UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

DIPARTIMENTO DI SCIENZE DELLA TERRA E GEOAMBIENTALI

Bari, October 3, 2012

SCIENTIFIC REPORT OF THE IUGG GRANTED PROJECT:

PREDICTING VOLCANIC ASH DISPERSAL COMBINING FIELD, EXPERIMENTAL AND METEOROLOGICAL DATA INTO SUPER-COMPUTATIONAL NUMERICAL SIMULATIONS

Project outlook

The main target of the granted project was to improve the forecasting of the dispersal of fine ash from explosive volcanic eruptions. The project is part of an ongoing collaboration among Italian, Spanish and Mexican researchers for the study of ash dispersal from three selected volcanoes, Somma-Vesuvius (Italy), Fuego de Colima and Popocatepetl (Mexico), in the case of an explosive eruption of any intensity and magnitude. The main aim of the collaboration is to forecast the concentration at ground level and in the atmosphere of different size ash particles. This is a crucial variable to be used for human and animal health care, assessment of ground and water pollution, and evaluation of expected impact on buildings and infrastructures. To date, this is an issue that has been approached only for very small eruptions and with simplified models valid at scales smaller than few hundreds of km. Moreover, except for the potential impact on air traffic managed by volcanic ash advisory centers (VAACs), effects of fine ash are poorly addressed by present day mitigation plans. The achievement of the main target has been pursued following three main cross-integrated research lines: i) collection and collation of field data; ii) laboratory analyses and experiments; and iii) numerical modeling. At present, the results of research lines 1-3 have been merged into large-scale 3D numerical simulations of volcanic ash dispersal at Somma-Vesuvius using super-computational facilities. Similar protocols are developing for Colima volcano, for which only preliminary numerical simulations are available. These outputs represent a step forward in the current research in volcanology and civil protection strategies in the study areas.

Results

As part of a larger scientific collaboration, the funds were mainly used for financing travels and participation to international meetings (see attached financial report). The grant supported research on ash dispersal mainly at Colima and Somma-Vesuvius volcanoes, and IUGG support is acknowledged in 3 published and 2 submitted papers on international journals. Follows the description of the main content of paper in which IUGG is acknowledged.

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- *Caron B., Siani G., Sulpizio R., Zanchetta G., Paterne M., Santacroce R., Tema E., Zanella E. (2012). Late Pleistocene to Holocene tephrostratigraphic record from the Northern Ionian Sea. Marine Geology 311-314, 41-51. doi: 10.1016/j.margeo.2012.04.001.*
This paper reconstructs the dispersal of ash layers from Italian volcanoes through the tephrostratigraphic study of a marine core located in the Ionian sea. Tephra deposits from Lipari ana Somma-Vesuvius volcanoes were recosgnised and their dispersal traced using also data from other marine and lacustrine cores and terrestrial exposures.

- *Sulpizio R., Folch A., Costa A., Scaini C., Dellino P. (2012). Hazard assessment of far-range volcanic ash dispersal from a violent Strombolian eruption at Somma-Vesuvius volcano, Naples, Italy: Implications on civil aviation. Bulletin of Volcanology, 74, 2205–2218.*
This paper provides probabilistic maps of ash dispersal in case of renewal of explosive activity at Somma-Vesuvius, considering a violent Strombolian scenario. The focus of the paper is on potential effects of volcanic ash on aerial corridors and airport operativity in the Central Mediterranena area.

- *Roverato M., Capra L., Sulpizio, R. (2012). First evidence of hydromagmatism at Colima Volcano (Mexico). Journal of Volcanology and Geothermal Research, doi: 10.1016/j.jvolgeores.2012.10.012.*
This paper reports, for the first time, occurrence of hydromagmatic deposits a t Colima volcano, until now considere a "dry" volcano for its explosive activity. The paper deals with the recognition and study of a succession of fine ash deposited in a lacustrine environment developed on top of debris avalanche deposits at around 13 ka BP. The ash were investigate using SEM image analysis, which highlight their generation from magma-water interaction.

- *Sulpizio R., Alçiçek M.C., Zanchetta G., Solari L. (2012). Recognition of the Minoan tephra in Acigöl Basin, Western Turkey: implications for inter-archive correlations and fine ash dispersal. Journal of Quaternary Research, submitted for publication*
This paper deals with the reconstruction of volcanc ash from the famous Minoan eruption from Santorini Island (Aegean Sea). Important point is the highlight of different behaviours of transport and dispersal of fine ash along and transverse the main dispersal axes, due to the contrasting patterns of high- and low-atmosphere winds.

- *Sulpizio R., Zanchetta G., Caron B., Dellino P., Mele D., Giaccio B., Insinga D., Paterne M., Siani G., Costa A., Macedonio G., Santacroce R. (2012). Volcanic ash hazard in the Central Mediterranean assessed from geological data. Bulletin of Volcanology, submitted for publication.*

This paper provides, for the first time, maps of cumulative dispersal of ash from Italian volcanoes during Holocene. The collation of the different dispersal areas provides frequency maps of ash deposition over a broad area that encompasses central and southern Italy and Balkans. The economic and social impact of ash deposition in case of renewal of explosive activity at Italian volcanoes is also discussed.

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Conclusive remarks

The granted project has provided significant steps forward into the comprehension and forecast of ash dispersal during explosive volcanic eruptions. Some innovative papers were published and submitted for publication, between which the most relevant is that related to use of supercomputing facilities for the numerical simulation of ash dispersal at a regional scale. The use of field, laboratory, and meteorological data as input parameters for numerical simulations were merged together, providing an interdisciplinary approach to the study of volcanic ash dispersal.

The outputs of these papers represent tools of paramount importance for volcanic hazard managements in the central Mediterranean and western Mexico, which are all densely inhabited.

Sincerely

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