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Seismological and Geotechnical Aspects of the 2017 M7.1 Puebla-Mexico City Earthquake



ASCE Geo-Institute San Diego
November 24, 2017



UNAM-GFER Advance team

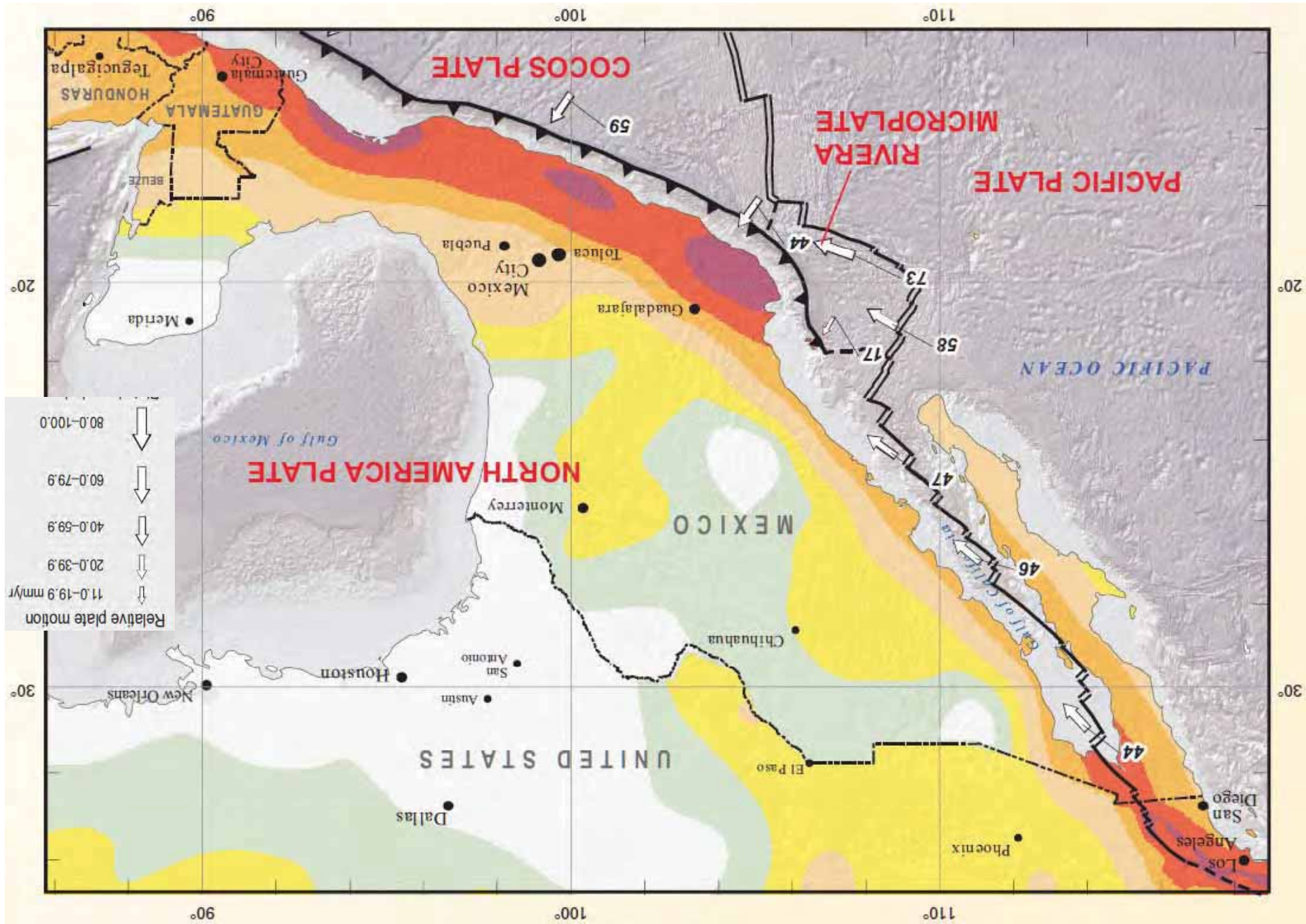
- Universidad Nacional Autónoma de México (UNAM) Instituto de Ingeniería
- Geotechnical Extreme Events Reconnaissance (GEER)
- September 24-30, 2017
- Mexico City, Puebla and Morelos
- Valsequillo Dam
- Epicentral area



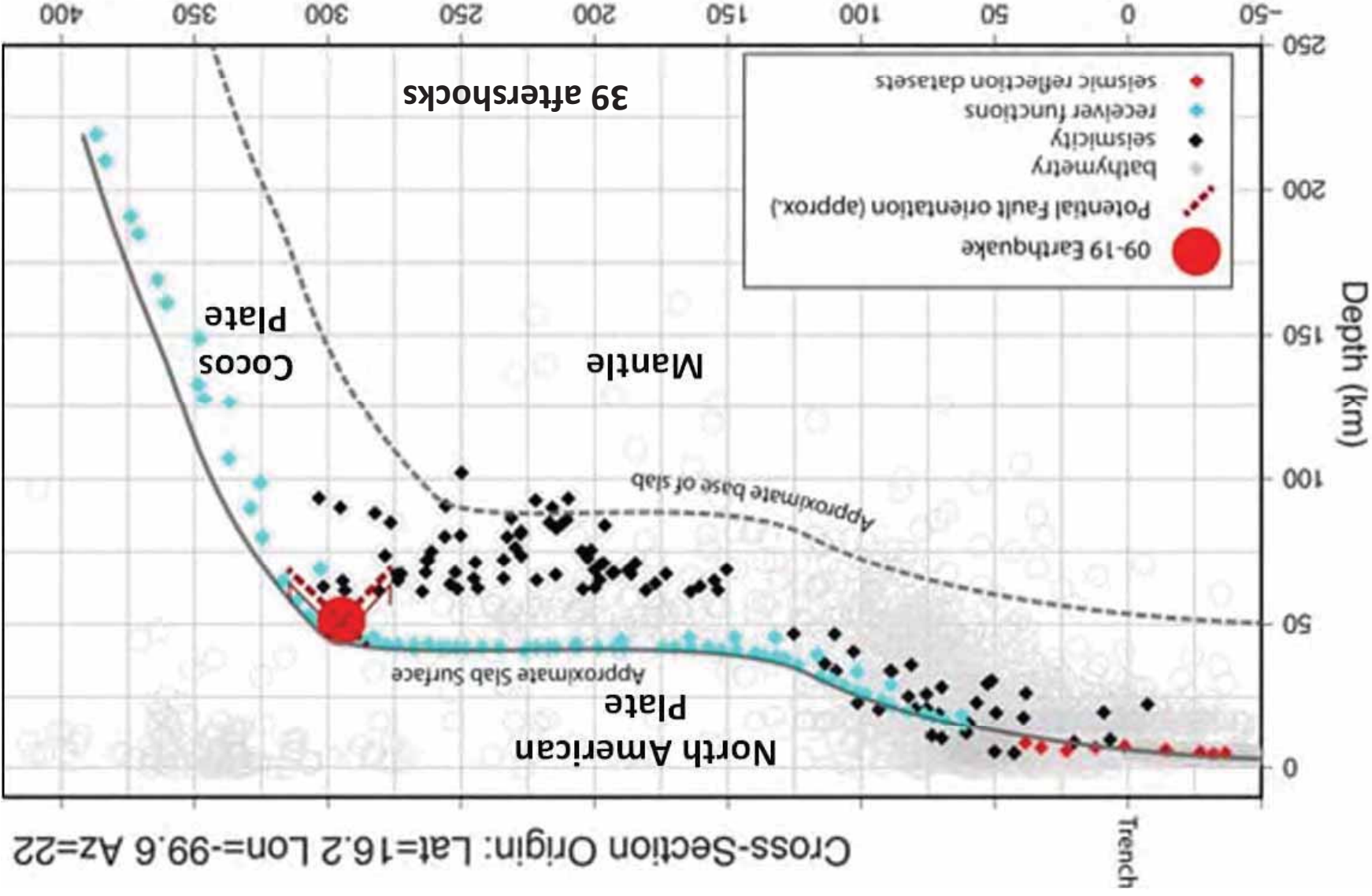
UNAM-GEER Advance Team

AKA "The Scouts"

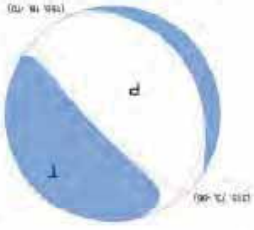
- Kevin Franke (BYU, Lead); Chadi Mohtar (UTA), Christian Ledezma (Chile), Anne Lemmitzer (UCI), Alejandro Martinez (UCD), Jorge Meneses (CSSC), Gonzalo Montalva (Chile), Mark Yashinsky (Caltrans)



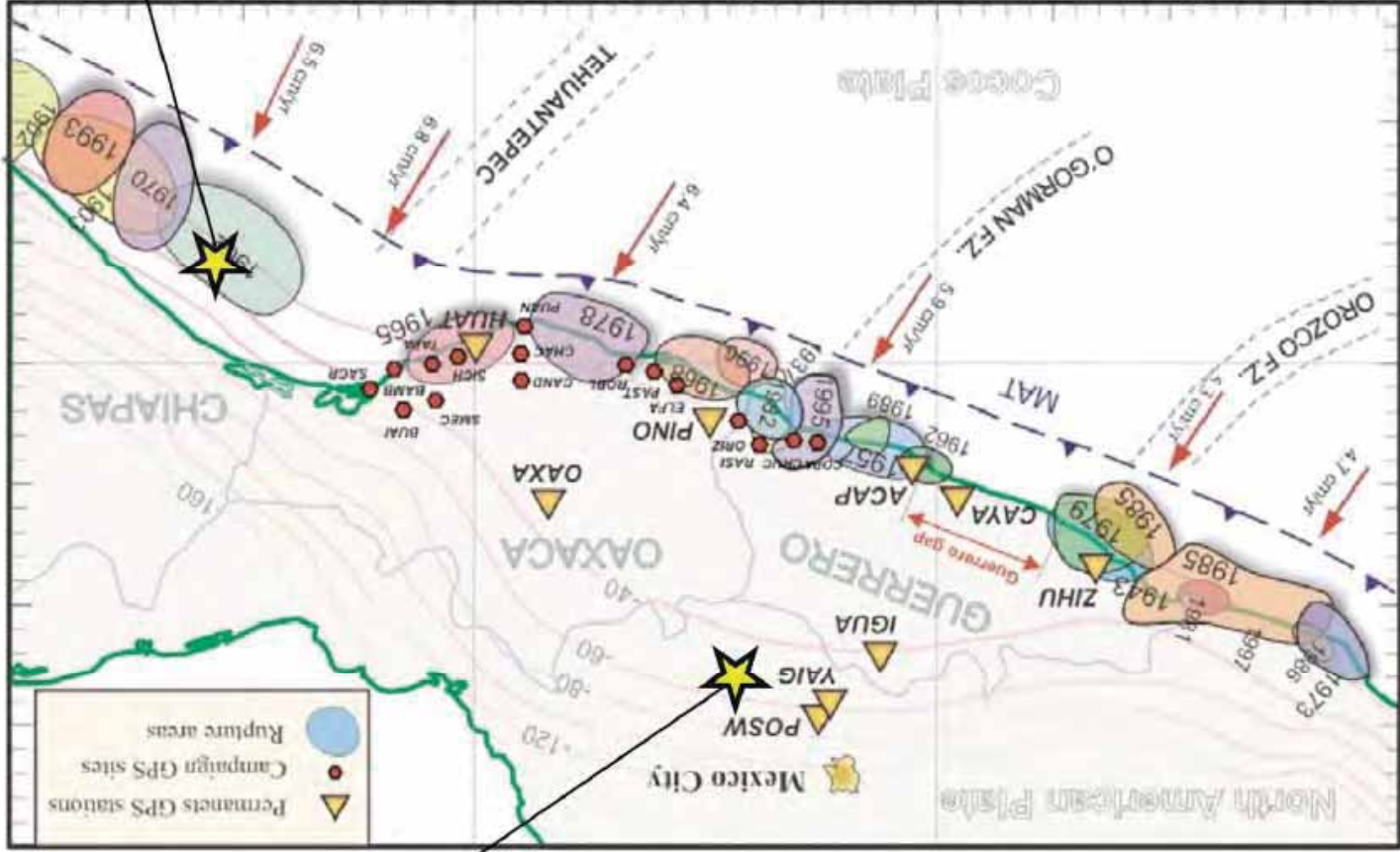
Tectonic plates



7 Sep. 2017 Mw=8.1
depth = 69 km

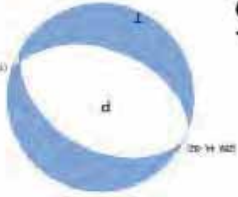


Longitude, °E -104 -102 -100 -98 -96 -94 -92



Latitude, °N 14 16 18 20

19 Sep. 2017 Mw=7.1
depth = 51 km



Franco et al., EPS, 2005

1985 and 2017 earthquakes

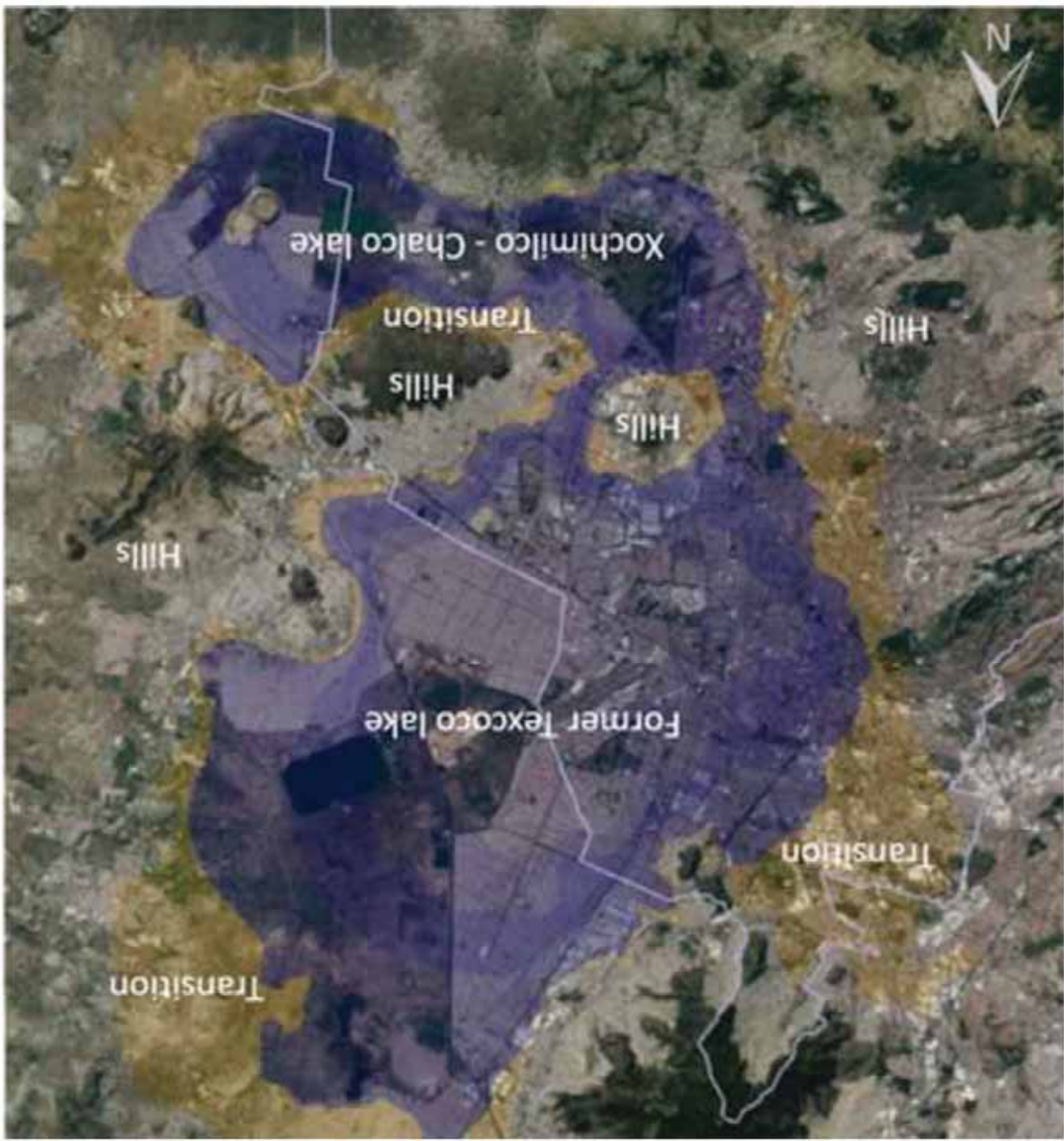


1985 Eq released 32 times more energy than 2017 Eq

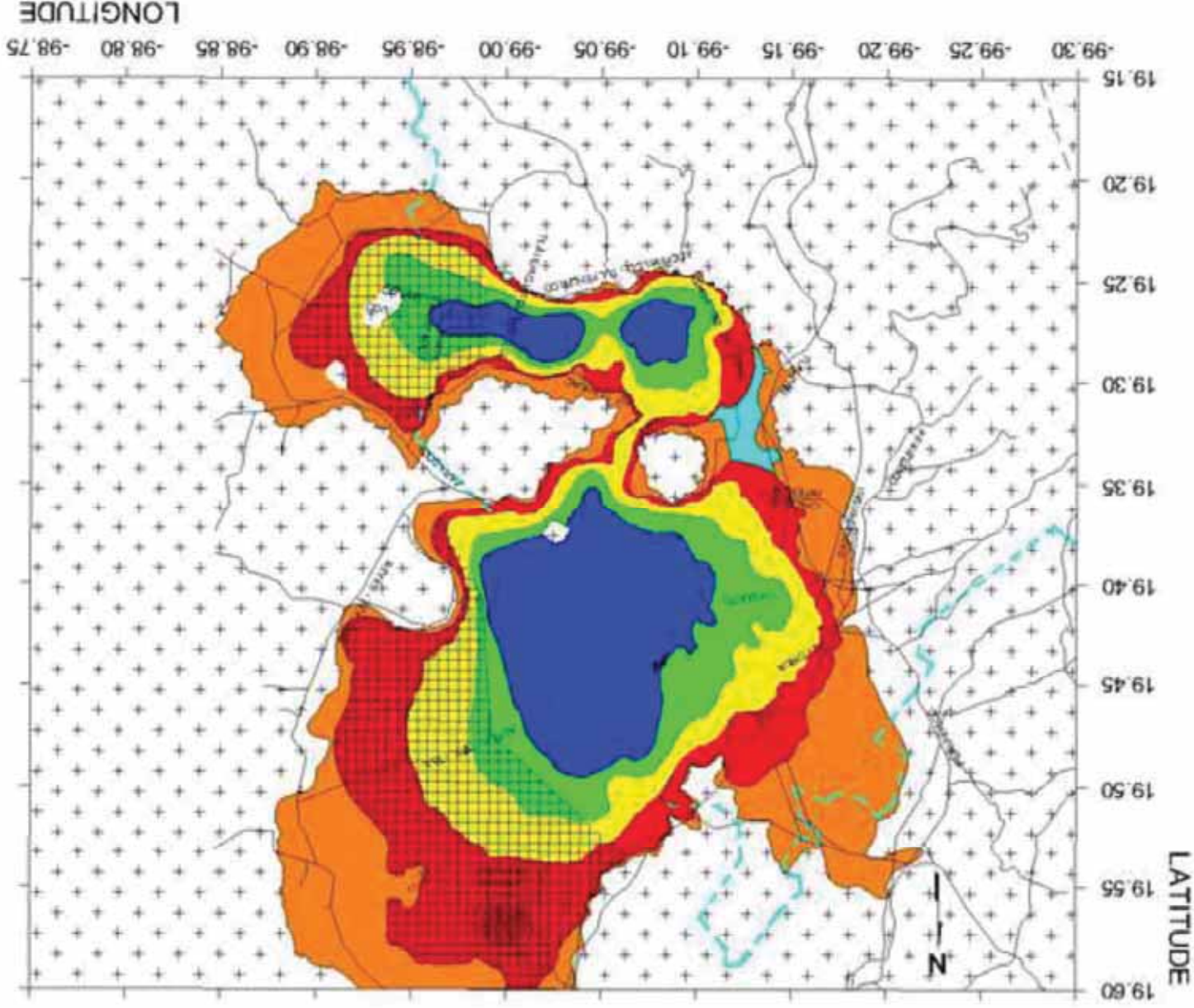
1985 Eq: >400 km; 2107 Eq: 120 km

**Mexico City:
Main
Geotechnical
Zones**

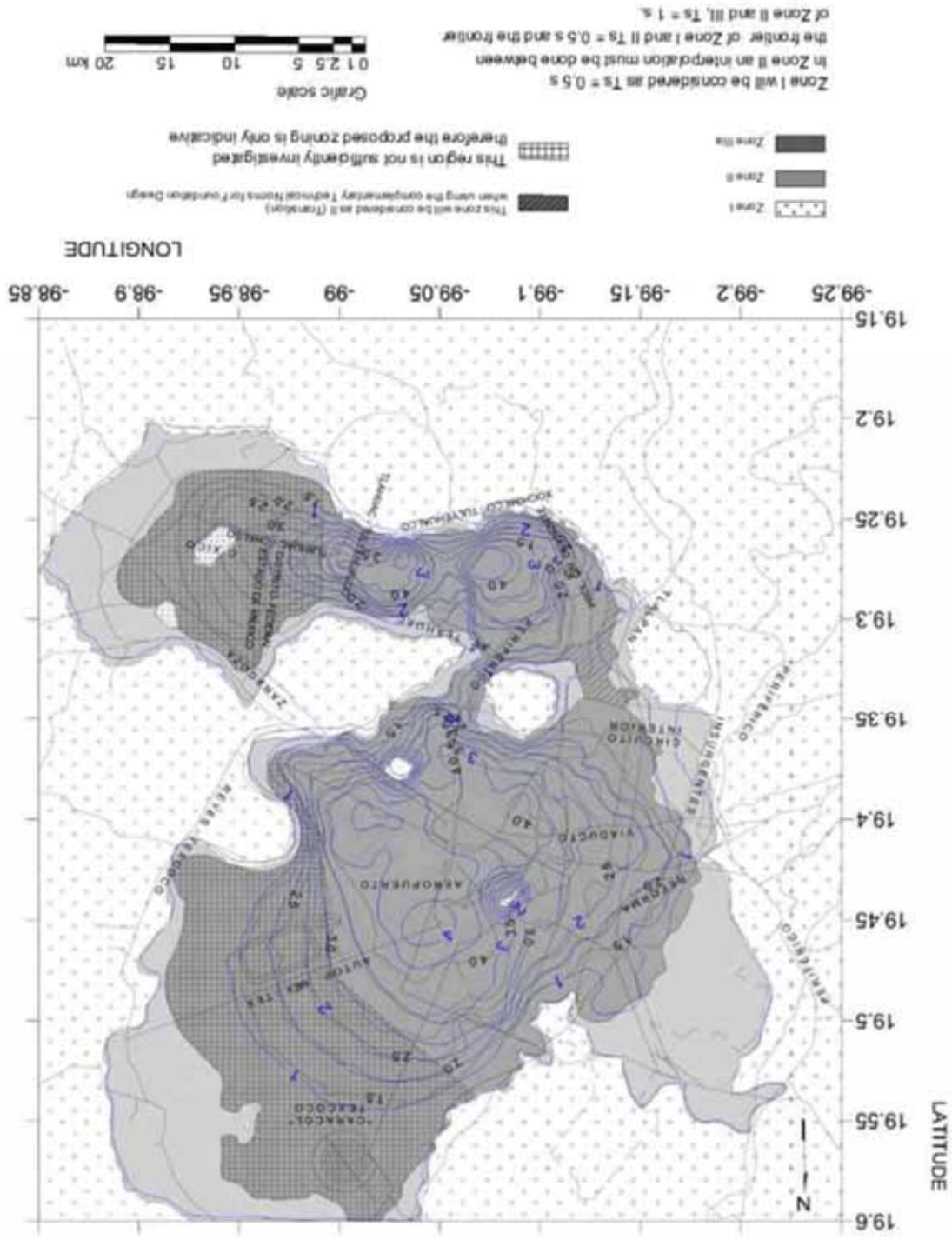
Report No. GEER-055A
16 October 2017



Mexico City Geo-seismic Zoning



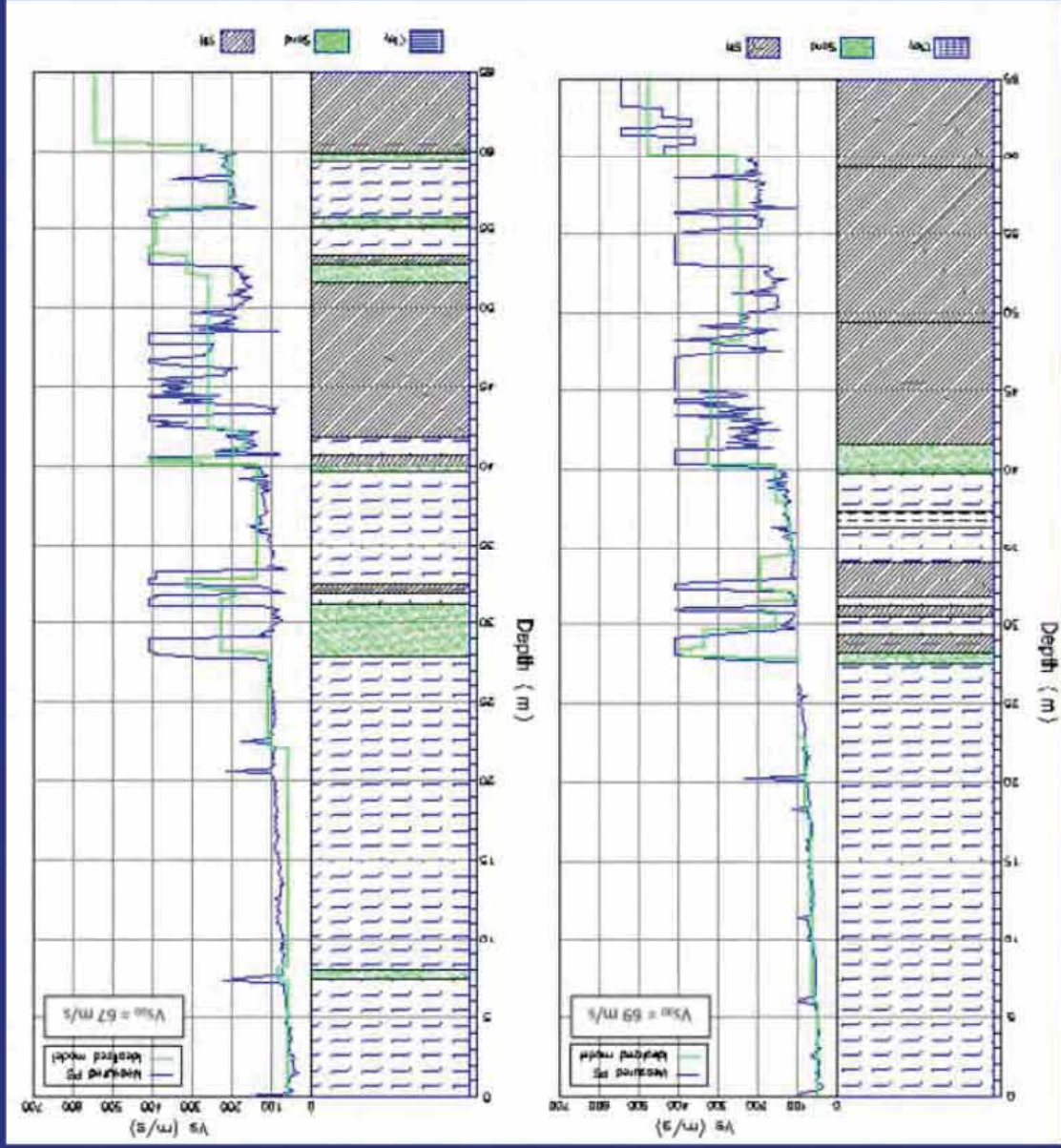
Map of predominant periods (Arroyo et al. 2013)



Typical Soil Profile (Zone III, Lake)

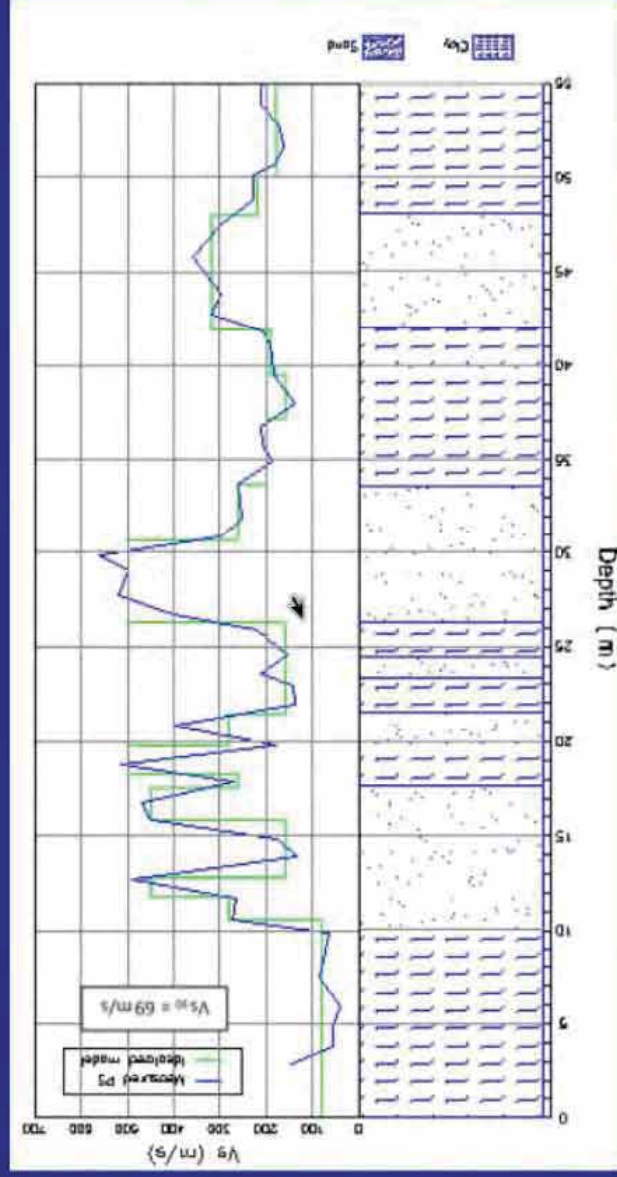
- ~1-2m desiccated clay crust
- ~25-35m very soft clay sand/silt
- ~50-60m stiff clay
- Competent very stiff sandy silt-silty clay

Mayoral et al., 2016

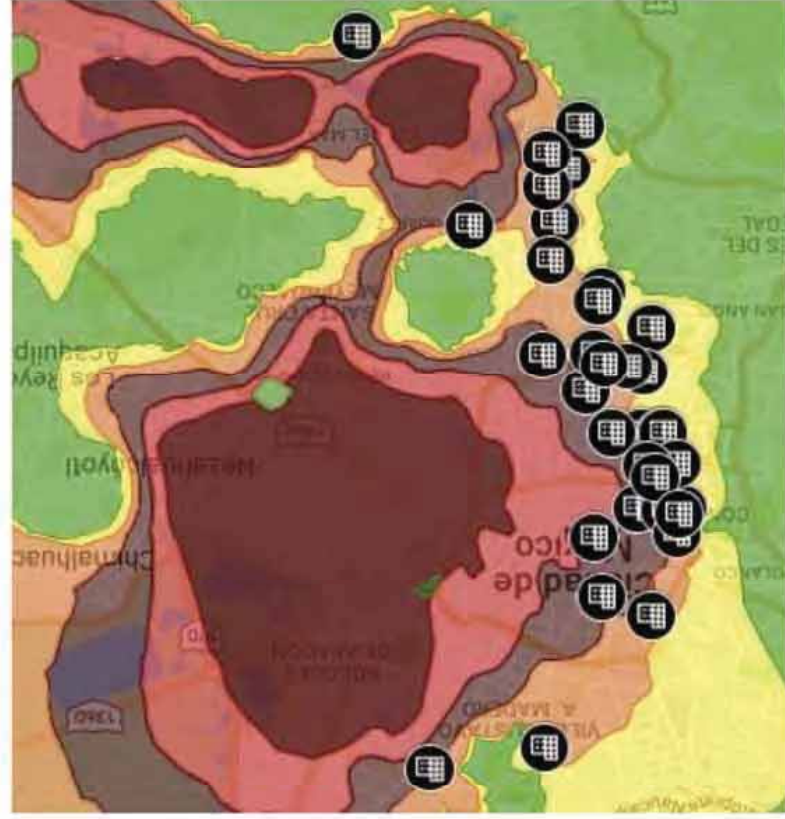


Zone II (Transition) Soft Clays

- ~0-20m soft clay
- Stiffer soils, with interbedded sandy silts/silty sands
- Competent very stiff sandy silt-silty clay
- Zone I (Hill)
 - Volcanic rock and/or stiff soil



www.sismosmexico.org



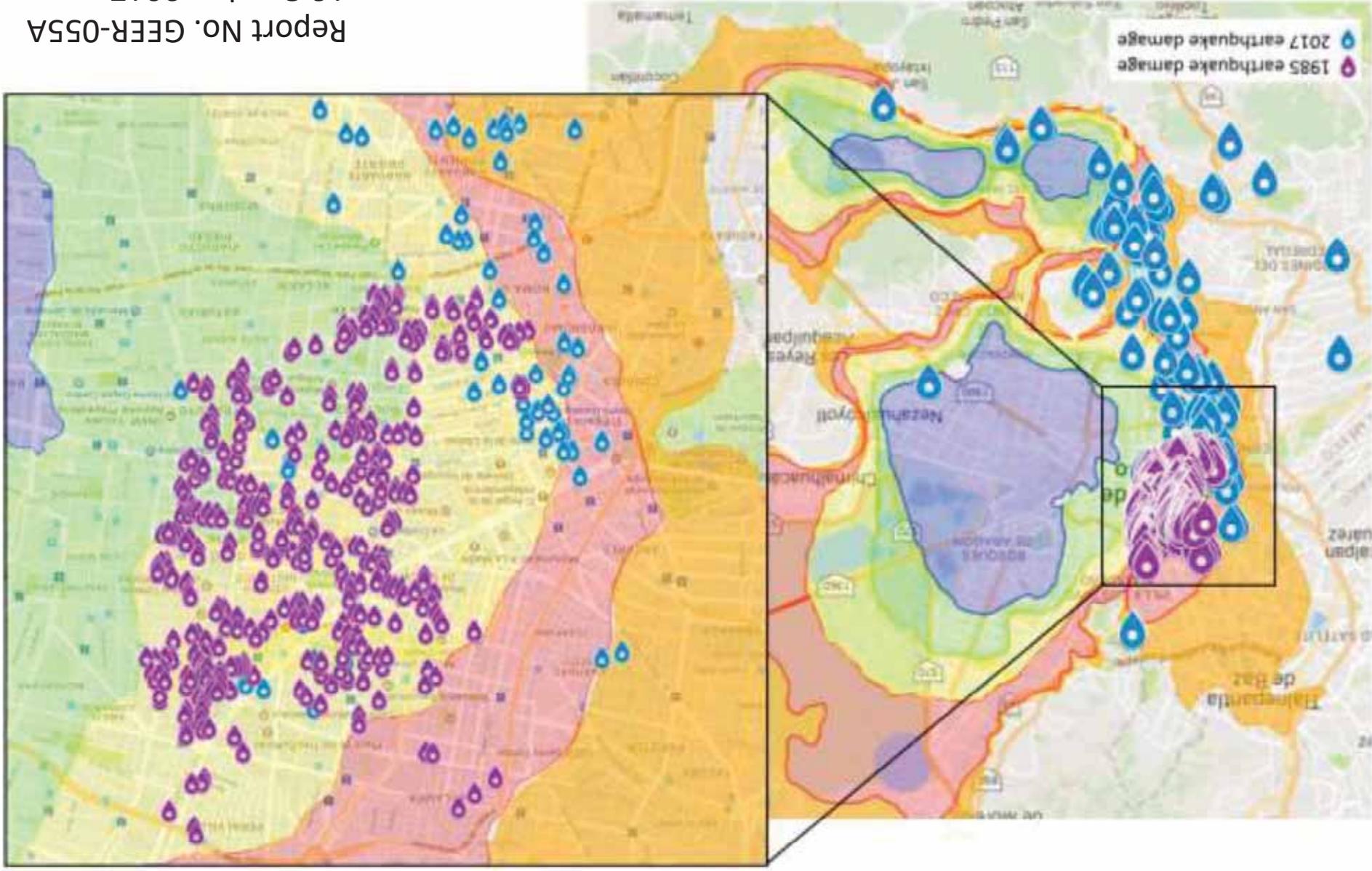
● Rock
● Transition (<20 m)
● IIIa (20-30 m)
● IIIb (30-40 m)
● IIIc (40-50 m)
● IIId (>50 m)

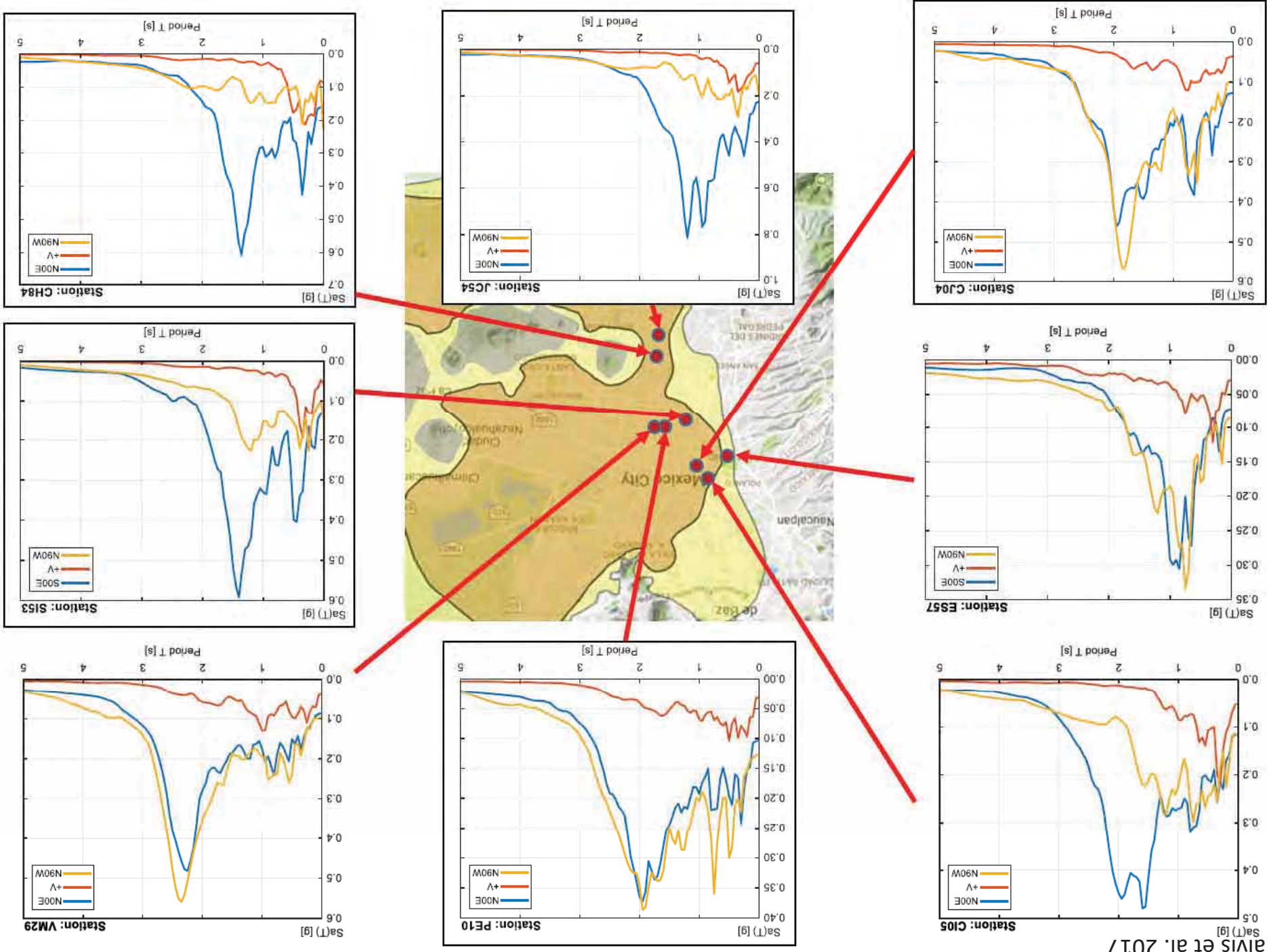
21 cases from 4 to 7!!!!

No of buildings	Height (Stories)
2	>9
5	8
4	7
3	6
10	5
4	4
2	3
5	2

Collapses (32 buildings)

Collapsed Buildings (1985 and 2017)





- 5-story RC apartment building
- Built in 1966



Directionality
effects?



Valsequillo Dam



Valsequillo Dam





Valsequillo Dam





Pilcaya – Damaged houses



Human chains

Lessons

- Importance of local soil effects on seismic response of buildings and infrastructure
- Amplification and resonance
- Basin effects (3D effects)
- Distribution of damage
- Importance of building codes (pre- and post-1985)
- Existing buildings! Built and designed pre-1985
- Limitations of building codes
- Develop community-based approach policies
- San Diego-Tijuana Earthquake Scenario