Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SCG64-01 Room:101B Time:May 21 09:00-09:15

Preliminary Result of Groundwater Radon Survey around Tachikawa Active Fault Zone

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The Headquarters for Earthquake Research Promotion reported that occurrence potentials of earthquakes within 30 years around Miura and Tachikawa active fault zones increased due to the 3.11 Tohoku earthquake. We believe that a continuous monitoring of state of active fault zones by a geochemical method will contribute to reduce damages by big earthquakes forthcoming around above two fault zones, which are located at areas of high population density and around important facilities. We reported a result of a groundwater radon survey around the Miura active fault zone in the last conference. In this report, we will indicate a preliminary result of a groundwater radon survey around the Tachikawa active fault zone.

Sampling points were selected on a survey line in a direction perpendicular to the Tachikawa fault line. Analysis method of a groundwater radon concentration was as same as that used last year. Dissolved radon in groundwater was extracted by a gas-liquid equilibrium process in a PET bottle for a few minutes. A gas phase radon concentration was measured by an electrostatic collection and a semiconductor detection method. The gas phase radon concentration was converted to a groundwater radon concentration by a partition coefficient for radon and water.

The groundwater radon concentration around Tachikawa area was relatively higher than a mean value for Kanto area (Saito et al., 1993, 1994). A mean value of groundwater radon concentration of this study is as same as the Saito's results. However, a mean value of groundwater radon concentrations in an east area seems to increase, on the other hand, that in an west area seems to decrease. An amount of the radon supply from radium, which is included in rocks and has a 1600-years half-life, should be constant in a few decades. Hence, we checked a long-term changes of a discharging rate of groundwater in the east area and a flow rate of surface water of Tamagawa River in the west area. We have hound that the discharging rate in the east area is decreasing and the flow rate in Tamagawa River is increasing. Therefore, our preliminary results indicate that a long-term change of a groundwater radon concentration is dominantly perturbed by a flow rate of groundwater.

We have to find an appropriate sampling point of groundwater on which an effect of a flow rate of surface water is negligible. Then, we would like to start a continuous monitoring of groundwater radon concentration for inspecting geochemical status of the Tachikawa active fault zone.

Keywords: Groundwater, Radon, Tachikawa Active Fault

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SCG64-02 Room:101B Time:May 21 09:15-09:30

Roles of active faults for fluid-flow in the crust, examples from Chubu district, Japan

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Because of many seismic and volcanic activities in Japan, more than 27000 locations of hot springs are known to exist in Japan. Various kinds of studies of hot spring have been performed, but research areas for most of these studies were narrow with smaller numbers of samples. In comparative studies about the relationship between topography and geological structure and chemical composition of hot springs, many chemical composition data in broad region are required.

In Japan, hot springs are defined by law to be composed of hot water from underground, water vapor and other gases, and their temperature at the gushing points should be higher than 25 degree C, or containing some chemical components more than specific amounts. Chemical composition of hot springs reflects the geology (Maki 1994). It is obligated to analyze hot springs chemically and submit official sheets of chemical compositions by law. Oguma(2009) obtained 715 data of hot springs in Kanto-Koshinetsu area using these sheets and showed the relevance of the chemical composition of hot springs and plate subduction. Otsu(2010) and Terusawa(2012) used data of hot springs in Tohoku and Kyushu area, showed the relevance of chemical compositions and active faults. These studies were performed using temperature, pH and amount of chemical components data recorded in official sheets of chemical analysis.

The target area of this research is Chubu district, Japan. There are many volcanoes and active faults in Chubu area, so many hot springs exist. 3225 data of chemical composition of hot springs are collected from whole Chubu area, and chemical trend corresponding to the various geological setting are spatially analyzed on GIS. In this presentation, we report new insights about the relevance of several active faults and chemical composition of hot springs.

Keywords: hot springs, active faults, permeability, Chubu district

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SCG64-03 Room:101B Time:May 21 09:30-09:45

Examination of noble gas concentration by percolation by using ceramic membrane

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Noble gas elements generally show the characteristics of chemical inactiveness and small molecular weight. In earth scientific studies, it is important to quantify noble gasses by some chemical methods. However, the measurement of extremely low concentrations of isotopic species of noble gasses has not been an easy issue so far. In this presentation, we have examined ceramic membrane to achieve higher concentration of noble gasses, and developed evaluation method the performance of the membrane.

This membrane is made of three layers supporting substrate, intermediate layer and active layer. By this structure, it is expected that gases with lager molecules diameter (N_2,O_2,Ar) cannot pass membrane and small gasses (He) selectively pass membrane.

We made the air permeation experiments using quadrupole mass spectrometer with a variety of temperature conditions, and evaluated performance of membrane by permeance and concentration factor.

$P = M / (dP * S * t)$

(P: permeance, M: amount of transmission, dp: differential pressure, S: membrane area, t: time)

$A = C' / C$

(A : Concentration factor C ': before transmission C: concentration after transmission)

As a result, N_2, O_2, Ar gasses which account for majority of air showed almost the same permeance with pure gas experiment and He gas showed lower permeance than pure gas experiment but concentration factor was about 10. In this presentation, we show experimental results and discuss isotope fractionation.

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SCG64-04 Room:101B Time:May 21 09:45-10:00

Construction of diagnostic research of fault zone by fault- fluid monitoring

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It has been well known that change in water level in the wells and in chemical compositions of ground water is frequently associated with large earthquakes. Research for change in physical-chemical properties of fluid associated with earthquakes is still continuing all over the world including Japan.The main target of this kind of research was to detect anomalous signals, which can be interpreted as precursor of the earthquake. Some records of fluid data suggested clear signature of precursor of a large earthquake, which were interested in by many researchers. However, at present, fluid-monitoring research to explore earthquake precursor is significantly declined. The goal of the way of research would inevitably be ”statistics”. However, the researchers had not been interested in examinations whether observed change can be explained strictly by physical and chemical process in the crust associated with earthquakes. Consequently, fluid monitoring to find seismic precursor becomes an ironic example to lose support from seismic society.

Recently the presence of fluid that can be defined as fault fluid has emerged by development of fault zone material science. Fault fluid is defined as follows and if the presence and the premise of this fluid are acknowledged, the observed results are interpreted as follows. Active fault zone has fracture zone at one side or both sides of fault surface, which shows higher permeability than surrounding host rocks, indicating that the crustal fluids preferentially flow through the fracture zone in the crust. Therefore, change in fault-fluid properties associated with earthquakes exclusively means that (1) change in fluid path connection-disconnection and (2) fluid - fractured rock interaction resulting in change in fluid properties.

If we acknowledge above consideration, fluid-monitoring related to seismic activities is changed form statistic research to diagnostic research. Long time effort of try and error is necessary to realize above consideration and establish the measurement method. At present, following three subjects are especially important. First, establish the reliable basis to choose the location of well to monitor the fault zone fluid , second, designing and constructing the mass-spectrometer which have sufficient performance for fluid continuous monitoring at on-site close to the fault zone, and finally, establish and improvement of diagnostic theory of fault zone fluid.

Some results from above point of view will be reported and discussed in this session. Sugai et al., (2013) performed chemical mapping of hot springs and compared them with geological and topographical maps, which gives us insight to find the better location for fault-fluid monitoring. Tsunomori et al. (2013) will report long time variation of radon concentration, which is necessary to evaluate the episodic change of radon concentration by seismic activity. Terusawa et al (2013a) will report the results of measurements of permeability of gas membrane, which will be installed to the mass spectrometer. They also report the fundamental process resulting in change in gas concentration.

The purpose of this presentation is to summarize and supplement above researches and introduce high resolution mass-spectrometer (GROWDAS).Kawabata et al./(2013) will report the site-construction and data presentation techiniques about our Website.

Keywords: fault, fracuture zone, fluid, monitoring, hot spring, mass-spectrometer

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SCG64-05 Room:101B Time:May 21 10:00-10:15

Approach for short-term forecasting model improvement based on the phenomenon before the 1946 Nankai earthquake

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There are the witness testimonies of the inhabitants that the water level of well water decreased several tens of cm of more before the 1946 Nankai earthquake (M8.0). These changes can be explained qualitatively by the ground uplift because of pre-slip occurrence in the deep side of the assumed source region, but have not been able to explain quantitatively. On the other hand, in the small delta or the sandbar where fresh water balanced with seawater, Umeda *et el.* (2010) showed that the well water largely decreased by a little upheaval of the ground, qualitatively .The quantitative relation between the water level of well water and the upheaval of the ground was obtained based on the Umeda's model and the structure of underground water at Saga district where is small delta.

In addition to examining the phenomenon before the 1946 Nankai Earthquake by research literature and testimony, and to clarify the relationship between crustal movement and groundwater change from such integrated observation of earthquakes, crustal movements and groundwater, we aim to suggest the scenario before the Nankai Earthquake.

Tokai earthquake prediction is dependent simple pre-slip model (Japan Meteorological Agency, 2003). We do not know weather change occurs similar to that described above. However, the short-term forecasting model based on a careful verification of the phenomenon and elucidation of the source of the variation is very important in order to increase the possibility of short-term forecasting.

Keywords: Nankai Earthquake, short-term forecasting, earthquake prediction, pre-slip, groundwater, SSE

Japan Geoscience Union Meeting 2013
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SCG64-P01 Room:Convention Hall Time:May 21 18:15-19:30

Variation of concentration of dissolved gas in groundwater observed at Atotsugawa station

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A fault zone can be regarded as paths of crustal fluids. Quantification of chemical properties of the fluids penetrating the fault zone and their variation with time are important subjects to understand the relationship between fault zone activity (earthquake) and geochemistry. For the data from continuous monitoring of the fluids in the fault zone, local variations by difference in geological structures, the seasonal variation and secular change are should also be taken into account.

A new machine for continuous monitoring of dissolved gas using a quadrupole mass spectrometer (GROWDAS:GROund Water Data Analyzing System) is established and started measurement at Atotsugawa in Gifu Prefecture. In recent 10 months, we captured specific signature of chemical variation with time. We examined the factors that cause changes in the concentration of dissolved gas by comparing a variety of factors (temperature, pressure, precipitation, crustal movement). In this presentation, we discuss fundamental processes of change in chemical variations with time in the fault zone.

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SCG64-P02 Room:Convention Hall Time:May 21 18:15-19:30

Towards real-time fault monitoring: A real-time gas composition data delivery by GROWDAS

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Understanding fault activity is important to estimate earthquake generation process and for disaster prevention, however, there is no certain index for the fault activity based on geochemical observation. The goal of the GROundWater Data Analysing System (GROWDAS) Project is to understand the fault activity by continuous observation of dissolved gas composition in ground water within a fault. To observe gas composition continuously and automatically, a new gas analyzer GROWDAS was developed. Currently, the GROWDAS provides relative concentration of gases within the Atotsugawa fault. We aim to reveal the relationship between fluctuations of gas concentration and change in the fault condition using the data, and establish a model for the evaluation of the fault activity. We believe the data are important not only for researchers but also for the public to predict the fault activity, and therefore, we are trying to open all the data.

The GROWDAS is mainly composed of five systems, which are Purification-system, Analysis-system, Exhaust-system, Control-system and Power control-system. Analysis-system consists of the Heating and Cooling subsystems. We currently measure relative concentrations of ^{4}He, CH_3^+, H_2O, N_2, O_2, ^{36}Ar, ^{40}Ar and CO_2gases, which are analyzed with the following procedure.

1. Get gases from pumping groundwater by degassing in Purification-system, which are dried by Cooling-system and conducted to Analysis-system. The degassed water is disembogued to outside of GROWDAS.
2. The purified and dried gas is analyzed in Analysis-system. The gas is then conducted to Exhaust-system after analysis. An external PC is linked for recording and monitoring the data.

All above procedure is done automatically by Control-system and the data is sent to the data server installed at the University of Tokyo. The data of daily average (Day data) is uploaded to the web server and displayed in a chart for recent 30 days. This quasi-real-time data delivery is opened to public (http://growdas.com). We plan to provide a new download system, with which anyone can access and download the original and processed data and the charts in selected period.

Keywords: fault, grownd water, continuous observation, gas, Mass Spectrometry