1P6-1

Hypocenter in the central sea area and their regional structural changes

Toshiaki Kikuchi[1†], Koichi Mizutani[2] ([1]NDA; [2]Uiniv. of Tsukuba)

1. Introduction

There are several sea areas where earthquakes are frequently observed in the central sea area. Not only are their hypocenter regions confined to a limited depth range, but there are regions where the depth range is clearly divided into two. The hypocenter off the southeast coast of the Kii Peninsula is a representative hypocenter region. This dichotomous hypocenter structure was found to be energetically related[1,2]. It was also shown that the seismic structure of this dichotomous structure represents the transition of earthquakes in this sea area. As a result of examining other hypocenter regions in the central sea area from this point of view, some dichotomous structures were found. In addition, their dichotomous structure showed different characteristics depending on the existing sea area. From these characteristics, we can know the transition of regional seismic activity.

2. Dichotomous hypocenter structure

The region where most earthquakes occur in the central sea area is off the southeast coast of the Kii Peninsula. The hypocenter depth occurred in 2018 shows in **Fig.1**. The horizontal axis is the elapsed time based on January 1, 2018. The vertical axis is the depth of the earthquake that occurred. As is clear from the figure, the hypocenter region is clearly separated into earthquakes shallower than 50 km in depth and earthquakes deeper than 300 km in depth. It has been observed that this form of separation is not limited to 2018, but has continued from 2003, when observations began, to the present day. Therefore, this distribution structure is clearly attributed to the geographical structure peculiar to the region.

3. Energy transition

The hypocenter of the offshore the southeast coast of the Kii Peninsula, are divided into two depths as shown in the previous section. Therefore, the stored strain energy is also dichotomized. Therefore, in order to relationship show the energy relation between the deep hypocenter region and the shallow hypocenter region, we investigate their energy transitions in mutual. The seismic energy E (Jule) is expressed by the following equation [3].

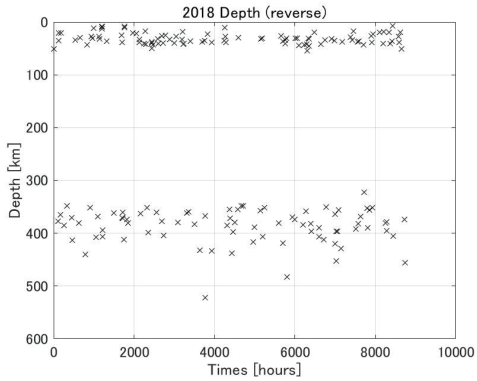

Fig.1 The time distribution of the hypocenter depth of the earthquake that occurred off the southeastern coast of the Kii Peninsula in 2004.

$$\log 10E = 4.8 + 1.5M \qquad (1)$$

M is the magnitude. **Figure 2** shows the

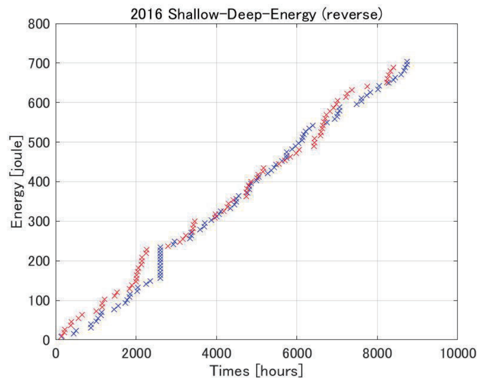

Fig.2 Accumulated energy of the Kii Peninsula southeast offshore earthquake in 2016.

accumulated energy of the Kii Peninsula southeast offshore earthquake in 2016. The horizontal axis is elapsed time with New Year's Day set to 0, and the vertical axis is the accumulated energy of earthquakes that occurred from New Year's Day. The accumulated energies of 76 earthquakes from M 1.5 to 3.7 that occurred in the deep hypocenter are indicated by + signs. The cumulative energy of 86 earthquakes from M 1.5 to 3.1 that occurred in the shallow hypocenter is indicated by + sign. As is clear from the figure, although the number of earthquakes and their magnitude range are different in the two regions, not only the rate of increase in the cumulative energy of the two earthquakes but the

†ads01881@nifty.com

detailed fluctuations are the same.

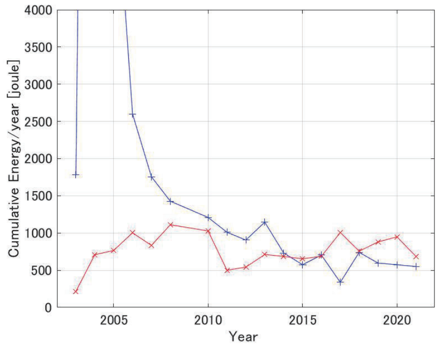

Fig.3 Annual changes in the annual accumulated energy in the focal region off the southeast coast of the Kii Peninsula.

4. Annual accumulated energy

The occurrence of megaquakes is periodic, but the period is long. Since an earthquake is a release phenomenon of strain energy accumulated in the earth's crust, the energy of a new earthquake begins to accumulate after similar earthquakes have occurred in the same region in past [4]. Therefore, we examine the annual accumulated energy to observe long-term fluctuations. That is, the final value of the accumulated energy. The final value of the accumulated energy shown in Fig.2 is obtained in each year. The obtained results are shown in **Fig.3**. The shallow earthquake represents the 2004 M 6.9 aftershock. Deep earthquakes represent the energy associated with plate movement. In 2016, the energies of the shallow and deep areas will balance each other, and from here the accumulation of energy for the next earthquake will begin.

5. Locality of accumulated energy

As shown in the previous section, the annual accumulated energy indicates over time in the hypocenter region. Therefore, in order to investigate regional characteristics of seismic activity over time in the hypocenter regions. We investigate the annual accumulated energy in the hypocenter region adjacent to the southeast offshore of the Kii Peninsula. **Figure 4** shows the results for the far offshore south of the Tokai region and **Fig.5** shows the results for the south offshore Surugawan. Regional variation is clear in the figure. It was shown that the residual energy in the far offshore south of the Tokai region is large and rising.

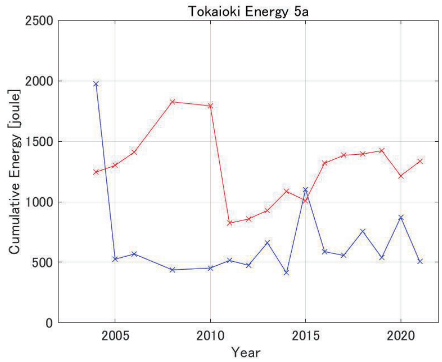

Fig.4 Annual changes in the annual accumulated energy in the hypocenter of The Tokaioki region

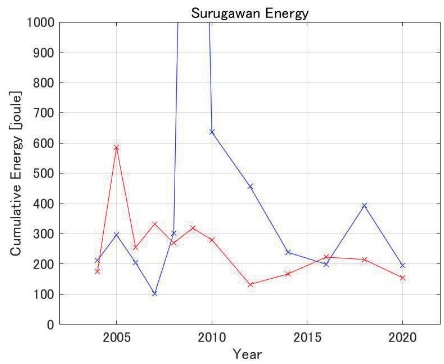

Fig.5 Annual changes in the annual accumulated energy in the hypocenter of The Surugawan area.

On the other hand, the annual accumulated energy in the south offshore of Suruga Bay is almost equal to the release of energy related to M 6.5 generated in the shallow area in 2009.

Summary

It was confirmed from the hypocenter region of the generated earthquakes that the hypocenter structures off the southeast coast of the Kii Peninsular are divide into two depth regions. We modeled the source structures and investigated their energy transitions. As a results, it was showed that there is are a relationship between the energy of deep and shallow earthquakes, and that the difference between them is important for future earthquakes are cause by plate movement, so the relationship between them and stored energy is an important predictive factor.

References

1)T. Kikuchi and K. Mizutani, ASJM, 2022.9,2-P-18
2) T. Kikuchi and K. Mizutani, ASJM, 2023.3 3-7-3
3) Wikipedia, Magnitude Scale
4)T. Danbara, Report of the Coordinating Committee for Earthquake Prediction. 2, 80-84