

Mexico 1985

Les faits

La source

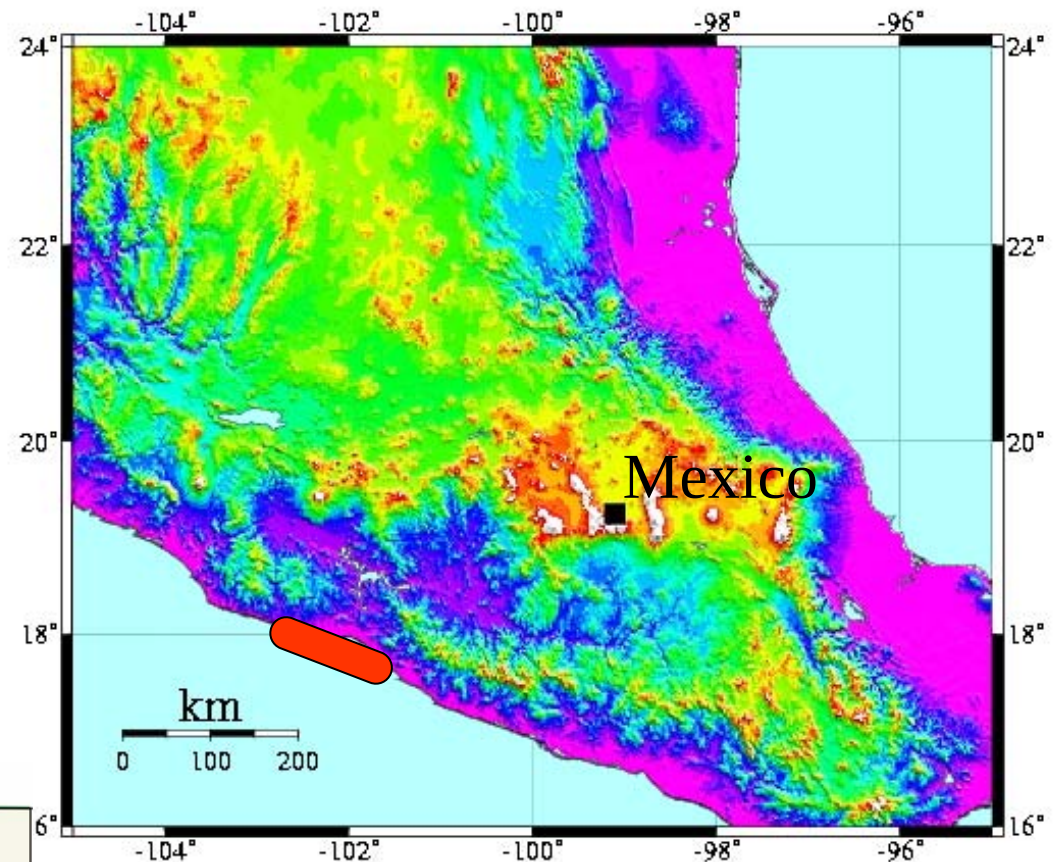
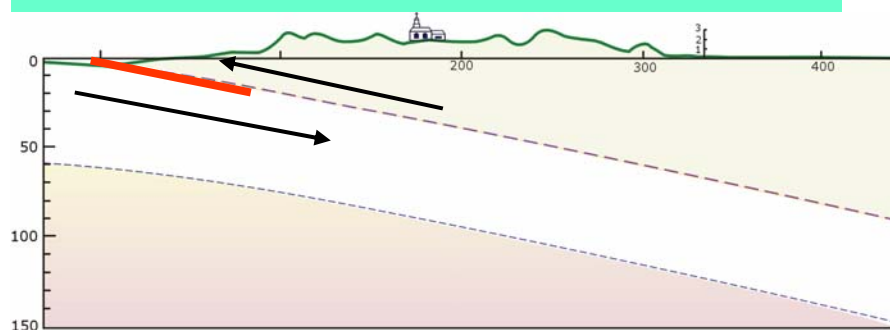
La propagation

Les effets locaux

Et ensuite?

Le séisme de 1985

Subduction sous la côte pacifique



Plusieurs milliers de victimes à Mexico

Rapport journalistique....

**SEP 19 13 17 47.3 18.190 N 102.533 W 28 6.8 8.1 1.3 311 MICHOACAN, MEXICO. Ms 7.9 (BRK), 7.9 (PAS).
Mo=1.1*10**21 Nm (HRV).**

At least 9,500 people were killed, about 30,000 were injured, more than 100,000 people were left homeless, and severe damage was caused in parts of Mexico City and in several states of central Mexico. According to some sources, the death toll from this earthquake may be as high as 35,000.

Four hundred twelve buildings collapsed and another 3,124 were seriously damaged in Mexico City. About 60 percent of the buildings were destroyed at Ciudad Guzman, Jalisco. Damage also occurred in the states of Colima, Guerrero, Mexico, Michoacan, Morelos, parts of Veracruz and in other areas of Jalisco.

The maximum Modified Mercalli intensity was IX at Mexico City, Ciudad Guzman and the Pacific Coast towns of Lazaro Cardenas, Ixtapa and La Union. Felt reports were received from Mazatlan, Sinaloa to Tuxtla Gutierrez, Chiapas, and as far away as Guatemala City, Guatemala and Houston, Texas.

Landslides caused damage at Atenquique, Jalisco and near Jala, Colima. Rockslides were reported along the highways in the Ixtapa area and sandblows and ground cracks were observed at Lazaro Cardenas.

A tsunami was generated which caused some damage at Lazaro Cardenas, Zihuatenejo and Manzanillo. Estimated wave heights were 3 meters at Zihuatenejo and 2.8 meters at Lazaro Cardenas.

It is estimated that the quake seriously affected an area of approximately 825,000 square kilometers, caused between 3 and 4 billion U.S. dollars of damage.

A large percentage of the buildings which were damaged in Mexico City were between 8 and 18 stories high, indicating possible resonance effects with dominant two-second period horizontal ground accelerations which were recorded in the area.





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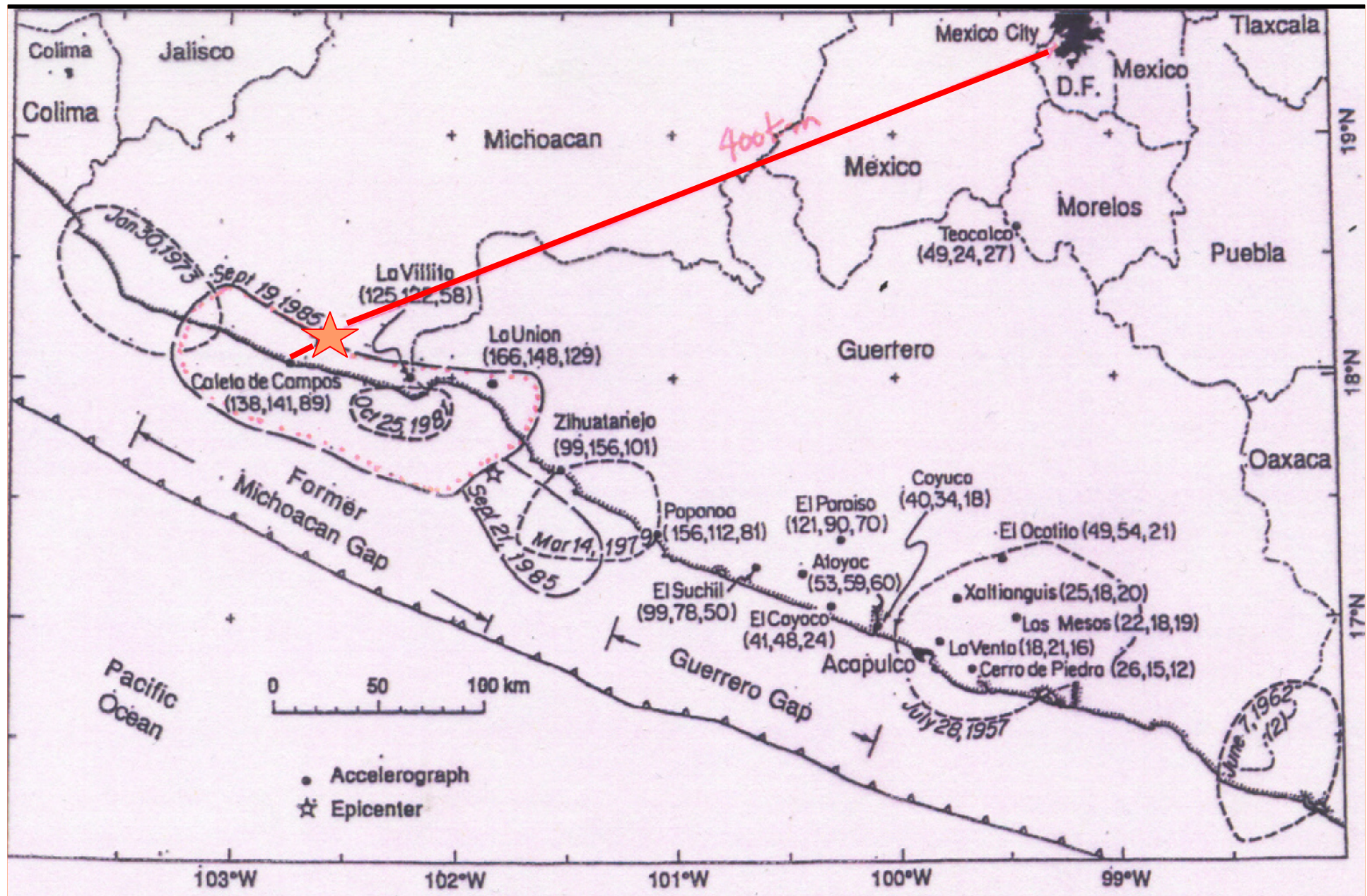
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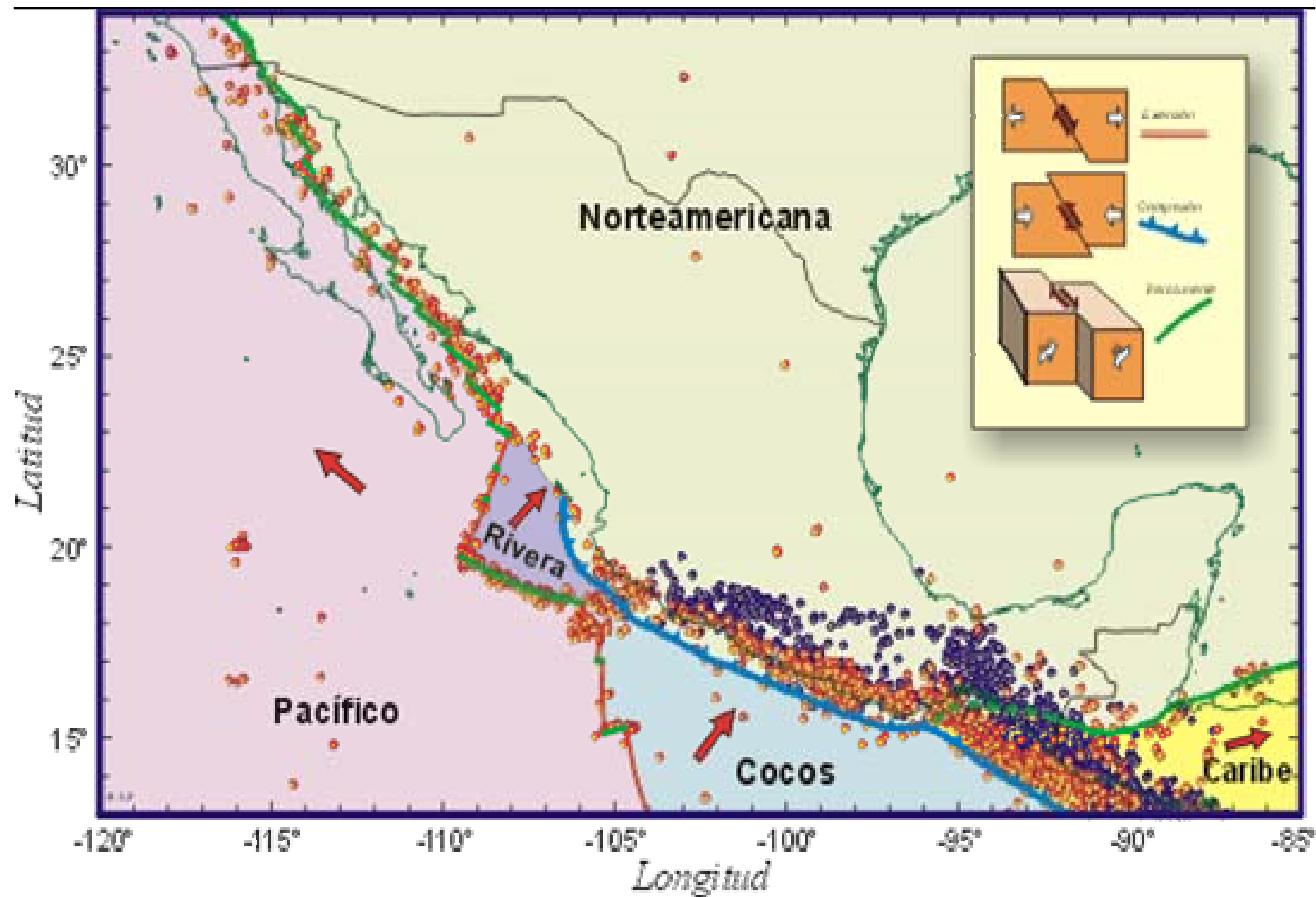
Les effets locaux

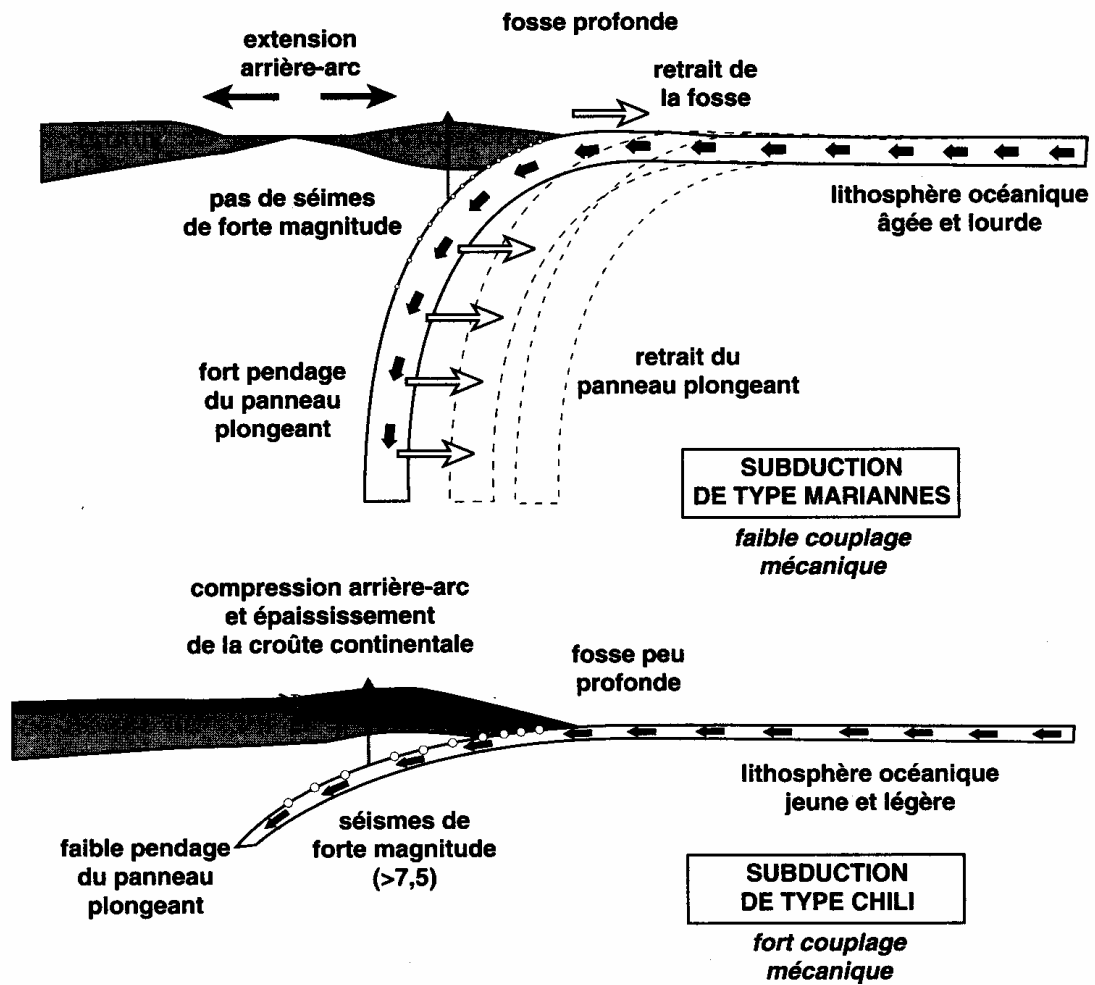
Et ensuite?

Sismo de Michoacán 19/sep/1985

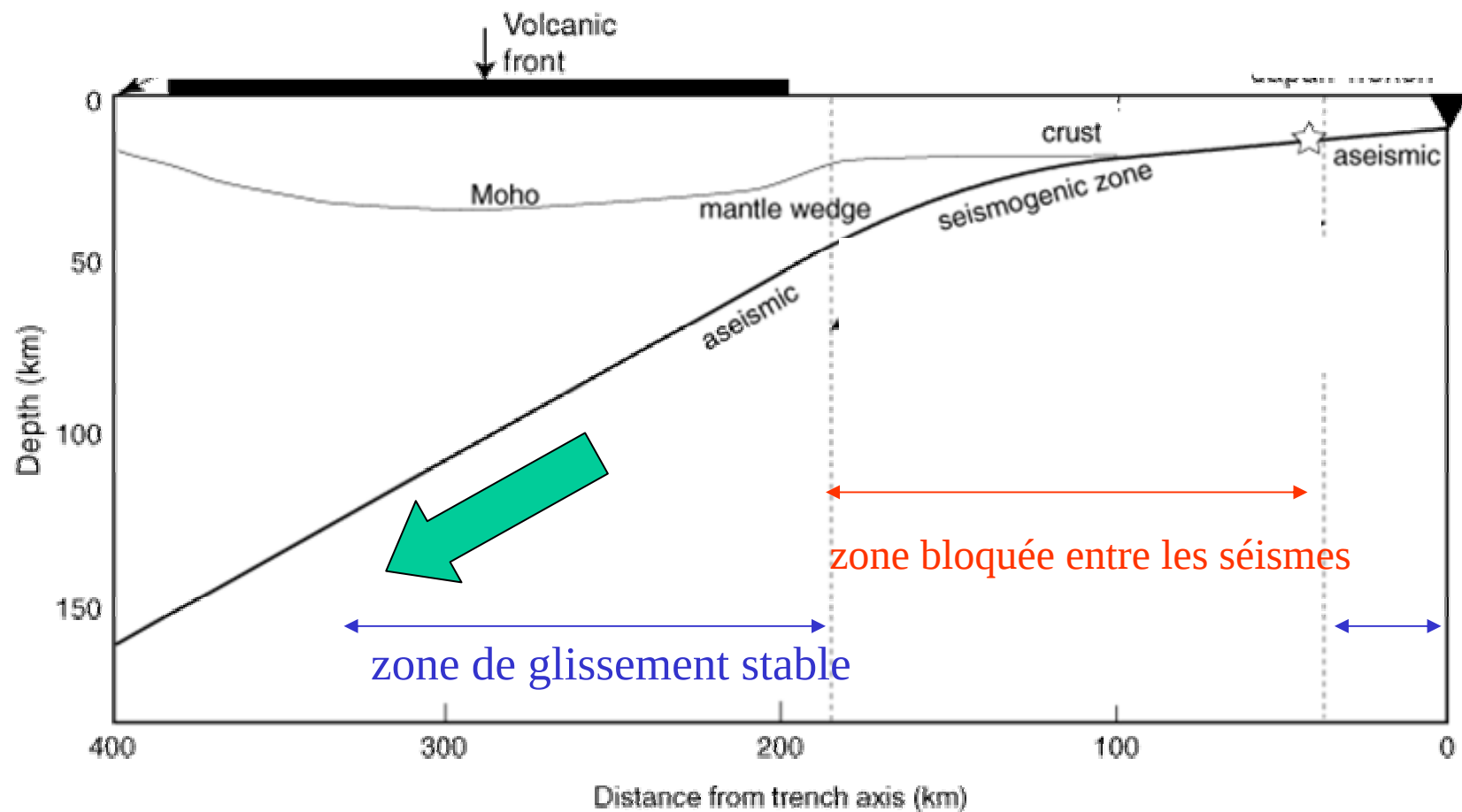


Fuente





Modèle de fonctionnement



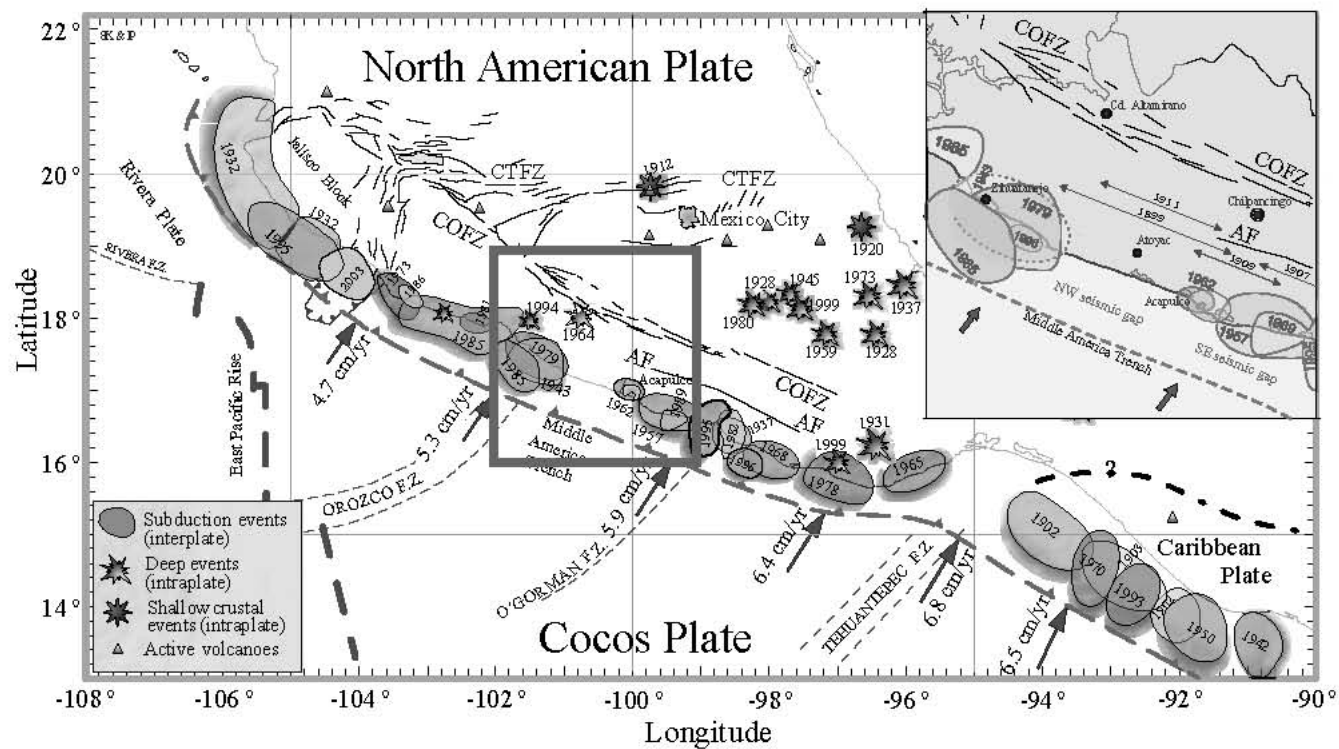
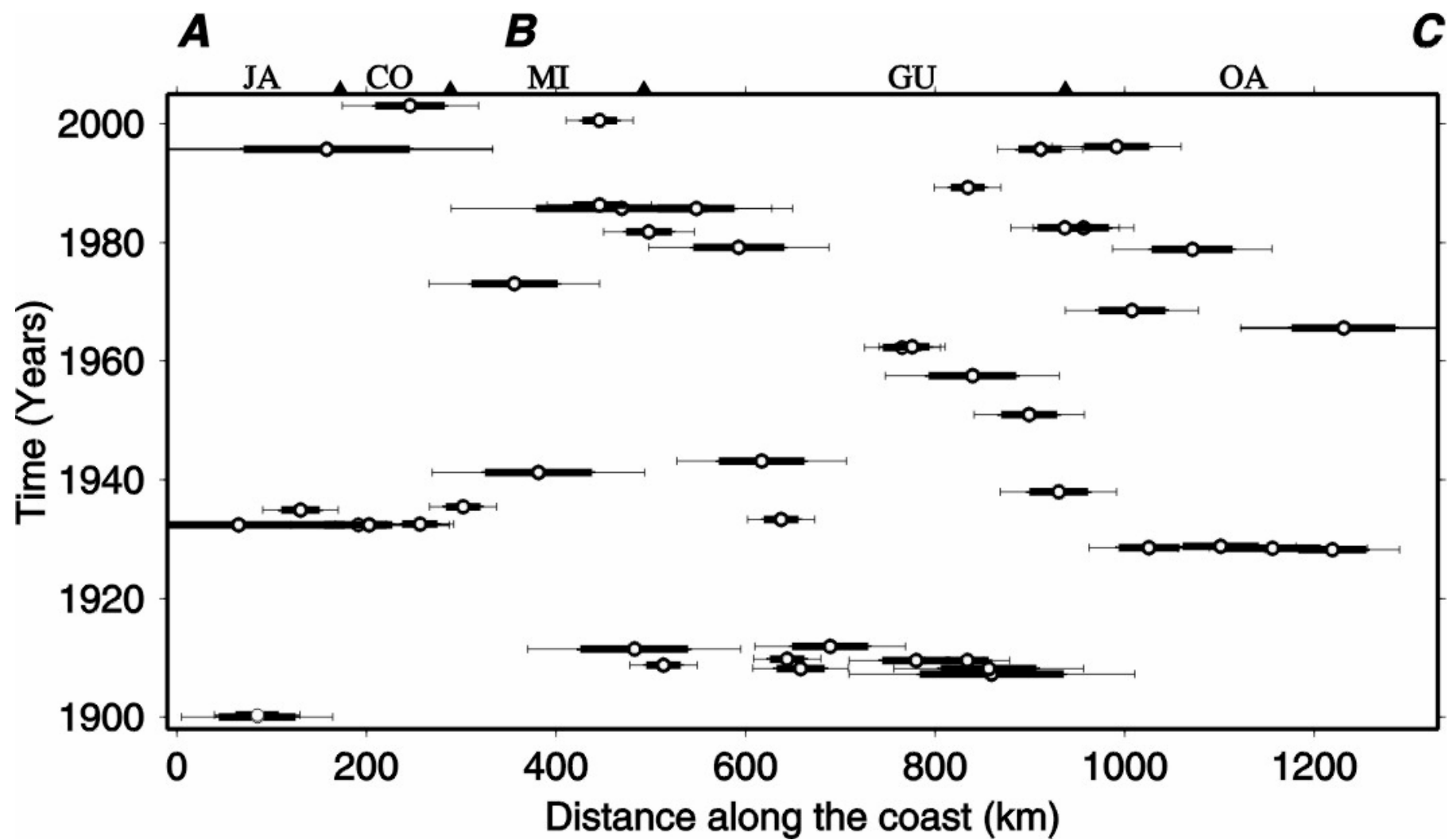
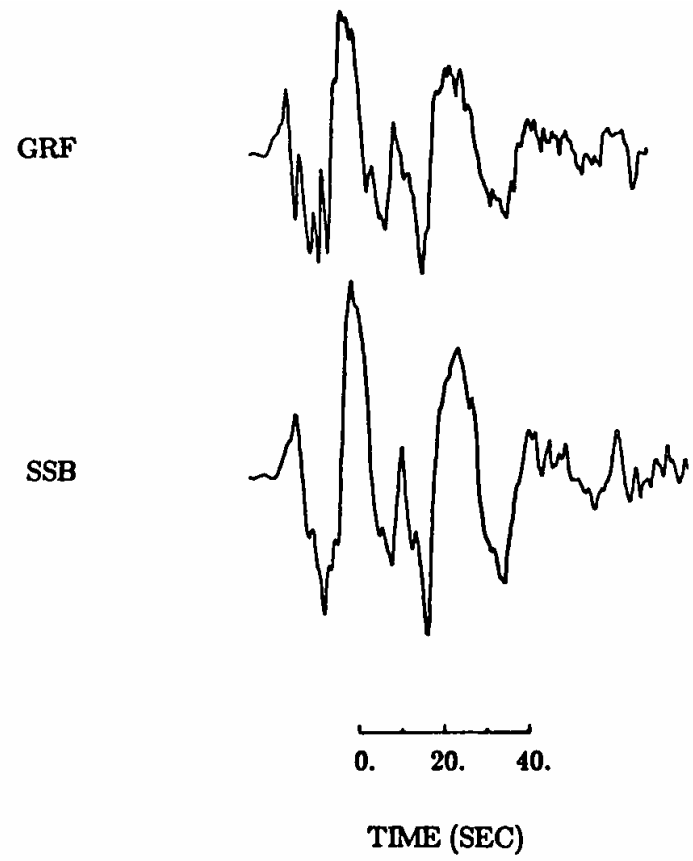
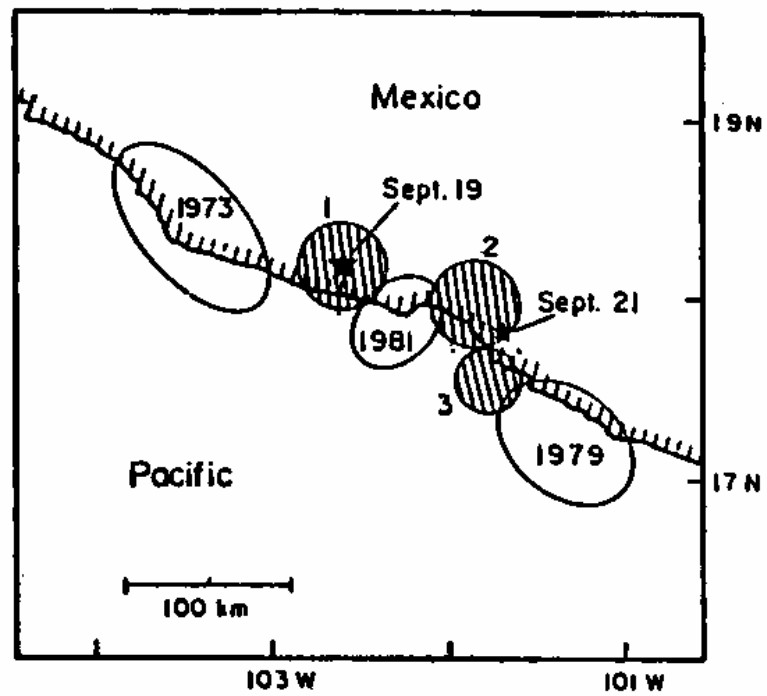


Figure 1. Seismotectonics of southern Mexico. Arrows indicate the direction and magnitude of NUVEL1-A relative plate motion (DeMets et al. 1994). Major earthquake slip zones are shown with the year of the event. Dark gray box shows location of inset, which expands the tectonic setting of the Guerrero seismic gap. Inferred extent of rupture for earthquakes that predate seismic instrumentation are indicated by double-headed lines. AF denotes Atoyac fault; COFZ: Chapala-Oaxaca fault zone; CTFZ: Chapala-Tula fault zone after Johnson & Harrison (1990).









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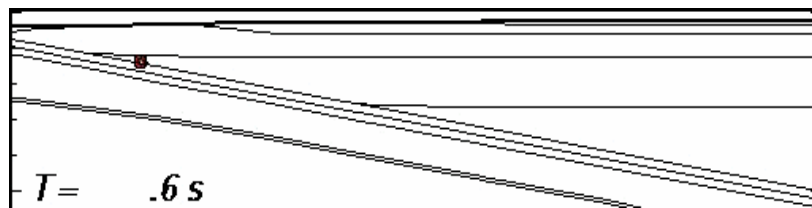
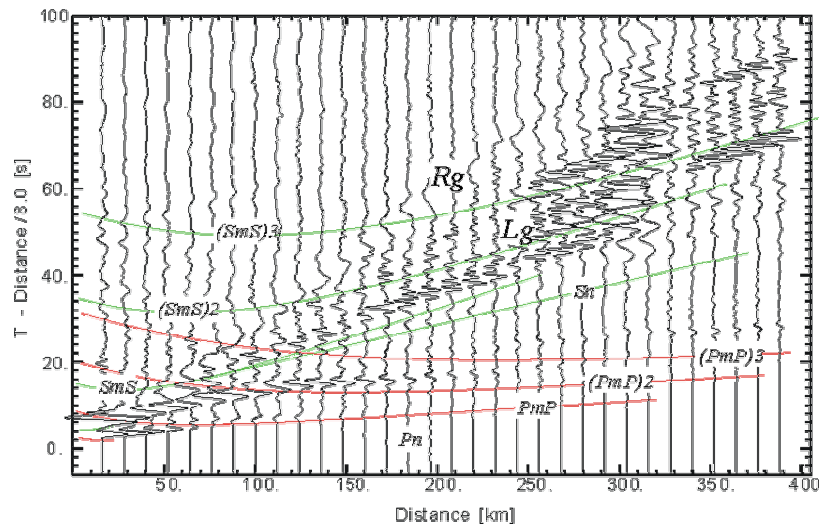
Les effets locaux

Et ensuite?

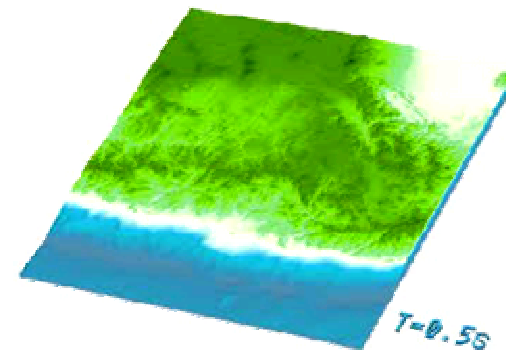
Lg wave and regional wavefield in Mexico

Shallow, subduction zone event produce large **Lg wave** along propagation path to Mexico City

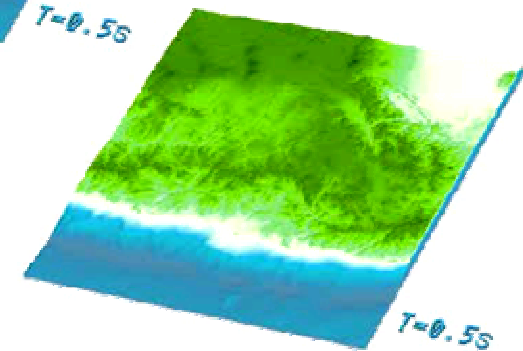
Inland path from coast to Mexico City is a good wave propagator for frequency around **2s (0.5 Hz)**



Furumura and Kennett (1998)

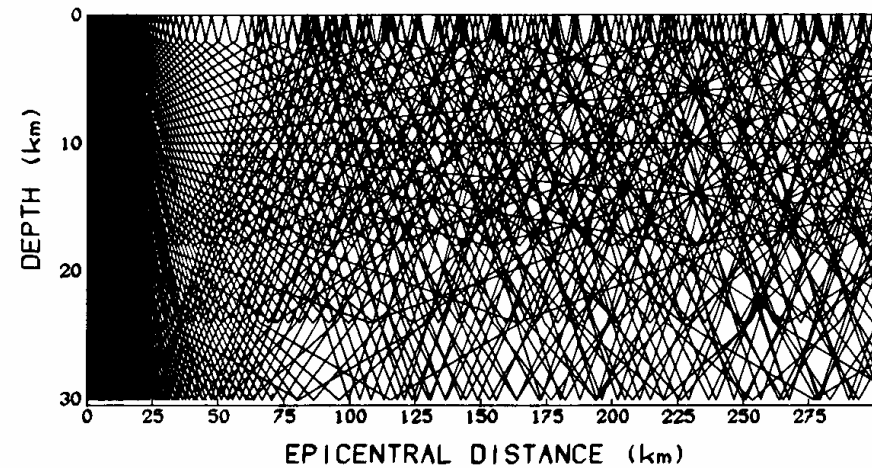
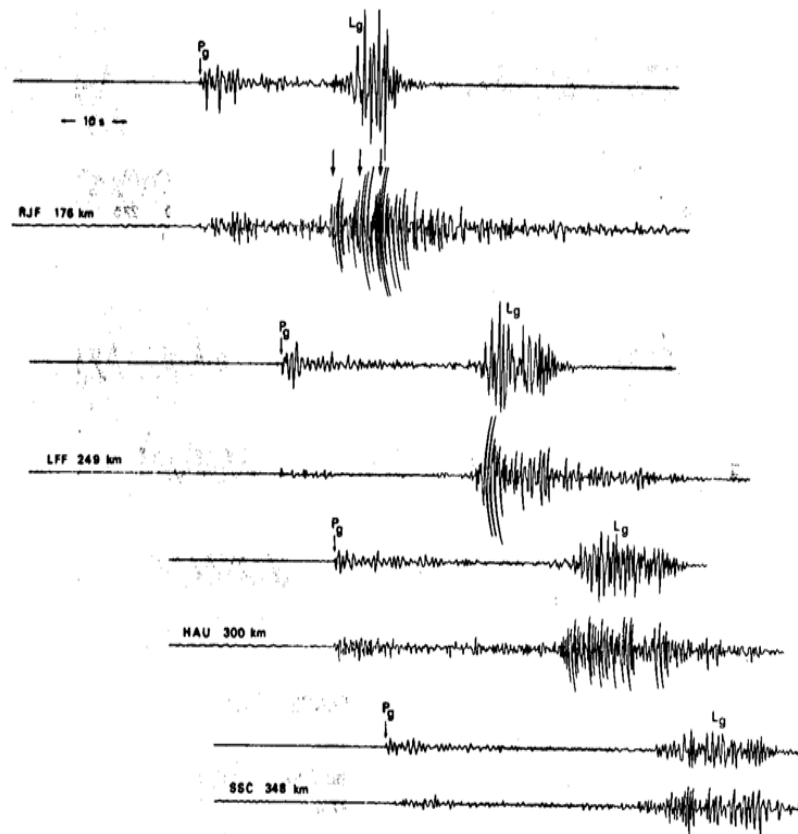


1995 Guerrero Earthquake



1997 Oaxaca Earthquake

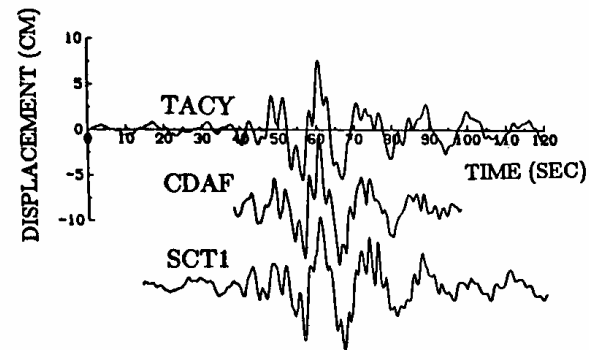
Lg:
multiple critical reflection in the continental crust
or
Rayleigh and Love high frequency higher modes



Simulation of observations

Lg and strong motion: the case of the Michoacan earthquake of 1985

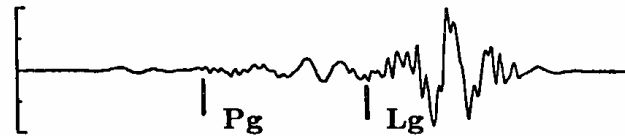
Observations



(C)

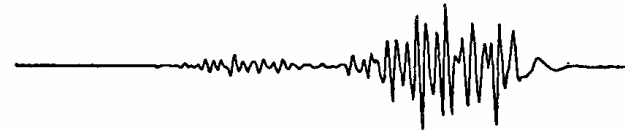
Model

Broad band



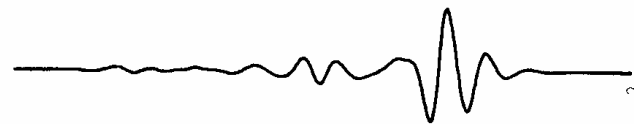
Lg

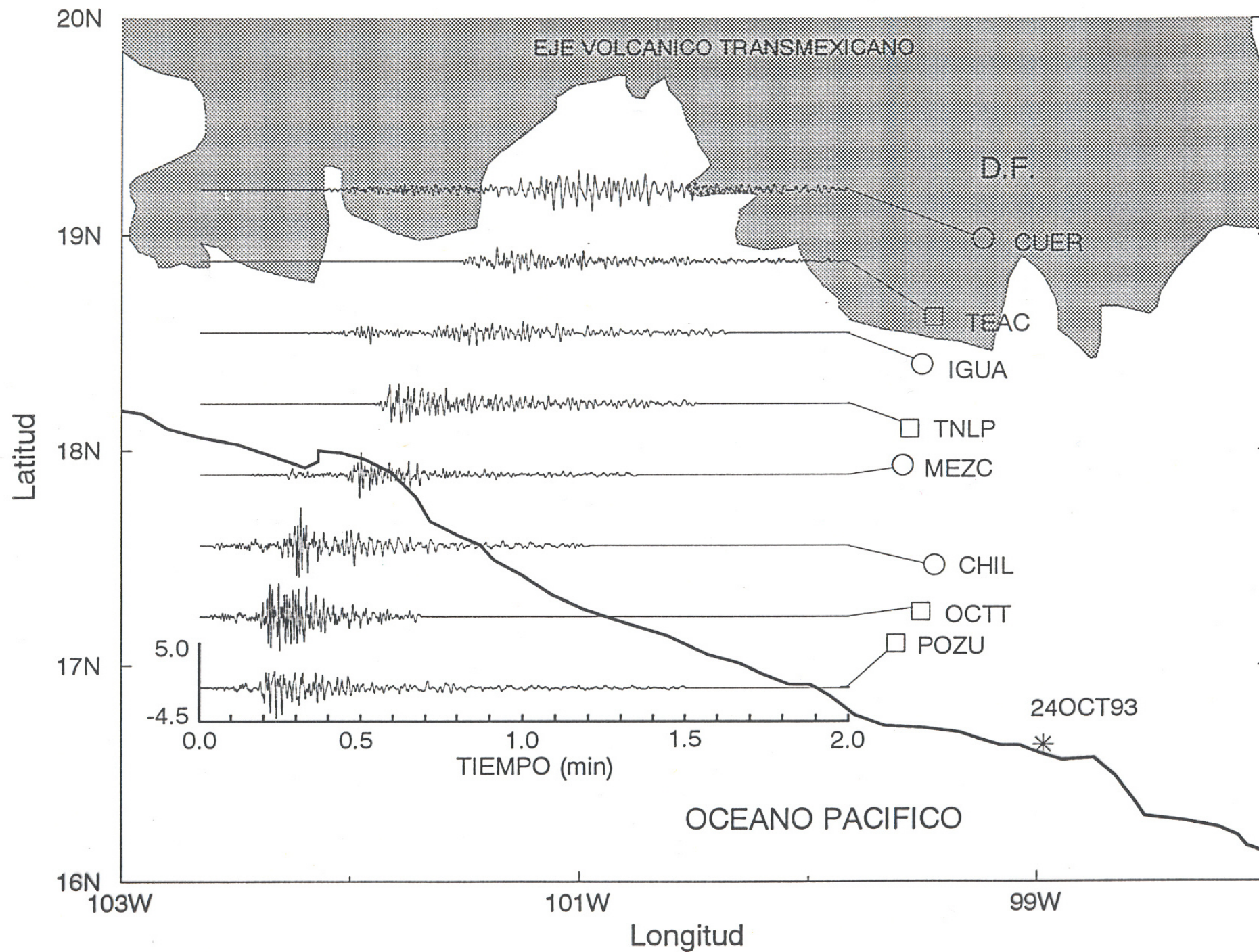
(B)



Fundamental
Rayleigh

(A)





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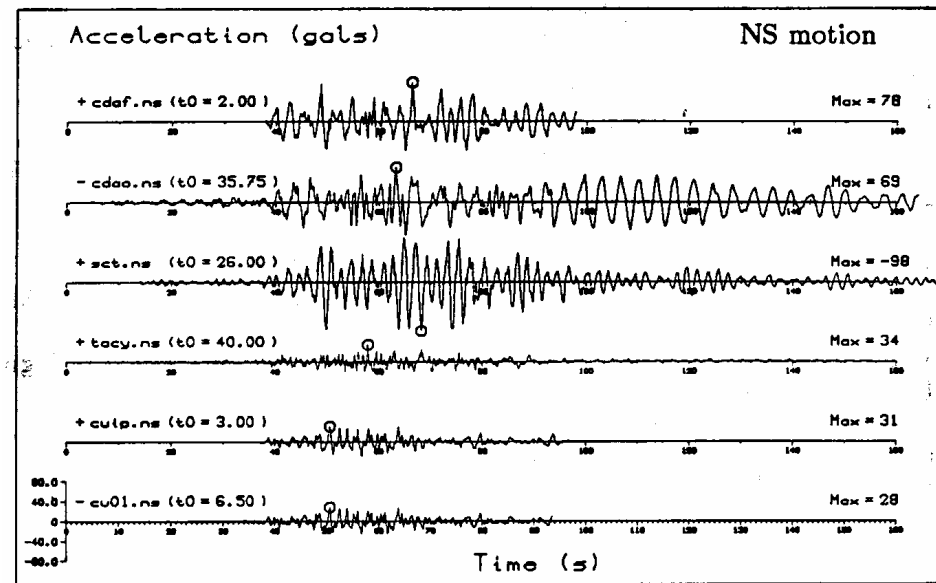
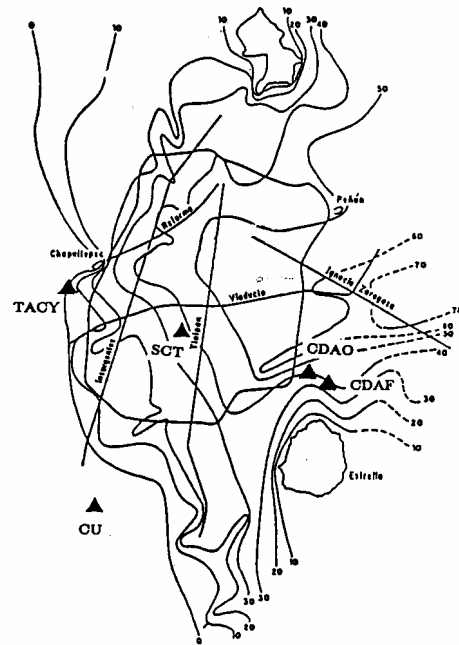
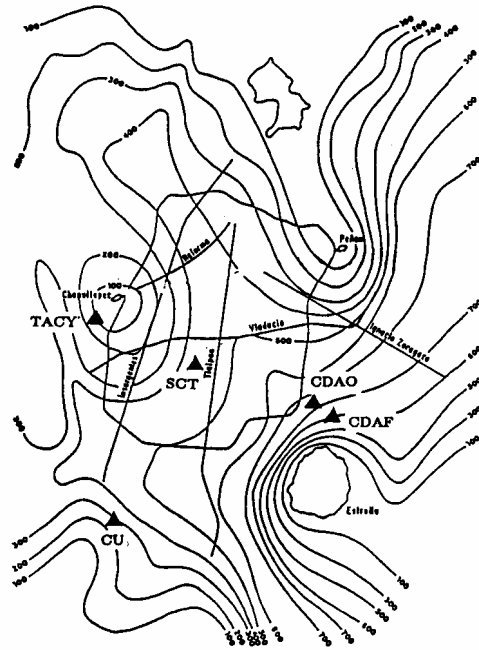
Les faits

La source

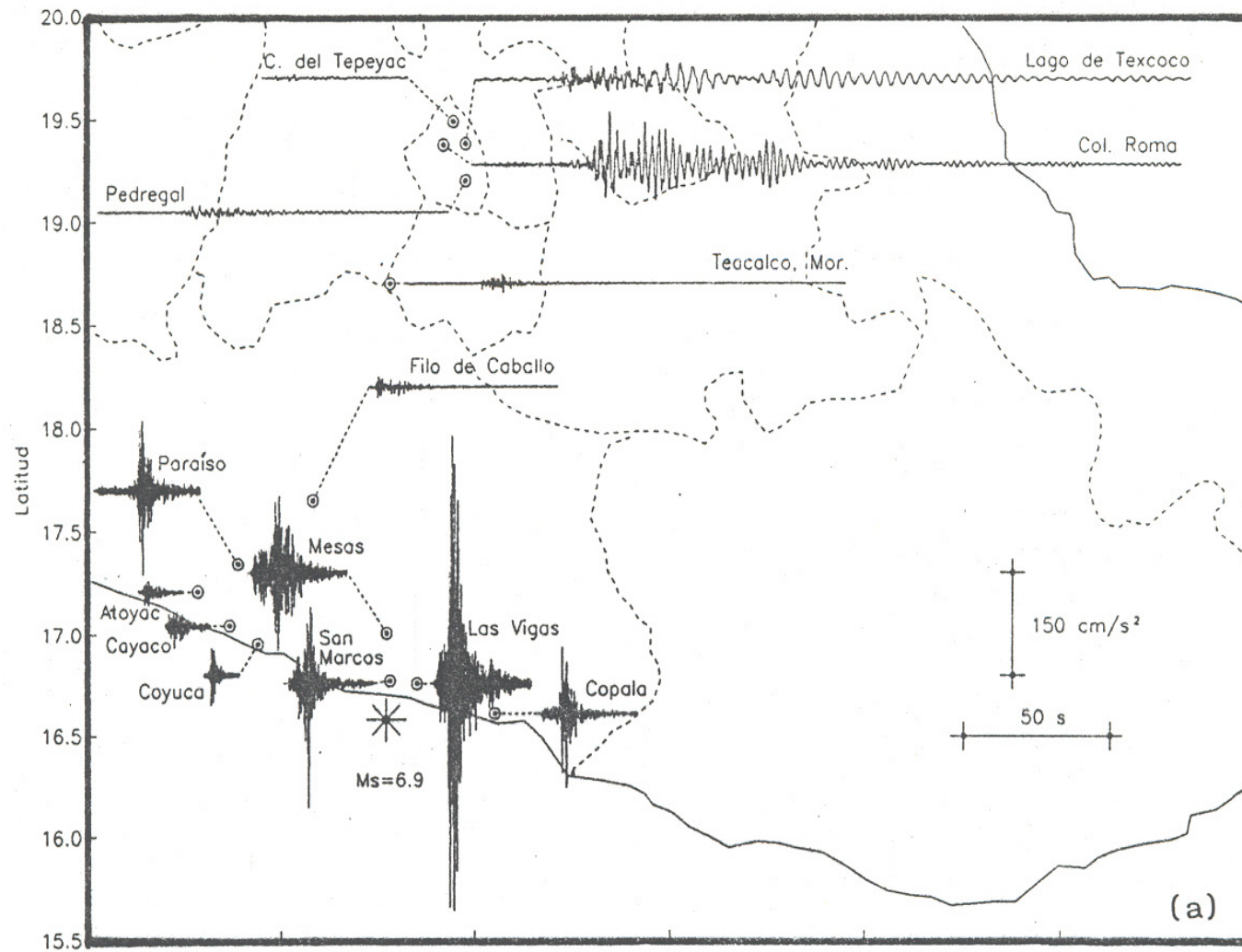
La propagation

Les effets locaux

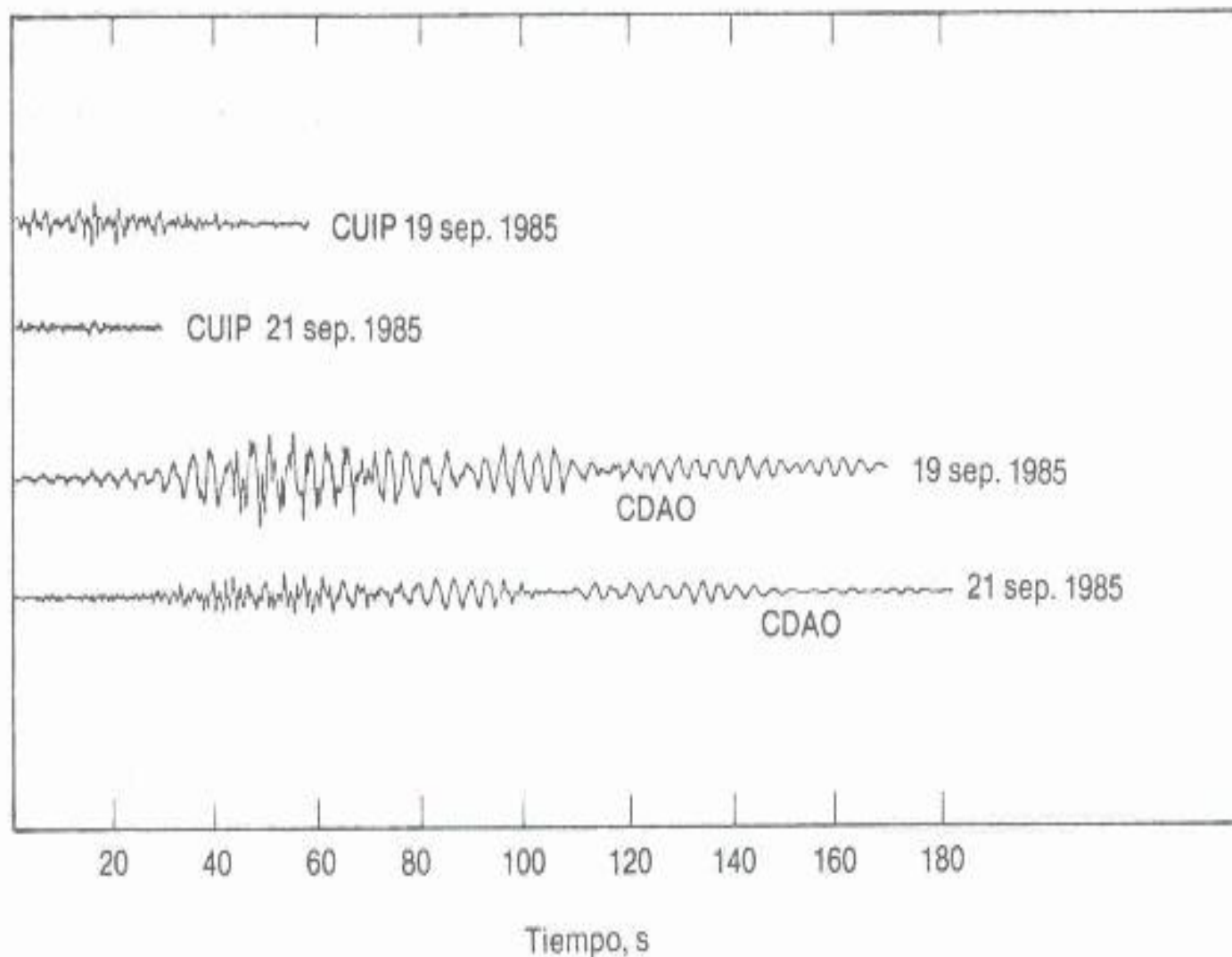
Et ensuite?

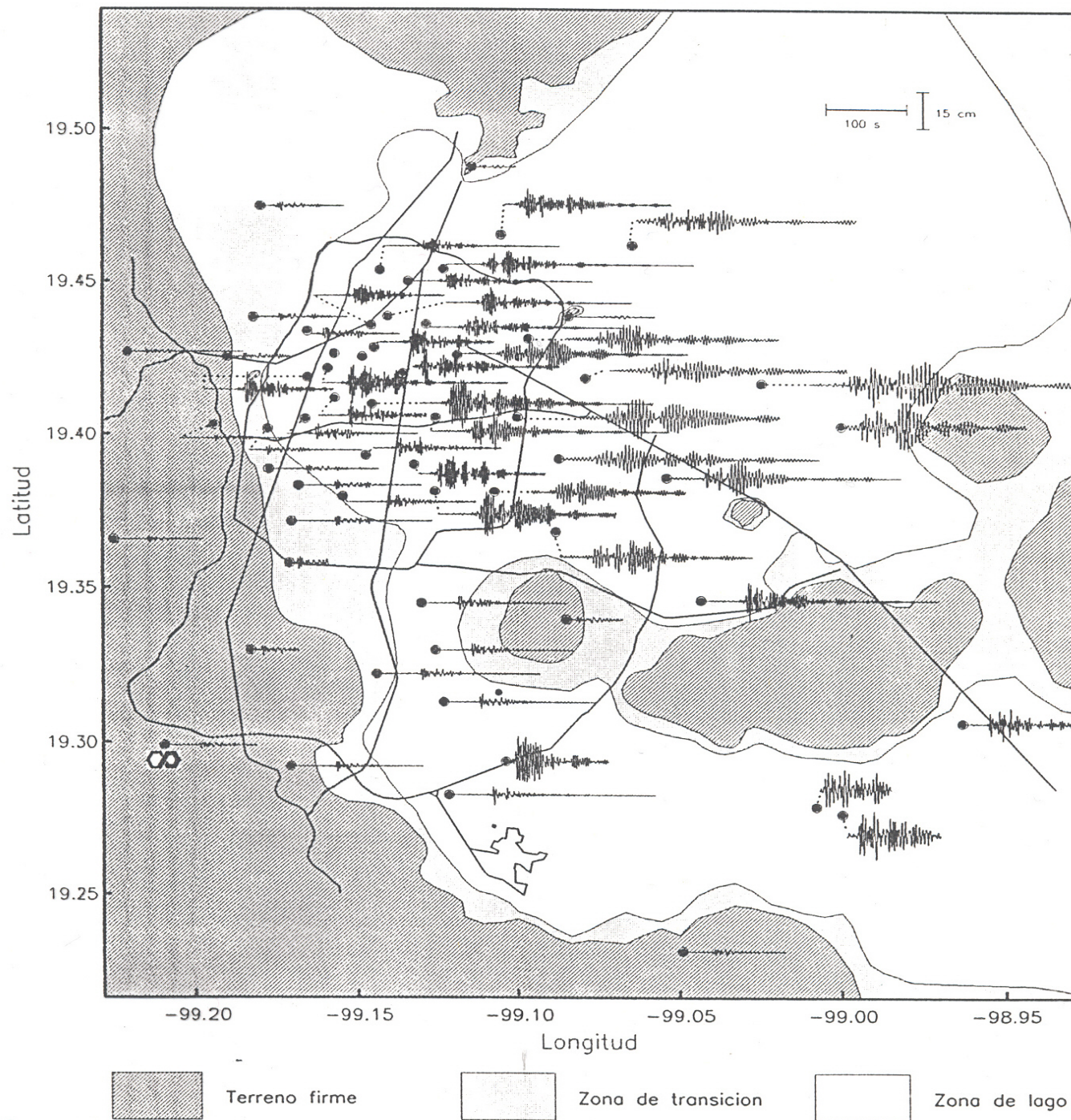


Effet de site



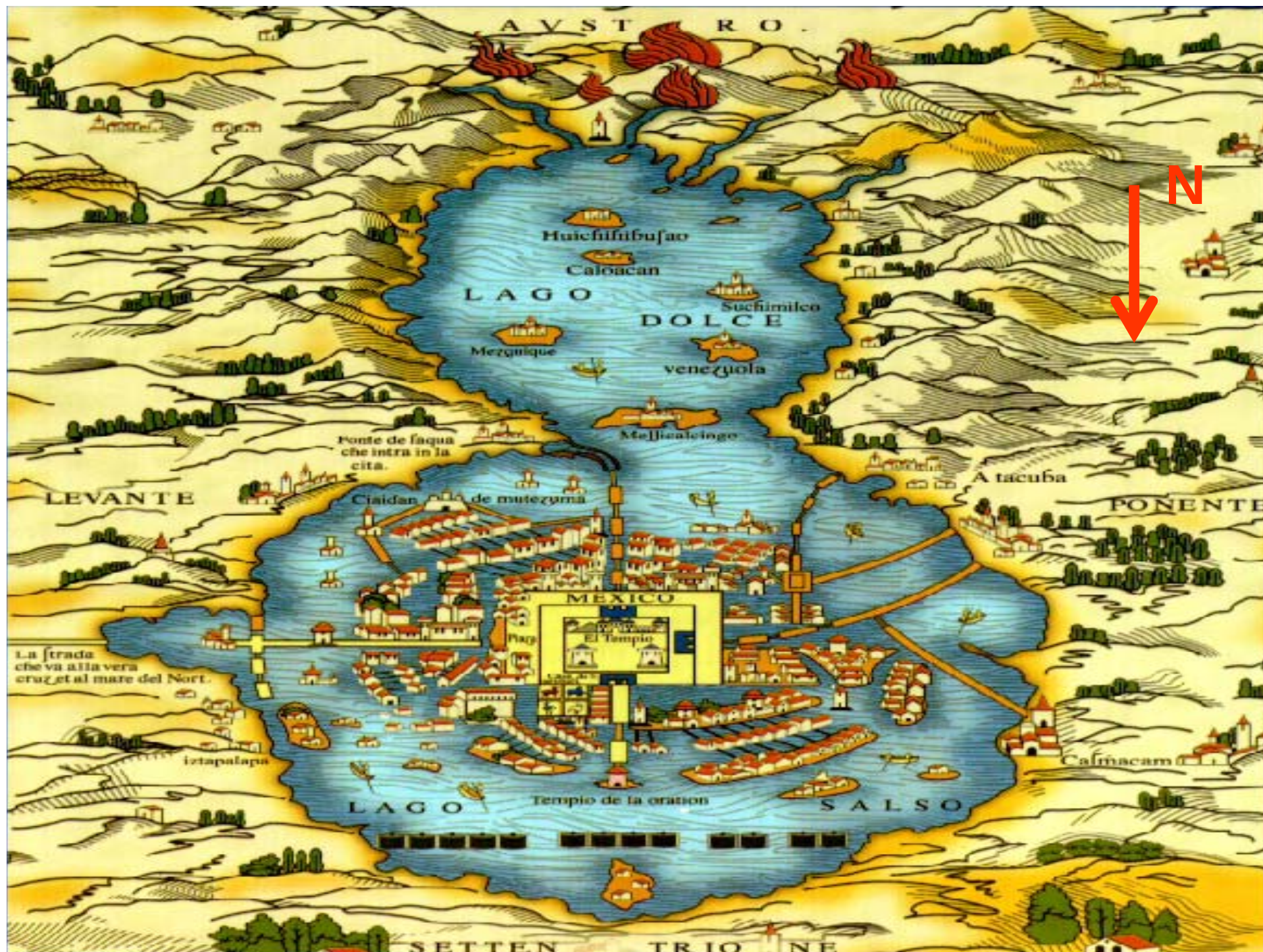
Origine locale de la durée







Conditions historiques de l'implantation de Mexico





Alonso de Santacruz (1531)

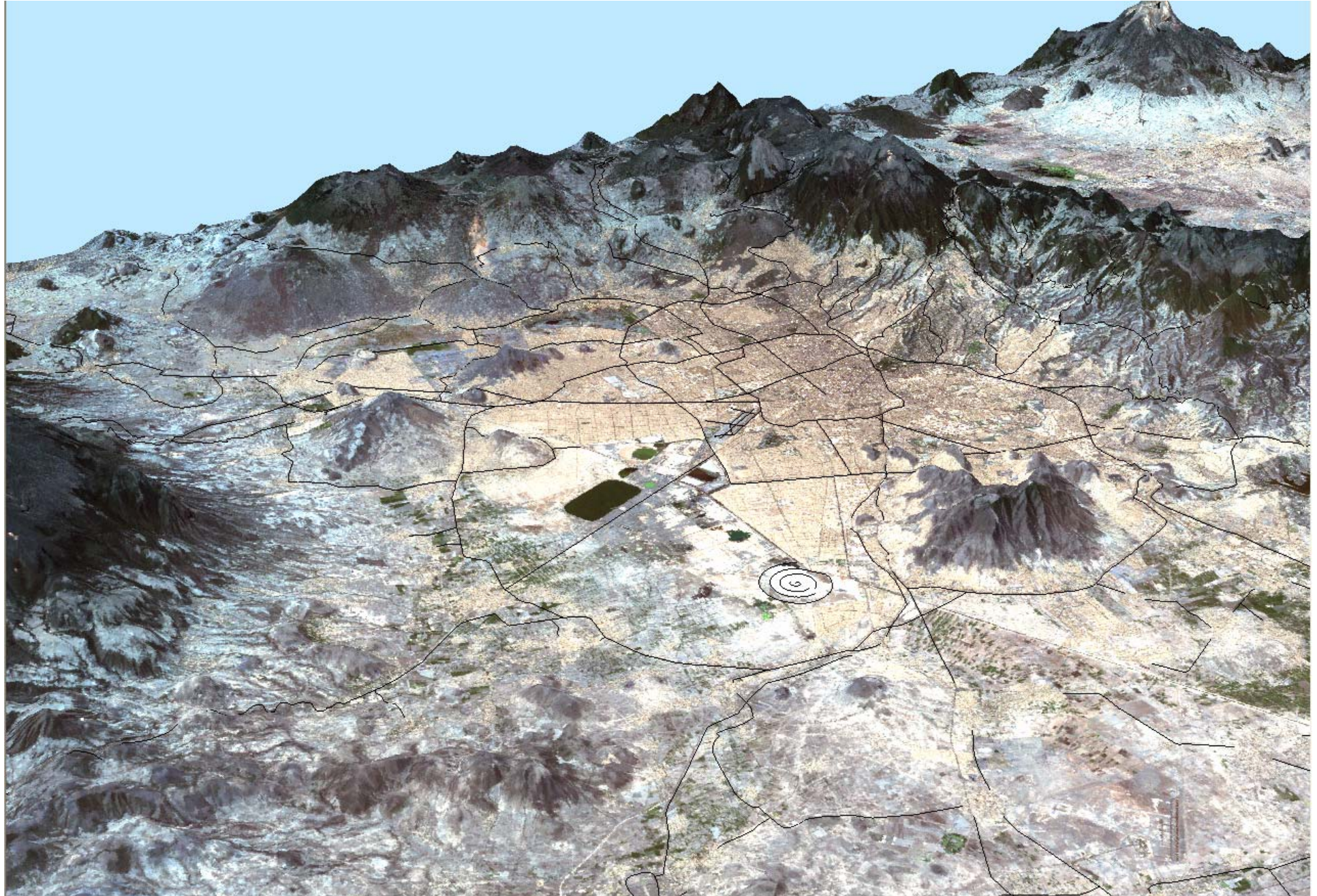
Casimiro Castro (1831)

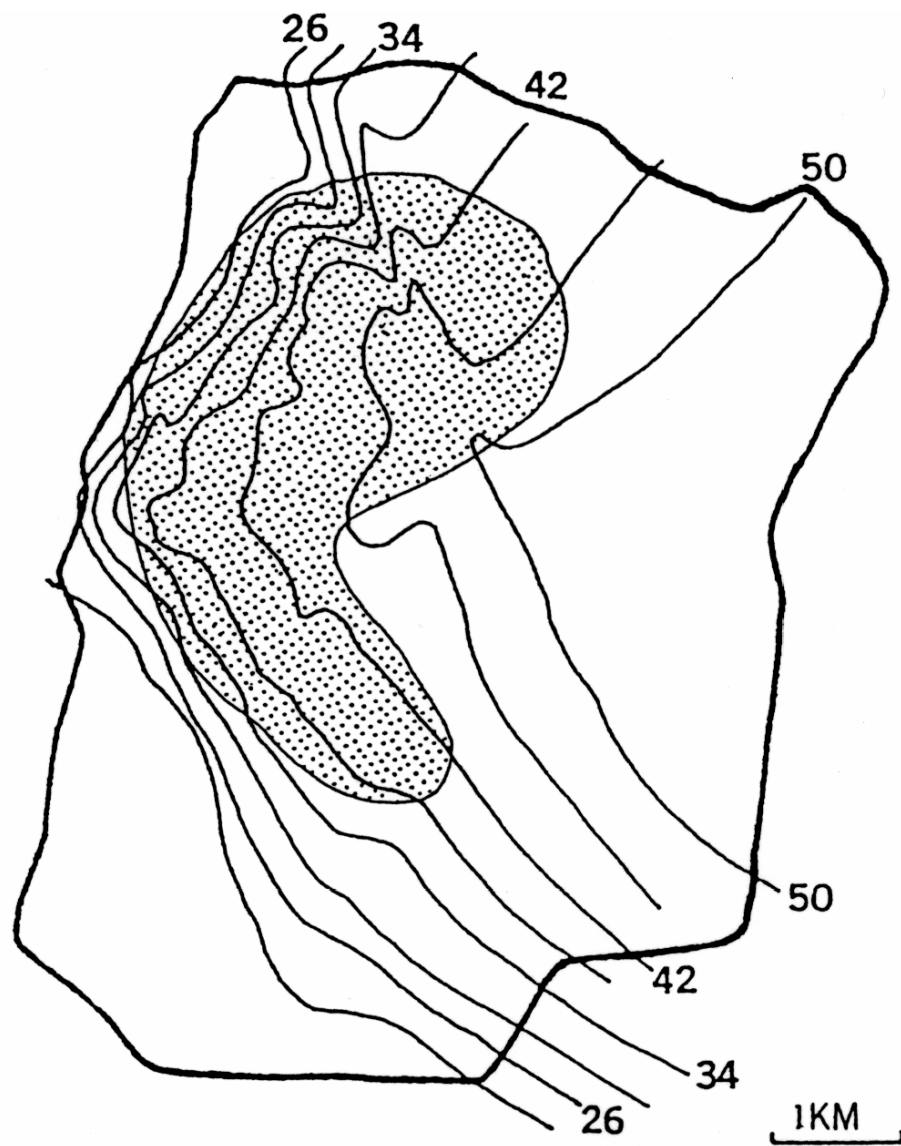


Tenochtitlan: le lac aujourd'hui

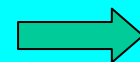
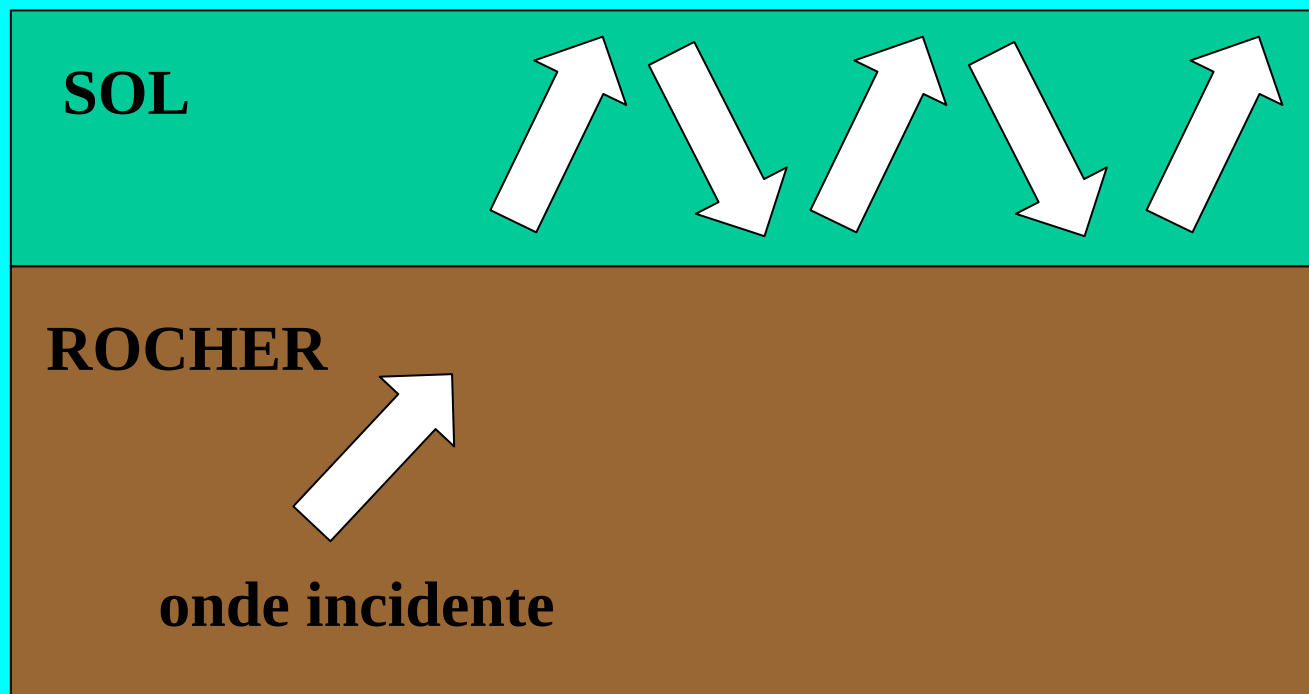


« ...as a cup of jelly. »



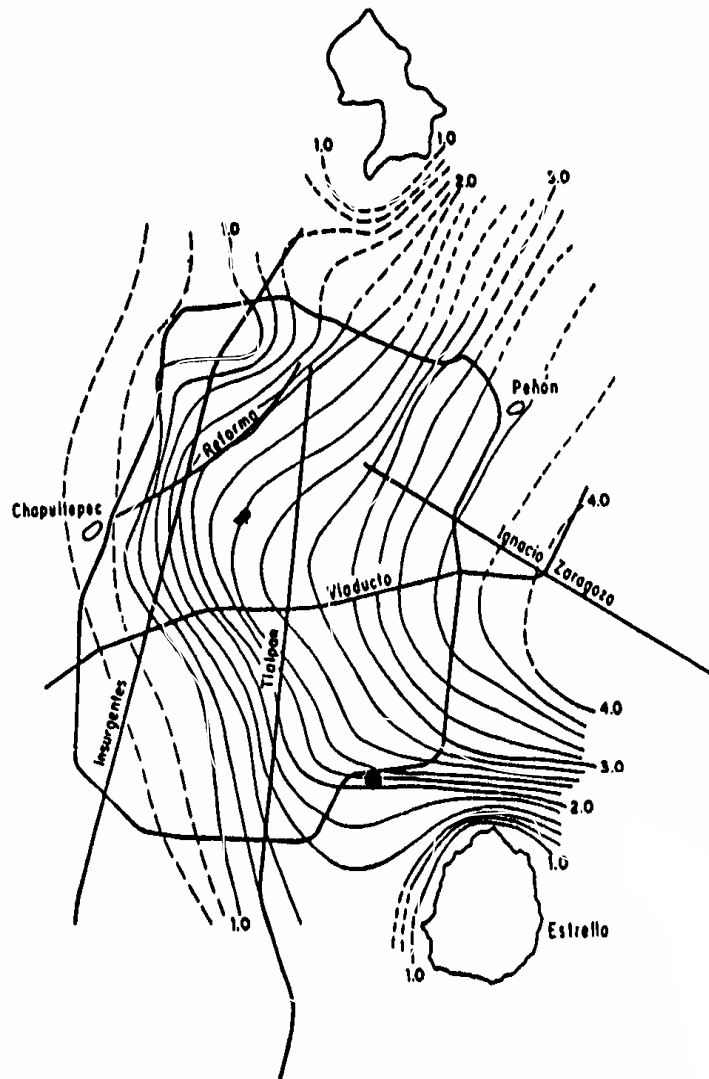


Principe de la résonance dans les couches

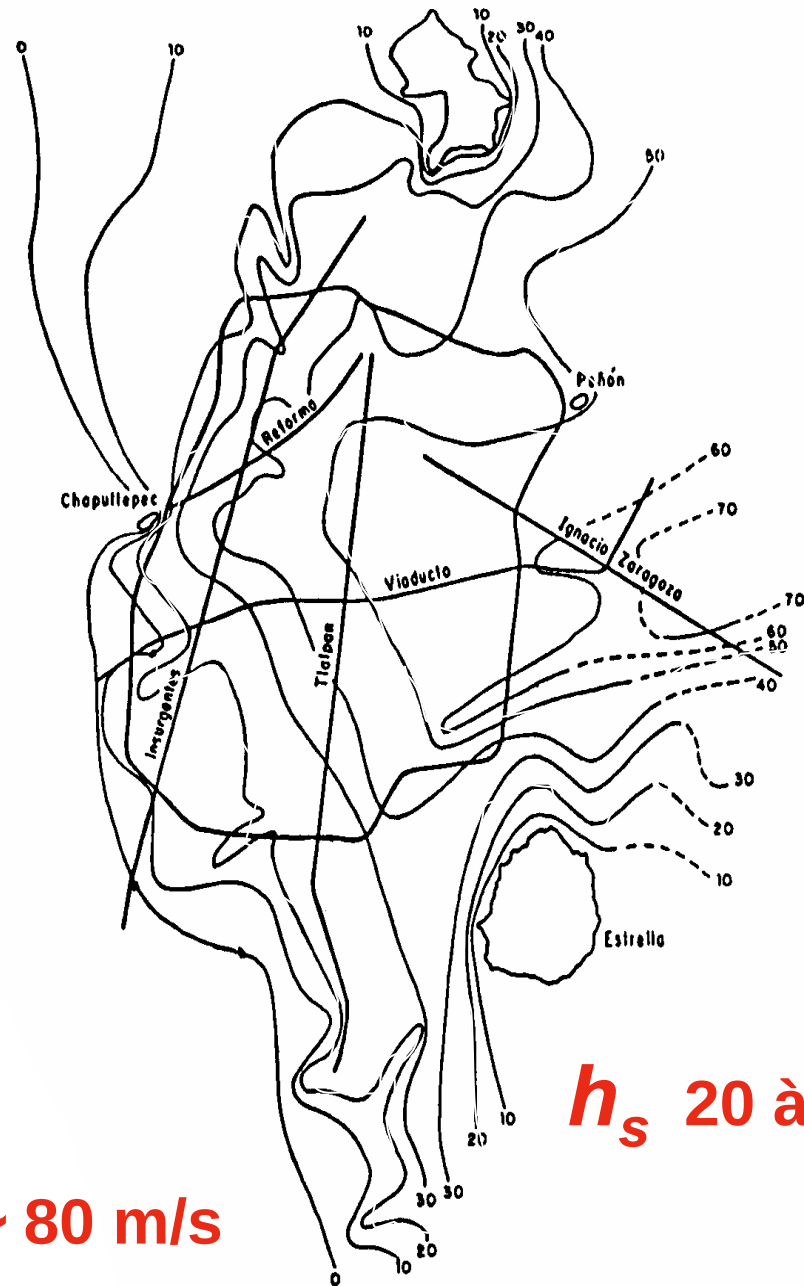


Fréquences spécifiques

T_s 1 à 3 s

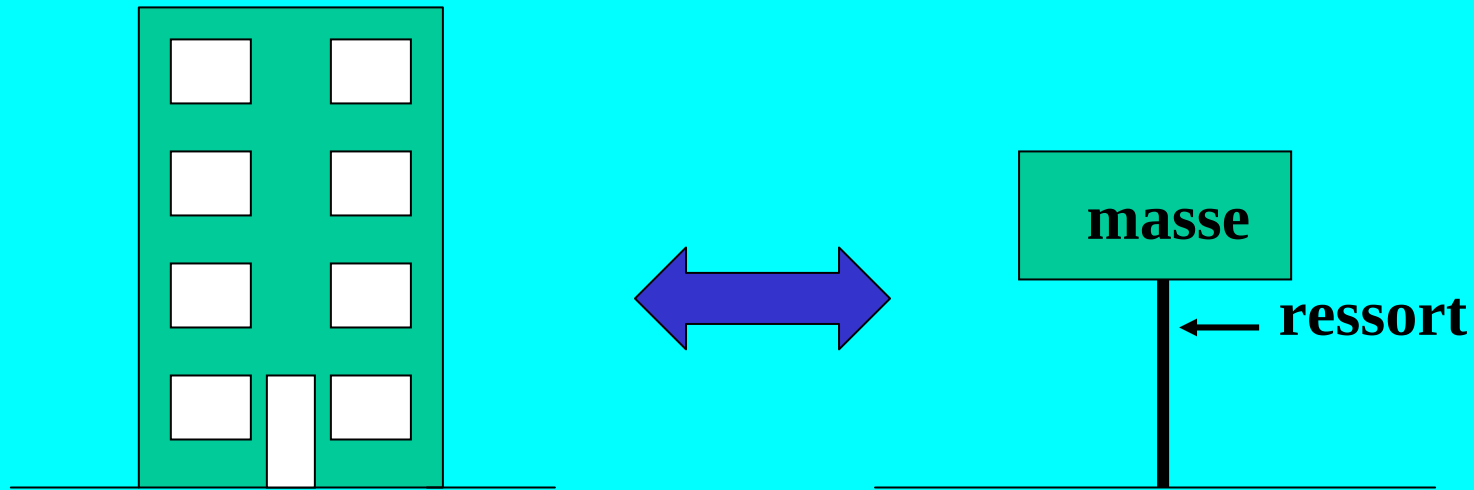


$$T_s = 4h_s/\beta; \quad \beta \sim 80 \text{ m/s}$$



h_s 20 à 50 m

Principe (sommaire) de la résonance des bâtiments

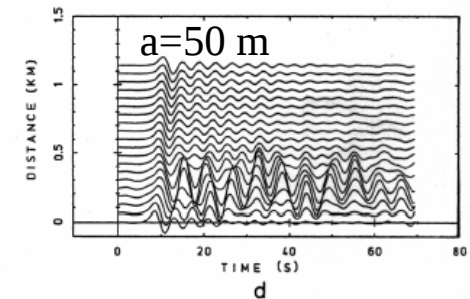
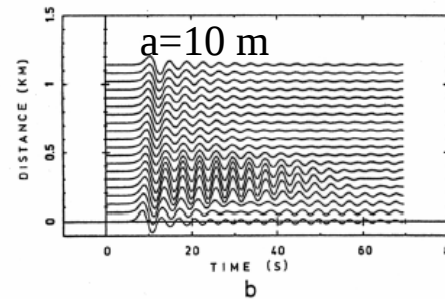
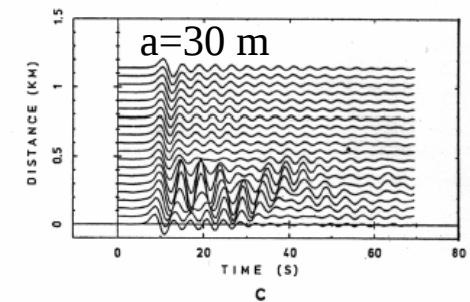
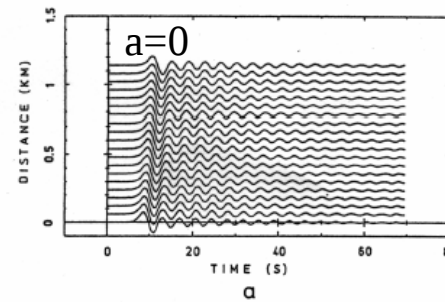
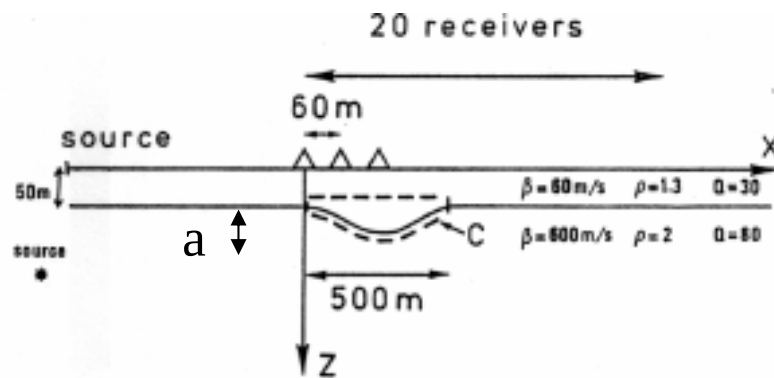
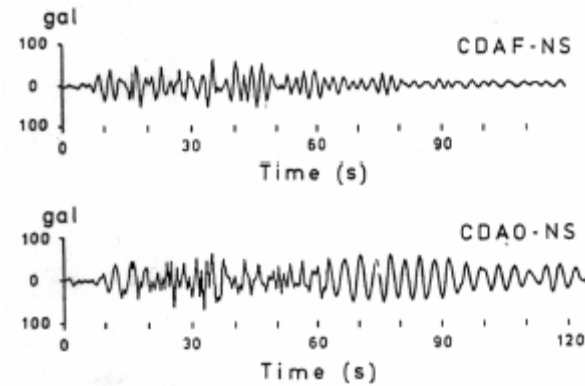




Les leçons à tirer....

Le problème de la durée (résistance des matériaux de construction)

Un effet très local:
2 stations à 800 m de distance



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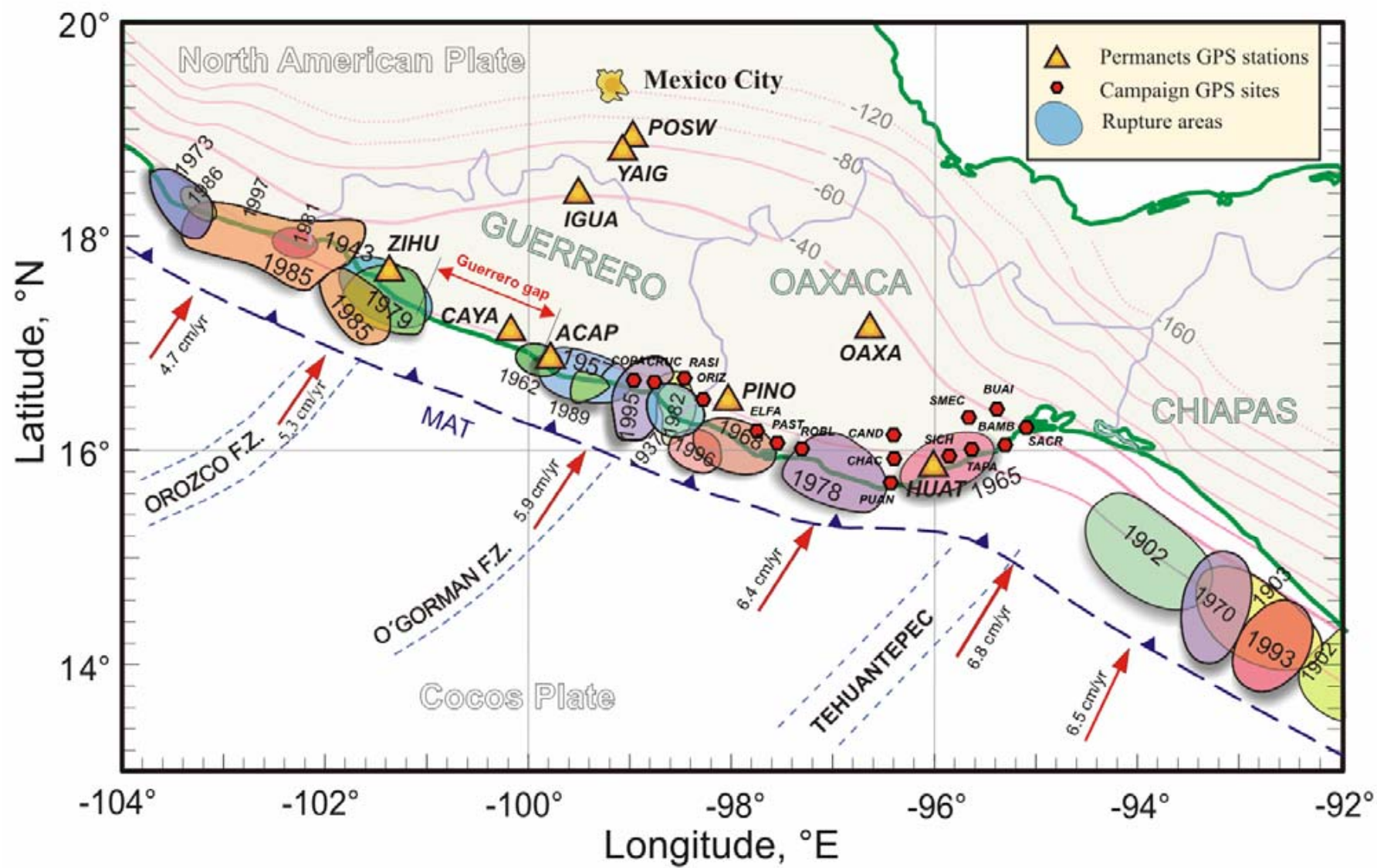
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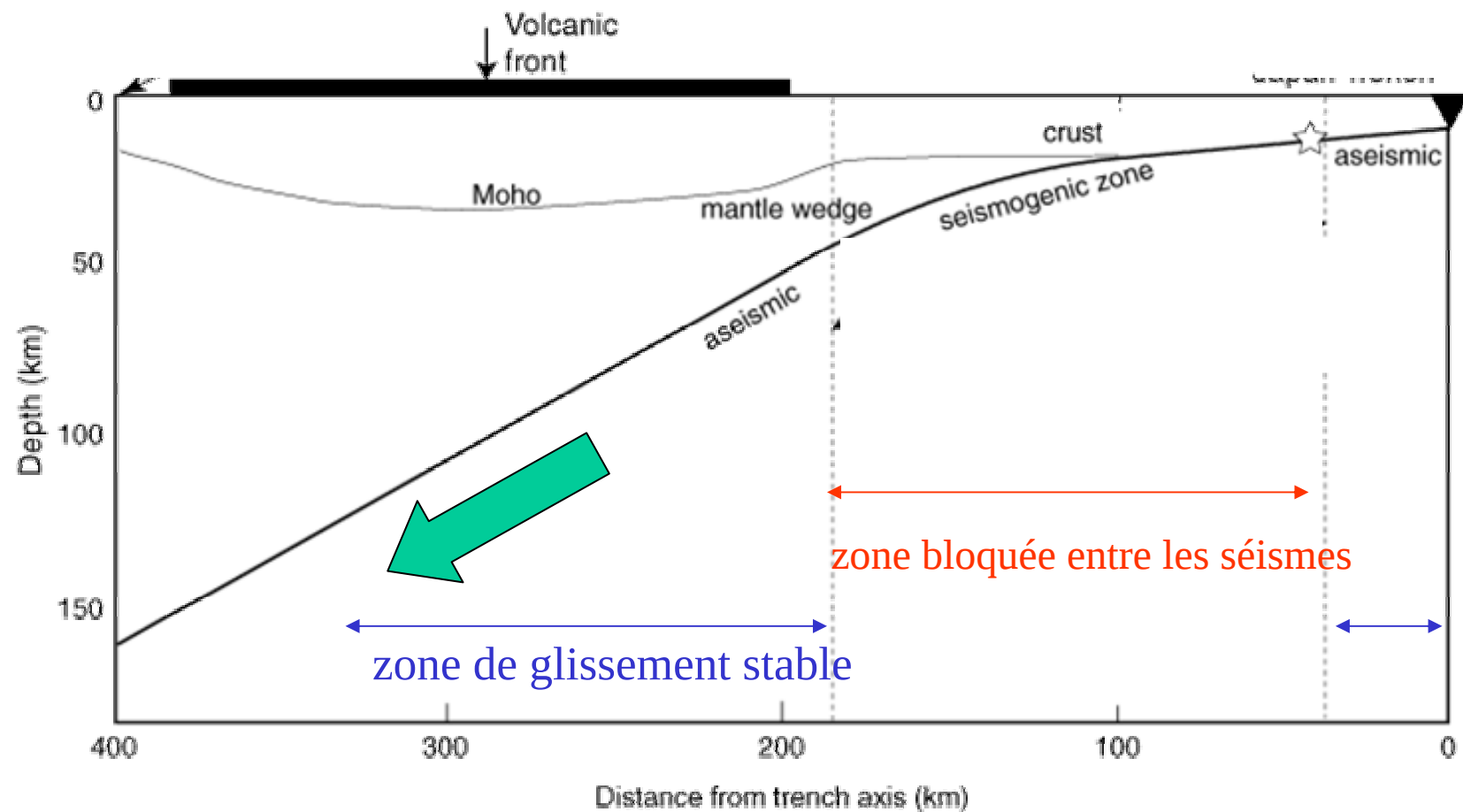
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Les effets locaux

Et ensuite?



Modèle de fonctionnement



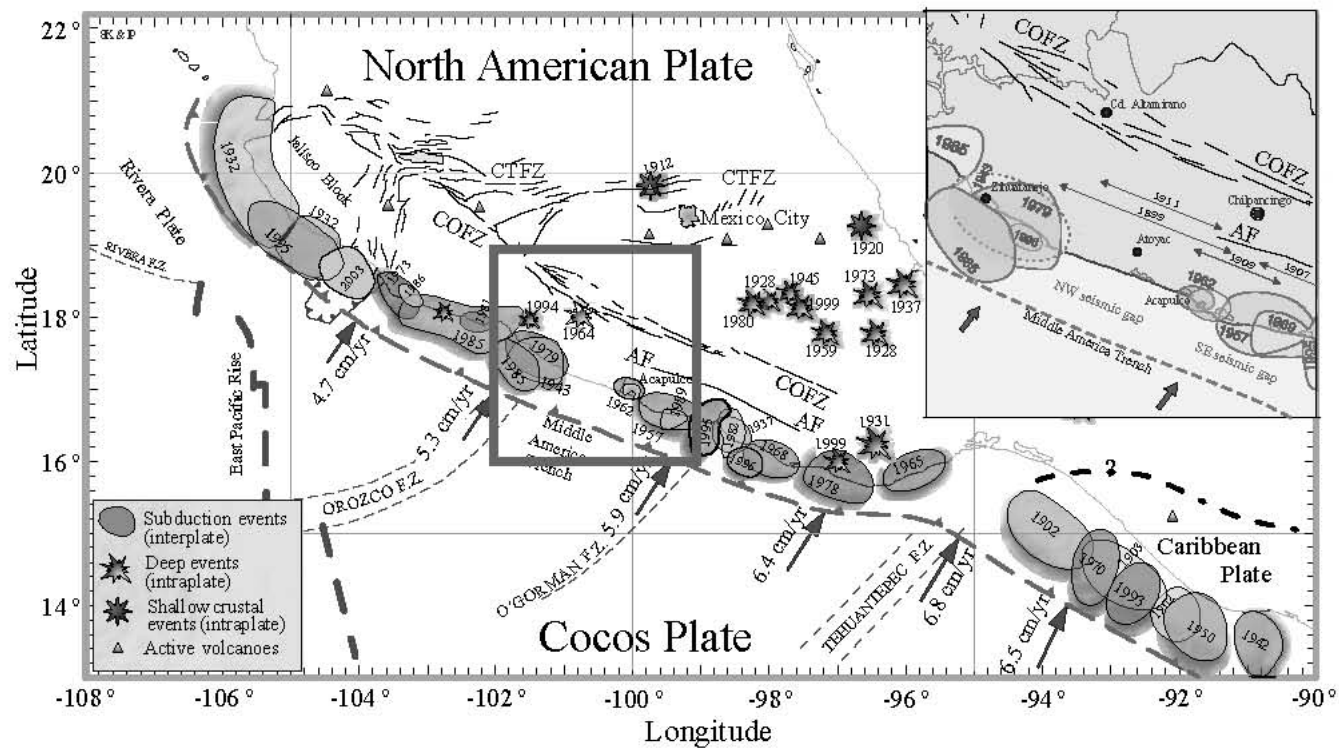
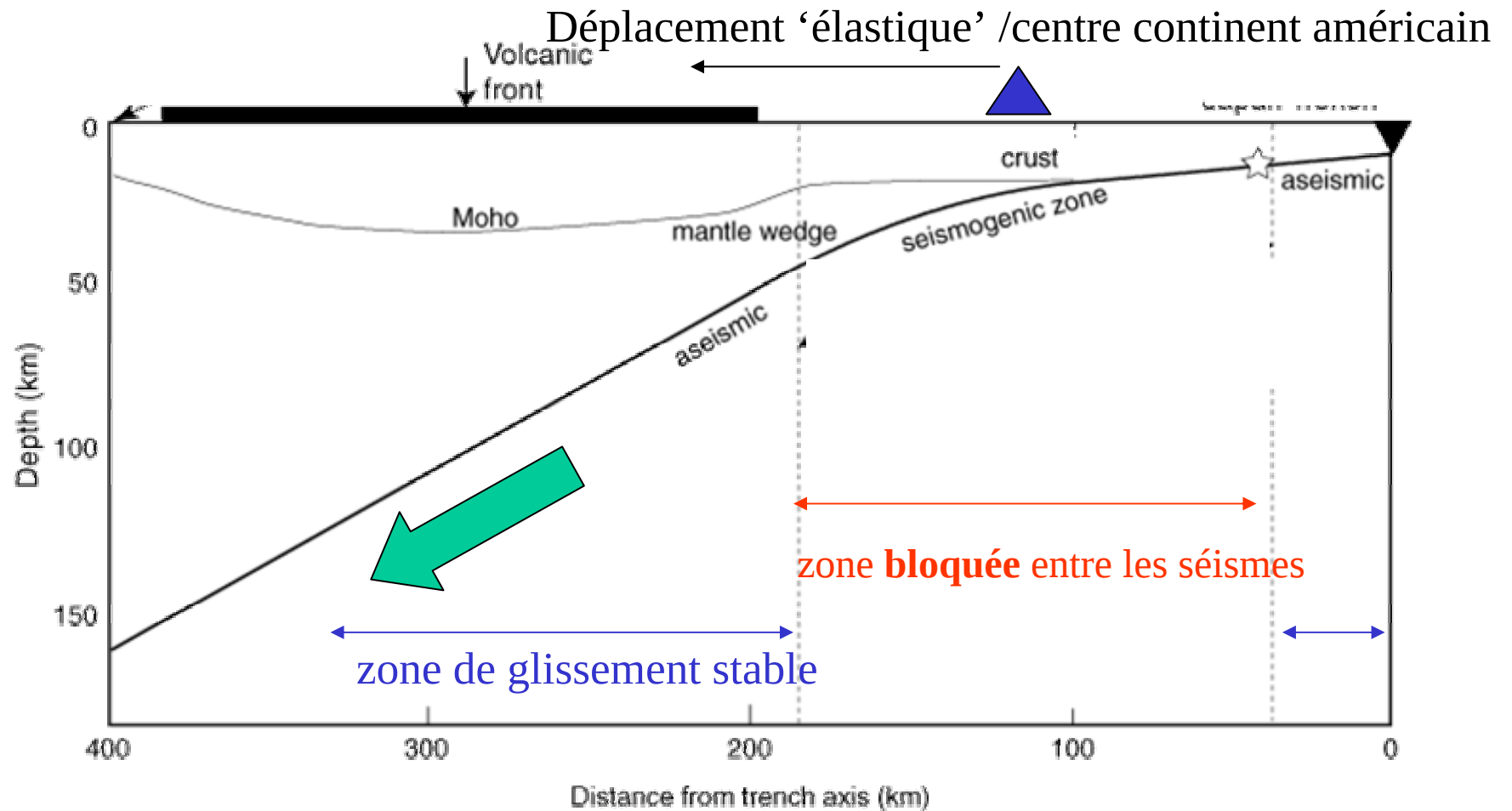
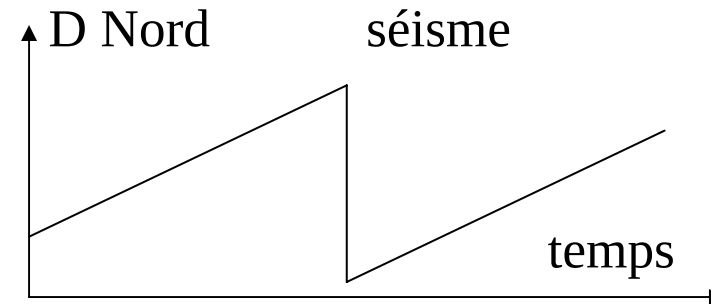
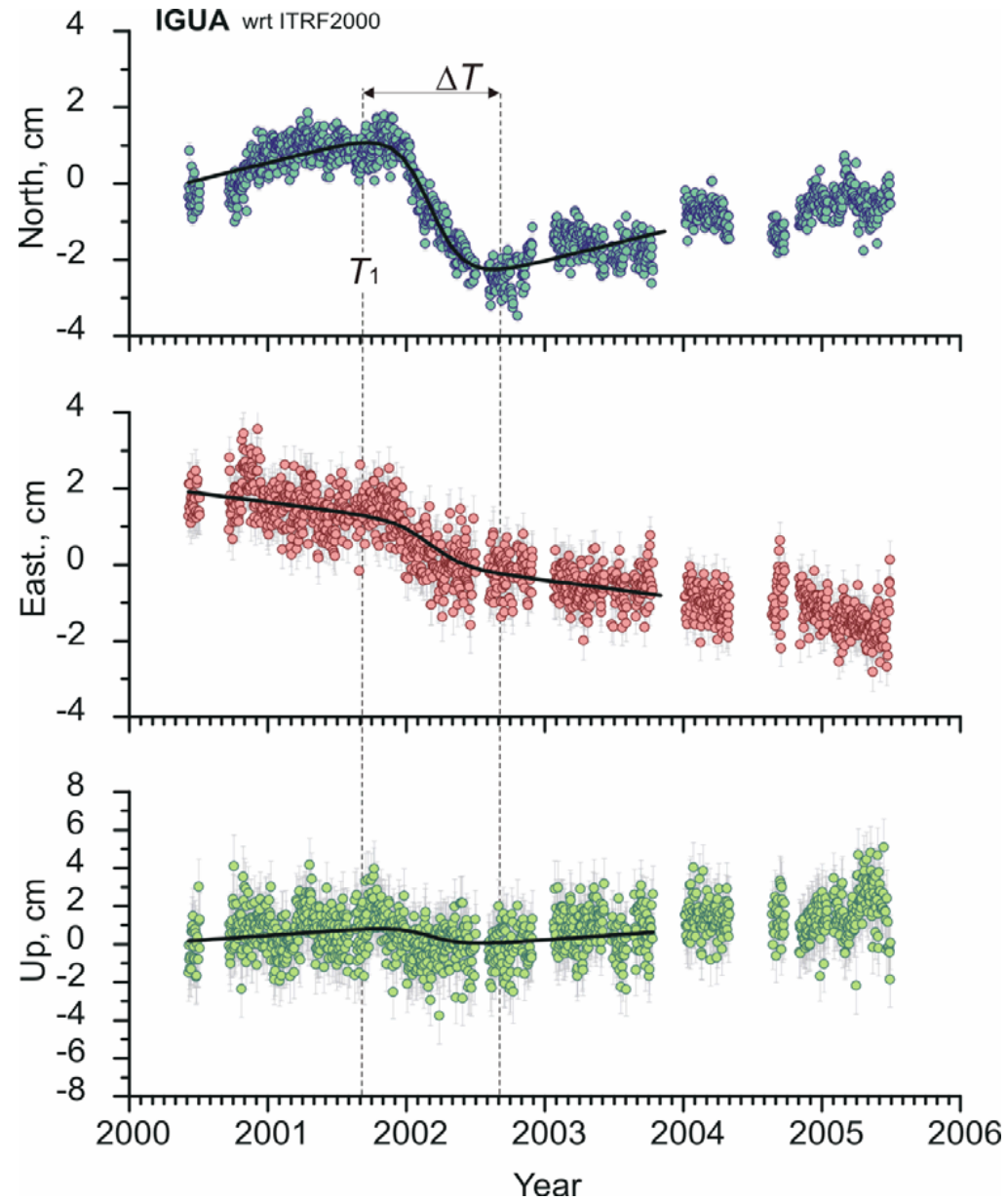


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Mouvement inter-sismique?

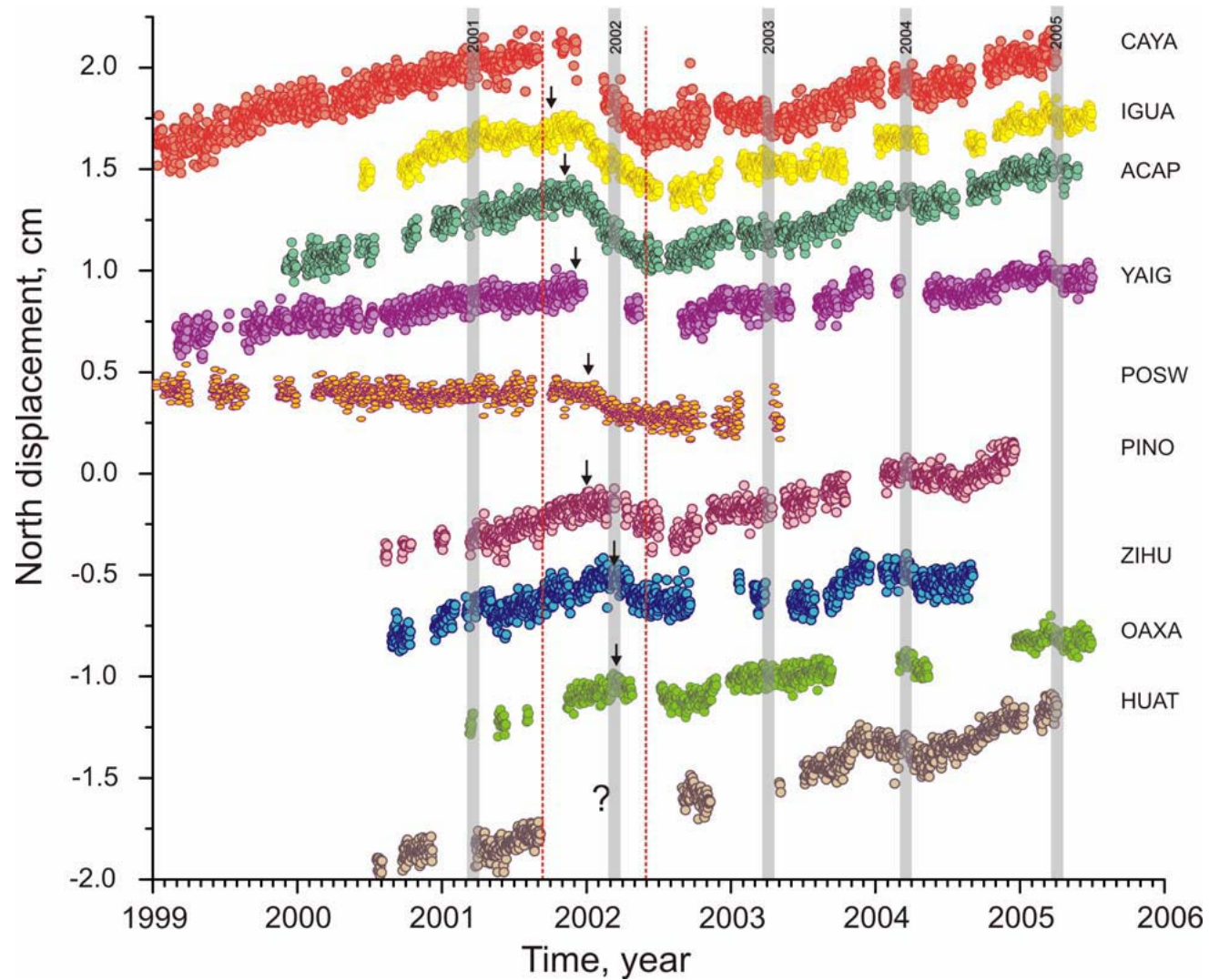


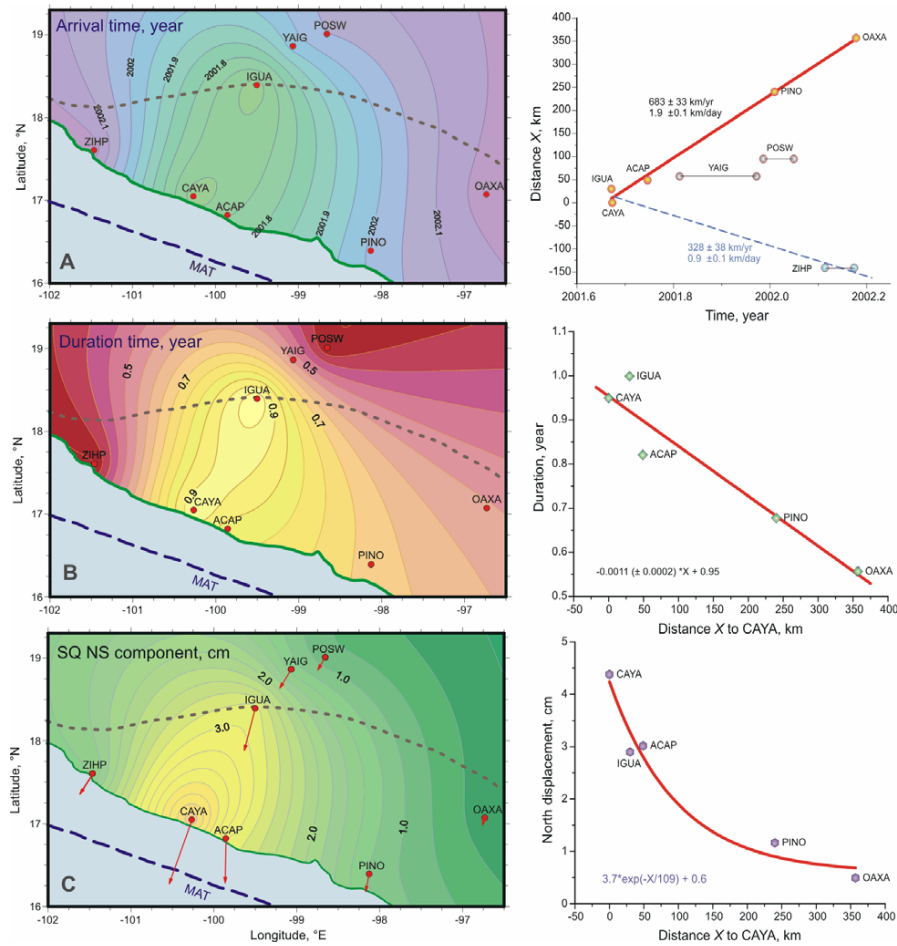
Observations:



Pas de 'séisme'!!

Propagation du glissement en profondeur



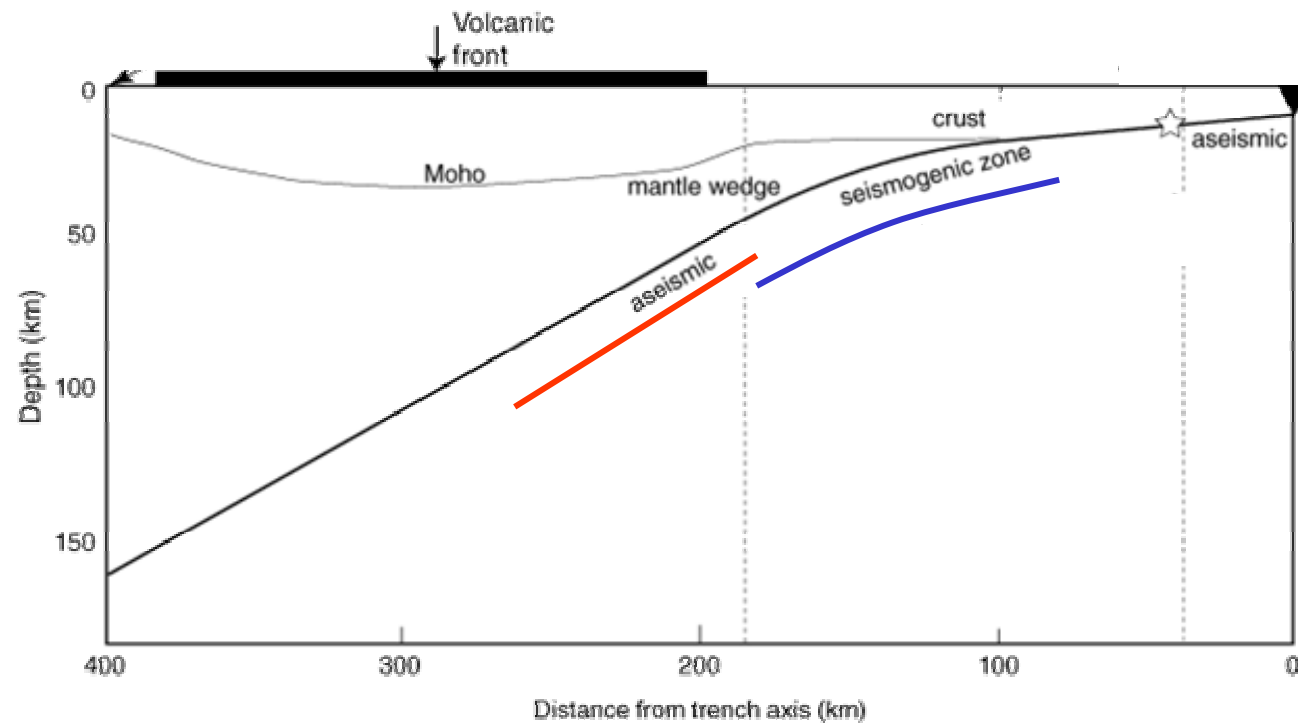


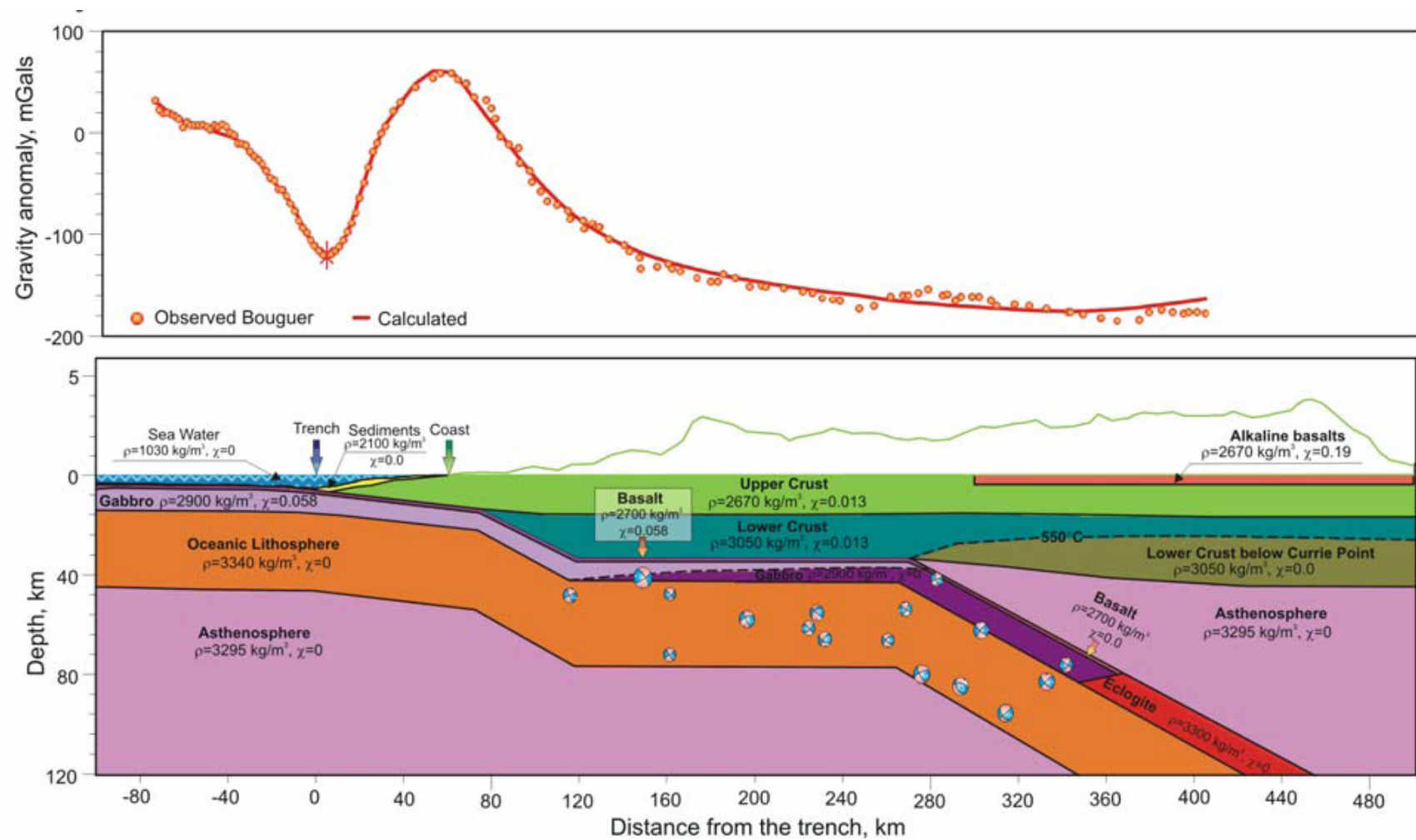
Un séisme ‘silencieux’/’lent’.. Mw=7.5!!

2 possibilités:

1- La rupture lente s'est produite sur la surface asismique: le risque de rupture sismique est augmenté

2- La rupture lente s'est produite sur la surface sismique: la contrainte est relâchée et un séisme au moins différé





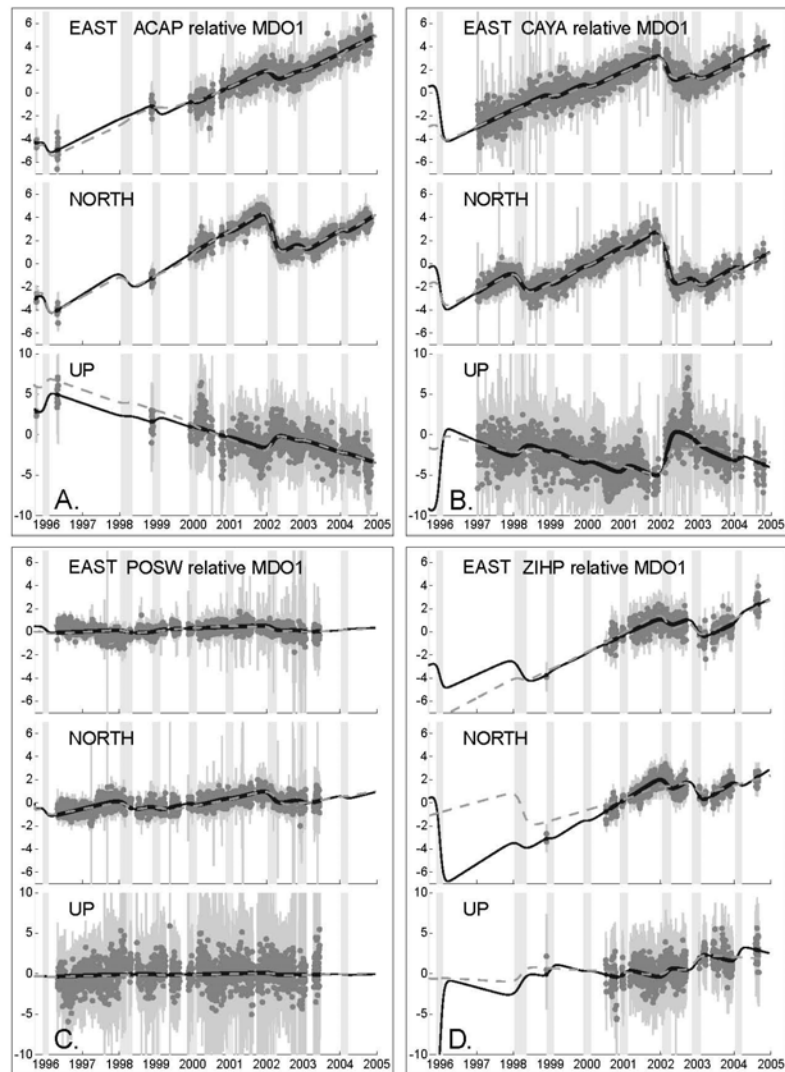


Figure 13. Example best-fit model time series of baseline coordinates relative to MDO1 for (a) ACAP, (b) CAYA, (c) POSW, and (d) ZIHP. Gray circles are GPS coordinates, shown with scaled 95% uncertainties (thin light gray bars). Black line is the best-fit discretized model time series for displacement at each site; the dashed gray line superimposed is the corresponding best-fit model of single rectangular patches. The very light gray bands denote periods of transient displacement.