The stress shadow induced by the 1975 - 1984 Krafla rifting episode

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It has been posited that the 1975 - 1984 Krafla rifting episode in northern Iceland was responsible for a significant drop in the rate of earthquakes along the Hùsavìk-Flatey Fault (HFF), a transform fault that had previously been the source of several magnitude 6 - 7 earthquakes. This compelling case of the existence of a stress shadow has never been studied in detail, and the implications of such a stress shadow remain an open question. According to rate-state models, intense stress shadows cause tens of years of low seismicity rate followed by a faster recovery phase of rate increase. Here, we compare the long-term predictions from a Coulomb stress model of the rifting episode with seismological observations from the SIL catalogue (1995-2011) in northern Iceland. In the analyzed time-frame we find that the rift-induced stress shadow coincides with the eastern half of the fault where the observed seismicity rates are found to be significantly lower than expected, given the historical earthquake activity there. We also find that the seismicity rates on the central part of the HFF increased significantly in the last 17 years, with the seismicity progressively recovering from west to east. Our observations confirm that rate-state theory successfully describes the long-term seismic rate variation during the reloading phase of a fault invested by a negative Coulomb stress. Coincident with this recovery, we find that the b-value of the frequency-magnitude distribution changed significantly over time. We conclude that the rift-induced stress shadow not only decreased the seismic rate on the eastern part of the HFF but also temporarily modified how the system releases seismic energy, with more large magnitude events in proportion to small ones. This behavior is currently being overturned, as rift-induced locking is now being compensated by tectonic forcing.