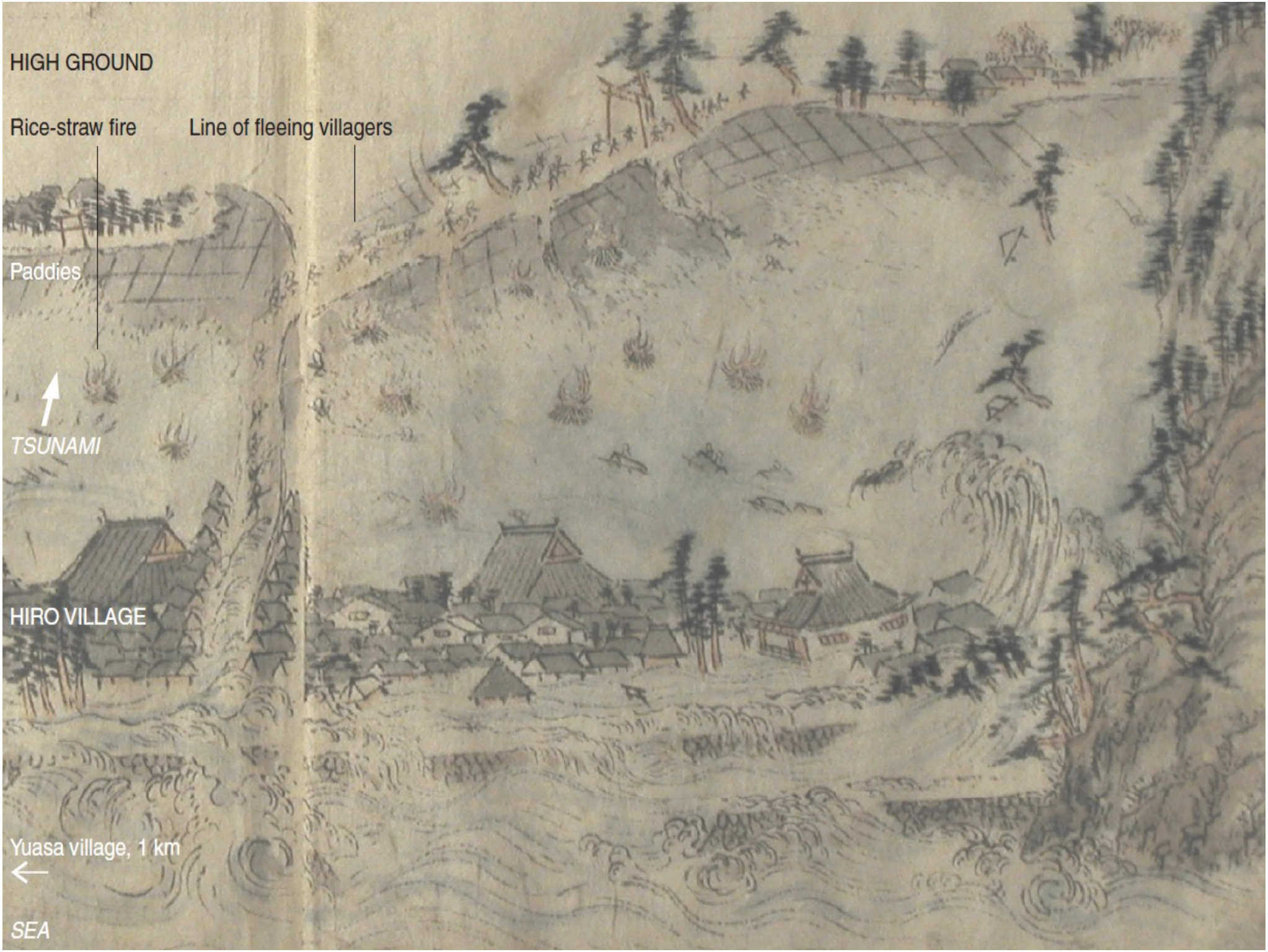
UNESCO-IOC / NOAA ITIC Training Program in Hawaii (ITP-TEWS Hawaii)
TSUNAMI EARLY WARNING SYSTEMS
AND THE PACIFIC TSUNAMI WARNING CENTER (PTWC) ENHANCED PRODUCTS
TSUNAMI EVACUATION PLANNING AND UNESCO IOC TSUNAMI READY PROGRAMME
15-26 September 2025, Honolulu, Hawaii

Hazard Assessment
Role of Tsunami Deposits

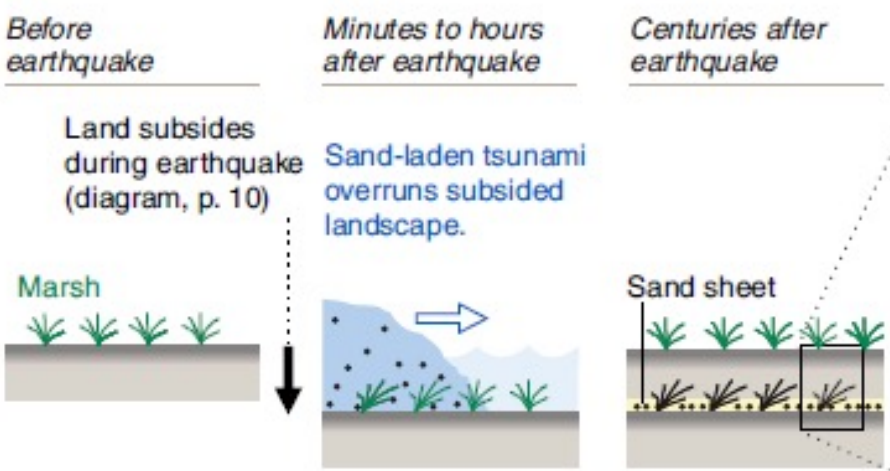
Mario Guerra Vera
Pontificia Universidad Católica de Valparaíso, Chile

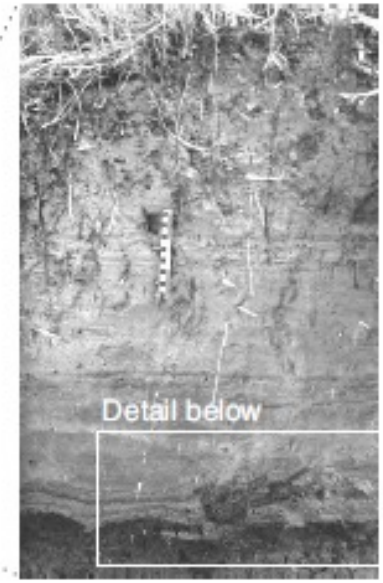
一元禄十四年六月八日ニ九日之内ニ海道切ル合
水ニ成レ中山道ハ信濃ノ国ハ善光寺ノ
稲荷山ヨリ下ル中山道ハ大雨ニ而
流レ出シ中ノ仕
此度ハ石仕右ノ通大雨ニ而流レ申候ハ


HIGH GROUND
Rice-straw fire
Line of fleeing villagers
Paddies
TSUNAMI
HIRO VILLAGE
Yuasa village, 1 km
SEA

40-90 cm
SR.23.OPB2.RA. 40-90 cm

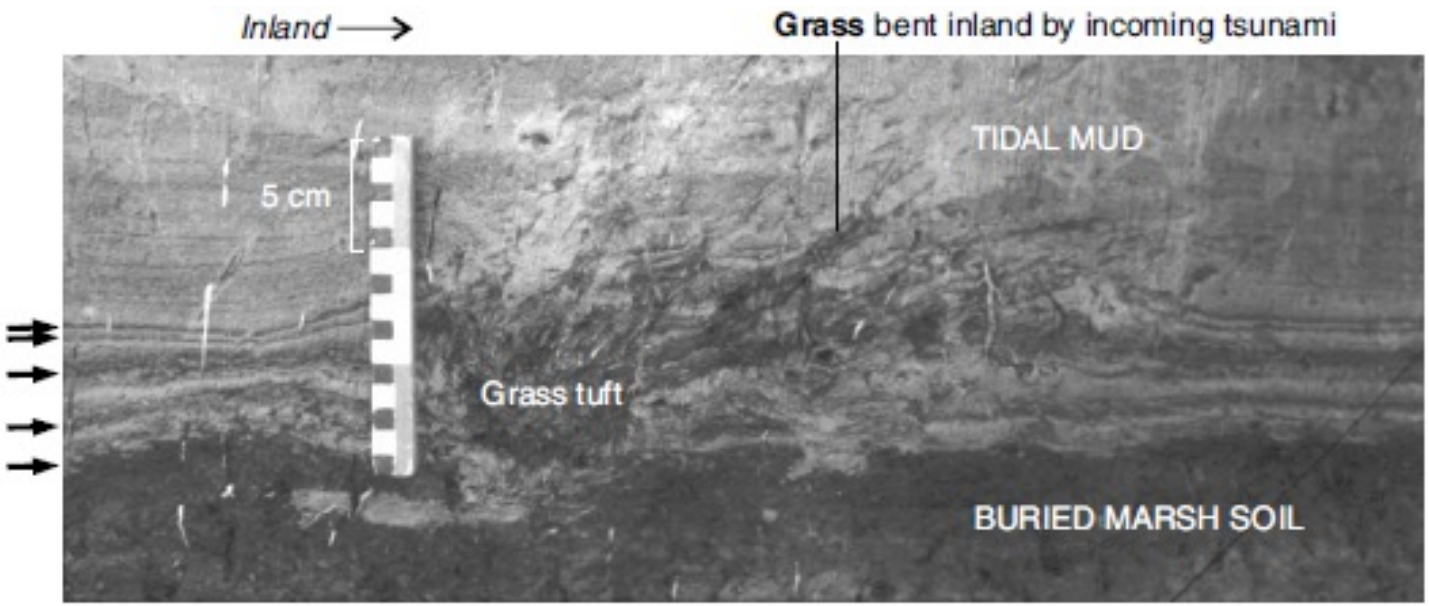
A TSUNAMI LAYS DOWN A SHEET OF SAND





Mud deposited by tides since 1700. Contains coarse silt but lacks sand except just above a subsided, buried soil. Mud thickness, 80 cm

Buried soil of marsh that subsided in 1700



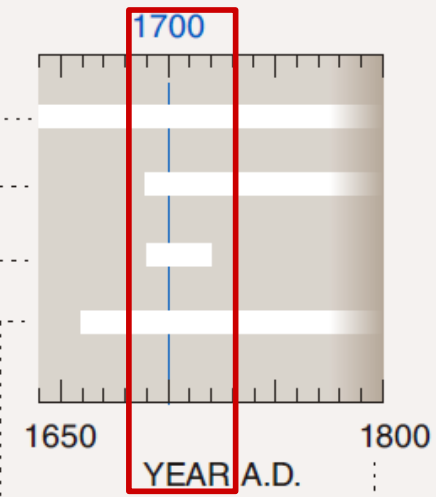
→ **Sandy layer**, each the likely record of an onrushing wave in the tsunami train that began the evening of January 26, 1700 (inferred timing, p. 42-43). The sandy layers alternate with mud that probably records the slack water of crested waves.

Niawiakum River, Willapa Bay (Oyster locality of Atwater and Hemphill-Haley, 1997)

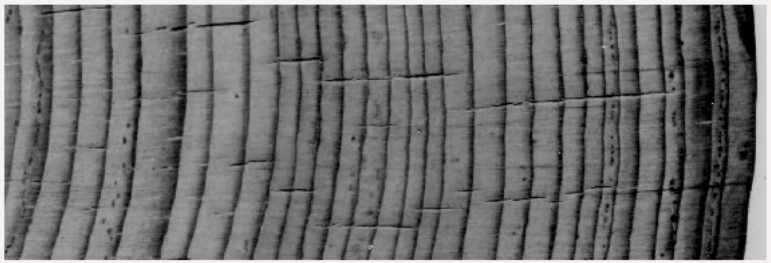
Oprhan Tsunami, 2016

MATERIAL DATED (and year first measured)	AGE OF MATERIAL RELATIVE TO TIME OF EARTHQUAKE	METHOD (and typical uncertainty)	EVENTUAL COASTWISE EXTENT
Peat and other plant remains in or above buried soil (1986)	Commonly decades or centuries older, or decades younger	Conventional radiocarbon (± 50 ^{14}C yr)	Most estuaries, southern B.C. to northern Calif.
Rings of weather-beaten trunks of western red cedar killed by post-earthquake tides (1988)	Outermost preserved ring older by intervals unknown until 1996, when the trees' final rings were dated in bark-bearing roots (p. 96)	Ring-width pattern matching to calendar year (p. 97)	Four estuaries in southern Washington
Rings of bark-bearing roots of Sitka spruce killed by postearthquake tides (1990)	Typically older by amounts known, to within a few years, from counts of annual rings	High-precision radiocarbon (± 10-15 ^{14}C yr)	Four estuaries (facing page)
Leaves and stems of herbaceous plants killed by post-earthquake tides (1993)	Older by a decade or two at most for woody stems of perennials; by a few years at most for leaves	AMS radiocarbon (± 50 ^{14}C yr)	Seven estuaries (facing page)

TIME WINDOWS FOR MOST RECENT GREAT EARTHQUAKE as inferred by 1995



***Written history** rules out the occurrence of any great Cacadia earthquake after 1800 and probably since 1775 (p. 12).*



One annual ring, composed of cells added early (light) and late (dark) in growing season, which runs May to September

1 cm

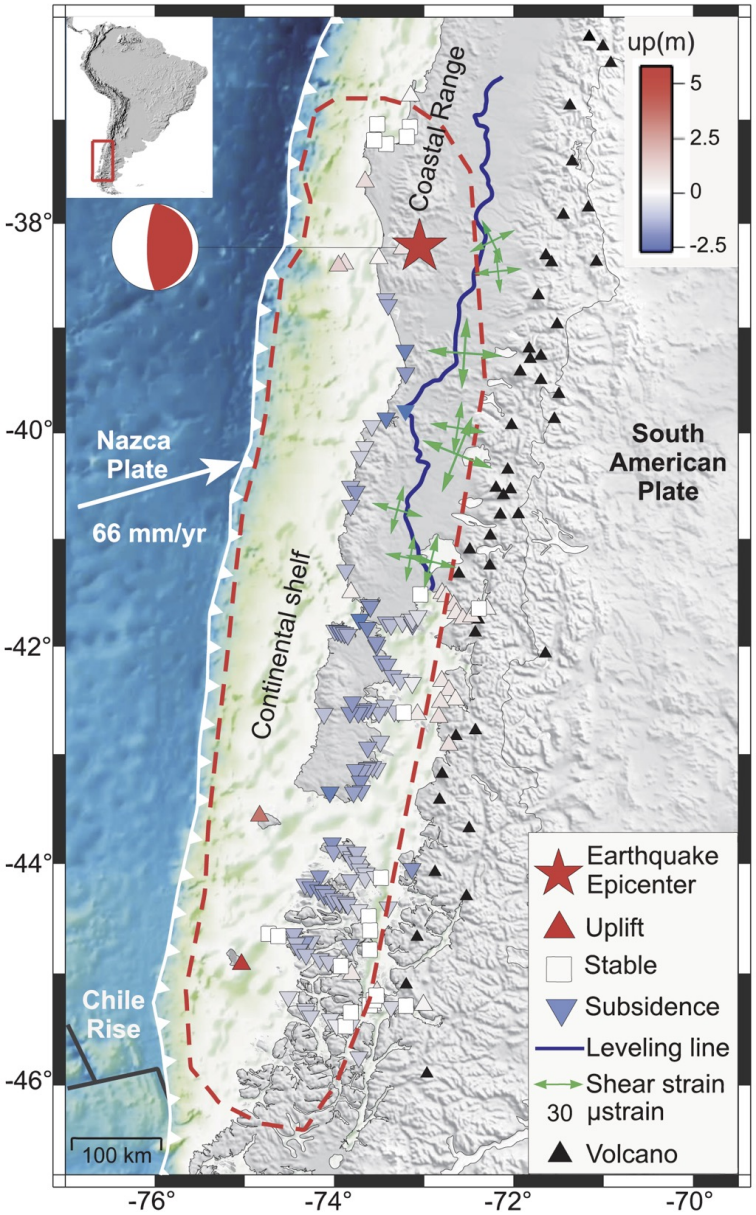
Final ring

Bay Center, Willapa Bay

Oprhan Tsunami, 2016

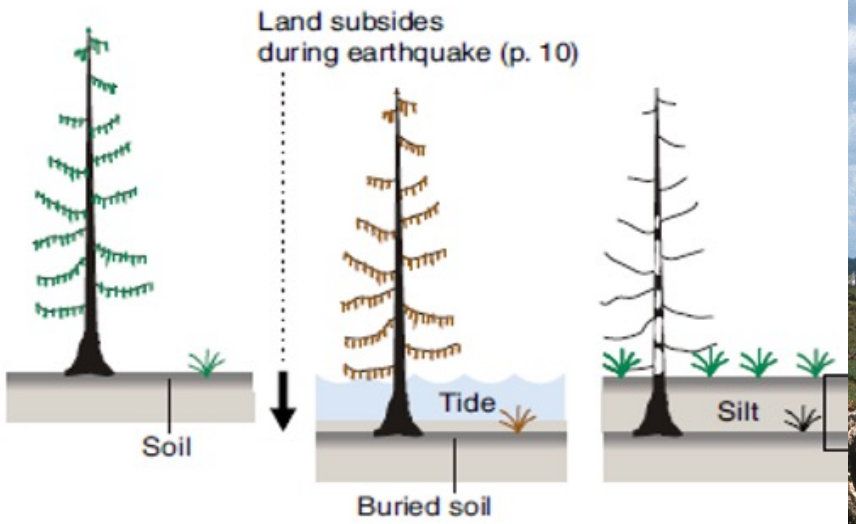

Cap du Nord
D. d'Hudson
Baye du Nord
I. Phelipeaux
BAYE D'HUDSON
Ne Ultra
LABRADOR
Eskimaux
Baye de l'Assomption
Baye des Eskimaux
Bellisle
Ouchestigouecs
F. Ponchartrain
TERRE NEUVE
Cap Raze
Grand Banc
Plaisance
R. du Loup
R. Danoise
R. Bourbon
I. Bourbon
Nieusavane
Lac des Forts
Quichichouen
F. St Louis
F. Louis
R. de St Laurent
Golfe S. Laurent
Gaspé
Isle Royale
Cap Breton
Canceau
Isle de Sable
Lac Tacamamiouen
Lac du Brochet
CANADA
Tadoussac
Quebec
les 5 Rivieres
Montreal
Gaspesie
Pentagouet
Acadie
Royal
Sioux
Quivira
Mississipi
Renards
L. Michigan
L. Huron
Iroquois
Ontario
Boston
ANGLETERRE
Nouvelle York
C. Blanc
Cap Mendocin
Panis
Missouri
Illinois
L. Erie
MARILAND
S. Mary
VIRGINIE
Jamestown
la Bermude
Cap de Nieve
Port de la Conception
AMERIQ SEPTENTRIONALE
LOUISIANE
CAROLINE
Bourg François
Charlestowne
Nouveau Londres
S. Mathieu
S. Augustin
R. de Coral
S. Fe
NOUVEAU MEXIQUE
Nouv. Navarre
Acansa
Chacta
R. Rouge
Fort Louis
Pensacola
Cenis
Orleans
N. Biloxi
I. St Clement
Cap St Augustin
I. de Paxaros
I. de Cedres
CALIFORNIE
MER VERMEILLE
R. du Nord
Mississipi
F. Francois
GOLFE DU MEXIQUE
ISLES LUCAYES
Guanahani
Providence
Cinaloa
Culiacan
Cap St Lucas
Mogane
le Cap
Panuco
la Havane
CUBA
Porto Rico
S. Christophe
les 3 Maries
Guadalajara
la Veracruz
Merida
Golfe d'Hondures
Santiago
S. DOMINGUE
ANTILLES
la Guade
la Marti
Route de Gaetan
Cap Corientes
Port
I. St Thomas
Rocca partida
Mexico
Tabasco
JAMAICA
C. Gratias a deos
Marguerite
Barba
Grenade
Acapulco
Aguatulco
Soconusco
Guatimala
Nicaragua
Curazou
S. Marthe
Realejo
C. Blanco
Portobelo
Core
Cartagene
Caracas
Comana
Caino
CASTILLE D'OR
S. Thomas

EARTHQUAKE ANALOGS ON FACING PAGE

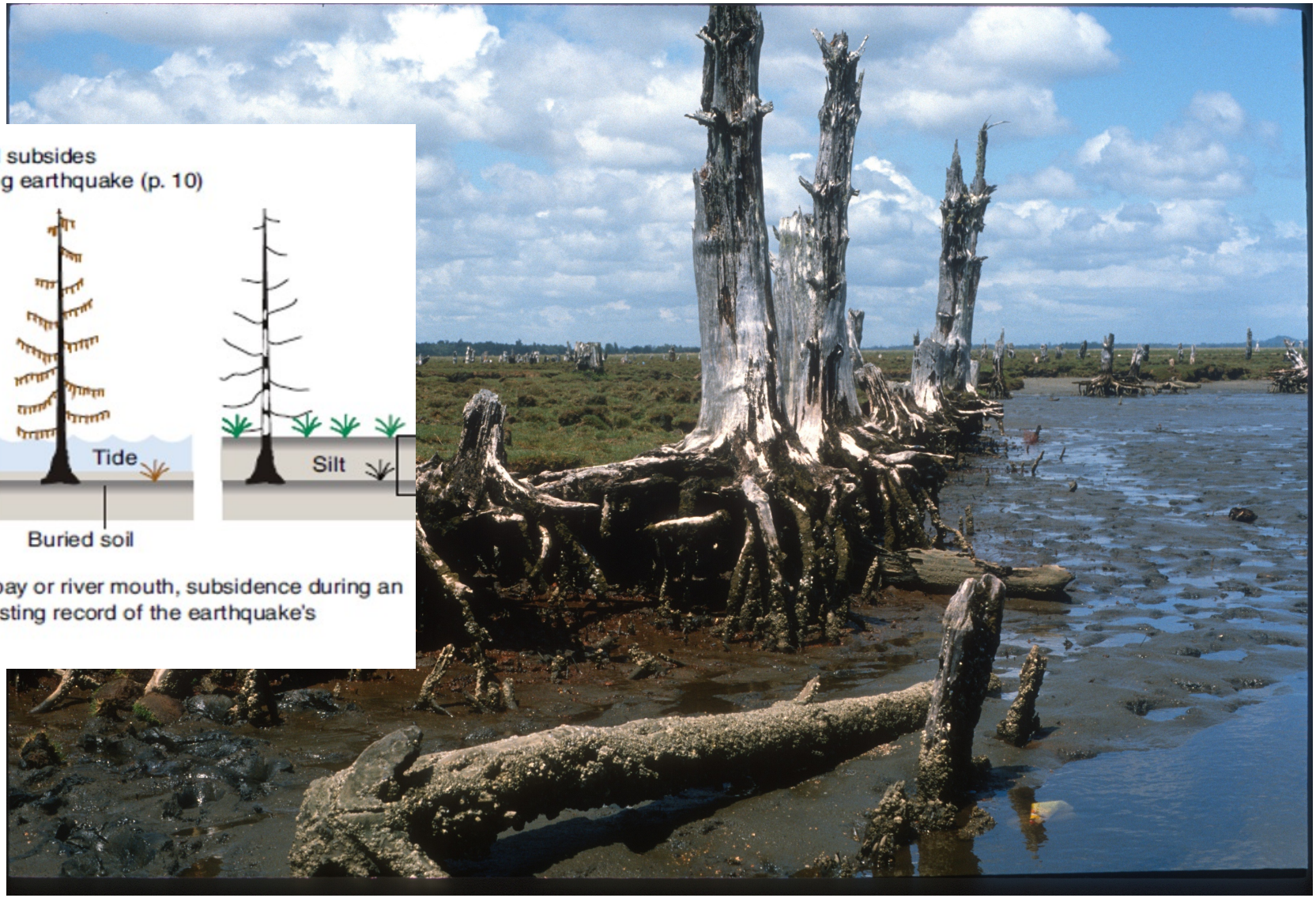


Oprhan Tsunami, 2016

Same Evidence



By lowering land into a bay or river mouth, subsidence during an earthquake produces a lasting record of the earthquake's occurrence.



TIME IN JAPAN
(~120-minute hours; p. 43)

TIME SINCE EARTHQUAKE
(60-minute hours)

0

Hour of eight, afternoon of 8th day, 12th month, 12th year, Genroku era
Cascadia earthquake, ~9 p.m., Jan. 26, 1700

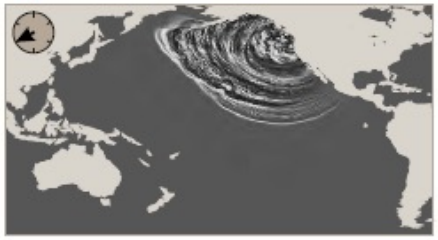
1

Tsunami already striking Pacific coast at Cascadia (resulting deposits, p. 18, 20)

2

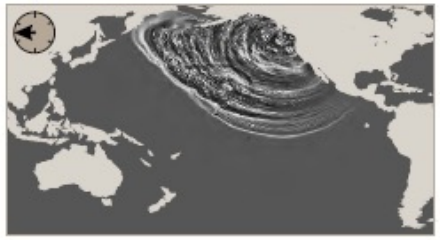
Hour of seven, afternoon, 8th day of 12th month

6

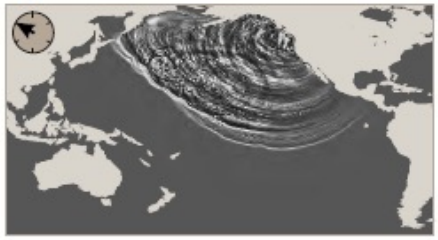


Hour of five, evening, 8th day of 12th month

7

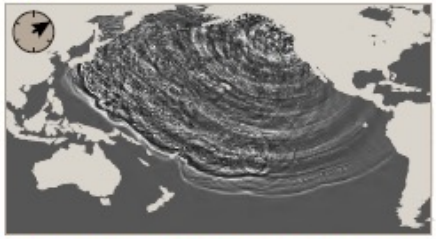


8



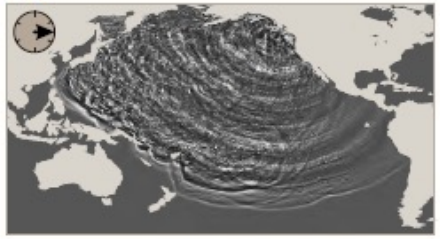
Hour of four, night, 8th day of 12th month

12

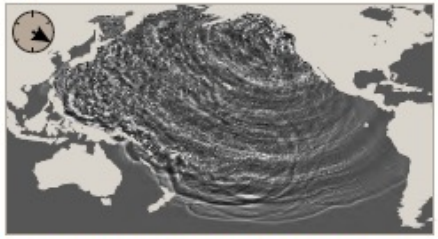


Hour of eight, night, 8th day of 12th month
At Cascadia, 9 a.m. of January 27

13

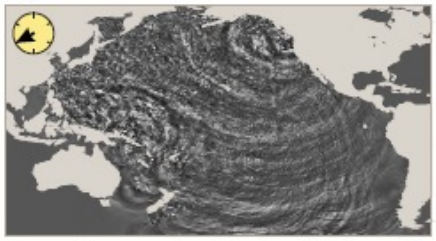


14



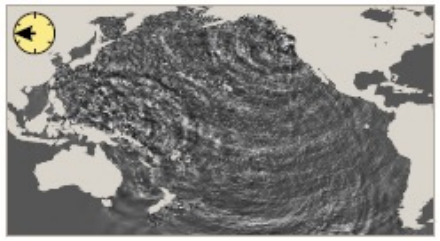
Hour of seven, night, 8th day of 12th month

18

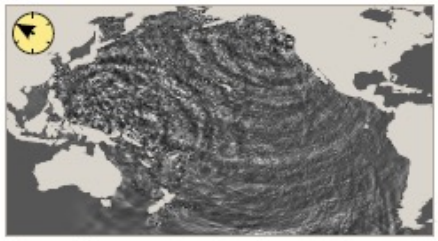


Hour of five, morning, 9th day of 12th month

19



20



Hour of four; morning, 9th day of 12th month

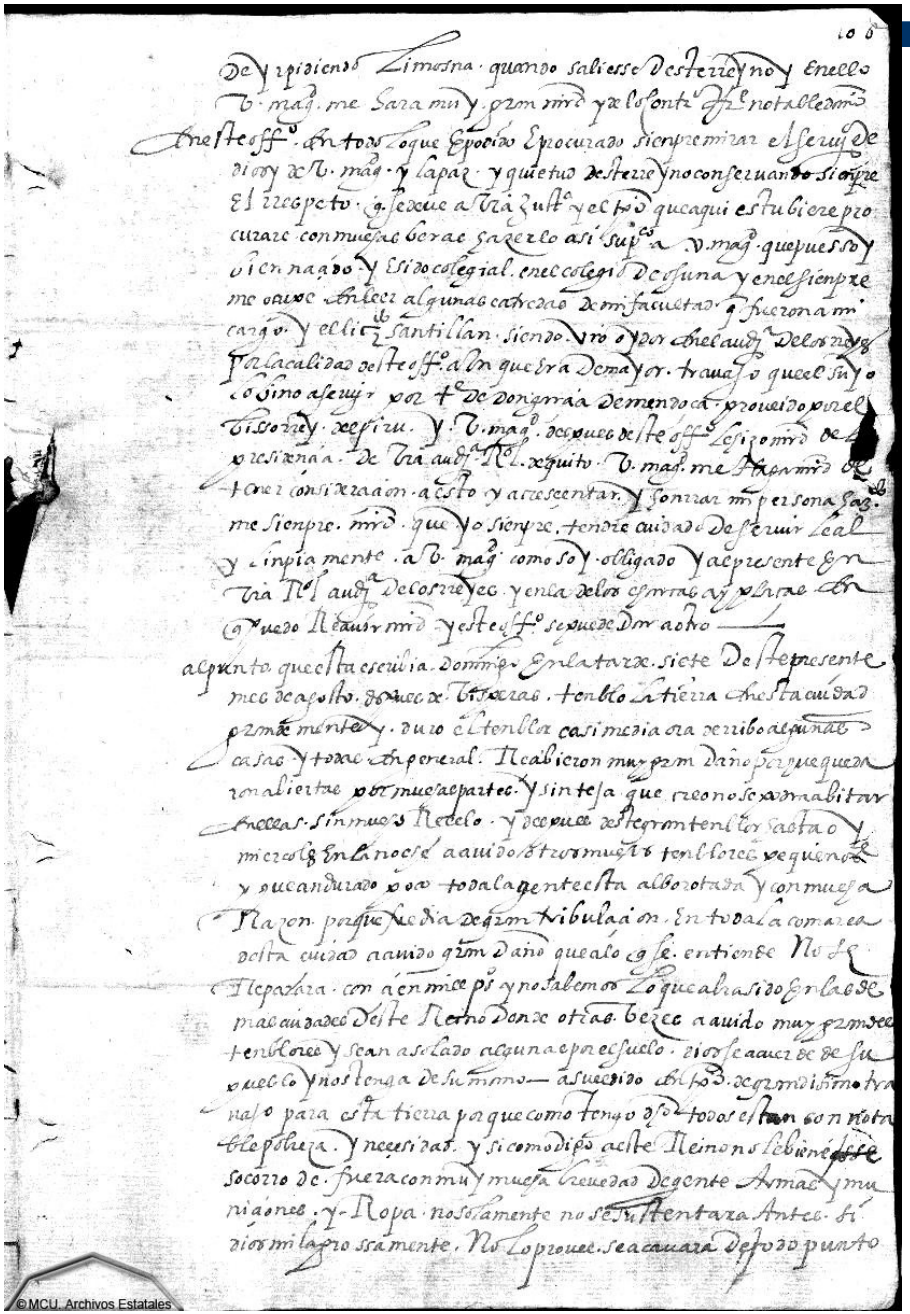
ESTIMATED SOURCE AREA OF THE 1700 CASCADIA EARTHQUAKE

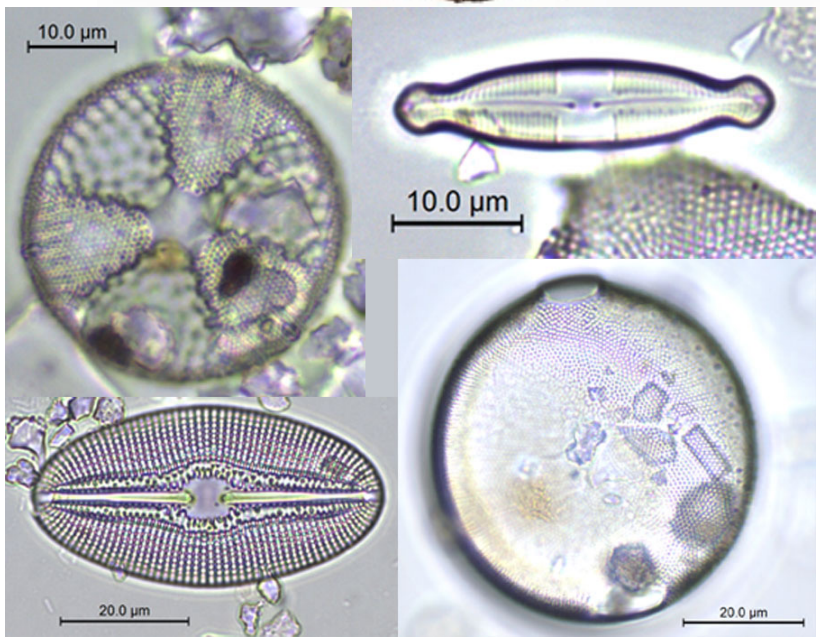
KNOWN SITES OF THE 1700 TSUNAMI IN JAPAN

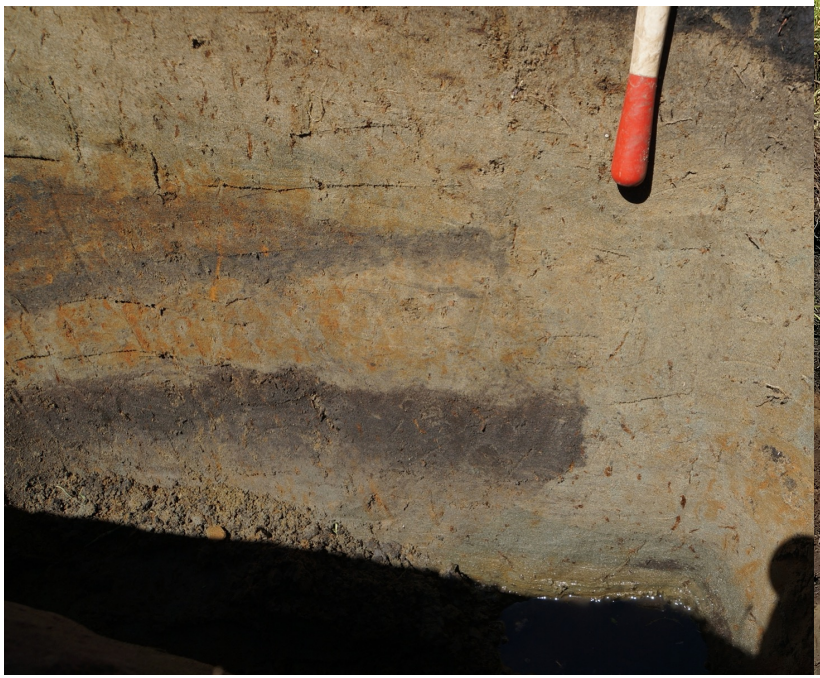
Tsunami in Japan

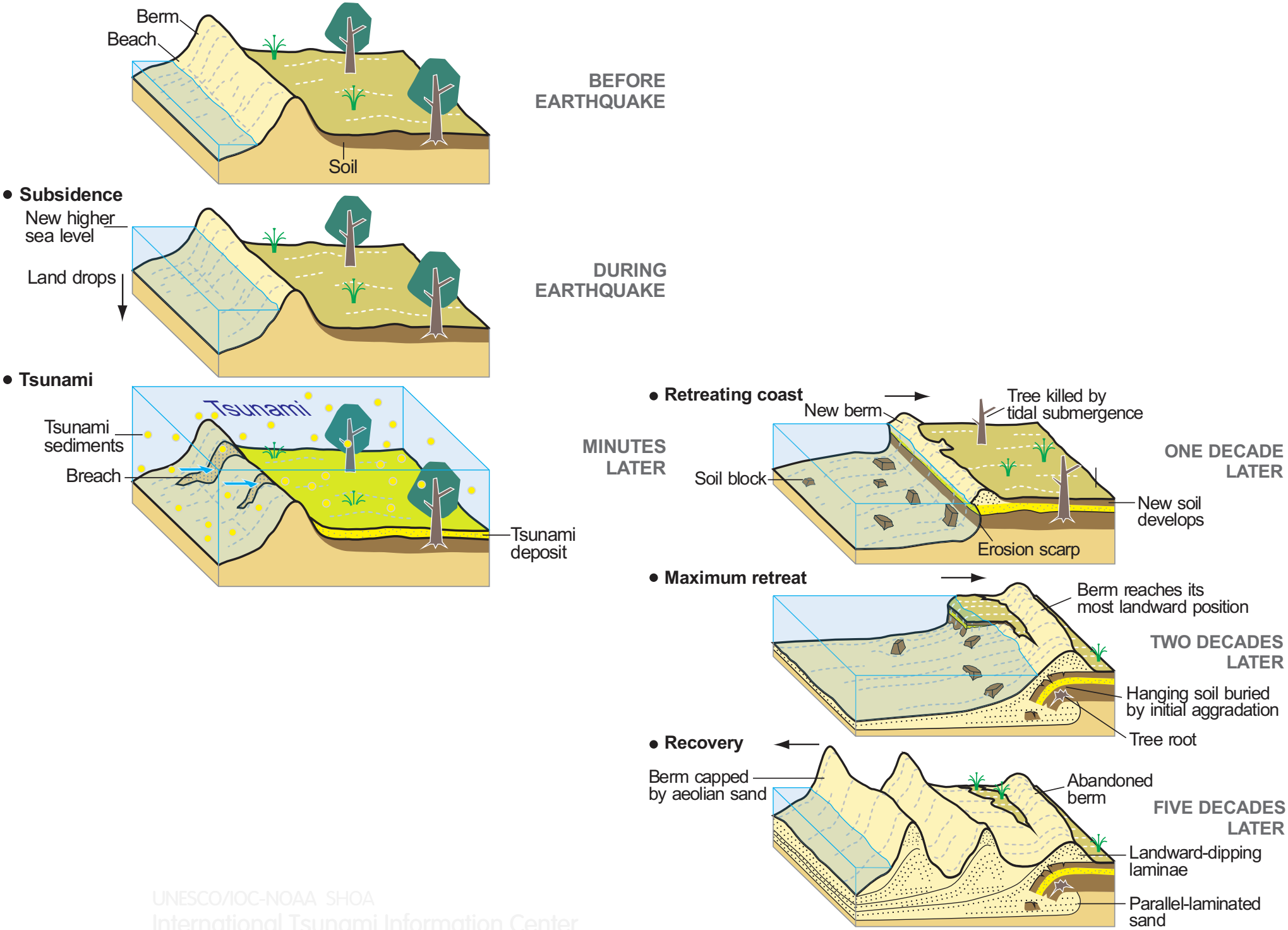
Earthquake in North America

Paleoseismological Research

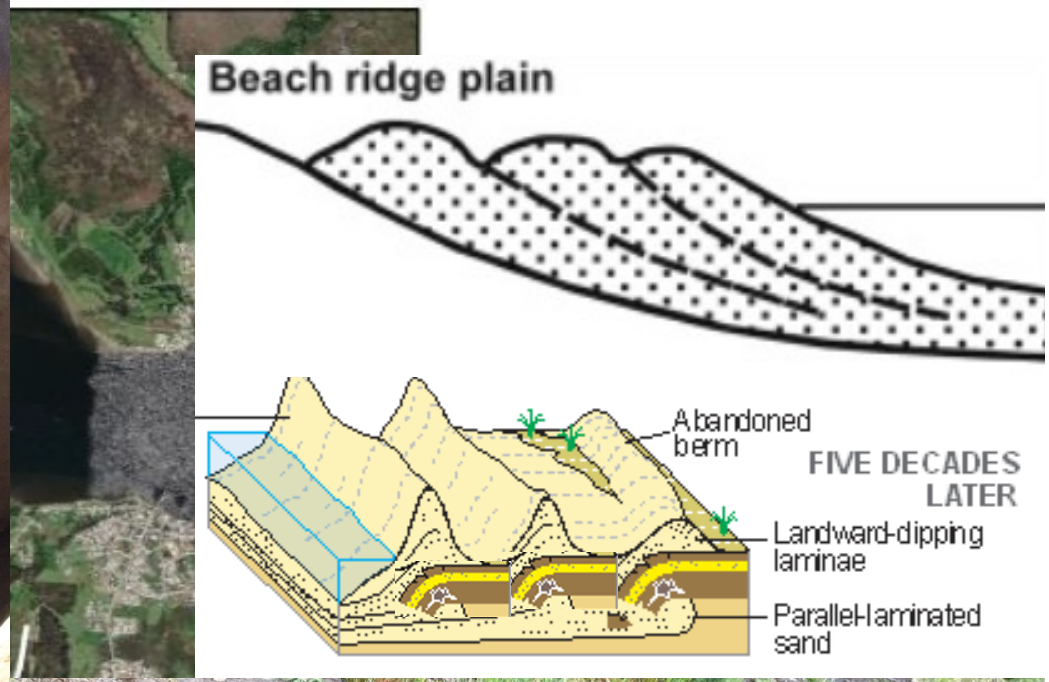




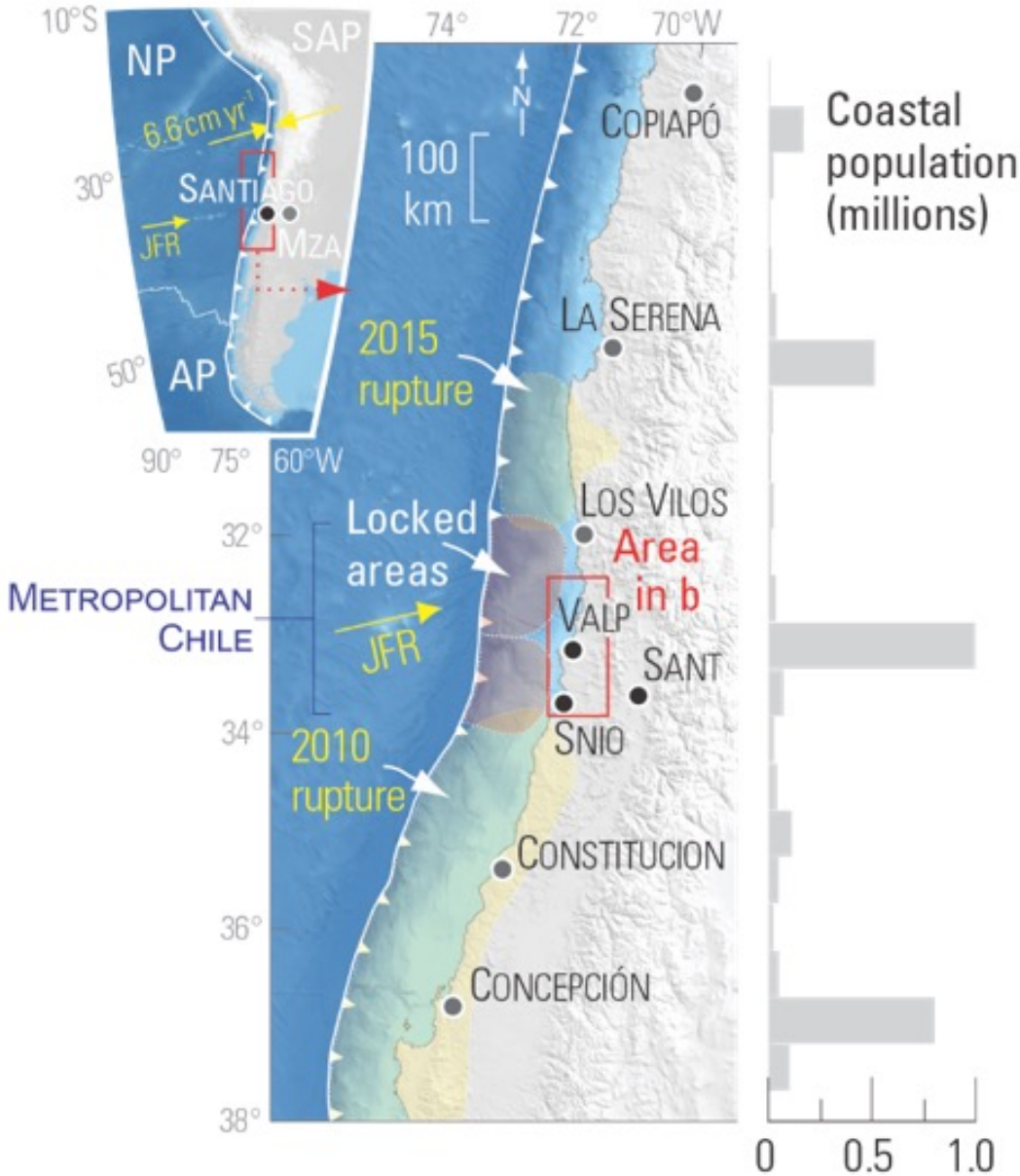




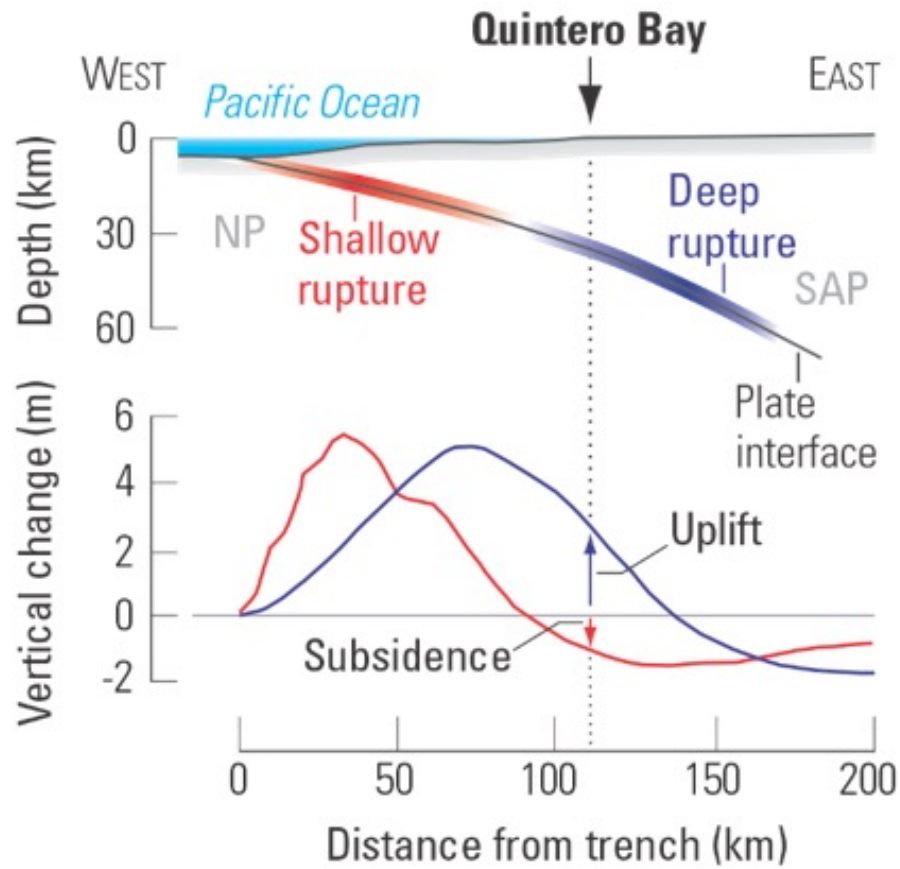

ENOC 5


Beach ridge plain
Abandoned berm
FIVE DECADES LATER
Landward-dipping laminae
Parallel-laminated sand

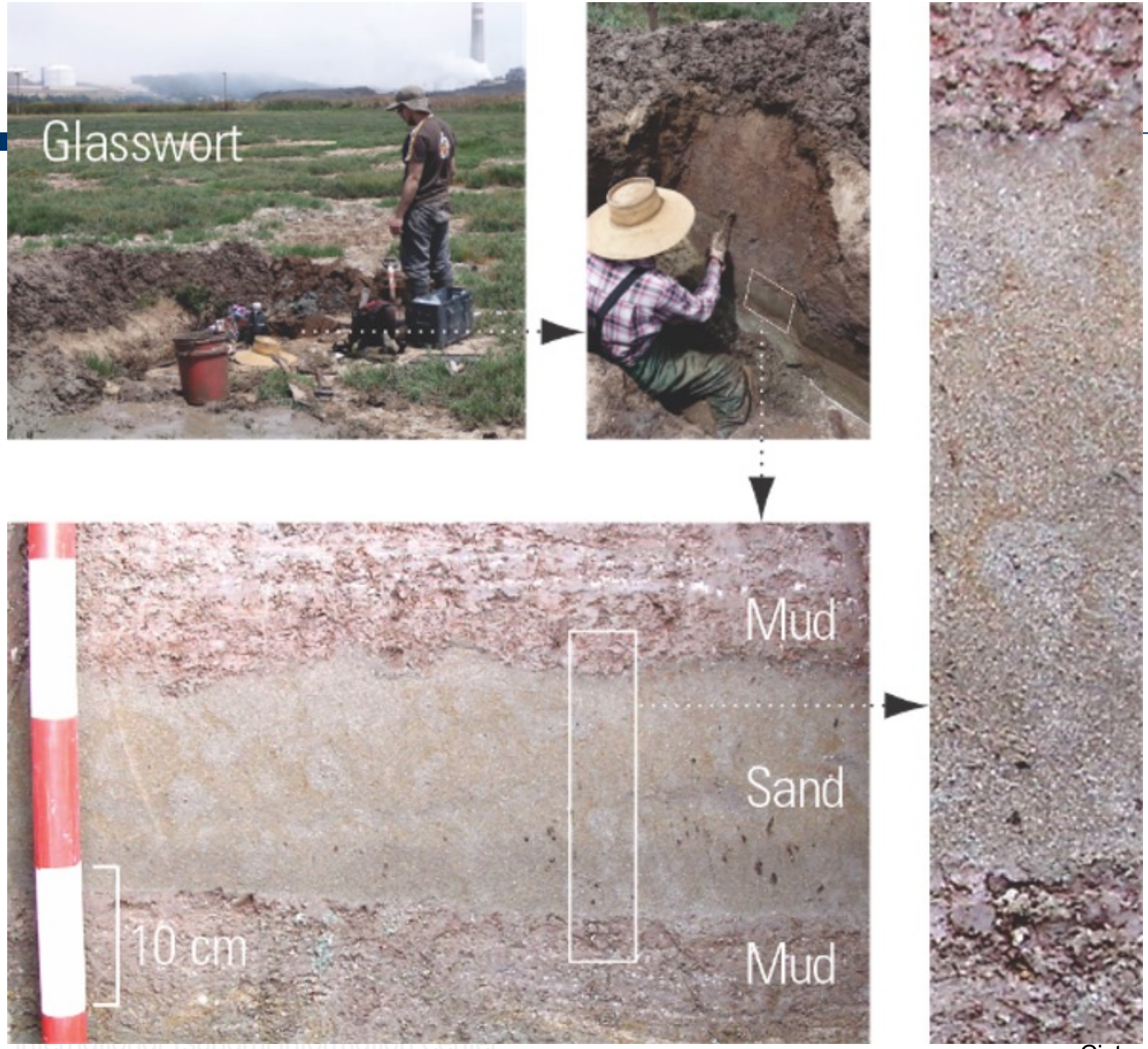
So what is it good for?



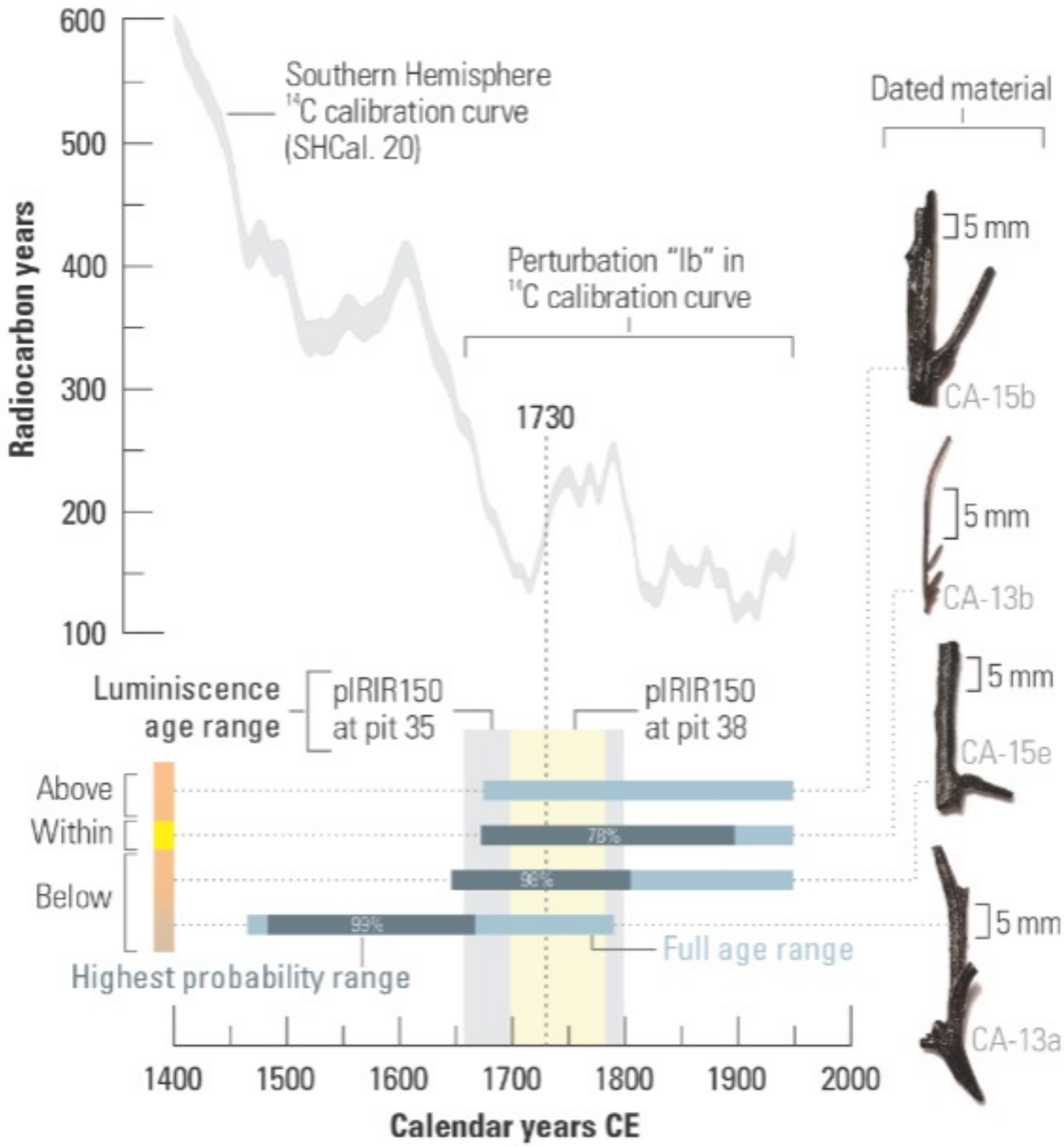
Central Chile



Cisternas, 2025!!!!

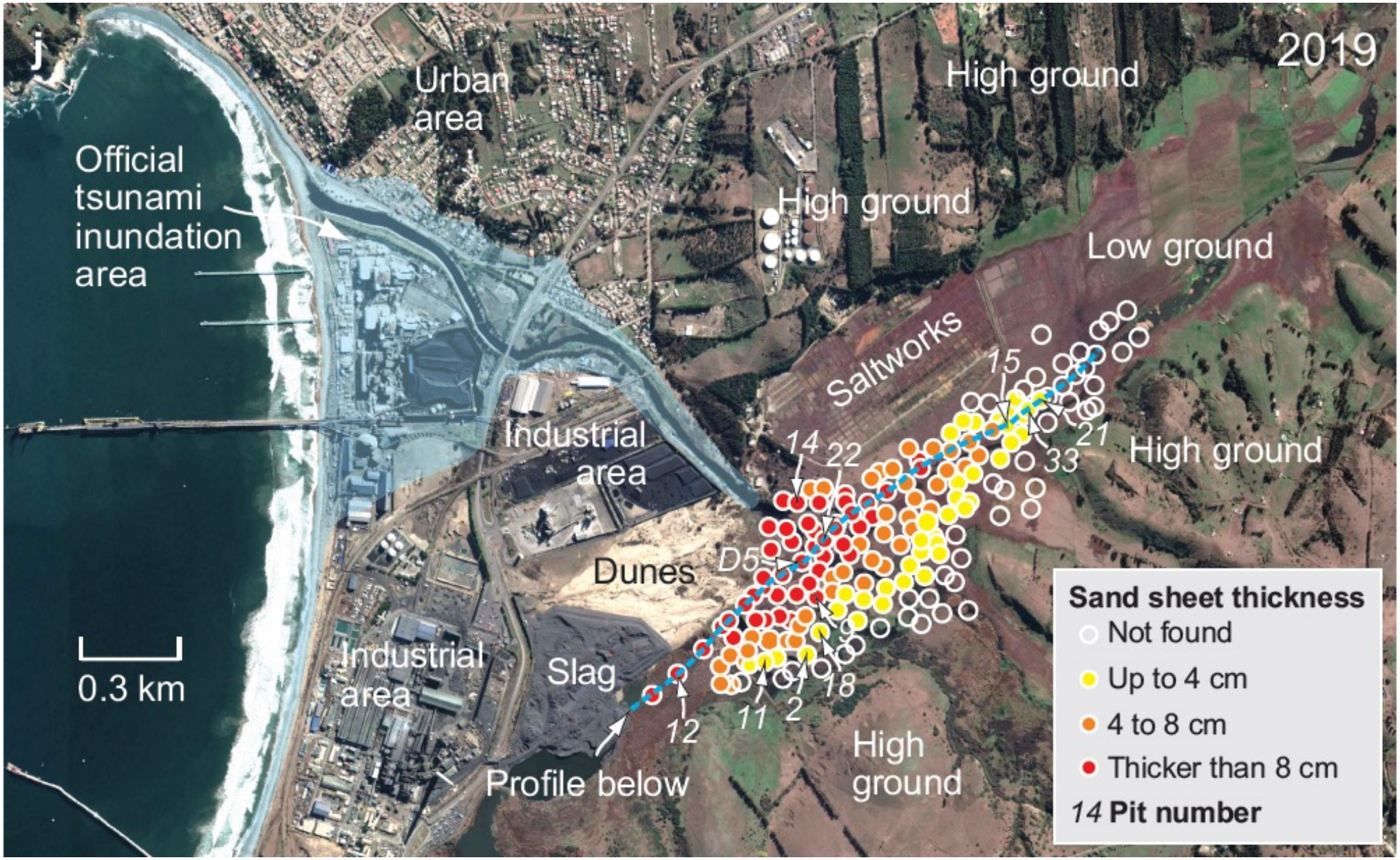


Cisternas, 2025!!!!



Cisternas, 2025!!!!

Provide new information to evacuations maps



Intergovernmental Oceanographic Commission

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Thank You

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