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Offshore source fault modeling using late Quaternary paleoshoreline records, Northeast Japan

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The eastern margin of Japan Sea is a tectonically active zone of Northeast Japan back-arc and a fold and thrust belt under compressive stress field in Quaternary, which is characterized by inversion tectonics succeeding to the middle Miocene opening of the sea. The differential uplift showing tilting and warping of late Quaternary marine terraces along a 500 km long coast of this eastern margin is understood due to offshore causative fault movements and related large earthquakes. Holocene terrace morphology with steps, historically documented coastal uplift at large earthquakes along the Japanese coast, and harmonious displacement patterns among MIS 5e and Holocene paleoshoreline heights, indicate the occurrence of intermittent and repeated coastal uplift produced by co-seismic distinctive crustal movements. Shallow submarine reverse fault segments with either west dip or east dip, close to the coastlines, are undoubtedly responsible for coastal uplift and accumulative marine terrace tilting and warping demonstrated as fault-related fold structures. Calculating co-seismic displacement distribution to be best fit to marine terrace records, by the use of crustal dislocation model, individual fault parameters range in length from 20-60 km, in dip angle from 30-50 degrees, in slip from 2-7 m (in uplift from 1-3 m), suggesting earthquake magnitude in the range of Mw7.0-7.5 and recurrence time of 1000-4000 years. This implies that the eastern marginal coastal areas of Japan Sea have high probability of large magnitude earthquakes accompanied by coastal uplift, which will happen somewhere in near future. Particularly in the area where present abrasion platforms widely develop, the next large earthquake seems imminent.

Keywords: Late Quaternary, paleoshoreline records, dislocation, source fault modeling, Japan Sea-eastern marginal tectonic zone