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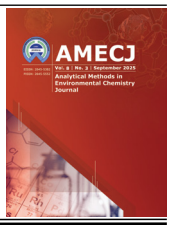

Analysis and evaluation of toxic heavy metals in sediments of seabed cores using inductively coupled plasma optical emission spectroscopy

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ABSTRACT

Soil sediments were studied in three areas in the northern Gulf within Iraqi territorial waters, where sediments were collected to cover all depths from 0 to 40 meters below the sea floor. The concentrations of the elements lead (Pb), cadmium (Cd), nickel (Ni), chromium (Cr), and vanadium (V) were measured using the inductively coupled plasma optical emission spectroscopy (ICP-OES), and arsenic (As) was determined by the graphite furnace atomic absorption spectrometry (GF-AAS) (%RSD < 5). The detection limits of Pb, As, Cd, Ni, Cr, and V were obtained at 0.511, 0.554, 0.525, 0.528, 0.501, and 1.221 µg L^{-1}, respectively. The Geoaccumulation Index (I-geo) compares the concentration of heavy metals in six classes in a sediment sample to its background value. The results were compared using I-geo calculations, which indicated high levels of contamination for arsenic and cadmium, with I-geo values ranging from 2.5 to 6.7 for arsenic, with moderately to significantly contaminated (Class 3 and 6), and from 2.4 to 3.9 for cadmium, with moderately to heavily contaminated (Class 3 and 4). There were lower contamination rates for nickel, as the I-geo values ranged from 0.23 to 2.09, while the concentrations of lead, chromium, and vanadium remained within safe levels. So, no dangerous concentrations for Pb, Ni, Cr, and V were found in any areas or depths from 0 to 40 meters below the seafloor.

1. Introduction

Heavy metals are among the key components of the Earth's crust. The level of heavy metals in soil varies widely depending on geological formation, depth, and location [1]. These elements can have a significant impact on the environment, economy, and human health when present in soil. Therefore, it is essential to understand the levels and concentrations of these minerals in sediment, especially in areas where human activities, such as commercial, industrial, agricultural, and marine fishing, are closely linked to the sediment [2]. The Earth's crust contains about 15 µg g^{-1} of lead. Lead levels in global soils vary from 2 to 200 µg g^{-1} on average. Lead is also present in many rocks, including argillaceous and magmatic types, where it can be found in significant amounts (10–40 µg g^{-1}), as well as in ultramafic rocks (0.1–10 µg g^{-1}) [3]. Cadmium is regarded as a rare element. Although its approximate abundance in the earth's crust is 0.1 µg g^{-1}, it is not found in nature as a

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