Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

SCG66-P01 Room:Poster Time:April 30 18:15-19:30

Spatial relationship between the volcanic chain and high gravity anomalies in subduction zones

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The most conspicuous features of arc-trench systems are active seismicity, characteristic topography and gravity anomalies, and volcanism. The topography and gravity anomalies are low in the trench and high in the arc, which can be theoretically explained by mechanical interaction between the subducting oceanic plate and the overriding plate (Sato & Matsu'ura, 1993, GJI; Hashimoto et al, 2004, PAGEOPH). Because the topography is more complicated to be understood, free-air gravity anomaly is more suitable to be compared to the theoretical model. Free-air gravity anomalies with long wave length basically represent the effect of tectonic force, which disturbs gravity equilibrium.

Volcanoes align along the volcanic front in most arcs. Since both of the high free-air gravity anomalies and volcanic front have a subparellel strike to the trench, it should be possible to classify arc-trench systems according to the spatial relationship between them. Based on such an idea, Fukahata (2008, JPGU meeing) classified arc-trench systems, but there was a problem that the recognition of the location of high gravity anomalies was quite subjective. So, in this study, I improved this process.; the location of high gravity anomalies were more quantitatively recognized. As a result, the location of high gravity anomalies relative to the volcanic front did not change for most arcs, but I found that it was difficult to define its location in some arcs (mostly tensile). Using the result, I discuss the spatial relationship between the volcanic chain and high gravity anomalies in subduction zones and consider causes of topographic evolution of island arcs.

Keywords: island arc, subduction zone, gravity anomaly, volcanic front

SCG66-P02 Room:Poster Time:April 30 18:15-19:30

Uplift and denudation history of the Yoro-Suzuka-Nunobiki Mountains: Constraints from apatite FT thermochronology

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The Yoro-Suzuka-Nunobiki Mountains are fault block mountains distributed along the Isewan-Tsurugawan Tectonic Line, a tectonic boundary between the Kinki and Chubu districts. The Kinki district on the west of the mountains is characterized by predominance of reverse faults and alternation of N-S trending mountain ranges and basins (Kinki Triangle; Huzita, 1962), whereas the Chubu district on the east of the mountains has predominance of strike-slip faults and westerly tilting landforms (Chubu tilting block; Kuwahara, 1968). Miyoshi & Ishibashi (2008) mentioned that the Philippine Sea Plate slab beneath the region around the Yoro-Suzuka-Nunobiki Mountains has shallow subduction angle and form a convex shape (Isewan-Kohoku slab) and proposed this shallow slab resulted in the tectonic boundary between the Kinki and Chubu districts in the region. On the eastern and western sides of the Yoro-Suzuka-Nunobiki Mountains, two major subsidence areas have formed and moved northward since the end of the Miocene as recorded by deposition of the Tokai group and Kobiwako group (e.g., Yokoyama, 1995; Yoshida, 1990). On the other hand, there is some debate over the formation process and mechanism of the Yoro-Suzuka-Nunobiki Mountains; Okada (2004) speculated the mountains have uplifted from south to north generally corresponding to the northward moving of the subsidence areas, whereas Ohta and Takemura (2004) proposed the formation of the mountains were still later and independent from the formation of the subsidence areas.

We are attempting revealing uplift and denudation history of the Yoro-Suzuka-Nunobiki Mountains in the past few million years by using apatite fission-track (AFT) thermochronology. We have obtained AFT ages and length distribution data in one site for the Yoro Mountains, eight sites for the Suzuka Range, and one site for the Nunobiki Mountains. Highlights of the results are as below: 1) the AFT ages range 47-30 Ma, 2) the ages were youngest in the middle to south parts of the Suzuka Range and get older to the north and south, 3) thermal histories calculated from the AFT ages and length distributions indicate rapid cooling events in the past few million years in the middle to south parts of Suzuka Range, but not in the Yoro and Nunobiki Mountains and the north part of the Suzuka Range, 4) the rapid cooling events in the past few million years are attributable to the the uplift of the Suzuka Range since ~1.3 Ma (Yokoyama, 1995). We are conducting additional AFT analyses in seven sites of the Nunobiki Mountains to expand our results to the south. In this presentation, we are planning to provide progressed discussions containing the results of the additional data.

Keywords: Yoro-Suzuka-Nunobiki Mountains, apatite fission-track thermochronology, denudation, eastern margin of the Kinki Triangle

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Self-affinities for Amplitude and Wavelength of Folds

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In general, many folds are apparently curved or jagged on a wide range of scales, so that their geometries appear to be similar when viewed at different magnifications. By Matsushita and Ouchi (1989a, b)'s method, we also analyzed the self-affinities of folds in the North Honshu Arc, Japan (Kikuchi et al., 2013). Based on this analysis, geometries were found to be self-affine and can be differently scaled in different directions. We recognize the self-affinities for the amplitude and the wavelength of folds and a crossover from local to global altitude (vertical) variation of the geometries of folds in the Northeast Honshu Arc.

Buckingham's Pi-theorem is sufficient to the first problems of fold systems (Shimamoto, 1974). However, the complete similarity cannot give us the self-affinities of folds. A general renormalization-group argument is proposed to the applicability of the incomplete self-similarity theory (Barenblatt, 1979). Based on the general renormalization-group argument, we derive the self-affinities for the wavelength (L) and the amplitude (a) of folds:

$$L^{(1-d)} \propto a.$$

The relationship between Hurst exponents H of fold (Kikuchi et al., 2013) and d are equation:

$$1\text{-}d=H,$$

where H is index of the continuity of a given fold curve and obtained by the ratio between horizontal scaling exponent and vertical scaling exponent. d is an exponent of a given incomplete self-similarity theorem.

In $d \neq 0$ case, the Hurst exponent $H \neq 1$ indicates self-affinities for the given fold curve. In this case, scale invariance of the fold might be affected by a variety of tectonic processes under the anisotropic stress field. In $d = 0$ particular case, the Hurst exponent $H = 1$ indicates self-similarity for the given fold curve. In this case, scale invariance of the fold might not be affected by a variety of tectonic processes under the anisotropic stress field. These results imply that anisotropic stress fields by gravitation and tectonic stresses might cause self-affinities of folds. Self-similarity and self-affinities of the fold might be affected and by a variety of tectonic processes under the isotropy or anisotropic stress field.

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Keywords: Fold, Self-affinity, Buckingham's Pi-theorem, Incomplete self-similarity theory

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Reason for strange appearance of Mt. Hakone, and Reason why the Boso Triple Junction has moved to the west most

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(Refer to the chart)

Mt. Fuji penetrates through the north end of the Philippine Sea Plate(PHSP), and is the front of land side plate incision, and is the starting point of Suruga and Sagami Trough(1). Mt. Hakone and Mt. Mihara have decided the position of Sagami Trough.

"Tokai Slab" seems to stop beneath the north side of Mt. Fuji. On the other hand, "Sagami Slab" seems to sink and reach the interior of Kanto.(3) It is unnatural as one board. Though the crustal deformation that GPS caught shows that the Izu Peninsula moves to the west, tendencies of Izu islands and Southern part of Kanto to move to the north are strong(4). In 135-140*east, it has been understood that the section of especially 140*meets the requirement of the temperature structure that the power to make the Pacific Ocean's side go north is generated. In a word, I think that only the side of "Sagami Slab" sank greatly in PHSP in the past and the current situation was caused.

Then, where is the crack (lateral fault) that becomes a boundary? There is the earthquake-prone zone that symbolizes subducting of Slab on the north side of the Mt. Hakone(5). If the edge of west side within the range of that distribution is traced, the Mt. Hakone and Mt. Mihara can be connected in a smooth line(red broken line). The line of blank for south-north, that divides the earthquake-prone zone to the east and the west, passes the Mt. Hakone(blue broken line). Because there was no fault in the south from Mt. Mihara, I think the slipping fault shifted to the fault shown in blue broken line though there was an age that the fault shown in red broken line slipped. The Mt. Hakone has the meaning of the west edge of PHSP in the Izu-islands-east and of the starting point of subducting.

On the other hand, why has the trench axis around the Boso Triple Junction moved to the west most? Pacific Plate that goes west compresses land side Plate and PHSP that get on on it into the direction of east-west. And, pulls them for south-north. The Part where land side Plate and PHSP overlap shifts mutually and the overlap becomes shallow. The upper plates expand for south-north to Pacific Plate. As a result, the trench axis becomes easy to go west by the east-west compression. Land side Plate and PHSP and Pacific Plate become tight in the direction of east-west. And, fold and collapse occur in them. As a result, the trench axis becomes easy to go west further. Because usual stresses are absorbed to the fold and collapsing, the trench axis is not easy to returns east even if a massive earthquake occurs. This is the cause that the trench axis moves to the west.

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