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Numerical simulation of emplacement and structures of the 7500 BP Socompa rock avalanche, Chile. Implication for the rheological behaviour of a typical long runout avalanche.

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The 7500 BP Socompa sector collapse emplaced 25 km^3 of fragmented rock as a thin, but widespread (500 km^2) avalanche deposit, followed by late-stage sliding of 11 km^3 as Toreva blocks. Modelling of avalanche motion was carried out using the depth-averaged granular flow equations in order to provide information on the rheological state of the flowing debris. Movement was assumed to take place by slip on a thin layer of basal lubricant, as implied by field evidence. Results were constrained using structures preserved on the surface of the deposit, as well as by deposit outline and run-up. Models assuming constant friction fail to produce realistic results because the low friction angles ($\sim 2^{\circ}$) necessary to generate observed runout permit neither adequate deposition on slopes nor preservation of significant morphology on the deposit surface. A reasonable fit is obtained, however, if the avalanche is assumed simply to experience a constant retarding stress in the range 50-75 kPa during flow. This permits long runout as well as deposition on slopes and preservation of realistic depositional morphology. In particular the model explains a prominent topographic escarpment on the deposit surface as the frozen front of a huge wave of debris reflected off surrounding hills. One possibility is that this stress was a cohesive component related to fracture and grinding in a rock mass in which frictional stresses were kept very low by high pore fluid pressures.