# Radiochronology of Marmara sea sediments by natural $^{210}Pb$ and a uniform mixing model

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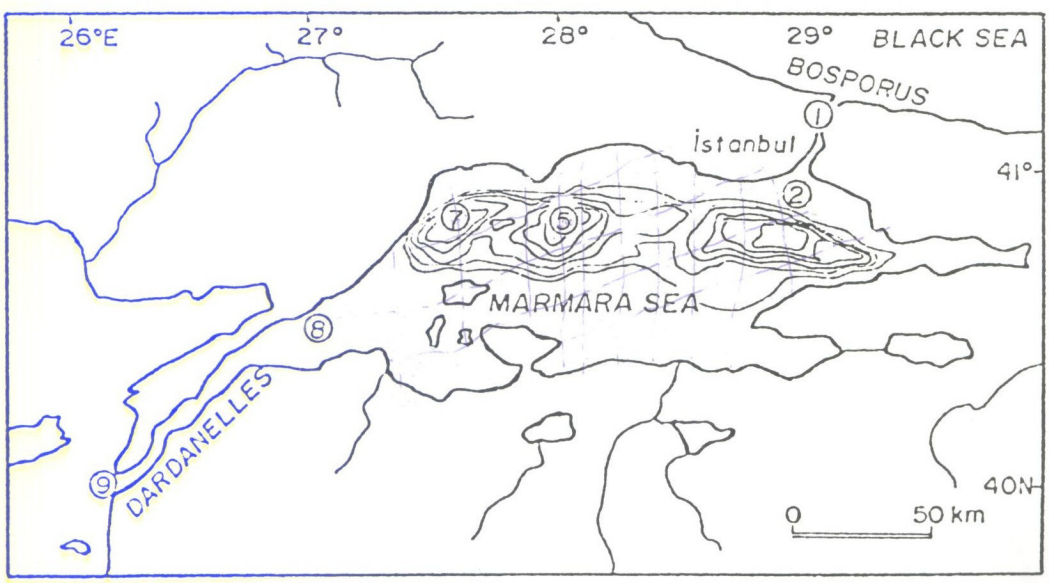
The sedimentation rates, the atmospheric fluxes of $^{210}Pb$ and the mixing depths of sediments collected from the north-northwestern part of Marmara sea are measured by using the $^{210}Pb$ dating method. Six samples are collected from Marmara sea by research ship R/V Knorr using Soutar Box corer (50x50x60 cm) on its 1989 cruise. The samples coming from Bosporus and Dardanelles cannot be analyzed due to the mixing of sediments in the strong currents in these straits. The samples collected from the site M2 on the southern part of Bosporus and from the site M8 on the northern part of Dardanalles at depths of 64 and 65 m, respectively, are subject to high particulate matter fluxes (1). The other two samples, M5 and M7 are collected from the two basins located at the northern part of Marmara sea at depths of 1226 and 1106 m. The locations of sites of samples are shown in Figure 1.

The core samples were cut in 2 cm thick layers and their densities and porosities were measured. In the analyses of samples the alpha particle activity of $^{210}Po$ were measured which was in secular equilibrium with $^{210}Pb$. A surface barrier detector, ORTEC BA-018-300-100, was used in the measurements and spectra were analyzed by a multichannel analyzer, Canberra 35+, and an IBM-XT computer interfaced to it.

The measured activity profiles of samples M2, M5, M7 and M8 show three characteristic regions. Usually the activities at the top few centimeters are constant due to physical and biological mixing,

Figure 1. The locations of sample sites in Marmara Sea



which follows a decaying activity region. The last region of profile has constant activity due to the supported $^{210}$Pb activity which is produced on the sea floor. This supported activity is then subtracted from the total activity which yields the unsupported $^{210}$Pb activity coming from the atmosphere.

In this study a novel model is developed for the simultaneous analysis of the sedimentation rate, S, the atmospheric flux of $^{210}$Pb, P, and the sediment mixing depth, x0. The constant activity in the mixing region may be expressed as;

$$A_0 = P/[S.\rho.(1-\phi)]\ (1-e^{-\lambda/S.x0}) \quad \text{for } x<=x0 \quad (1)$$

Here, $\rho$ is the density of the dry sediment and $\phi$ is the porosity of samples. The activity in the decaying part of $^{210}$Pb may be shown as;

$$A(x) = A_0\, e^{-\lambda/S(x-x0)} \qquad \text{for } x<x0 \qquad (2)$$

Using the activity relations 1 and 2, for x<=x0 and x>x0, respectively and experimental data, the optimum values of parameters S, P and x0 are computed by using the non-linear least square minimization of parameters by grid search algorithm. The results of analysis are given for these four sites in Table 1.

**Table 1. Parameters from uniform mixing model**

S(cm.g$^{-1}$)

| core | Flux, P (dpm.cm$^{-2}$.y$^{-1}$) | Mix.Depth, x0 (cm) | Mass S.R., w (g.cm$^{-2}$.y$^{-1}$) | |
|---|---|---|---|---|
| M-2 | 2.26 (0.40) | 7.04 (1.23) | 0.181 (0.07) | 0.184 |
| M-5 | 2.05 (0.22) | 4.00 (0.79) | 0.058 (0.011) | 0.111 |
| M-7 | 2.43 (0.29) | 7.17 (0.85) | 0.059 (0.013) | 0.090 |
| M-8 | 2.20 (0.29) | 10.6 (1.3) | 0.084 (0.030) | 0.137 |
| M* | | 3 | 0.087 | |

The mass sedimentation rate, w, is found largest at the southern part of Bosporus which has a large particulate matter flux. The sample collected at the northern part of Dardanalles is found lower than that of Bosporus and those of M5 and M7 from the two basins located in the northern Marmara sea are the lowest. The mass sedimentation rate measured at the south of location M2 (southern Bosporus) at a depth of 1200 m in a previos study (2) shows decreasing sedimentation rates with distance and depth from Bosporus.

References

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