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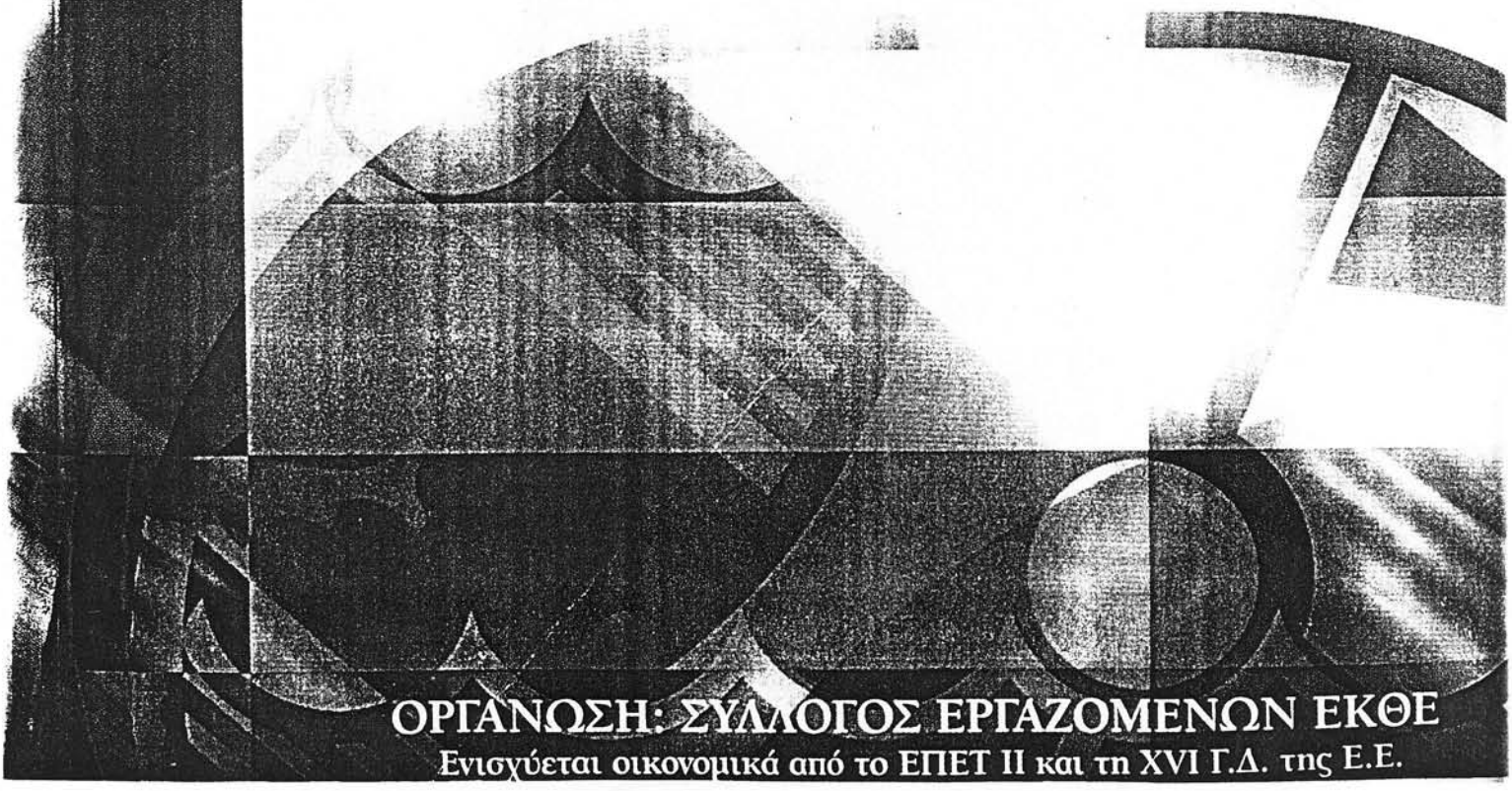

ΟΡΓΑΝΩΣΗ: ΣΥΛΛΟΓΟΣ ΕΡΓΑΖΟΜΕΝΩΝ ΕΚΘΕ
Ενισχύεται οικονομικά από το ΕΠΕΤ ΙΙ και τη XVI Γ.Δ. της Ε.Ε.

SEASONAL VARIATION OF PARTICULATE MATTER DISTRIBUTION IN A SEMI-ENCLOSED MARINE AREA: MALIAKOS GULF, CENTRAL GREECE

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ΠΕΡΙΛΗΨΗ

Αναγνώστου, Χ., Κράνης, Χ, Καψιμάλης, Β., Παπαγεωργίου, Α. και Καμπούρη, Γ. • Εποχιακή διακύμανση αιωρουμένου σωματιδιακού υλικού σε μία ημίκλειστη θαλάσσια περιοχή: Ο Μαλιακός κόλπος (Κεντρική Ελλάδα)

Η εποχιακή διακύμανση και οι υψηλές τιμές του αιωρούμενου σωματιδιακού υλικού στον Μαλιακό κόλπο ελέγχονται κυρίως από την στερεοπαροχή του Σπερχειού ποταμού. Δευτερεύοντα, αλλά σημαντικό ρόλο παίζουν οι ποταμοχείμαρροι που εκβάλλουν απευθείας στον κόλπο από τη νότια πλευρά του, καθώς και η πρωτογενής παραγωγή τους τελευταίους εαρινούς μήνες. Συνολικά ο κόλπος παρουσιάζει υψηλές τιμές συγκέντρωσης αιωρούμενου σωματιδιακού υλικού, γεγονός που αποδίδεται τόσο στο αυξημένο φορτίο του Σπερχειού, όσο και στο γεγονός ότι ο κόλπος είναι ρηχός και ημίκλειστος.

INTRODUCTION

Matter transfer in a marine environment is governed by numerous parameters that characterise this system (geomorphology and geology of the drainage area, climatic conditions, hydrographic network, river discharge, water circulation, physical and chemical parameters of the water column, productivity of the area). The linkage among these parameters varies in space and time, which in turn leads to differentiation in particle transfer and flux in space and time.

The aim of this study is to approach the mechanism controlling particulate matter distribution in a semienclosed marine area influenced by an important river discharge. Maliakos Gulf in the central Greece was selected for this purpose. An important key to this task is the understanding of the processes of the particulate matter dispersion and deposition in space and time.

GEOGRAPHICAL, GEOMORPHOLOGICAL AND GEOLOGICAL SETTING OF THE STUDY AREA

Maliakos Gulf is a semienclosed shallow (max depth: 27 m) marine system in Central Greece, between 38°:50′ and 38°:55′ N and 22°:32′ and 22°:42′ E. with a total area of 91.5 km^2 (Fig. 1). Its shape is elongated along an E-W axis and can be considered as the eastward submarine prolongation of the Sperchios graben, which is a major transverse tectonic feature in Central Greece. This graben is bounded on the south by steep mountain

fronts, while its northern boundary is much smoother. As for the boundaries of the Gulf itself, the northern one consists of semi-mountainous terrain with mature geomophological configuration (smooth, rolling hills and gentle slopes), while the southern on coincides mostly with an extended alluvial plain, fed by the fluvial system present there, and a hilly area further to the south.

CATCHMENT AREA AS A SEDIMENT SUPPLIER

The geological structure and rock composition of the catchment is essentially the source for the matter transferred into Maliakos Gulf. The major sediment supplier to the gulf is Sperchios River, with a total catchment area (TCA) of 2116 km^2 and a total runoff of 501 106 m^3 [1]. The geology of the catchment comprises alpine and postalpine formations; the former occupy mainly the mountainous areas and cover an approximate 79% of the TCA (1672 km^2). The lowlands, but also portions of higher-lying areas are covered by postalpine (Neogene - Quaternary) sediments that extend over an area of approximately 445 km^2 (21% TCA). The thickness of the quaternary cover increases from eastwards and becomes a maximum at the eastern part of the basin, reaching more than 1000 m.. The total volume of matter transfer within the catchment was estimated to be 2.65 106 m^3 per year, 21% of which (557760 m^3) enters the marine system [2].

Other potential sediment suppliers are the smaller-order rivers and torrents that do not belong in the catchment of Sperchios and discharge directly into the gulf, on the northern and southern margins of it. The streams at the northern side, with a TCA of approximate-

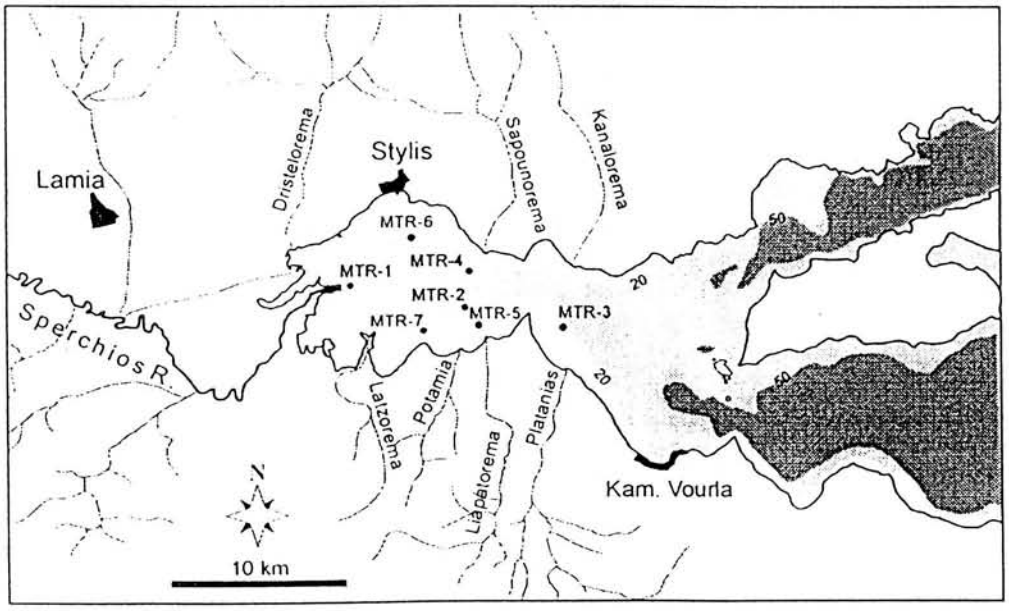

Fig. 1. Location map, to show the sampling stations employed in the project. MTR 1, 2 and 3 are both sediment trap and water sampling locations. Light and dark shading is for depths of more than 20 and 50 m, respectively. Also shown the western end of Sperchios River and the smaller-order rivers and ephemeral streams that discharge directly into the Gulf.

ly 280 km², erode mainly mesozoic neretic limestones and, to a lesser extent, ophiolitic rocks and seem to play a minor role in the sediment transportation towards the Gulf. The fluvial system, however, on the southern side of the Gulf comprises three rivers with a TCA of 190 km², whose role in the sediment supply to the Gulf seems quite important. These rivers (Latzorrema, Potamia and Liapatorrema) (Fig.1) erode mainly loose and semi-cohesive neogene and plio-pleistocene deposits, while their headwater area is within mesozoic limestones and ophiolites.

METHODS

Field work was carried out with a small vessel, in fourteen cruises from October 1997 to January 1999. The sites of the stations for water sampling are shown in Fig. 1. Positioning during the field work was obtained by handheld GPS (Trimble Navigator). Two GO FLO 10-liter bottles were used for water sampling. A volume of 10 lt was filtered in the laboratory through preweighed membrane filters (Milipore HTTP04700, diameter 47 mm, pore size 0.4 μm). The filters were air dried and reweighed to measure the dry weight of the particulate matter concentration.

RESULTS

The particulate matter concentration for each sample period and station, together with the average for each period and each station are presented in Table 1.

Table 1. SPM Concentrations (mg/lt) for all sampling cruises in Maliakos Gulf. Bold numerals are for the maximum concentration in each cruise. The highest concentration in Sep. 98 is considered abnormal and has not been included in the calculations of Fig. 2.

Station	Oct.97	Jan.98	Feb.98	Apr.98	May98	Jun98	Jul.98	Aug.98	Sep.98	Nov.98	Dec.98	Jan.99	*Station Average*
MTR-1		1,986	**4,624**	4,058	**6,188**	4,570	1,538		2,905	1,993	**9,040**	2,775	**3,9676**
MTR-2	1,900	1,866	1,210	2,576	3,668	3,233		0,748	**6,430**	**2,043**	3,163	2,057	2,6267
MTR-3	1,300	1,028	2,140	1,930	1,588	3,296	0,568	1,315	2,007	1,043	3,550	2,120	1,8236
MTR-4	1,750	3,253	2,148	2,271	1,570	4,953	**1,863**	0,525	2,555	1,043	3,380	1,805	2,2597
MTR-5	**3,000**	**3,670**	2,720	2,296	3,186	2,628	0,785	1,248	3,478	0,825	2,947	2,808	2,4657
MTR-6		1,330	2,042	1,654	3,180	2,425	1,433	**1,390**	2,368	1,313	2,663	1,923	1,9745
MTR-7		2,050	3,284	**4,670**	4,362	**5,757**	0,438	1,293	1,515	1,320		**3,473**	2,8161
average	1,988	2,169	2,595	2,779	3,392	3,837	1,104	1,086	3,037	1,368	4,124	2,423	2,562

Particulate matter distribution in the surface layer and its monthly variation is presented in Fig. 2. Concentrations vary between 0,44 and 9,04 mg/l. It is clearly figured that highest values of particulate matter (>5-6 mg/lt) are measured in the western part of the area, close to the river mouth of Sperchios river. Relative high concentrations are measured also near the outlets of the ephemeral streams of the southern part of the area in the winter months.

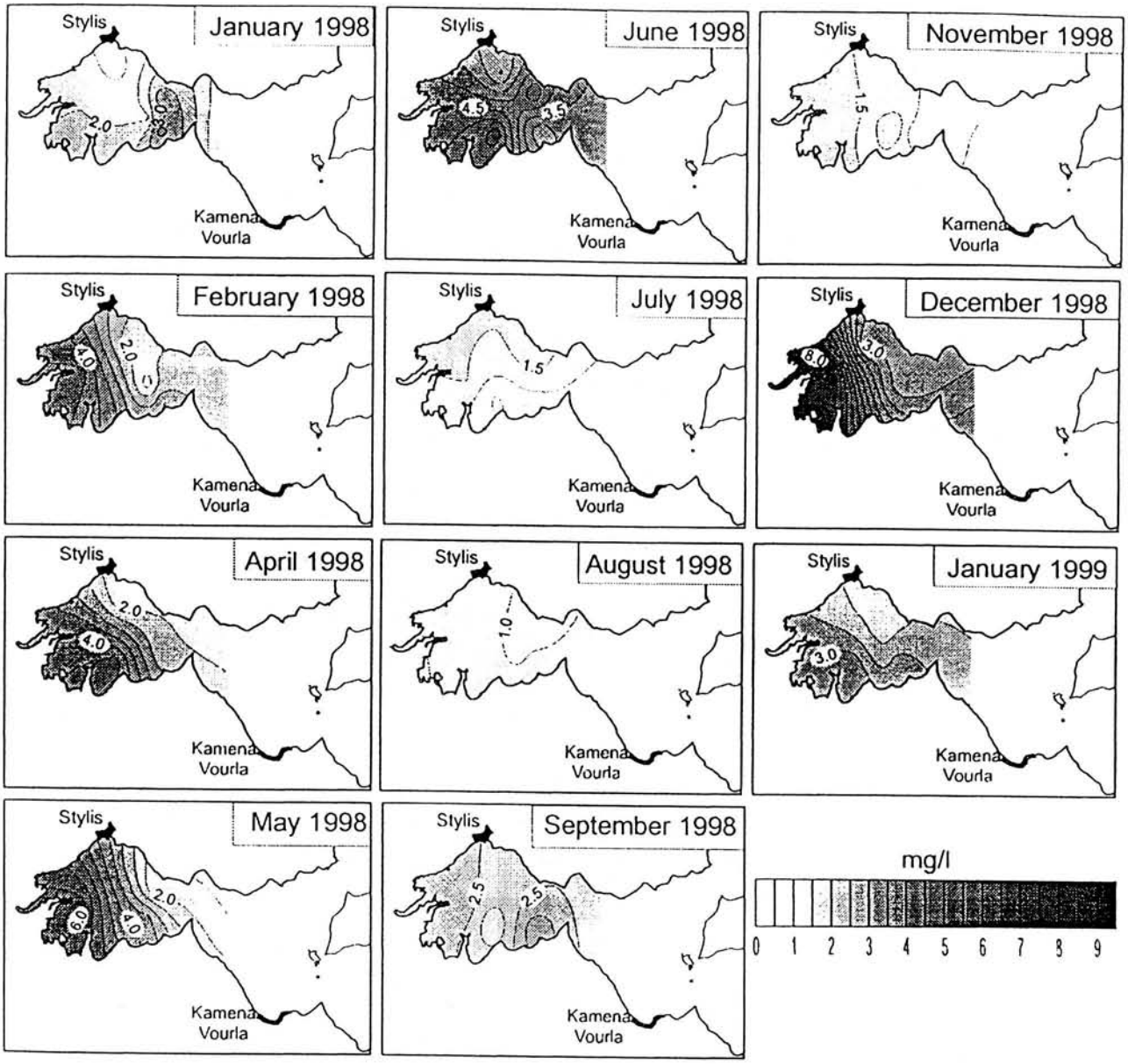

Fig. 2. SPM-distribution for eleven sampling dates between January 1998 and January 1999. The contribution of Sperchios River is important and is particularly obvious in spring and autumn months. In winter, sediment supply is enforced by the streams on the southern margin of the gulf. Note the apparent similarity in SPM distribution between January 1998 and 1999.

The spring period is related to increased river water supply and subsequent higher sediment load, resulting in the highest particulate matter concentrations observed. On the other hand, summer period shows an opposite pattern with lower supply of riverine water and sediment, and subsequent lower particulate matter concentrations.

The high values observed in the months May and June seems to be related with the higher productivity of the area during this period. A general decrease of the concentrationfrom west to the east is observed generally for the whole experimental time.

DISCUSSION

The distribution of particulate matter shows clearly the maximum concentration in the western part of the area, influenced by the river yield. Unfortunately, recent data regarding the water and sediment load of the rivers are not available. In an annual cycle, the dominating factor controlling the particulate matter concentration is the variation of the river sediment and water discharge, which show a remarkable decrease during the summer season. In the months May and June, the primary productivity plays a very important role as a mechanism of particle production [6]. However, comparison of SPM concentrations with the averaged monthly precipitation height for the last 50 years [1] shows that the interrelation is tight:

Note also that, compared to other marine systems studied so far [3], [4], [5] Maliakos Gulf has a quite higher SPM concentration (Thermaikos 4.97 mg/lt, Saronikos 1.84 mg/lt, N. Aegean 6.19 mg/lt). This may be explained by the combination of the controlling factors, which are, in this case, the high sediment load from Sperchios River, and the fact that the Gulf is a shallow and semi-enclosed marine system.

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