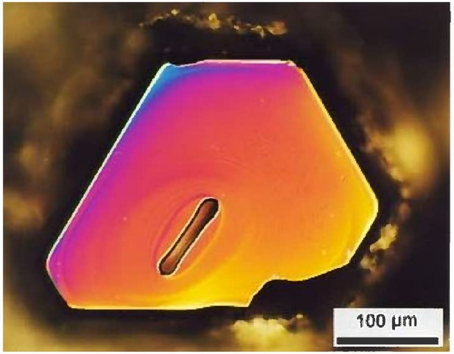
Crystal Growth of Synthetic and Natural Mineral Crystals

Our research interest is in the crystal growth of minerals, i.e. crystals occurring in nature. In order to understand the growth process and mechanism of mineral crystals, we observe and analyze the internal crystal texture and the surface morphology showing the growth characteristics, such as zoning, element distribution and growth step. In addition to natural mineral crystals, we synthesize mineral crystals, such as plagioclase and pyroxene, in a laboratory and use them for analyses. For this purpose, we conduct growth experiments mainly by the flux method. Finding suitable flux systems and chemical components is another subject of our study.



Growth pattern observed on the surface of ilmenite in Aso pyroclastic deposit

About Researcher

ABE Toshiya, Ph.D.

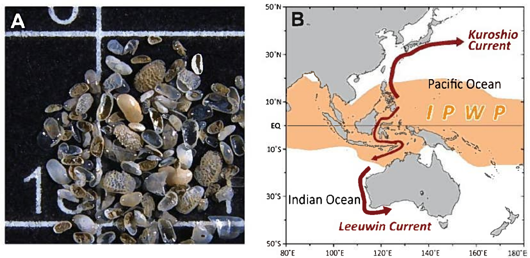
Ph.D., 1988, Tohoku University

Paleoenvironmental Evolutions and Biotic Response of Tropical and Warm Current Regions

I have broad interests in the environment and ecology of paleo-oceans. Our lab has been investigating climatic evolutions and faunal transitions using geological, oceanographic, and paleontological (**fossil ostracods**, Fig. A) evidence based on field research.

My recent research has focused on the paleoenvironmental evolutions and biotic response of tropical and warm current regions. The Indo-Pacific Warm Pool (IPWP) currently exhibits the world's highest mean annual sea surface temperature, and broadly overlaps several marine biodiversity hotspots. Significant heat and water are transported from this region to mid-latitude regions via the Kuroshio and Leeuwin Currents (Fig. B). The Indo-Pacific Warm Pool influences global climatic and oceanographic dynamics.

I conduct research to reveal the history of Cenozoic **climatic transitions** and marine **ecosystem and diversity evolutions** in these regions.



A. SEM photographs of fossil ostracods. (The grid length is ~4.5 mm.)
B. IPWP distribution and warm currents.

About Researcher

IWATANI Hokuto, Sc.D.

Sc.D., 2011, Shimane University

WEB ≫ https://sites.google.com/view/iwatani-lab/

Submarine Slides and Sedimentary Environments in Deep-seas

My research interest is in submarine slides and related fields where it is studied in soil mechanics, clay microstructures, submersible studies, sedimentary environments and sedimentary processes. Research now underway in our laboratory is focused on the following five fields: 1) formation processes and mechanisms of submarine slides; 2) sedimentary processes and environments of the deep-sea floor; 3) microplastic pollution in deep-sea sediments; 4) development processes of clay microstructures during various deformations; and 5) deep-sea geologic surveys using submersibles. The formation processes and mechanisms of submarine slides have been investigated using two approaches: 1) geological approaches using bathymetric images, chirp sonar images, submersible survey data, scientific drilling data and piston coring data; and 2) geotechnical approaches using slope stability estimation. We are also interested in the formation processes and mechanisms of landslides.

Landslide in the Yamaguchi Prefecture.

About Researcher

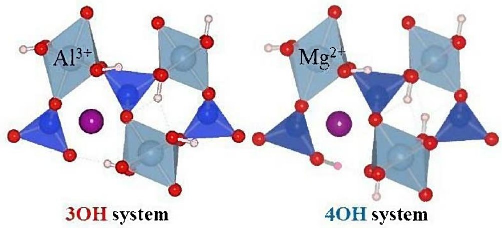
KAWAMURA Kiichiro, Ph.D.

Ph.D., 2005, University of Tsukuba

Element Distribution in the Crystal Structure of Natural and Synthetic Minerals

To study the relationship between ionic substitution and structural changes is a primitive subject; however, it is very important to understand the physical and chemical properties of materials. In the case of minerals, such a feature give clues including "Where does it come from?" and "How was it formed?" Moreover, the interaction between minerals and water commonly occurs at the earth's surface, the crust and mantle, which are responsible for magma formation, accumulation of elements, alteration and so on.

In my study, special focus is given to the natural and synthetic hydrous minerals crystallizing at low-grade metamorphism and hydrothermal activity. These subjects are poorly understood due to chemical heterogeneity, low crystallinity and uncertain phase relations. Many silicate minerals forming under such conditions contain hydroxyl groups and/or water. There are still unsettled fundamental problems among such minerals; for instance, the uncertainty of the form of the hydrous component (OH or H_2O) and the atomic position of H. The intended approach, focusing on structural variations and phase transition upon dehydration or water absorption, is less common. However, an understanding of such minerals significantly contributes to the general comprehension of earth materials.



Sursassite (general formula: $Mn^{2+}{}_2Al_3Si_3O_{11}(OH)_3$)

$Me^{3+} + 3OH^- \leftrightarrow Me^{2+} + 4OH^-$

Hydrous Mn-silicate, sursassite, has multiple hydrogen-bond systems due to the variation in the oxidation state of the cation.

About Researcher

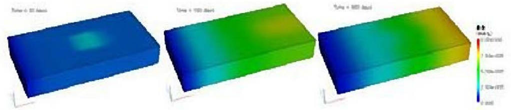
NAGASHIMA Mariko, Ph.D.

Ph. D., 2006 Shimane University

WEB ≫ http://web.cc.yamaguchi-u.ac.jp/~nagashim/index_eng.html

The Interaction between Geology and Human Activities

Human activities on the surface of the earth, such as infrastructure construction and disaster prevention, are based on geology. Our studies aim to understand the relationships between human activities and geology.
To predict the natural hazard locations and timing, we will clarify the relationship among disaster occurrences, topography, geology and rainfall conditions.
We are developing a prediction method of groundwater quality, which changes due to human activities on and under the earth surface.
By considering natural hazards and the environmental changes underground, we will propose an effective and economical method of constructing and maintaining infrastructures based on the prediction of geological and hydrogeological change around the structures.



Prediction of dispersion of arsenate in aquifer by numerical simulation

About Researcher

OHTA Takehiro,Ph.D.

Ph.D., 1992, Tohoku University

Earthquakes and Faults, Rock Physics and Crustal Deformation

In order to understand the deformation processes of earth's crust, we have conducted research on crustal deformations such as earthquakes and faults, folding and accretion of oceanic lithosphere based on both fieldwork and laboratory experiments. The Japanese islands have been very tectonically active throughout the geologic time scale making them the best example for learning crustal deformations. Our present fieldwork theme includes 1) active fault research in and around the Yamaguchi Prefecture; 2) ancient seismogenic faults in exhumed accretion prisms (the Shimanto accretionary complex); and 3) the damage zone architecture of the Niigata-Kobe tectonic zone. In the laboratory experiment, we conducted low- to high-velocity friction experiments to obtain the frictional properties of rocks and fault zone materials and to study the physico-chemical processes that occur during an earthquake.

An example of natural pseudotachylyte (formed by frictional melting during an earthquake) and an experimentally reproduced melt layer.

About Researcher

OOHASHI Kiyokazu, Ph.D.

Ph.D., 2011, Hiroshima University

Evolution of Continental Crust and Petrogenesis of Mantle and Crust Derived Magma

The earth was born in the solar system 4.6 billion years ago. The first continental crust was produced more than 4.0 billion years ago. The continental drift driven by the plate tectonics gathered many continents 600 million years ago and the supercontinent Gondwana was formed. I study the igneous and metamorphic rocks collected from various tectonic settings to reveal the evolution of continental crust. Recent research topics are as follows: 1) magmatism in continental collision; 2) subduction zone magmatism in active continental margins; 3) low-pressure type metamorphism affected by mantle-derived mafic magmatism; 4) crustal differentiation due to partial melting of granitic crust and 5) formation of continental crust during early Earth. My research area covers from Siberia in the north to Antarctica in the south. The Sør Rondane Mountains in Antarctica and Southwest Japan are typical tectonic settings exhibiting the magmatism of the continental collision and active continental margin tectonics, respectively. I am also interested in the mechanism for the weathering of granitic rocks and the analysis of the genesis of the rock avalanche accident.

Geological field work in the Sør Rondane Mountains, East Antarctica.

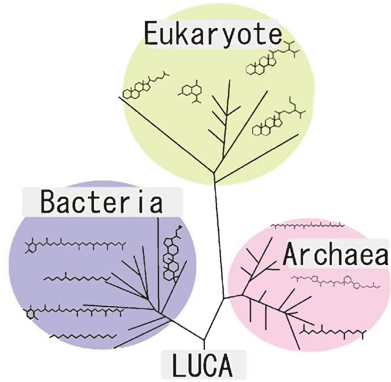
About Researcher

OWADA Masaaki, Ph.D.

Ph. D., 1989, Hokkaido University

Exploring the History of Life on Earth Using Biomarkers and Kerogen

My research interests are in **the history of life on Earth, the history of the Earth's environment, and organic geochemistry**. In prehistoric times, life on Earth interacted with the global environment, **diversifying and going extinct repeatedly like a roller coaster**. The causes of change to the global environmental and global life history events are still unknown, and their mechanisms are complex. For example, in the case of the end-Permian mass extinction which occurred 250 million years ago, volcanic activity in Siberia has been identified as the root cause, and several other events have been identified as candidate causes. Organic geochemical research deals with **fossils of bioorganic molecules called biomarkers**. Biomarkers are molecular fossils, so if the molecular skeleton of an original bioorganic molecule is strong enough, it will remain as a fossil. Therefore, biomarkers have the advantage of remaining as fossils even as many large fossils and microfossils disappear from the geological record during a mass extinction. By making use of this advantage, it is possible to clarify what happened during a mass extinction.



Molecular Fossils and Evolutionary Phylogenetic Trees

About Researcher

SAITO Ryosuke, Dr.Sc.

Dr.Sc., 2015, Tohoku University

Plate Subduction Zone and Great Earthquakes

The plate subduction zone, my main research target, has repeatedly experienced great earthquakes and Tsunamis throughout history. Present fault zone develops deep region under the sea and an ancient fossil fault is exposed on land.

These fault rocks tell us the history of earthquakes and the seismogenic mechanism. I discovered the first pseudotachylyte, typical fossil evidence of an earthquake caused by a seismogenic fault formed by frictional heat melting, in the Shimanto complex, Shikoku Island. Since data reflecting a faulting mechanism and earthquake energy in the plate subduction zone is recorded in this rock, this finding has had a huge impact on the field of Geology. This fault zone was established as a national monument.

The drilling research vessel "CHIKYU" has taken the core sample from deep present seismogenic fault in the Nankai trough, off SW Japan. I found the signature of seismogenic faulting at the shallowest portion of the plate subduction zone, which was formerly believed to be an aseismic zone. This rupture propagation at the shallowest portion is likely to cause unexpected and great tsunamis similar to the Tohoku Earthquake of 2011. The Japanese government's tsunami hazard map was rewritten as a result of this finding.

The drilling research vessel "CHIKYU" (left) and the signature of seismogenic faulting at the shallowest portion of the plate subduction zone (right).

About Researcher

SAKAGUCHI Arito, Ph.D.

Ph.D., 1997, University of Tsukuba

Metamorphic Petrology and Crustal Evolution

Metamorphic rocks are good indicators of the crustal evolution of Earth. The mineral assemblages, petrographic textures and radiometric ages of the metamorphic rocks imply the pressure–temperature–time condition in the crust. My main research subjects are as follows:

1) Crustal evolution and tectonics of the Hidaka metamorphic belt, Hokkaido, Northern Japan.

2) High- and ultrahigh-temperature metamorphic terrane of Antarctica (e.g. the Napir Complex, the Lützow-Holm Complex and the Sør Rondane Mountains).

3) Phase equilibrium of spinel, högbomite and related minerals. We have found a new mineral magnesiohögbomite-2N4S (IMA# 2010-084) from Antarctica.

4) Geological age determination of rocks and minerals (e.g. U-Th-Pb radiometric ages of zircon, monazite, uraninite and zirconolite).

5) Melting of lower crust. Origin of migmatite.

The new mineral magnesiohögbomite-2N4S (red) occur among corundum (blue), spinel (purple), mica (brown) and chlorite (green).

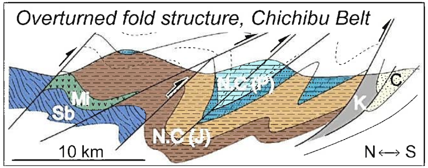
About Researcher

SHIMURA Toshiaki, Ph.D.

Ph.D. , 1992, Hokkaido University

Geological Studies of Orogenic and Volcanic Processes in Plate Convergent Zones

My research concerns conducting geological studies of orogenic processes in subduction zones using a combination of structural geology and sedimentology. I have analyzed sedimentary structures preserved in mixed rocks and found a large-scale **overturned fold structure** in low-grade metamorphosed accretionary complexes in the Northern Chichibu Belt on Shikoku Island, Japan. The finding suggests that large-scale tectonic processes have occurred. Ultimately, I want to understand **the orogenic processes** in plate convergent zones.
I also research **caldera volcanism**, combining a range of different techniques used in stratigraphy, sedimentology and petrology to understand how caldera volcanos develop, and how pyroclastic flows and falls transport material. We analyzed sediment cores and found volcanic ash layers with a similar composition to that of caldera magma erupts prior to caldera eruptions. The goal of these studies is to **assess future caldera eruptions and their impact**.



Large-scale overturned fold structure in the Northern Chichibu Belt on Shikoku Island (up). Volcanic eruption of Aso volcano (low).

About Researcher

TSUJI Tomohiro, Ph.D.

Ph.D., 2014, University of Ehime