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Geomorphological Mapping and Flood Hazards in the Somma-Vesuvio Volcanic Area (Campania, Italy)

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Somma-Vesuvio, a well known dormant volcano of Central Italy, has been the object of many detailed studies concerning the eruptive mechanisms, the reconstruction of the volcanism evolution and the assessment of volcanic risk. But studies on surface features and on the combined role of endogenous and exogenous processes in shaping this volcanic area have often been disregarded. At present hazardous processes which affect this area most frequently are due to surface running waters, responsible for sudden and severe floods; therefore a deep knowledge of the morphological characters of this area and of the processes which affect it cannot be postponed. Thus, careful investigations and field surveys have been started; the aim is to produce a detailed geomorphological map, which can help in reconstructing the morphological evolution of the volcanic relief. Moreover, the elaboration and overlapping of other thematic maps, showing the variability of some morphometric characters of the study area, can aid the identification of the main factors of flood hazard and of the sectors most prone to undergo such disastrous events.

Key words: volcanic geomorphology, flood hazard, Somma-Vesuvio, Italy

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Morphographic and Morphometric Characteristics of Isole Eolie Archipelago (Southern Italy)

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The main geomorphological features of the Isole Eolie Archipelago, located in the Tyrrhenian Sea to the North of Sicily are examined. This archipelago includes seven main volcanic islands and its geophysical structure can be referred to like an arc-trench system. Volcanic activity began starting from Lower Pleistocene and lasted up to present times; two of the main islands, Vulcano and Stromboli, consist of active volcanoes. Careful geomorphological field surveys and aerial photo interpretation led to the compilation of detailed geomorphological maps. Moreover, morphometric studies were carried out to express quantitatively the main morphological features of these volcanic islands; in particular, the ratios height/width of the volcanoes and the acclivity of the relief slopes were examined. Finally, the fractal analysis of the shoreline trend and of the relief geometry was performed for each island.

The comparison of data obtained with the available geological, petrographic and volcanological knowledge allowed a morpho-evolutionary scheme to be outlined for each island and for the whole archipelago.

Key words: volcanic geomorphology, quantitative geomorphology, volcanic arc, Italy

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A tentative groundwater contour map in Lahar disaster area, Mt. Pinatubo, the Philippines.

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Volcanic mudflow (Lahar) deposits, generated after the voluminous 1991 Mt. Pinatubo eruption, have caused disastrous damage in the Mt. Pinatubo area, including changes to the groundwater resources. Electrical survey was applied to investigate groundwater along Pasig-Potrero river basin. The resistivity of aquifers was estimated according to the relationship between water-saturation and sediment resistivity. We made the geomorphological map which was based on photographic interpretation and then provided a tentative groundwater contour map by compiling geomorphological map and the observed data.

Keywords:ground water, lahar, landform classification, electrical survey

Slope Degradation of Scoria Cones in Cheju Island, Korea

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Morphometric parameters such as height/width ratio and slope angle are measured to investigate the rates of slope degradation of 49 scoria cones in Cheju Island. The parameters systematically decrease with increasing age of scoria cones, suggesting that comparative morphology of scoria cones is a useful age indicator. Cone age is most highly correlated with average slope angle because summit craters are infilled and eventually removed by erosional processes. Average slope angle is estimated from the ratio of cone height to the difference between cone width and crater width as $\theta_{ave} = atan(2 \cdot H_{co}/W_{co\text{-}cr})$. Cheju Island was formed through four eruptive stages during Pleistocene. The youngest cones of stage 4(0.1~0.025Ma) have a mean average slope angle of 23.6±1.7°, whereas stage 3(0.3~0.1Ma) and stage 2(0.6~0.3Ma) cones have mean values of 18.9±1.7° and 12.8±1.9°, respectively.

Key words : *scoria cone*, *morphometry*, *slope degradation*, *Cheju Island*

Annual rate of Sediment Yield on Merapi and Semeru Volcanoes, Indonesia

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The main originality of volcanic geomorphology is the limited life span of volcanic landforms, due to the rapidity of the construction/erosion rates. On the Merapi and the Semeru volcanoes, in Java Island, sediment yields set world records. On these two active volcanoes, the efficiency of the erosion doesn't result from a large volume of pyroclastic deposits following each eruption, but is a consequence of the almost yearly return period of lahars. The strong erosive force of lahars is related to sediment concentration, fluid density, hydraulic depth, and to shear stresses. At Merapi, the annual rate of sediment yield exceeded 100 mm/year in the Boyong valley in 1994-95. The total volume of sediment removed by lahars (1.63×10^6 m^3) was calculated on the basis of field surveys before and after each lahar event, field measurements during the flows, and laboratory analysis of the volcaniclastic sediments. At Semeru, we calculated the annual rate of sediment yield in the Lengkong valley for the year 2000. Data, which are still in process, result from: (1) systematic measurements of small size (mainly sand, granules and pebbles) sediment discharge every 5 minutes during the lahars; (2) assessment of cobbles and boulders from visual observations of the flows and from sediment deposits analysis.

Key words: lahar, sediment yield, Merapi volcano, Semeru volcano, Java Island.

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ICG ABSTRACT- Session 6 Volcanic geomorphology and hazards

The paleoenvironment of the Cuicuilco basin, Mexico City, affected by the historic eruption of the Xitli volcano

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The historic eruption of the monogenetic Xitli volcano affected the southern area of Mexico city, silting water environments and forming a rugged lava field. Recent archaeological and geomorphological findings at a new commercial center near the Cuicuilco pyramids, have allowed the palaeoenvironmental reconstruction of the area and a consideration of the possible relation of the eruption to the end of the Cuicuilco culture.

The main physical processes included the filling of the Cuicuilco lake by direct volcanic ashfall and transported volcanic sediments by large floods, and the covering of an extensive piedmont with thick lava flows. The obtained C_{14} age of $1490.^{+}55$ BP is among the youngest measured on the site. The eruption affected a populated area and was one of the most devastating eruptions in human history.

Key words: geoarchaeology, radiocarbon dating, volcanic morphology, Cuicuilco culture, Mexico City basin

Profile Evolution Models for Volcanoes built up by Lava Flow and Ash Fall

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Morphometric analysis of volcano profile features reveals that distinct breaks in slope curvature exist and each of the profile segments is represented by the relation $S = k x^{-m}$, where S is slope gradient and x is horizontal distance. The value m represents the concavity or convexity of each segment, which reflects the accumulation processes of eruption products. Shield volcanoes have a convex upper segment ($m<0$) and a concave lower segment ($m>0$), and tephra cones have a straight segment ($m=0$). Digital simulation models which can well reproduce the profile properties are developed. The movement of lava flow is described by $u = gh^2 \sin A/v$ where u is flow velocity, h is flow depth, A is slope angle and v is viscosity which is a function of time. The flux of ejected fragments from a central crater is inversely proportional to x. Frequency of the magnitude of eruptive events is given by an exponential distribution. The upper concave profile of shield volcanoes is formed by rapid widening of lave flow near the crater, and the lower concave profile is attributable to the frequency distribution. Straight segment of conical volcanoes is talus slope with angle-of-repose. Concave lower slope of composite cones is resulted from radial dispersal of ejecta, deposition of mudflows and the exponential frequency .
Key words: volcano profile evolution, simulation model, lava flow, ash fall, composite cone

Presentation Poster

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Abstract Submission Form

Numbers of applied Session and/or Symposium

1st Choice: Volcanic geomorphology and hazards, 2nd Choice: Hillslope processes and hydrogeomorphology, 3rd Choice: Others

Influence of Volcanic Ash on Surface Runoff in the Slope Area of Mount Unzen, Japan

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It is known that surface runoff on slopes covered with fine-grained tephra during eruptive activity are usually produced by relatively small rainfalls.

We scattered fine-grained volcanic ash on the surface of a study plot in the Mount Unzen and covered one-third of the plot with that tephra. Surface runoff was measured on the slope in order to clarify the surface runoff characteristics on the ash-covered slope from 1998 to 1999. The rainfall intensity generating the surface runoff on the ash-covered slope was smaller than that before the treatment. The amount of the peak runoff and the total runoff increased after the treatment. These results suggested that the hydrological characteristics at the study slope were changed by accumulation of fine-grained volcanic ash after the treatment.

Key words: Mount Unzen, surface runoff, volcanic ash

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ABSTRACT 3
Dr. Jean-Claude THOURET
Session 6 or 9
Preferred : Poster

Late Glacial and Holocene Tephro-Stratigraphy and Chronology in Peru

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Multidisciplinary investigations of cores from peat-bogs, lakes, and nearby outcrops on the Western Cordillera, Southern Peru, have enabled us to trace tens of tephras which span the past 15,000 years. In addition to small ashfall deposits, ten tephras (TP1-10) are widespread (>1,000 km^2) and voluminous (>0.5 km^3) pumice-fall deposits linked with seven volcanoes. In the Laguna Salinas salar, TP1, 2 & 3 are andesitic pumice falls (of Ubinas or Misti?) contemporary with glacier retreat 14,690 yr BP, while a dacitic ashfall TP4 (of Huaynaputina?) is dated 9700 yr BP. TP5 is a pre-Holocene dacitic pumice fall from Nevado Sara Sara. An andesitic pumice fall TP 6 of the Ticsani domes was dated 11,600 yr BP. TP7 is an andesitic pumice fall 7840 yr BP from the Ubinas volcano. The andesitic/dacitic pumice-fall TP8 was delivered by the Misti volcano between AD 340 and 200 BC. TP9 is an andesitic pumice fall ~980 yr BP of Ubinas. The AD 1600 Huaynaputina plinian eruption delivered TP10, the most widespread (100,000 km^2) and voluminous (5 km^3) dacitic pumice-fall deposit in the Andes in historical times.

Key words : Late Glacial, Holocene, tephra, Andes, Peru, chronology, sources.

Presentation: Poster

Number of applied Session and/or Symposium;
First choice: S20 (Geomorphometry, DEMs and GIS)
Second choice: (6) (Volcanic geomorphology and hazards).

Characteristics of Landform Change in Mizunashi Watershed, Unzen Volcano

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The 1990-1995 eruption of Unzen volcano in southwestern Japan caused pyroclastic flows and deposited a vast quantity of blocks and ash in Mizunashi Watershed. Purpose of this study is to know characteristics of landform change in the watershed after the end of the eruptive activity. In this study, air photos taken during 1995-1999 were prepared. By using the photos, characteristics of landform were interpreted and digital elevation model (DEM) was prepared. Finally, characteristics of landform change were numerically analyzed by the DEM.
Key words: *Unzen volcano*, *DEM*, *Landform change*, *Pyroclastic flow*

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Volcanic Landform and Evolutionary History of the Aoso Volcano, Northeast Japan Arc

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The Aoso volcano is one of representative stratovolcanoes of the volcanic front in northeast Japan arc. We constructed the evolutional history of the Aoso volcano based on the observation of aerial photographs, combined with volcanic stratigraphy. The Aoso volcano was mainly established on sediments that might deposit inner part of a large caldera formed before the activity of the Aoso volcano. The volcanic activity of the Aoso volcano can be classified into earlier and later stages divided by a summit collapse. During the initial part of the earlier stage, a conical shaped stratovolcano might be constructed, after that the upper part of this volcano collapsed with eruptions of pyroclastic flows. During the initial part of the later stage, pyroclastics were erupted, and after that several lava domes were grown. Taking account of the volume of the eruptive rocks (earlier stage; 3.6km^3, later stage; 0.8 km^3), the evolutionary history is similar to that of one type of stratovolcanoes, which belongs to a large caldera volcano system.
Keywords: Aoso volcano, volcanic development, volcanic landform, northeast Japan arc, Quaternary volcano

Dr. Jean-Claude THOURET
ABSTRACT 2
Session 6 Volcanic geomorphology and hazards
Preferred : Oral

Effects of the largest historical eruption in the Andes, AD 1600

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The large-scale and complex plinian eruption at Huaynaputina lasted from 19 February to 6 or 15 March AD 1600, but aftermath has been severe and protracted for years. An area 4900 km^2 was devastated by pumice-fall, pyroclastic flows, and surges. The plinian fallout ~5 km^3 covered an area 100,000 km^2. Co-plinian and co-ignimbrite ash mantled 260,000 km^2 in southern Peru, western Bolivia, and northern Chile. Voluminous lahars swept the Río Tambo valley and entered the Pacific Ocean. A volume of 3-4 km^3 of tephra was rapidly removed toward the valleys, but 2-4 km^3 are still available for runoff and lahars. Approximately 1500 people were killed, owing to roof collapse, burnings, lahars, and earthquakes. At least 11 villages are known to be buried within 25 km distance of Huaynaputina; the towns of Arequipa and Moquegua 75 km away suffered havoc from ashfall and earthquakes. Recovery of villages and formerly cultivated terraces has been very slow and difficult. The economic ruin was due to the total loss of crops, cattle, and seeds, and to trade interrupted for years between the valleys of south Peru and Bolivia. Epidemics, famine, and poverty were added to the general ruin.
Key words : Volcanic hazards, Huaynaputina, Peru, tephra, ignimbrite, aftermath