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One-dimensional pore pressure diffusion of different grain-fluid mixtures

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During the release and the flow of fully saturated debris, non-hydrostatic fluid pressure can build up and probably dissipate during the event. This excess fluid pressure has a strong influence on the flow and deposition behaviour of debris flows. Therefore, we investigate the influence of mixture composition on the dissipation of non-hydrostatic fluid pressures. For this we use a cylindrical pipe of acrylic glass with installed pore water pressure sensors in different heights and measure the evolution of the pore water pressure over time. Several mixtures with variable content of fine sediment (silt and clay) and variable content of coarse sediment (with fixed relative fractions of grains between 2 and 32 mm) are tested. For the fines two types of clay (smectite and kaolinite) and loam (Stoober Lehm) are used. The analysis is based on the one-dimensional consolidation theory which uses a diffusion coefficient D to model the decay of excess fluid pressure over time. Starting from artificially induced super-hydrostatic fluid pressures, we find dissipation coefficients ranging from 10-5 m^2/s for liquid mixtures to 10-8 m^2/s for viscous mixtures. The results for kaolinite and smectite are quite similar. For our limited number of mixtures the effect of fines content is more pronounced than the effect of different amounts of coarse particles.