

# TRACE ELEMENTS AND RADIONUCLIDES IN SEDIMENTS AND BIOTA FROM THE KÜÇÜKÇEKMECE LAKE

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## Abstract

This paper reports concentrations of selected elements and radionuclides in sediments and biota from the Küçükçekmece Lake near Istanbul. Comparisons of the Cr concentrations in sediments with data reported for the Sediment Quality Guidelines of the Ontario Lake indicate that Küçükçekmece sediments are heavily contaminated. The Cr and Co values in macroalgae were higher than that of shrimp and fish species. The maximum and minimum activity levels of  $^{137}\text{Cs}$  in sediments were 4.5 and 13.5 Bq/kg. The level of  $^{137}\text{Cs}$  in macroalgae was 6 Bq/kg whereas in shrimp  $^{137}\text{Cs}$  was not detectable. In contrast,  $^{232}\text{Th}$  concentration in shrimp was higher than that of sediment and macroalgae.

**Key-words :** trace elements, radioactivity, sediments, Sea of Marmara

## Introduction

The Küçükçekmece Lake (41°00 N-28°43 E) is a brackish water lagoon of 15.22 km<sup>2</sup> surface area and a maximum depth of 20 m. It is connected to the Marmara Sea via a narrow channel. The main fresh water supply comes from underground springs and several small streams.

The Çekmece Nuclear Research and Training Center was established near the lake and the drainage system of the Center is connected to lake. The lake water has been contaminated by trace elements and organic pollutants from a combination of industrial, agricultural and municipal activities. At the same time, this lake was greatly affected by atmospheric input of particulate matter originating from the sweepings of waste storage and use of fossil fuels in the region.

Some paper have been previously published concerning heavy metal, detergent and radioactivity levels observed in water samples of the lake (1-3). However, no data on trace elements and radioactivity levels in sediment and biota samples from the lake have yet been published in the scientific literature. On the other hand, several radioecological investigations have been carried out using lake species and radiotracers (4-6).

This paper reports data for the trace element (As, Se, Zn, Cr, Cs, Co, Sb, Ni, Sc, K, Ca, Fe) and radionuclide ( $^{238}\text{U}$ ,  $^{232}\text{Th}$ ,  $^{137}\text{Cs}$ ,  $^{40}\text{K}$ ) levels in sediment and biota collected from the lake 1994.

## Material and Methods

The sediment samples were collected from five stations of the lake by using of a Lenz Bottom sampler (Fig. 1). About 4 cm of the top of the sediment samples were dried at 85°C for 48 h, crushed and homo-

genized prior to the analyses. The biota samples were *Enteromorpha linza* (macroalgae), *Crangon vulgaris* (shrimp), *Proterorhinus marmoratus* (goby fish), *Syngnathus abaster* (pike fish). The samples were pooled and freeze-dried for several days to constant weight.

Trace element analyses were carried out by an instrumental neutron activation technique. About 0.2 g. sediment and biota samples were placed in 1 cm<sup>3</sup> polyethylene tube and irradiated for 4 hours at the thermal neutron flux of about  $2 \times 10^{13} \text{ncm}^{-2} \text{s}^{-1}$  in the TR-2 Reactor of the Çekmece Nuclear Research and Training center. IAEA's CRM SL-1 was used as the standard. The gamma spectra of both samples and standards were measured using a Canberra S-85 4K MCA gamma-ray spectrometer. The detector was high purity Germanium (Ortec, GMX) and its resolution was 1.9 keV (at 1333 keV for  $^{60}\text{Co}$ ). Decay periods were 24 hours for short-lived and 3-4 weeks for long-lived isotopes. Counting times were varied between 3000 and 8000 sec.

The sample powders (about 100 g) were pressed by hand into special cups for gamma isotopic analyses. Determination of the radioactivity levels was similar to that previously described (7, 8).

## Result and Discussion

The trace element contents of the sediments are shown in Table 1. The highest concentration of As, Zn, Cr and Co were detected at station 3 (Fig. 1), probably due to the municipal and factory waste discharged into the lake. The Co, Fe, Ni, Cs and As concentrations at station 7 were lower than the other stations. At the same time the Se, K and Ca contents at station 7 were significantly different from levels at the other stations. It is suggested that these differences depend on sediment composition.

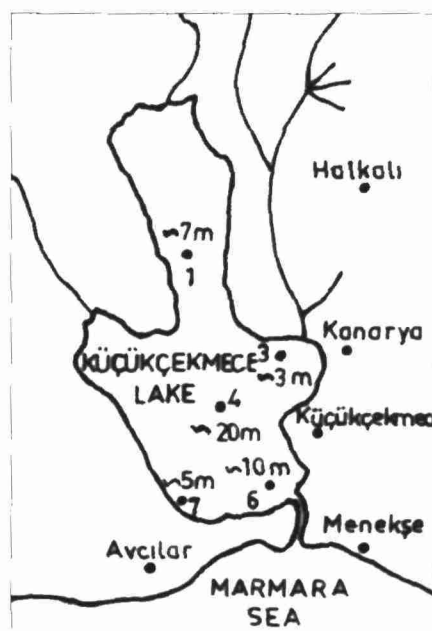


Fig.1. Sampling stations at the Küçükçekmece Lake.

Table 1. Trace element concentrations in sediment samples ( $\mu\text{g/g}$  dry weight).

| Station Element | No.1     | No.3     | No.4     | No.6     | No.7     |
|-----------------|----------|----------|----------|----------|----------|
| As              | 6.8±1.9  | 12.8±1.4 | 10.6±2.0 | 10.2±1.7 | 3.9±1.7  |
| Se              | <1.6     | ~1.4     | <1.6     | ~1.0     | <1.6     |
| Zn              | 153±9    | 219±8    | 135±6    | 212±10   | 155±13   |
| Cr              | 105±7    | 120±6    | 100±5    | 115±7    | 102±10   |
| Cs              | 6.8±0.8  | 5.8±0.5  | 5.0±0.4  | 4.1±0.4  | 1.3±0.4  |
| Co              | 13.7±0.6 | 15.0±0.4 | 11.4±0.4 | 11.8±0.4 | 5.1±0.3  |
| Sb              | 1.4±0.2  | 1.5±0.2  | 1.3±0.1  | 1.5±0.2  | ~0.1     |
| Ni              | ~40      | 70±26    | 67±16    | 72±29    | <40      |
| Sc              | 12.2±0.4 | 12.3±0.7 | 8.8±0.2  | 8.8±0.2  | 2.7±0.4  |
| K,%             | 1.4±0.1  | 1.5±0.1  | 1.2±0.1  | 1.4±0.1  | 0.7±0.1  |
| Ca,%            | 9.0±1.7  | 13.0±1.6 | 7.8±1.0  | 13.9±1.6 | 20.8±2.5 |
| Fe,%            | 3.2±0.1  | 3.4±0.1  | 2.5±0.1  | 2.4±0.1  | 0.7±0.1  |

The Cr concentrations in Küçükçekmece Lake sediments were higher than those in sediments collected from the Black Sea and Bosphorus (9, 10). These concentrations in sediment indicated that they were heavily polluted and are approaching the "severe effect level" when compared with the Sediment Quality Guidelines of the Ontario Ministry (11). The Ni concentrations were also near the severe effect level at stations 3, 4 and 6. The trace element concentrations in the algae, shrimp and fish samples are given in Table 2. The Cr and Co values