15th International Congress of the Geological Society of Greece
Athens, 22-24 May, 2019 | Harokopio University of Athens, Greece
Bulletin of the Geological Society of Greece, Sp. Pub. **7** Ext. Abs. GSG2019-187

High-Resolution AUV Mapping of Kolumbo submarine volcano, Santorini, Greece

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An important component of volcanic activity in the southern Aegean Sea is focused along a linear feature known as the Christiana-Santorini-Kolumbo (CSK) rift (Nomikou et al., 2018). Running in a NE-SW direction, it hosts a number of volcanic centers of late Pliocene to Pleistocene age as part of the overall east-west trending Hellenic subduction zone south of the island of Crete. Natural hazards from the CSK rift pose significant threats to the eastern Mediterranean region. They include earthquakes, subaerial or submarine volcanic eruptions, gas release from volcanoes, tsunami inundation of neighboring coastlines due to eruptions or submarine landslides, and potential aviation impacts from volcanic ash plumes.

Kolumbo volcanic chain lies just off the northeast coast of Santorini the consisting of 25 submarine cones and craters (Nomikou et al., 2012; Hooft et al., 2017), that extend in a NE-SW direction along the floor of Anhydros basin. The largest of these is Kolumbo crater, a 3 km diameter cone with a 1700 m wide crater, a rim as shallow as 18 m below sea level, and a flat crater floor 505 m below sea level. Kolumbo is currently the most active and dangerous submarine volcano in the Mediterranean Sea and its crater floor hosts a high-temperature hydrothermal field with active massive sulphide deposition of potential economic significance (Kilias et al., 2013). The 1650 eruption had significant impacts in the southern Aegean area. At least seventy people, who were in the sea offshore or along the NE coast of Santorini died, from asphyxiation by acidic gases. A large tsunami on 29 September caused widespread damage on Santorini and elsewhere within a 150 km radius (Ulrova et al., 2016).

The first detailed bathymetric map of the Kolumbo volcano was produced in 2001 using the 20 kHz SB2120 swath system on R/V Aegean (Nomikou et al., 2012; 2013). Bathymetric data were also acquired on-board the R/V Marcus Langseth using the Simrad Kongsberg EM122 12 kHz multibeam echo sounder in 2015. For the first time, high resolution AUV (Autonomous Underwater Vehicle) data were collected during POS510 cruise, in 7 missions of AUV Abyss (GEOMAR) (Hannington et al., 2017), under the framework of the collaborative project "ANYDROS: Rifting and Hydrothermal Activity in the Cyclades Back-arc Basin". The goal of this project was to understand the initiation of arc rifting and associated back-arc hydrothermal activity. The focus was on the CSK rift system and Santorini-Kolumbo volcanic line, one of the few places in today's oceans where submarine rifting of a continental margin arc can be studied in its earliest stages.

We present a new bathymetric map of Kolumbo volcano based on AUV bathymetry with 2m resolution which helps to map: a) the abrupt inner slopes of Kolumbo caldera, b) the active vent field at the northern part of the crater floor (485m depth), c) the lava dykes in the inner slopes, d) the mass wasting deposits in the inner slopes, e) the curvelinear scarps with inward dipping faces at the W-NW base of Kolumbo's flanks (faults and/or remnant crater rims).

Using developed autonomous underwater vehicles (AUVs) with capabilities to map the seafloor with higher resolution than is possible with hull-mounted or towed sonar systems so as to identify seafloor geomorphological characteristics and produce detailed morphotectonic and hazard maps of active volcanic areas.

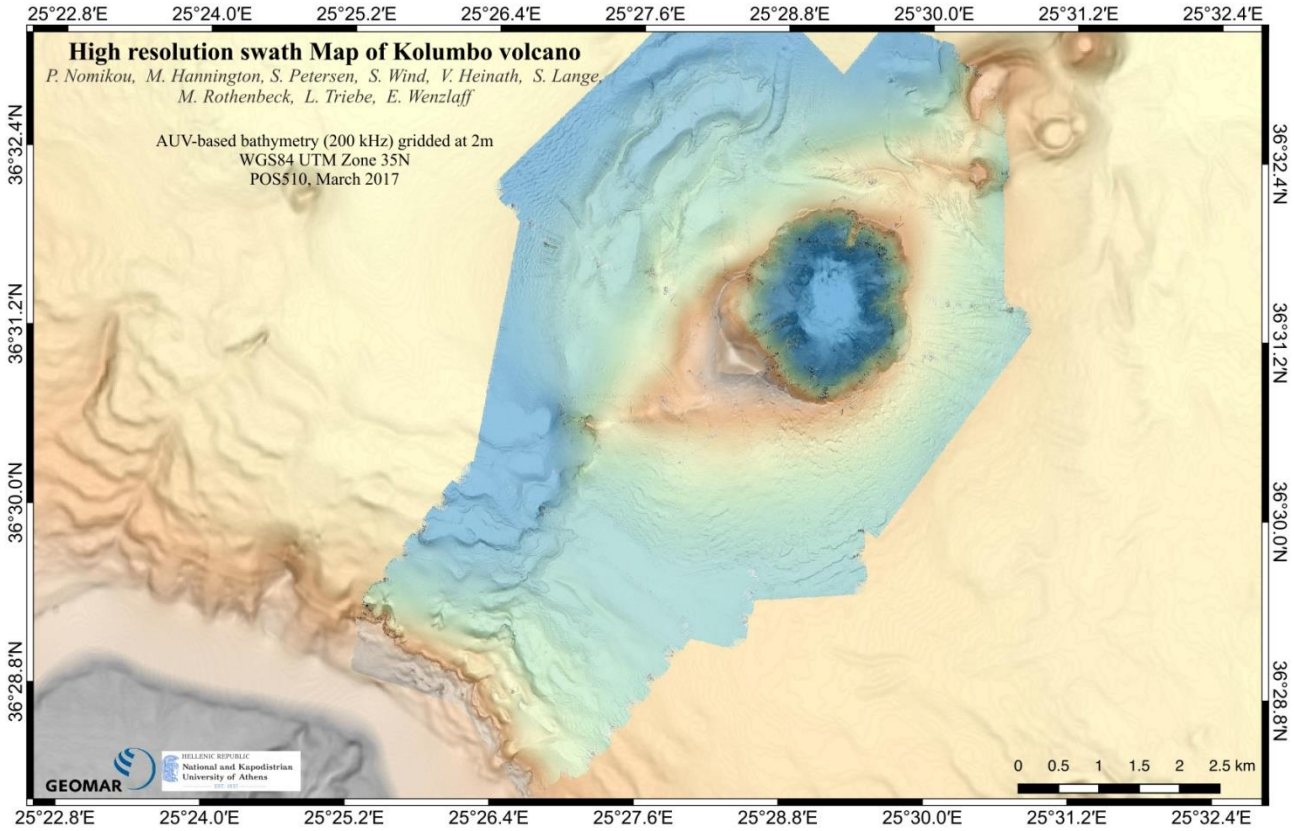

Figure 1. AUV multibeam compilation from 7 dives on Kolumbo volcano and Kolumbo line northeast of Santorini.

Acknowledgements

We thank the ship's captain and crew and science officers of the R/V Poseidon for their indispensable contribution to collecting swath datasets. For the data processing, visualization, and bathymetric maps we used the freely available software packages MBsystem and QGIS. We acknowledge funding from the "RESEARCH-CREATE-INNOVATE" of the "Competitiveness, Entrepreneurship and Innovation (EPANEK)", NSRF 2014-2020, R.G. 15336 (Research project: VIRTUAL DIVER) for the Department of Geology and Geoenvironment.

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