

From the Nordic SIL research project towards warnings on the long- and on the short-term before large earthquakes

Ragnar Stefánsson

University of Akureyri

From its start in 1988 the SIL project was based on physical approach in earthquake prediction research. It was also stated from the start that the best information about crustal processes preceding earthquakes would come from multidisciplinary information carried with micro-earthquakes from seismogenic depths.

The old efforts in earthquake predictions were to a large extent based on “precursor statistics”, mostly on shallow origin precursors, which were so large that they could be observed by the old seismic networks and by people. It was very difficult to invert these shallow precursors to what was happening at depth, until after the big earthquake. So the result was many “hindsight predictions” and very few successful “pre-earthquake predictions”. These mistakes are gradually convincing more and more scientists that we cannot assume that pre-earthquake activity is the same before any two earthquakes, so statistics does not work at this level.

But these early precursor studies had the very significant outcome that something happens before most large earthquakes, although the observers did not understand what it was telling us. There the SIL project came in which aimed to revealing the physics of such pre-earthquake processes. One of the well known precursors was the so called seismic quiescence before large earthquakes, i.e. no earthquakes during days to years preceding them. But for how long time there was no information during the quiescence or in general about the pre-earthquake process. Going down to micro-earthquakes (magnitude zero) there is information all the time.

Multinational and multidisciplinary studies of the physics of pre-earthquake patterns in Iceland from SIL to PREPARED (1988-2005+) especially in the South Iceland Seismic Zone indicate that it is possible to observe and physically to model fault conditions and crustal process leading to a large earthquake during decades before it strikes.

The preparation process of earthquakes cannot be assumed to be the same. This and the long observable preparation period moves our efforts towards studying the ongoing pre-earthquake process at individual faults: “To create a constitutive relationship for the possibly pre-earthquake process, to extrapolate these conditions in space and time to predict activity, to constrain the model by the forthcoming activity, and thus gradually to refine the constitutive relationship towards the earthquake.”

It is stated that by such an approach useful warnings/information about significant aspects of any large earthquake in Iceland may be issued during its preparation period, provided that relevant multidisciplinary geo-watching procedure is applied. Such a watching procedure, consisting of automatic and manual operations, should be capable of real time modeling explaining the continuous observations, from seismic observations of deep origin towards observations of forerunners with shallow origin.