



International Union of Geological Sciences (IUGS)—Sendai—Foreseeable but Unpredictable Geologic Events—IUGS Reactions

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Abstract

This paper gives an overview of the International Union of Geological Sciences (IUGS) activities that are related to the geologically related events—geohazards that pose risk to contemporary society. As geohazards are common events, IUGS has established an initiative with the aim to address the issue from a geological perspective and consequentially enable more holistic approach to the geohazards, including understanding processes, approaching them with the most effective solutions and educating public.

Keywords

Geohazard • Geological risk • IUGS

What Is IUGS?

The International Union of Geological Sciences (IUGS) is the international umbrella organisation for all geoscientists. It has represented all geoscientists at the highest international level since its formation in 1961 and supports both fundamental research and applied aspects of the Earth Sciences of an international and interdisciplinary nature. Through member countries and affiliate members it represents around a million geoscientists. Its main scientific forum is the International Geological Congress (IGC). IUGS promotes development of the Earth Sciences through:

- developing broad-based scientific studies relevant to the entire Earth system;
- applying the results of these and other studies to preserving Earth's natural environment, using all natural resources wisely and improving the prosperity of nations and the quality of human life;
- strengthening public awareness of geology and advancing geological education in the widest sense;
- developing/endorsing geoscientific standards such as stratigraphic charts, rock nomenclature, GIS data management and interoperability, isotope half-life times, as well as geochemical baselines;
- its new strategic initiative “Resourcing Future Generations”.

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IUGS Risk and Hazard Activities

The “Risk and Hazard” (R&H) theme, for the long term, was at the heart of the International Geophysical Union (IUGG), the home of seismology and volcanology. In IUGS main emphasis was placed on rock-fall, landslides and flooding. Because tectonic signs of R&H are obvious in the sedimentary record, in 2013 IUGS decided to place more focus on disaster risk reduction and hazards.

The basic phenomena of earthquakes and volcanic eruptions, for instance, are primarily geological, such as earthquakes being related to active fault movement, and volcanic activities being due to magma genesis and tectonic conditions. It is well known that earthquakes are triggers of liquefaction and land sliding (slope failure) and also, if occurring under the sea, of tsunami. Historic occurrences are

recorded as geological events in landscapes (topography) or outcrops of sediments showing deformation, or both (as shown in Fig. 1).

While many affiliated organizations already had a focus on these themes, IUGS, with its former Secretary General Ian Lambert, decided to undertake an initiative on Hazard and Risk. The first step took place after the Tohoku Tsunami

Fig. 1 Above record of a major tectonic event (paleoearthquake) in sediment accreted in a volcanic arc, Bono peninsula, Japan (*above*); soft-sediment deformation (paleoearthquake?) in a fluvio-lacustrine sequence near Lake Van, Turkey (©R. Oberhänsli) (*below*)



2011. This led to an IUGS sponsored G-EVER meeting at Sendai, Japan. The outcome of the meeting was the Sendai agreement that was published as part of a special issue of EPISODES (Vol. 37(4) 2014). Following this first meeting, which was combined with an excursion to the areas damaged by the tsunami, the special issue was published. In a trench dug near Iwanuma, not only were the effects of the 2011 Tohoku tsunami visible, but also the 1611 Keicho event, as well as one before the 915 Towada volcanic eruption (Fig. 2).

Renewed attendance at the G-EVER meetings and a series of IUGS contributions at the “Capacity Building of Earth Sciences toward Decrease of Geohazards: Establishment of Global Networks for Decreasing Geohazards” Workshop at the 3rd United Nations World Conference on Disaster Reduction at Sendai, Japan finally led to the concept and establishment of a Task Group (TG) on Disaster Risk Reduction and Geo-hazards.

By convening this task group, IUGS expanded its responsibilities for dealing with societal impacts of geologic events. Effects of energy release in geologic systems and the socio-economic consequences of foreseeable but

unpredictable events (Fig. 3) to society are taking an increasingly prominent position in modern geosciences.

This calls for new efforts, not only in specific geoscience education, but also for public literacy in earth science and increasing understanding at the administrative level of governance. This need led to the establishment of courses in geo-governance for political administrators at Potsdam University in Germany; an inspiring initiative for IUGS.

Of course, geologic phenomena related to the disaster risk and hazard themes had been worked on much earlier under the auspices of IUGS, but mostly out of scientific curiosity through basic investigations of geologic processes undertaken by:

- the Commission on Tectonics and Structural Geology (TekTask) focusing on geodynamic processes and their geologic expression such as thrusts and faults, paleo earthquakes, landslides, rock falls, etc.
- the Commission of Geosciences for Environmental Management (GEM) dealing with man-made strata and geo-pollution particularly in respect of liquefaction-fluidization.

Y. Ogawa’ s observation with interpretation of the archaeological trench site (Stop 2) of Iwanuma City, Sendai Plain, Miyagi Prefecture (Oct. 21, 2013; Red and white band scale 5 cm long each; refer to HP of Iwanuma City report as

<http://www.city.iwanuma.miyagi.jp/kakuka/050300/050302/kikakuten.html>)

Mud layer deposited during inundation stage of March 11, 2011.

Turbidite-like sandy deposits of normal grading of sands with upper parallel laminations during the first tsunami overwash, March 11, 2011.

Paddy field muddy layer probably cultivated during Edo period (17th C) to 2011 (Present upper part yields late 18th C potteries, the original upper part may be eroded by Tohoku Tsunami).

Yellow, fine-grained sandy deposits probably corresponding to 1611 Keicho tsunami. Upper part was dated 17th C, lower part 15th C.

Peat layer, suggesting swamp environments.

Ash layer from Towada (To-a) AD 915, convoluted into pinch-and-swell structure (by liquefaction?)

Jogan tsunami deposits of AD 869. Laminations or irregular layers may be roots of plant of the late peat stage??

Mud layer of lacustrine environments. Several tsunami deposits were recognized below in other trenches or cores, showing approx. 1000 yrs intervals.

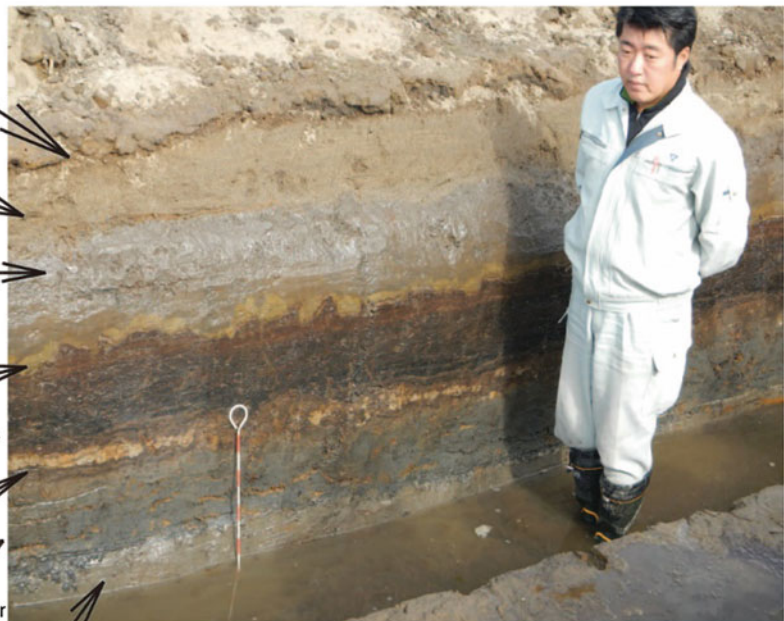
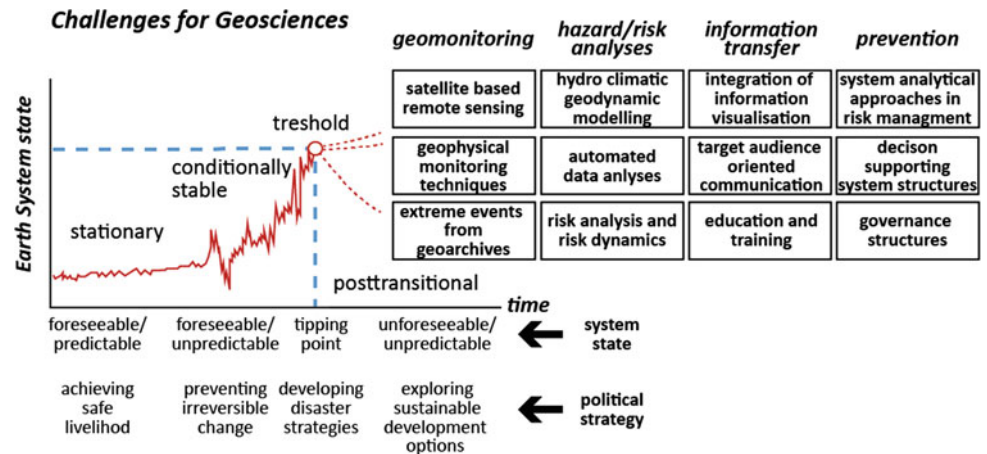


Fig. 2 Trench in the Sendai Plain near Iwanuma city recording three major tsunamis: Tohoku 2011, Keicho 1611 and one before the Towada volcanic eruption 915. (Ogawa et al. 2014)

Fig. 3 Preparing for the unpredictable. Consequences for geoscience education and communication with a target audience (adapted from www.geogovernance.de and documents of Potsdam Earth Science Institutions; courtesy M. Strecker)



– the Commission of Management and Application of Geoscience Information (CGI). The efforts of this commission producing standards for IT-based maps are also relevant for topical maps on risk distribution.

The joint-research programs that IUGS runs in co-operation with UNESCO and the International Union of Geodesy and Geophysics (IUGG) have distinct foci and a long history in addressing problems of risk and hazard. With UNESCO, the IUGS has run for over 45 years the International Geoscience Program (IGCP) and with IUGG the International Lithosphere Program (ILP).

One of IGCP science themes is: “Geohazards: mitigating the risks”. A selection of recent and active projects under this umbrella is listed below. These encompass historical as well as health aspects such as: earthquake archaeology; medical geology; the environmental and health impacts of major and abandoned mines in Sub-Saharan Africa; impacts of mining on the environment in Africa; preparing for coastal change; seismo-tectonics and seismic hazard in Africa; the significance of modern and ancient submarine slopes and landslides; and deformation and fissuring caused by exploitation of subsurface fluids. In addition to this plethora of geohazard-focused research projects in the past 45 years, several have also addressed the landslide issue. Some of such IGCP projects are Submarine Mass Movements and Their Consequences (IGCP-585 project): S4SLIDE—Assessing Geohazards, Environmental Implications and Economic Significance of Submarine Landslides across the World’s Continental Margins (IGCP-640 project), E-MARSHAL—Submarine Mass Movements and Their Consequences (IGCP-511 project), M3EF3—Mechanisms, Monitoring and Modelling Earth Fissure generation and Fault activation due to subsurface Fluid exploitation (IGCP-641 project) and the

Landslide Hazard Assessment and Cultural Heritage (IGCP-425 project) that resulted in a “spin-off” the International Consortium on Landslides (ICL) and it’s very successful initiative, the International Programme on Landslides (IPL), which focuses on research and capacity development in the field of landslide themes.

All aspects of the IGCP program, which was the first scientific program to be started under the UNESCO logo jointly with IUGS and which served as a template for other UNESCO science programs, are compiled in “Tales Set in Stone” (Fig. 4). The program has been reshaped recently but keeps its important place and logo in the new structure 2015 of the Earth Science Division of UNESCO that now also includes a risk & hazard department.

A second joint program that IUGS runs with IUGG is devoted to scientific studies of the Lithosphere. Different task groups focused on seismology, magmatism, volcanism and geodynamics undertake curiosity-driven research relevant to disaster risk and hazard assessment. A flagship for modern research with high societal relevance is the International Continental Drilling Program ICDP (<http://www.icdp-online.org>) with the three main research areas: climate and ecosystems, sustainable geo-resources and natural hazards. The ICDP hazard theme focuses on faults, volcanic eruptions, impact structures and plate boundaries. From studies on faults, principles for understanding seismic processes and early warning systems are being developed (e.g. GONAF; <http://www.gonaf.de/>).

IGCP continues to be one of the IUGS tools that help different research fields with seed money in the first phases of geoscientific networking. ICL is a living proof that such an approach is successful. Therefore IUGS will continue to support interesting and relevant topics, including various geohazard research topics, into the future.

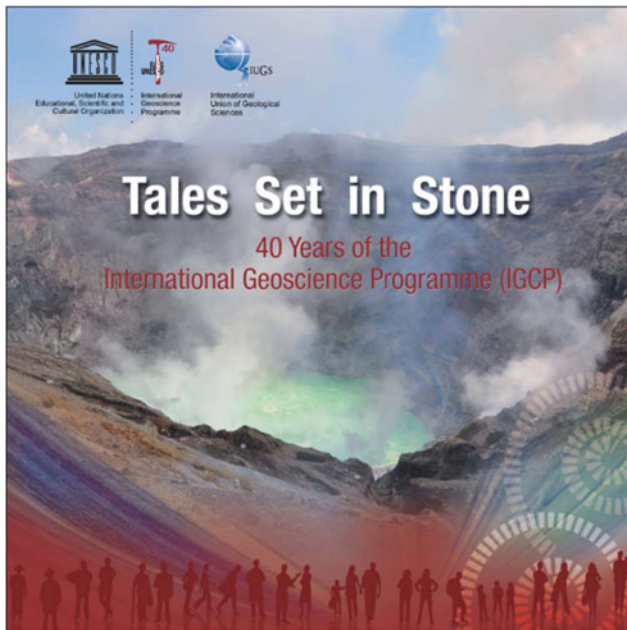


Fig. 4 UNESCO IGCP brochure, 2015 (*above*); Rock fall, 1978, in the northern Adula nappe, Switzerland (©R. Oberhänsli) (*below*)

Acknowledgements Authors would like to thank all geoscientists around the world that contribute to IUGS expertise and its bodies with their knowledge and expertise.

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