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Acoustic Emission Measurements in a deep Gold Mine in South Africa; Instrumental Setup and First Results (JAGUARS Project)

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Acoustic emission (AE) measurements are often applied in rock laboratories. This method is also successfully applied in some German salt mines. The aim of this presentation is to call attention to a new AE experiment, going on in a hard-rock formation (diorite and quartzite) about 3,500 meters below the Earth's surface. All involved scientists and companies are building the new research group 'JApanese-German Underground Acoustic emission Research in South africa: JAGUARS'.

Our underground laboratory is situated in the Mponeng Gold Mine in South Africa. Access to our working place is provided by the mine's tunnel system. For the AE observation a site was found which will experience mining-induced seismicity of magnitudes up to 2 or 3.

While the final setup of all sensors is still going on, the AE observation is running with enough sensors for an approximate event localisation. A three-component accelerometer is already included. The observation includes automatic in-situ localisation and waveform storage of all relevant events as well. Ultrasonic transmission tests are performed to determine P and S wave velocities and Q values [Naoi et al., this meeting]. The AE measuring system can be remotely controlled by an internet access.

The first results we could obtain show that there is a reasonable number of AE events

with main frequencies in the ultrasonic range which can only be detected by highly sensitive AE sensors. Due to a high Q value and homogeneity of the surrounding rock the high-frequency signals (above 20 kHz) of small events can travel more than 50 m to the sensors. We also observe events with lower frequencies at distances of over 300 m. Close to the sensors (about 10 m) the frequency often reaches the range of 100 kHz, sometimes up to 200 kHz. Detailed frequency analysis is shown in a separate presentation (poster) [Plenkers et al.].

During a test run of the measuring system a seismic event of magnitude 2.1, as determined by the mine's seismic network, occurred near the AE network. At the same time we observed a sudden increase of AE activity. Thousands of AE events, partly building clusters, could be localized automatically within a few hours after the M 2.1 event. After three days the AE activity was still five times higher than before the large event.

The first results already show that AE measurements in a mine give the chance to close the gap between laboratory AE analysis and common seismic or microseismic analysis. After final completion of the sensor array we will determine the source characteristics of AE events and their relation to large seismic events. This may lead to a better understanding of rock-fracture and earthquake mechanisms.