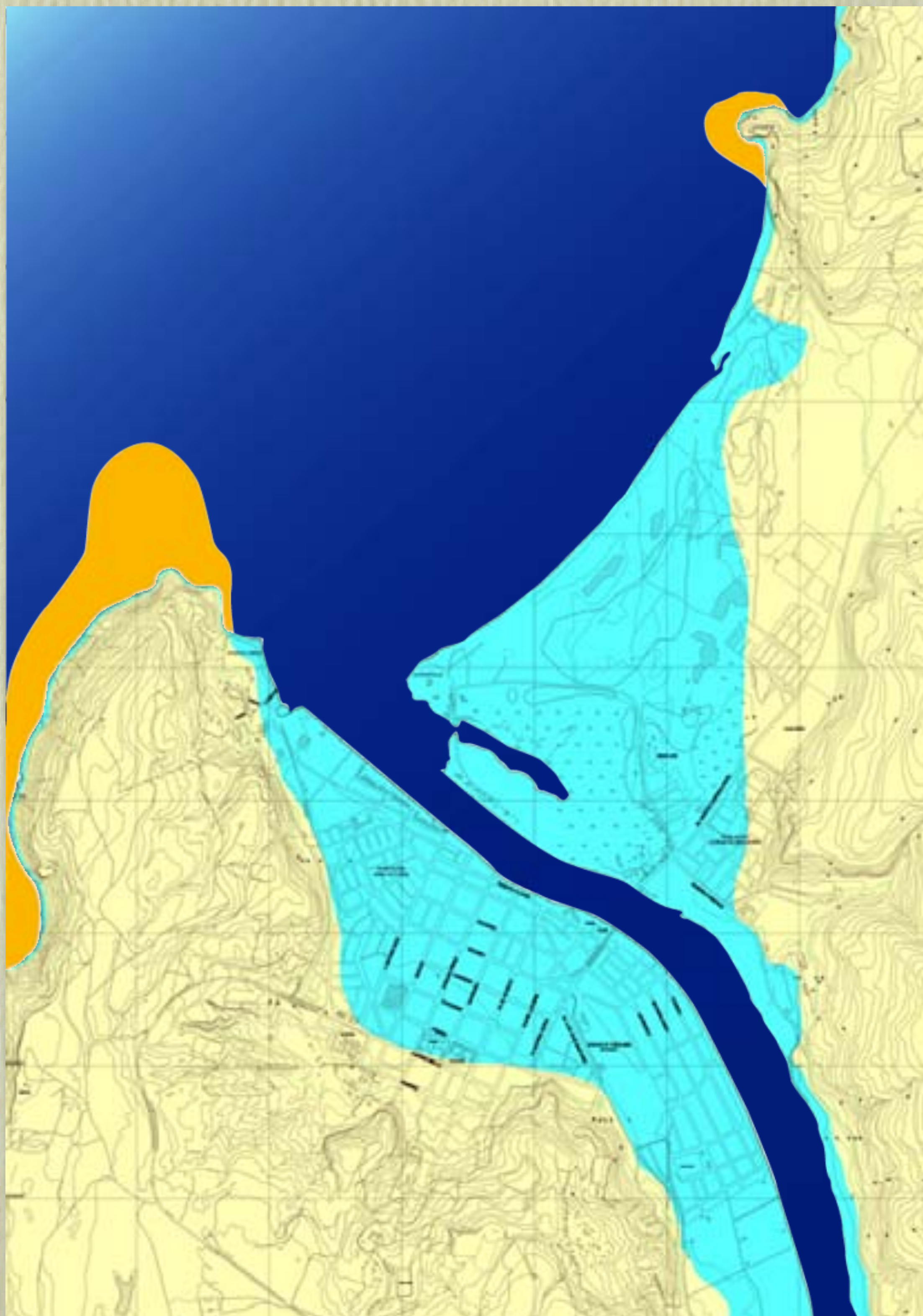
+2.5 m

Tectonic Uplift

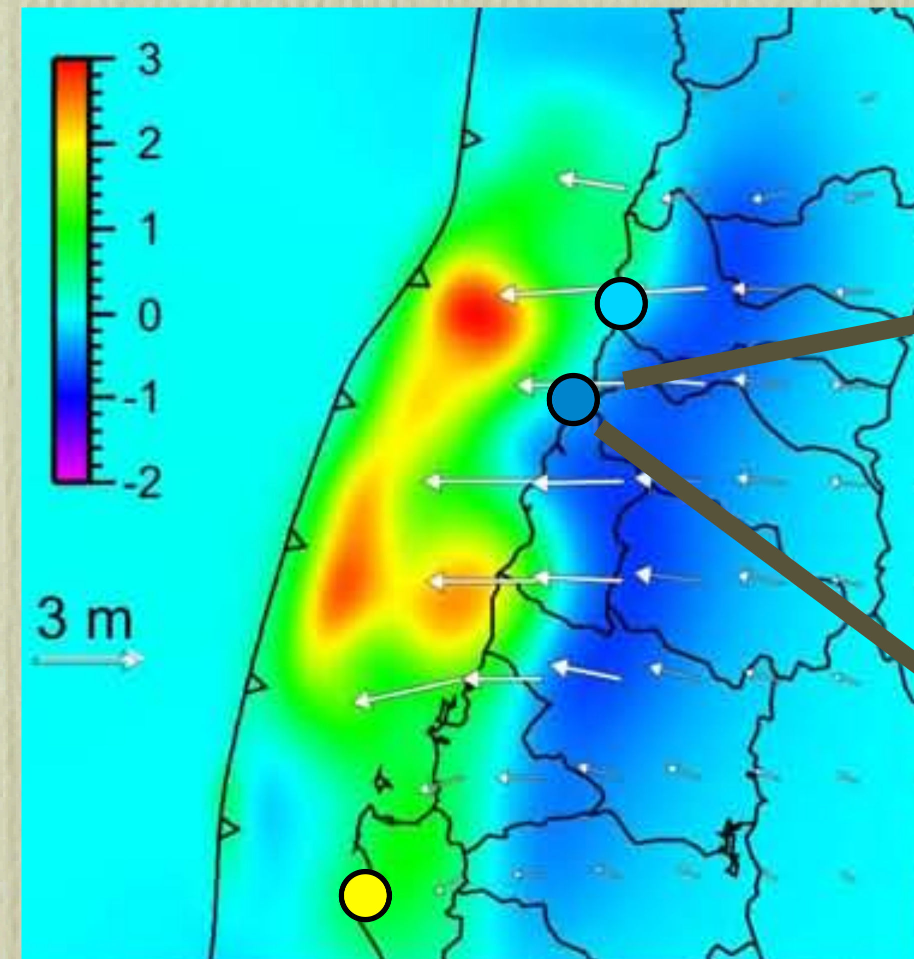


+2.5 m

Uplift Influenced Areas of Inundation



Tectonic Subsidence

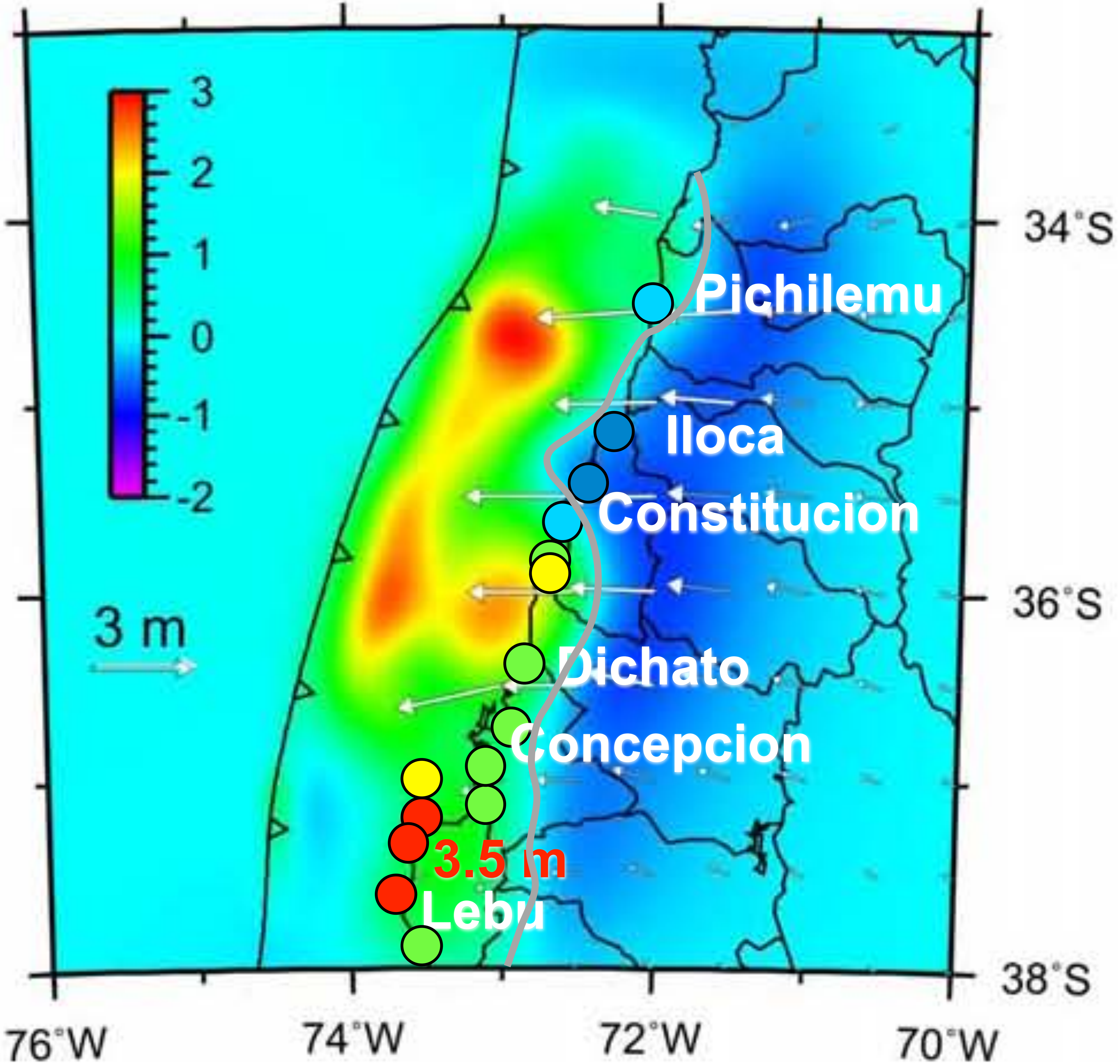


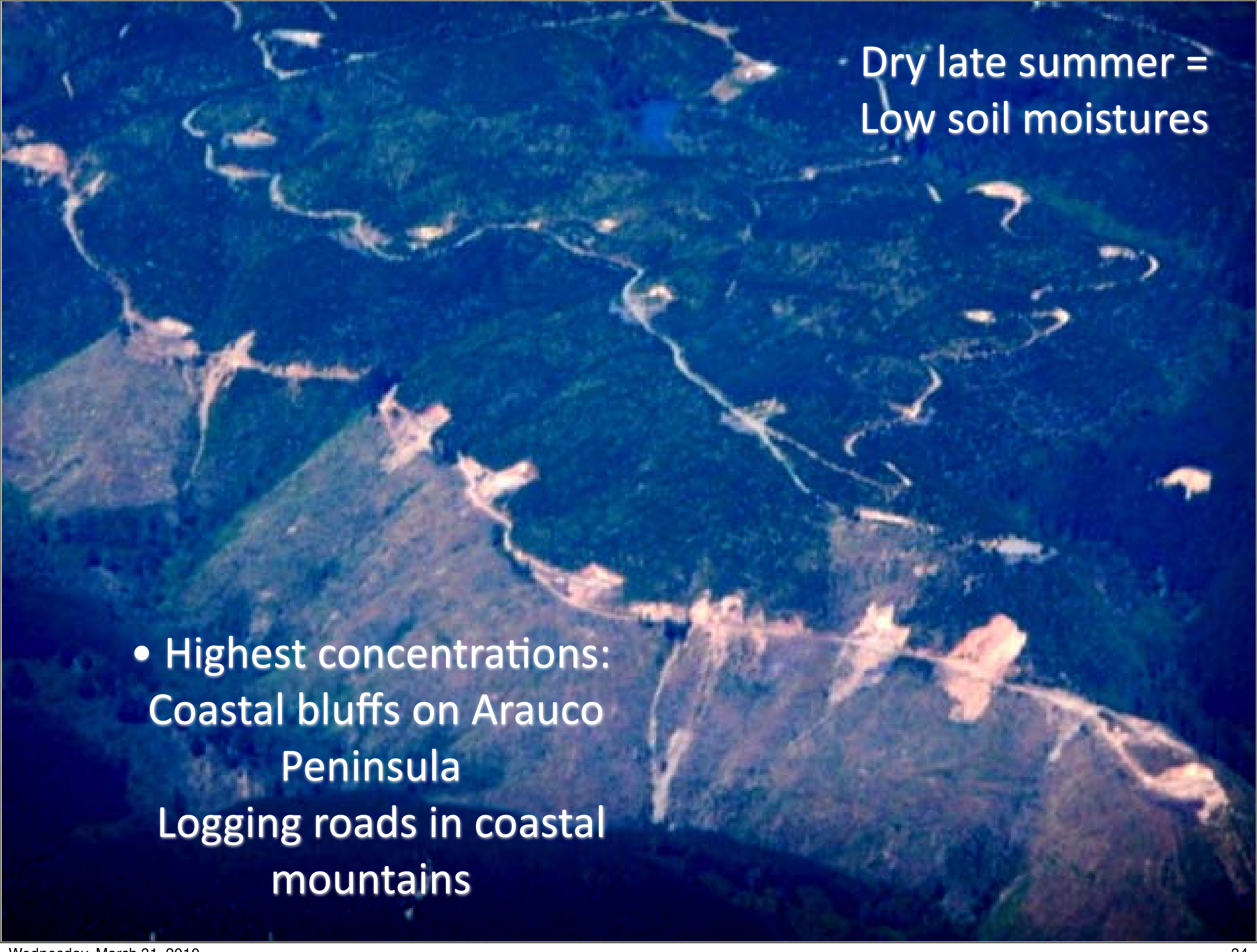
(-0.5 m)

Village of Curalnipe

Town of Dichato

Estimated Coseismic Vertical Displacements



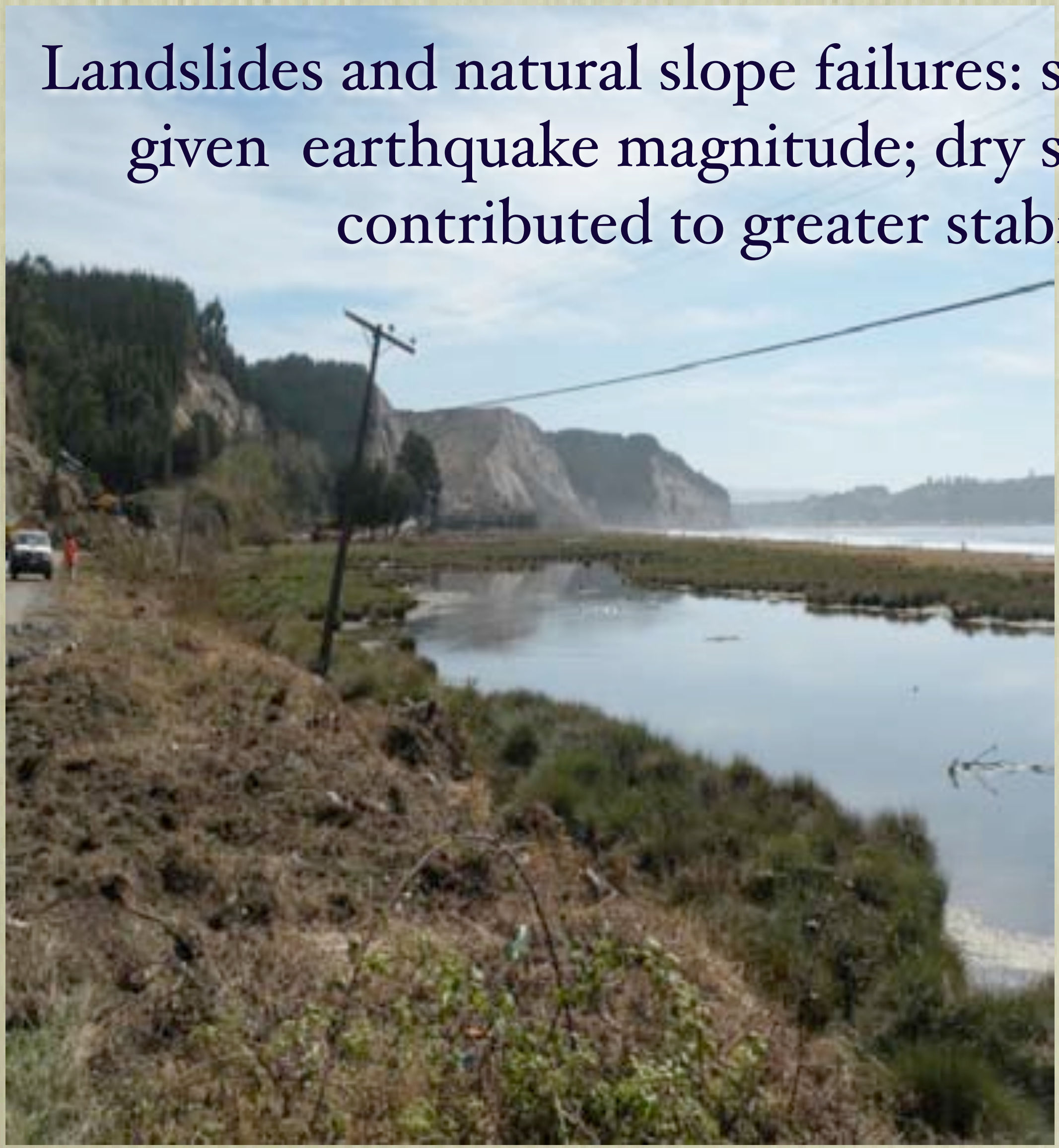

Dry late summer =
Low soil moistures
• Highest concentrations:
Coastal bluffs on Arauco
Peninsula
Logging roads in coastal
mountains

- Highest concentrations:
  Coastal bluffs on Arauco Peninsula
  Logging roads in coastal mountains

Dry late summer = Low soil moistures

Landslides and Slope Failures

Landslides and natural slope failures: surprisingly few given earthquake magnitude; dry season likely contributed to greater stability.



Liquefaction

Ground Failure along Highway 5

Poor fill compaction and poor foundation materials

Effects of Ground Failure on Port Facilities

Coronel : a) Lateral Spreading/Settlement, b

Sediment Ejecta/Sinkholes, & c) Pile Damag


msc
03/17/2010 14:32


03/15/2010 14:55


03/14/2010 15:23


03/17/2010 15

Seismic Performance of Dams

Coihueco Zoned Earth Dam Upstream Slope Failure


Rapel Concrete
Dam
(most dams
performed well)

Seismic Performance of Tailings Dams

Las Palmas Tailings
Dam Failure


PAZ
PAZ

Geo-engineering Extreme Events Reconnaissance
Turning Disaster into Knowledge

GEER

Geo-engineering Extreme Events Reconnaissance

http://www.geerassociation.org/

- Home
- Goals
- Activities
- Organization
- Post-Event Reports
- Join GEER

Welcome to the GEER Association website.

Extreme events engineering is an experience-driven field. Immediately following the occurrence of an extreme event (e.g., earthquake, tsunami, hurricane, landslide, or flood), perishable data that can be used to advance our understanding should be systemically collected. The importance of detailed mapping and surveying of damaged areas relative to general damage surveys cannot be overemphasized, as they provide the hard data of the well-documented case histories that drive the development of many of the empirical procedures used in geoengineering practice.

The GEER Association is working to develop a systematic approach to conducting the NSF-sponsored reconnaissance efforts of the the geotechnical effects of extreme events. The project is formalizing the manner in which extreme events reconnaissance efforts are organized by the GeoPrograms of NSF.

Click on the Goals button to read about our Current Objectives and Purposes.

Location: Haiti
Magnitude: 7.0
Date: January 12, 2010

Location: Duzce, Turkey
Magnitude: 7.1
Date: November 12, 1999

Location: Denali, Alaska
Magnitude: 7.9
Date: November 2, 2002

The GEER activity is sponsored by

NSF nehrp