RESEARCH FIELD:
Field and experimental volcanology, monitoring active Volcanoes, Geothermics, assessment and modelling of physical properties of rocks, magmas and silicate melts, archaeomagnetic dating of sites of volcanological and archaeological interest

RESEARCH TOPIC:
Magmatic and volcanic processes, geochemical monitoring and satellite-thermal monitoring. Rheology of volcanic materials, archeomagnetic dating on active volcanoes for civil protection purposes

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RESEARCH DESCRIPTION:
The group has been recently concentrated its research in monitoring radon emissions at active volcanoes and has been collecting satellite thermal data. Research studies are also concentrated on the petrology and geochemistry of magmas. Experimental research is focused on the determination and modelling of the rheological, physical, structural and petrophysical properties of magmas, lavas and silicate melts. Real-time radon monitoring and satellite thermal analysis seems to be rather promising and strategic for identifying precursory signals: we developed a software that automatically downloads the original MODIS (Moderate Resolution Imaging Spectroradiometer) and VIIRS (Visible Infrared Imaging Radiometer Suite) data. These are automatically processed, elaborated within 3

hours thus measuring the Volcanic Radiative Power (cf. http://www.mirova.unito.it) that can be converted into time average lava discharge rates (TADR). Satellite monitoring allow us to detect, in near-real time, the values of thermal background, threshold and anomaly typical of a given volcano that may be associated with changes in volcanic activity.
Experimental data on the physical (e.g., porosity and permeability), rheological and viscoelastic properties (such as viscosity, elastic moduli, brittle behavior) as well as the themodynamic properties (specific heat, density, glass transition temperature) of volcanic materials and experimental analogs are modeled following numerical approaches. Petrophysical properties are determined as a function of P and T, by reproducing deformation mechanisms at simulated effective pressures. Identification of slow deformation/pre-failure mechanisms and related physical parameters is carried out in the laboratory and the field. Experimental results contribute to better assess deformation mechanisms and flank instability.
Dating volcanic and archeological materials may contribute to better constrain hazard on active volcanoes.

LABORATORIES OF THE DST IN USE:
SEM-EDS, X-ray Microfluorescence, Thin section, Crushing rocks and separation materials, Microraman, Engineering Geology and Hydrogeology Laboratory

RESEARCH PRODUCTS:

- Cigolini C., Di Martino M., Laiolo M., Coppola D., Rossetti P., Morelli M. (2012). Endogenous and non-impact origin of the Arkenu Circular Structures, al-Kufrah Basin (SE Libya). Meteoritics & Planetary Science, 47/12, 1-17, ISSN: 1945-5100, doi: 10.1111/maps.12012.
- Coppola D., Laiolo M., Piscopo D., Cigolini C. (2013). Rheological control on the radiant density of active lava flows and domes. J. Volcanol. Geoth. Res., 249, p. 39-48, ISSN: 0377-0273, doi: 10.1016/j.jvolgeores.2012.09.005.
- Coppola D., Piscopo D., Laiolo M., Cigolini C., Delle Donne D., Ripepe M. (2012). Radiative heat power at Stromboli volcano during 2000-2011: Twelve years of MODIS observations. J. Volcanol. Geoth. Res, 215, 48-60, ISSN: 0377-0273, doi: 10.1016/j.jvolgeores.2011.12.001
- Giordano D., M. Polacci, P. Papale, and L. Caricchi (2010). Rheological control on the dynamics of explosive activity in the 2000 summit eruption of Mt. Etna. Solid Earth, 1, 61–69, 2010 doi:10.5194/se-1-61-2010.
- Heap M. J. , Baud P., Meredith P.G., Vinciguerra S., Bell A.F., Main I. G. (2011) Brittle creep in basalt from Mt Etna volcano: implications for time-dependent volcano deformation, Earth and Planetary Science Letters, doi: 10.1016/j.epsl.2011.04.035.
- Laiolo M., Cigolini C., Coppola D., Piscopo D. (2012). Developments in real-time radon monitoring at Stromboli volcano. J. Environmental Radioactivity, vol. 105, p. 21-29, ISSN: 0265-931X, doi: 10.1016/j.jenvrad.2011.10.006.
- Mercier M., Di Muro A., Métrich N., Giordano D., Belhadj O., Mandeville C.W. (2010). Spectroscopic analysis (FTIR, Raman) of water in mafic and intermediate glasses and glass inclusions. Geochim. Cosmochim. Acta 74, 5641-5656.
- Mollo S., Tuccimei P., Heap M.J., Vinciguerra S., Soligo M., Castelluccio M., Scarlato P., and Dingwell D. B.(2011) Increase in radon emission due to rock failure: An experimental study, Geophys. Res.Lett.,38,L14304,doi:10.1029/2011GL047962.
- Vinciguerra S., Del Gaudio P., Mariucci M. T., Marra F., Meredith P. G., Montone P., Pierdominici S., Scarlato P., Physical properties of tuffs from a scientific

borehole at Alban hills volcanic district (central Italy), Tectonophysics, 471, 161–169, doi: 10.1016/j.tecto.2008.08.010, 2009.

- Vona A., Romano C., Dingwell D.B., Giordano D. (2011). The rheology of crystal-bearing basaltic magmas from Stromboli and Etna. Geochim. Cosmochim. Acta 75, 3214-3236.

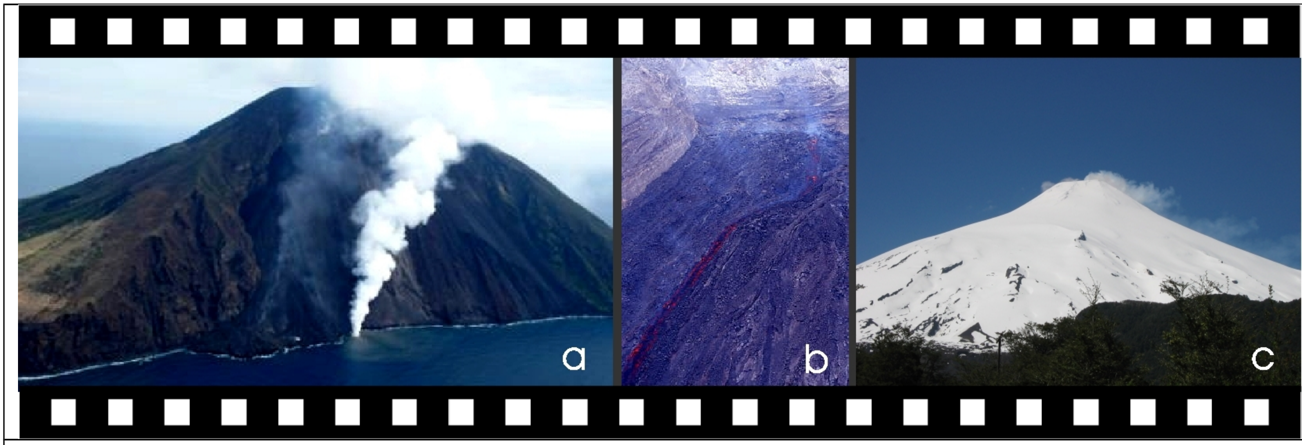

Figure 1 a) Stromboli eruption 2007 (Mar, 2007); b) detail of the 2002-2003 Stromboli lava flow (Jan, 2003); c) summit degassing activity at Villarrica volcano (Nov, 2004).

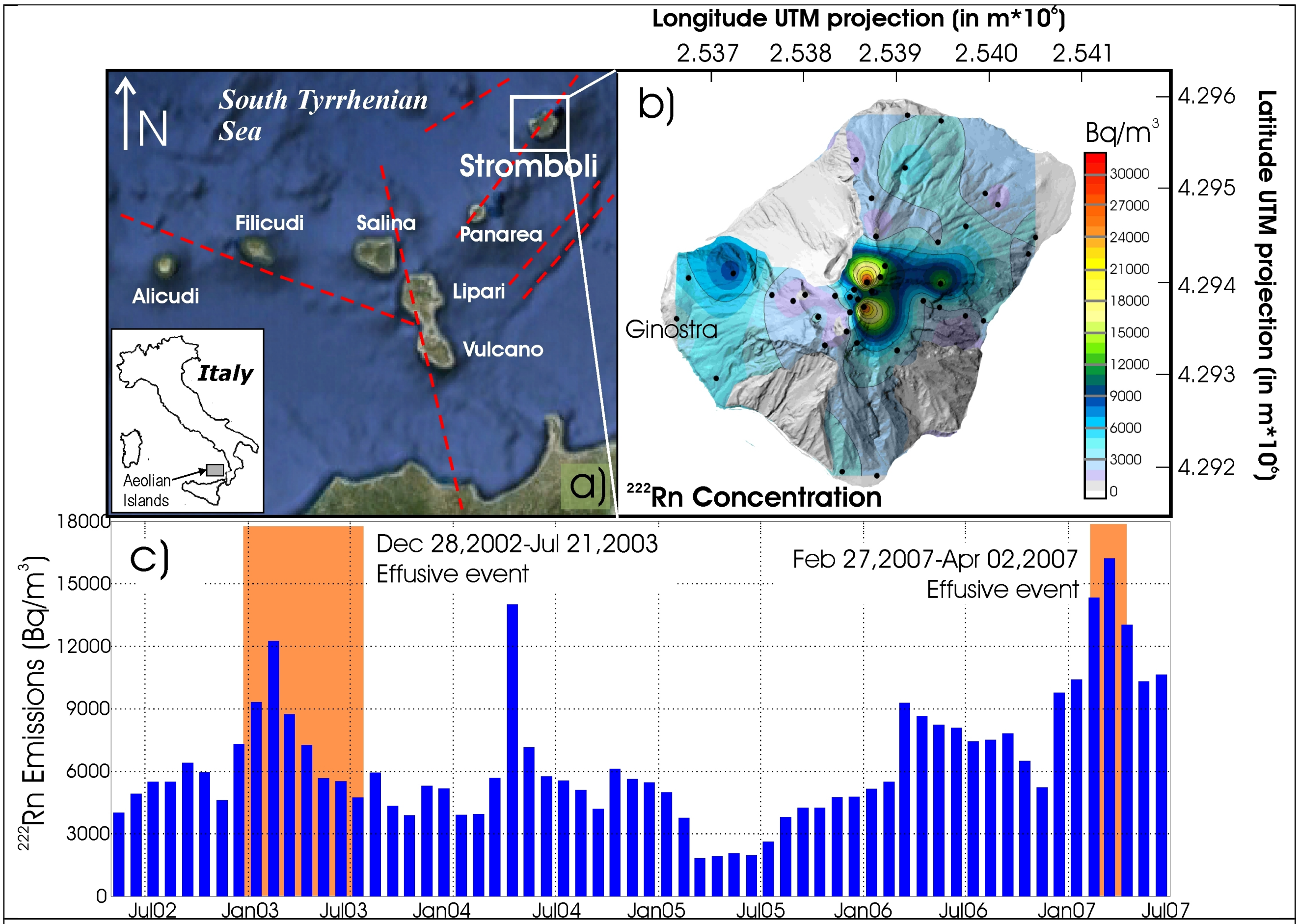

Figure 2 – In-soil radon concentrations measured at Stromboli island (a-b) and time-series of monthly radon emissions at Stromboli during 2002-2007 (c) (cf. Cigolini et al. 2009; J. Volcanol. Geotherm. Res., DOI: 10.1016/j.jvolgeores.2009.04.019) .

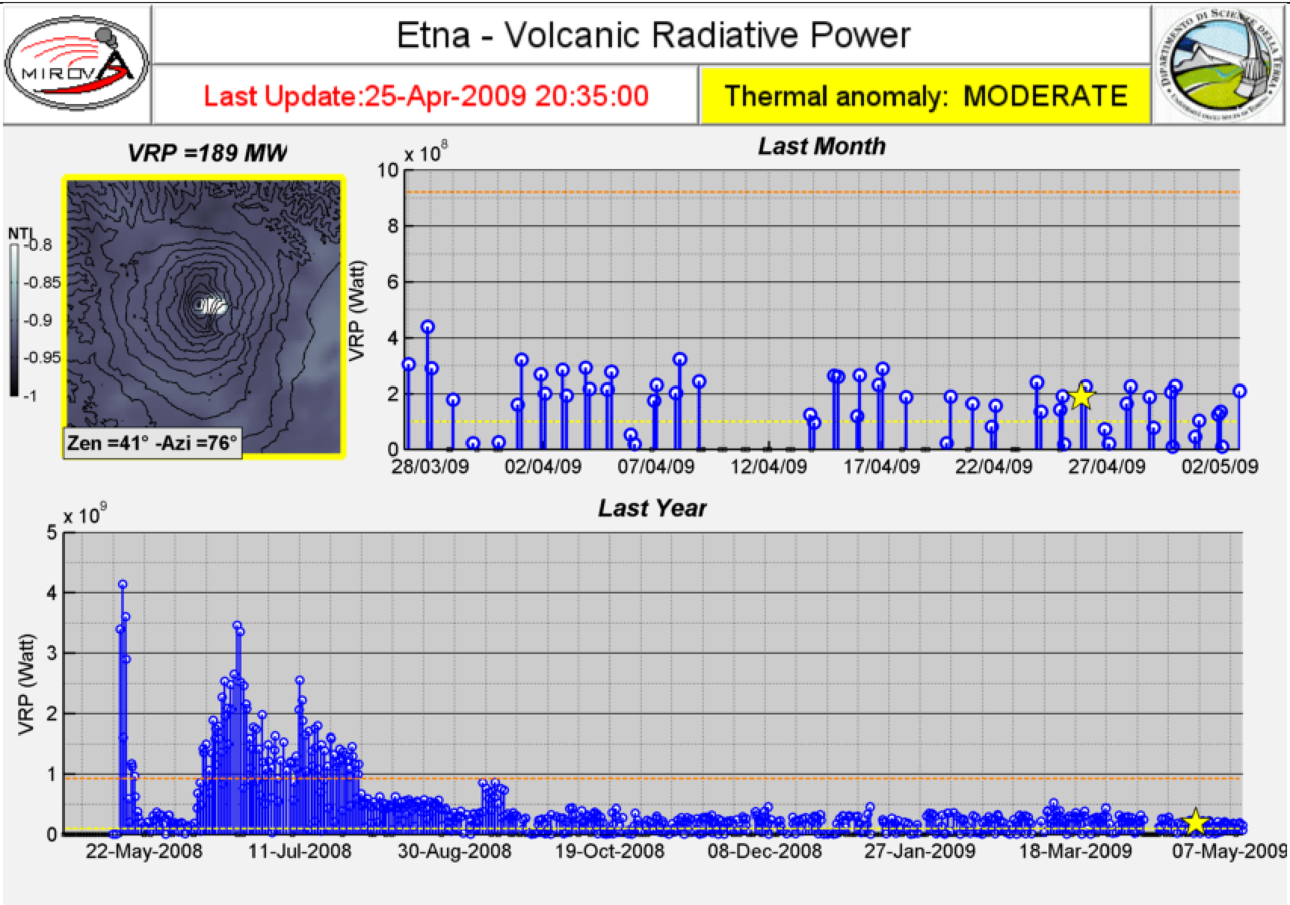

Figure 3 – Time-series of thermal activity at Mt. Etna during 2008-2009. The Volcanic Radiative Power (VRP) is obtained by using MODIS data.

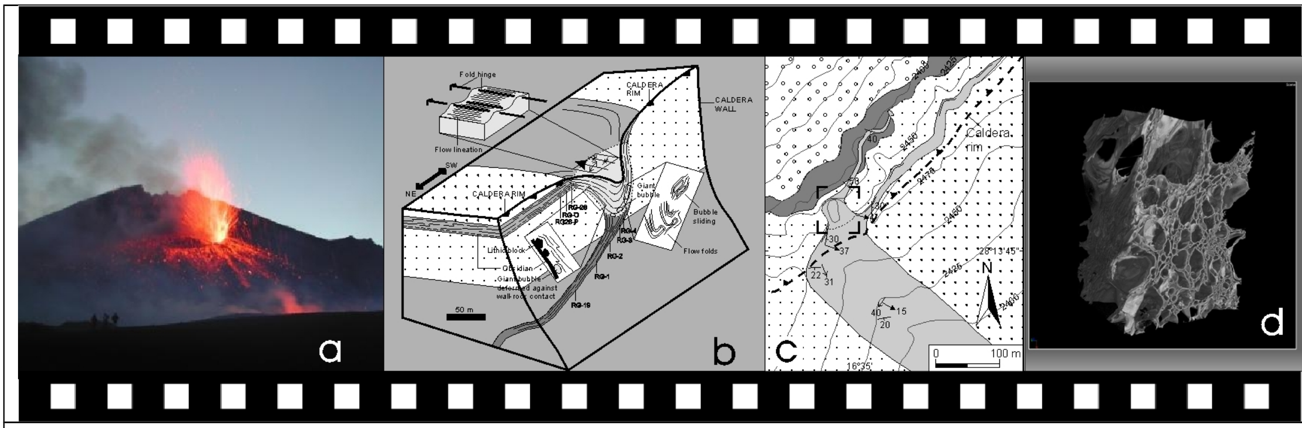

Figure 4 – a) Strombolian activity at the Etna volcano (cf. Giordano et al., 2010, Solid Earth, doi:10.5194/se-1-61-2010); b-c) structural scheme and geological map of the La Grieta Member, Tenerife (cf. Soriano et al. 2009, Bull. Volcanol., DOI 10.1007/s00445-009-0275-9); d) textural features of pomice obtained with synchrotron X-ray computed microtomography (cf. .Polacci et al 2013, submitted).

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