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

SSS34-01 Room:502 Time:April 29 09:00-09:15

Height Distribution of the tsunami of the Ansei North Sanriku-Oki earthquake of August 23, 1856

TSUJI, Yoshinobu[1*] ; MABUCHI, Yukio[2] ; OKADA, Kiyohiro[2] ; KUROYANAGI, Yosuke[2] ; OOIE, Takayuki[2] ; KURIMOTO, Masashi[2] ; KINAMI, Takahiro[3] ; HORIE, Takehito[4] ; HASHIMOTO, Keisuke[4] ; SASAKI, Takayuki[4] ; IWABUCHI, Yoko[5] ; IMAI, Kentaro[6] ; IMAMURA, Fumihiko[6]

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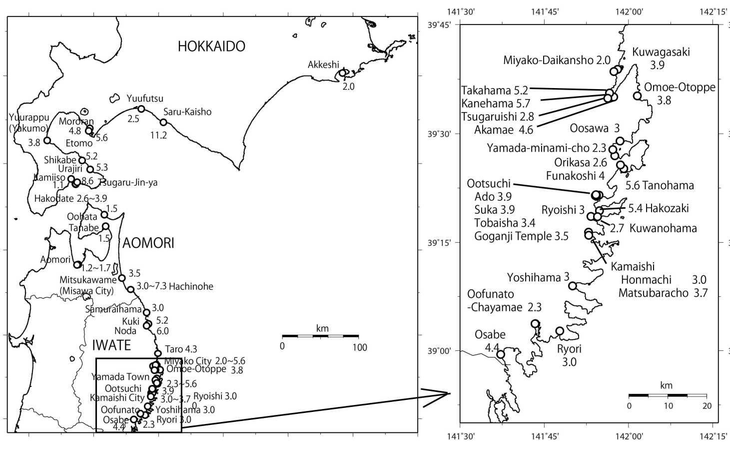
A large earthquake occurred in the sea area between Aomori coast, most northern district of Honshu, and Hidaka coast, Hokkaido, on 23rd August, 1856 (3rd year of Ansei era) . This earthquake is a one of the series of the plate boundary earthquakes at the joint point of the Japan and the Kuril trenches, where the 1968 Tokachi-Oki earthquake occurred. The 1677 Enpo North Sanriku-Oki earthquake is considered also as the same typed one. The tsunami of the 1856 North Sanriku-Oki earthquake hit the coasts of Sanriku districts, the north east part of Honshu, and the pacific coast of Hokkaido. As the total number of victims of the tsunami was only 38 people in all, and it was considered not to be a large natural hazard. So it did not become a lecture for tsunami hazard in the time of the 1896 Great Meiji Sanriku tsunami. The diary kept by a priest of Kokutaiji Temple at Akkeshi in east Hokkaido records that human disturbance broke out there, and tsunami height was estimated at 2.0 m. At Saru-Kaisho office in Monbetsu town, Hidaka district, a strong tide came in front of the building of the office, where sea water rose up to the height of 11.2 meters. At Etomo village in Muroran city, sea water invaded into the residential area (height: 5.6m). On the pacific side of Hakodate peninsula, sea water flooded up to the fort of Tsugaru Clan "Tsugaru-han Jin'ya" where the ground height is 8.6 m. At Same fishery port in the central area of Hachinohe city, residential area was flooded up to 7.3 meters height. At Kanehama village in Miyako city, which is located at the innermost point of the V-shaped bay, inundation height was 5.7 meters. As for the coasts of south part of Iwate Prefecture Tsuji et al.(1995) conducted survey. Together with this result,we have the distribution map of the tsunami height as the figure. The authors of the present study wish to express their thanks to JNES for its financial support in promoting our research.

Keywords: historical earthquake, historical tsunami, Sanriku coast, Hokkaido, Japan trench



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

SSS34-02 Room:502 Time:April 29 09:15-09:30

Reexamination of 1945 Mikawa earthquake disaster (1) Detailed distribution of earthquake victims

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Iida (1978) organized the Mikawa earthquake disaster under the cooperation of Aichi prefecture, and clarify the whole picture of the disaster. However, he could not discuss the disaster in community level precisely. For example, 46% of 1200 houses were collapsed in Hukuji village, Hazu-gun in 1944 ToNankai earthquake, and additionally 67% of left 650 houses were also collapsed in 1945 Mikawa earthquakes one month later. The reason of strong damages in Hukuji is not discussed enough until now.

It is very important to make clear whole picture of the earthquake disaster in history and in near future as national government. As the earthquake disaster remains a rare event, detailed research of the historical earthquake disasters needful to understand the following disasters. In the presentation, we would like to discuss the disaster of the Mikawa earthquake in local community level.

1. Discussion on characteristic disaster based on earthquake victim distribution

Earthquake fault shaped S was appeared in the ground surface at the Mikawa earthquake. However recent researches of fault geomorphology and ground deformation based on geodesy point out two main faults striking with NNW-SSE direction, and an E-W striking fault is tear fault caused by slips on two faults. Additionally, dominant rupture should be occurred at Fukodu fault located in east. The total Mo estimated by ground deformation is the earthquake moment of 1.6x1019Nm(Mw6.7), and the third four of the released one is by slip of Fukodu fault. In our presentation, we discuss earthquake disaster with the local community level based on two N-S striking earthquake faults.

1) Katahara: compact cluster of dead located close to Fukodu fault

Katahara town of Hoi-gun (then-9300 people and 1887 houses) located just on Fukodu fault, lose 227 people and 319 completely destroyed houses (15.2% collapse rate). In the town, the damages are different in each street corner. Numbers of dead and completely destroyed houses within the town are shown as bar charts and color scale in 59 neighborhood blocks. The dead are limited in the narrow zone of 1 km wide along the earthquake fault. There are some communities with no collapsed house, which are located 1 km distance from the fault. Dead are corresponding to 73 % of completely-destroyed houses, and some blocks closing the fault show the rate over 90%. Precisely, people are attacked by strong seismic waves during the hours of sleep, and they had no time to evacuate to outsides from houses. There are many blocks to have no dead and no collapsed houses, which are locating more 1 km far from the fault.

2) Fukuji: Decentralized dead far from fault in river plain

On the one way, Fukuji village (then-673 houses), Hazu-gun locating 5 km southwestward from the Yokosuka Fault, one of main faults, lost 162-350 peoples and 400 houses completely. In one month before, the village also attacked by 1944 ToNankai earthquake, lost 21 people and 550 houses completely. They lost 1000 houses by earthquakes in 1200 houses for one month. The numbers of the dead are shown in each block in Fig.1B.

The dead distributions are obviously different with that in Katahara. They lost many people in almost all blocks in the village. The collapse rate of ToNankai earthquake is by far the worst in Aichi prefecture, because, second worst is 21.3% in Tomiki village, Chita-gun. The Fukuji village is just located in river plain with Yahagi and old-Yahagi rivers. An exist of thick alluvial formation caused the large damages in Fukuji.

The dead by Mikawa earthquake are caused by two reasons. One is there are very strong shaking at the blocks located immediately above the fault, and second is amplitude shaking by alluvial formation in river plain. The former is a case of Katahara and later is a case of Fukuji.

Keywords: Mikawa erathquake, Fukozu fault, Yokosuka fault, earthquake disaster, seismic victim, collapse rate

Japan Geoscience Union Meeting 2014
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SSS34-03 Room:502 Time:April 29 09:30-09:45

Interpretation of an illegible old stone inscription by SfM image analysis at Itsukushima shrine, Nojimazaki

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This study shows that interpretation the illegible old stone inscription by structure from motion (SfM) image analysis. The stone monument built in 1927 for memorial on the 1923 Taisho Kanto Earthquake, the inscribed capitals can hardly read. We captured 158 photographs on the surface of the stone, and processed by SfM to generate 3 D model of it. As a result, illegible capitals became clear on the 3 D model, so visible coated contamination removed by SfM. It is effective method to archive stone inscriptions.

Keywords: structure from motion (SfM), stone inscription, interpretation, historical natural hazard, Nojimazaki

SSS34-04 Room:502 Time:April 29 09:45-10:00

The Evidence of the Uplift associated with the Kanto Earthquakes inferred from the Marine Terrace in the Alluvial Valley

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Recurrent giant earthquakes at the plate boundary along the Sagami Trough have been considered as one of the greatest thread of the Tokyo Metropolitan area. At the southwestern tip of the Miura Peninsula, in south of Tokyo, the tide gauge station records the coseismic uplift amount of 1.4 m and the interseismic subsidence amount of 0.3 m in and after 1923 earthquake, respectively. It is effective to reveal evidences of the past coseismic uplift to know the future earthquake.

Wave-cut benches which emerged in 1923 are widely distributed along the rocky coast. Higher wave-cut benches, good indicators of coseismic uplift prior to 1923, are also recognizable. It is, however, often difficult to spatially compare one another due to the erosion.

We investigated the distribution of the tidal-flat deposits and the 1923 wave-cut benches at two small bays in the southwestern and southern parts of the Peninsula. The aggradation of the coastline associated with the 1923 uplift was identified by the comparison between the 1:25,000 topographic maps before and after the 1923 earthquake. Observations of outcrops and drilling cores at the 1923-formed marine terrace showed that the tidal-flat deposits consist of shelly sand and gravels. The elevation of tidal-flat deposits indicates the coseismic uplift in 1923 and the interseismic subsidence after 1923. The uplift amount was estimated approximately 0.9 m and 2.1 m at the southwestern and southern parts of the Miura Peninsula, respectively. The uplift amount inferred from the tidal-flat deposits is concordant with that inferred by the wave-cut benches.

Keywords: Kanto Earthquake, Paleo-earthquake Record, Alluvial Valley, Microlandform, Tide-zone Deposits, Miura Peninsula

Japan Geoscience Union Meeting 2014
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SSS34-05 Room:502 Time:April 29 10:00-10:15

Coseismic uplifts of the southern Izu Peninsula and the coastal area of Shimizu Plain

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We examined coseismic uplift events in the coastal area of the Shimizu Plain, and at the southern end of the Izu Peninsula. On the basis of lithologies, fossil contents, and radiocarbon dating, we identified geological and paleontological evidence for abrupt changes in depositional environments related to coseismic uplift associated with the AD 1854 Ansei-Tokai earthquake. We estimated a maximum coseismic uplift of 1.2 m and post-earthquake gradual subsidence of ca. 0.6 m. Radiocarbon dating of the emerged sessile assemblages at the southern end of the Izu Peninsula, central Japan suggest that at least four coseismic uplift have occurred in the area, during 3387-2485 cal yr BP, AD 570?820, AD 1000?1270, and AD 1430?1660.

Keywords: Coseismic uplifts, southern Izu Peninsula, Shimizu Plain, Holocene, Ansei-Tokai earthquake

Japan Geoscience Union Meeting 2014
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SSS34-06 Room:502 Time:April 29 10:15-10:30

Former shoreline height and Active Faulting around Obama Bay, Fukui, Central Japan

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I examined the distribution of marine terrace surface assigned to the oxygen isotope stage 5e along the coast around Obama Bay, Fukui Prefecture, central Japan. The marine surface is recognizable on the western and southern coast of Obama bay, which indicates only southwestern coast has progressively uplifted. There is no marine terrace surface along the NE coast of the bay. This strongly suggests that an active fault divides the bay just on the extension of the FO-A fault and the Kumagawa fault. The FO-B and FO-A fault are left-lateral active fault trending NW-SE direction. The Kumagawa fault trending WNW-SES direction display the same vertical displacement as them and SW hanging-wall uplift. These active faults composing of an extensive active fault ca. 65-km long across Obama bay displaying distinct trace jog close to the mouth of the bay (Nokogiri-zaki point). Height distribution of the former shoreline on the marine terrace surface shows the uplift pattern in this area. Comparing the uplift pattern with calculated displacement based on the dislocation theory, the fault model mentioned above explains the general features of the crustal deformation.

Keywords: marine terrace surface, former shoreline, submarine active fault, caclculated displacement, Obama bay

SSS34-07 Room:502 Time:April 29 11:00-11:15

Comparison of the fault zones of the fault activity terminated until the Early Pleistocene and the active fault

OHTANI, Tomoyuki[1*] ; KONO, Masahiro[1] ; KOJIMA, Satoru[1]

[1]Gifu Univ.

In the active fault surveys without younger sedimentary layers, it is desired that the new method is developed to assess the fault activity using the fault rocks in the basement rocks. To achieve this, it is important to understand the characteristic features of the fault zones not only active faults, but also the faults terminated their activity recently. We studied the fault zone of the Median Tectonic Line (MTL) in Yoshino, Nara, and compare its results with those of active faults.

The MTL is the active fault in the west of the central part of the Kii peninsula, in which the fault activity is terminated recently in the east. In this eastern area, Okada and Togo (2000) show the fault which terminated its activity until 300 ka in the active fault maps. Sangawa and Okada (1977) reported an exposure of fault zone that makes a border of the Early Pleistocene Shobudani Formation and the Cretaceous Izumi Group, and that is covered by the Middle Pleistocene Gojo Formation unconformably. Based on the sedimentary ages of their formation, the MTL in this area is terminated until 1 to 1.2 Ma. The fault exposure reported by Sangawa and Okada (1977) is covered by concrete presently, we studied the fault exposure 13 km east away from the previous exposure.

In this exposure, the fault gouge zone with ca. 1 m thickness strikes E-W. The Izumi formation is in the northern side of the fault zone, in which no exposure in the southern side. The Izumi Formation in this exposure is mainly mudstone. Bedding plane is subholizontal in the host rock, in which foliation is subvertical in cataclasite near the fault gouge. Composite planar fabric in foliated cataclasite indicates the uplift of the southern side.

The powder X-ray diffraction and X-ray fluorescence analyses were performed using the samples from this fault exposure. The results of the powder X-ray diffraction analysis shows disappearance of mica and formation of chlorite in the foliated cataclasite close to the fault gouge, and decomposition of plagioclase and formation of calcite in foliated cataclasite and fault gouge. The altered minerals indicate a remarkable alteration in foliated cataclasite rather than fault gouge. Smectite is not detected in fault gouge and cataclasite.

The results of the X-ray fluorescence analysis show the increase of TiO_2, Al_2O_3, MgO, K_2O and P_2O_5 toward the fault gouge and the decrease of CaO, Na_2O and MnO in foliated cataclasite and fault gouge. The decrease is especially in foliated cataclasite rather than fault gouge.

The studied feature is compared by that of the active faults. In the active fault zone, the latest fault gouge is characterized by the formation of smectite and concentration of Mn. Smectite is the mineral formed under lower temperature. Mn deposits under the oxidized condition. These are consistent with recent near-surface condition of the active fault zone. The studied fault zone would be displaced in the deeper part because its activity has been terminated and present surface exposure should be exhumed from 1 to 1.2 Ma to present. Mn is difficult to concentrate in the deeper reduction condition.

Keywords: Early Pleistocene, fault zone, active fault

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SSS34-08 Room:502 Time:April 29 11:15-11:30

Analysis for deformation structures, mineral composition, and elemental composition in the Atera fault

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The Atera fault is an active fault extended 70 km along southern — central Gifu Prefecture, Japan, which is considered to slip at 1586 Tensho earthquake based on the field outcrop and trenching survey by previous researches. However, the seismic slip behavior along the fault has been understood. In this study, we performed the field observation on the Tase outcrop of the Atera fault, microscopic observation, X-ray diffraction, trace element analysis by using ICP-MS for investigating the deformation structure, mineral assemblage, and geochemical anomaly in the Atera fault. We will present their preliminary results.

Keywords: Active fault, Fault gouge, Trace element

SSS34-09 Room:502 Time:April 29 11:30-11:45

Deformation simulations by the discrete element method controlling basement motions by the dislocation solutions

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In previous studies on deformation of sedimentary layer due to fault motions within the basement by means of the discrete element modeling, the basement has been treated as rigid body. In this study, we attempted to control motions of the basement by dislocation analytical solutions based on the elasticity in order to discuss the deformation field of the sedimentary layer in connection with fault parameters.

As a result, we found tilt of deformed sedimentary layer which did not appear in the rigid basement model. And, shapes of deformed sedimentary layer around the fault tip were different from rigid basement model, and even in the elastic basement model it was shown that their shapes will be varied by the fault parameters selected in the modeling.

Since sedimentary layers deform by following to shape of deformed basement, and the basement controlled by the dislocation analytical solutions deforms by the fault parameters, it was shown that not only shape of deformed sedimentary layers but trishear and its propagation processes will be able to be discussed in connection with the fault parameters. In the future, we will accumulate some know-how on practical analyses method by applying our modeling procedure to interpretations of topography, geological structures and seismic survey data, and we would like to hasten quantitative discussions on tectonics and/or forming processes of geological structures.

Keywords: Discrete Element Method, Dislocation analytical solutions, Displacement of sedimantary layer, PFC

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SSS34-10 Room:502 Time:April 29 11:45-12:00

The reproductive experiments of stratum deformation on the trench for the Kushibiki fault using numerical experiments

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Introduction

The Quaternary regional stress field in eastern-central Japan tend to be east and west compaction force. Therefore, a number of thrust faults develop in this area. These faults sometimes indicate complex features, such as back thrusts or branches above 3 km depth.

It is considered that seismic waves are generated by fault activity below 3 km depth. Therefore, indirect earthquake surface faults which branch off from a earthquake source fault not generate seismic waves. Additionally, earthquake surface faults which directly connect to a earthquake source fault specify crustal movements around these faults. Therefore, we must distinguish between indirect earthquake surface faults and faults which directly connect to a earthquake source fault.

According to the approach of foam rubber models and dynamic lattice model simulations, it is known that a fault slip velocity accelerates toward a ground surface (e.g., Oglesby *et al.*, 2000; Ma and Hirakawa, 2013). According to numerical calculations which base on dynamic models, peak slip velocities of thrust faults with dip angles of 30-45 degree are 2.5-4.0 m/s (e.g., Oglesby *et al.*, 2000; Ma and Hirakawa, 2013). On the other hand, according to the numerical calculation, the peak slip velocity of the back thrust which was the indirect earthquake surface fault from the 2008 Iwate-Miyagi Nairiku earthquake in Japan was 0.05 m/s (Ando and Yamazaki, 2013). Therefore, we may be able to distinguish between indirect earthquake surface faults and faults which directly connect to a earthquake source fault, from peak slip velocities. Thus I estimated the peak slip velocity of the Kushibiki fault which is considered as indirect back thrust of the Fukaya fault, from numerical experiments.

Relation between the Kushibiki fault and the Fukaya fault

Sugiyama *et al.* (2009) described that the Kanto-heiya-hokuseien fault zone is active fault zone which intervenes between the Kanto mountain terrain and the Kanto plain with NW-SE strike. The Kanto-heiya-hokuseien fault zone which is SW dipping thrust consists chiefly of fault groups along the Fukaya fault and the Fukaya fault.

The Hirai-Kushibiki fault zone which is considered as back thrust of Fukaya fault except the Hirai fault, consists of the Hirai fault, the Kushibiki fault and Kamikawa fault. In addition, the Kushibiki fault is bedding fault of Neogene sediments which have a dip angle of about 20 degree (Sugiyama *et al.*, 2009b; Shintani *et al.*,2009).

Methods

In this study, I performed numerical experiments about stratum deformation by faulting of the Kushibiki fault, and these experiments were executed by SDSSC (Strata Deformation Simulation System using CIP method) Ver 4.09. The model which feeds into SDSSC is modeled by the stratigraphy, the dip angle and the unit displacements from drilling surveys (Sugiyama *et al.*, 2009b) and trenching study (Shintani *et al.*, 2009).

Numerical experiments were performed with taking into account the erosional vacuity and the sedimentation for stratum by the faulting at the trenching area, and the peak slip velocity was estimated by comparison between experimental results and trenching results.

I adopted CWFS (cohesion weakening and frictional strengthening) model (Hajiabdolmajid *et al.* 2002) as the deformation characteristic about the stratum.

Result and Discussion

I estimated the peak slip velocity of the the Kushibiki fault at 1-1.5 m/s. Therefore, this conclusion leads to the suggestion that the peak slip velocity of the indirect back thrust is slower than the thrust faults.

Achnowlegement

For this study, I have used the computer systems of the Earthquake and Volcano Information Center of the Earthquake Research Institute,the University of Tokyo.

Keywords: Kushibiki fault, earthquake surface faults, back thrust, fault slip velocity, numerical experiment, CIP method

SSS34-11 Room:502 Time:April 29 12:00-12:15

Spatial Variation on Recurrence-time Distribution of Paleoearthquakes and Its Influence for Long-term Forecast

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The Earthquake Research Commitee (ERC) of Japan performs and publishes the long-term forecast of major paleoearthquakes in Japan. The ERC adopts renewal processes assuming that the recurrence intervals of paleoearthquakes are independently and identically distributed as the BPT (Brownian Passage Time) distribution. When applying this model, we need to estimate the mean and coefficient of variation (CV) on recurrence times. The estimation error in CV occationally affect so much on the long-term forecast. However, while the mean parameter can be estimated with a certain precision from only the number and approximate ages of historical activities,the estimates of CV parameter have quite large errors without plentiful and accurate data. So the ERC assumes a common estimate for all active faults in Japan to ensure a certain reliability for the estimate.But as the historical paleoseismic data are accumulated by investigations, some active faults show significantly large variation in recurrence times.

Renewal processes with the BPT distribution are based on an physical model that assumes a cyclic mechanism where stress on a fault surface is accumulated by tectonic forces until an earthquake occurs that releases the accumulated stress to a basal level. In this model, the mean recurrence time represents the rate of stress accumulation by tectonic motionand the CV implies the strength of stress perturbation caused by nearby seismicity. Therefore, these parameters are supposed to have regional trends as seen in the analysis of Nomura et al. (2011). In our study, we estimate the spatial variation of these parameters on the BPT distribution in Japanand apply it to the long-term forecast on the active faults with very few historical data. In addition, we compare our forecast with the forecast by the ERC to discuss the influence of parameter estimation on earthquake prediction.

Keywords: long-term forecast, BPT distribution, renewal process, coefficient of variation, spatial model

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SSS34-12 Room:502 Time:April 29 14:15-14:30

Spatial distribution of faults and folds in the offshore extension of the western margin fault zone of the Takada plain

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We carried out a marine geological investigation on an offshore extension of the western margin fault zone of the Takada plain. The main purpose of this study is to clarify the total length of the fault zone and characterization of recent faulting. The western margin fault zone of the Takada plain is west dipping reverse fault, and the total length of this fault zone is 30 km from land to sea are based on the existing material.

We conducted 31 lines of high-resolution multichannel seismic reflection survey to recognize the detailed structure of the faults and folds. The reflection profiles depict the geological structure with extremely clear images.

The reflection profiles showed that the geological structure of the offshore area is characterized by the fold belt along the northern margin of the sedimentary basin that is formed in front of Takada plain. The shape of the fold is asymmetric weakly, and suggesting the fault related fold that has been deformed by west or north west dipping blind reverse fault as with land. This fault related fold zone is continuous to the Northern Kashiwazaki-oki Anticline from the Naoetsu-oki fault while changing asymmetry on the way. The North Kashiwazaki-oki Anticline is an active structure that has been pointed out the relevance of the source fault of the Chuetsu-oki earthquake.

Keywords: The western margin fault zone of the Takada plain, offshore, fault, fold, active structure, high-resolution seismic reflection survey

SSS34-13 Room:502 Time:April 29 14:30-14:45

Geologic structures and their activities around junction of main part and southern part of the active eastern boundary f

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A 130-km-long N-S trending active fold and thrust zone (eastern boundary fault zone of Ishikari lowland) occurs in the Ishikari lowland and off the Yufutsu plain. This fault system is one of the boundary faults between the Kuril arc and the Northeast Japan arc. This fault system consists of east-dipping thrusts accompanying with fault-related folds. This fault system is subdivided into two parts with gap and echelon arrangement around the Yufutsu plain. The main part is 72 km-long and its mean vertical displacement rate is larger than 0.4 m/ky since the late Pleistocene. The south part is 86-km-long and its mean vertical displacement rate is 0.2-0.3 m/ky since the late middle Pleistocene. The southern part of this fault zone includes discontinuous structures such as short-axis anticlines and short monocline in the terrestrial part. This discontinuity of geologic structure would be related to irregularity of basement rocks underlying the southern part of Ishikari Lowland.

Keywords: Eastern margin fault zone of Ishikari Lowland, fold and thrust belt, active fault, mean displacement rate, geographical information system

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SSS34-14 Room:502 Time:April 29 14:45-15:00

Revisited most recent paleoearthquakes along the ISTL active fault system, central Japan

KONDO, Hisao[1*] ; TANIGUCHI, Kaoru[1] ; SUGITO, Nobuhiko[2]

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The ISTL active fault system, central Japan, is well-known as one of the most hazardous fault systems based on the previously-reported paleoseismological works. Since the first paleoseismic trench survey was performed in 1980s, the number of paleoseismic sites becomes over 44 sites along the 150-km-long fault system, that is the highest density on active fault zone in Japan. In those studies, the timing of the most recent paleoearthquake had been reported around 1200 y.B.P., and the events had been longly estimated to be correlated with one muti-segment earthquake either 762 A.D. or 841 A.D. historical earthquakes. On the other hands, the recent result of geoslicer survey at the middle section of the ISTL indicate that the most recent event occurred around 2300 y.B.P., contradicting with the correlations with the historical earthquakes. Thus the most recent earthquakes on the ISTL is still ambiguous, therefore, we carried out systematic paleseismic surveys around the largest segment boundary, Lake Suwa segment boundary, at the middle of the ISTL active fault system. The Lake Suwa segment boundary is structural Quarternary basin formed by left fault step-over between left-lateral strike slip faults. At three paleoseismic sites inside of the Suwa basin, we revealed the most recent events occurred a few thousands years before ~1200 y.B.P. and those are not correlatable with the historical earthquakes. These data indicate that the most recent earthquake along the ISTL did not rupture through the Lake Suwa segment boundary. In addition with this, the compiled timing of the most recent event along the entire the ISTL suggest that spatial clustering of the most recent earthquake. One large earthquake ruptured between the Kamishiro fault and the Gofukuji fault or possibly up to the Okaya fault, and another event ruptured between the Kamanashi-Yama faults and the Shimotsutaki fault. These two events will be correlated with either the 841 A.D. and the 762 A.D. earthquakes along with more reliable historical document surveys. Furthermore, this paleoseismic scenario during the most recent earthquake cycle do not deny the possibly that the larger multi-segment earthquake rupturing through the Lake Suwa segment boundary. In fact, paleoseismic event occurred between 2000 y.B.P. and 2300 y.B.P. was identified at the sites on the Gofukuji fault, the Okaya fault, and the Chino fault. Since those faults have left-lateral-strike slip component forming the pull-apart basin, the 2000-2300 y.B.P. event might have ruptured through the Lake Suwa segment boundary. To be testified this possibility, further investigation on the slip per event around the segment boundary is necessary.

Keywords: active fault, paleoearthquake, historical earthquake, ISTL active fault system

Japan Geoscience Union Meeting 2014
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SSS34-15 Room:502 Time:April 29 15:00-15:15

High resolution seismic reflection profiling across the Kurehayama fault, Otokawa Line, central Japan

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We collected and processed shallow high-resolution seismic reflection data in order to resolve shallow structures and to understand structural linkage between active faults and folds recognized at ground surface and deeper, complicated fold and thrust structures along the Kurehayama fault, Toyama Prefecture, central Japan. We deployed more than 800 seismic channels, 10-Hz geophones, and Enviro-Vib (IVI, Inc) as a seismic source along about 8-km-long seismic line. Common midpoint stacking by use of initial velocity analysis successfully illuminates subsurface geometries of active fault-related fold to 1.5 two-way time in time section and up to about 1.5 km in depth section. Detailed seismic reflection analyses including refraction and residual statics, migration, deconvolution, and time-space variant bandpass filters, and depth-conversion by use of stacking velocities enable to obtain subsurface depth section of these active structures.

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SSS34-16 Room:502 Time:April 29 15:15-15:30

Active faults in and around the Yoshinogari Heritage

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The normal faults are distributed around the boundary line of between Saga Plain and Sefuri Mountains (The Research group for Active tectonics in Kyushu, 1989, etc.). Shimoyama (2010) suggested that this normal fault zone relatively uplift the north side block, based on the displacement of boundary between Aso-4 and Mitagawa Formation. According to the Regional evaluation of the active fault (Kyushu), the Headquarter of Earthquake Research Promotion evaluated that the normal fault zone (Saga Heiya Hokuen Fault Zone) can be traced about 22 km from Ogi City to Yoshinonogari Town, based on the feature of gravity anomaly and tectonic geomorphology. However, the distribution and activities of active fault are not understood well. Yoshinogari Heritage, one of the Japan's important heritages, is on a terrace that is formed by Aso-4 pyroclastic flow deposits. Many relics during the Paleolithic era and Early-modern era have been excavated from here. Especially, it is famous for moat-surrounded settlements of the Yayoi period. The prospered moat-surrounded settlements were abandoned in the late third century. In the Nara period, Kando (ancient road) and government agencies which extend to Hizen Province (Saga and Nagasaki Prefecture) from Dazaifu,were established in the northern Saga Plain including the Yoshinogari Heritage. Yoshinogari Heritage and surrounding areas are regions where the civilizations of the many periods remain. Therefore, in this area that records man's activity for a long time, it is expected that influences of fault activities on civilizations can be known. To clarify the time and spatial relationships between active faults and ruins, we described the distribution map on active faults and ruins in and around the Yoshinogari Heritage, based on interpretation of topography using large-scale maps, aerial photograph, 5m DEM and results of field and archaeological surveys, and also conducted several very shallow seismic reflection profiles across clear tectonic scarps.

Keywords: Normal fault zone, Saga Plain, Yoshinogari Heritage, DEM, Very shallow seismic reflection profiling

SSS34-17 Room:502 Time:April 29 15:30-15:45

Study on great palaeoearthquakes and the decline of the Sanxingdui and Jinsha civilizations, Sichuan basin, China

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The ruins of ancient civilizations damaged by large palaeoearthquakes, which have been reported worldwide, are often used as surface markers for Holocene tectonic and palaeoseismic events. Previous studies have demonstrated that recurring palaeoearthquakes have caused repeated soil liquefaction at the same site, leaving a record in both sediments and ancient ruins; such records can reveal a great deal about earthquakes that occurred prior to human-recorded observations or measurements5?10.

The Sanxingdui civilization, which developed on the Sichuan Plain, central China, during the Bronze Age (ca. 4800 years ago), flourished from ca. 4200 to ca. 3500 years ago until its sudden disappearance ca. 3200 years ago. Subsequently, the Jinsha civilization arose in the area around Chengdu city, ca. 40 km southwest of the Sanxingdui site, but it too suddenly disappeared ca. 2500?2200 years ago. It has been speculated that floods or regime changes might explain the collapse of both civilizations, but no solid evidence for such causes has so far been reported.

In this study, to search for a link between palaeoearthquakes and the abrupt unexplained falls of the Sanxingdui and Jinsha civilizations, we investigated the liquefaction induced by great palaeoearthquakes that occurred repeatedly in the past 5000 years on the Sichuan Plain, central China, in the region of the former Sanxingdui and Jiasha civilizations. Here, we present evidence that great palaeoearthquakes may have caused the collapse of both the Sanxingdui and Jinsha civilizations, as the cultures flourished in the periods during ca. 4200?3500 years and ca. 2800?2300 years ago, respectively, on an active fault zone of the Longmen Shan Thrust Belt (LSTB) that triggered the 2008 Mw 7.9 Wenchuan earthquake. Field observations, archaeological evidence, and radiocarbon dating reveal that at least four great palaeoearthquakes have induced liquefaction in wide areas around the Sanxingdui and Jinsha civilization sites during the past 5000 years, with an average recurrence interval of ca. 1000 years. We suggest that palaeoearthquakes occurring ca. 3300 and ca. 2200 years ago caused the fall and disappearance of the Sanxingdui and Jinsha civilizations, respectively, by causing extensive damage to infrastructure and manufacturing facilities, as well as numerous deaths.

Keywords: palaeoearthquake, Sanxingdui civilization, Jinsha civilization, Yangtze River civilization, Longmen-Shan Thrust Belt, Sichuan Basin

SSS34-18 Room:502 Time:April 29 15:45-16:00

Active thrusting beneath an alluvial terrace in the southern Longmen Shan range front, Sichuan basin, China

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The devastating 2008 Mw7.9 Wenchuan earthquake, China, demonstrates that the central and northern parts of the Longmen Shan are currently active. However, evidence for active faulting and folding in the southern Longmen Shan remains poorly documented. In this paper, we define the structural geometry, fault kinematics, and seismic hazard of the Qiongxi thrust fault system (QTF) along the southern Longmen Shan range front by integrating deep and shallow seismic reflection data and geomorphic observations. The QTF is a 50-km-long, N-S-trending set of faults and associated folds that exhibit geomorphic evidence of Quaternary surface deformation. Geomorphic observations and seismic reflection data reveal that these faults dip steeply to the east and merge at depth with a blind, west-dipping thrust ramp. The trend and reverse sense of slip along the QTF indicates that the structure accommodates east-west crustal shortening. Based on uplift of stratigraphic horizons across the fault zone, we define a late Pliocene to early Pleistocene fault slip rate of 0.2-0.3mm/yr, and a middle Pleistocene to present rate of 0.4-1.2 mm/yr on the west-dipping thrust ramp.. This ramp soles to a basal detachment in the Triassic section at a depth of 4.5-5.5 km. To the west, this detachment steps down onto a blind, northwest-dipping thrust termed the Range Front Thrust. A rupture of the QTF in combination with the Range Front Thrust could generate a Mw7.8 earthquake with averages displacement of 5.7m. This type of earthquake source poses significant hazards to the adjacent, highly populated Sichuan basin.

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SSS34-P01 Room:Poster Time:April 29 18:15-19:30

Identification of Fault Displacement and Stratigraphic Correlation of Black Soils based on Radiocarbon Ages

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In order to clarify the stratigraphic correlation around the fault and the timing of faulting event, we carried out radiocarbon dating of the black soil sampled from the trench wall of the Atera Fault. Black soils were sampled at an interval of 3-6 cm along the vertical direction on both the hanging wall and footwall located approximately 50 cm away from the fault plane. Sample preparation and radiocarbon dating were carried out in the JAEA-AMS-TONO of Tono Geoscience Center, JAEA. Calendar years were obtained by calibrating ^{14}C age using OxCal 4.2.3 (Bronk Ramsey, 2013) with IntCal13 atmospheric curve (Reimer et al., 2013).

The dating results show that the soil ages vary from 4,000 to 2,000 years with depth of the sampling points. Black soil was deposited at approximately constant rate each at both sides of the fault in 4,000-2,000 years ago. This indicates that the fault didn't move during this period. In the upper part, there is no variation in ages of black soils including the gravel with depth. This suggests that sedimentation rate was faster. One of the causes that the sedimentation rate around the fault suddenly changes is fault displacement. It is thought that this fault move in about 2,000 years ago. About this timing, it is necessary to consider in behavioral segments of the Atera Fault zone in detail.

In addition, we are going to present results of the volcanic ashes analysis and radiocarbon ages of the lower part.

Keywords: radiocarbon dating, C-14 age, black soil, Atera fault, timing of faulting event

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SSS34-P02 Room:Poster Time:April 29 18:15-19:30

SEM observation on the active fault surface

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SEM observation of the fault surface was attempted in order to clarify the feature of the fault plane of active fault. The sharp plane of cutting other structures in outcrop was judged to be the latest activity surface, and the block sampling of the latest surface was carried out. After identifying the continuity of the fault plane by observing the internal structure of the sample in detail using helical X-ray CT, the samples for SEM observation were prepared. As a result of observation on the latest activity surface with a stereomicroscope and a scanning electron microscope, the following features have been identified. (1) A slickenside and striations are observed on the latest fault surface. (2) The fault plane is formed of the crushed fine-grained particles, and the dumpling-like structure where fine-grained particle was covered with paste-like clay is observed as a feature. (3) Growth of euhedral minerals formed by diagenesis in deep such as illite and chlorite, were not observed on the latest fault surface.

Keywords: active fault, fault surface, clay minerals

SSS34-P03 Room:Poster Time:April 29 18:15-19:30

Examination of evaluation method for fault activity based on an observation of fault zone - 1. Selection of outcrops -

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The activity of a fault is normally evaluated by observing the displacement/deformation of strata which cover the fault. However, it is difficult to evaluate the activity of a fault which exists only in the basement rock without any overlying strata. In such a case, the fault activity needs to be judged carefully through a comprehensive approach to geomorphology, geology and present/past stress fields. Items in analyzing a fault zone include observation of the fault plane, width of fracture zone, color, hardness, magnetic susceptibility, form of fractured material, mineral and chemical composition analysis, dating, etc. Since some of these items have uncertainties in quantification and reproducibility, a method for evaluating fault activity by analyzing the fault zone in the basement rock is yet to be established. The authors have been carried out the observation and analysis of the fault zone to establish more scientific method of evaluation of fault activity.

In order to do the survey of certain active fault, we should study the outcrop of fault which give a displacement/deformation to the overlying certainly younger formations, and should observe the extension of fault from the overlying formations to the basement rocks. On the other hand, in order to do the survey of the fault zone of certain non-active fault, we should study the outcrop of fault which is covered by the old enough formations from the evaluation point of view.

We selected the outcrops which fulfilled the above-mentioned conditions through literature, then we decided the study outcrops through geological survey. The study area are limited in granite-bearing area, because granite show generally homogeneous and simple structure, is widely distributed in land, and well documented about fault rocks.

Examples of outcrops of active fault are one of the Gosukebashi Fault (Loc. 5 of Maruyama et al., 1997, Active Fault Res.) and one of the Rokko Fault (Loc.1 of Maruyama and Lin, 2002, Tectonophysics) in the Rokko Mountains, southern Hyogo Prefecture.

The fault zone of the Gosukebashi Fault appears in the Rokko Granite at the upperstream of the Gosuke-Dam site. Sand and gravel beds are bounded with granitic fault zone in the upper part of the outcrop. The fault zone consists of thick fault gouge in black and brown color, foliated cataclasite and granitic cataclasite.

At the western Funasaka, the Rokko Granite is in contact with rhyolitic volcaniclastic rocks of the Arima Group and overlying gravel beds through the Rokko Fault. The fault zone of the granite are remarkably altered and composed of brown fault gouge, foliated cataclasite and granitic cataclasite. The fault zone of the rhyolite is composed of black Fe-Mn-bearing layer, rhyolitic cataclasite and damaged rhyolite.

An example of non-active fault was selected from the fault which does not effect the strata of higher terrace deposits. Higher terrace deposits surrounded by badlands of weathered granite are well developed around the Rokko Horai-kyo in the northern Rokko Mountains. The fault including relatively thick gouge which is overlain by the deposits was selected for this survey, and is named the Rokko Horai-kyo Fault. For keeping the safety against the rock fall, the survey has done in the lower extension of granitic slope from the unconformity. The fault zone appears in the weathered granite, and composed of brown gouge, with black Fe-bearing layer and cataclasite.

The observation of fault zone (evaluation of fault plane, in-situ measurements of color and hardness), striation analysis, observation of fault structure by slabs, sections and SEM samples, mineral composition (XRF) and chemical composition (ICP-MS) analysis, mechanical and physical tests were done at the fault zones of these 3 faults. In this paper, the outline of this study and the results of geological survey are described. The details of the observation results of fault zones are explained in another paper (Okazaki et al., 2014, Abst. JpGU).

Keywords: active fault, evaluation method of fault activity, Rokko Mountains, Gosukebashi Fault, Rokko Fault, fault zone

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Examination of evaluation method for fault activity based on an observation of fault zone - 2. in-situ experiments -

OKAZAKI, Kazuhiko[1] ; KAMETAKA, Masao[1*] ; NAKAYAMA, Kazuhiko[2] ; SESHIMO, Kazuyoshi[2] ; AOKI, Kazuhiro[2] ; TANAKA, Yoshihiro[2] ; SHIMADA, Koji[2] ; SUZUKI, Kazushige[1] ; SHIMOGAMA, Kota[1] ; INADA, Noriyuki[1]

[1]Dia Consultants, [2]Japan Atomic Energy Agency

In order to establish a method for evaluating fault activity based on observation and analysis of fault zone in the basement rock, a comparative study has been carried out at outcrops of active and non-active fault. Of the three outcrops selected in the Rokko Mountains situated in southern Hyogo Prefecture, two were of an active fault and one of non-active fault. They are: the outcrop of Gosukebashi Fault at the upperstream of Gosuke-Dam site (GSB) and the outcrop of Rokko Fault at the western Funasaka (FSW) for active fault, and the outcrop of Rokko Horai-kyo Fault overlain by higher terrace deposits (HRK) for non-active fault (Kametaka et al., 2014). This paper focuses on an evaluation method which is relatively brief and easily enforceable at the outcrops, and describes the suitability of making a morphological observation of the fault plane and conducting in-situ experiments on hardness and color.

Fault plane of the active fault seems to be well continued, smooth surface and cut the older texture of the fault zone. To describe these features objectively and quantitatively, we measure 1) the relationships between the fault plane and the older texture, 2) the continuity of the fault plane, 3) planarity of the fault plane, 4) semi-quantitative observation using guideline of ISRM (Rock Net Japan, 1985, ISRM Guidelines), 5) arithmetic average toughness based on the authorized photograph. The results indicate that the fault plane of GSB and FSW show good continuities and well cut the older texture, while that of HRK show discontinuous part and poorly cut the older texture. The planarity, surface roughness and waviness, of the fault plane are well in GSB and poor in HRK, and partly poor in FSW possibly caused by the texture of alteration. The fault plane in the basement rock show relatively better planarity than that between basement rock and gravel beds. The arithmetic average toughness leads quantitative evaluation of fault plane, though there are some soluble problems about forming of outcrops and recognition of fault plane.

It qualitatively said that the fault gouge of an active fault is possibly soft and that of a non-active fault gouge is possibly hard and consolidated (Kimura, 1981, Jour. Japan Soc. Eng. Geol.). To quantify the hardness of intrafault materials, in-situ experiment of needle penetration test has been done. The result indicates that the fault gouge of GSB, FSW and HRK show 0 kN/m2. The altered cataclasite and weathered granite (damaged granite) of rock surface even show low value, while they show higher value at 20 cm below the surface. On the other hand, the fault gouge of the underground indicates still low value.

Fault gouge of an active fault possibly show reductive color and that of a non-active fault possibly show oxidative color (Research Core for Deep Geological Environments, AIST, 2012, GSJ Open File Rep.). To quantify the color of intra-fault materials, color measurements (Lab color) were done by using portable soil color meter. The results indicates that the fault gouge of GSB show low a*value and low-middle b*value, that of FSW show high a*value and very high b*value, and that of HRK show low-middle a*value and low-high b*value. The fault rocks around the fault gouge show intermediate value between fault gouge and non-deformed granite, indicating color change associated with weathering pass of granite.

In this paper, we show the specific contents of each measurement, and discuss about the validities of evaluation methods of the fault activity.

Keywords: active fault, evaluation method of fault activity, Rokko Mountains, Gosukebashi Fault, Rokko Fault, fault zone

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SSS34-P05 Room:Poster Time:April 29 18:15-19:30

Active faults and topographic surfaces on the stereoscopic topographic map

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Thematic topographic maps have developed by the progress in analysis using digital elevation model (DEM) and have made clear representation possible.

We made digital stereoscopic topographic maps in scale 1:25,000, by using 5m mesh DEM data arranged by Geospatial Information Authority of Japan (GSI) . These 3D maps have same information, mode, scale and interval 10m contour, comparing to Quadrangle topographic sheet map.

We demonstrated the overlapping active fault line (Nakata and Imaizumi, edit 2002) on these 3D maps, in order to easily interpretation of the location of fault line, fault feature, evidence of faulting and displacement of faulting from professional and educational viewpoints.

Keywords: Active fault, Topographic surface, Stereoscopic topographic map, Interpretation of topographic map

SSS34-P06 Room:Poster Time:April 29 18:15-19:30

Genetic algorithm-based displacement extraction technique for LiDAR dataset

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Owing to recent progress of aerial survey with laser transmitting device, we can easily obtain detailed digital elevation model represented by point cloud data. This model is applicable to many purposes such as active fault detection, quantification of bluff lines, and extraction of ground displacement caused by an earthquake.

Although some methods for seismic displacement extraction from point cloud data have been proposed, we need more robust and powerful method in terms of noise immunity. In this study, we propose a new method based on the RBF (Radial Basis Function) interpolation and the GA (Genetic Algorithm) for the seismic dis-placement detection and then conduct a series of inquests including the parameter setting, the evaluation of noise resistance, and the comparison among four optimization techniques: GA, L-BFGS-B, Nelder-Mead, and COBYLA.

The results of considerations revealed that: (1) the size of unit for pattern matching should be set to 24 m square for the point cloud divided into 1 m grid; (2) the proposed method stably detect the correct dis-placement even under ill-posed condition; (3) the combination of the RBF and the GA is well suited for this problem because the objective function appearing in this study possesses extreme multimodality, suggesting that we should not use the optimization method based on gradient information.

Keywords: genetic algorithm, interpolation, LiDAR, displacement, optimization

SSS34-P07 Room:Poster Time:April 29 18:15-19:30

Geologic structures around the coastal area of the southern part of the active eastern boundary fault zone of Ishikari l

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A 130-km-long N-S trending active fold and thrust zone (eastern boundary fault zone of Ishikari lowland) occurs in the Ishikari lowland and off the Yufutsu plain. This fault system is one of the boundary faults between the Kuril arc and the Northeast Japan arc. We surveyed around the coastal area of the Yufutsu plain based on the marine high-resolution seismic-survey and the database of land borehole cores. As a result, two active anticlines (Yufutsu anticline and Hamaatsuma anticline) were recognized. These anticlines can be correlated to the anticlines described as a part of the active eastern boundary fault zone of Ishikari lowland (AIST, 2007). The trand of the Yufutsu anticline was N-S despite The Headquarters for Earthquake Research Promotion reported the trend was NW-SE. The Hamaatsuma anticline continued to the Mukawaoki anticline and the southern end of the fault zone extend to the southern end of the Mukawaoki fault which is concerned to the Mukawaoki anticline.

AIST(2007)Activity survey of the eastern boundary fault zone of Ishikari lowland. Working papers. H18-8, 35p.

Headquarters for Earthquake Research Promotion(2010) Evaluation of the eastern boundary fault zone of Ishikari lowland (revised). 34p.

Keywords: Active eastern boundary fault zone of Ishikari lowland, Seismic survey, Quaternary, Hokkaido, Coastal area

SSS34-P08 Room:Poster Time:April 29 18:15-19:30

Seismic reflection survey across the northern part of the Western Boundary Fault Zone of the Yamagata Basin

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The Western Boundary Fault Zone of the Yamagata Basin borders the western margin of the Yamagata basin and is traceable for about 60 km. In the northern part of this fault zone (from Sagae to Ooishida area), subpallarel traces of the active fault distribute in the western side of the basin. At the center of the basin, Kawashima-yama located as a tectonic bulge and its western side the Mogami river incise and meander in the fault zone. Along the eastern side of the Kawashima-yama, syncline is indicated as a frontal deformation by Ikeda (2002) and Imaizumi (2001).

To reveal the subsurface structure and tectonic evolution of this fault zone, we carried out two lines (Line A and Line B) of seismic reflection survey from September to October 2013. The Line A has a length of 4.11 km and started from Saigo area to Oomaki via. Kyouei bridge. The Line B has about 3.75 km length and started from Taruishi area to Goten along the Taruishi river. The source used in this survey was an Enviro Vib (IVI Inc.). Sweep length was 16 sec and sweep frequency range beginning at 10 Hz up to 120 Hz. The receiver was GS-20DX (natural frequency, 10 Hz; Geospace Inc.). The source and receiver spacing was 10m, with 192 ch geophones used for each recording. We selected the Geode (Geometrics) for the recording system and its sampling rate is 1 msec.

We thank to students of Tohoku University and Kanazawa University for their assistance in our survey. This work was supported by project research of the International Research Institute of Disaster Science (IRIDeS), Tohoku University.

[References]

Ikeda et al., 2002, Atras of Quaternary Thrust Fault in Japan, Univ. of Tokyo Press, 254pp.
Imaizumi et al., 2001, Active Fault Map in Urban Area, Geographical Survey Institute.

Keywords: active fault, seismic reflection survey, the Western Boundary Fault Zone of the Yamagata Basin, subsurface structure, Murayama City

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Very shallow seismic surveys of the Shionohira earthquake fault appeared at the Fukushima-ken Hamadori earthquake

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In the southern part of the Fukushima-ken Hamadori area, seismicity increased after 2011 Tohoku earthquake and an M7.0 earthquake occurred on April 11th, 2011. Remarkable surface raptures appeared along active faults by this earthquake. We conducted very shallow seismic surveys to reveal subsurface structure of the surface rapture down to 20 m in depth.

The survey line is located along a road in the Shionohira of Iwaki city. The displacement of the surface rapture is 2m east-side-up and 0.4m left lateral at the cross point of the survey line. The road was fixed and flat at the survey time.

The survey menus were S-wave survey and P-wave survey. Survey instruments and specifications are as following. Seismic source: S-wave/SWG-5(Suncoh), P-wave/10kg hammer, receiver: S-wave/GS20DM(Oyo Geospace, 28Hz), P-wave/GS11D(OyoGeospace, 4.5Hz), recorder: DSS-12(Suncoh), line length: 191m, source interval: 1m, receiver interval: 1m, stack number: 1-5, spread: S-wave/192ch fixed, P-wave/96ch landstreamer. The data quality was good because of low traffic noise.

The data were processed by S-wave refraction, S-wave reflection, P-wave refraction and surface wave methods. S-wave tomography and P-wave tomography analyses were applied and confidence of resolution and dependency to primary model were estimated. P-wave data were processed by inversion of phase velocity dispersion and S-wave velocity structure was obtained. S-wave data was processed by CMP stacking method and time section, migrated section and depth section were obtained.

According to S-wave velocities by S-wave refraction and surface wave methods, velocity layers below 0.7 km/s is thick to the west of the fault and thin to the east of the fault. Strong reflector between sediments and basement is deep and continuous to the west of the fault, shallow and uneven to the east of the fault and steps are recognized around the fault. The basement rises between this step and 135m of the survey line. This corresponds to the part of high Bouguer anomaly of 0.06 mgal.

Keywords: Fukushima-ken Hamadori earthquake, Itozawa fault, Shionohira fault, subsurface structure, very shallow seismic survey

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SSS34-P10 Room:Poster Time:April 29 18:15-19:30

Pit excavation along the Tachikawa fault at Sayama Shrine Site

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We excavated a 10-m-long, 2-m-deep pit across the hypothesized south-facing topographic scarp on along the Tachikawa fault. Preliminary results include clear evidence of accumulated, west-facing monoclonal folding of underlying conglomerates, predicted by the topographic scarp. Asymmetric ductile shear zone exposed on the bottom indicate nature of significant sinistral strike-slip component of faulting, rather than a simple reverse faulting. Future works include establishing stratigraphy based on radiocarbon dating and tephrostratigraphy.

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SSS34-P11 Room:Poster Time:April 29 18:15-19:30

Geological structure interpreted from two boring cores beside the Tachikawa Fault Zone, Tokyo, NE Japan

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In order to clarify the accurate position and activity of the Tachikawa Fault Zone, which possibly cause an earthquake under Tokyo in future, survey on the Quaternary sediments with tephrochronological method is effective. We conducted an all-core boring (TC-12-1) survey at Enoki in Musashi-Murayama City in 2012, where a relative subsidence will be occurred at its activity. By this result, we pointed out the evidence of deformation in altitudes of Middle Pleistocene gravel bed base, and also found a tephra layers estimated its age to be at 1.63 Ma. In this study, an additional all-core boring (TC-13-1) survey in relative uplifting side was carried out. The following are preliminary report of TC-13-1 core survey. Site of all-core boring (TC-13-1) with the length of 90 m is ca. 300 m northwest of Tachikawa Fault Zone of which the altitude is 109.50 m. Sediment with a depth 0 to 28.65 m is composed of coarse gravels with diameters 3 to 10 cm (max. 20 cm). Upper part of this gravel bed is equivalent to the fluvial terrace deposits of Tachikawa 2 Surface, and lower one is most likely to be the gravel bed identified as Middle Pleistocene sediment in the survey of TC-12-1 in 2012. Altitude of the base of this gravel bed (80.85 m) is higher than that of TC-12-1 (71.97 m), suggesting the evidence of fault activity with uplifting of east side. Sediment with a depth 28.65 to 90.00 m is composed of the alternation of silt (mudstone), sands, and gravels, and is correlative to the Kazusa Group of Lower Pleistocene. Five cycles of sedimentation composed of upper consolidated silt to mudstone and lower gravel bed were recognized. Also. shell in mudstone of 67.15-68.00m in depth and tuffaceous mudstone layers were found. We will examine theses sediments in detail.
This survey was financially supported by Ministry of Education, Science, Sports, and Culture (Intensive Survey and Observation on the Tachikawa Fault Zone).

Keywords: Tachikawa Fault Zone, Underground geology, Boring core, Musashi-murayama

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Examination of tectonics of the Shinano River basin, Niigata and Nagano prefectural border.

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In Niigata and Nagano, the trend of a general structure has a NNE-SSW strike called what is called the direction of Niigata. Moreover, it is thought that the trend of an active fault has the direction of Niigata similarly. However, the western Tokamachi fault belt continuous from Tokamachi city to Niigata and Nagano prefectural border contains in the south the Miyanohara fault which is an ENE-WSW strike(Headquarter of Earthquake Research Promotion 2010).

The Shinano River syncline which has in Tokamachi a NNE-SSW strike which exists in Shinano River and parallel being crooked in Tsunan-cho, and becoming an E-W trend.(Shimazu and Tateishi 1993. And Takeuchi et al 2000).

However, the exact position and a posture are not specified.

That is, it was not necessarily confirmed based on detailed investigation, the structure of the area is the direction.

The tectonics of the area has many questions as mentioned above. It inquired for the purpose of solving the tectonics of the area.

It was able to ask for the exact position of the Shinano Kawamuki slant continuous to a the area as a result of investigation. Moreover, Chikumagawa anticline and hokushin syncline was was newly authorized in the area.

Moreover, the sectional view over the Miyanohara fault in this research was compared with Sega (2012MS) in a Tokamachi basin west marginal fault belt. When done so, it turned out that the form of folding is alike. Therefore, it is thought that a Tokamachi basin west marginal fault belt and the Miyanohara fault are the same postures. Therefore, these connect and it is thought that the western Tokamachi fault belt is constituted. Moreover, the form of folding is alike also around hirataki. Therefore, the southernmost end of the western Tokamachi fault belt may be extended further west.

Furthermore, small fault method which used the Multiple Inverse Method was conducted. A result, it turned out that the small fault is recording two or more times of transcurrent fault type stress.

Horizontal gap stress is as conformable as the earthquake mechanism of aftershock of the northern Nagano earthquake in 2011,3,12.

Therefore, it is possible that Japan of those days was also placed by the same stress-ization as the present after the offing earthquake of the Tohoku earthquake.

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Tectonic geomorphology around the eastern piedmont of the Myoko volcano and their tectonic implications

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The Myoko volcano group is located in the south of Takada plain, and its eastern piedmont is intermontane trough (hereafter, referred as the Myoko trough) between the Nishi-kubiki Mountains and the Higashi-kubiki Hills. The Myoko trough is located from the south of the Takada plain to the north of the Nagano Basin. The Takada-heiya-toen fault, Takada-heiya-seien fault, and the Nagano-bonchi-seien fault are located along the eastern margin of the Takada plain, the western margin of the Takada Plain, and the western margin of the Nagano Basin, respectively (Nakata and Imaizumi, 2002). Based on detailed analysis of areal photographs, we newly mapped active faults and tectonic landforms in the Myoko trough. we describe evidences of recent activity and discuss the property of these tectonic landforms and their tectonic implications. Newly mapped active faults and tectonic landforms are distributed almost continuously from the southern edge of the Takada-heiya-toen-fault to around Fujisato village in the Shinano town. Based on these distributions, we judged that newly mapped active faults constitute a part of the Takada-heiya-toen fault, and that the length of the Takada-heiya-toen fault may be elongated from 26 km to max. 55 km. However, active faults in the Myoko trough and the Nagano-bonchi-seien fault are distributed in parallel at distance of 13-14 km. Therefore, these two faults may be converged at depth of 6-7 km, and the southern part of the Takada-heiya-toen fault may be a backthrust of the Nagano-bonchi-seien fault.

Keywords: Takada plain, active fault, air photo, Myoko volcano group, Takada-heiya-toen fault

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Investigating the role of the Itoigawa-Shizuoka tectonic line in the evolution of the Northern Fossa Magna rift basin

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The Itoigawa-Shizuoka tectonic line (ISTL) fault system is considered to have one of the highest probabilities for a major inland earthquake occurrence in the whole of Japan. It is a complex fault system with the dip directions of the local fault segments changing from north to south between an east-dipping low-angle thrust fault, a strike slip fault and a west-dipping thrust fault. The tectonic relations between the different parts of the fault system and the surrounding geological units are yet to be fully explained. This study aims to reveal the juncture of the northern and central parts of the ISTL and investigate its contribution towards the shaping of the Northern Fossa Magna rift basin. We conducted 3 deployments of 1 or 2 linear arrays of seismic stations across the central and northern ISTL regions and observed local micro-earthquakes for a period of 3 years. Each deployment recorded continuous waveform data for approximately 3 months. Using arrival times of 1193 local earthquakes, we jointly determined earthquake locations and a 3D velocity model, applying the tomography method. We were able to image the regional crustal structures from the surface to a depth of 20 km with a spatial resolution of 5 km. Subsequently, we used the obtained 3D velocity model to relocate the background local seismicity from 2003 to 2009. The juncture of the northern and central parts of the ISTL was well constrained by our results. The depth extension of the northern parts of the ISTL fault segments follows the bottom of the Miocene Northern Fossa Magna rift basin (NFM) and forms an east-dipping low-angle fault. In contrast, the central parts of the ISTL fault segments are estimated to lie along the eastern boundary of the Matsumoto basin forming an oblique strike slip fault.

Keywords: Itoigawa-Shizuoka tectonic line, tomography

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Mapping of active faults in the area around the southern segment of the Itoigawa-Shizuoka Tectonic Line, central Japan

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It is well known that tectonic-related topographic features that develop around active faults record displacements during large-magnitude earthquakes, and that tectonic-related topographic studies are essential for developing a historic and/or paleoseismic perspective of the locations, magnitudes, recurrence intervals, and slip patterns of seismogenic faults. Therefore, it is important to recognize and identify active faults and tectonic-related topographic landform features for studying the present activity of active faults to assess the seismic hazard in a densely populated region.

This study focuses on the mapping of active faults in the area around the southern segment of the Itoigawa-Shizuoka Tectonic Line (ISTL), central Japan. Although previous studies have reported the presence of some active faults in this area, the detail distribution and geometric features of active faults are still unclear. In this study, we identified the active fault traces using perspective maps made from the digital elevation mode (DEM) data with 5-m-contours and stereo-examination of aerial photography and conducted field investigations. Interpretations of perspective topographic maps, field investigations, and structural analysis of fault zones reveal that i) many fault traces are newly found, which formed a deformation zone of up to ~100-500 in width; ii) the active fault traces show more irregular shape than that previously reported, curved around boundary between the mountains and basin, indicating the lower dip-angle thrust fault structures; iii) the active faults developed along the southern sector of the ISTL are found to be extended to the south at least ~25 km longer than that reported previously.

The findings of this study show that the detail mapping of the active faults can provide new insights to study the tectonic activity and fault nature of active faults and to reassess the seismic hazard for the densely populated area around the ISTL.

Keywords: active fault, fault mapping, Itoigawa-Shizuoka Tectonic Line (ISTL), fault trace, fault geometry, thrust fault

SSS34-P16 Room:Poster Time:April 29 18:15-19:30

ESR dating of the Shimotsuburai and Hoozan faults in the Itoigawa-Shizuoka Tectonic Line Active Fault System

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The Shimotsuburai fault, which is located in the south part of the Itoigawa-Shizuoka Tectonic Line (ISTL) Active Fault System, displaces the lower terrace deposits formed at about 20 kaBP. The trenching survey at the Tozawa outcrop revealed that the latest fault movement occurred at 1,550 +or- 70 yBP - 2,350 +or- 60 yBP (Toda et al., 2000). Along the fault plane of the Shimotsuburai fault, black injection veins are distributed forming complex networks and a part of the black veins is injected into the fault gouge or lower terrace deposits. Kano et al. (2004) proposed that this black intrusion veins are crushing-originated pseudotachylyte formed at 30-40m or less in depth at the time of the latest fault movement. On the other hand, the Hoozan fault is distributed about 6km west of the Simotsuburai fault. At the Dondokozawa outcrop, fault gouge is hardly recognized besides cataclasite and mylonite. This suggests that the Hoozan fault may not have moved since its formation in Neogene to early Quaternary, and that the main activity of the ISTL may have shifted to the Simotsuburai fault (Koyama, 1990). The Gofukuji fault located at the northwest extension of the Hoozan and Shimotsuburai faults may cause a Magnitude 8-class large earthquake, and besides its activity may have increased after the 2011 Tohoku-oki earthquake (M9.0). When the Gofukuji fault moves in the future, it is unclear whether or not its southeast extension would also move operating together. It is important to exactly assess the activity of the Hoozan fault as well as the Shimotsuburai fault. We thus carried out XRD (X-ray diffraction) and ESR (electron spin resonance) dating of fault rocks collected from the Shimotsuburai and Hoozan faults.

As a result of XRD analysis, smectite is detected from the Shimotsuburai fault gouge at the Tozawa outcrop, and smectite and a chlorite/smectite (C/S) mixed layer mineral from the black injection vein just on the fault plane, while besides illite chlorite and C/S are respectively detected from the black and gray gouges of the Hoozan fault at the Ishiutoro-gawa outcrop. In general, the formation depth of clay minerals tends to increase in order of smectite, C/S, chlorite and illite. Therefore, the result from the XRD analysis suggests that the Hoozan fault was much more active at deeper positions. As a result of ESR dating, strong signals of the Al and Ti centers are detected from quartz in the Shimotsuburai fault gouge and black injection vein however these centers show the tendency of saturation implying that the resetting by frictional heating did not work. Since the Al and Ti centers can be completely reset at about 300-350 degree C (Fukuchi, 2004), the result from the ESR dating shows that the frictional heat temperature did not rise so much at the time of the latest fault movement. On the other hand, the quartet signals intrinsic to montmorillonite are detected from the gray gouge of the Hoozan fault, and give the age of 2.8-3.2 +or- 0.4 Ma. The chlorite/smectite mixed layer is considered to be formed at about 130-200 degree C (Yoshimura, 2001), so that its formation age may be estimated as 2.2-3.3 Ma assuming the upheaval rate of 2 mm/y and the geothermal gradient of 30 degree C/km. This formation age is consistent with the ESR age obtained from the gray gouge.

References

T. Fukuchi (2004) ESR dating of fault movement, Fukadaken Library 63, 45p.
K. Kano et al. (2004) J. Geol. Soc. Japan, 110, 779-790.
A. Koyama (1990) J. Geosci. Osaka City Univ. 33, 1-47.
S. Toda et al. (2000) Zishin (Bull. Seism. Soc. Japan), 52, 445-468.
T. Yoshimura (2001) Clay Minerals and Alteration, Chigakusosho 32, 293p.

Keywords: electron spin resonance, ESR dating, Itoigawa-Shizuoka Tectonic Line, active fault system, pseudotachylyte, clay mineral

SSS34-P17 Room:Poster Time:April 29 18:15-19:30

The SEM observation on the latest active fault plane - the Atera Fault, Tase, Gifu prefecture-

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To evaluate of seismic activity of fault, we performed mineralogical and morphological studies by SEM on the latest fault plane of the Atera fault. On the results of SEM observation, authigenic minerals do not crystallize on the whole shear planes including the latest active fault plane.

Study area is outcrop along the Tase path, Gifu prefecture (Toda et al., 1994). Granitic rock (hanging wall) is thrusted on the late Quaternary sandy formation including a lot of conglomerate and humus soil layer. The Atera fault consists on gouge: 3 - 20 cm thickness.

There are two light grayish green gouge zones: 3 - 10 cm width each, including dark brownish gouge: about 3mm width. The sharpest share zone, which is straightly brownish gouge, distributes in the gouge of hanging wall side. This gouge continues under the humus soil (440y B.P. Toda et al., 1994). This sharp zone was confirmed by X ray CT observation collected mass samples from the outcrop. Another dark brownish gouge zone runs parallel in the light grayish green gouge zone distributed the footwall side, converged into the sharpest shear zone at the central parts of the outcrop. At the footwall side, clayish sandy sediments were intruded into the light grayish green gouge with ductile deformation toward the left direction.

SEM observation was performed for the whole shear planes to be able to identify. For the dark brownish gouge zone, the observation was performed for the bottom, top, and sharp plane. On the results, authigenic minerals do not crystallize on the whole planes. Clay mineral (smectite) aggregates to form small clay ball (0.2 micron diameter), which covered the small particles as the paste (Kamachi et al., 2014).

Column shape? minerals (halloysite?) only coexist with Mn, Fe elements in the brackish lens zone including rhyolite and hexagonal biotite originating the foundation rock mass of the footwall side.

The results of this study show that authigenic minerals crystallized under the a few hundred degrees (clay and zeolite) do not confirm on the Atera fault plane to active after about 8400y B.P.

Reference; Toda et al.,(1994)Zisin,47,(1994),73-77. Kamachi et al.,(2014)JpGU2014.

Keywords: Atera, fault, latest plane, SEM

SSS34-P18 Room:Poster Time:April 29 18:15-19:30

Sand boiling traces at the Netsuno ruin in Ishikawa Prefecture and the Morimto-Togashi fault zone

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Sand boiling traces detected at an archaeological site provides important information to reveal historical seismicity. In the Bunyudo ruins located at the central part of the Tedori-river fan, Hiramatsu and Kozaka (2013) detected sand boiling traces, which are the evidence of liquefaction, and discussed its relation to the activity of the Morimoto?Togashi fault zone. We report here sand boiling traces detected by an excavation survey of the Netsuno ruin, near the Bunyudo ruins, in 2013.

In the Netsuno ruin, we observe four sand boiling traces on the plane on which traces of vertical caves housing and Tsukikage wares of the late Yayoi period (1800-1900 years ago) were found. The sand boiling traces consist of ash gray sand with a diameter less than 1 mm. The largest trace has the maximum width of 20 cm and the length of about 2 m. This trace extends from a sand layer between a gravel layer and a silt layer located about 50 cm below the plane on which the traces are observed. Furthermore, this trace does not penetrate into a black soil layer above the plane that deposited from the late Yayoi period to the early Heian period. The observed traces are likely to have been covered by the black soil layer after the boiling on the ground surface at the time, implying that the formation age of the traces is from 1800-1900 to about 1100 years ago.

The Togashi fault is located near the Netsuno and the Bunyudo ruins, and, together with the Morimoto and the Nomachi faults, constitutes the Morimoto?Togashi fault zone of which a the total length is 26 km. No active fault has been reported around the Netsuno and the Bunyudo ruins. We, therefore, consider that the sand boil traces detected at these ruins are possibly formed by the activity of the Togashi fault or of the Morimoto?Togashi fault zone. An excavation survey at the Umeda area located at the northern part of the Morimoto fault revealed that a fault movement occurred about 1800-2000 years ago. A ruin where the surface displacement caused by the fault movement was observed is formed in the late Yayoi period. This period is the same as those of the Netsuno and the Bunyudo ruins. We, thus, conclude that the latest event of the Morimoto?Togashi fault zone is likely to be occurred 1800-1900 years ago.

Keywords: strong motion, the Morimto-Togashi fault zone, liquefaction, geopark

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Offshore active faults of the Mikata and Nosaka fault zones in Fukui Prefecture, revealed by high-resolution seismic pro

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The Mikata and Nosaka fault zones are located in coastal and shallow sea area off Mihama, Fukui Prefecture. National Institute of Advanced Industrial Science and Technology (AIST) and Tokai University conducted, as part of MEXT 2013 nearshore active fault survey project, a high-resolution multi-channel seismic survey using Boomer and a 12-channel streamer cable, acoustic profiling survey using parametric sub-bottom profiler and shallow-sea drilling survey, in order to clarify distribution and activity of the Mikata and Nosaka fault zones. We present mainly about the results of the high-resolution multi-channel seismic survey.

The most remarkable reflection surface in the seismic profiles is the ravinement surface that truncated evenly the lower sediment. Holocene sediments cover this surface and the sediments become thinner toward offshore.

In seismic profiles across the fault zones, flexure-like deformation in the Holocene sediments continue in the N-S direction in the Mikata fault zone and in the NW-SE direction in the Nosaka fault zone along faults shown by Komatsubara et al. (2000). The deformation in the Holocene sediments has been growing by displacements of an underlying active fault. The vertical offset of the flexure on the ravinement surface is larger than those on other reflectors in the sediments covering the ravinement surface and these offsets decrease upward. This growing deformation indicates that faults are reactivated several times in the last 10000 years. At the Mikata fault zone, vertical displacement of ravinement surface is about 11 meters. Based on the formation age of the ravinement surface presumed by sea level change in the world, we estimate the mean vertical slip rate at about 0.9 m/ky. On the other hand, at the Nosaka fault zone, vertical displacement of the erosional surface is about 8 meters. We obtained core samples reaching to the erosional surface at the Nosaka fault zone. We will compare in detail the seismic profiles with sedimentation ages obtained from the cores, in order to estimate vertical slip rate of the Nosaka fault zone. Event history, latest event and slip rate of the Mikata and Nosaka fault zones are further examined, incorporated with advanced analysis of seismic survey data and core samples.

Keywords: Offshore active fault, the Mikata fault zone, the Nosaka fault zone, high-resolution seismic survey, Event history

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Offshore active fault survey ”Mikata fault and Nosaka fault zones”. Result of high-resolution stratigraphic survey.

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The 26km long Mikata fault zone is extending from Kaminaka to Wakasa Bay. The fault zone consists of fault A, Hiruga fault, Mikata fault and Kuramitouge fault. The fault zone is estimated to cause M7.2 earthquakes (The Headquarters for Earthquake Research Promotion, 2002).

The 31km long Nosaka fault zone is extending from Nosaka Mountains to the Wakasa Bay. This fault zone consists of fault B, Nosaka fault and Nosaka southern fault. FaultB displaced the Holocene deposits and the vertical displacement rate is estimated to be about 0.8m/thousand years which are proposed by The Headquarters for Earthquake Research Promotion, 2002. Mikata fault and Nosaka fault zones show horizontal converges a single fault in the continental shelf.

Tokai University performed high-resolution stratigraphic survey to confirm a formation, distribution, and displacement of crust around the coastal area of the Mikata fault and Nosaka fault zones at Wakasa Bay in 2013. Transparent layer with poor internal reflection was observed as the surface layer in this survey area. This transparent layer is defined to as layer A. Layer A is ranges in thickness between 8 and 0 meter generally increase toward west. Displacement of the layer A is about 10m in most. Below layer A, sediments characterized by several reflections. First, we confirmed tilted reflection toward the Nosaka fault in the faults horizontal convergence section. Second, we confirmed progradation pattern reflection inclines to the offshore in the around Mikata fault.

Mikata fault and Nosaka fault are represented as a significant step in the seabed. The west side layer A is thicker than others. In the layer A, faults have not displaced surface sediments in this region. But several characteristic formations are which shows activities of fault has confirmed in sediments below layer A. The analysis still going on, the studies including the boring data will show more detail.

Keywords: Wakasa Bay, Mikata fault zone, Nosaka fault zone

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Drilling survey of the seaward extension of the Mikata and Nosaka fault zones off Mihama Town, Fukui Prefecture

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AIST and Tokai University conducted, as part of MEXT 2013 nearshore active fault survey project, high-resolution acoustic reflection surveys and shallow-sea drilling survey across the Mikata and Nosaka fault zones off Mihama Town, Fukui Prefecture. We present the major results of the drilling survey. For the N-S-trending Mikata reverse fault zone, a 4-m-deep core was extracted from the 51-m-deep sea bottom on the western (downthrown) side. For the NW-trending Nosaka strike-slip fault with a reverse component, 27m- and 12m-deep cores were obtained from the 12m-deep sea on the SW (downthrown) and NE (upthrown) sides, respectively. We compiled geologic columns at scale of 1: 10 and conducted magnetic susceptibility measurement, radiocarbon dating, volcanic ash analysis, and diatom and pollen analyses.

Regarding the Mikata fault zone, obtained radiocarbon ages are proportional to the depth, reaching 6,180 to 6,010 and 6,380 to 6,260 cal.yBP at a depth of 3.8m. The average sedimentation rate during the recent 6ky is calculated at 0.6 m/ky. Acoustic reflection surveys have revealed several continuous reflection surfaces displaced by the fault, including the probable base of the postglacial deposits. We are trying to identify faulting-event horizons, using height difference of each reflection surface across the fault. Because drilling survey was unable to determine the age of each reflection surface, we are making efforts to estimate them, extrapolating possible depth-age curves of the postglacial deposits.

The deposits extracted from the both sides of the Nosaka fault zone are divided into the following stratigraphic units based on lithofacies and radiocarbon ages: A1 (<ca.6ka), A2 (ca.6-7.3ka), A3 (ca.7.3-7.5ka), B1 and B2 (ca.7.5-8ka), C (ca.8-10ka) and D intercalating 30-ky-old AT tephra. A1 is subdivided into the upper part (<ca.4ka) and the lower part (ca.5.5-6ka). While the basal surface of B2 shows 5m height difference across the fault, that of the lower A1 represents 1.7m difference across the fault. The lower A1 also shows drastic change in thickness from 1.1 m on the downthrown side to 0.2 m on the upthrown side. These suggest that faulting occurred twice; in the periods post-C/pre-A (8-6ka) and post-lower A1/pre-upper A1(ca.5.5-4ka). Faulting history and slip per event are further examined, incorporated with analyses of acoustic reflection survey data.

Keywords: Mikata fault, Nosaka fault, active fault, acoustic reflection survey, sea drilling

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The fault gouge along the Ikoma active fault zone

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The characteristic of the topography of Middle Kinki is reflected as an alternation arrangement of a mountainous district and the basin of north-south characteristics. Ikoma mountains share the Osaka plain and the Nara Basin. The NNE-SSW-N-S trending Ikoma active fault zone is recognized as a high-angle reverse fault under the E-W compressional stress field in the Quaternary Japan. However, from the rock mechanics point of view, high-angle fault is favorable as normal fault formed under extensional stress regime. The high-angle reverse faults may be resulted from the reactivation of the high-angle normal faults (inversion tectonics). In this study, we examined some fault gouge zones along the Ikoma fault zone (Katano and Ikoma faults).

We found three fresh outcrops of mesoscopic fault zones developed along the Ikoma fault zone at Kuraji of Katano City, Kiyotaki of Shijonawate City and Iimoriyama of Shijonawate City. In these fault zones, fault gouge wit the width of 5-20 cm can be observed. We collected some oriented samples and made thin sections parallel to the striation and normal to the fault plane. In the samples, many dark seams develop parallel to the main fault plane (striation) to form a distinct foliation within the fault gouges. Many fragments with various sizes are observed and their long axis aligned oblique to the fault plane. The parts where edges of the fragments meet the dark seam the edges tends to be rounded, suggesting that the formation of the dark seam was associated with material transportation due to pressure solution. The fragments with high aspect ratios tend to align oblique to the fault plane, suggesting the rigid-body rotation caused by non-coaxial shear deformation. The asymmetric structures, i.e., preferential orientation of the long axis of fragments, drag folds and shear lenses indicate the top-down-sense-of-shear. Furthermore, fractal dimensions of the fragments in samples near the main fault plane are higher than in samples at the margin of the fault gouge.

Consequently, we found the lines of evidence indicative of normal fault movement in the fault gouges associated with the Ikoma active fault zone, suggesting that the N-S striking Ikoma fault zone is recognized as a high-angle reverse fault under the E-W compressional stress regime are of reactivation of the preexisting high-angle normal faults that may be formed under extensional stress field.

Keywords: Ikoma fault zone, active fault, tectonic inversion, fault gouge, internal structures, fracture zone

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Subsurface density structure in Southern Osaka Plain based on gravity and magnetic anomalies

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Geomorphological, geological and geophysical surveys have been carried out in the Osaka plain for the highly precise construction of a model to predict strong ground motion. In recent years, many seismic surveys were performed in the south of the plain. The outline of the basement configuration was estimated from the relationship between gravity anomaly and the depth of the basement. The depth of the basement inferred from the gravity anomaly was shallower than that from the seismic and micro tremor surveys at several points in the Osaka plain. The difference is considered the variation of density contrast due to some local distribution of the volcanic rocks. The magnetic anomaly indicates higher value at these points. The density structure was discussed from the gravity anomaly in consideration of the high magnetic anomaly area.

Keywords: gravity anomaly, magnetic anomaly, density structure, Osaka plain

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Age and horizontal offset of the latest faulting event on the Okamura fault of the MTL fault zone in central Shikoku

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In general, information about fault offsets along active faults is one of the important factors to estimate faulting behavior in seismogenic zones. However, it is challenging to determine the information about fault offsets. So far, the average slip-rate and the amount of a single-event offset are obtained only 30 and 6 points on the Median Tectonic Line active fault zone (MTLAFZ) in the Shikoku area (200 km-length), respectively (Tsutsumi and Goto, 2006).

We conducted a trench survey for the Okamura fault which is a part of the MTLAFZ in order to determine the latest faulting event age and the fault offset. The Okamura fault is distributed in a rage of 30 km on the central Shikoku. The survey point, Hagioi point, locates on a central part of the Okamura fault. The amount of the fault offset at the latest faulting event is estimated to be below 5.7 m (Tsutsumi et al., 1991). However, this is just one data about fault offset on the Okamura fault. Moreover, the latest event age of the Okamura fault has not been sufficiently constrained by some previous research results; 4-7th century (Okada et al., 1998), 1090-960 yBP (Ehime Prefecture, 1999) and after 16th century (Goto et al., 2001).

The main two results of this trench survey are as fallowing. The latest faulting event age is estimated to be after AD 1490, consisting with after 16th reported in Goto et al. (2001). Moreover, the amount of fault displacement at the latest faulting event is estimated to be below 7.5 m. This value is consistent with the trend of the surface offset information that the surface slip associated with the latest event is greater than 5 m between the Zunden and Okamura faults, and decrease gradually to the east and west.

In taking hypothetical consideration, the fault offset 7.5 m is greater than 5.7 m (Tsutsumi et al., 1991) at 5 km away from this survey site. The recurrence interval (938-1500 years) calculated on the basis of average slip rate (5-8 mm/y) and the fault offset 7.5 m is consistent with the value (1245-1620 years) from the paleoseismological data (Morino and Okada, 2002; Okada et al., 1998). Therefore, the survey result might indicate variety of fault offsets along the Okamura fault, however this fault offset 7.5 m contains estimation errors. Since the fault offset becoming larger toward the fault end is unreasonable, this survey site might not locate on near the end of the Okamura fault and but near the asperity region.

Keywords: latest faulting event age, fault offset, Median Tectonic Line active fault zone, Okamura fault

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Seafloor exploration at off Kochi Prefecture for coseismic subsidence during hysterical Nankai earthquakes

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Paleoseismic trenching study and tsunami deposit analysis on land has been performed to understand the historical earthquakes and the scale of disasters caused by the earthquakes. Paleoseismic records are probably stored in seafloor sediments near the coast as well, though the seafloor researches were rarely performed.

In ancient documents, the great Hakuho Earthquake (684 A.D.), that had been classified a Nankai earthquake, had caused large subsidence near the coast and submerged a small village named "**Kuroda-gori**". In addition that, ancient artificial buildings and artifacts were found at off Kochi Prefecture from Aki city to Cape Ashizuri cape. However the relationship between the ancient foundation and the historical Nankai earthquake is not well understood.

Here, we investigate the seafloor foundation at off Kochi Prefecture based on marine seismic profiling and diving. We collect artifacts and sediment core samples from seafloors, and perform chemical and age analyses using them. We then evaluate the coseismic uplift and subsidence process and a magnitude scale of earthquake during paleo-Nankai earthquakes. We begin seafloor exploration at two sites, off-Tochi site and Nomi bay site in Kochi area. We introduce preliminary results of seafloor research on March 2014 and our future plan.

Acknowledgement
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Keywords: Hakuho earthquake, earthquake foundation, Nankai Trough earthquake, coseismic uplift and subsidence

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Fault activity of the Kokura-higashi fault and the Fukuchiyama fault zone in northern Kyushu Island, Japan

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The Kokura-higashi fault is an active fault extending in NNE-SSW direction with west-side-up vertical displacement. The Fukuchiyama fault zone consists of the Tonda and Fukuchiyama faults extending in NNW-SSE direction with also west-side-up vertical displacement. Both are located in the northern Kyushu Island. The Earthquake Research Committee evaluated that the probability of the earthquake occurrence in the future on the Kokura-higashi fault and the Fukuchiyama fault zone are unknown or ambiguous because of the luck of paleoseismological data. We carried out a trench excavation study and boring surveys in four sites with total 20 cores on these faults.

A trench is excavated across a reverse scarplet along the estimated fault trace of the Tonda fault in the Fukuchiyama fault zone. On the trench wall, steeply inclined sandstone and mudstone of the Paleogene Ashiya Group and overlaid gravel and silt layers are cropped out. However, no clear fault is observed in between bedrocks and sediments.

Based on arrayed boring surveys at the Shii and Shindoji site on the Kokura-higashi fault, a few meters differences in depth of the bedrocks are recognized.

Faults are observed in the cores from the arrayed boring surveys at the Ikeda and Horita sites on the Fukuchiyama fault zone.

Keywords: Kokura-higashi fault, Fukuchiyama fault, Tonda fault, Fukuoka Prefecture, Kyushu Island, active fault

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Revised fault model of the 1771 Yaeyama tsunami, southwest Ryukyu

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The 1771 Yaeyama tsunami (Meiwa tsunami) has been the largest and devastating tsunami in the Ryukyu Trench since about 300 years. The maximum runup height was about 30 m and 12000 people were dead by the tsunami. Although this tsunami is important for estimating the maximum tsunami in the Ryukyu Trench, the fault model has been unsolved. Then we estimated the source fault model of this tsunami.

(1) The maximum runup heights were 30 m near the southeast coast of Ishigaki Island, 15 m at Tarama Island, 15 m at Irabu Island, and 18 m at south coast of Miyako Island (Goto et al., 2011). The runup height at south coast of Miyako Island was estimated to 10.5 m from the old document "Kyuyo". However, folklore (Goto et al., 2011) and the inundation area estimated from the old document "Otoegaki" (Kato, 1988) showed the runup height were about 20 m.

(2) Tarama Island is formed by the coral middle terrace at the height of 10-14 m. The tsunami reached at the villages (Nakasuji and Shiokawsa) which were located at the center-to-north of the Island. The estimated runup heights in these villages were about 15 m. Since the hill, whose height is 30 m, is located at the north of the villages, the tsunami will have inundated about 1.5-3.0 km from the south or east coast. Shimoji Island is also formed by the middle coral terrace at the height of 10-20 m. Although the Island was uninhabited at that time, the terrace was inundated by the tsunami, and the soil was stripped by the tsunami inundation, and cattle and domestic animals drown by the inundation (Shimajiri, 1988). These suggest that the wide area of the Tarama and Shimoji Island are inundated by the tsunami.

Using these data, we re-construct the fault model of this tsunami. We employed intraplate earthquake and landslide (Miyazawa et al., 2012), interplate earthquake (Nakamura, 2009), and splay fault (Hsu et al., 2013) models.

First, in the case of intraplate earthquake and landslide model, calculated runup heights were consistent with the observed ones. However, the calculated inundation area is limited within about 500 m from the shore at Tarama Island.

In the case of splay fault model, we set the western part of fault at the 125.5E based on Hsu et al. (2013). The calculated tsunami heights were smaller than the observed in the Ishigaki Island. The inundation area is limited within 500 m from the shore at Tarama Island.

Finally, we set the interplate earthquake model, which is revised the model of Nakamura (2009). We set the fault length, width, slip, and dip to 200 km, 70 km, 20 m, and 12 degrees, respectively (Mw8.6). In this case, the calculated runup heights were almost consistent with the observed ones except southeast coast of Ishigaki Island. The calculated inundation area is 1.5 km from the shore at Tarama Island. Then we added the local patch at the south of Ishigaki Island. The length, width, and slip of the patch is 40 km, 30 km, and 40 m (total Mw=8.7). Then we could reproduce the observed runup heights.

Keywords: tsunami, Ryukyu Trench, interplate earthquake, historical tsunami

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Systematical deflections and offsets of stream channels along the left-lateral strike-slip Kunlun Fault

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During the past two decades, the integration of geologic, geomorphic, seismic, and geophysical information has led to increased recognition and understanding of the tectonic significance of geomorphic features caused by strike-slip along active strike-slip faults. Tectonic landforms developed along active strike-slip faults are mainly characterized by systematic deflections and offsets of streams which are regarded as reliable displacement markers useful for reconstructing the long-term activity of active faults. It has been demonstrated that stream offsets have resulted from repeated large strike-slip earthquakes. The study of tectonic geomorphology will provide a new insight into the seismic activity, longevity and structural evolution of active strike-slip faults.

The Kunlun Fault is a typical active strike-slip fault zone extends for ˜1200 km in the northern Tibetan Plateau that has triggered the 2001 Mw 7.8 Kunlun great earthquake. In this study, we present evidence for the systematical sinistral deflection and/or offset of the stream channels and valleys of the upper Yellow River drainage along the eastern intramontane segment of ˜400 km of the fault zone. Topographic analysis of 3D perspective images constructed using Digital Elevation Model (DEM) data, high resolution Google Earth images and 15-m-resolution Landsat Enhanced Thematic Mapper (ETM+) images reveals the following: (i) various amounts of sinistral offset have accumulated on the tributary stream channels, valleys, and gullies of the upper Yellow River; (ii) the eastern intramontane segment of Kunlun fault accumulated sinistral offset amount for at least 12 km; (iii) the linear relationship between the between the accumulated offset amount and the upstream length from the deflected point to valley head of the stream involved can be reliable indicator of long-term slip rate.

The findings of this study support that the Kunlun Fault is a left-lateral strike-slip that partitions deformation into the eastward extrusion of the Tibetan Plateau to accommodate the continuing penetration of the Indian plate into the Eurasian plate.

Keywords: Kunlun Fault, left-lateral strike-slip fault, stream channel, systematical deflection, Tibetan Plateau, eastward extrusion