RELOCATED MICROEARTHQUAKES USED FOR MAPPING ACTIVE FAULTS AT DEPTH IN ICELAND

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Abstract

We have used seismological data, recorded by the SIL-network, to map fault patterns at depth in several different regions in Iceland. By using a double-difference relative relocation method (Slunga *et al.*, 2005) it is possible to reduce relative location error between events such that fault patterns may become resolvable. Slip direction on the fault planes can be estimated trough the joint interpretation of the event distribution and mechanisms (Rögnvaldsson and Slunga, 1993). It is also possible to estimate mechanisms of large earthquakes by slip distribution of aftershocks near the hypocentre. During the first years following the development of the software, the method was used to map faults in the Tjörnes fracture zone (TFZ) (Rögnvaldsson *et al.*, 1998), the Hengill area (Rögnvaldsson *et al.*, 1999) and in the South Iceland seismic zone (SISZ). After significant reconstruction of the software during 1999-2002, the first large mapping project was carried out on the seismic activity in the Hengill region during the uplift period between 1994 and 1998 which illuminated many fault planes in the area. The fault mapping was based on relocated events occurring between 1997 and 1998 (Vogfjörd *et al.*, 2005). The results show rather large N-S faults in the southern part, on Hellisheiði, which are cut through by more westerly trending faults, striking ~70°. In the northern part the faults tend to lign up along the surface fractures mapped in the area, although other strikes are also observed.

The next major project involved the seismicity following the two M_L~6.5 June 2000 earthquakes in the SISZ. The two large earthquakes induced over 16 thousand events in all Southwest Iceland during the next six following months. The mapping has not only revealed the details of the two large fault planes, but also many smaller fault segments in the SISZ, the western volcanic zone and on the Reykjanes Peninsula (Hjaltadottir *et al.*, 2005).

The aftershocks of the 2008 M_L6.3 earthquake in the Ölfus district (SISZ) were used to map the two fault planes of the earthquake, spaced 4 km apart. The mapping shows for example the left stepping en echelon structure of the larger fault plane, the Kross fault.

Further fault mapping based on several years of data has also been carried in selected areas on the Reykjanes peninsula (RP) and in the western volcanic zone (WVZ). Mapping of sub-surface faults near to Fagradalsfjall on the RP (Hjaltadóttir and Vogfjörð, 2006) has shown, similar to the SISZ, many N-S trending fault segments, but also faults trending SW-NE and SSW-ENE. Similar mapping in the vicinity of Prestahnúkur in the WVZ (Hjaltadóttir and Vogfjörð, 2009) shows that the event distribution forms a lineament which trends SW-NE, and that most of the faults segments strike SW-NE too.

The most recent fault mapping was carried out within a selected area on the Húsavík-Flatey fault in the TFZ where the whole SIL-catalogue was used. The comparison of relocated events with small relative location error and bathymetric data (Brandsdóttir *et al.*, 2005) shows clusters of events correlating with faults on the seafloor. Specifically, the seismicity shows clearly a N-S striking fault cutting through the largest lineament in the seafloor where it is offset by roughly half a kilometre.

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