Programma Sessione 5

Sessione 5 - Modelli matematico-statistici nelle GeoScienze

ORALE:
Chairman: Antonella Bucchi & Carlo Cardellini
Mercoledì 08.09.2010
Aula Economia 1

5-1  14.00 - 14.15
RICCUCCI S.*, SALVINI R., FRANCIONI M. & MACHETTI E.
Application of distinct elements methods for rocky slope stability analysis in the Carrara Marble District (Apuan Alps)

5-2  14.15 - 14.30
SALVINI R.*, FRANCIONI M. & RICCUCCI S.
Slope stability analysis and rock fall simulation for the assessment of geological risk of a railroad line

5-3  14.30 - 14.45
PASCADELLA A., AUDISIO C.* & LOLLINO G.
Application of cellular automaton model for river morphological studies: CAESAR and the Pellice River (Piedmont, Italy)

5-4  14.45 - 15.00
LEPORE S.*, SCARPA C.
Transient behaviour simulation of large, explosive, and ignimbrite forming eruptions by a multiphase thermo-fluid dynamic model

5-5  15.00 - 15.15
D'ALBORE F.*, LUONGO G.
An analogue model of triple junction for the Neapolitan volcanism

5-6  15.15 - 15.30
PASCADELLA A. & NOVEMBRE D.*
An empirical-analytical mathematical model to simulate the loss in weight of CI during the synthesis process of sodalite by the use of meta kaolinite

POSTER: MERCOLEDÌ

5-7
FEDORYSHYN O.
Study of basic physical properties of rocks based on theory of stochastic inhomogeneous mediums
**Transient behaviour simulation of large, explosive, and ignimbrite forming eruptions by a multiphase thermo-fluid dynamic model**

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Key words: ignimbrite-forming eruptions, multiphase dynamic model, stratified deposits, two-dimensional numerical simulations

**INTRODUCTION**

A multiphase thermo-fluid dynamic model has been improved to assess the effect of a range of particle size on the transient two-dimensional behaviour of large, explosive, and ignimbrite forming eruptions. The model accounts for mechanical and thermal non-equilibrium conditions between a continuous gas phase and N solid phases characterized by specific physical properties (NERI A. et alii). The dynamics of the process was simulated by adopting a grid scale approach able to resolve the meso-scale features of the flow and the high sub-grid gas turbulence. Viscous and interphase effects were expressed in terms of newtonian stress tensors and gas-particle or particle-particle coefficients (DARTEVELLE S. et alii). Several numerical simulations of such collapsing explosive eruptions were carried out. Their dynamics depict the formation of the vertical jet, the column collapse, the building of the pyroclastic fountain, the generation of radially spreading pyroclastic current, and the development of thermal convection instabilities in the fountain and in the current. The results highlight the importance of the multiphase development of the model and describe several mechanical and thermal non-equilibrium effects. Low concentration zones tend to follow the dynamics of the hot ascending gas, both in the convective plume above the fountain, and in the propagation of the associated pyroclastic current. High concentration parts tend to sediment mainly along the ground, both in the proximal area for the mixing of material in the fountain, and in the boundary layer for the loss of momentum.

**DISCUSSION**

Two large, explosive, and ignimbrite forming eruptions occurred during the last 40 ka in the Campi Flegrei volcanic field. The oldest (39 ka) and largest (>300 km$^3$) is the Campanian Ignimbrite (CI) that emplaced a grey to yellow ash deposit widely dispersed. The general features of the CI are quite similar to the standard ignimbrite (SPARKS et alii). The youngest is the Neapolitan Yellow Tuff (NYT), a phreatoplinian eruptive event (50 km$^3$ in DRE) occurred about 15 ka ago (DEINO A. L. et alii). Two different depositional members (A and B) have been identified. The member B is constituted by pyroclastic currents deposits which form a thinly stratified succession tens of metres high, with hundreds of layers from centimetres to metres thick (SCARPATI C. et alii). This succession is composed of six depositional units: massive, inverse-graded, regressive sand-wave, stratified, particle aggregate, and vesicular. Vertical and horizontal facies variations testify the unsteady and non-uniform nature of the parental pyroclastic currents. The stratified unit is poorly sorted and characterized by numerous laminae whose thickness varies from a few millimetres to about ten centimetres (COLE P. D. et alii). The thinly stratified nature of this unit can be interpreted as the deposition product from a concentrated boundary layer of a turbulent and stratified pyroclastic current, where sedimentation is mainly due to traction carpet motion (BRANNEY M. et alii). For a more clear view, in Fig. 1 a schematic picture of the dynamics of a stratified pyroclastic current is represented, together with the associated concentrated and traction-dominated boundary layer.

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![Fig. 1 – A picture of a stratified pyroclastic current with a concentrated boundary layer (from Branney M. and Kokelaar P., 2002)](image)
The numerical simulations carried out recently reproduce the behaviour of a pyroclastic current emplacing such type of stratified units. In Fig. 2 two snapshots at 90 and 135 seconds of a numerical simulation of a collapsing explosive eruption are shown. After about five hundred metres, the high-concentration (red) layer may be assimilated to the concentrated and traction-dominated boundary layer, while the stratified and turbulent section (orange → blue) represents the main part of the pyroclastic current. Closer to source, phoenix clouds start to form because the flow system is losing its horizontal momentum. At greater distances, other rising phoenix clouds come out for turbulence from the high-concentrated basal part. Our final purpose is to relate stratified ignimbrites with the simulated turbulent pyroclastic current.

REFERENCES


