

Radiated and Frictional Energy of the 2011 Tohoku-oki Earthquake

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The Japan Trench Fast Drilling Project (JFAST) estimated the level of dynamic friction on the shallow portion of the fault that had the very large slip during the 2011 Tohoku-oki earthquake. From both laboratory experiments on the fault zone material and temperature measurements across the fault zone, the shear stress during the earthquake rupture was estimated to be about 0.6 MPa at 820 meters below the sea floor (including the water depth this is equivalent to about 3.5 km of rock overburden). This shear stress corresponds to a coefficient of friction of about 0.1. Combining these results with estimates of the radiated energy, show that the ratio of frictional heat to radiated energy is less than 1.0 for the shallow portion of the fault. These estimates are related to the large slip portion of the earthquake in the shallow region of the megathrust and are not representative of the deeper portions of the earthquake rupture area. Averages for the whole earthquake suggest that the ratio of frictional heat to radiated energy is much larger (about 10) and similar to values inferred for typical earthquakes. This implies there is a significant difference in the energy partition between the shallow portion (with large slip) and the deeper portions (moderate slip) of the subduction fault. The shallow/deep portion of the fault produces relatively more/less radiated energy compared to the frictional heat.

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