Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SCG67-P01 Room:Convention Hall Time:May 25 13:45-15:15

Tectonic geomorphology and surface exposure dating of the Kumkol basin in the north-eastern margin of the Tibetan Plateau

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The Tibetan Plateau has been growing due to the collision of the Indian plate against the Eurasian plate. The plateau is now expanding laterally by invading stable continental plates surrounding it. However the growth mechanism is still a debate, especially in the northeastern margin, which is the boundary between the Kunlun Range and Qaidam basin. The Kumkol basin, which is bounded by the East Kunlun, Altyn Tagh and Qiman Tagh Ranges, has been uplifted rapidly and now being morphologically incorporated into the Tibetan Plateau. In the central part of Kumkol basin, there is a nearly E-W trending huge Kumkol Anticlinorium, which is over 40 km wide. The large-scale Kumkol Anticlinorium is likely to be a crustal-scale structure and give an important clue to understanding the growth mechanism of the Tibetan Plateau.

Our preliminary investigations based on the analysis of remote sensing data suggested that the Kumkol Anticlinorium is formed as a set of fault-propagation folds that developed near the up-dip edges of north dipping crustal-scale thrust faults. Uplifted and deformed fluvial terraces (Kaxaklik terraces) develop along the.Kaxaklik He (= River), which comes from the Kunlun range and crosses the Kumkol Anticlinorium from the south to the north. It was inferred that the highest terraces were formed in the penultimate glacial period (ca.140 ka) and their uplift rate is about 2.0 mm/yr by our climatic-geomorphological study.

Instead of climatic-geomorphologically inferred ages, we need reliable absolute ages to discuss more precise development history of the Kumkol Basin. To get some absolute ages we conducted field investigations and sampling. As there is almost no vegetation and therefore 14C samples rarely exist in this area, the surface exposure dating was applied. We could not access the core area of the Kaxaklik terraces because of bad road condition. Fortunately, we have investigated the Bazarak terraces in the eastern edge of the Kaxaklik terraces. The Bazarak terraces are formed on the Kumkol Anticlinorium and they are uplifted and tilted to the north probably caused by the north-dipping thrust fault. The highest step of the Bazarak terraces continues westward to the highest step of the Kaxaklik terraces, implying that these terraces are almost the same age. In this presentation, we report the result of the field investigation and some surface exposure ages of the Bazarak terraces.

Keywords: Tibetan Plateau, Qaidam Basin, Tectonic Geomorphology, Surface Exposure Dating, Late Quaternary

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Uplift and denudation history of the Akaishi Range, central Japan: Constraints from low-temperature thermochronology

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Zircon He, zircon U-Pb, and additional fission-track (FT) analyses are used to identify the denudational history and pattern of the Akaishi Range, which has been uplifted since the late Pliocene. Zircon He grain ages from nine samples range from 21.5 to 3.0 Ma, while the ages are systematically younger to the east. These ages are interpreted to reflect the uplifting of the Akaishi Range because the youngest ages are consistent with the age at which uplifting was initiated according to the depositional ages of gravel. The decreasing ages to the east can be explained by subsequent denudation of the uplifted Akaishi Range, assuming a westerly tilting uplift of the region west of the Itoigawa-Shizuoka Tectonic Line (ISTL). Although denudation cannot be identified exactly because of a lack of precise estimates of the paleo-geothermal gradient of the study area, it is certain that the entire area between the Median Tectonic Line and ISTL has been denuded by a few kilometers since the onset of the range uplift. This implies that the topography of the Akaishi Range reflects post-uplift factors, e.g., spatial distribution of bedrock uplift rates and various denudation processes, rather than inherited geometry from the pre-uplift topography. Considering younger apatite FT ages previously reported in the southern part of the Akaishi Range, the Akaishi Range is considered to have had at least two uplifting stages, i.e., uplifting of the northern part since the late Pliocene and uplifting of the southern part since ~1 Ma, probably attributable to faulting of ISTL and collision of the Izu block to the south Fossa Magna area, respectively.

Keywords: low-temperature thermochronology, (U-Th)/He method, fission-track method, U-Pb method, denudation, Akaishi Range

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SCG67-P03 Room:Convention Hall Time:May 25 13:45-15:15

3D crustal deformation of Japan by GEONET

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Japan was originally created by subduction zones. The volcanic front and accretionary prisms are the result of convergence of plates, and the plate convergence make mountain area higher by the push force. Without subduction zones, earthquakes, crustal motions and Japan itself would never exist.

The GPS observation made it much easier to understand the crustal motions. The Geographical Survey Institute of Japan(GSI) has about 1400 GPS stations(GEONET) over Japan for observing Japanese crustal deformations, and the GEONET enabled us to watch how Japan continuously deforming. However, time series plotting or vector arrow figures of the GPS data are sometimes not easy to understand the three dimensional deformation with time.

In this study, we created 3D animations for Japanese crustal deformation using GPS data obtained by GSI, and make it easier to understand the Japanese crustal motions. The GSI already had created animation of Japan for horizontal motion of only limited time and area, whereas we can make animations for three dimensional deformation of any given time and area if the GPS data are available. The newly created animations revealed the detailed crustal deformation in Japan.

We compared our results to a 100 years leveling data of Japan and the geological data for about two million years. In spite of time differences, a lot of similarities can be seen on the pattern of deformation of Japan, and amount of crustal motions were comparable between GPS data and leveling data.

Keywords: GEONET, crustal deformation, 3D, GPS

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SCG67-P04 Room:Convention Hall Time:May 25 13:45-15:15

Deviation of directions of rakes of thrust-type earthquakes along the MAT from subduction direction of the Cocos plate

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The Cocos plate is subducting beneath the North America plate along the Middle America Trench (MAT), and many subduction zone earthquakes have occurred there.In this study, we investigated relation between subduction directions of the Cocos plate and directions of rakes of thrust-type earthquakes.We extracted thrust-type earthquakes from the Harvard CMT catalogue, amouting to 184 events with Mw ranging from 4.8 to 8.0, which occurred from 1976 to 2010, and depth ranges from 10 to 50km. Plate motions of the Cocos plate with respect to the North America plate are determined by the plate motion models, such as NUVEL-1A and MORVEL.Directions of rakes of thrust-type earthquakes which occurred in this region are rotated by counterclockwise 5~15 degree from directions predicted from the plate motion models.Furthermore, in order to select earthquakes which occurred on the plate boundary more rigorously, we extracted 32 earthquakes which occurred at depths less than +-10 km from the upper surface of the subducting plate. Using a rose diagram, although we investigated whether directions of rakes of these earthquakes are dependent on depth of hypocenters, Mw, time, and the region, we could not find any dependency.

In order to consider the cause of the difference between subduction directions determined by the plate motion models and the directions of rakes of thrust-type earthquakes which occurred on the plate boundary along the MAT, it may be important to compare the result with those which occur in the regions with forearc sliver and oblique subduction, such as Nicaragua, Cascadia, the Nankai Trough, and Indonesia.

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SCG67-P05 Room:Convention Hall Time:May 25 13:45-15:15

About the 18.6-year periodicity observed in the occurrence of huge earthquakes of the plate convergence zones near Japan

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1. Introduction

It has been understood that tidal force driven by the Moon and the Sun works as a trigger of earthquakes (Tanaka et al., 2004). The related function is called the tidal triggering. Since move of the celestial bodies have periodicities, then the earthquakes which are triggered by such forces should have these same periodicities. In fact, in the case of long periods, the presence of a 18.6-year cycle have already been reported by such several researchers for instance concerning the Southern California (Kilston and Knopoff, 1983), several regions in the Pacific-rim (Petukhin and Gusev, 2007) and the Vrancea zone in Romania (Souchay and Stavinschi, 1999).

2. Investigation of the 18.6-year periodicity for the case of earthquakes in Japan

In this paper we investigate the 18.6 y cycle for the earthquakes occurring in Japan.

2.1 Method

The time intervals of the largest earthquakes in the plate convergence zones near Japan, and more specifically the regions of the Sanriku-Oki of the Japan trench, of the Sagami trough, and of the Nankai trough are investigated. The results are shown below.

2.2 Results

In the following we present the name of each historical earthquake, their date (Y/M/D), as well as the corresponding fraction of the 18.6 y cycle.

Sanriku-Oki region

(Tested Earthquakes: Meiji-Sanriku earthquake 1896/06/15 M8.5, Showa-Sanriku earthquake 1933/03/03 M8.1, 2011Tohoku earthquake 2011/03/11 M9)

1933/03/03 - 1896/06/15 = 13409 days = 36.71 yrs = 1.97 x 18.6 yrs

2011/03/11 - 1933/03/03 = 28497 days = 78.02 yrs = 4.20 x 18.6 yrs

Sagami trough

(Tested Earthquakes: Genroku earthquake 1703/12/31 M8.2, Taisho Kanto earthquake 1923/09/01 M7.9)

1923/09/01 - 1703/12/31 = 80232 days = 219.67 yrs = 11.81 x 18.6 yrs

Nankai trough

(Tested Earthquakes: Hoei earthquake 1707/10/28 M8.4, Ansei Nankai earthquake 1854/12/24 M8, Showa Nankai earthquake 1946/12/21 M8)

1854/12/24 - 1707/10/28 = 53748 days = 147.16yrs = 7.91 x 18.6 yrs

1946/12/21 - 1854/12/24 = 33599 days = 91.99 yrs = 4.94 x 18.6 yrs

3. Conclusion

All the 5 studied cases show close to integer multiple of 18.6 years, which suggests a real periodicity of the events. The errors are 18.6 years x 0.2 = abt. +/- 4 years for the Sanriku-Oki and the Sagami trough, while for the Nankai trough it is 18.6 years x 0.1 = abt. +/- 2 years. From the viewpoint of physics, this means that same amount of tidal forces work on the regions from same direction.

The period when the same stresses will be loaded to the Sagami trough and the Nankai trough regions are shown below. The more specific value of 18.613 yrs is used for the calculation. It should be noted that the following figures only show highly stressing periods, but not forecast occurrence of large earthquakes, because stress situations in each regions are not known today.

Sagami trough

1923/09/01(Taisho Kanto eq)+ 5 x 18.613yrs = 2016/09/24 +/- 4yrs

Nankai trough
1946/12/21(Showa Nankai eq)+ 4 x 18.613yrs = 2021/06/03 +/- 2yrs

We know that this work must be considered as a preliminary report, and more specific tests are necessary to confirm the effect.

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Keywords: tidal triggering, 18.6 years

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The power to form and maintain oceanic basin and island arc

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The hot things of both sides that place a cold thing to the center are mutually pulled.(1) Globally the belts of high temperature located on upper and lower both sides of the subducting plate of low temperature always tighten it.(2) In addition, the electromagnetic radiation generated by the belt of high temperature at this time converts into heat and there is a possibility of maintenance and reinforcing the high temperature.(3) I have insisted that the mainspring of the phenomenon that happens in the seam of the plates is this while reinforcing it by the result of the experiment.(4)

I will use the earth internal structure by seismic wave tomography (Zhao, 2009) in (5) as a references cited.

Pacific Plate (B) that sinks in Japan Trench, Izu-Ogasawara Trench is accompanied by the belt (A) of high temperature the upper part of (B). And (B) is accompanied by the belt (C) of high temperature along the inclining part on the other side of (B). The appearance is different in the north and the south on the boundary of north latitude 36degrees. (B) sinks from Japan Trench in the cross section that passes the Tohoku region, and the point exceeds Korean peninsula and reaches the continent.

However, the part of (B) that is sure to exist in about 300-400km in depth is lacked in north latitude 35degrees. The inclination of (B) becomes sudden by going south on the boundary of this, and it enters the state that hangs down below from the trench.

If this(5) is analyzed, the theory can be reinforced, and it can explain the raison d'etre of geographical features.

I want to think for the first time how the power generated in (A)(C) transforms (A)(B)(C).

[X] Because (A) and (C) compress (B), (B) has the possibility of collapsing and thinning. In the cross section that passes the Tohoku region, the vicinity at the center of (B) within the range placed between (A) and (C) is thin actually.

[XX] In the cross section that passes the Tohoku region, the power to pull (A) downward as a whole for the east works in (A). (A) is sure to rise on the slope along (B) because (A) cannot advance downward in the eastern edge of (A). The part that corresponds under the soil in the Sea of Japan is a blood red. I think that the fact that the Sea of Japan keeps the sinking geographical features depends on the power to pull downward for the east. Moreover, the mantle of high temperature that rises on the slope along (B) generates the magma, and causes the volcano exactly. I think that the rise of this mantle is the mechanism that creates the land and supports it. The above is the cause of oceanic basin and island arc.

[XXX] Then, why does not West Japan sink and become a basin? The power to pull downward for the east in the west of east longitude 137degrees is not generated immediately, remarkably, because as previously stated (B) lacks part in north latitude 35degrees. This might be one of the big reasons.

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