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Reexamination of the source fault of 1804 Kisakata earthquake,analyzed by emerged shoreline topography

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The 1804 Kisakata earthquake was accompanied by rocky coastal upheavals, the disappearance of Kisakata lagoon and tsunami. The fault model by Hiwatashi et al (2002) was proposed to explain tsunami height distribution, but it could not explain the crustal uplift amount. In this study, we investigated the deformation associated with the earthquake and surface geology, in an attempt to clarify the geomorphic evolution of this area. Then, we estimated the source fault and its parameters by calculation of crustal dislocation. Further, we reexamined the possibility of previously occurred earthquake events.
We identified two levels composed of emerged notches and benches (L1, L2). The height of L1 is 300-480cm and that of L2 is 140-230cm. L2 is correlative the uplift event by the 1804 Kiakata earthquake and L1 suggests the previous uplift by the penultimate earthquake. Considering that notch and bench are formed at high tide level, uplift amounts of 1804 earthquake are calculated to 130-210cm, which is 50cm larger than those by Hirano ea al (1979). By hand-augering we found drift pumices originated from Towada-a(915.A.D) deposited in the pre-1804 Kisakata lagoon. This indicates that the lagoon was reduced by some uplifting between 915.A.D-1804.A.D. The L2-related earthquake event is likely a candidate which made a reduction of the Kisakata paleo-lagoon.
Based on these co-eathquake uplift data, we calculated crustal deformation associated with Kisakata earthquake using dislocation models, using the software of Coulomb3.1 (Toda et al.,2005 ;Lin.and Stein,2004). We can assume three fault models located in Kisakata offshore. Their faults parameters are :
F1: 2km offshore, length=32km, width=24km,dip angle=45 degrees, slip =3.5m, top depth=1km, bottom depth=13km, MW=7.1,
F2: 14km offshore , length=56km, width=24km, dip angle =30 degrees, slip=6m, top depth =1km, bottom depth =13km, MW=7.5,
F3: 18 km offshore , length=42km, width=24km, dip angle=30 degrees, slip=7.5m, top depth=1 km, bottom depth =13km, MW=7.5.

F1 shows the best agreement with the observed distribution of upheaval amount. but it cannot explain tsunami height generation. Although F2 also explain the upheaval amount, it does not fit the tectonic scarp topography. F3 can explain the distribution of tsunami and upheaval amounts. Thus, we conclude that F3 is the best source fault of 1804 Kisakata earthquake.

Keywords: Japan Sea eastern margin, offshore active fault, 1804 Kisakata earthquake, emerged shoreline topography, source fault modeling