Budzinski, D., Spies, T., Alheid, H.J., Eisenblätter, J. (2002):

Detailed investigation of fracturing at the boundary of rock salt and anhydrite using engineering geology methods and ultrasonic measurements

Salt deposits, owing to their good barrier properties, are suitable as repositories for hazardous waste and storage of fluids. Deformation of large rock salt formations occurs for the most part without the formation of fractures. Fracturing can occur, however, near cavities and at rock boundaries. A typical problem in salt and potash mining for the stability of drifts, caverns, etc. and the hydraulic integrity of the rock mass is the succession of layers with very different mechanical properties. The cavities are mined mostly in ductile rock salt and potash salts, which have a high tendency to creep. It is not always possible to avoid excavating cavities near anhydrite beds. Anhydrite is much more rigid and has a higher strength than rock salt and is brittle. The redistribution of stresses around the cavity includes the nearby anhydrite beds, leading to deviatoric stresses, especially at the boundary between the ductile and the rigid rocks. If these stresses exceed a certain level, microcracks form.

Acoustic emission measurements providing the locations of microcracks were performed in a mine segment near anhydrite beds. Often clustering of acoustic emission events was found in the rock but could not be attributed to certain geological features as the locations of geological boundaries were not known precisely. So the results of acoustic emission measurements were verified by the drilling of two boreholes into a region of the rock in which a prominent cluster of events was observed. The investigated cluster consisted of about 800 single acoustic emission events which occurred in a time span of a few days. The spatial arrangement of the events is a ring of about 8 m diameter. Evidence of fracturing should be found by careful inspection of the rock cores in the laboratory. Furthermore the borehole walls were inspected using a video camera to detect geological boundaries as well as joints or cracks. The latter investigation was very important as the core may be cracked because of loading during drilling. Ultrasonic measurements were conducted in and between the boreholes to detect joints and the possible connection of the boreholes by single joints.

Drilling confirmed that the cluster of acoustic emission events was located at the boundary of rock salt and anhydrite. Combining the results of the various methods it is concluded that the appearance of the cluster marked the shape of a roughly circular macroscopic fracture plane of 8 m diameter. Acoustic emission indicated the intermittent growth of the fracture. The fracture lies within a thin clay layer in a zone of weakness directly behind the boundary of rock salt and anhydrite. The lack of acoustic emission within the ring of events is interpreted as being due to complete fissuring there before the cluster appeared.

References

Spies, T., Eisenblätter, J. (2001): Acoustic emission investigation of microcrack generation at geological boundaries. Engineering Geology 61 (2001), p 181 – 188.

Eisenblätter, J., Spies, T., Manthei, G. (2002): Statistische Analyse zweier Cluster der akustischen Emission in einem Salzbergwerk. 62nd Annual Meeting of the Deutsche Geophysikalische Gesellschaft, March 2002, Hanover, Germany.