Analysis of the Zn, Cu and Pb relative contents in soils and sediments and their use to identify contamination

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This study was aimed at the evaluation of the conservative behavior of Zn, Cu and Pb in the environment; and to the evaluation of the use of their relative contents to evaluate outliers, attributable to contamination. The selection of an appropriate element to normalize the concentrations of metals in a selected matrix to detect anthropogenic inputs is a complex task, and this may be even more complicated when analyzing the evolution of several elements across four several matrixes: soils, suspended sediments, bed sediments and in-depth cores. In addition, the selected basin has a complex geology composed by multiple bands of different composition running in a North-South direction, and also different land uses, which make difficult the use of the commonly employed normalisers, such as iron, aluminium, clayey fraction, rare earth elements, etc. In this case, it is hypothesized that the Zn:Cu:Pb relative contents, which have a conservative ratio in the environment in the absence of contamination, allow identifying anomalies of these elements in the matrixes analyzed, thus making an useful tool when the selection of other normalisers is not possible.

The results obtained evidenced that there is a conservative behavior between the relative contents of Zn, Cu and Pb in superficial samples (soils, bed or suspended sediments). Only the in-depth cores showed a non-conservative behavior, showing depletions in the Zn and Cu, with respect to the superficial samples, which must be attributable to diagenetic processes. On the other hand, it has been proposed that the average relative concentrations of Zn, Cu and Pb, together with the value of three times the standard deviation for each element, includes the normal range of variation of these elements when represented in ternary plots [1]. Thus, the visual inspection of the results allows assessing which points show an anomalous paragenetic Zn:Cu:Pb ratio, which are those to be likely affected by pollution sources. When Zn, Cu and Pb relative contents were plotted in ternary diagrams, outliers were identified based on the differences between Zn, Cu and Pb distributions in the samples, as high differences between these elements classify these samples as out of the normal range of variation. Also, the ternary diagrams were effective to discriminate outliers either in the less than 63-μm

or less than 2-mm fractions, which may be useful to compare samples with different grain sizes. Among the variables tested, the only limitation of this method is the lack of reliability when evaluating in-depth cores, so this method should only be applied to superficial samples.

References

[1] Weng, H.-X., Zhang, X.-M., Chen, X.-H., Wu, N.-H., 2003. The stability of the relative content ratios of Cu, Pb and Zn in soils and sediments. Environmental Geology 45: 79 – 85.

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