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Electromagnetic radiation in fractures of various scales from microns to kilometers

D. Bahat (1), V. Frid (1) and A. Rabinovitch (2)

The Deichmann Rock Mechanics laboratory of the Negev, Geological and Environmental Sciences (1) and Physics (2) Departments, Ben Gurion University of the Negev, Beer Sheva, Israel

e-mail:vfrid@bgu.ac.il

Electromagnetic radiation (EMR) has been measured in fractures of multiscale lengths (microns up to tens of kilometers) for different materials. It has been measuring for fracture a lot of time in various materials, including metals and alloys, rocks, ice, glass and glass ceramics.

Careful investigations in micro-scale showed that the shape of individual EMR pulses is invariant to the type of the material fractured (brittle and amorphous, rock and man-made), the cracking mode (tensile and shear, quasi-static and dynamic) and the loading (extension or compression). Moreover, the same shape was obtained during “asperities” failure in friction.

An expansion of EMR studies to a pilot scale, both for explosions in quarries and for monitoring rock collapse in underground mines, showed again the same, scale adjusted, shape.

The Gutenberg-Richter and Benioff strain release laws, that are valid for earthquakes, laboratory studies of acoustic emissionand even for energy distribution of neutron starquakes, was shown to be valid also for EMR induced by rock failure.

Thus EMR is universal tool for multi-scale fracture investigations:

- polarization measurements in minerals (small scale);
- evaluation of orientation and magnitudes of stress fields in associations with faulting;

- blast monitoring and control in quarries;
- rock burst and roof collapse forecast in mines;
- stress control in mines and tunnels;
- perhaps the most challenging application is earthquake prediction.