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Cyclic Fatigue Testing for Application for paraglacial rock slope stability modelling

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In glacial environments, rock mass damage is influenced by stress redistribution caused by glaciation and deglaciation cycles. The intact rock strength, discontinuities, stress regime and environmental factors all contribute to the mechanical behavior of the rock slope. Critically-stressed rock walls are exposed to changing boundary conditions. The effect of stress changes during deglaciation of a major glacial period is not well constrained, neither the influence of smaller stress magnitudes of repeat glacier cycles during an interglacial. In an effort to constrain numerical rock slope model input values, a laboratory testing program has been conducted to address the role of fatigue on the intact rock strength. Baseline unconfined compression and Brazilian tensile testing has been conducted on gneissic rocks from the Aletsch valley in Switzerland. The baseline testing results are used to determine load levels for cyclic fatigue compression and tension testing. In the cyclic tests the intact rock samples are taken to the load levels determined from the baseline tests and cyclic loading and unloading is conducted around the nominal load level. The stress fluctuation chosen is between 2-10 MPa, which is equivalent to a glacial loading and unloading of 200-1000m of ice. Such ice thickness change are typical for the Grosser Aletsch glacier during the Lateglacial and Holocene. During cyclic loading and unloading the amount of damage is estimated by recording the number of acoustic emission events with time. Once the acoustic emission events per cycle decrease well below initial cycling levels the load level is increased and cyclic loading is continued at the new load level. This was done for both cyclic compression and cyclic Brazilian tensile tests. The aim of the cyclic tests is to understand what degree of pre-existing damage is required such that 2-10 MPa stress fluctuations could cause crack propagation and failure of laboratory samples in long-term cyclic fatigue tests. The laboratory testing results will be compared with future thermo-hydro-mechanical modelling of stress changes during successive glacial cycles in driving long-term progressive damage and conditioning paraglacial rock slope failure.