Determination of total mercury in sediment samples from Serra Do Navio, Amapa, Brazil, by radiochemical neutron activation analysis

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The pollution caused by heavy and toxic metals such as Hg is one of the causes of the forest environment degradation process. Mercury is the only metal which is known to have caused serious environmental contamination that resulted in deaths.

The natural cycle of Hg has been changed in the last decades, mostly due to the gold mining activities, where Hg is employed to amalgamate gold during the extraction step.

The study of the impact caused by Hg must consider its chemical form. The danger for the environment and man begins when metallic mercury, which is not so toxic and little absorbed by organisms, is transformed in methyl-Hg, its most toxic form, which accumulates fastly in organisms, showing a long residence time. This way, the impact caused by mercury discharging in the ecosystem can result in the generalized pollution of water, sediments, atmosphere and biota.

The studies area is a gold mining region in Serra do Navio, in Amapa (Brazil) in the midst of alluvial/eluvial ways of gold exploration and where the mercury contamination is intensive, due to the exrtractive technique used - amalgamation.

As background to quantitative balances, an area located far from Serra do Nario was chosen, where the forest is found totally preserved from any anthropogenic contribution.

In this work, sediment samples from the mentioned region, separated in two different granulometric fractions (silt - < 0.062 mm - and sand - < 2 mm and > 0.062 mm), have been analyzed by neutron activation method. Since mercury levels are low, radiochemical separation was employed to obtain a better sensitivity of the proposed method.

Samples and standards were irradiated for 16 hours in quartz vials, under a 10^{12} $n.cm^{-2}.s^{-1}$ thermal neutron flux, in the IEA-R1 reactor from IPEN/CNEN - SP, Brazil. Determination of total Hg was carried out by using the ^{203}Hg and ^{197}Hg radioisotopes.

The method has consists of the irradiated sediment samples lixiviation with acqua regia in a microwave oven and subsequent Hg extraction with bismuth diethyldithiocarbamate ($Bi(DDC)_3$ selectively. The chemical yield of this separation procedure was determined by using ^{203}Hg tracer and inactive sediment samples and the average value was 95 ± 5 %.

Mercury contamination has been easily detected in sediment samples collected near the gold mining activities, where levels of Hg can reach values as high as 3.2 µg/g, while in the area considered as background this concentration varied from 0.46 µg/g to 0.022 µg/g.