

HEAVY METAL POLLUTION HISTORY IN THE SEDIMENTS FROM CANDARLI GULF OF TURKEY

G. Yaprak¹, S. Aytas¹, D. Yasar², I. Sert¹, S. Yusan¹, H. S. Sazak³,
S. Sahin¹, S. Gurleyen¹, G. Takan¹, G. Dursun¹

¹Ege University, Institute of Nuclear Sciences, Izmir, Turkey, ayaprak.gunseli@gmail.com

²Dokuz Eylul University, Institute of Marine Sciences, Izmir, Turkey

³Ege University, Faculty of Sciences, Department of Statistics, Izmir, Turkey

Sediments are historical natural archive of environmental changes, and accurate sediment dating provides a chronology of these changes. In particular, ²¹⁰Pb is the most common and reliable method during more than 5 decades, through dating of undisturbed sediment cores, to study ecosystem changes during the last 100 yrs. Meanwhile, it is common practice to use ¹³⁷Cs as an independent age control to verify ²¹⁰Pb method. Candarli Gulf is one of the major industrial regions on the Aegean side of Turkey. Hence the study is dealing with the determination of the sedimentation rates and heavy metal pollution history in the sediments from Candarli Gulf (including Aliaga Bay) derived from ²¹⁰Pb and ¹³⁷Cs chronology. The results were provided a realistic picture of the environmental changes of the Candarli Gulf.

Keywords: ²¹⁰Pb, ¹³⁷Cs, sediments, Candarli Gulf, pollution

Particle-reactive radionuclides such as ²¹⁰Pb (²¹⁰Pb_{ex}) and ¹³⁷Cs have been widely used as tracers and chronometers for understanding the fate and transport of pollutants in aquatic systems such as rivers, estuaries and oceans [1]. Generally, ²¹⁰Pb is widely applied as environmental tracers to study ecosystem changes during the last 100 yrs. The applicability range of the ²¹⁰Pb method is coincident with the time of the greatest environmental changes due to industrial and agricultural activities and to human influences on the environment in general. Meanwhile, ²¹⁰Pb chronology needs to be corroborated with an independent age control, and ¹³⁷Cs is usually chosen for this [2, 3]. Candarli Gulf which has performed this study has extensively surrounded with residential, industrial and agricultural areas. In particularly, Aliaga city which is south of Candarli Gulf on the Aegean Coastline of Turkey, includes many heavy industries such as Turkish Petroleum Refinery (TUPRAS), Petrochemical Holding Company (PETKIM), shipbreaking facilities, phosphate fertilizer plant, paper factory, iron and steel plants and two thermal power plants based on natural gas. The rapid urbanization and industrialization in the region since the 1970-s has resulted a significant environmental impact on the aquatic environment. Hence, the main objectives of the present study are to establish the sedimentation rates and heavy metal pollution and to investigate the evolution of heavy metal input history during the 5 decades of Candarli Gulf.

Materials and methods. Candarli Gulf has placed between 38°57'37'' and 38°43'44'' N geographic latitudes and 26°44'58'' and 27°04'23'' E geographic longitudes in the Aegean Sea. The sampling via a gravity corer has been performed by "Koca Piri Reis" research vessel from Dokuz Eylul University, the Institute of Marine Sciences and Technology. Sediment cores were collected systematically at 20 stations in the Candarli Gulf during August 2014 (fig. 1). The cores were cut longitudinally, opened with a nylon string and described and sliced at 1-cm intervals for further analyses. Sediment subsamples were dried at 40–60 °C to constant weight, and water content was determined. The dried samples were powdered in a ball-mill for geochemical and radionuclide analysis. In this study, the

quantitative determination of the ^{210}Pb and ^{137}Cs was carried out by HPGe gamma spectrometry. For this purpose, the samples were pressed into pellets of 40,6 mm radius and 3–4 mm thickness under a pressure of 300 kg cm^{-2} for providing an easily repeated geometry as well as avoiding for self-absorption of the sample matrix.

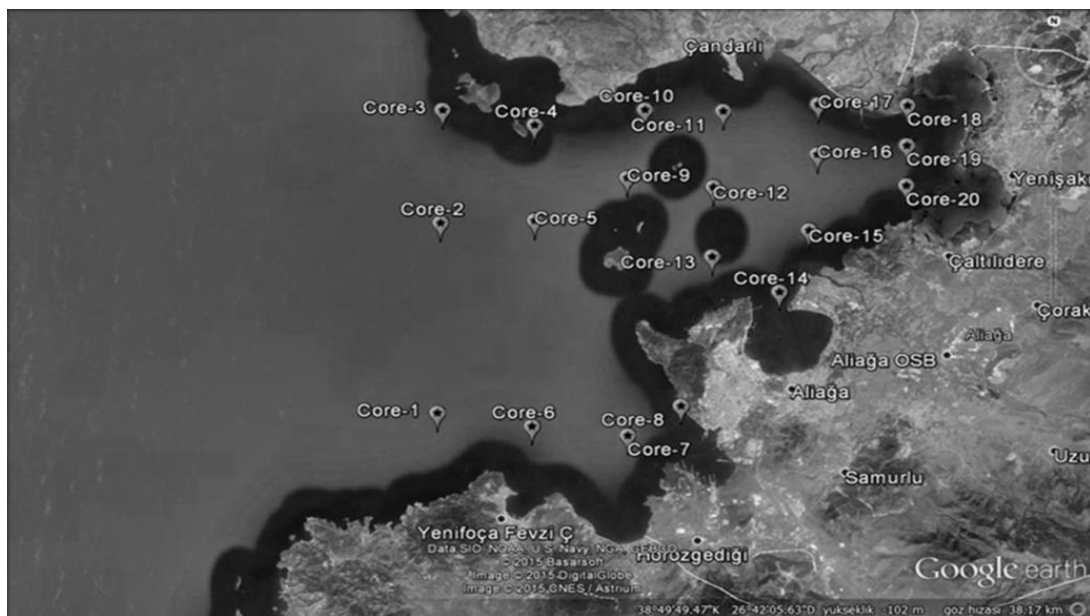


Fig. 1 Location of the sediment cores

Results and discussion. In this work, preliminary results regarding with the continuing project are summarized and practically evaluated. Because of the preferential sorption of $^{210}\text{Pb}_{\text{ex}}$ onto fine-grained, organic-rich sediments, a normalization of the specific activity profile is required to minimize grain-size effects and allow the assumption of relatively constant porosity. We selected normalization by Al because it is the usual grain-size proxy recommended in geochemical studies [2]. Corrected sedimentation rates obtained from ^{210}Pb dating were appeared in the range of 0.06 ± 0.01 – $1.5 \pm 0.2 \text{ cm yrs}^{-1}$. There is not a significant discrepancy between CRS and CIC Models [4–6] and give the almost same results. Furthermore, the validity of the proposed methodology is confirmed by records of ^{137}Cs distribution in the sediment sequence. The established chronology indicated that sediments mainly started to receive anthropogenic inputs of heavy metals, since the 1980-s.

Conclusions. The rapid industrialization and urbanization surrounding the Candarli Gulf since the 1970-s has resulted in growing pressure on the local environment. In the present study, twenty sediment cores were collected in 2014 from Candarli Gulf for a study on heavy metal pollution in the region. The five dated sediment cores were used to historical records of contaminant inputs in the region. According to the established chronology showed clearly that the increase in the concentrations of the As, Cd, Cu, Ni, Hg and Pb in the recent sediments were caused by human-induced changes.

Acknowledges. This Project (Contract No: 113Y486) is financially supported by the TUBITAK (The Scientific Technological Research Council of Turkey).

1. Du J. Z., Zhang J., Baskaran M. Applications of short-lived radionuclides (^7Be , ^{210}Pb , ^{210}Po , ^{137}Cs and ^{234}Th) to trace the sources, transport pathways, and deposition of particles / sediments in rivers,

- estuaries and coasts // *Handbook of environmental isotope geochemistry* / Ed. M. Baskaran. Springer, 2011. P. 305–330 [ISBN: 978-3-642-10636-1].
2. Alvarez-Iglesias P., Quintana B., Rubio B., Perez-Arlucea M. Sedimentation rates and trace metal input history in intertidal sediments from San Simon Bay (Ria de Vigo, NW Spain) derived from ^{210}Pb and ^{137}Cs chronology // *Journal of Environmental Radioactivity*. 2007. Vol. 98. P. 229–250.
 3. Sert I., Ozel E., Yaprak G., Eftelioglu M. Determination of the latest sediment accumulation rate and pattern by performing ^{210}Pb models and ^{137}Cs technique in the Lake Bafa, Mugla, Turkey // *Journal of Radioanalytical and Nuclear Chemistry*. 2016. Vol. 307. P. 313–323.
 4. Appleby P.G., Oldfield F. The calculation of lead-210 dates assuming a constant rate of supply of unsupported ^{210}Pb to the sediment // *Catena*. 1978. Vol. 5. P. 1–8.
 5. Appleby P.G., Oldfield F. The assessment of ^{210}Pb data from sites with varying sediment accumulation rates // *Hydrobiology*. 1983. Vol. 103. P. 29–35.
 6. Appleby P.G. Three decades of dating recent sediments by fallout radionuclides: a review // *The Holocene*. 2008. Vol. 18, no. 1. P. 83–93.

ЗАГРЯЗНЕНИЕ ТЯЖЕЛЫМИ МЕТАЛЛАМИ ДОННЫХ ОСАДКОВ ЗАЛИВА ЧАНДАРЛЫ, ТУРЦИЯ

Г. Япрак¹, С. Айтаз¹, Д. Ясар², И. Серт¹, С. Юсан¹, Х. С. Сазак³,
С. Сахин¹, С. Гюрлеен¹, Г. Такан¹, Г. Дурсун¹

¹Университет Эге, Институт ядерных наук, Измир, Турция, ayaprak.gunseli@gmail.com

²Университет Докуз Ейлыл, Институт морских наук, Измир, Турция

³Университет Эге, Факультет наук, отдел статистики, Измир, Турция

Донные осадки являются природной летописью изменений среды, и их точная датировка обеспечивает хронологию процесса. В частности, датировка ненарушенного керна с помощью ^{210}Pb является наиболее широко используемым и надежным методом для изучения изменений в экосистемах за последние 100 лет. Также часто для независимого контроля и проверки ^{210}Pb -метода используется ^{137}Cs -метод. Залив Кандарли – один из важнейших индустриальных регионов на побережье Эгейского моря в Турции. Таким образом, целью работы было исследование истории загрязнения тяжелыми металлами и определение их содержания в морских грунтах залива Кандарли (включая бухту Алиага) с помощью хронологии ^{210}Pb и ^{137}Cs . Результаты обеспечивают достоверную картину изменений среды в заливе Кандарли.

Ключевые слова: ^{210}Pb , ^{137}Cs , донные осадки, залив Чандарлы, загрязнение