ABSTRACTS

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Physical Mechanism of Groundwater Related Earthquake Precursors

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Groundwater related earthquake precursors, such as groundwater level, groundwater temperature, chemistry and Radon content, have been widely reported. It has been found in China that long-term anomalies usually take the form of slow variation, while short-term anomalies often show abrupt changes. Anomalies do not appear on all observation wells before major earthquakes and amplitudes of anomaly have no simple correlation with the distance between the well and the epicenter. there are so called sensitive wells which probably is located at special structural location. Mechanism for the anomalies is not clear and the phenomenal complexity makes it difficult to recognize the anomaly before the occurrence of great earthquakes. A study of the mechanism is expected helpful for understanding the characteristics of the anomalies.

Dilatation is believed to be of essential importance for production of earthquake precursors. Induced microcracks with preferred orientation under external load lead to macroscopic anisotropy. Therefore, based on experimental data, anisotropy constitutive relation for dilatation rocks was summarized and is incorporated into finite element analysis to calculate stress and strain near faults under tectonic loading. Porous water flow driven by differential pore pressure due to volumetric deformation as well as heat / mass transfer by the flow are also calculated.

Computational results indicate that increases in regional tectonic stress can yield weakening and creep of faults, which in tern can cause further stress concentration and brake out of major earthquakes. Dilatation can occur at both the main seismogenic fault and other faults nearby. Groundwater is driven by volumetric deformation and complex time-dependent anomaly pattern can be produced related to geological structure. Short-term anomalies are closely related to local hydrogeology. These findings are useful for anomaly recognition and layout of observation network.

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Precursor activities of the eruptions of Nyamuragira, Zaire

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The activity of Nyamuragira volcano in Virunga zone was investigated using seismic, geomagnetic and geodetic methods. The investigation period includes seven eruptive episodes of this volcano. The results obtained are summarized as follows:

- Seismicity: Data are collected at 4 seismic stations located around the two active volcanoes -Nyiragongo and Nyamuragira- and Lviro station about 100 km away. We noticed that the current seismic activity is usually confined around the Nyiragongo and Nyamuragira field. The cumulative energy curves show a steep increase of about 5.2×10^{15} ergs, about 3 months prior to an eruption. The slope of the curves increase several weeks before the eruption. The frequency of events with high amplitude increases gradually as the eruption approaches. An earthquake swarms is observed few days before the eruption.
- Geomagnetism: From geomagnetic surveys we have noticed that the spatial distribution of recent cones of Nyamuragira coincides with zones of low local geomagnetic anomalies, this suggests the existence of demagnetized rocks at shallow depths due to the magmatic intrusion.
- Geodesy: The geodetic measurements performed every two years on the Nyamuragira crater show the progressive inflation of its crater. A good correlation have been found between the direction of the maximum inflation and the location of the future cone.

We may conclude that a good combination of seismic, geomagnetic and geodetic surveys appear as a powerfull tool for the prediction of volcanic eruptions of Nyamuragira.

II-21-5

Landslide mapping in the world

Presiding:

Earle E. Brabb, Stanislav Novosad and Norio Oyagi

II-21-5 P-1 5307

LANDSLIDES AND RELATED PHENOMENA OF THE STIGLIANO TOWN (BASILICATA, SOUTHERN ITALY)

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Abstract

The ancient town of Stigliano rests on the inner boundary of the Bradanic Fore deep, in the external strip of the Southern Apennine. Some parts of the town were built on bodies of large ancient landslide. The oldest quarters has been destroyed by large landslides. The remains of them resting on a calcarenitic plate, which overlies instable argillitic flischioid formations, are undergoing further disintegration.

The main landslide types include " lateral spreadings " of the rock masses on the argillitic soils and other types such as slumps and slips very often passing to long and wide multiple flows.

A detailed map of the landslides is presented.

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MASS MOVEMENTS HAZARD MAP OF MAGNESIA REGION (CENTRAL GREECE)

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Detailed analysis of all landslides which took place in Magnesia region (Central Greece) showed that the factors reasponsible for their demonstration were the following:

A. The Geological conditions and especially the presence of soil materials on metamorphic formations
B. The action of surfacial water and especially the linear erosion along the torrents
C. The action of underground water which decrease the geomechanical parameters.
D. Morphological slopes and discontinuities
E. Human activities and insertions such as land depilation, removed of natural supports, extra burden e.t.c.

The action of these factors in every single area, has different importance and role in the beginning and evolution of these phenomena. As a result it is possible to map them in thematical maps at a scale of 1:100.000. The elements taken from the maps were inserted in a computer and with a landslide hazard a synthetical map (scale 1:100.000) was composed. In this map we can distinguish four areas with different hazard and concretely:

A. Section of high landslide hazard, where the demonstration of the landslide is extremely possible when one of the previous factors take place. The region in the Northern section of Pilio mountain fall into this section
B. Section of medium landslide hazard where the demonstration of the landslides is possible when two of the previous factors take place. The area of Neochorion belongs in this section.
C. Section of low landslide hazard where the demonstration of the landslides is possible only when many factors take place in the same time. The region of South Pilio fall into this section
D. Section without landslide hazard, where the demonstration of these phenomena is extremely difficult or impossible. The area of Tisseon mountain and plain areas are enlisted in this sector.

It is possible to make a landslide hazard map in every area after analysing and elaborating the factors responsible for the landslides. It is also possible to use this map for urban planning and also for planning of large scale techical projects.

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LANDSLIDE INSTABILITY ASSESSMENT AND HAZARD MAPPING USING GIS TECHNIQUES IN THE LOESS OF NORTH-CENTRAL CHINA.

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ABSTRACT

Mass movements in the Loess Plateau of Gansu Province, P.R. China, form a recurrent hazard causing considerable damage to infrastructure and severe loss of life. Loess consists mainly of silt-sized quartz particles. Both cohesive and cementation bonds occur, so that in a dry state, loess sustains vertical walls up to 20 m high. Under moist conditions, on the other hand, loess is prone to liquefaction, and catastrophic failure may occur.

Strong demand for land, mainly used for agricultural purposes, has resulted in a landscape where even steep slopes (up to 35°) are artificially terraced. Irrigation is widespread (precipitation ± 350 mm/yr; evaporation ± 1500 mm/yr) and the subsequent increase in moisture content of loess slopes often leads to slope instability.

To assess the existing loess slope instability a landslide database has been created. Statistical analysis of this database has provided an inventory of the environmental factors affecting mass movement in this region. The results have been projected on to a Digital Elevation Model (DEM), derived from a SPOT stereopair and from digitized contour lines. Spectral information from LANDSAT/TM images is used to add variables to the existing set. A combining of spectral information and DEM variables (degree of slope, aspect, and elevation) allowed the creation of algorithms from which the distribution of loess thickness, bedrock/loess interface topography, and loess layer morphology have been calculated.

Overlays containing all variables have been combined in a rule-based GIS. The generated output consists of a loess mass movement susceptibility map and its derivative, a loess mass movement hazard map.

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