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The Rupture Process of 2004 Sumatra-Andaman Earthquake Viewing from the Data Obtained by the Strainmeters of JMA

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The great Sumatra-Andaman earthquake (M9.0), which occurred on 26 December, 2004, is one of the largest earthquakes in the instrumental record. This event was so large and the duration and extent of rupture is still in discussion. Some researchers have suggested a slow slip occurred at the northern part of the rupture area. The instrument response of the strainmeter is very wide and even it can record DC components, it's a good tool to detect the long period wave in the data. JMA (Japan Meteorological Agency) has deployed volmetric strainmeters and Ishii-type 3-components strainmeters in and around Tokai area. In this study, the source time function of the event was estimated using these strainmeters. The validity of strainmeter records was checked by comparing synthetic and observed data. Nias earthquake(M8.2), which occurred on 28 March, 2005, was used for this comparison because the rupture process of the main shock was too complicated to compare with. Synthetic records are calculated by the summation of earth's normal modes. The moment tensor of this event was assumed to that obtained by Harvard group and considered finiteness of the source duration (half duration=50.3s). Generally the local strain recorded by strainmeter and wide area strain is different, the calibration value for volmetric strainmeter (Kamigaichi et al., 1994) and calibration matrix for Ishii-type strainmeter (Kamigaichi et al., 1999) was used to calibrate strain data. The maximum amplitude difference between observed and synthetic waveforms band-pass filtered between 1000 and 100 sec is within 20%. Ishii-type strainmeters actually have 4 components for redundancy. We have checked the consistency of these four components. Four pairs of independent 3 strain components (surface and 2 shear strains) have been calculated using 3 among 4 components. The difference among 4 pairs is within several percent. Above results showed the wide area strain was well represented from the strainmeter records. The source time function of Sumatra-Andaman earthquake has been derived by deconvolving observed data with the synthetic ones.18 stations of volmetric strainmeter have been used in this analysis. The moment tensor solution was fixed that derived by Harvard group and both waveform data was low-pass filtered whose corner frequency is 10mHz. The source is fixed to the centroid location and only time variation of rupture process was calculated. One source time function was derived from one station. So we got 18 source time functions. The shapes of these 18 functions were resembling each other. There were 3 peaks in source time function (0 $\sim$ 200sec, 200 $\sim$ 400sec and 400 $\sim$ 700sec)

and the total duration was about 800sec. The seismic moment of these peaks were 3.5e22Nm, 1.0x1022Nm and 0.7e22Nm. Thus the total seismic moment is 5.2e22Nm(Mw9.1). Above results were consistent with other researches (e.g. Ammon et al., 2005). The direction of principal axis can be estimated using 2 independent shear strains obtained from Ishii-type strainmeter data. The direction of principal axis corresponds to that of wave propagation (Tono Geoscience Center, 2005). The wave propagation direction was stable between 200 to 500sec after P wave arrival. In this time range, the direction was gradually changing from 230 to 250deg at Sakuma station. This has suggested the rupture propagated from south to north. Other stations cannot be seen such systematic changing of the propagation direction but stable around 240deg partly because the error of the estimation is large. Although we couldn't estimate the extent of the rupture, this method is powerful for estimating arrival direction roughly. Another method was introduced to estimate arrival direction. Volmetric strainmeters were densely deployed in Tokai and Southern Kanto area, these strainmeters can be used as an array. Semblance was estimated using strainmeter data. Because the distribution of stations spreads through EW direction, the resolution of NS direction, which coincides with the rupture propagation, is relatively poor. But arrival direction is stable between 200 to 500sec after P wave. It indicates the validity of semblance analysis of volmetric strainmeter data. From the analysis of strainmeter records, we can get following results. The duration of source time function is about 800sec and the total seismic moment is 5.2e22Nm(Mw9.1). The shape of the source time function is consistent with other researches. This result has showed the validity of strainmeter records for estimating temporal extent of source time function. The spatial extent of this event was estimated by the direction of principal axis. We could estimate the arrival direction, but could not estimate extent of rupture area because the error was large. Another method is necessary to improve the spatial resolution of source process.