

## Imaging the source regions of normal faulting sequences induced by the 2011 M9.0 Tohoku-Oki earthquake

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Intense swarm-like seismicity associated with shallow normal faulting was induced in Ibaraki and Fukushima prefectures, Japan, following the 2011 Tohoku-Oki earthquake. This seismicity shows a systematic spatiotemporal evolution, but little is known of the heterogeneity in crustal structure in this region, or its influence on the evolution of the seismicity. Here we elucidate a high-resolution model of crustal structure in this region, and determine precise hypocenter locations. Hypocenters in Ibaraki Prefecture reveal a planar earthquake alignment dipping SW at about 45-degree, whereas those in Fukushima Prefecture show a more complex distribution, consisting of conjugate sets of aligned small earthquakes. On the north of the hypocenter of the largest earthquake in the sequence (the M7.0 Iwaki earthquake), we imaged a high-velocity body at shallow depths that lacks aftershock seismicity. Based on fault source models, the large-slip region of the Iwaki earthquake is situated along a zone that roughly coincides with this high-velocity body. We delineated a separate low-velocity anomaly directly beneath the hypocenter of the Iwaki earthquake, indicating crustal fluids in this region. We hypothesize that strong crust underwent structural failure due to the infiltration of crustal fluids into the seismogenic zone from deeper levels, causing the Iwaki earthquake.