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Dense seismic networks as a tool to characterize active faulting in regions of slow deformation

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The theory of plate tectonics states that the relative motion between lithospheric plates is accommodated at plate boundaries, where earthquakes occur on long faults. However, earthquakes with a wide range of magnitudes also occur both off plate boundaries, in intra-plate settings, and along discontinuous, diffuse plate boundaries. These settings are characterized by low rates of lithospheric deformation. A fundamental limitation in the study of slowly deforming regions is the lack of high-quality observations. In these regions, earthquake catalogs have traditionally displayed diffuse seismicity patterns. The location, geometry and activity rate of faults – all basic parameters for understanding fault dynamics – are usually poorly known.

The dense seismic networks deployed in the last years around the world have opened new windows in observational seismology. Although high-magnitude earthquakes are rare in regions of slow deformation, low-magnitude earthquakes are well observable on the time-scale of these deployments. In this presentation, we will show how data from dense seismic deployments can be used to characterize faulting in regions of slow deformation. In particular, we will present the case study of western Iberia, a region undergoing low-rate deformation and which has generated some of the largest earthquakes in Europe, both intraplate (mainland) and interplate (offshore). The methods that we employ include automated earthquake detection methods to lower the completeness magnitude of catalogs, earthquake relocations, focal mechanisms patterns, waveform similarity and clustering analysis.