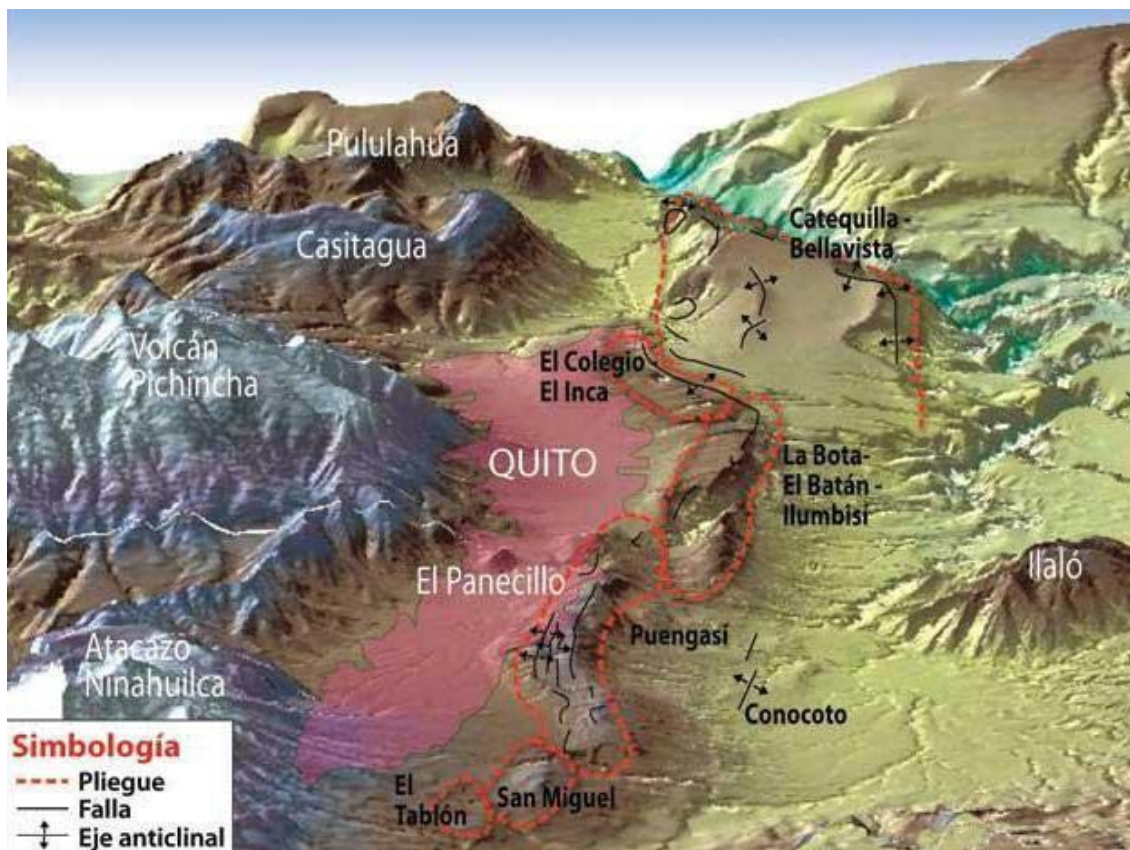


How the earthquakes and landslides affect Quito, my place.

Ecuador is located on the Northwestern part of the South-American plate which is being subducted by the Nazca plate. Due to this subduction a big mountain range called "The Andes" was formed. This mountain range also belongs to the Pacific ring of fire which is an area where large volcanic eruptions occur.

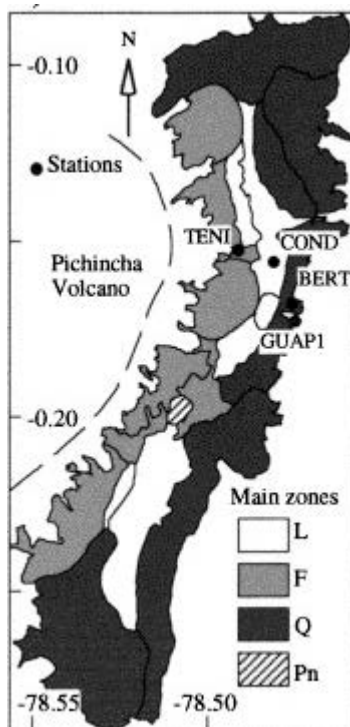
Quito, the capital of Ecuador, is a city located in the highlands of Ecuador (2800 meters above the sea level in The Andes mountain range), a highly and risky seismic zone. Historically Quito has been shaken by strong earthquakes. Given this tectonic environment, it is possible to say that the earthquakes that happen in Quito are a product of the movement of plate tectonics, volcanism but mostly because of the movement of the active faults.

Quito is built above many faults which together form the "Quito's fault system", it is primarily a reverse fault which makes the city (hanging wall) to be uplifted approximately 400 meters above the valley (foot wall). The fault is about 60 km long and it is dipping 40°W. Also, the thrust is up to 4mm/yr. (Alvarado et al.,2014)



Due to this active fault system, multiple Earthquakes happen throughout the year with magnitudes varying from 3.0 and 6.5 in the Richter scale. However earthquakes bigger than 7 in magnitude have been recorded but happens every few hundreds of years.

One of the most recent an important earthquakes (5.1 Ritcher Scale) happened in August 2014, the focus was about 7.7 km deep. This earthquake caused more than 50 aftershocks, few deaths but multiple injured people because of the landslides, liquefaction and collapsed houses.



In order to understand this kind of events it is necessary to know how strong the ground under Quito is. Since the city is surrounded by 6 volcanos, and is at the foot of the Pichincha volcano, the primary material of the ground is a material known as “cangagua” which is composed of volcanic ash and pyroclastic flows expelled in the eruptions of this volcano and deposited afterwards (Barberi et al., 1992)

The picture show the different type of deposits found in the regions of Quito.

L: Mostly lacustrine deposits with soft soil layers

F: Volcanic ash and deposits

Q: Cangahua deposits (volcanic origin)

(Guéguen, Chatelain, Guillier, & Yepes, 2000a)



However, as the topography of the city is very irregular with many steep slopes and ravines, there are some places in which the ground is more stable and consolidated than other places. Ravines and slopes are most common at the sides of the city. Certainly in the slopes and ravines the material is slippery and unstable. As a result of an earthquake this zones are most likely to have landslides. After the earthquake in 2014 there were landslides which were mostly soil, debris and rock fall, however in some parts there was also rotational slides; this blocked many highways and injured people in their cars. (see pictures)



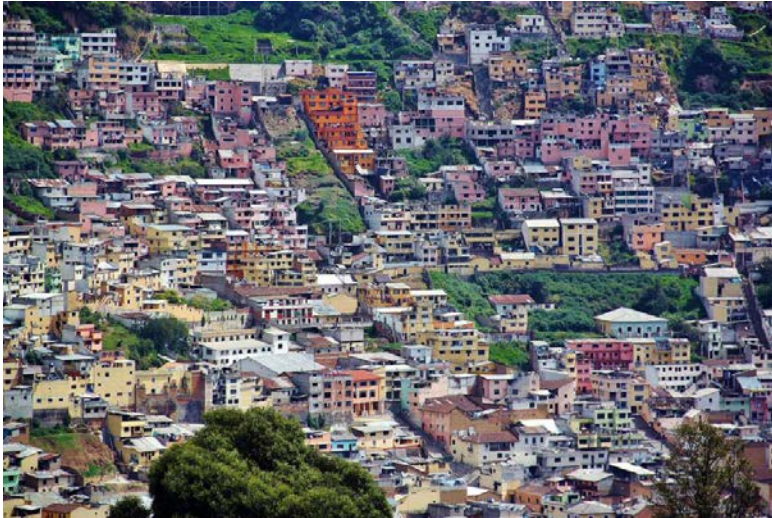
After this incidents the mountains were cut and shaped in order to make it less dangerous in future events. (Below there are 2 pictures of the same highway, the mountains have been cut in terraces).



On the other hand, Quito's rapid urban growth caused the expansion of the city along the valley floor. However, the city was not prepared to receive such unprecedented population increase which is why people started to build illegally wherever they could without municipal permits. This means filling ravines with soil



and waste to make the place flatter and build houses. (Guéguen, Chatelain, Guillier, & Yepes, 2000) This is very dangerous because the soil is not compacted enough which makes it unstable and most likely to liquefaction, landslides and collapse. Not only earthquakes but also the heavy rain falls, put in danger all this houses which obviously are not anti-seismic structures.

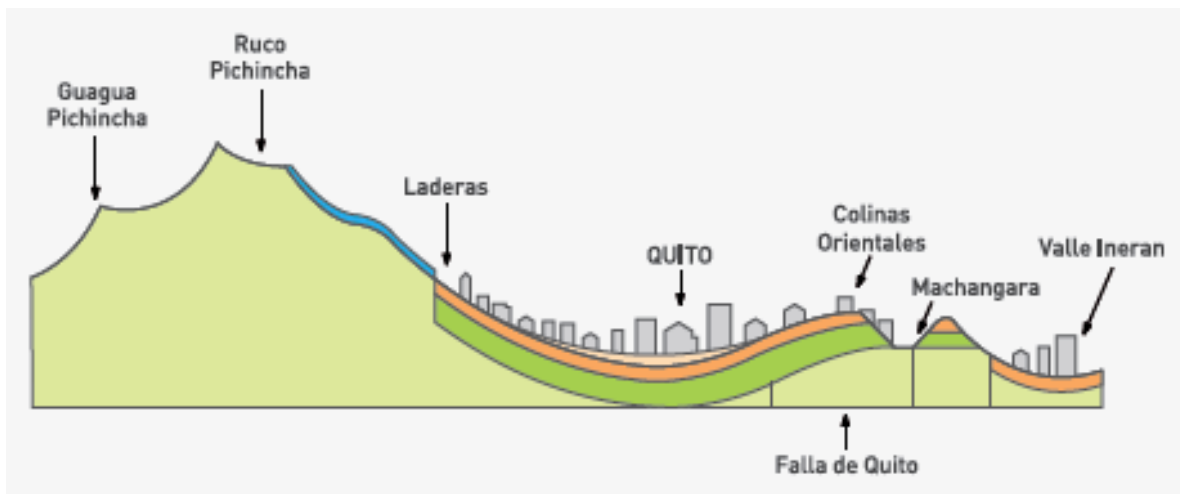




LIQUEFACTION



In conclusion, there are places in the city mostly in the middle in which the ground is very stable and consolidated due to its thick material which is mostly cangagua. Here, in case of an earthquake, the structures are in less danger than the structures at the sides of the city which at the west are most likely to be affected by colluvial deposits of the Pichincha volcano landslides and eruptions; at the east the multiple houses built above filled ravines are most likely to collapse, and the highways built at the bottom of steep slopes are most likely to be blocked by landslides.



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