The Tectonic Evolution of the Tjörnes Fracture Zone, o.shore Northern Iceland - Ridge Jumps and Rift Propagation

Robert S Detrick1 (508 289-3335; rdetrick@whoi.edu); Bryndýs Brandsdóttir2 (bryndis@raunvis.hi.is); Neal Driscoll3 (ndriscoll@ucsd.edu); Bjarni Richter4 (br@isor.is); Larry Mayer5 (larry.mayer@unh.edu); Dan Fornari1 (dfornari@whoi.edu); Brian Calder5 (brc@ccom.unh.edu); Graham Kent3 (gkent@igpp.ucsd.edu)

1Woods Hole Oceanographic Inst., 360 Woods Hole Rd, Woods Hole, MA 02543, United States
2Science Institute, Univ. of Iceland, Hagi, Hofsvallagata 53, Reykjavík 107, Iceland
3Scripps Inst. of Oceanography, Univ. of California, San Diego, La Jolla, CA 92037, United States
4Iceland GeoSurvey, Grensasvegur 9, Reykjavík 107, Iceland
5CCOM, Univ. of New Hampshire, Durham, NH 03824, United States

The Tjörnes Fracture Zone (TFZ) links the rift zones in northern Iceland with the Kolbeinsey Ridge north of Iceland. The TFZ was initiated during the Miocene (7-9 Ma), following an eastward jump of the spreading axis in northern Iceland. A roughly 150 km long (EW) and 50 km wide (NS) deformation zone has since developed which includes both right-lateral, strike-slip faults and three N-S trending extensional grabens (from west to east the Eyjafjörður, Skjálfandi and Óxarfjörður basins) which are filled with a 0.5-4 km thick sedimentary sequence. There are two WNW striking bands of seismicity in the TFZ, a northern band known as the Grýmsey lineament and a southern band associated with the WNW-trending Húsavík-Flatey fault (HFF). Over the past three field seasons we have mapped a large portion of TFZ utilizing Multibeam echo sounders (both EM300 and a Reson 8101 shallow water system), collected high-resolution multichannel seismics and Chirp sonar, and obtained bottom photographs. The HFF can be traced offshore from Húsavík village across Skjálfandi Bay as two WNW trending, south-facing fault scarps nd northwest of Flatey Island into the southern Eyjafjörður basin as sub-parallel of the main HFF. Offshore Flateyjarvögl, west of Flatey Island, a zone of intense deformation has been mapped, including clear evidence of right-lateral strike-slip faulting. The sediment-filled basins north of the HFF are bounded by numerous NStrending faults, some of which extend to the seafloor, suggesting they are actively extending. The very subtle expression of the HFF in eastern Skjálfandi Bay, and the more prominent but simple expression of recent (post-glacial) faulting along the western HFF near Flatey Island are consistent with historical and recent seismicity which is concentrated on the Húsavík fault system on the Tjörnes peninsula, along the western HFF and in the southern Eyjafjörður, basin. A GPS geodetic station on the Tjörnes peninsula, northeast of the HFF, maintained by the Iceland Meteorological Service shows that over the past 2 years the southern TFZ has been moving with the North American plate suggesting that little strain accommodation is currently occurring along the main HFF. These
observations are consistent with a model for the tectonic evolution of the TFZ in which the continued northward propagation of the northern rift zone in Iceland has progressively shifted relative motion between the North American and Eurasian plates northward to the series of NNESSW trending rift zones along the Grýmsey seismic lineation. A WNW-trending, north-facing scarp. In Skjálfandi Bay several smaller WNW-trending faults are located sub-parallel of the main HFF. Offshore Flateyjarskagi, west of Flatey Island, a zone of intense deformation has been mapped, including clear evidence of right-lateral strike-slip faulting. The sediment-filled basins north of the HFF are bounded by numerous NStrending faults, some of which extend to the seafloor, suggesting they are actively extending. The very subtle expression of the HFF in eastern Skjálfandi Bay, and the more prominent but simple expression of recent (post-glacial) faulting along the western HFF near Flatey Island are consistent with historical and recent seismicity which is concentrated on the Húsavík fault system on the Tjörnes peninsula, along the western HFF and in the southern Eyjafjörður basin. A GPS geodetic station on the Tjörnes peninsula, northeast of the HFF, maintained by the Iceland Meteorological Service shows that over the past 2 years the southern TFZ has been moving with the North American plate suggesting that little strain accommodation is currently occurring along the main HFF. These observations are consistent with a model for the tectonic evolution of the TFZ in which the continued northward propagation of the northern rift zone in Iceland has progressively shifted relative motion between the North American and Eurasian plates northward to the series of NNESSW trending rift zones along the Grýmsey seismic lineation.