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Significant advances in earthquake prediction based on the earthquakes year 2000 in Iceland.

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We present some results which are significant for useful long term and short term warnings, based on 20 years of multinational earthquake prediction research in the South Iceland Lowland “Natural Laboratory”. The research period involves two magnitude 6.6 earthquakes which occurred in the area in the year 2000. Both of the earthquakes had long term prediction with good location and magnitude estimation, as the next large earthquakes in the South Iceland Seismic Zone (SISZ). A useful short term warning was given to civil protection organizers 26 hours before the second earthquake including correct place, size and immediacy.

The basic observations for the predictions were:

High level information carried from microearthquakes in the area, complete down to magnitude zero.

Historical seismicity, mainly from year 1700.

Geological and seismic mapping of active earthquake faults.

Modelling based on historical seismicity, microearthquakes and fluid rock interaction, indicates that the place and time of earthquake in the area is strongly constrained by high pore pressures at the bottom of the elastic/brittle crust, which penetrate up into the crust in response to straining, making faults unstable. On the other hand the size of large earthquakes depends strongly on the time of release within the earthquake build up cycle. This modeling explains the success in the predictions before the two 2000 earthquakes, as well as multidisciplinary observations of hindsight preearthquake activity.

Future warnings for large earthquakes will be based on gradual approach on basis of

the research results, i.e. finding dangerous faults, possibly decades before they rupture, followed by enhanced multidisciplinary monitoring related to these faults. Modelling on basis of the new and continuous observations, “real time research”, to study the nature of the faulting in the impending earthquake, the precise location, fault length and probable slip. Warning algorithms will be applied, especially seismic, to detect the start of “slow” earthquake faulting at depth, and it’s straining of the hard core, asperity, of the upper or locked part of the fault. Build up of an early information and warning system (EWIS) to keep track of such warning procedures is being developed.