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Original Research Article

Determination of Natural Radiation Levels in Izmit Gulf Altinova Shipyard Area

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ABSTRACT

The aim of this study was to develop a first insight regarding the radioactivity grade of sediment samples from Altınova shipyard region. For this purpose, six sediment samples taken from Altınova shipyard region of Yalova province at the entrance of Izmit Gulf. A gross alpha and beta count system (Berthold, LB770-PC 10-Channel Low-Level Planchet Counter) was used to determine the radioactivity levels to the samples. In the completed analyzes, the resulting gross alpha activity was calculated as 211 ± 21 Bq/kg, and the gross beta activity was calculated as 717.7 ± 60 Bq/kg. It was also found that the lowest alpha activity in the samples was 129 ± 26 Bq/kg while the highest was 309 ± 13 Bq/kg. Similarly, when beta activity was examined, it was determined that the lowest and highest levels were 508 ± 51 - 914 ± 40 Bq/kg, respectively. The data obtained were compared with previous studies in the literature. This work, which will reveal the current radioactivity of the area, could be a reference data to future works about radiological mapping or environmental monitoring on the region.

Keywords: Sediment, Radioactivity, Gross alpha, Gross beta, Altinova, Yalova, Izmit Gulf

INTRODUCTION

Radiation is a phenomenon that the whole ecosystem has been continuously exposed since earth's existence. In addition to the cosmic rays, there is a natural ionizing radiation generated by radioactive materials such as uranium, thorium and potassium in the air, water and soil. Mankind is exposed to this ionizing radiation at any given moment in the environment (IAEA 2011, CNSC 2012).

Ionizing radiation can be in the form of particles (alpha (α), beta (β)) as well as in the form of electromagnetic waves (X and gamma (γ)). The alpha particle, which is the result of radioactive decay, generally appears as the product of uranium and thorium. Alpha decay often occurs with beta and gamma. To become stable, the unstable nucleus sometimes undergoes gamma decay while doing alpha decay only. The same process applies to beta decay. Some unstable nucleus only go into base state by making beta decay, while others go through beta decay followed by gamma decay. Gamma radiation is evident during decay of the nucleus in the excited state (CNSC 2012, DPH 2004).

Radiation, which is the result of nuclear reactions and which human beings are exposed at any moment, has been used by scientists for various purposes. In the past and today, various nuclear events, such as atmospheric tests, underground tests and nuclear power plant accidents have occurred. Such nuclear studies result in increased environmental contamination. Moreover, it is inevitable that radioactive particles, which are the result of nuclear tests, travel through the atmosphere and increase the radiation level of different regions. Geographical conditions should be investigated in nuclear tests and the risk of transporting radioactive particles to different regions by underground waters should not be overlooked (IAEA 2011). Periodic examination of radioactivity levels, which have increased for a number of reasons in specific regions, is thought to be beneficial in terms of vital health. For this purpose, the radioactivity level of the region, which is investigated using especially soil, water and sediment samples, can be easily determined by making various analyze (UNSCEAR 2016 Report).

The gross alpha/beta analysis of sea and lake sediments reveals the total radiation level of a region that has been examined. Examination of sediments is important in terms of determining the conditions that could threaten the health of the living beings in the area being investigated and taking precautions. A number of studies have been conducted in previous years in different regions of the world about radioactivity levels (Yümün and Kam 2017, Kam *et. al.* 2016, Yümün *et. al.* 2016, Kam *et. al.* 2010, Agbalag and Onoja 2011). In this study, the

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natural radiation levels of the sediment samples taken from Altınova Shipyard Region of Yalova province at the entrance of Izmit Gulf has been determined.

The Study Area

Yalova province; it has a considerable geographical advantage in terms of its proximity to Istanbul, Kocaeli and Bursa. With these three metropolitan cities, transportation facilities are good and Yalova is developing gradually (Kazel 2014). In addition, employment rates are increasing due to highly efficient industrial activities, various initiatives for tourism development and academic orientation. Therefore, Yalova is a tourism city that receives immigration today and has an increasing population every day (Kazel 2014, Yalova 2018)

Altınova Industrial Zone (Figure 1), which is a working region, is connected to the province of Yalova at the entrance of Izmit Bay and covers a region of approximately 7 km along the coastal road (Google Maps). In the area from the Hersek quarter to the Topcular area, there are very busy shipyard operations (Kazel 2014). After the coastal sections of Altınova started to be used for shipbuilding after 2004, human population and shipyard operating crowd that can be considered to be small scale has been occurred for this region. The formation of this small-scale crowd directly in the coastal zones has brought to our agenda the extent to which the marine ecosystem has been intervened. For this reason, it is appropriate to conduct a risk analysis by taking measures against adverse situations that may occur in this region, and to examine the region in order to provide a reference to the studies to be carried out on the region in future (Aliefendioglu 2015).

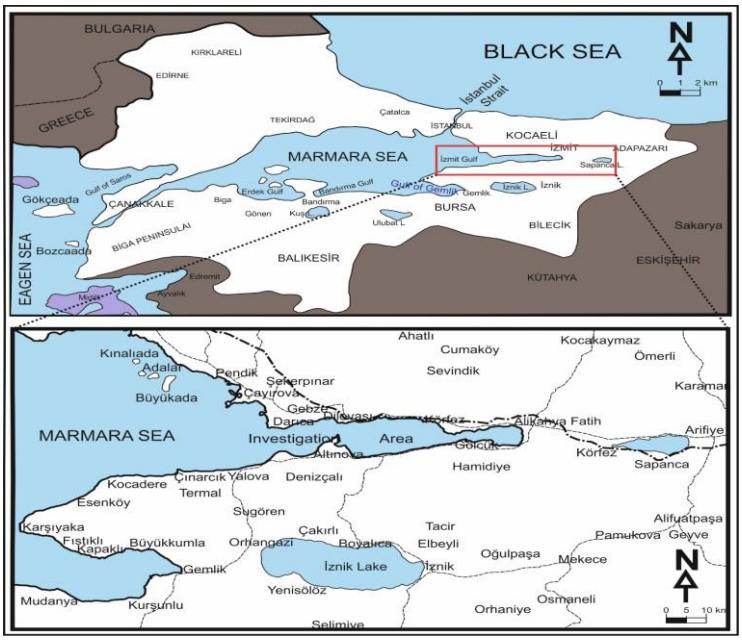

Figure 1. Location map of investigation area.

Obtaining Samples

The area under investigation was examined and sediment samples were taken from six regions which are suitable from coastline up to Topcular site in Hersek area (Figure 2). Regions where intensive shipyard activities are being carried out have been specifically selected when taking samples. The depths of the samples vary between 7 m and 38 m. Sediment samples taken to be delivered to the laboratory were individually named and bagged. Coordinates and water depths were recorded (Table 1).

Table1. Sediment Sample Locations of Altınova (Yalova) Region.

Sample No	Depth of Sample (m)	Sample Coordinates (WGS-84, 6^0)	
		Y (East)	X (North)
ALT-2	36	707472.83 d D	4508710.82 m K
ALT-3	25	708515.39 d D	4510087.64 m K
ALT-4	38	708213.88 d D	4510457.64 m K
ALT-5	7	710247.21 d D	4511234.23 m K
ALT-6	16	709718.67 d D	4511605.90 m K
ALT-8	27	706038.94 d D	4512214.84 m K

Figure 2. Sample Locations.

Experimental Setup

The activity concentrations of the gross alpha/beta in the six sediment samples were measured using a gas proportional counter of low background multiple detector type (Berthold LB-770) (Taskin 2011). The sediments were subjected to some classical operations before they were analyzed in the detector. Sediment samples were first dried at room temperature for about 15 days. Following the drying process, 300 grams of the powdered samples were milled and weighed with a precision scale. The weighed sediment samples were transferred to the vessels separately. Then the distilled water was dropped into the vessels to make the solution homogeneous. The samples subjected to these treatments were dried for a while in the oven set at 105 ° C. The samples were kept in a desiccator to prevent the risk of exposure of the dried sediment samples to the outside moisture. Each of the sediment samples which had been dried was weighed with a precision scale of 100 grams and dried again in a furnace set at 105 ° C. The samples dried for about 2 hours were transferred to the desiccator. Finally, to determine the gross alpha/beta concentration levels of the sediments, sediment samples were transferred to the detector and counted for 1000 minutes in 2 cycles. At the end of the counting process, activity calculation for each sample was made.

RESULTS

In this study, the radiation level of six sediment samples taken from the Altınova region of Yalova province at the entrance of Izmit Gulf was examined. The resulting alpha/beta analysis results are listed in Table 2.

Table 2. Gross alpha/beta concentration levels of sediment samples.

Locations	Gross α (Bq/kg)	Gross β (Bq/kg)
ALT 2	213±21	673±48
ALT 3	309±13	709±71
ALT 4	214±20	914±40
ALT 5	197±26	704±70
ALT 6	204±20	798±80
ALT 8	129±26	508±51

The lowest and highest values of gross alpha activity obtained from the investigation are 129 ± 26 Bq/kg - 309 ± 13 Bq/kg, respectively. Gross beta activity was the lowest of 508 ± 51 Bq/kg, the highest being 914 ± 40 Bq/kg. The average beta activity was calculated as 717.7 ± 60 Bq/kg while the average alpha activity was calculated as 211 ± 21 Bq/kg. ALT 8 Sample is the farthest sample taken from the shore. Also, the sample ALT 8 is the sample with the lowest alpha and beta activity among other samples.

In all 6 sediment samples the alpha concentration was calculated well below the beta concentration (Figure 3).

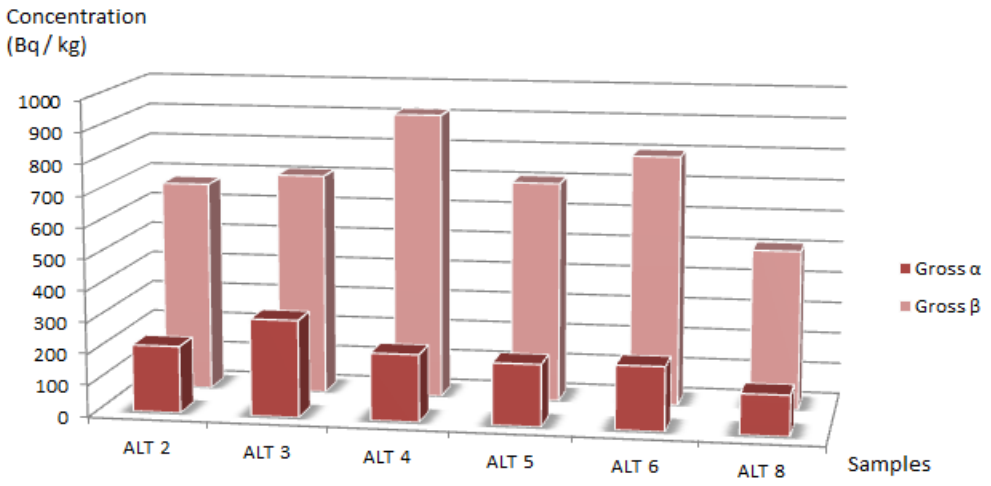

Figure 3. Comparison of the gross alpha/beta values.

The level of radioactivity of the farthest sample to the shore is lower than that of the other samples, indicating that radioactive pollution is the result of activities in coastal areas. However, it can be said that this pollution is innocuous because it is at very low levels and it does not pose any risk in terms of live health.

Other studies on sediment analysis in the world have been examined. In conclusion, the results were compared with the studies performed in different regions (Table 3).

Table 3. Comparison with the study results in different regions in the world.

Stations	Gross α (Bq/kg)	Gross β (Bq/kg)	References
Maritza River,Turkey	30 - 200	6 – 1397	(Aytas 2012)
Tundja River, Turkey	30 - 158	180 - 1526	(Aytas 2012)
İzmit Gulf, Turkey	537 - 1800	993 - 1842	(Kam 2017)
Bendimahi River, Turkey(in May)	782-4596	482-10372	(Zorer 2009)
Bendimahi River, Turkey (in August)	580-5824	303-9702	(Zorer 2009)

CONCLUSIONS

The main goal of this study is to measure the radiation levels of these regions by identifying the most active regions in the study area. It has been investigated whether any radioactive pollution has occurred as a result of activities

in the region. According to the laboratory results, radioactive pollution rates of the shipyards area are low. And, the results show that there was no situation that would threaten the living health.

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