Dynamics of Fold-Thrust Structures in Physical Models Deformed in a Large Geotechnical Centrifuge

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ABSTRACT
We investigate the development of fold and thrust structures by scaled physical modelling, using the large geotechnical centrifuge with a radius of 5.5 m at C-CORE, Newfoundland. The experiments replicate models previously deformed in the smaller but higher-***g*** centrifuge at Queen's University. Multilayer models of foreland stratigraphic sequences are constructed of plasticine and silicone putty and shortened horizontally to simulate development of fold-thrust structures. The large models are ~950 mm long, 100 mm wide and 60-80 mm thick, and scaled at ~1×10^{-5} (10 mm = 1 km), 10x larger than the Queen's equivalents. The large centrifuge accommodates a servo-controlled mechanical drive system and load-monitoring devices to measure stress/strain/strain-rate relationships during shortening of a model.

In accord with scaling theory, the large models successfully reproduce the small-scale modelling results from the Queen's laboratory. Compression load cells in the test package measure changes in strength of a stratigraphic sequence, as fold and thrust structures nucleate during shortening of a model. The stress-strain curves derived from load-cell measurements indicate cyclical strain-hardening and strain-softening during progressive shortening of the models, and these strength variations may correlate with development of particular structures. The demonstration that load oscillations can be detected provides impetus for further investigation of the dynamics of folding and thrusting using the centrifuge technique. The large models will also be suitable for model seismic experiments aimed at refining techniques of seismic data processing and interpretation in areas of complex structure.