Geophysical Research Abstracts
Vol. 15, EGU2013-10834, 2013
EGU General Assembly 2013

Investigation of anticlines using field measurements and remote methods: Influence and impact of tectonic settings on large rock slope failures

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Structural and rock mass quality characterization of rock slopes using remote methods has greatly improved over the last years. In particular, the use of GB-LiDAR and High Resolution Digital Elevation Models allows identifying geometry and characteristics of ductile and brittle structures with the possibility to extend the investigations to other inaccessible areas.

This study proposes to combine field mapping, Aerial and Terrestrial Laser scanning (ALS, TLS) to investigate the structural features and characteristics of folded layers (fold shape and geometrical evolution, fractures associated to folding) and to interpret the role of these tectonic features in terms of predisposing factors to large rock slope instabilities. Two study sites were investigated; both affected by décollement folds (thin-skinned tectonics) and large rock slope deformations (Graitery anticline in the Swiss Jura Mountains and Livingstone anticline in the Canadian Foothills).

The results show the impact and influence of large scale tectonic structures (here regional scale anticlines) on the distribution and the geometrical characteristics of the different discontinuity sets. The spatial variability of the fracturing orientation and of the blocks volumes allows separating the different sectors of the anticlines in distinct areas.
Morphological indicators of large scale gravitational movements (mainly large gravitational cracks) present in the anticlines are used to determine the extent of the unstable rock compartments. In addition to field and remote sensing evidences, geomechanical modelling is performed to evaluate the contribution of the tectonic structural features (mainly orientation, spacing and persistence) on the unstable compartments' failure mechanisms and volumes.

This study also shows the usefulness and power of remote sensing data for structural geology interpretations as it allows dealing with information in 3D and proposing multi-scale approaches (from outcrop-scale to anticline-scale structures).

Eventually, the results from both field sites along with the interpretations from other comparable sites open new perspectives in the understanding of fold related brittle structures development, as well as their significance for mechanisms and location prediction of large rockslides affecting folded sedimentary strata.