Grain size distributions of volcanic particles by CAMSIZER

Lo Castro M.D., Andronico D.

Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Catania

Grain size distribution is a key parameter in physical volcanology to describe and characterize tephra fall deposits. Walker (1973) used grain size parameters to propose a classification scheme of explosive volcanic eruptions. More recently, the role of grain size populations of eruptive mixtures at the vent has been widely considered a crucial *input parameter* for the application of numerical models simulating both plume and tephra dispersal (e.g. Cioni et al., 2003; Andronico et al., 2008; Scollo et al., 2008). Grain size analysis can be performed by various techniques that differ in their applicability, technology and affordability. The most commonly used technique is sieving, performed by a nested column of sieves arranged in decreasing order of aperture size (http://www.ivhhn.org/). Sieving can be performed manually or by machine shaking, usually in the particle range from 64 mm to less than 32 µm. Both these procedures are cumbersome, time-consuming and subject to many errors.

Here, we present a new methodology to measure the distribution of volcanic particles by CAMSIZER® (Figure 1), an instrument developed by Retsch Technology GmbH (Haan) and Jenoptik AG (Jena) in Germany (see at http://www.retsch.com).

CAMSIZER is a compact laboratory instrument for the simultaneous measurement of particle size distribution and particle shape of incoherent materials in the range of 30 µm to 30 mm, based on digital image processing. The sample is fed in from a vibrating feed channel that controls particles falling through the measurement field, where images of the particle flow are recorded by two digital cameras (Basic and Zoom) with different resolutions (Andronico et al., 2009). The Basic camera provides the analysis of the larger particles, while the Zoom camera focuses on smaller particles furnishing high resolution images of the finer classes of the wide measuring range. Software created by Retsch Technology enables processing digital images and providing grain size and shape parameters. Although this instrument is becoming very common in industry for quality control, research and production monitoring of very different kinds of materials, it has never been used before in volcanology.

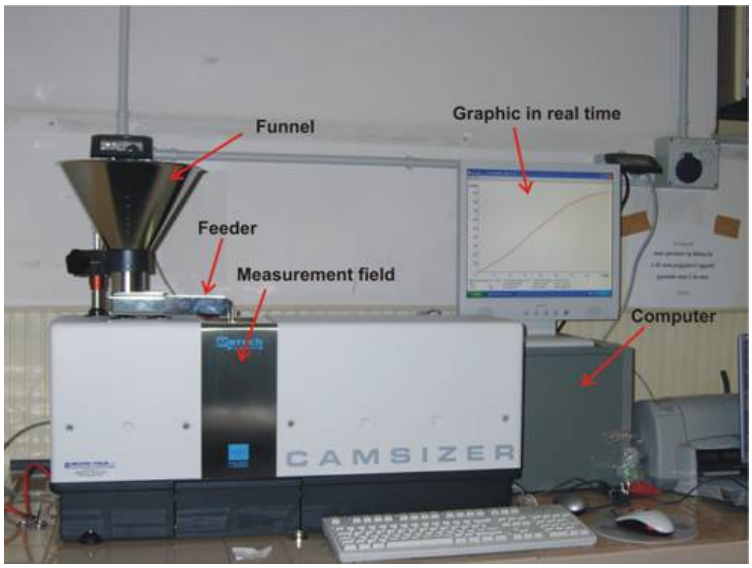

Fig. 1 - CAMSIZER instrument at INGV-CT. The most important components and accessories are indicated.

CAMSIZER has recently been installed at Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Catania (INGV-CT) to measure grain-size distribution of volcanic particles within the volcanic monitoring activity of Eastern Sicily (Lo Castro and Andronico, 2008). As is well-known, this area is characterized by the presence of two of the most active volcanoes in the world, Mt. Etna and Stromboli, which commonly produce large quantities of tephra (e.g. Rosi et al., 2000; Alparone et al., 2007). The use of CAMSIZER on volcanic products ranging from fine lapilli to ash have allowed us to obtain detailed particle size analysis and drastically reduce the work and measuring time needed in classical sieve analysis. To optimize these objectives, CAMSIZER has been tested on different materials, not only volcanic, in order to calibrate the instrument and compare results with those obtained by sieving. In particular, we present results derived by two different kinds of test: the first regards repeatability by measuring the same sample several times to determine the accuracy of the instrument, the second concerns the compatibility between sieve analysis and CAMSIZER results. Our work suggests that CAMSIZER may constitute a good tool to improve grain size analysis in volcanology and thus help in tephra hazard assessments.

References

Alparone S., Andronico D, Sgroi T., Ferrari, F., Lodato L., Reitano, D., 2007. Alert system to mitigate tephra fallout hazards at Mt. Etna Volcano, Italy. Nat Hazards, DOI 10.1007/s11069-007-9120-7.

Andronico D., Scollo S., Cristaldi A., Caruso S., 2008. The 2002-03 Etna explosive activity: Tephra dispersal and features of the deposit. J. Geophys. Res., 113, B04209, doi:10.1029/2007JB005126.

Andronico D., Scollo S., Cristaldi A., Ferrari F, 2009. Monitoring ash emission episodes at Mt. Etna: the 16 November 2006 case study. J. Volcanol. Geotherm. Res., doi: 10.1016/j.jvolgeores.2008.10.019, 180, 123-134.

IVHHN - International Volcanic Health Hazard Network, 2006. Guidelines for Grain-Size Distribution Analysis, available at http://www.dur.ac.uk/claire.horwell//guidelines/grainsize/gsd.html.

Lo Castro D., Andronico D., 2008. Operazioni di base per la misura della distribuzione granulometrica di particelle vulcaniche tramite il CAMSIZER. Rapporti Tecnici INGV, 79.

Rosi M., Bertagnini A., Landi P., 2000. Onset of the persistent activity at Stromboli volcano (Italy). Bull. Volcanol. 62, 294–300.

Scollo S., Folch A., Costa A., 2008.A parametric and comparative study of different tephra fallout models. J. Volcanol. Geoth. Res., 176, 199-211.

Walker G.P.L., 1973. Explosive volcanic eruptions - a new classification scheme. Geol. Rundsch. 62, 431–446.