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Mechanical anisotropy of the Rothbach sandstone

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Anisotropy in rocks has been long recognized to influence their elastic, transport and mechanical properties, especially in foliated materials such as phyllite, mica schist, gneiss, slate and some clayey sedimentary rocks. In these rocks, the existence of parallel surfaces with relatively low cohesion provides at an angle of 30-45 degrees to the foliation low compressive strength that usually contrasts chiefly with the compressive strength measured along other directions. In some sandstones bedding provides, at least visually, a feature similar to foliation of which the role in mechanical tests has so far not been studied in detail.

In order to elucidate the role of the bedding on mechanical strength at intermediate angle a series of mechanical experiments have been conducted on samples of layered sandstone (Rothbach) cored at 45 degrees to the bedding to complement earlier data acquired at 0 and 90 degrees to the bedding. The samples were deformed in a triaxial press at 10 MPa pore pressure over a range of confining pressures spanning from 10 MPa to $\sim$240 MPa (hydrostatic strength) effective pressure. Brittle failure occurred up to 40 Mpa and at higher confining pressure several failure modes involving compaction localization were observed.

In the brittle faulting regime, the strength of the samples decrease from 90˚ to 0˚. These results are comparable to previous data on the mechanical behavior of a similar sandstone (Adamsviller). At higher confining pressure, our set of data showing the effect of the bedding orientation on compaction localization is, to our knowledge, unique. The onset of shear-enhanced compaction C* for oblique samples occurred at values of differential stresses intermediate to the ones for samples cored parallel and perpendicular to the bedding. Microstructural data suggest that C* is controlled by a preferential orientation of intergranular contacts. Using an anisotropic formulation

of the yield envelopes for the three orientations, we inferred an anisotropy ratio comparable to the one deduced from earlier measurements of the anisotropy of P-wave velocity.