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The medial offshore record of Plinian arc volcanism in the Eastern Aegean Sea: Implications for tephrostratigraphy, correlations, ages and volumes

Steffen Kutterolf¹, Armin Freundt¹, Thor H. Hansteen¹, Rebecca Dettbarn¹, Fabian Hampel^{1,2}, Carina Sievers¹, Cathrin Wittig¹, Timothy Druitt³, Paraskevi Nomikou⁴, Jocelyn McPhie⁵, Katharina Pank¹, Julie C. Schindlbeck-Belo¹, Kuo-Lung Wang^{6,7}, and Hao-Yang Lee⁶

¹GEOMAR Helmholtz Institute for Ocean Research, Kiel, Dynamics of the Ocean Floor, Kiel, Germany (skutterolf@geomar.de)

²Institute for Geology and Paleontology, University of Hamburg, Germany

³Department of Geology and Geoenvironment, National Kapodistrian University of Athens, Greece

⁴Laboratory Magmas-Volcanoes, Clermont-Auvergne University, Clermont-Ferrand, France

⁵University of Tasmania, Hobart, Australia

⁶Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan

⁷Department of Geosciences, National Taiwan University, Taipei, Taiwan

The Hellenic arc hosts several active volcanic centers, of which the Milos, Santorini-Kolumbo and Kos-Yali-Nisyros volcanic fields present particularly high threats due to recent unrest (2011-2012 and 1996-1997 at Santorini and Nisyros, respectively). These volcanic centers have repeatedly produced highly explosive eruptions (VEI 4 to 7) from ~360 ka into historic times. The marine tephra record provides information not only on the number of events, but also on their magnitudes and intensities inferred from tephra dispersal characteristics, and is thus essential to quantitatively assess future volcanic hazards and risks.

Here we complement earlier work on distal to ultra-distal east-Mediterranean sediment cores, which captured the largest eruptions. We present results from a grid of medial to distal sediment cores collected in 2017 during RV Poseidon cruise POS513 with core positions both comparatively close to and between the three volcanic fields, in order to record medium- to large-scale eruptions.

During this cruise, 47 gravity cores up to 7.4 m long, and 3 box cores of the uppermost 0.5 m sediment were recovered, which contain more than 220 primary ash layers. The compositions of glass shards from all layers were characterized by major (EMP) and trace-element (LA-ICPMS) analyses.

Geochemical fingerprinting supports correlations with 20 eruptions from all three volcanic fields as well as with the 39 ka Campanian ignimbrite eruption from the Campi Flegrei, Italy. Correlations with eleven eruptions from Santorini-Kolumbo (Kameni, Kolumbo 1650, Minoan, Cape Riva, Cape Tripiti, Upper Scoria 1 and 2, Middle Pumice, Cape Thera, Lower Pumice, Cape Therma 3) are

established, and we newly identify two widespread tephras from eruptions on Milos (Lower and Upper Firiplaka). We have probably been able to solve some previous chronostratigraphic problems at Kos-Yali-Nisyros by correlating marine tephras with the Kos Plateau Tuff, and with the Yali 2 tephra, whereby we identify a second, less evolved facies produced by that eruption that has not yet been recognized on land. We also find tephras from four eruptions on Nisyros (Nisyros 1 to 4) including the previously established Lower (Nisyros 4) and Upper (Nisyros1) Nisyros Pumice eruptions.

These correlations also provide new age constraints for hitherto poorly or non-dated Aegean tephras based on sedimentation rates derived between multiple anchor points of dated terrestrial tephra ages. We deduce ages of ~22 ka and ~36 ka for Upper and Lower Firiplaka tephras from Milos (the latter overlying the Campanian ash) which are significantly younger than other eruption ages known from Milos, ~54 ka, ~62 ka, ~69 ka, and ~76 ka for the Nisyros 1 to 4 tephras, and ~52 ka for the Yali 1 tephra as well as a verified age of 33 ka for the Yali 2 tephra with its two contemporaneous facies.

These new tephrostratigraphic results help to improve quantifications of distribution and eruption characteristics for all these eruptions, and provide important pre-site survey data for the Santorini IODP proposal VolTecArc.