SPATIAL AND TEMPORAL DISTRIBUTION OF HEAVY METALS IN DOWNWARD PARTICULATE MATTER FROM THE NORTHWESTERN ALBORÁN SEA

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Abstract

Metal concentrations in settling particles within and around the Guadiaro submarine canyon were analysed to study spatial and temporal distribution of metals in the northwestern Alborán Sea. Ni, Cr, Al and Fe were associated to lithogenic components, whereas the Zn and Pb were related to the biogenic components. The heavy metals content decreases down-canyon and an important transfer towards the Western adjacent slope at the channel depth occurs, probably due to the alimentation from other canyons.

Keywords: particulate metal fluxes, Guadiaro submarine canyon.

Introduction

The FLUXALB project was conducted in the Guadiaro canyon and its adjacent continental slope. The main objective was to determine the vertical fluxes of particulate matter on the northwestern Alboran Sea, their composition, their spatial and temporal variability and the main processes controlling their variability. Previous studies have provided information of dissolved and particulate heavy metals (1), however, the seasonal variability of metal fluxes and contents in the settling particulate matter had not been studied before.

Sampling area and Methodology

Downward particulate matter was collected by means of five Technicap PPS3 sequential sediment traps (2) installed in three mooring sites. One of the moorings was deployed inside the Guadiaro canyon, at 592 m depth, with one sediment trap installed 25 m above the seafloor (5°10.135'W, 36°11.595'N). A second mooring was deployed at 717 m depth, in the Guadiaro channel (5°11.61'W, 36°09.30'N), equipped with three sediment traps located at 135, 500 and 692 m depth respectively. A third mooring site was located at the open slope westward from the Guadiaro canyon (5°11.61' W, 36°08.39'N) at 720 m water depth with a sediment trap 25 m above bottom. The total sampling period comprised of 348 days.

The total sample was divided following the method described by (2). To analyse the heavy metal content, particulate matter samples were totally digested according to (3). MESS-3 was used as a Certified Reference Material (National Research Council Canada). Two major elements (Al and Fe) were analysed by inductively coupled plasma atomic emission spectrometry (ICP-AES), whereas four trace elements (Cr, Ni, Zn and Pb) were determined by inductively coupled plasma mass spectrometry (ICP-MS).

Results and discussion

Mean heavy metal contents in the downward particulate matter of the Guadiaro canyon and its western adjacent slope are shown in Table 1. During the autumn-winter period, the concentration of Al, Fe, showed an increasing trend. During this period there were two Guadiaro river avenues that produced significant increases of total mass fluxes. In the first event (late December) there was not a significant metal increase, but in the second (early February) there was an important increase of Ni and Cr contents (around twice) and also a slight increase of Fe and Al. This second avenue coincided with a storm, suggesting that the increases of Ni and Cr were produced by resuspension of shelf sediments that have high contents of these metals. The more general Al and Fe increases are more related to the increase of lithogenic inputs produced by the stronger wave climate during the winter season. During the spring-summer period, the Al and Fe contents decrease indicating a reduction of terrigenous input as a consequence of lower river discharge and the absence of storms in this season. This decrease is more evident in the settling particulate matter of the most superficial level (135 m depth) at the channel site.

During summer, a maximum of Zn content was recorded (end of August of 1998). This increase of Zn concentration was not associated to any river avenue, storm or mass flux increase. The positive correlation of Zn and Pb with OC and biogenic silica, and the negative correlation of Zn with Al, indicate that Zn and Pb are mainly associated to biological components.

Near the bottom along the canyon axis, the mean Cr, Ni, Fe and Al contents tend to decrease with depth between the canyon and the channel sites, whereas, the Zn and Pb contents increase as well as organic matter and biogenic silica content. This indicates the decrease of the influence of the terrigenous components versus biogenic components down canyon.

Near the bottom, at the open slope, the mean heavy metal contents were slightly higher than those of the Guadiaro channel at the same depth during autumn-winter, which could be related to particulate matter inputs from the western adjacent submarine canyon (La Línea canyon).

Table 1. Mean contents of trace metals in particulate matter recollected by sediment traps in the study area

		Cr (µg/g)	Ni (µg/g)	Zn (µg/g)	Pb (µg/g)	Al (%)	Fe (%)
Canyon trap near bottom (592 m)	Spring-summer	142.4	103.6	144.3	44.5	7.9	4.1
Channel trap near surface (135 m)	Autumn-winter	125.5	70.1	155.3	44.6	7.4	4.2
	Spring-summer	112.5	74.5	202.6	50.1	5.8	3.2
Channel trap mid depth (500 m)	Autumn-winter	137.7	77.6	160.0	50.7	5.9	4.2
	Spring-summer	123.9	76.5	179.9	50.8	7	3.8
Channel trap near bottom (692 m)	Autumn-winter	126.2	68.1	140.4	49	7.8	4.1
	Spring-summer	110.2	66.4	179.5	56.9	6.6	3.5
Open slope trap near bottom (720 m)	Autumn-winter	131.1	83.7	157.3	36.4	8	4.3

Conclusion

In the study zone, Ni, Cr, Al and Fe were clearly associated to terrigenous components, whereas Zn and Pb to the biogenic components. The storm-river avenue episodes produce increases in terrigenous metals like Cr and Ni. Zn increases were associated to biological productivity blooms that occurred during spring and summer.

References

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