Acoustic emissions unveil internal motion in granular materials

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When confronted with a heavy load or deformed by stress, the individual particles in a granular material will sometimes reorganize to a more stable arrangement. At small scales these reorganizations are little more than the redistribution of grains in the pile. In some cases, though, a reorganization is the first step of a critical failure, the trigger for an avalanche or landslide.

Understanding how the motion of individual grains translates into mass movement requires having a way to peer inside the pile without interfering with its behavior. Through a series of experiments, Michlmayr et al. find that specially tuned vibration sensors could be used to listen in on grain-scale dynamics. They find that elastic waves of different frequencies can be used to track and measure different types of motion within a granular material.

In their experiments, the authors stressed granular materials with varying grain sizes. They find that when subjected to a constant deformation, stresses in the materials oscillate in a sawtooth pattern—increasing steadily before dropping suddenly. The drops in shear stress—the sign of a reorganization—correlate with observations of low-frequency acoustic emissions. Materials with smaller grain sizes experience more frequent but less powerful stress drops than those with larger grain sizes. Observations of high-frequency acoustic emissions, the authors find, were associated with grain-on-grain interactions.

More information: Shear induced force fluctuations and acoustic

emissions in granular material, *Journal of Geophysical Research-Solid Earth*, DOI: 10.1002/2012JB009987, 2013
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