# REGIONAL GEOCHEMISTRY OF SURFACE SEDIMENTS FROM THE NORTH AEGEAN SEA

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**Abstract**
The composition of surface sediments from the North Aegean Sea is characterized by variable admixtures of terrigenous aluminosilicates and autocthonous biogenic carbonates. Element spatial distribution is controlled mainly by riverine inputs, domestic/industrial sources and water depth. On the outer continental shelves, relict, rich in quartz, coarse-grained sediments predominate. Sediments of a few coastal areas and semi-enclosed gulfs exhibit high heavy metal contents. The determination of enrichment factors (EF) revealed that sediment contamination related to human activities is recorded for Thessaloniki Bay and Gulf, and Ierissos Gulf, whilst the other areas are influenced by natural metal enrichment processes. High Mn contents observed at slopes and deep waters are initially attributed to in situ formation of Mn oxides.

*Keywords: Geochemistry, Sediments, Continental margin, Aegean Sea, Pollution*

The North Aegean Sea (NAS) extends from the Greek mainland (Thessaly, Macedonia) to the west, up to Thrace, the Gulf of Saros and W. Turkey to the east, covering an area of ~280x170 km. The NAS exhibits fairly complex morphology, comprising extensive continental shelves, deep basins, and island complexes, whilst it receives freshwater from numerous rivers draining the Balkan Peninsula. Scope of the present work is to bring together previous and recently acquired data on surface sediment geochemistry, thus presenting, for the first time a unified assessment of their chemical composition.

A total of 417 surface sediments were collected between 1996 and 2015 and were analyzed for major and minor elements by wavelength-dispersive X-ray fluorescence [1, 2]. The main sediment constituents are Si and Al, representing terrigenous clay minerals and aluminosilicates, and Ca, chiefly representing biogenic carbonates. A ternary plot with end members $Al_2O_3$, $SiO_2$ and CaO shows that most samples exhibit similar composition to the average shale (AS) or the average crust (UC) (figure 1). A significant number of samples, however, show progressively higher carbonate contents and plot along a mixing line stretching from AS/UC towards the carbonate end member.

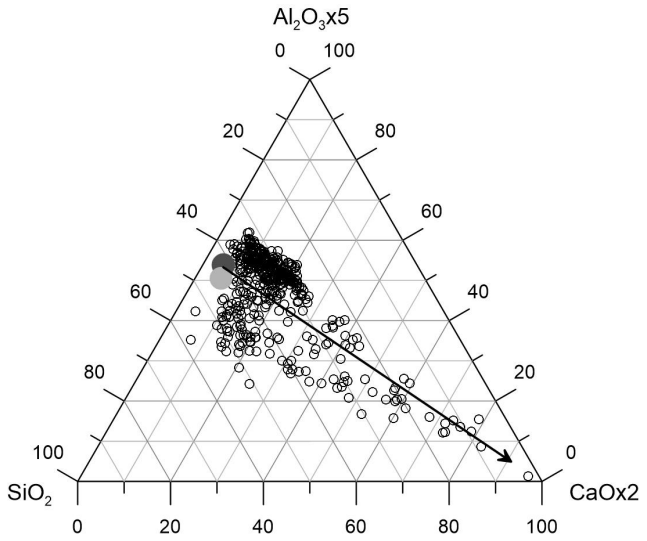


Fig. 1. Major components of North Aegean Sea surface sediments in comparison with average shale (dark grey filled circle) and upper crust (grey filled circle).

Fe, Ti, K and Na are significantly correlated with Al, corroborating for terrigenous origin. Terrigenous aluminosilicates originate in the rivers discharging into the Aegean Sea, as they exhibit higher values in front of the river mouths, whereas their dispersal is controlled by longshore transport processes and local circulation patterns. Silicon, however, displays different distribution patterns, as high Si contents are recorded offshore at deeper waters, up to 120-m depth. Such features are associated with quartz-rich relict and/or palimpsest sediments that were deposited during the last sea transgression, and remained uncovered or partly mixed with modern sediments. Sediments of a few coastal areas and semi-enclosed gulfs exhibit high heavy metals content: i) Thessaloniki Bay and Gulf (Cu, Pb, Zn); ii) Axios and Aliakmon deltas (Co, Cr, Cu, Ni, Pb, V, Zn); iii) Pinios delta (Co, Cr, Cu, Ni, V); iv) Ierissos Gulf (As, Cr, Ni, Pb, V, Zn); v) Strymon delta (Cu, Pb, Zn); vi) Evros delta (Cr, Cu, Pb, Zn). Enrichment factors (EF) were determined for a suite of heavy metals, using Al as normalizer and local pre-industrial sediment as background. The highest EFs were obtained for Pb (72), As (37), Zn (12), occurring in the Ierissos Gulf and are attributed to the combination of natural weathering of sulfide ores and mine tailings. The Thessaloniki Bay also exhibits high EFs related to anthropogenic activities (Pb: 16, Zn: 6, Cu: 3). Manganese shows high EF values up to 16 in slope sediments (water depths 368-857 m; figure 2). Scanning electron microscope analysis revealed the presence of sizable aggregates (~100 μm) composed of clay minerals and biogenic fragments, joined and/or coated by Mn (hydr)oxides. Additional work is required to fully-explain the observed Mn distribution patterns and associated accumulation processes.

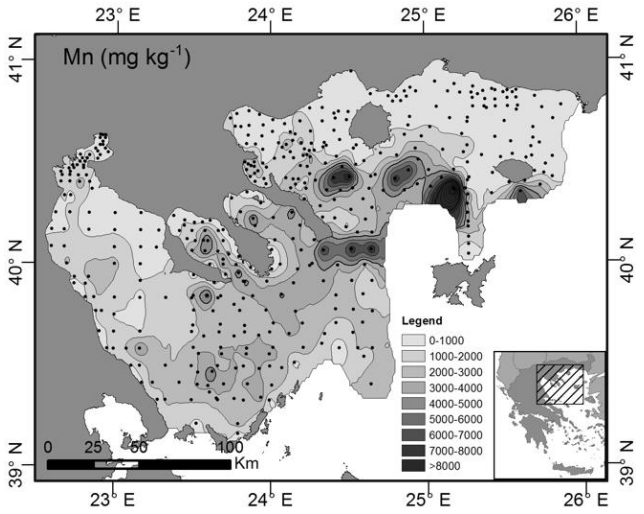


Fig. 2. Spatial distribution of Mn contents in surface sediments from the N. Aegean Sea.

## References

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