



Rock fall susceptibility assessment using structural geological indicators for detaching processes such as sliding or toppling

Sandra Melzner, Nils Tilch, Michael Lotter, and Arben Kociu

Geological Survey of Austria, Department of Engineering Geology, Vienna, Austria (sandra.melzner@geologie.ac.at, www.geologie.ac.at)

A structural geological assessment of cliffs in terms of rock fall susceptibility is expensive and time-consuming particularly in remote areas (exposed cliffs) where it may even be impossible. Hence it is important to develop methods and strategies that can be used to extrapolate the acquired knowledge from representative sub-regions to the whole study area. Using a case study in Carinthia (Austria), a GIS method was developed which can be used for regional, qualitative determination of the susceptibility of cliffs in carbonatic sedimentary rock, regarding two potential initial detachment processes of rock fall: sliding and/or toppling.

During the development of this GIS method, it was found that not all of the mapped structural geologic parameters are equally suitable for a comprehensive regionalisation. Subsequently, only those parameters were included in the assessment which experts deemed to be representative in terms of parameter homogeneity/heterogeneity and thus applicable to the entire survey region: bedding thickness, tectonic lineaments, orientation of discontinuities and type of rock mass structure. Regions of homogeneity/heterogeneity differ with regard to parameter values, as well as parameter uncertainties and scattering.

At first, the cliffs were categorised in terms of potential form and size of rock blocks by overlaying various parameter maps. In the next step, the relative orientation of the rock mass structures and their variations towards slope aspect and slope inclination were considered within a region of homogeneity. This allowed an accurate estimate of the possible maximum dip angle (or apparent dip angle) of a joint set over a wide area. It also permitted those areas to be pointed out in which process-initialising sliding and/or toppling might be possible along one or several joint sets.

Comparing this method to the acquired field data has proven the approach to be successful when it comes to assessing cliffs in carbonate rocks in terms of form and size of rock blocks, but also in terms of varying susceptibilities of rock fall-inducing processes (sliding, toppling), in order to establish a relative rating (e.g. quite likely, quite unlikely). The latter is essential to classify the cliffs according to varying process susceptibilities and thus put special focus on future investigations and/or modelling approaches (e.g. delineation of rock fall runout zones) of particularly susceptible regions. The approach, however, still needs to undergo further testing in terms of usability and efficiency in other carbonate regions and – if necessary – will be adapted to fit other area settings such as in areas of crystalline rocks.