Workshop IODP-Italia "Lo stato delle proposte di perforazione nell'area mediterranea"
Scientific Drilling in the Mediterranean Sea
Roma, 15-16 gennaio 2018

Abstract

I giovani ricercatori italiani nell'ambito dei programmi internazionali di perforazione scientifica

The relevance of studying the areal and thickness distribution in the Mediterranean Sea of Campanian Ignimbrite, Campi Flegrei, Italy

AURORA SILLENI(*[1]), GUIDO GIORDANO([1]), ROBERTO ISAIA([2]), PETE J. ROWLEY([3])

(*[1]) Dipartimento di Scienze, Università di Roma Tre, Roma, Italy *corresponding author*
(2) Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Vesuviano, Napoli, Italy
(3) School of Environmental Sciences, University of Hull, Hull, United Kingdom

Key words:

Campi Flegrei, Campanian Ignimbrite, isopach, large-scale ignimbrite, ocean drilling.

Argomento della ricerca nella perforazione scientifica

The drilling of the Mediterranean Sea near Pozzuoli and Napoli Bay is the topic of this research. The aim of this work is to evaluate the thickness of the Campanian Ignimbrite (CI) eruption at sea, in order to complete an isopach map developed for the PDC of CI and fasten data from drilling with seismic lines that already exist. The isopach map is essential to calculate a new accurate volume value, a key topic in the eruptive history of Campi Flegrei.

Abstract

The study of large scale explosive eruptions and their deposits is essential to understand the eruptive dynamics of active volcanoes as Campi Flegrei. Campanian Ignimbrite (CI) is the largest caldera forming eruption of Campi Flegrei, which occurred 39 ka (De Vivo et al. 2001). The main CI is interpreted as emplaced by a highly energetic and dilute PDC that travelled more than 80 km from the source, over an area of > 30.000 km^2, and surmounted ridges more than 1000 m high (Fisher et al. 1993; Dade and Huppert 1996). Despite the large number of works regarding volume estimation of the eruption, the calculation of volume DRE ranges from 23 to 300 km^3 (Cornell et al. 1983; Rosi and Santacroce 1983; Fisher et al. 1993; Civetta et al. 1997; Fedele et al. 2003; Rolandi et al. 2003; Giaccio 2006; Marianelli et al. 2006; Pyle et al. 2006; Pappalardo et al. 2008; Costa et al. 2012; Scarpati et al. 2014).

Isopach map is a significant work instrument intended to show the dispersion of pyroclastic deposits, as well as the thickness of deposits and dispersal area in relationship to paleotopography. CI is one of the most investigated ignimbrites, but it still lacks a complete isopach map reporting a detailed description of the thickness variations related to distance and across topography. In the Napoli Bay CI is more than 100 m thick (Milia 1999; Rolandi et al. 2003), but data about Pozzuoli Bay and Mediterranean area are still missing. Seismic study data exist for the Napoli Bay, however, there is a lack of borehole data to gather the physical properties of CI (e.g. seismic velocity) to convert travel times to unit thicknesses across the survey areas.

Abstract

I giovani ricercatori italiani nell'ambito dei programmi internazionali di perforazione scientifica

Furthermore, it is difficult to recognize CI compared to other volcanic deposits from Campi Flegrei or Vesuvio in the seismic data so tying to borehole data is necessary.

Bibliographic data were collected both in proximal and distal areas from more than 80 published papers. All the data have been geo-referenced in the open source Quantum GIS (QGIS) along with geological maps of Italy at the scale 1:100.000 and 1:50.000. Stratigraphic logs and boreholes were divided in two different categories: first group includes those showing the maximum thickness of CI, with some units at the bottom and at the top, and second group those presenting a minimum thickness because of the lack of a unit at the base. A topographic slope map has been derived from a Digital Elevation Model. Assuming that the 39 ka paleo-topography was not too different from the present-day topography, isopach lines were traced on this map. Geological maps at the scale 1:50.000, if possible, or 1:100.000, were used to trace the isopach line 0 m in correspondence of CI limits. In addition to the data collection, field work has been conducted in strategic locations to detail the topographic control over the deposit distribution.

Isopach map (Fig. 1) could be briefly completed with some field work for subaerial part, but there are still missing data in the Mediterranean area, except in the Napoli bay (Milia 1999; Rolandi et al. 2003). Data collected from boreholes and ocean drilling are indispensable to calculate the physical properties of CI and to integrate the map with the seismic lines that already exist.

Studying the depositional features of CI from the boreholes is also possible to define the paleo environment and the position of coastline 40 ka. As a matter of fact, depositional characteristics gave us the information if the deposition occurred in subaerial or submarine environment.

To figure out the physical properties, the thickness and the areal distribution of CI, especially in the Mediterranean area, is a key point to understand the PDC dynamics and the relation with topography associated with large scale explosive eruption. The availability of data about deposition in the western sector of Campi Flegrei could be a significant help to calculate a new accurate volume value, to improve the numerical modelling of large pyroclastic flows and it could be used to determine the hazard in Campi Flegrei area.

Workshop IODP-Italia "Lo stato delle proposte di perforazione nell'area mediterranea"
Scientific Drilling in the Mediterranean Sea
Roma, 15-16 gennaio 2018

Abstract

I giovani ricercatori italiani nell'ambito dei programmi internazionali di perforazione scientifica

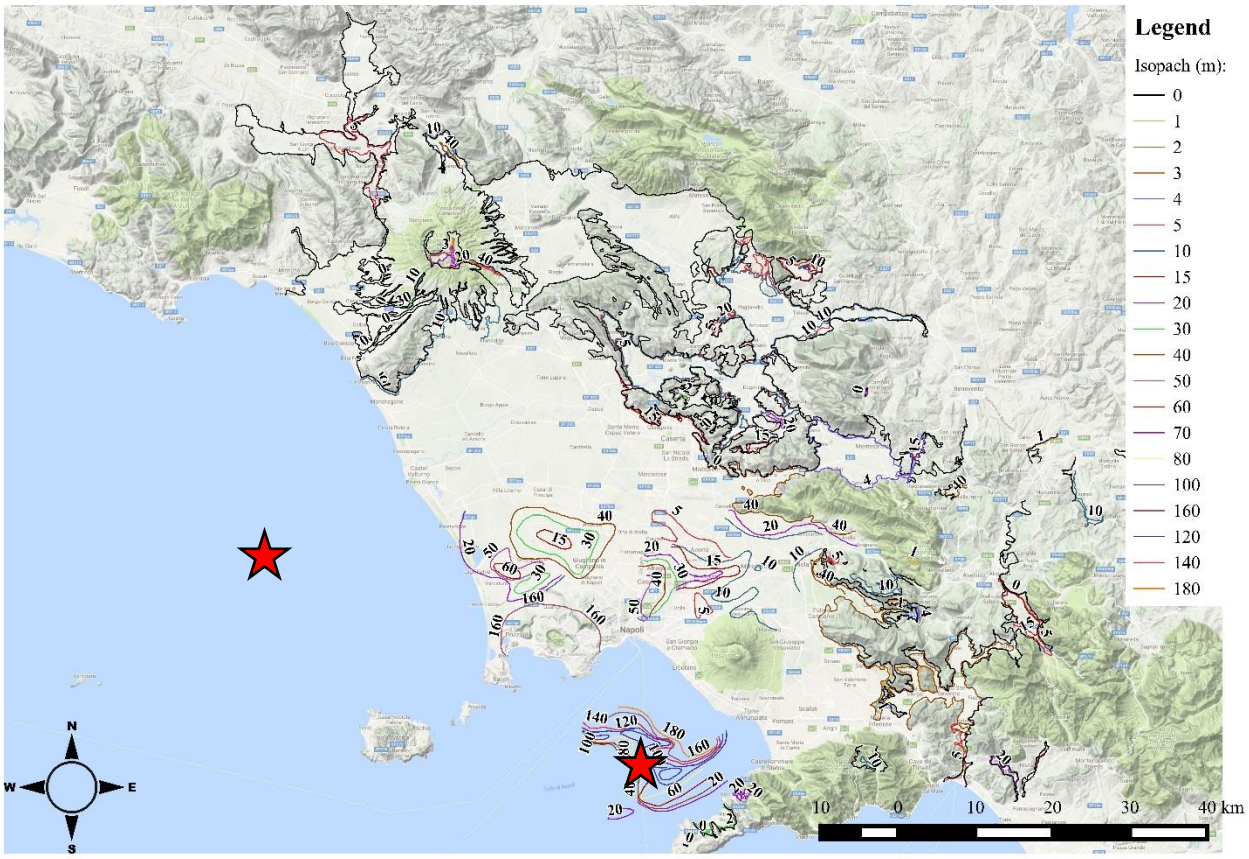

Fig. 1 Preliminary isopach map of Campanian Ignimbrite, Campi Flegrei. Isopach lines in the Campanian plain and Mediterranean Sea are from bibliography (Scandone et al. 1991; Rolandi et al. 2003). Red stars point out possible areas for ocean drilling, which could fasten seismic lines already performed. Google Terrain on QGIS was used like a base map for this work.

References

Civetta L, Orsi G, Pappalardo L, et al (1997) Geochemical zoning, mingling, eruptive dynamics and depositional processes - the Campanian Ignimbrite, Campi Flegrei caldera, Italy. J Volcanol Geotherm Res 75:183–219.

Cornell W, Carey S, Sigurdsson H (1983) Computer simulation of transport and deposition of the campanian Y-5 ash. J Volcanol Geotherm Res 17:89–109. doi: 10.1016/0377-0273(83)90063-X

Costa A, Folch A, Macedonio G, et al (2012) Quantifying volcanic ash dispersal and impact of the Campanian Ignimbrite super-eruption. Geophys Res Lett 39:3–7. doi: 10.1029/2012GL051605

Abstract

I giovani ricercatori italiani nell'ambito dei programmi internazionali di perforazione scientifica

Dade WB, Huppert HE (1996) Emplacement of the Taupo ignimbrite by a dilute turbulent flow. Nature 381:509–512.

De Vivo B, Rolandi G, Gans PB, et al (2001) New constraints on the pyroclastic eruptive history of the Campanian volcanic Plain (Italy). Mineral Petrol 73:47–65. doi: 10.1007/s007100170010

Fedele FG, Giaccio B, Isaia R, Orsi G (2003) The Campanian ignimbrite eruption, Heinrich event 4, and Palaeolithic change in Europe: a high-resolution investigation. Geophys Monogr 301–325. doi: 10.1029/139GM20

Fisher R V., Orsi G, Ort MH, Heiken G (1993) Mobility of a large-volume pyroclastic flow - emplacement of the Campanian ignimbrite, Italy. J Volcanol Geotherm Res 56:205–220. doi: 10.1016/0377-0273(93)90017-L

Giaccio B (2006) L ' eruzione dell ' Ignimbrite Campana (c . 40 ka BP), oscillazioni climatiche sub-orbitali e i cambiamenti bioculturali dell ' OIS 3 europeo Tesi di Dottorato.

Marianelli P, Sbrana A, Proto M (2006) Magma chamber of the Campi Flegrei supervolcano at the time of eruption of the Campanian Ignimbrite. Geology 34:937–940. doi: 10.1130/G22807A.1

Milia A (1999) Aggrading and prograding infill of a peri-Tyrrhenian basin (Naples Bay, Italy). Geo-Marine Lett 19:237–244. doi: 10.1007/s003670050114

Pappalardo L, Ottolini L, Mastrolorenzo G (2008) The Campanian Ignimbrite (southern Italy) geochemical zoning: Insight on the generation of a super-eruption from catastrophic differentiation and fast withdrawal. Contrib to Mineral Petrol 156:1–26. doi: 10.1007/s00410-007-0270-0

Pyle DM, Ricketts GD, Margari V, et al (2006) Wide dispersal and deposition of distal tephra during the Pleistocene "Campanian Ignimbrite/Y5" eruption, Italy. Quat Sci Rev 25:2713–2728. doi: 10.1016/j.quascirev.2006.06.008

Rolandi G, Bellucci F, Heizler MT, et al (2003) Tectonic controls on the genesis of ignimbrites from the Campanian Volcanic Zone, southern Italy. Mineral Petrol 79:3–31. doi: 10.1007/s00710-003-0014-4

Rosi M, Santacroce R (1983) The A.D. 472 "Pollena" eruption: volcanological and petrological data for this poorly-known, plinian-type event at vesuvius. J Volcanol Geotherm Res 17:249–271. doi: 10.1016/0377-0273(83)90071-9

Scandone R, Bellucci F, Lirer L, Rolandi G (1991) The structure of the Campanian Plain and the activity of the Neapolitan volcanoes (Italy). J Volcanol Geotherm Res 48:1–31. doi: 10.1016/0377-0273(91)90030-4

Scarpati C, Sparice D, Perrotta A (2014) A crystal concentration method for calculating ignimbrite volume from distal ash-fall deposits and a reappraisal of the magnitude of the Campanian Ignimbrite. J Volcanol Geotherm Res 280:67–75. doi: 10.1016/j.jvolgeores.2014.05.009