Z164-P009 **Room: Poster Session Hall** **Time: May 20**

Lahar deposits preserved in a relict plunge-pool, northern flank of Vesuvio Volcano, Italy

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Post- and syn-eruptive hydrological processes (i.e. lahar) can create more cataclysmic hazards than primary eruptive processes (e.g., Newhall and Punongbayan, 1996), in terms of extensiveness (e.g., inundation of far-distant areas less affected by primary pyroclastic fall/flow deposits) and persistence (i.e., 10's to 1000's of years of influence on surrounding river basins by high sediment loads of volcanic debris). Hence, triggering mechanism, transportation and depositional processes of lahar should be understood and addressed well from the viewpoint of post-eruptive volcanic hazards.

Lahar deposits derived from historic eruptions are good examples in the discussion of lahar processes, characteristics and controlling factors such as eruptive styles, history and volume, topography, drainage patterns, and climate. However, such young lahar deposits in downstream areas (i.e., distal volcanic fan to apron areas) are rarely dissected by gullies and channels, limiting direct field observation of sedimentary successions. Also, lahar sequences and evidence may not always be preserved in proximal areas of active volcanoes (i.e., volcanic edifice to fan areas) due to generally erosional or bypassing nature of sediments and/or overprinting by other lava and pyroclastic deposits. On the other hand, recognition and hydrologic reconstruction of ancient floods have been addressed by geomorphological and sedimentological analyses of slackwater deposits preserved in gorges and tributary mouths of rivers in mountainous areas (Kochel and Baker, 1988; Jones et al, 2001). However, such geomorphological and sedimentological characteristics of lahar in slackwater environments are rarely preserved completely in volcanic edifice, and are often overlooked in geological studies.

Facies and grain-size analyses for deposits preserved in a rockshelter near a relict plunge pool in the upstream area of Somma-Vesuviana, northern flank of Vesuvio volcano, Italy, indicate post-eruptive lahar events after scoria fall eruption. The eruptive and post-eruptive sequence can be subdivided into seven litho- and sedimentary facies units, namely unit 0, unit 1, unit 2/3, unit 4, and unit 5/6, in ascending order. Unit 0 consists of well-sorted scoria fall deposits overlain by fine ash fall deposits. Massive unit 1 deposits, very poorly sorted, are rich in silt component that can be interpreted as cohesive debris flow deposits. Unit 2/3, composed of very coarse sand to pebble sized volcaniclastic material, is characterised by massive facies to very crude stratifications. Their strongly bimodal grain-size distribution indicates en masse sedimentation from debris flow. Unit 4 deposits are laminated fines derived from suspension settling. Unit 5/6 deposits are moderately sorted and crudely stratified, indicating hyperconcentrated flow/streamflow deposits. The grain-size distribution of the units shows unimodal patterns suggesting grain-size segregation within flows. The scoria fall deposits are most probably derived from the AD 472 eruption of Vesuvio volcano, based on the lithofacies. Temporal changes of the lahar event in the eruption aftermath include: stage 1) cohesive debris flow; stage 2) cohesionless debris flow; stage 3) ephemeral slackwater environment; and stage 4) hyperconcentrated flow/stream flow phases. The lahar event, thus, shows a progressive decrease in solid sediment particle concentration and subsequent flow transformation into more dilute ones with time, and finally background sedimentation was reestablished.

The good preservation of lahar event deposits was probably due to a sudden drop of flow velocity of lahar at the waterfall (nick-point) and the notch-like shape of the rock shelter that protected sediments against erosion. Volcanic edifices usually contain water- and lava-fall topography with rock shelters, and analyses of sediments preserved there, if any, provide a key to understand lahar event history, magnitude, and controlling factors.