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Dual seismic migration velocities reveal imbricated fluid diffusion and aseismic slip In a Corinth Gulf swarm (Greece)

Louis De Barros[1], Pierre Dublanchet[2], Frédéric Cappa[1], and Anne Deschamps[1]
[1]Université Côte d'Azur, CNRS, OCA, IRD, Geoazur, Sophia Antipolis, France
[2]MINES ParisTech, PSL Research University, Centre de Géosciences, 35 rue Saint-Honoré 77305 Fontainebleau, France

Fluid induced earthquake sequences generally appear as expanding swarms activating a particular fault. Such swarms are generally interpreted as fluid diffusion, which ignores the possibility of static, dynamic or aseismic triggering, and the existence of rapid migration. Here, we study the temporal evolution of a seismic swarm that occurred over a 10-day period in October 2015 in the extensional rift of the Corinth Gulf (Greece) using high-resolution earthquakes relocations. The seismicity radially migrates on a normal fault at a fluid diffusion velocity (~125 m/day). However, this migration occurs intermittently, with periods of fast expansion (2-to-10 km/day) during short seismic bursts alternating with quiescent periods. Moreover, the growing phases of the swarm illuminate a high number of repeaters. Therefore, we propose a new model to explain the combination of multiple driving processes for such swarms. Fluid up flow in the fault may induce aseismic slip episodes, separated by phases of fluid pressure build-up. The stress perturbation due to aseismic slip may activate small asperities in the fault that produce bursts of seismicity during the most intense phase of the swarm. We then validated this model through hydro-mechanical modeling, where earthquakes consist in the failure of asperities on a creeping fault infiltrated by fluid. For that, we couple rate‐and‐state friction, non‐linear diffusivity and elasticity along a 1D interface. This model reproduces the dual migration speeds observed in real swarms. We show that migration speeds increase linearly with the mean pressurization, and are not dependent on the hydraulic diffusivity, as traditionally suggested.