

Investigating contamination and sources of heavy metals and polycyclic aromatic hydrocarbons (PAHs) in surface sediment of Qarasoo River, Kermanshah

Meisam Rastegari Mehr¹, Adnan Deshaee^{1*}, Ata Shakeri¹

1-Assistant Professor in Environmental Geology, Faculty of Earth Sciences, Kharazmi University

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1-Introduction

Land use change and entry of pollutants such as sewage sludge, mineral waste, industrial waste, pesticides and use of fertilizers are the main factors changing flood flow and contaminating river sediments with heavy metals and organic contaminants (Chen et al., 2004; Lepane and Heonsalu, 2007; Gautam et al., 2013; Amin et al., 2014; Singh et al., 2014; Narsimlu et al., 2015; Kumar et al., 2017). In general, sediments are the important indicators for contamination, by which the type and amount of contaminants could be identified, to help decision makers for better management. In developing countries such as Iran, ecological problems associated with heavy metals and organic compounds can be exacerbated by inappropriate management and poor standards. Most of the previous studies in Iran have investigated the pollution of large rivers such as Karoon and Zayandehrud (Keshavarzi et al., 2015; Rastegari Mehr et al., 2012), while less attention has been paid to smaller rivers such as Gharasoo in Kermanshah, despite numerous sources of industrial and urban pollution. Due to crossing the river from different land uses including agricultural, industrial and urban, the present study was conducted to assess heavy metals and polycyclic aromatic hydrocarbons (PAHs), and source identification for the first time in the Gharasoo River sediments which is located in the boundaries of the Kermanshah province.

2-Materials and Methods

A total of 19 surface sediment sampled from different points, were analysed using ICP-MS and GC-MS methods after preparation to determine the concentration of selected heavy metals and 16 polycyclic aromatic hydrocarbons (PAHs), respectively. For analyzing the data (geochemically and statistically) contamination factor (CF), pollution load index (PLI), enrichment factor (EF), toxic equivalence index (TEF) and principal component analysis (PCA) were used (Hakanson, 1980; Tomlinson et al., 1980; Ergin et al., 1991; Nisbet and LaGoy, 1992; Cabrera et al., 1999; Sutherland, 2000; Blaser et al., 2000; Zhang and Liu, 2002; Sprovieri et al., 2007).

3-Results and discussion

The texture of Qarasoo River sediments were mainly sandy silt, silty loam, and sandy-silty-loam, indicating fine-grained texture. High concentrations of metals at the sediment surface indicate that the presence of one or more point source of contaminants may increase the concentration of these elements. The main contamination sources includes discharging various types of sewage, refinery waste and existing garbage in the river's margin. The differences in heavy metals concentrations between samples taken from urban areas and distant points from contaminating sources indicated the role of human activities on sediment quality. In general, the contamination factor in most stations is moderate or high, which indicates the relative pollution of the Qarasoo River sediments. Also, the results of PLI calculation showed that in 47.36% of stations the values of this index are more than one. The lowest amount of PLI is related to Brimvand and Meymoon Baz stations, indicating the dominance of geogenic sources for elements in the upstream of the river. The results of the enrichment factor showed that all of the studied metals are more or less enriched in the sediments of the river compared with the average of shale. It seems that the elements in the first and second components in PCA have anthropogenic origins. The third component indicates the dominance of geogenic source for aluminium, which is due to the erosion and release of this element from the lithology of the upstream and the soil formation.

* adnandeshaee@gmail.com

Classification based on total concentration for PAHs showed that 15.78% of the stations had very high pollution, 10.52% of the stations had moderate pollution and the remaining stations had a low level of pollution. The compounds with three, four and five rings had 36.13, 34.9 and 16.42 percent of the total concentration, respectively, so the three-ring compounds are the dominant type of PAHs in this study. The concentration of PAH compounds was compared with the values of ERL and ERM. The results showed that the concentration of total PAH for all stations was lower than the ERL except for the Velayat bridge station, which had a much higher concentration and it was close to the ERM. These results showed that in some stations, specific PAH compounds alone may cause adverse biological effects. The TEQ index showed different values, which the high value were in the stations of Velayat bridge station, industrial town of Kermanshah, international exhibition and Shahrak Janbazan Phase 3. The ratios that used show different origins (petrogenic and pyrogenic) for PAH at each station. The first component of PCA with 50.43% of the total variance, mostly containing low molecular weight compounds: NAP, Ace, Fl, Phen, Ant Flu, Chr, DiBA and ΣPAHs. The companion of these compounds with ΣPAHs in the first component demonstrates the role of low weight compounds with petrogenic source in the concentration of total PAHs. The second component, with a distribution of 26.51% of the total variance, mostly contains four and five rings (HMW) compounds (Pyr, BaA, BeP, BbF, BkF and BaP). The high concentration of these compounds in the sediment represents the origin of pyrogenic or the transformation of low PAH to heavy over the time. In the third component, which only has 15.5% of the total variance, there are two combinations of BghiP and IndPy, both are 6-ring PAHs, and showed lower concentrations change in samples taken from Qarasoo.

4-Conclusions

In general, this study showed that the Qarasoo River sediments are relatively contaminated, in particular at the stations in the city. Also, based on the location of contaminated stations and statistical analyzes, it can be concluded that the activity of the Kermanshah Oil Refinery and its effluent into the river, urban and industrial wastewater in the city, as well as the illegal disposal of solid waste in the margin of river considered are the main contributors of Qarasoo river to heavy metals and polycyclic aromatic hydrocarbons. Continuing the discharge of contaminants to the river may disrupt the environmental security of the area, and the river will lose its ability to self-purification and will create a worrying situation in the near future.

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