

THE SPATIAL DISTRIBUTION OF HEAVY METALS IN SURFACE SEDIMENTS FROM THE SOUTHERN BLACK SEA SHELF

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Abstract

The surface sediments were collected at sixty-three stations from the southern shelf area of the Black Sea. Spatial distribution of the heavy metals in southern shelf is mainly controlled with the geochemical differences in the southern hinterland. Southwest shelf sediments contain low values. Relatively high metals (Cu, Pb, Zn, Fe, Mn, Cr and Ni) values are found mainly in the southeast Black Sea shelf, indicating the great influence of metallic ore deposits transported by rivers. However, local anthropogenic influences are also detected from the high enrichment factors of Pb, Zn and Hg.

Keywords : *Metals, Black Sea, Sediments.*

The Black Sea is the largest anoxic basin in the world and connected to the Mediterranean Sea via the Marmara Sea and its narrow straits; Istanbul and Çanakkale). It receives a huge amount of riverine inputs which transport both the natural and anthropogenic loads to be accumulated in the basin. The southern shelf off the Anatolian coasts is narrow (2-25 km) and dissected by numerous submarine canyons. Hence, the shelf sediments are not preserved extensively but are immediately transported via these canyons beyond the shelf edge and into the deep Black Sea basin. However studies dealing with the heavy metal content of the southern shelf sediments are very few [1].

In this study, sixty-three surface samples were collected on board of R/V Arar (Istanbul University, Institute of Marine Sciences and Management) from 20, 50 and 100 m water depths in the southern shelf. In general, the mean metal contents of surface sediments from the southern shelf of the Black Sea are comparable to average crust's composition and to the ranges of sediments from adjacent seas, regardless of local elevations (Table 1).

Tab. 1. Total metal content found in this study and other studies. ^a[2], ^b[3]; ^c[4].

	This study		Marmara Sea shelf areas ^a		Shale Average ^b		Black Sea (NW shelf) ^c	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Al (%)	6.4	2.6-9.1	6.7	1.1-11	9.2	-	-	-
Fe (%)	3.5	0.8-5.2	3.7	0.6-7.7	4.7	0.5-7	-	-
Mn (μg/g)	654	244-1155	448	101-2,610	850	8-1,321	-	-
Cr (μg/g)	110	25-390	127	11-654	100	1-135	-	-
Ni (μg/g)	49	8-141	64	8-173	80	1-207	-	-
Cu (μg/g)	51	23-109	31	3-107	50	2-108	-	-
Pb (μg/g)	29	10-63	33	10-85	20	0.5-50	-	-
Zn (μg/g)	103	61-215	118	33-410	90	1-185	-	-
Hg (μg/g)	0.13	0.0-0.6	0.5	0.04-0.7	0.3	-	-	-

Relatively high Cu, Pb and Zn values occur in samples collected from the eastern part of the study area (between Yeşilirmak and Hopa). Cu and Zn clearly indicate increments at the deeper stations, and locally in front of Kızılırmak River. Although Hg is generally lower than the "average Shale", it is relatively high (100-300 μg/mg) at the western Black Sea shelf and also off the rivers Yeşilirmak and Kızılırmak. Spatial distribution pattern of Cu, Pb, Zn, Fe, and Mn is similar, being high in the southeast, and low in the southwest shelf sediments. Ni, Cr and Hg have different pattern. They are higher off the Kızılırmak and Yeşilirmak Rivers and lie within low and narrow range of values in the rest of the study area. Relatively strong positive relationships can be seen between Pb and Zn ($r=0.62$), Ni and Cr ($r=0.77$), Mn and Fe ($r=0.76$), and Cu and Fe ($r=0.59$). This indicates that these elements are enriched with a common mechanism. To assess the origin of each element, the enrichment factors (EF) relative to 'average crust' were calculated. EF values of Pb and Zn indicate enrichment in the southeast (>2), whereas EF values of Cu are mostly around 1 and locally exceeds 2. EF values of Ni and Cr are significantly high (>5) in the samples collected off the Kızılırmak and Yeşilirmak rivers. EF of Fe and Mn do not exceed 2. Hg has EF values mostly lower than 1 in the study area, however values between 2.5 and 3 are found locally in the southwest and southeast shelf. The variability of the metal contents of the Black Sea shelf sediments is primarily governed by the geochemical differences in the southern hinterlands, except local anthropogenic sources. There are Cu-Pb-Zn mines in the eastern Black Sea between Artvin and Ordu. Besides from the natural high background in the southeast shelf, some anthropogenic influences are evident from EF values of Pb, Zn and Cu. The accumulation of these metals in the sediments results from both natural processes (weathering products from

geological formations) and anthropogenic processes, such as mining activities, industrial and domestic discharges. Pb, Zn and to a lesser extend Hg, unlike to other metals, appear to be also enriched in southwest shelf sediments, based on EF values.

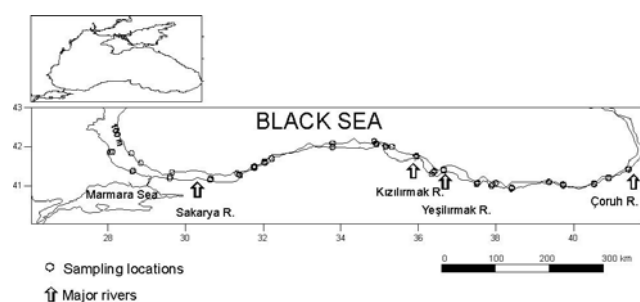


Fig. 1. The locations of the surface sediment samples from the southern shelf of the Black Sea.

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