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Monitoring crustal stress by microearthquake analysis

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During the PRENLAB projects in Iceland an earthquake warning algorithm based on the statistics of the microearthquakes was earlier designed. The following microearthquake parameters were included: hypocenter location, origin time, seismic moment, slip size, static stress drop, and fault radius. This EQWA is described by Slunga (2003). Within PREPARED there is an intention to go into a more physical analysis of the microearthquakes preceeding an earthquake which possibly will increase the predictive value of the EQWA. An example of such a parameter is the stress level. Conventional interpretation of microearthquake fault plane solutions normally only give the principal stress directions and the shape factor relating the medium principal stress size to the largest and smallest principal stresses. By assuming the vertical stress to equal the lithostatic pressure, the shear stresses to be critical, and using a reasonable value for the water pressure one gets enough of constraints for determining the whole stress tensor. A simple model for relating the water pressure to the rock stresses and rock strength is presented. Examples are shown based on the Icelandic microearthquake data, about 300000 microearthquakes in the magnitude range 0-6.6 during 1991-2004. All events have fault plane solutions by the robust method of spectral amplitudes (impulses) and the auxiliary plane can often be eliminated by high accuracy relative locations. The preliminary results are promising. This accentuates the value of the microearthquake analysis. Their value is furtherly increased if the fault plane solution process eliminates the auxiliary plane. This is also tested as it will reduce the required number of microearthquakes for accurate stress estimation.