

Historic seismicity in Ecuador

Ecuador is a seismic country. This means that low magnitude earthquake occur every day. High magnitude earthquakes, like the ones registered in the country's past, can also occur and are usually associated with subduction processes. Historical mega-thrust Ecuadorian earthquakes include:

- 1906** - Esmeraldas (8.8 Mw) Mompiche's coast
- 1942** - Manabí (7.8Mw) Pedernales
- 1958** - Manabí (7.8 Mw) Pedernales
- 1979** - Esmeraldas (8.1Mw) San Lorenzo's coast
- 2016** - Manabí (7.8 Mw) Pedernales

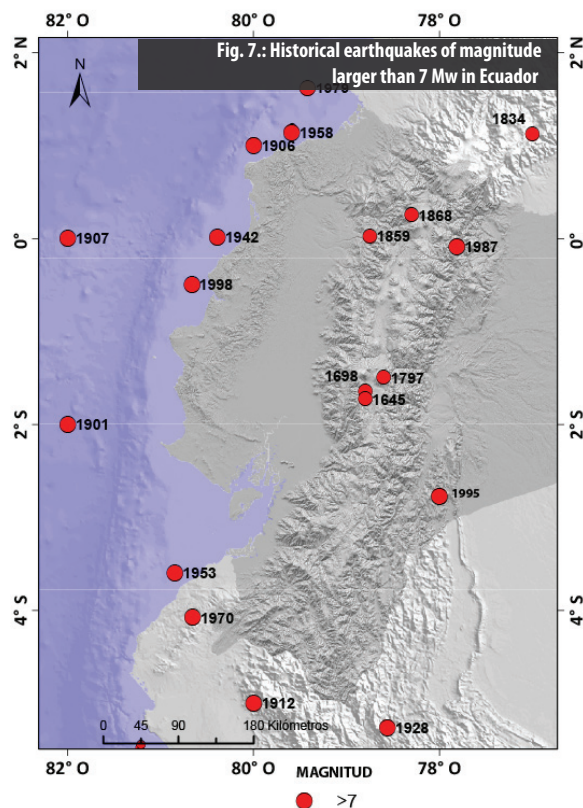


Fig. 7.: Historical earthquakes of magnitude larger than 7 Mw in Ecuador

Magnitude & Intensity

Magnitude is the amount of energy released during an earthquake, while the intensity is the way how people and buildings feel the shaking. Magnitude and Intensity are measured in different scales, and while the intensity decreases with the distance to the source, the magnitude is always the same.

IG's Monitoring Network

The seismicity in Ecuador is monitored 24/7 by the IGEPN. 61 seismic stations and 89 accelerograph stations register the earthquakes and send the data in real time to the technicians of the TERRAS center in Quito.



Fig. 9.: Technicians of IG working at the TERRAS center

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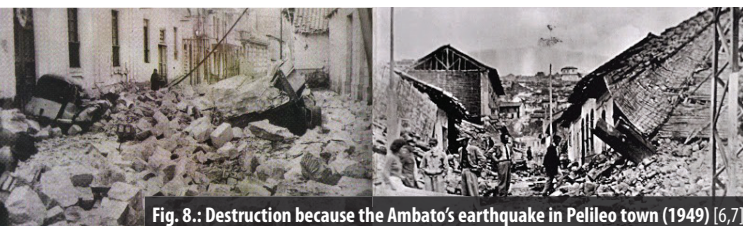
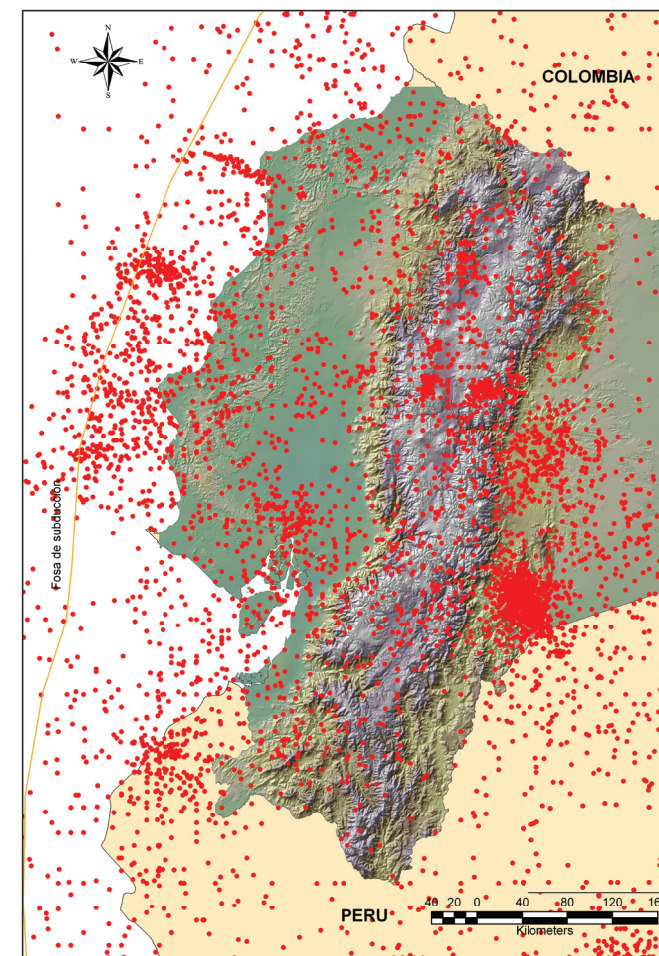


Fig. 8.: Destruction because the Ambato's earthquake in Pelileo town (1949) [6,7]

Earthquakes associated with tectonic faults can also be very dangerous. Some examples are the earthquakes of: Riobamba in 1797 (estimated magnitude 8.3 Mw, intensity XI) and Ambato in 1949 (estimated magnitude 6.6 Mw, intensity X).

EARTHQUAKES



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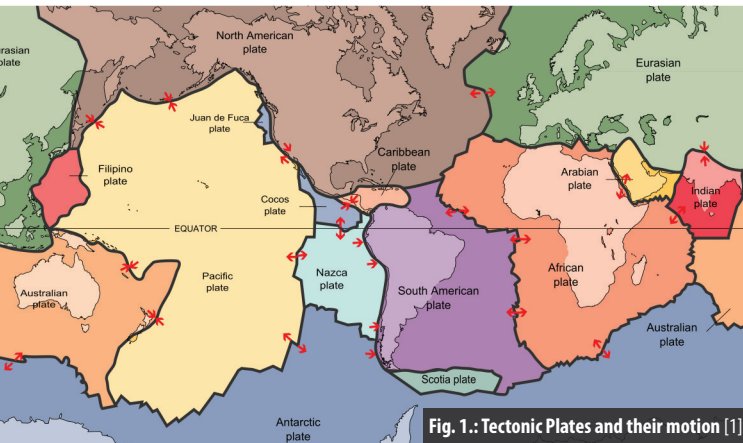
GENERALITIES

What is an Earthquake?

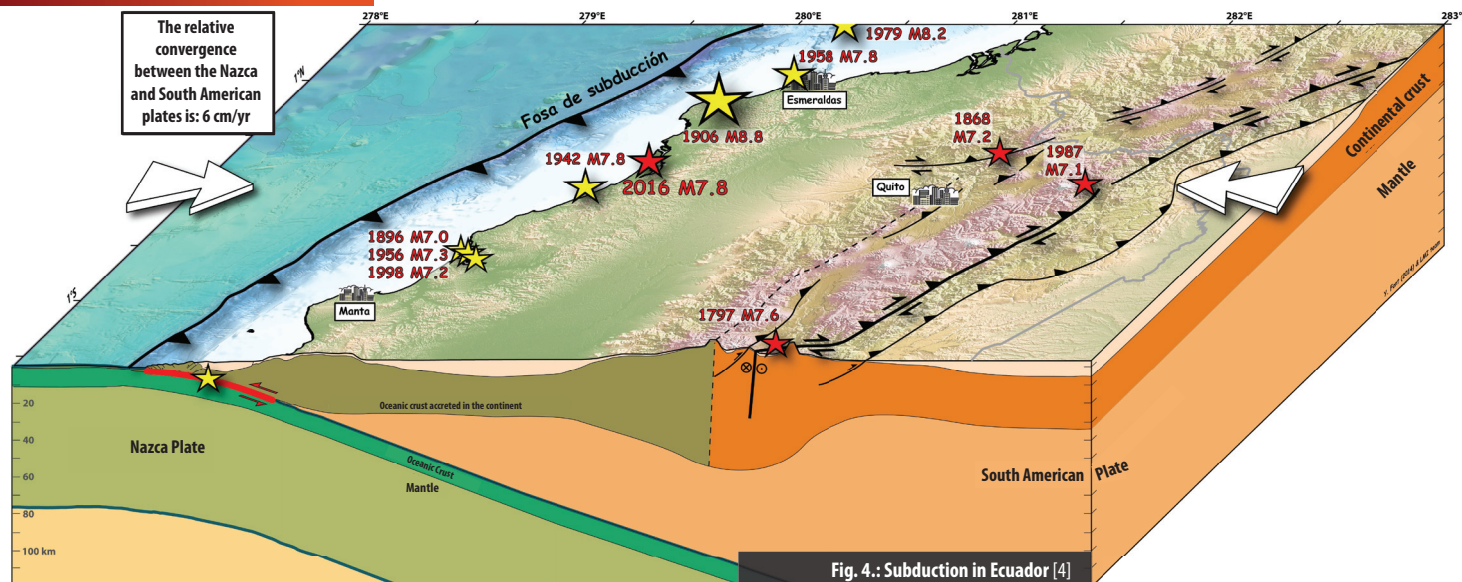
It is the abrupt release of accumulated energy that is transmitted like seismic waves: this causes movements in the ground. Earthquakes can be volcanic or tectonic.

But... Why are earthquakes generated?

The Earth is divided into 4 layers: lithosphere, asthenosphere, mesosphere y endosphere. The outward layer, lithosphere, is divided in tectonic plates (Fig.1).



Subduction in Ecuador



★ Esquema de la zona de falla sísmogénica interplaca capaz de generar megaterremotos
★ Terremotos corticales ($M > 7$)
↙ Trazas de falla inversa (en la superficie)
↗ Trazas de falla transcurrente

The boundaries of the tectonic plates in Ecuador are of convergent type. In this limit the denser plate or Nazca Plate (oceanic) pushes and slides under the continental plate (South American Plate). These plates do not move freely: they are blocked, and when the resistance of the materials of the crust is overcome, the rocks that compose the plates are broken producing large earthquakes. The phenomenon of subduction is also responsible for the volcanic activity in Ecuador, since it causes the partial melting of the Earth's mantle wedge, generating new magma which rises to the surface.

What is a fault?

A geological fault is a crack in the Earth's crust resulting from the stress and displacement caused by the plates interacting between them. There are hundreds of faults along Ecuador and they are clustered in fault systems.



Fig. 5.: Quito's fault system in the sector of the Guayllabamba's bridge

Tsunamis and Earthquakes

If an earthquake is larger than 7 magnitude (M_w), and was generated at the bottom of the sea, this earthquake could produce a Tsunami. The abrupt vertical motion due to the earthquake produces the displacement of a huge volume of water which is propagated towards the coast flooding it.

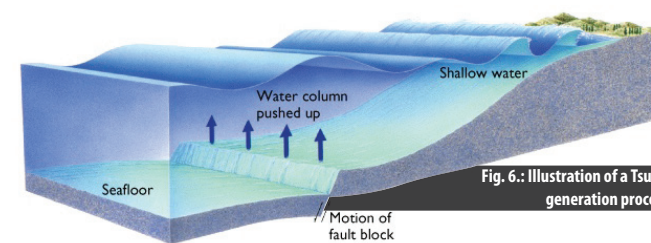


Fig. 6.: Illustration of a Tsunami generation process [5]

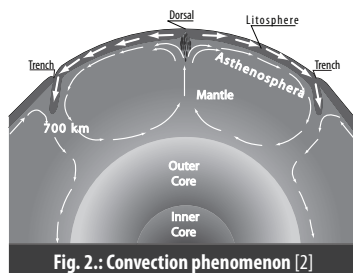
References:

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Due to the asthenosphere dense fluid behavior, thermal currents occur inside of it, allowing the plate tectonics to move.

Tectonic plates can be categorized according to their relative motion: they can slide towards each other, slide apart from each other and grind past each other along a transform fault.

On the boundaries of the tectonic plates is where the accumulation of energy occurs. There are 3 types: convergent, divergent and transform.



Hypocenter vs. Epicenter

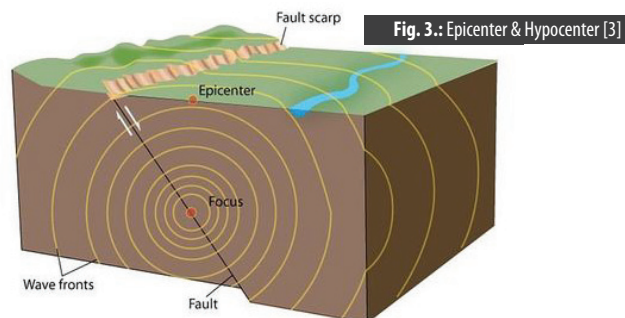


Fig. 3.: Epicenter & Hypocenter [3]

The hypocenter is the point within the Earth where an earthquake rupture starts. Epicenter is the point on the Earth's surface directly above a hypocenter or focus.