Source of Sedimentary Organic Matter in the Adriactic Sea

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Organic C, N and P contents, and $^{13}C/^{12}C$ and C/N ratios of organic matter in surficial sediments of the Adriatic sea were used to study the distribution, origin and diagenetic transformations of sedimentary organic matter. Using the differences in $\delta^{13}C$ values and C/N ratios between autochtonous marine (planktonic) and allochtonous (riverine) organic matter in the Adriatic was possible to determine the origin of recent surficial sedimentary organic matter and that from the short cores indicating the past environmental conditions in the sea. Linear relationship between sedimentary organic C and $\delta^{13}C$ values demonstrated an important influence of terrestrial to surficial sedimentary organic C and an organic C content of purely planktonic origin

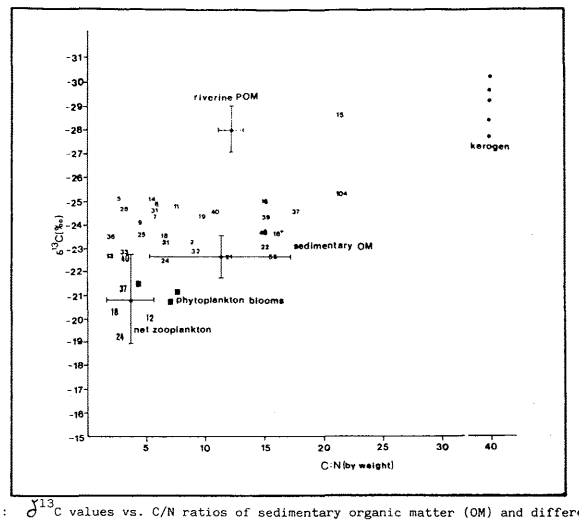

Fig. 1: $\delta^{13}C$ values vs. C/N ratios of sedimentary organic matter (OM) and different classes of organic matter (phyto- and zooplanktonic, allochtonous particulate organic matter - POM, middle Adriatic kerogen) in the Adriatic area. Mean values $\pm$ SD of $\delta^{13}C$ and C/N ratios are presented for organic matter from the Gulf of Trieste (N.Adriatic)

of about 0.15 %. Constructing the mixing model for determination of marine and terrestrial contributions to sedimentary organic matter we used the $\delta^{13}C$ values and C/N ratios of different end-members (Fig. 1), i.e. phytoplanktonic ($\delta^{13}C$ = -21.0 °/oo; C/N = 6) and riverine ($\delta^{13}C$ = -28.0 °/oo; C/N = 12) organic matter in the Adriatic area. We supposed the shift of $\delta^{13}C$ values of about 1.5 - 2 °/oo due to diagentic transformations of organic matter occuring in the water column and surficial sediments.

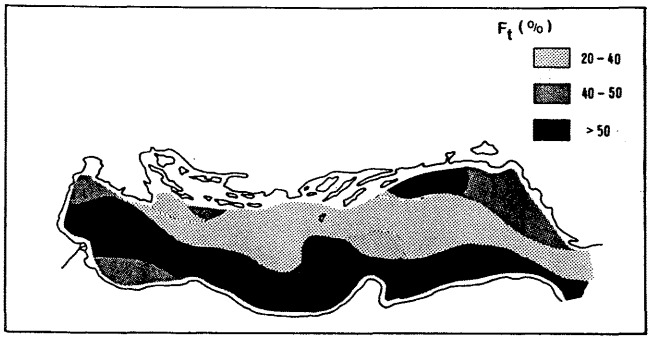

Fig. 2: Distribution of terrestrial organic carbon (F_t) in the Adriatic surficial sediments

The geographycal distribution of higher terrestrial contribution to sedimentary organic matter (Fig. 2) also reflected in the higher organic C, N and P contents, is restricted to the western part of the Adriatic along the Italian coast strongly influenced by the river Po and other Italian river inflows and to southeastern part of the Adriatic affected by local (Albanian) riverine inputs. This areal distribution is a consequence of the general counterclockwise water circulation system and sedimentological properties of the Adriatic. The area of higher organic C content in the Jabuka Pit is, on the other hand, more direct consequence of higher biological production in this area. The distribution of organic C content and the $\delta^{13}C$ values within the short dated cores collected in the middle Adriatic suggested that the bioproductive conditions in the past were similar to those of the present day. The higher C content and lower $\delta^{13}C$ value observed in horizont from about 15 000 B.P., after the last glacial period, was attributed to a larger terrestrial contribution by increased river flow.

Sediment Fluxes on 100 YR Time Scale in Different Environments of the Adriatic Sea (Italy)

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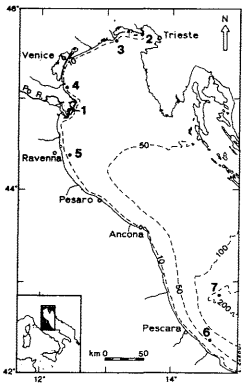
Seven cores from different environments of the Adriatic sea were studied in order to calculate accumulation rates and provide a description of the principal factors affecting present sedimentation and sedimentary processes. The data were also used to test the models used to calculate sediment chronologies from ^{210}Pb and ^{137}Cs profiles.



Core locations are shown in the figure. The sites cover a wide range of environments. They include a lagoon of the Po delta with no input from land, coastal sites from the Northern Adriatic influenced by high sediment supply, and coastal sites from the Middle Adriatic.

Cores were sectioned in slices 1-3 cm thick with the greatest detail in the upper levels. ^{210}Pb, ^{137}Cs, grain size, mineralogical composition and loss on ignition at 375 C (as an indication of the organic matter content) were determined.

The core collected in the lagoon, by divers, shows no evident traces of bioturbation and the sediment is fine grained. The excess ^{210}Pb profile indicates a regular accumulation in recent times although some downcore irregularities are probably due to the period when the lagoon was directly connected to the river. The depth distribution of silt and clay fractions suggests a progressive decreasing of the energy of the environment toward present.

Cores 2, 3 and 4 represent different prodeltaic environments. The first, influenced by the material delivered by the Isonzo River,

sites	depth m	sup.act. dpm/g	acc.rate g/cm²/yr	invent. dpm/cm²	Pb flux dpm/cm²/yr	LOI %	OM flux mg/cm²/yr
1 lagoon	1.5	4.35	0.11	12.6	0.4	8.31	9
2 Isonzo	6.5	3.30	6.62	>170	>5	4.50	298
3 Tagliamento	10.0	2.47	nd	>8	>0.2	2.40	nd
4 Adige	20.0	4.39	0.77	79.9	2.5	6.67	51
5 Porto Corsini	14.0	2.42	0.40	39.0	1.2	3.49	14
6 Ortona	65.0	4.50	0.45	63.1	2.0	2.40	11
7 MAD	251.0	4.25	0.04	7.3	0.2	2.75	1

is characterized by a very high accumulation rate. In this case the core was not long enough to include the whole excess ^{210}Pb profile. An accumulation rate of 10 cm/yr was calculated by BALDI et al. (1990) on the basis of the peak activity of the ^{137}Cs from Chernobyl. A profile of the short lived ^{7}Be in the first 4 centimeters accounts for a rate of 8.2 cm/yr or 6.6 g/cm²/yr which substantially confirms the previous result. On the other hand, the excess ^{210}Pb activity at a depth of 100-105 cm (about 10 years) should be 28-30% lower than the superficial activity. Assuming a supported activity of 0.8 dpm/g, which is typical of these sediments, we can see that this prediction is confirmed. In this case the flux of organic matter is very high, due both to the high concentration in the sediment and to the high accumulation rate. Core 3, near the mouth of the Tagliamento River comes from a highly dynamic environment: the excess ^{210}Pb profile is very irregular and incomplete. It is interrupted, at a depth of 7-8 cm, perhaps due to an erosive event. In this case the ^{210}Pb data are not adequate for the calculation of the accumulation rate.

The site 4 is characterized by a fairly regular profile, although there are some fluctuations in activity above 22 cm depth. In this case both the CF-CS and the CRS models (ROBBINS, 1978; APPLEBY & OLDFIELD, 1978) give the same average accumulation rate.

The core taken offshore from Porto Corsini, south of the delta (site 5), represents a sediment strongly influenced by the water dynamics during the winter season. This creates an irregular, discontinuous ^{210}Pb profile. The mean accumulation rate calculated using the CRS model (Table) has a value similar to that determined for other cores in this area (FRIGNANI & LANGONE, 1989). The accumulation rate determined (using the CF-CS model) from the regression of the log-normal activities vs. depth gives a significantly higher value, and this is perhaps an effect of the mixing of the surficial sediments.

The ^{210}Pb activity profile of core 6, taken from a coastal zone of the Middle Adriatic, is fairly regular. Accumulation rates calculated with all the usual models give similar results. The same is true also for core 7, taken from the Meso Adriatic Depression. In this last case the profile has intervals with different slopes, which could be due to periods characterized by different accumulation rates.

Where available the ^{137}Cs data substantially confirm the rates obtained from the ^{210}Pb profiles as for core 1, 2 and 4.

Organic matter fluxes mainly depend on the accumulation rates: the minimum value is found for the Meso Adriatic depression, far offshore, which shows the lowest rate while the maximum occurs in the Isonzo prodelta where the accumulation rate is very high. At site 1 the organic matter content (estimated on the basis of the total organic carbon: 3.57%) is far higher than in the other cores, but the flux is not very high because of the low accumulation rate.

In conclusion the study sites show very different accumulation rates (from 0.04 to 6.62 g/cm²yr). In particular the prodelta areas are of the greatest interest for the establishment of the transport mechanisms and mass balances. Because of this it is needed to study the prodelta areas in greater detail.

REFERENCES

APPLEBY, P.G. & OLDFIELD, F., 1978. The calculation of lead-210 dates assuming a constant rate of supply of unsupported ^{210}Pb to the sediment. Catena, 5, 1-8.

BALDI, A., DELFANTI, R., FIORE, V., GALLI, C., LAVARELLO, O., PAPUCCI, C., PENTASSUGLIA, C., VENTURA, G.C., GIACOMELLI, R., DE GUARRINI, F., & MATASSI, G., 1990. Distribution of artificial radionuclides in North Adriatic coastal sediments. Yugoslavian-Italian Symposium on Radiation Protection: Advance in Yugoslavia and Italy (Udine, 22-24 June 1988), in press.

FRIGNANI, M., & LANGONE, L., 1989. ^{137}Cs and ^{210}Pb geochronology of sediments off the Po River delta and the Emilia-Romagna coast (North-Western Adriatic sea, Italy). Proceedings of the 28th Int. Geol. Congress (Washington, D.C., July 9-19, 1989), 1, 513.

ROBBINS, J.A., 1978. Geochemical and geophysical applications of radioactive lead. In: Biogeochemistry of Lead in the Environment, J.O. NRIAGU ed., Elsevier, Amsterdam: A, 285-339.