

## BEHAVIOR OF A LIMESTONE ROOF SUPPORTED BY SPOT BOLTING

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In this case study, a highly stressed limestone roof that would eventually fail was instrumented. This instrumentation was used to continuously monitor bolt loads, roof movement, temperature and humidity over a 9 month period. The only roof support in the test room was provided by the instrumented bolts thus making it a spot bolting system. Prior to the start of the roof failure, a direct correlation between a change in air temperature from mining and in bolt loads was established. Finally, the increase in air temperature caused by heat generated by mining equipment was sufficient to induce an added roof stress that triggered the failure process. Before mining was halted by roof activity, the room temperature reached a maximum of 110 degrees F. A fracture developed in the roof at a depth of about 1 ft with a vertical displacement of 0.075 in. Once initiated, the failure continued to progress over a period of 3.5 months with no mining activity in the room during this time. Roof movements were small while maximum bolt loads although changing were less than 7,000 lb. However there was a continuous pattern of bolts loading and unloading across the room. Just before mining was resumed there was a sudden increase in the load on one bolt that reached 26,000 lb followed shortly by a sudden load decrease. This change in bolt load was associated with the development of another roof fracture at a depth of 2 ft that indicated the roof had failed. A roof fall occurred adjacent to the instrumented area in the room shortly after mining was resumed while the roof with the bolts did not fall. In this roof failure, only the roof skin was affected while continuous monitoring of the instrumentation was necessary to capture the sudden roof movements and changes in bolt loads that occurred.