CONTROLS ON DISTRIBUTIONS OF REDOX METALS IN THE BLACK SEA

YIĞITERHAN, Oğuz[1]; YEMENICIOĞLU, Semal,[1] and MURRAY, James[2]

[1] Institute of Marine Sciences, Middle East Technical University, P.O. Box 28, 33731, Erdemli, Icel,
Turkey. E-mail:ozeus@ims.metu.edu.tr

[2] School of Oceanography, Box 355351, University of Washington, Seattle, WA. 98195-5351, USA.
E-mail: jmurray@u.washington.edu

ABSTRACT

The distribution of major and trace elements in particulate matter is a sensitive indicator of biogeochemical processes occurring in the Black Sea. In this study we analyzed Al, Ti, Fe, Mn, Cu, Ba, Cd, U, Mo, V, Ag, Ni and Re in samples of water column particulate matter and in sediment samples. The samples were obtained from the central western basin and along the transects to the NW shelf and SW shelf regions of the Black Sea during Autumn 2000 R/V Bilim, and Spring 2001 R/V Knorr cruises. Analyses were done by using ICP-MS after digestion of the samples with a modified version of Nameroff's microwave acid digestion technique. Isotope dilution technique was used for the determination of concentrations when applicable. For this purpose, isotope spikes of ^{100}Mo, ^{50}V, ^{130}Ba, ^{109}Ag, ^{185}Re, ^{235}U were used. The other elements were determined by the standard curve and standard addition methods. Some of these elements (e.g. Cd, Cu, Mo, Re, U, V) have been used as redox tracers for the determination of redox geochemistry of ocean environments. The Paleo sedimentary record of these tracers provides important clues to how the redox environments have changed over time. Analyses were also conducted for Al and Ti for the estimation of the lithogenic fraction, for Fe and Mn whose oxides play an important role in scavenging processes, and for Cu and Ba, which have been proposed as tracers for planktonic material and new production.

The origin and maintenance of the suboxic layer, as well as the complex biogeochemical reactions taking place across the anoxic interface, which prevent the sulphidic waters to rise towards the surface, are not fully understood and deserve further investigations. Some of the hypotheses proposed for the formation and maintenance of the suboxic zone include the distribution of trace metals. We hypothesize that the vertical zonation in redox conditions through the oxic/suboxic/anoxic zones influence the dissolved/particulate partitioning of reactive redox trace metals. Therefore, the goal of this study is to answer the questions:

How are the geochemistry of some of the important trace elements influenced by suboxic and anoxic conditions in the Black Sea; water column and sediments; and do the suspended particles in the water column have a unique "suboxic" geochemical signature?

We predict that the suboxic water column will be characterized by maximum values of Mn and the concentrations of Cu, Ba, Cd, Mo, Re, U, and V will be unaffected by the suboxic conditions. Al, Ti, and Fe must be mostly of lithogenic origin; however there should be significant amount of non-lithogenic Cu, Ba, Cd and Mo that may be of biogenic origin. We are dealing with metal ratios, which have been proposed as tracers for the redox environment. We hope to confirm the validation of the non-lithogenic Cd/Mn ratio for the surface and down-core sediments of the Black Sea. The ratio is expected to change in ascending order from oxic to suboxic and anoxic layers in the Black Sea. The new data of the recent Black Sea cruises will be shown and interpreted for the first time in this study.

Key words: Trace elements, tracers, redox metals, suboxic zone, Black Sea.