



The process of upward loosening of the roof of a karst cavern in a stratified limestone mass

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The behaviour of a natural karst cavern within a stratified limestone mass of Upper Cretaceous age at Castellana Grotte (Southern Italy) is here discussed. The cave consists of wide caverns, 10 to 60 m high, which are connected by narrow and high corridors; the present configuration of the caves represent a particular stage of the karst process evolution. The observed behaviour of the rock mass around the caves is characterised by the gradual failures of horizontal slices of the ceiling due to the propagation of vertical tensile joints; this leads to the sudden fall of rock slabs with thicknesses between few centimetres and more than one metre. The slow failure mechanism of the caves and the factors controlling this process have been investigated in the present study both by means of in situ surveys and by numerical modeling using the distinct element method. The influence of the progressive degradation of the tensile strength of the limestone due to chemical and humidity weathering processes has been highlighted as one of the main factors controlling the whole instability process. As a consequence, the stability of the cave roof undergoing crack propagation depends both on the geometry of the newly formed blocky systems at the roof and on the residual strength of the existing rock bridges. The reason for the asymmetric collapse of the roof, which has been observed to be frequent in these natural caverns, has been also investigated in the numerical analysis. Preliminary results from in situ monitoring carried out by means of continuous logging instruments, which have been installed to validate the interpretation of the failure mechanism here proposed, are also presented.