EARTHQUAKE AND TECTONIC PROCESSES IN THE MID-ATLANTIC US PASSIVE MARGIN AND THE ECUADOR SUBDUCTION ZONE

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Our ability to minimize the risks associated with earthquake hazards is directly linked to our fundamental understanding of the causes, processes and dynamics associated with this type of natural event. This dissertation presents my research work towards a better understanding of earthquake and tectonic processes in two distinct settings: the Mid-Atlantic US passive margin and the Ecuador subduction zone.

The first part of my dissertation focused in studying intraplate seismicity and crustal structure in the Mid-Atlantic US. Our understanding of the characteristics of and mechanisms responsible for seismicity in passive margins is limited. Although less frequent than their plate boundary counterparts, large intraplate earthquakes occur and when they intersect with society can have very damaging effects. To assess a plausible mechanism for intraplate seismicity and deformation in the Mid-Atlantic US, I calculated receiver functions to image the crustal structure, and characterized the spatio-temporal distribution of seismicity. Receiver functions imaged a steep gradient in crustal thickness, in the transition from the Coastal Plain-Piedmont into the Valley and Ridge. The spatial distribution of earthquakes coincides with the observed crustal thickness gradient. This suggests that lateral variations in crustal structure, inherited from past orogenic and rifting processes, play a role in the concentration of stress, and the spatial distribution of seismicity.

The second part of my dissertation focused on an active tectonic margin. On April 16, 2016, a Mw7.8 megathrust earthquake ruptured a ~130x100km segment of the Ecuador subduction zone. An automatic catalog of 9,056 events was created to analyze the post-seismic activity associated with this large earthquake. Calibrated multiple-event relocations were calculated for moderate to major earthquakes. This seismic sequence is dominated by pronounced spatial and temporal clustering. Some clusters occur in regions that have remained active during the interseismic period and/or experienced slow slip events, repeaters and swarms, while other clusters locate in regions of low level of background seismicity. The mainshock appears to have induced stress transfer towards the northern 1958 M7.7 rupture area and southward towards a region of aseismic creep. Event locations show a sharp downdip limit in seismic activity where the slab reaches a depth of ~30km. This suggests a well-defined transition in frictional properties from the seismogenic zone into the conditionally stable downdip region. A better definition of the updip and downdip limits of the seismogenic zone helps to assess which inland population centers may be more affected by large co-seismic slip in the future.