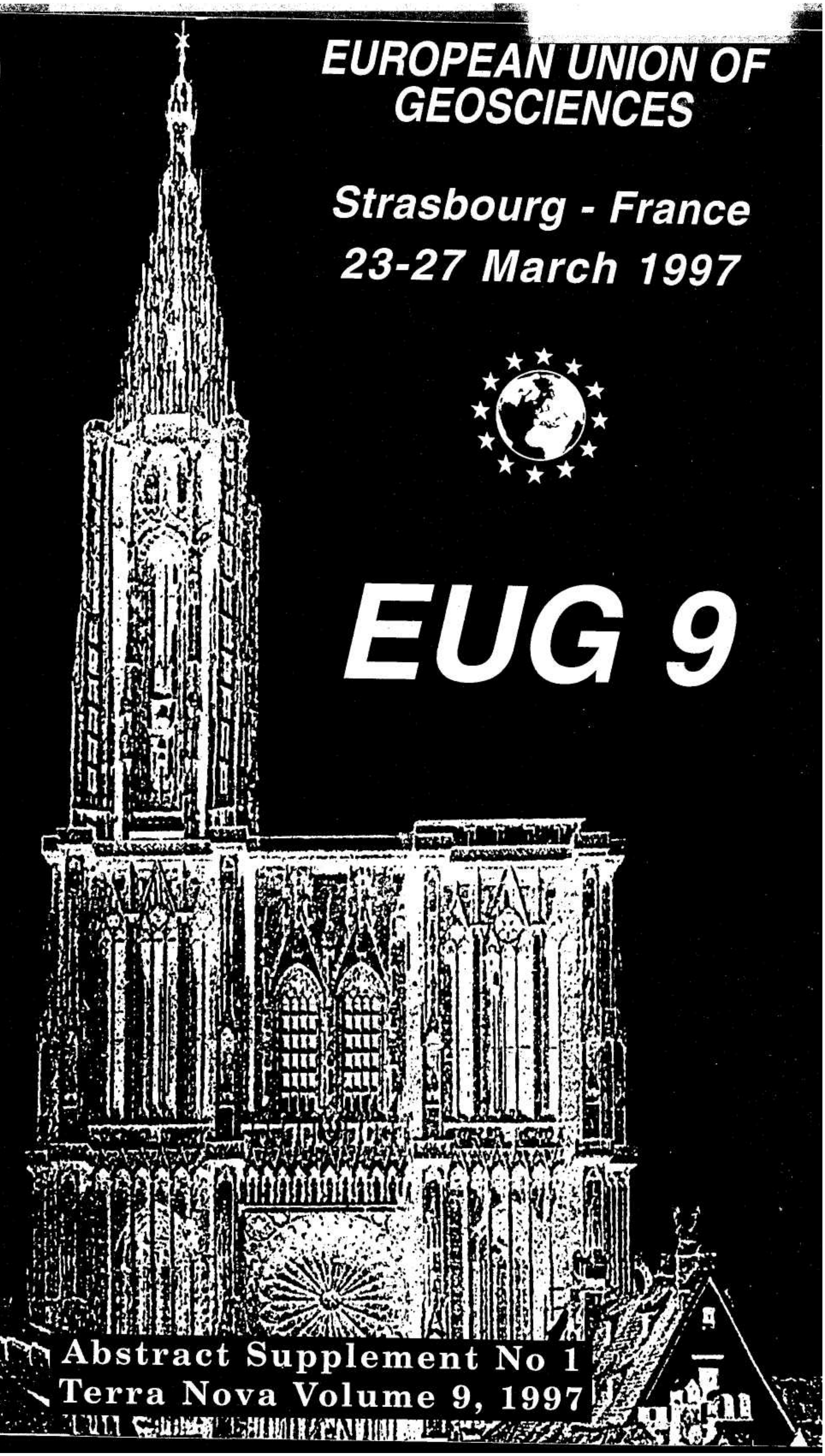
ABSTRACTS

EUROPEAN UNION OF GEOSCIENCES

Strasbourg - France

23-27 March 1997



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ABSTRACTS OF ORAL AND POSTER PRESENTATIONS

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Symposium 16

Mitigation of Geological Hazards

Convenors:

J. Zschau
G. F. Panza
F. Roth
R. Stefansson

16/3P15

?OBLE GASES AND STABLE ISOTOPES IN UMAROLES OF PHLEGREAN FIELDS (ITALY)

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The volcanic Phlegrean Fields (400 km^2 area, NW of aples) are characterised by hydrothermal phenomenon umaroles and thermal springs) and bradyseism which ›nsists in ground uplift of several meters during short ›ne. A magma chamber presumably underlies the area of ılegrean Fields at 5 km depth. At least two aquifers are ›ove this magma chamber (1600 m and 3046 m of depth). he use of noble gases and stable isotopes as natural trac-·s can provide a relationship between the magma and the uifers.

$^3He/^4He$ of the fumaroles normalised on the air ratio Ra 2.98. Such ratio could result from mixing between man-: and crust derived helium. However its stability during adyseism, despite He content variation, indicates a agma source characteristics. Thus the isotopic composi-›n of He is of little value to forecast bradyseismic activ-y. Isotopic ratios of the other noble gases are essentially mospheric. We consider saturated water with air at sur-ce or near surface conditions. Addition of air derived ›ble gases occurred through solution of air in surface ater in fixed proportion. Subsequently, atmospheric noble ıses (ANG) were partitioned between this water phase and gas phase until equilibrium was reached. Therefore ANG ›undance allow to determine the gas/water ratio, which is und to be within 0.092 and 0.429. The δD - $\delta^{18}O$ rela-›nship of the water of the fumaroles is linear. It reflects .her mixing between meteoric and magmatic water cont-ninated by crustal water (δD = -30 to -10 ‰ and $\delta^{18}O$ = 4 8 ‰), non-equilibrium evaporation, or mixing between ıuifers with water-rock interactions.

Phase changes in the aquifers seem to be the driving ·ocess. During bradyseism, tectonic movements can cause odifications in the deep structures and increase the heat ɔw. As a consequence, the hydrostatic pressure increases, ading to greater fracturation, pore volume expansion and ound uplift.

16/3P16

:ROUNDSHAKING ASSESSMENT FOR THE CITY F CATANIA (ITALY)

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nternational Centre for Theoretical Physics-SAND Group, Trieste, Italy.

In the framework of the GNDT activities, one of the sks is the reduction of seismic hazard and seismic risk at sub-regional and urban scale. A pilot project is devoted to ıe definition of a risk scenario in the city of Catania 3icily), which is located in a highly seismic area.

Our contribution to the task is based on the computation f synthetic seismograms by the modal summation tech-que that allows us to:

- model the macroseismic fields due to strong earth-ıakes that occurred in the area;
- perform parametric analyses to estimate the influence ˚ structural and source parameters on ground motion;
- estimate the tsunami hazard due to strong earthquakes :curring offshore.

When detailed geotechnical and geological information ill be available, deterministic ground motion modelling ill take also into account site amplification due to local ›il conditions.

16/3P17

SEISMIC GROUND MOTION MODELLING IN THE CITY OF SOFIA

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Sofia, the capital of Bulgaria, is situated on a sedimentary basin within a graben structure characterised by relatively high seismic activity. Shallow depth earthquakes have caused great damages in the past. The importance of the city of Sofia as an administrative and economical centre of the country defines the significance of the seismological investigations in the Sofia valley. In an attempt to estimate the seismic ground motion for the area a variety of techniques have been applied. Using attenuation relations for the region in terms of intensity and peak ground acceleration the area of investigation has been defined. An earthquake catalogue has been compiled and seismogenic zones within the region have been delineated from causal relationships established between geological structures and earthquakes. A focal mechanism working catalogue has been compiled from all available sources. For the earthquake sources beneath the city 1-D response based on the vertical propagation of waves in a plane layered media has been computed. The seismic ground motion caused by more distant sources has been computed with hybrid technique based on the mode summation and finite difference methods. The technique allows us the realistic modelling of source and propagation effects, including soil conditions. As a contribution to the seismic microzoning of Sofia, we present maps of maximum acceleration, velocity and displacement.

16/3P18

STRENGTH-DEPTH PROFILES FOR FAULTS AT HIGH FLUID PRESSURE

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Low frictional strength of continental crust is predicted from a model which accounts for high fluid pressures in faults. Frictional strength for faults oriented at an optimum angle to σ_1 has been calculated using a Coulomb criterion. Based on evidence for lithification of fault gouge and for faulting at high fluid pressures from many exhumed shear zones, faults are assumed to attain a cohesive strength and to reach near-lithostatic fluid pressures with increasing depth.

In order to evaluate the effects of changes in fluid pressure gradient on the frictional strength of faults, a computer program was developed to calculate fault strength versus depth. For an average coefficient of friction for non-clay gouge and for hard rock ($\mu \approx 0.75$), a pronounced strength minimum is predicted to occur at an upper crustal level (Fig. 1). This strength minimum lies at the top of the inferred near-lithostatic fluid pressure regime (see also Sibson, 1990). A less pronounced strength minimum or a near-zero strength gradient is predicted to occur at a similar upper crustal level (Fig. 2), if the upper portion of the fault contains clay-rich gouge ($\mu \approx 0.4$).

The predicted fault strengths are compatible with estimates on crustal stresses inferred from earthquake stress drops and from palaeopiezometry on quartz mylonites. This strongly supports the idea that faulting in the middle crust is assisted by high fluid pressures. The high frequency of microearthquakes and aftershocks along several active faults at a depth of around 6 km is consistent with a predicted strength minimum at a shallow crustal depth. An increasing pore fluid pressure gradient around this depth, probably due to hydrothermal sealing of permeability, is inferred to provide a shallow earthquake source meachanism.

Sibson, *Geol. Soc. Spec. Pub.*, **54**, 15-28 (1990).

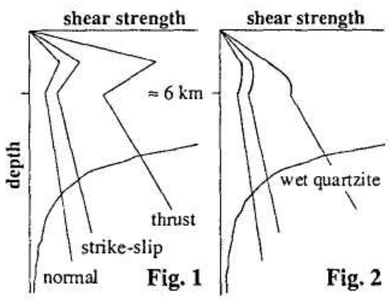

Fig. 1 Fig. 2

16/3P19

SH WAVE MOTION IN THE BEIJING AREA DUE TO THE 1976 TANGSHAN EARTHQUAKE

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The reasons for the anomalous high macroseismic intensity caused in the Xiji-Langfu area by the Tangshan, 1976 earthquake can be found in its special geological conditions. This area is formed of deep deposits beside the Xiadian fault, that consist mainly of alluvium sands and clays, which are poorly consolidated with high water content. Resonances, excitation of local surface waves and their propagation cause strong amplifications and long durations of signals. Based on simulated strong ground motion, we have computed quantities commonly used for engineering purposes: the maximum amplitude (AMAX) and the total energy of ground motion (W), which is related to the Arias Intensity. AMAX and W do not decrease gradually as the epicentral distance increases, since the low velocities and the thickness of the deposits are responsible for the large increment of the values of AMAX and W inside the basin. On the two sides of the Xiadian fault AMAX and W can vary by 200% and 700% respectively. This computational result can be used to explain the large macroseismic intensity observed in the Xiji-Langfu area, in connection with the Tangshan earthquake. The spectral ratios show that over the whole area significant amplifications occur in the range of frequencies from 0.3 Hz to 1.5 Hz, while the largest amplification is above 6 and takes place around 3 Hz at a distance of about 112 km. from the epicentre.

1616/3P20

AUTO-SEISMO-GEOTECH: A GIS BASED MULTIDISCIPLINARY MICROZONATION PROJECT – PART I SEISMICITY – SEISMOTECTONICS AND SEISMIC HAZARD ASSESSMENT

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It is a well known fact that the purpose of a detailed microzonation study is to provide analytical expressions of the future seismic exposure of an investigated area. This target is approached using a wide variety of geophysical methods, the contribution of which in reaching the final goal, is not well defined.

In an attempt to incorporate the maximum possible amount of information and in view of the continuously expanding use of Geographical Information Systems, as a tool for organising, analysing and integrating geological, geotechnical, seismological and geophysical data, AUTO-SEISMO-GEOTECH, a user friendly GIS based multidisciplinary microzonation approach has been designed and is presently implemented for the city of Heraklion (Crete island).

Initially a portable seismographic network has been deployed to monitor the microseismic activity and to define possible active fault zones. The well located events have been used to estimate 3-D P and S and velocity structure of the investigated region.

Emphasis is given on the accurate estimation of the expected ground motion in terms of acceleration and velocity. Based on the fact that seismic hazard cannot be uniquely estimated, all available algorithms have been investigated and tested by incorporating seismotectonic and historical seismological data. Detailed mapping of the ground motion parameters for the broader area of Heraklion has been obtained and integrated in the above mentioned GIS structure for practical use.

16/3P21

Effecting of Megacities from Natural Disasters in Turkey

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Natural disasters are effected different size of areas with different effects. according to the magnitudes, earthquakes can be more destructive and effect big areas. According to the rate of flow and capacity of the riverbed, floods can cause big damages and property losses. But floods do not effect big areas like earthquakes. Other natural disasters like avalanche, rockfall, landslide, etc. are effected small areas.

Although there are big differences in size of effecting areas, all disasters may cause a big property losses or damages especially in settlement areas. Property losses due to disasters effect negatively urbanization. Living people may leave from disaster prone areas in all over the world.

Flood events caused very big damages and property losses in all big cities especially in Eastern Black Sea and Aegean Regions. Settlements are in valleys and alluvial cones in Eastern Black Sea Region because of topography of the region. Settlements are effected from rockfall and avalanche events in mountainous and rough parts of Turkey (East part of Turkey-Eastern Anatolia). All these settlements need resettlement in safety areas. In the areas which are effecting from landslides, telecommunication and transportation interrupts frequently.

Urbanization is under negative effects of natural disasters. More financial support needs to reduce these effects in Turkey.