Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-01 Room:302 Time:May 24 14:15-14:30

Manganese concentration in the latest slip plane of the Neodani fault zone

Ryosuke Kutsuna[1], Tomoyuki Ohtani[1*], Satoru Kojima[1], Masaki Enami[2], Kazuhiko Kakamu[3], Shoji Wakai[3]

[1]Gifu University, [2]Nagoya University, [3]JAEA

Occurrence, mineral assemblage and chemical composition of the fault gouges in the Neodani fault zone are studied to clarify the characteristics of the slip plane ruptured during the 1891 Nobi earthquake. Studied sites are Midori and Osso at Neo region of Motosu city in Gifu prefecture. Midori is at the site of 6m vertical displacement in the 1891 earthquake, and the trench site has been opened to the public as the Seismic faults observation and experience house. Samples collected from this site are studied. Osso is 1km away from the site (Naka) of 8m displacement in the 1891 earthquake, and probably ruptured during the 1891 earthquake from the trace of surface rupture. Fault exposure appeared by the road construction is studied. At both sites, fault plane is subvertical, and the Jurassic accretionary complex of Mino belt in the northeast side is bounded by the terrace deposit in southwest side. The accretionary complex of Mino belt contains the matrix of mudstone and blocks of greenstone and chert. At Midori, the surface displacement of the 1891 earthquake is equal to the displacement of the basement rocks, suggesting that the boundary of fault gouge and terrace deposit is slipped during the 1891 earthquake. At Osso, the fault gouge zone with a thickness of 3cm is developed, and divided into 3 different fault gouges based on their color. Brown fault gouge zone is inferred to be the rupture zone of the 1891 earthquake according to the cutting relationship.

X-ray fluorescence (XRF) and powder X-ray diffraction (XRD) analyses of 9 samples from Midori and 8 samples from Osso were performed. As enough amount of samples is collected at Osso, thin section observation, SEM observation and EPMA analysis are also performed. The results of XRF analysis shows MnO concentration at the fault gouge zones. At Osso, 3 kinds of fault gouges are divided into mudstone and greenstone origins based on SiO2, MgO and CaO contents. MnO content in the brown fault gouge of mudstone origin is 4 times greater than the origin of this fault gouge. The results of XRD show the precipitation of smectite and break down of plagioclase in the fault gouges. Manganese bearing minerals are not detected by XRD. Microstructure of the brown fault gouge shows that the fragments of quartz and greenstone are surrounded by brown material. These fragments with brown material are observed in section using SEM-EDX. SEM observation shows that manganese concentrates at the margin of fragments. EPMA analysis of these fragments clarified that Ba is concentrated with manganese, and Fe is not.

Generally, manganese is dissolved in the ground water, and is precipitated under oxidic condition. Basically, fault gouge is not permeable due to clay minerals. But the rupturing during earthquakes may temporally increase the permeability of fault gouges. If ground water flows from underground reductive condition to subsurface oxidic ones, manganese will be precipitated. Manganese concentration in the fault gouges may indicate fault gouges with manganese are ruptured recently. The occurrence of manganese is similar to the oceanic manganese nodules. But their growth rate is very slow (1mm/100 thousand year). Slip and/or frictional heating of fault may reflect to the manganese growth rate.

Keywords: Neodani fault, fault zone, latest slip plane, manganese concentration

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-02 Room:302 Time:May 24 14:30-14:45

Frictional property of earthquake rupture surfaces in soft basement rock

Yasuto Kuwahara[1*], Tadashi Maruyama[1]

[1]AIST, GSJ

Frictional properties of earthquake rupture surfaces were examined in laboratory experiments to obtain a fundamental data for probing causes of variability of surface slips on an identical active fault accompanied by repeated large earthquakes.

A surface slip of a few tens cm on an active fault was associated with the 2008 Mw 6.9 Iwate-Miyagi inland earthquake, while paleoseismic trench studies on the identical fault reveal past earthquakes with a substantially larger slip of about 2 m (Maruyama et al., 2010). The 2004 Mw 6.6 Mid-Niigata earthquake also showed such variability of surface slips: a small surface slip of about 20 cm on an active fault was associated with the 2004 earthquake, while a trench survey reveals a large slip of about 2 m with a past earthquake on the identical fault. Such a variability of surface slips on active faults poses a major issue in assessing earthquake hazard based on active fault evaluations, because the variability leads an underestimation of a repetition of past earthquakes.

Rock samples of lapilli tuff involving earthquake faults and intact rock samples from its hanging wall and footwall were hewed out from a trench wall exposed for the paleoearthquake study in the source region of the 2008 Iwate-Miyagi inland earthquake. A density, a porosity, P- and S-wave velocities of the these samples are about 1.6 g/cm^3, 50 %, 1.7 km/s, and 0.3 km/s, respectively. Box shear and triaxial compression methods were adopted to measure frictional coefficients (FC) and cohesive stresses (CS) of the earthquake faults and compressional strengths of the intact rock samples. Normal stresses and confining pressures for both the tests are given at 0.1-0.6 MPa and 0.1-0.4 MPa, respectively. Additionally, reciprocating slips were repeatedly applied to the earthquake fault sample in the box shear test in order to emulate a large slip up to 1 m of an actual earthquake.

Experimental results are summarized as follows:

1) FC and CS of the sample from earthquake faults are 0.27-0.38, and 14-64kPa, respectively. The frictional coefficients are much less than the standard FC 0.85 of hard rocks under low normal stresses (Byerlee, 1978).

2) FC and CS of the samples from both the hanging wall and footwall rocks are about 0.2 and 200 kPa, respectively. The cohesive stresses of these rocks are, thus, much larger than those of the earthquake fault.

3) Repeated sliding test for emulating a large slip suggests that frictional strength is not largely depend on the slip amount.

4) Compressional strengths of the hanging wall and footwall rocks are almost the same: Internal frictional coefficients (IFC) of both the rocks are about 0.8. A large difference of IFC and FC from the above result 2) is likely caused by a difference of fracturing mechanisms involved in the two different test methods.

Keywords: surface earthquake fault, variability of surface slip, frictional property, box shear test

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-03 Room:302 Time:May 24 14:45-15:00

Estimate of fault angle about Isehara fault by computer simulation which use CIP method

Koichi Ando[1*], Haruo Yamazaki[1]

[1]Tokyo Metropolitan University

Isehara fault is reverse fault which exist in north east shore of Tanzawa mountainous region.
Isehara fault is parallel with Fusinoki-Aikawa line which is a boundary of Pre Neogene and Neogene (Research Group for Active Faults of Japan 1991).
Isehara fault length is 20 km.
Isehara fault is concealed active fault and appearing flexure at ground surface.
Cover layer thickness from bed rock is 35m that is estimated by drill core data at Miyasita Isehara city near Isehara fault (Takeda et.al. 2003).
Most upper region of cover layer consist of loam and under region of cover layer consist of gravel and sand.
Assuming that connect fault scarp and fault surface that is confirmed by drill core, fault angle is about 40 degree.
But, Isehara fault angle is 50-60 degree that is estimeted by reflection seismic survey (Kanagawa prefecture 1996).
This difference is according to Isehara fault's fault angle become the smaller at near ground surface (Takeda et.al. 2003).

Therefore, Isehara fault's fault angel is uncertain.
In this study, we conduct two-dimensional computer simulations assuming that a covering layer on the bedrock is cut perpendicular to the fault line, and we setimate the fault angle at bed rock for Isehara fault.
In this study, the covering layer is considered to be not an elastic medium but a Bingham fluid. Therefore, its consist of sand and gravel.
We use the constrained interpolation profile (CIP) method to calculate the Bingham fluid.
The CIP method is a type of difference method.
A function and differentiation of function use to advect function for CIP method.
As a result, CIP method succeed with reducing numerical diffusion that is fault of difference method.
The CIP method have advantages which is possible calculate large deformaton and division of layer by the faulting.

We attempt to simulations which is running by changing fault angle, maximum fault slip rate and unit displacements.
We surch parameters which can reproduce fault flexure of Isehara fault.
As a result, we discovered that fault angle is 30 degree, maximum fault slip rate is 0.5 m/s and unit displacements is 3.0 m.
This fault angle is different from previous study value.
This difference is according to Isehara fault's fault angle become the smaller at near ground surface (Takeda et.al. 2003).

Keywords: active fault, Isehara fault, fault flexure, simulation, CIP method, fault parameters

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-04 Room:302 Time:May 24 15:00-15:15

Late Holocene faulting along the Sarobetsu fault zone in northern Hokkaido, Japan

Sunao Ohtsu[1*], Gentaro Kawakami[1], Kenji Nishina[1], Makoto Tamura[1]

[1]Geol. Surv. Hokkaido

Detailed mapping based on LiDAR by Ministry of the Environment, analysis of morpho-sedimentary units, and radiocarbon dating of the prograding beach-ridge complex of the Teshio Lowland in northern Hokkaido allow the differentiation of six prograding units. These are called: III-VII, 6000-4650 yBP; VIII, 4650-2190 yBP; IX, 2190yBP-Present. Theses units are deposited during periods of high relative sea level.

Longitudinal profiles of swales parallel to shoreline, show southward titling of the beach-ridge plain. The relative heights between the northern and southern end of the profiles are 6.5m (III-VII), 1.5-1.7m (VIII), and 1.4m (IX). These differences seem to be caused by coseismic coastal uplift due to the active blind thrust fault, the Sarobetsu fault zone.

Keywords: the Sarobetsu fault zone, late Holocene faulting, beach ridges

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-05 Room:302 Time:May 24 15:15-15:30

Estimation of ground movement of the Iwate-Miyagi Nairiku Earthquake 2008, from the Geomorphic Image Analysis of LiDAR D

Sakae Mukoyama[1*], Norichika Asada[1]

[1]Kokusai Kogyo Co., Ltd.

In the previous work, authors developed the new method to estimate the ground deformation of 1m order quantitatively and easily used high resolution periodical DEM, applied the technique of the image matching analysis - Patent No.4545219. And we showed the result of measurement of displacement of the mass movement due to the earthquake with high accuracy by using this technique. In the present study, we applied the same technique to the area of about 20km2 where the surface rupture appeared due to Iwate - Miyagi Nairiku Earthquake 2008, and tried the extraction of wide area ground deformation.

The topographical data used in this research is two times of 2mDEM by the Airborne laser survey immediately after the disaster in June 2008, and September 2006. The slope angle map where the angle of gradient in the grid point had been shown by gray- scale was used for the digital geomorphological image used for the image analysis. The software improved to use MPIV described with MATLAB for three dimensional analyses was used for the image matching. When 2mDEM is used, the displacement magnitude that can be extracted by the digital geomorphological image matching is about the 1/10 grid size or more.

As a result of the investigation, 0-0.8m upheaval tendency to the rise on the west side was admitted in the entire region. And, the tendency of horizontally shortening of the surface by displacement for the eastward and for the westward was admitted. Moreover, a lot of small area where the direction of the movement was different was found, and the displacement magnitude in each small area was 0.2- 1m. The sites where the ground surface displacement was found by existing investigations are corresponding to the places where the direction and the magnitude of displacement of the ground change suddenly. Especially, the site Okayama where low cliff of westward up was formed is located in the collision zone of the displacement of the direction of east and west. In addition, the direction of displacement is greatly different in both shores along Ubusume River.

In conclusion, it is presumed that surface of the ground had been divided into the small blocks, and each block moved independently and minutely due to the earthquake. It is thought that the shape of the each block reflects the geological structure of underground. And it is thought that remarkable deformation of ground surface appeared in the zone where the direction and magnitude of displacement change suddenly. In the future, an unconfirmed surface deformation may be discovered in the area where a big distortion is assumed.

Keywords: active fault, DEM

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-06 Room:302 Time:May 24 15:30-15:45

Late Holocene fault scarps and activity of the Kozu-Matsuda fault

Tatsuya Ishiyama[1*], Masami Togo[2], Toshifumi Imaizumi[3], Takehiko Suzuki[4], Takahiro Miyauchi[5], Hiroshi Sato[1], Takashi Hosoya[6], Tomoo Hashimoto[6]

[1]ERI, University of Tokyo, [2]Hosei University, [3]Tohoku University, [4]Tokyo Metropolitan University, [5]Chiba University, [6]Chuo Kaihatsu Corporation

We show new evidence for active tectonics of Tokyo metropolitan area by use of actively deforming landforms, Quaternary stratigraphy, and shallow to deep seismic reflection data tied with these stratigraphic constraints, resolving otherwise elusive blind thrust structures beneath highly urbanized areas. At the leading edge of the subducting Philippine Sea plate beneath the Kanto region, most significant active structures are recognized as active folding and/or faulting of Holocene and late Pleistocene fluvial and marine deposits above emergent splay thrust faults extending from a subduction megathrust that generated the 1923 Kanto earthquake (M7.9). In particular, fault scarps above the splay fault are interpreted as formed during historic earthquakes based on stratigraphy and trench excavations.

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-07 Room:302 Time:May 24 15:45-16:00

Coseismic subsidence recorded in the Holocene of the Nobi plain and activity of the Yoro fault system

Yuichi Niwa[1*], Toshihiko Sugai[1]

[1]Environmental Studies, KFS, UT

The Nobi plain has been tilting down toward the west, subsiding at mean rates of 1 m/kyr, as the result of faulting on the Yoro fault system, fringing the margin of the plain (Sugai and Sugiyama, 1999).

The upper Holocene of the Nobi plain is represented by a prograding delta sequence formed on the footwall side of the Yoro fault system. On the basis of analyses of six drilling cores and 46 ^{14}C ages from the Nobi plain, vertical changes of sedimentary facies, grain size distribution and Electronic Conductivity (EC) value of sediment samples suggest that temporal relative sea-level rise occurred around 500, 1200, 1000 to 4300, 4000, and 4700 to 5600 years ago(Niwa et al., 2009; 2010). Niwa et al. (in press) also detected river channel change to west and temporal relative sea-level rise about 1600 to 2700 years ago based on analyses of uppermost Holocene sequence of the Nobi plain and 35 14C ages. Synchronicity of events and trend of relative-sea level lowering during middle to late Holocene to the influence of eustasy and hydroisostasy indicates that cause of these relative sea-level rise events can be coseismic subsidence along the Yoro fault.

The above-mentioned subsidence events broadly correspond with previously known faulting events at the Kuwana fault to the south of the Yoro fault. These results are consistent with the notion that the Yoro and Kuwana faults comprise a behavioral segment in the Yoro fault system (Sugai et al., 1999).

References

Niwa et al. (2009) The Quaternary Research (Japan), 48, 339 ? 349.
Niwa et al. (2010) Journal of Geography, 119, 668 ? 682.
Niwa et al. (in press) Transactions, Japanese Geomorphological Union.
Sugai and Sugiyama (1999) Geological Survey of Japan Interim Report, EQ/99/3, 69 ? 76.
Sugai et al. (1999) Geological Survey of Japan Interim Report, EQ/99/3, 77 ? 87.

Keywords: Holocene, coseismic subsidence, Nobi plain, Yoro fault system, ^{14}C age

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-08 Room:302 Time:May 24 16:00-16:15

Analyses of GPR and bed-distribution discontinuity along the Wadamisaki fault in the mouth of the Togagawa River, Kobe

Takao Miyata[1*], Asano, Yuri[2]

[1]Graduate School of Science, Kobe Univers, [2]Faculty of Science, Kobe University

Active faults are well known in the northern Osaka Bay and the Rokko Mountains. However, the fault linkage between the two areas is not yet known, except for the Gosukebashi fault. Hitherto, we analyzed the bed-distribution discontinuity for the marine Ma 13 bed (Holocene) using the database, Kobe JIBANKUN (Kobe City), in order to grasp a hidden fault in the mouth of the Togagawa River, Kobe. In addition, we curried out the ground-penetrating radar (GPR) investigation along three survey lines in the mouth of the Togagawa River, Kobe, showing the discontinuity of the Ma13 bed.

Detection of an anomalous reflector was found along the three GPR survey lines in the mouth of the Togagawa River. This result is well consistent with that from discontinuity analysis of the Ma13-bed distribution. This anomalous part distributes along two lines; one corresponds to the Wadamisaki fault, and the other can be interpreted as a hidden fault branching from the Wadamisaki fault. Therefore a combined use of the GPR and discontinuity analysis of bed distribution is very useful for grasping a hidden fault in the urban area of a mega-city.

Keywords: Ground-penetrating Radar Survey, discontinuity analysis of bed distribution, hidden fault, Wadamisaki faut, Ma13 marine bed (Holocene), Togagawa River, Kobe

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-09 Room:302 Time:May 24 16:30-16:45

Acoustic prospecting for the seaward extension of Kurehayama faults in Toyama Bay, central Japan

Akira Takeuchi[1*], Tetsuo No[2], Shigekazu Kusumoto[1], Tohru Watanabe[1]

[1]University of Toyama, Graduate School, [2]JAMSTEC

The southern Kurehayama fault-belt depicts the east margin of Imizu Hill and the central and northern parts are located on the Kurehayama hill which divides Imizu plains and Toyama plains (narrow sense). The latter hill is regarded as a tectono-morphological features by the Pleistocene fault-related fold of the Kurehayama fault (Yasuda Anticline). It is an asymmetric anticline with a low angle limb on the northwest, although the anticlinal axis and its southeast limb are eroded out by Ida-gawa and Jinzu-gawa rivers in the central belt. According to the previous data from geophysical exploration, the anticline is buried beneath the downtown Toyama city in Toyama plain. It was expected that the fault belt extends into the Iwase spur in front of Iwase and Mizuhashi towns, coastal Toyama Bay (Toyama Prefecture 1997).

The sea-bottom sounding was executed in the Toyama Bay aiming to acquire information on the grasp of an accurate position, shape and activity of the in the seaward section of the Kurehayama fault belt as part of consignment business ”Active fault survey in the nearshore waters” from the Ministry of Education, Culture, Sports, Science and Technology to National Institute of Advanced Industrial Science and Technology.

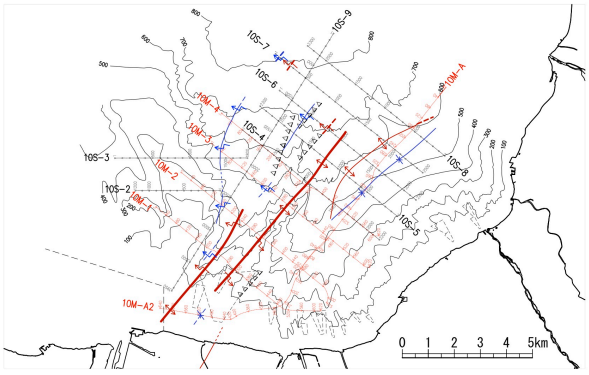
The target area is located in front sea area put from Toyama City to Uozu City, and the profiling lines were arranged in order to locatie the northernmost tip of the fault and to specify the strike of the assumed extension part, that is the Hamakurosaki spur, in a parallel and an orthogonal directions. The offshore operation including the trial run conducted 8 single channeled lines and 6 multichanneled lines from July 30 to August 7, 2010, acquiring seismic profiles of about 80km in the total extension.

In the prospecting line 10M-1 along the coast, the westerly dipping high-angle reverse fault of 700m in depth is presumable and also a buried fault-scarp in the shallower depths was interpreted. In addition, an anticline exists adjacent to the fault west side in this line, and is traceable to the entire Hamakurosaki spur (From 10M-A2 to 10M-4).

Based on discontinuity of the reflectors, a reverse fault more than 45 degrees in the dip angle, parallel to the west side of the anticlinal axis, is admitted from 10M-1 to 10S-4. Such a fault is also recognized to the north of10S-5. However it dips at 20 degrees or less, and is thought to be a surface phenomenon with no indication of the deeper fault. However, it is thought that the activity of this surface fault is new because the sea-bottom on the hanging wall to the west seems upheaved in 10S-6.

As for the seaward extension of the Kurehayama fault belt, the tectonic deformation by the fault is assumed in the area south of10S-6, and it is pointed out that length from the coastline is about 9.5km, and the dip of the fault becomes gentle while going to the north. Since the anticlinal structure of the Neogene (layer-N) is probably unconformable with the overlying layers at the horizon of reflector-d, it is possible that fault-related folding with the Kurehayama fault has been ceased already.

The previous surveys of the reflection method of land areas reveals the shallow structures of the Kurehayama fault less than 500m in depth. Acoustic prospection was done up to depth 1-2km in half of survey lines in this sea area, and the main Kurehayama fault was located on the just extension of the land fault trace. It can be especially said that the Kurehayama fault is characterized by accompanying asymmetric anticline structure in both regions in land and sea, and that the fault belt is a buried one whose displacement is expressed as flexures in the district from the downtown Toyama City through the coast up to the Hamakurosaki spur (south of line 10M-4).



Keywords: submarine active fault, acoustic prospecting, reflection method, Toyama Bay, Kurehayama fault, fault related fold

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-10 Room:302 Time:May 24 16:45-17:00

Fault distribution and activity in the offshore extension of the eastern margin fault zone of the Fukui plain

Shintaro Abe[1*], Tanio Ito[2], Hirofumi Yamamoto[4], Ryoyu Arai[3], Yoshitaka Nakyama[2], Yukinobu Okamura[5]

[1]ADEP, [2]Chiba University, [3]KGE Co., Ltd, [4]Fukui University, [5]AIST AFERC

We carried out active fault investigation by the request from Ministry of Education, Culture, Sports, Science and Technology in the offshore extension of the eastern margin fault zone of the Fukui Plain. We want to clarify the five following matters about the active fault based on this results. (1)Fault continuity of the land and the sea. (2) The length of the active fault. (3) The division of the segment. (4) Activity characteristics.

The eastern margin fault zone of the Fukui Plain consists of the main part fault and the west part fault including sea area. Based on an existing fault evaluation, main part length is 45km, and the west part length is 33 km. In this area, the Fukui earthquake occurred in 1948. Kaga-shi offshore fault and Mikuni-cho offshore fault have been described in existing material concerning sea area fault. The length of the fault is 7km and 5km respectively based on the map.

In this investigation, 12 lines of high-resolution multichannel seismic reflection survey were carried out to recognize the detailed structure of a shallow stratum. In addition, we carried out standard type of multichannel seismic reflection survey for deep geological structure. The high accuracy topography survey was executed in the coast region where the rock was exposed. Furthermore, the sampling with the vibrocoring to get information of the sedimentation age was carried out.

The reflection profiles of the active faults were extremely clear. The fault displacement of sea floor and the deformation of Holocene epoch layer were recognized in the offshore extension of the fault zone though the displacement of sea floor was not identified in the coast area where rock was exposed. And another faults were recognized to the southwest side of the main part fault. It is interpreted that northern terminal of main part fault has diverged.

Because the displacement of sea floor or the deformation of the layer of Holocene epoch were confirmed, it is thought that they are active faults on which it acted at the latter term of Quaternary Era in both the main part and the west part.

Keywords: Fukui earthquake, Fukui plain, sea area, active fault, seismic reflection survey, lateral fault

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-11 Room:302 Time:May 24 17:00-17:15

Identification of Active Faults in the Western Seto Inland Sea

Masaaki Tanaka[1*], Katsufumi Konishi[1], Tatsuya Kunishi[1], Eijiro Kochi[2]

[1]The Chugoku Electric Power Co., Inc., [2]Sogo Geophysical Exploration Co., Ltd

There are little seismic surveys on active faults in some areas of Suo-nada Sea and Iyo-nada Sea, which are the part of the Western Seto Inland Sea. We tried The Multi-Channel Seismic Survey in this sea area. The purpose of the survey is to reveal the geological structure, and clarify the formations of active faults in the Sea. The survey was conducted by high-resolution sonic method using boomer source, deep seismic reflection profiling using water gun and air gun.

As the result of this survey, we could find some faults which strikes NE-SW same as the Median Tectonic Line (MTL) active fault system in this sea area. Some fault displacements including pull-apart basin and depression with negative flower structure were figured out on the obtained seismic reflection profiling. These displacements are a little but represent the geological features of the movement of right lateral strike-slip fault. These faults action continues after Pleistocene.

In addition, the width of the active faults seem to become wide with disperse toward offshore. At present, we think that we can divide these faults into geometrical segment which is based on the extensional jog.

Although the relationship between these active faults and the MTL active fault system has not been clarified completely, the result of this survey implies their formation under the same tectonic situation.

Keywords: western seto inland sea, active fault, acoustic exploration, lateral fault

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-12 Room:302 Time:May 24 17:15-17:30

Creeping deformation along the Longitudinal valley fault at Yuli area in Taiwan estimated by the photogrammetric method

Nobuhisa Matsuta[1*], Satoshi Ishiguro[2], Masayuki Murase[3], Wenshan Chen[4]

[1]Nagoya University, [2]Nagoya University, [3]Nihon University, [4]National Taiwan University

The purpose of this study is to establish the deformation pattern and the distribution across the Longitudinal Valley Fault in Tongli (south of Yuli) area, based on the photographic method.

The Longitudinal Valley Fault (LVF), 150 km long and NNE-SSW striking, passes through the eastern Taiwan, and represents the obvious surface expression of the collision boundary between the Philippine Sea plate and the Eurasian continental plate. The southern of LVF segment is observed to be high speed creeping based on the creep meter and leveling survey etc. Owing to such a high deformation rate, many earthquakes have occurred along the LVF. The 1951 earthquake sequence represents a good example. It is shown that LVF has been displaced both co-seismically and inter-seismically. Murase et al. (2009, 2010, and 2011) established about 30 km leveling route from Yuli to Changbin to detect the vertical deformation across the LVF for two years. As a result, the vertical displacement is 1.7 cm in 200 m across the LVF and 2.7 cm in 1000 m, referred to the west end of our route. In addition, a synclinal deformation is detected on the hanging wall side of the fault.

We compared to the air-photographs which are taken at different age (1978 and 2007). If the creeping on the fault has continued for 30 years, the accumulation of displacement reaches about 1m, which is significantly?distinguishable by photogrammetric method. We decided and measured the GCP for the 2007 year air-photograph in the field. We oriented the 2007 air-photograph and then we apply the old-time coordinates of the triangulation point to 1978 air-photograph. We measure profiles across the fault on 1978 and 2007 air-photograph by photogrammetric system respectively. The comparing result is shown that the northern area has creeping but the southern area has undetectable creeping in Tongli. About this result, we think two possibility; one is the creeping is not uniformity along the fault, second is the photogrammetry has not enough quality. We should actually check the creeping or not. We made three new leveling survey lines in last year.

Keywords: Active fault, Photogrammetry, Creeping, Longitudinal valley fault, Taiwan, tectonic geomorphology

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-13 Room:302 Time:May 24 17:30-17:45

Recurrent morphogenic earthquakes in the past millennium along the strike-slip Yushu Fault, central Tibetan Plateau

Aiming Lin[1*], Gang Rao[1], Dong Jia[2], Bing Yan[2], Xiaojun Wu[2], Zhikun Ren[1]

[1]Graduate School, Shizuoka University, [2]Nanjing University, China

The magnitude (Mw) 6.9 (Ms 7.1) Yushu earthquake occurred on 14 April 2010 in a high mountain region in the Yushu area of the central Tibetan Plateau, resulting in approximately 3000 fatalities (including 270 missing) and widespread damage. Field investigations reveal that the earthquake produced a ˜33-km-long surface rupture zone along the pre-existing Yushu Fault of the strike-slip Ganzi?Yushu Fault Zone (Lin et al., 2011a). The Yushu earthquake provides us with a rare opportunity to understand the rupture mechanism and process of a large-scale strike-slip fault related to eastward extrusion of the Tibetan Plateau. The primary features of the seismogenic fault upon which the 2010 Yushu earthquake occurred are now understood, but details of its seismotectonic behavior, e.g., recurrence interval, slip rate, and maximum magnitude of morphogenic earthquakes, are largely unknown despite their importance in terms of assessing the seismic hazard in high mountain regions around the Yushu area on the central Tibetan Plateau.

Here, we present geological evidence regarding the occurrence of

paleo- and historical earthquakes that ruptured the strike-slip Yushu Fault of the Ganzi?Yushu Fault Zone during the past millennium, based on field work and observations of an excavated trench and outcrop in July 2010, after the 2010 Yushu earthquake (Lin et al., 2011b). Field surveys and analyses of an excavated trench and outcrop reveal that three morphogenic earthquakes have occurred on the Yushu Fault in the past millennium. Paleoseismic evidence, historical records, and radiocarbon age data show that (i) the penultimate large-magnitude earthquake occurred during the past 400 yrs, corresponding to the 1738 M 7.1 earthquake; and (ii) the third most recent event occurred between AD 650 and AD 1100, suggesting a recurrence interval of 300-400 yrs for morphogenic earthquakes on the Yushu Fault in the past millennium. An average slip rate of ˜4-5 mm/yr is estimated for the Yushu Fault. These results are consistent with those obtained from long-term geological evidence and GPS observations. Our findings reveal that most of the strain energy on the Ganzi?Yushu Fault Zone, caused by northeastward motion of the Tibetan Plateau to accommodate north?south shortening of the plateau due to ongoing northward penetration of the Indian Plate into the Eurasian Plate, is released as seismic slip.

References:

1) Lin, A., G. Rao, D. Jia, X. Wu, B. Yan, Z. Ren (2011a). Co-seismic strike-slip surface rupture and displacement produced by the 2010 Mw 6.9 Yushu earthquake. Journal of Geodynamics, doi:1016/j.jog.2011.01.001.

2) Lin, A., G. Rao, D. Jia, X. Wu, B. Yan,, Z. Ren (2011b). Recurrent morphogenic earthquakes occurred in the past millenarian along the strike-slip Yushu Fault, central Tibetan Plateau. Bulletin of Seismological Society of America, in press.

Keywords: Yushu earthquake, strike-slip Yushu Fault, Tibetan Plateau, morphogenic earthquakes, Paleoseismicity, Tibetan Plateau

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS032-14 Room:302 Time:May 24 17:45-18:00

Active faulting in southern Bhutan Himalaya and its application for active tectonics

Jamyang Chophel[1*], Yasuhiro Kumahara[2]

[1]Department of geology and Mines, Bhutan, [2]Faculty of Education, Gunma University

Introduction

The on-going collision between Indian and Eurasia plates has caused uplift of the Himalayan range, appearance of dense distributed fault system and also outbreaks of mega earthquakes in the past 100 year along the Himalayan front. Because active faults generate large and shallow earthquakes (over M6.5), detailed information on distribution and sense of active faulting is fundamental data for not only study on active tectonics, but also planning for seismic mitigation. Geological and geomorphic knowledge about active faulting of Pakistan, northwestern India and Nepal is collected by numerous works, but limited works such as Nakata (1972) and Yagi et al. (1992) has only done to understand that of Bhutan and northeastern India at present. In this presentation we show the preliminary result regarding to distribution and sense of the active fault in southern Bhutan Himalaya and discuss about relationship between active faulting and structural tectonics, comparing with active faulting in southern Nepal Himalaya.

Method and material

We interpreted air photos by stereo-view to identify the typical tectonic landform such as a series of stream offset on same line and fault scarp on terrace or fan surfaces as geomorphic evidence for active faulting. We used air photos of both Bhutanese government institutions: Department of Geology and Mines (DGM), Ministry of Economic Affairs and Department of Survey and Land Record, Ministry of Home Affairs. The air photos are vertical, gray color scale with a scale of 1:12,500, 1:15.000 and 1:25,000 taken in 1989 and 1991. Information on the tectonic landforms and surface trace of active fault were mapped in topographical maps with a scale of 1:50,000. The air photos of some areas closing to the border to India are not available. We concentrated to interpret the area south of N27 in Bhutan where active faults may be distributed densely according to other Himalayan area.

Characteristics of active fault in southern Bhutan Himalaya

The result we interpreted are shown below:

1. There are many fault traces with E-W striking, parallel to the Himalayan range.
2. No single fault traces run from east to west entirely in the southern Bhutan, but the fault traces less than 30 km long are recognized generally, overlapped with five to six traces in part.
3. Regarding to vertical displacement on the E-W striking fault traces, that on the traces along the footwall of the Himalayan range shows north up-thrown, that inside the Himalayan range shows both directions between south up-thrown or north up-thrown.
4. The NE-SW and NW-SE striking fault traces are visible inside the range, oblique to the general trending of the range. We observed the left-lateral strike-slip along the NE-SW striking fault trace, the right-lateral strike-slip along the NW-SE striking fault trace. Some of those may run toward north out of mapping area.
5. Eastward from Tshoki, density of fault traces is less than other part, also the E-W trending traces concentrate within 1 km width.

Relationship between structural geology and distribution of fault

The active fault we identified in the southwestern Bhutan are almost distributed widely not only along the Main Boundary Thrust (MBT), but also over the Lower Himalaya between the MBT and the Main Central Thrust (MCT). However in south-eastern Bhutan east of Tshoki the traces of active fault is almost single along the MBT in map view. In Nepal the surface traces of active faults follow the main geological boundaries such as the MBT and MCT, and the density of active faults in the Lower Himalaya is very low. The difference reflects the difference of type of long-term collision tectonics. Principal axes of horizontal strain based on slip sense and striking of the faults is N-S, which is suitable for the direction of plate motion.

This research was supported by Grant-in-Aid for Young Scientists (B) and JST-JICA, SATREPS.

Keywords: Bhutan, Himalaya, active fault, tectonic landform