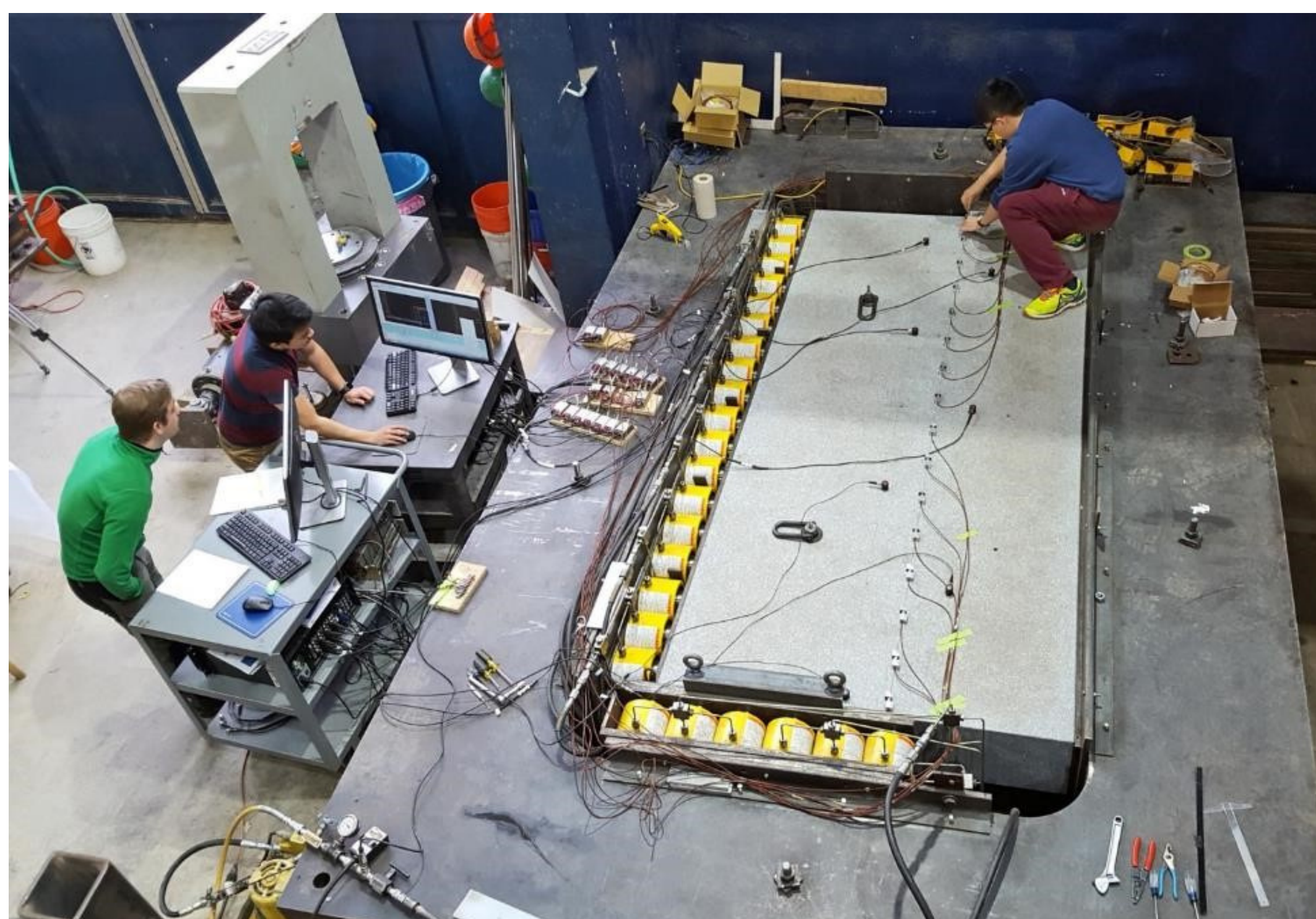




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Earthquakes in a laboratory by squeezing a 3 m rock



I describe sequences of magnitude -2.5 laboratory earthquakes generated on a 3-meter laboratory rock experiment that provide insights into how earthquakes begin and how earthquake ruptures stop. We slowly load the rock sample with up to 10 MN of force and wait for an instability—an earthquake—to spontaneously rupture the fault, which is the interface between two massive granite blocks. In the experiment, we measure the distribution of fault slip along the sample, as well as stress changes and ground motions. From slip sensor data, we image the initiation of the earthquakes and find that they begin as slow quasi-static slip on a localized region of the fault (the nucleation zone) that is about 1 m in size when it rapidly accelerates into a dynamic event. This information can aid in our understanding of how larger natural earthquakes initiate and how we should interpret foreshocks. Once the earthquake initiates, it ruptures as a shear crack that propagates close to the speed of sound in the granite (4 km/s). Unique to this large machine, some laboratory earthquakes stop before rupturing through the ends of the sample, and this allows us to study the stress conditions required to stop an earthquake rupture. I will also present some experiments where we trigger earthquakes by injecting fluid directly into the fault, and others where complex and unpredictable sequences of earthquakes can develop rather than highly periodic ruptures.