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Provenance of deep sea turbidites in two South Aegean basins

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Introduction

Gravitative sedimentation dominates deep basins in the Mediterranean and so far has received little attention in the Aegean Sea. An increase in sedimentation rates by a few orders of magnitude has been reported along the Hellenic Trench (Blanpied and Stanley, 1981; Anastasakis and Piper, 1991) and also in the South Aegean Sea (Koumoutsakou and Anastasakis, 1997). Especially in the South Aegean Sea volcaniclastic sedimentation within certain stratigraphy intervals can locally overprint any other sediment source (Anastasakis, 2006). However it is evident that there must be significant sediment source contributions from the recycled orogen.

Objectives

The purpose of this study is to present and discuss unequivocal evidence for the different provenance of turbiditic sequences that were deposited in the deepest two basins of the South Aegean Sea, the Karpathos Basin and the east Karpathos Basin, during the Late Quaternary. A tight stratigraphic control, based on sapropel stratigraphy and tephrostratigraphy (Koumoutsakou and Anastasakis, 1997; 2017), provides a chronological framework in order to evaluate sediment parameters such as texture and provenance.

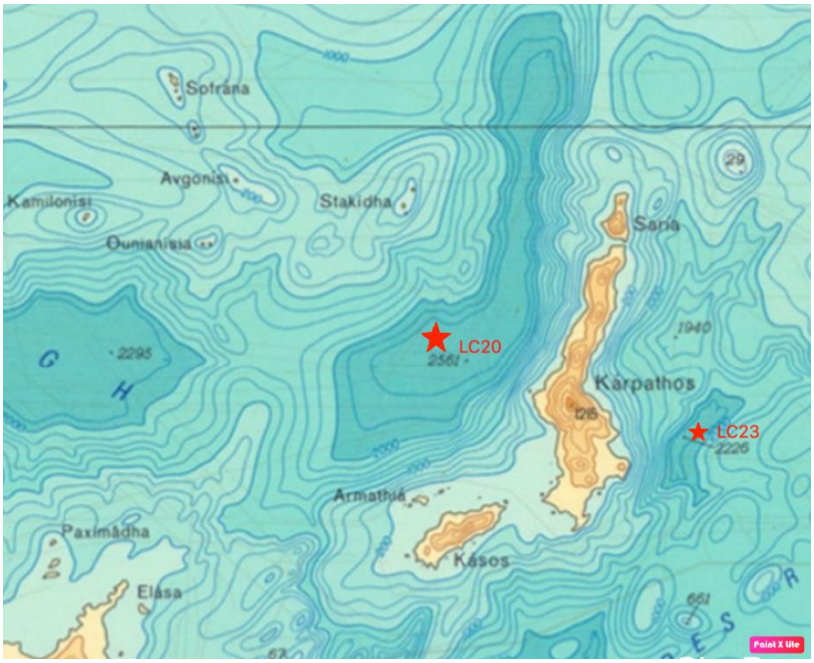

Figure 1. Bathymetric map of the study area with core locations presented in this study.

Two long Kullenberg piston cores, LC20 and LC23, were retrieved during Marion Dufresne Cruise 81 (MAST II PALAEOFLUX PROGRAMME EU-funded, 1995). The cores were scanned for magnetic susceptibility and then were sampled directly on board immediately after retrieval and splitting. Sediment color was determined using the 'Revised Standard Color Chart' (1991). Samples were oven dried at 40□C at the Department of Historic Geology-Paleontology. Calcium carbonate content (%) was measured using the carbonate bomb method (Muller and Gastner, 1971). Grain size analyses were performed by wet sieving, for any sand fraction present and then using a Sedigraph 5100 with a MasterTech 051 auto sampler. Bulk mineralogy was determined by powder X-ray diffraction (XRD) (Siemens D8000, CuKα radiation, graphite monochromator, 35 kV and 35 mA, using a 0.02□ step size and 1s per step counting time), on randomly oriented samples ground with a pestle and mortar. Minerals were estimated by measuring peak areas of main peaks on diffractograms and peak heights using the Muller and Mann (1979) method.

Core No	Location	Latitude	Longitude	Water Depth	Core Length
LC-20	Karpathos Basin	35 40.05'N	26 52.10'E	2490m	23.70m
LC-23	East Karpathos Basin	35 31.48'N	27 22.08'E	2154	19.33m

Results

Four main sediment types were recognized in the two cores and were distinguished on the basis of magnetic susceptibility, colour, grain size and composition. They are: 1) Hemipelagic sediments, 2) dark-coloured organic rich sapropel layers, 3) tephra and volcaniclastic layers and 4) turbidites that interrupt and distort all other lithologies.

Hemipelagic muds consist mostly of yellowish (10YR6/3) to brownish grey (10YR3/2) biogenic clayey marls and marly clays, with 25-65% CaCO3 and fine silt median diameter grain size. They are characterized by bioturbation and frequent foram tests.

Turbidites are recognized on the basis of sedimentary structures such as erosional bases, lamination and further verified by textural analysis. The basal coarser fraction is mainly composed of quartz, dolomite, and mostly biogenic grains. Many mm to cm turbidite layers have been identified and many of them have been analyzed for grain size (Koumoutsakou & Anastasakis 1997).

Distinctive organic rich sapropel layers occur in both cores. They were classified based on the definitions by Kidd et al. (1978) and found to be severely affected by reworking processes as described by Anastasakis and Stanley (1984). They are mostly well laminated with variable thicknesses of turbidite units developed over erosional bases.

Tephra and volcanic debris layers are characterized mostly by high susceptibility, contain elevated to overwhelming amounts of volcanic grains often reworked forming turbiditic sequences.

In between and within the above lithologies are deposited mostly base cut out turbiditic units of Tde and rarely of Tbe and Tce Bouma sequence development. Median and modal diameters of turbidites range from 500 μm to 1,1 mm.

Bulk mineralogy of all lithologies has revealed that the most important provenance indicator is dolomite. All turbidites with a medium sized sand to coarse silt base display dolomite contents higher than 7% reaching as high as 30%. Core LC-20 retrieved in the deepest Karpathos Basin contains a higher proportion of coarse based, dolomite rich turbidites apparently originating from the west Karpathos and north Kasos shelf and flowing along the steep slopes.

Conclusions

We clearly distinguish that both basins are dominated by gravitative sedimentation and we identify a high proportion of base cut out turbiditic sequences that display excellent textural sorting and fining upward grain size trends. With the exception of a few volcaniclastic coarser turbidites starting with a base of all other coarser than medium silt turbidites contain significantly enhanced dolomite contents, clearly denoting provenance of the sediments from the surrounding island shelves. Sedimentation rates in the studied cores are at least one order of magnitude higher than the surrounding margins. Turbidites are more frequent during rapid initial stages of transgressions, but seismicity appears to be triggering gravitative sedimentation time synchronous events.

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