

Earthquake Energy Generation of Mw9 East Japan Off 2011

Shozaburo Nagumo^{1*}

¹Earthquake Research Institute, University of Tokyo

1. Purpose of the article

What on earth happened there, the Mw9.0 huge earthquake of East Japan off 2011. We present here a view. Firstly, the huge energy generation of Mw9 was done by the volume source, not by the plane source. Secondly, the huge energy-generation of Mw9 is a large-scale stress-adjustment activity, not the asperity rupture. The reasons are based on such observational facts as listed below.

2. Indicative features of volume source

(2-1) 3 big seismic-wave radiations. (2-2) The long duration time of seismic wave radiation. (2-3) The huge source area. (200km x 500km). (2-4) The oceanic mantle seismic activation (OBS observation)

3. Mechanism of volume source generation

Why it is a volume source? The theory of elasticity says that the seismic wave generation is the body force generation and the elastic strain-energy release. The earthquake source volume is the 3D region in which seismic waves are generated. Therefore body forces generate seismic waves. And the body forces are generated by vanishing elastic strain inside. One cause is due to the sudden crash of pores-and-cracks, and the other is due to the sudden change of the confining pressure. This is the generation of earthquake as well as volume source.

Because the geological rock body is regarded as a porous-cracked elastic body, and it is under the initial stresses of gravity and tectonic stresses. And the incremental stresses accumulate around the pores-and-cracks in long years..

4. Mechanism of the large-scale volume source generation

Why such a large-scale volume source is generated? The potential is the tectonic forces of the island-arc oceanic-trench system itself. Firstly, under the inclined surface, horizontal forces are generated towards the trench axis caused by the gradient of the self-weight pressure. Secondly, in the neighborhood of the trench, some upward and downward forces may be generated, probably metamorphism origin such as serpentinization and eclogite. Moreover, in the arc-side of the trench, the island-arc rock masses overload the underlying oceanic mantle. Thus, such forces generate a large-scale flexure and buckling deformations of the oceanic lithosphere. The buckling deformation leads to the elastic instability (Biot, 1965, Incremental Deformations). The scale of the instability is very large, more than several hundred km horizontally, more than 50km in depth including the overlying crust.

Its associated stress-distribution in such a broad region is block-wisely heterogeneous because of the tectonic history. Around the block boundaries, stresses concentrate and accumulate in long years. Thus the stress imbalance could exist broadly in the lithosphere of the island-arc and oceanic-trench system. Once the buckling fractures occur somewhere, these stresses could be successively released. This is the generation of the large earthquake and the large-scale volume source.

5. Process of stress-adjustment activity

How the huge area (200km x 500km) turned to the source area? At the beginning, a certain buckling fracture took place in the oceanic lithosphere, where the degree of deformations is high. The buckling fracture extended into the earth's crust leading to the detachment of rock-blocks. Then, the block-wise detachment released the confining pressure, and the rock masses were subjected to collapse, fracture and crash. These processes could correspond to the first 2 big seismic wave radiations in the northern part.

During these processes, the rock bodies lose its rigidity and are led to the fluidization, and caused the rock-flows. Such rock-flows are the shape deformation so as to decrease the gravity potential. The outward spreading rock-flow causes forces at the front as well as side-wards. Such a force might lead to the 3rd big seismic wave radiation in the southern part. Such processes

Japan Geoscience Union Meeting 2013

(May 19-24 2013 at Makuhari, Chiba, Japan)

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SSS28-P08

Room:Convention Hall

Time:May 23 18:15-19:30

as above are the large-scale stress-adjustment activity to level the stress imbalance in a broad region. These processes are not the asperity rupture.