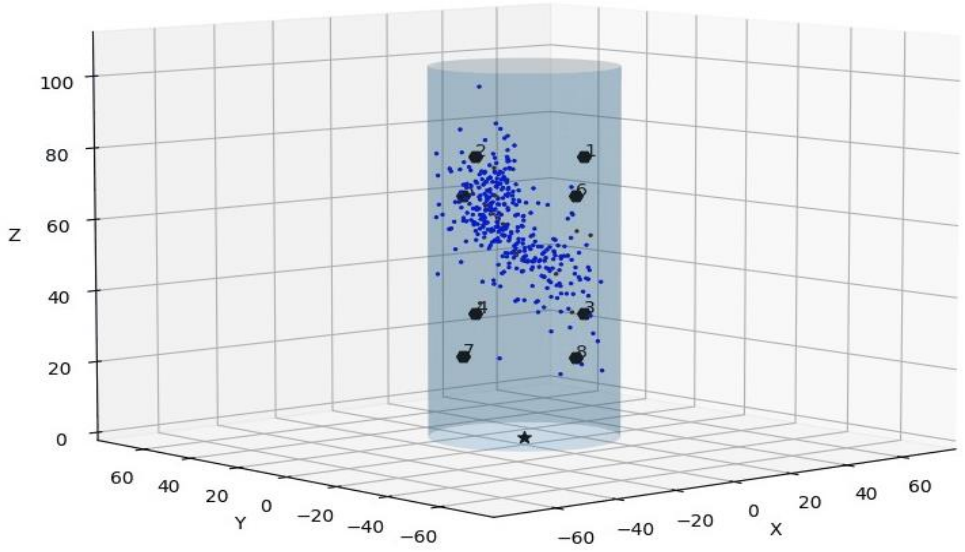
Acoustic Emissions: Detection and Location

The permanent deformation of brittle rocks at elevated stress is the result of the initiation and propagation of microcracks. These events often give rise to acoustic emissions (AE). With an array of acoustic detectors on the surface of the sample, the AE events can be detected and located. AE events occur not only as the external stress changes, but can also be generated by fluid flow, rock-fluid chemical interaction, phase changes, etc. This is a useful technique to track in real time the damage in the rock.

NER does not independently produce the whote AE detection systems, we use the Vallen AMSY-6AE System with our software and piezoelecric crystrals. A typical setup consists of eight (8) AE amplifiers, an independent computer, and eight (8) piezoelectric sensors manufactured by NER. The AE sensors are embedded into a rubber sample jacket in a documented, fixed position.



During a confined compression experiment, the development of microcracks emit stress waves. If the energy is sufficiently large, the piezoelectric transducers are excited, the Vallen system recognizes them as an AE event, and stores the data in an independent computer. After a specified dead-band, the system is rearmed and ready to collect another AE. Hundreds of AE events are collected during a typical experiment.

After the experiment, the database is examined. A large number will have insufficient data or poor signal quality. These must be discarded. The remaining candidate events are then analyzed by picking the first arrival on each trace (relative to the transducer that first detected the event). Then, by knowing the location of the transducers in the array, the relative travel times, and the velocity of the rock, the location of the damage, AE event, can be located. It is the same process as locating an earthquake detected within a seismic network. The AE events are then displayed on a 3D representation of the sample.