

The 3-stage earthquake generation process observed during 3 months before the 2011 Tohoku earthquake

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1.none

1 Introduction

Various phenomena were observed before the 2011 Tohoku earthquake. As for the broad band seismic network; F-net, its availability degraded. The 1st degradation occurred from December 22, 2010 to January 18, 2011, then 2nd one occurred from February 16 to March 2, after the part of the first degradation recovered to normal status. The main shock occurred on March 11, after the part of the second degradation returned to normal again.

Remarkable improvement of such measuring instrument as GNSS in recent years gives useful information about movement of crusts. So, seismic activities and measuring results of GNSS etc. are added to further check the degraded situation of the F-net.

2 Analysis

It seems that the period of approximately 3 months before the earthquake was consisted of 3 stages indicated below.

First stage

Period: End of December, 2010 to End of January, 2011.

Analysis: Accumulation of strain in the continental plate reached maximum limit in the Tohoku and Chubu regions. Possibly as a result of such situation, the wide area in Japan showed vibration or slip. Then the Pacific ocean plate stopped its advancement. Since such movements are on several day-basis, this slipping is the one like Creep. They occurred in the area far from the epicenter, the epicenter have not been formed at this moment.

Second stage

Period: Middle of February to early March

Analysis: As a result of the first stage, restless increase of stresses by the Pacific ocean plate can not be accepted any more. Then, small breakage was formed near the initial rupture point of the earthquake.

Third stage

Period: Several days before to the day of the main shock on March 11.

Analysis: Slipping of the continental plate started, and it reached the main shock.

Observed phenomenon:

On March 8, eastward movement was recorded by GNSS.

The Sanriku-oki earthquake (M7.3) occurred on March 9. The earthquakes with magnitude of 6 followed.

On March 11, The main shock of the Tohoku earthquake occurred.

Keywords: 2011Tohoku earthquake, F-net, GNSS

	2010/Dec	2011/Jan	/Feb	/Mar 3/11
東北地方の動き (Move. of Tohoku area) 地震・火山活動 (EQ and Volcano)	(西へ移動) X 父島近海 地震 M7.4	X (停止) (新燃岳) 箱根直下 低周波地震	噴火) X—X 震源域付近 M5以上地震	(東へ移動) X 震源域付近 M7.3-M9地震
GNSS (広域の動き)		X X 南,上方 西,下方		X (前兆滑り)
F-net (欠測)		三陸・北海道南部 及び能登・伊豆で欠測	三陸・北海道 南部で欠測	
解釈 (Analysis)		第一段階 (1st stage) 陸側プレートの広域で歪 の蓄積が限界に到達。 陸側プレートは弾性を失 い広域で動きを示した。	第二段階 (2nd stage) 陸側プレートと太平洋プ レートの境界に部分的な 破壊箇所が生まれた。	第三段階 (3rd stage) 部分的な破壊箇所が広 域の破壊 (本震) に発展 した。

図1 . 2011年東北地方太平洋沖地震発生までの3段階の過程

Fig1. 3-stage process before the 2011 Tohoku earthquake