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Structures and failure mechanisms analysis of Turtle Mountain using remote sensing and monitoring data

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Turtle Mountain in Alberta, Canada has become an important field laboratory to test different techniques related to the characterization and the monitoring of large slope mass movements. In order to better quantify the potential instable volumes and the most probable failure mechanisms, a structural study is a necessary step. The structural features of the South part of Turtle Mountain are investigated using DEM techniques and field analysis. We started to map structural features analyzing high resolution digital elevation model by means of a GIS based tool (COLTOP 3D software), in order to have a large overview of the relevant structures. An airborne light detection and ranging (LiDAR) was utilized to generate the high resolution digital terrain model (0.5 meter mesh size) of the entire mountain. At the same time, a field survey was carried out in order to analyze the small scale fractures in different parts of southern Turtle Mountain and to confirm the DEM analysis. These analysis were compared against the past 25 years of monitoring data to give an interpretation of the failure mechanisms and the associated movement directions. Field and DEM analysis allow identifying 6 main discontinuity sets that influence the Turtle Mountain morphology. The entire Turtle Mountain area appears to be divided in several slices, moving slowly toward North-east, following a persistent post-folding discontinuity set (020/45). The upper South Peak area represents the main important instability. In according to displacements data and structural observations, different instable blocks, with different failure mechanisms could be delimited. The structural setting can't explain alone all the measured movements, and a complex interaction between the different blocks must taken into account. The lower South Peal area shows an important fracturation and different

gravitational cracks indicating an important slope activity. These observations lead to the design of additional monitoring to the existing sensor networks in order to characterize the movements of the whole southern par of Turtle Mountain. This study has also permit to determine additional instable volumes susceptible to the rock slope movements, in particular in the lower South Peak area.