Crustal deformation associated with the 2001 August 14 event (M6.2) that occurred in a seismic gap off the east coast of Aomori

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The 1968 Tokachi-oki earthquake (Mw8.2) was caused by the rupture of two asperities that are about 80 km separate from each other in north-south direction. Later, the 1994 Sanriku-haruka-oki (Mw7.7) earthquake ruptured only the southern asperity and the northern asperity remained unbroken. Therefore the northern asperity is considered a seismic gap which has a seismic potential of generating Mw7.7 earthquake or so. On August 14, 2001, an earthquake with Mw6.4 occurred at the eastern tip of the northern asperity. Considering the possibility that this event might constitute a seismic activity precursory to the prospective larger event, we investigated the rupture process of the event and its associated crustal deformation both in co-seismic and post-seismic phases.

The waveforms recorded by the K-NET (NIED) were inverted for the rupture process. As a result it is estimated that the rupture propagated bilaterally for about 8 s, resulting in a ruptured area of 35 by 25 square km with an average slip of 13 cm. An average stress drop is 0.8MPa. A set of these parameters is normal in comparison with those previously documented for other interplate events. Daily site positions from GPS stations of GEONET (GSI) were used to investigate crustal deformation associated with the event. Looking closely at the time sequence of deviations from the stationary trend, we found co-seismic displacements of orders of a few millimeters on horizontal components of several stations located along the east coast of Aomori prefecture. Those stations are about 80 km distant from the epicenter. The observed easterly-southeasterly displacements are generally consistent with static deformations calculated using the fault parameters derived from the seismic data. On the other hand, we could not identify any post-seismic deformation that might be associated with an afterslip in the period of twelve months after the event. Presently it is difficult to identify slowly-varying crustal deformations with an amplitude of a few millimeters because the positions determined by GEONET show an uncorrectable seasonal variation of similar amplitude even for a period when no abnormal crustal deformations are taking place. In the present configuration of source and stations, displacements of a few millimeters are expected to be caused by slip events of Mw6.0-6.5. Therefore it can be said that an afterslip of magnitude corresponding to roughly Mw6.5 or greater did not occur. However we cannot tell whether any afterslip corresponding to Mw6.0-6.5 or smaller ever occurred or not. A method of reducing the seasonal noise in the GPS data is critical for discovering slow events which might play an important role during the preparatory stage of the prospective large earthquake in the vicinity of the 2001 event.