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Quantitative analysis of seismogenic shear-induced turbulence in lake sediments

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Spectacular deformations observed in lake sediments in an earthquake prone region (Lisan Formation, pre-Dead Sea lake) appear in phases of laminar, moderate folds, billow-like asymmetric folds, coherent vortices, and turbulent chaotic structures. These deformations are tied to earthquake events which are speculated to be intensified by seiche (mini Tsunami)-induced shear at the bottom of the lake.

Power spectral analysis of the deformation indicates that the geometry robustly obeys a power-law of -1.89, similar to the measured value of Kelvin-Helmholtz (KH) turbulence in other environments. Numerical simulations are performed using properties of the layer materials based on measurements of the modern Dead Sea sediments, which are a reasonable analogue of Lake Lisan. The simulations show that for a given induced shear, the smaller the thickness of the layers the greater is the turbulent deformation. This is due to the fact that although the effective viscosity increases (the Reynolds number decreases) the bulk Richardson number becomes smaller with decrease in the layer thickness. The latter represents the ratio between the
gravitational potential energy of the stably stratified sediments and the shear energy generated by the earthquake. Hence for thin layers the shear energy density is larger and the KH instability mechanism,
become more efficient. The peak ground acceleration (PGA) is related then to the observed thickness and geometry of the deformed layers.