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Heavy metals found at Umzimvubu River Estuary in the Eastern Cape, South Africa

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The aim of this research was to detect and measure the concentration of heavy metals found in the water and silt of the Mzimvubu River at Port St Johns in the Eastern Cape. The water from this river estuary is used by the people and animals of that area and is suspected to cause several health conditions. The objective of the research was to undertake a pilot analysis for heavy metals. Atomic Absorption Spectroscopy (AAS) was selected as a tool to determine the concentration of the heavy metals present in the water and sediment samples. Water and sediment samples were collected at the river mouth and 5 kilometers upstream, near the R61 bridge, on either side of the river. The atomic absorption spectrophotometer used to measure the heavy metal concentrations was a Varian Spectra AA 100 equipped with a single slot burner. Measurements were carried out in triplicate. Throughout the study it was evident that there are heavy metals such as lead, cadmium, zinc and nickel in the Umzimvubu River. The bio-accessibility of lead is a concern in view of the fact that it was found in high concentrations. Cadmium contamination was found to be in lower concentrations compared to the South African guidelines. Zinc and nickel were not severe since both were within the WHO and SADWAF guidelines. Therefore, it is concluded that the Umzimvubu River is an intimidation to many living organisms since it contains high concentrations of Lead, significantly higher than the South African guidelines. Severe damage in physical condition could be experienced by the human and animal populations in close proximity to the river. Further and more detailed studies are recommended, including bio-accessibility and bio-accumulation studies.

Key words: Mzimvubu river, heavy metals, atomic absoption spectroscopy.

INTRODUCTION

The Umzimvubu River is no exception to other rivers since it also suffers from pollution by human activities. The river pollution can be caused by three sectors namely; agriculture, households and industries and this can lead to the abundance of heavy metals in river water and sediment. These heavy metals can be life Threatening to plant and animal life.

Heavy metal poisoning can result, for instance, from drinking-water contamination, high ambient air concentrations near emission sources, or intake via the food chain (Njar et al., 2012). Heavy metals can enter a water supply by industrial and consumer waste, or even from acidic

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rain breaking down soils and releasing heavy metals into streams, lakes, rivers, and groundwater (Dmitri, 1993). Water pollution affects plants and organisms living in these water bodies; and, in almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities (Foy et al., 2000). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds (Lopes et al., 2005).

Among the heavy metals, the most serious effect of pollution is presently associated with lead emission (Olade, 1987). Human exposure to toxic heavy metals has become a major health risk on the continent and is the subject of increasing attention from national and international environmentalists (Yabe et al., 2010). Characteristics of heavy metal pollution in North, West, East and Southern regions of Africa have been described, as have major sources of pollution in the different regions (Yabe et al., 2010). Most of the countries within the West African sub-region are emergent nations which, for a long time, have been grouped among the less developed countries of the world. In recent years, some of these countries, such as Nigeria, Ghana and Ivory Coast have achieved significant strides in their quest for rapid economic growth through industrialization (Mombeshora et al., 1983). Thus, a number of factories, usually situated haphazardly, have mushroomed, and with increased affluence generated by income from the export of natural resources, the problems of urbanization, population explosion and the increased use of automobiles have become very common. At present, relatively little data are available on the extent of environmental pollution because there are no agencies charged with the routine monitoring and protection of the environment in these countries (Nriagu, 1978).

There has been a phenomenal growth in the use of automobiles within the last decade as a result of increased affluence. The level of lead in super grade gasoline in Nigeria is in the range of 0.7 to 0.9 gm/l which is higher than permissible levels in developed countries, where the range 0.4-0.5 gm/l is common. Preliminary studies show that the lead emission in air at ground level in Lagos, Nigeria, is far higher than for cities like London, UK, and New York, USA, but similar to those of Brazil or the Caribbean due to perturbation by roadside traffic. Roadside soils and dust are also getting increasingly contaminated (Olade, 1987). The city of Port Harcourt close to the oil-fields is lit brightly at night by gas being flared in the surrounding areas. No data are available on the extent of metal pollution associated with this practice (Mombeshora et al., 1983).

It is well known that fertilizers may contain up to 400 ppm lead which may constitute a major source of soil pollution, although phosphate lead is not often readily available to plants (Nriagu, 1978). The consumption of fertilizers in South Africa over t he fifty year period from 1955 to 2005 has increased from 800,000 tonnes to 1,500,000 tonnes as shown in Figure 1. The South African fertiliser industry annually supplies about 2,000,000 tonnes of fertiliser products to the local market (van der Linde and Pitse, 2006).

In Lagos no centralized sewage systems existed prior 2012, and the industrial effluents from the factories were usually discharged untreated into streams, lagoons, open drains and other water bodies. This has resulted in high, although not alarming, levels of lead, cadmium and copper in some localized areas. These levels of inorganic pollutants may be reduced to acceptable levels for potable re-usage (Smith et al., 1980). Studies of heavy metal contents of surface waters in Ibadan show that levels of lead may reach 50 µg/L (Mombeshora et al., 1983). In waters of the Lagos lagoon, lead levels exceeding 120 µg/L have been obtained (Olade, 1987). Clearly therefore, it is imperative to conduct environmental impact assessment studies before industries are located, so as to ameliorate environmental pollution from point sources (Vernet, 1991). Acidic mine drainage from disused mine shafts, open pits and dumps have contributed to localized metal pollution in the vicinity of these operations (Olade, 1987).

Municipal composts and farmyard manure are increasingly being applied to croplands. Heavy metal contents of municipal composts are similar to those of sewage sludge and their applications may increase metal contents of farm soils (Nriagu, 1978). South Africa is one of the world's leading producers of precious metals and minerals. The pollution of surface waters by heavy metals and acidic effluents from refineries are a serious problem in the country (van Hille et al., 1999). The majority of mines are located in the most highly industrialized and hence heavily populated areas, where the demand for fresh water for domestic and industrial use is highest (Henzen and Pieterse, 1978).

Heavy metals are used very often in South Africa in the textile industry, especially in the processes of dyeing, finishing, and health care. Many of these metals have unwanted effects on processing and on product quality. They are damaging to the textile material, toxic to man, and hazardous to the environment when released into streams and rivers as wastewater (Binning and Baird, 2004). Scientists need to understand not only the unique features and behaviour of individual heavy metals but also the differences, similarities and interactions of different metals at the ecosystem, systemic and cellular levels if we are to deal with the problems of global heavy metal pollution in a sustainable manner (Vernet, 1991).

In South Africa, the quality of a stream or river is often a good indication of the way of life within the community through which it flows. Healthy streams, wetlands and rivers support a great variety of water life. Rain water and tumbling mountain streams contain high levels of oxygen. Much of the oxygen comes from the atmosphere through rain, tumbling water in fast-flowing streams and

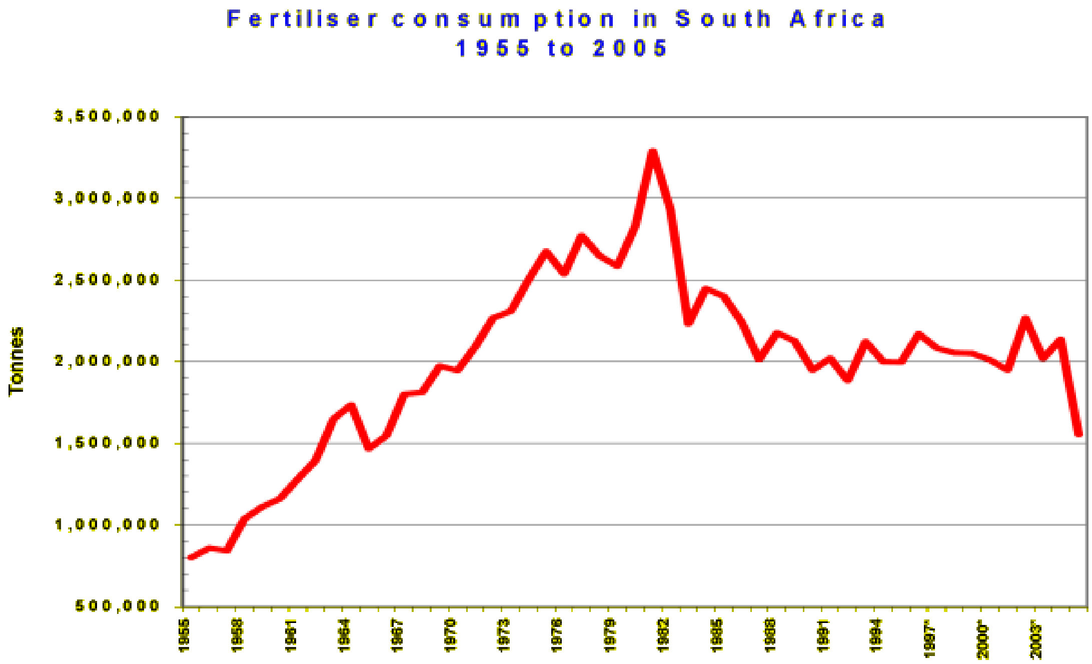

Figure 1. Consumption of fertiliser in South Africa from 1955 to 2005 (van der Linde and Pitse, 2006).

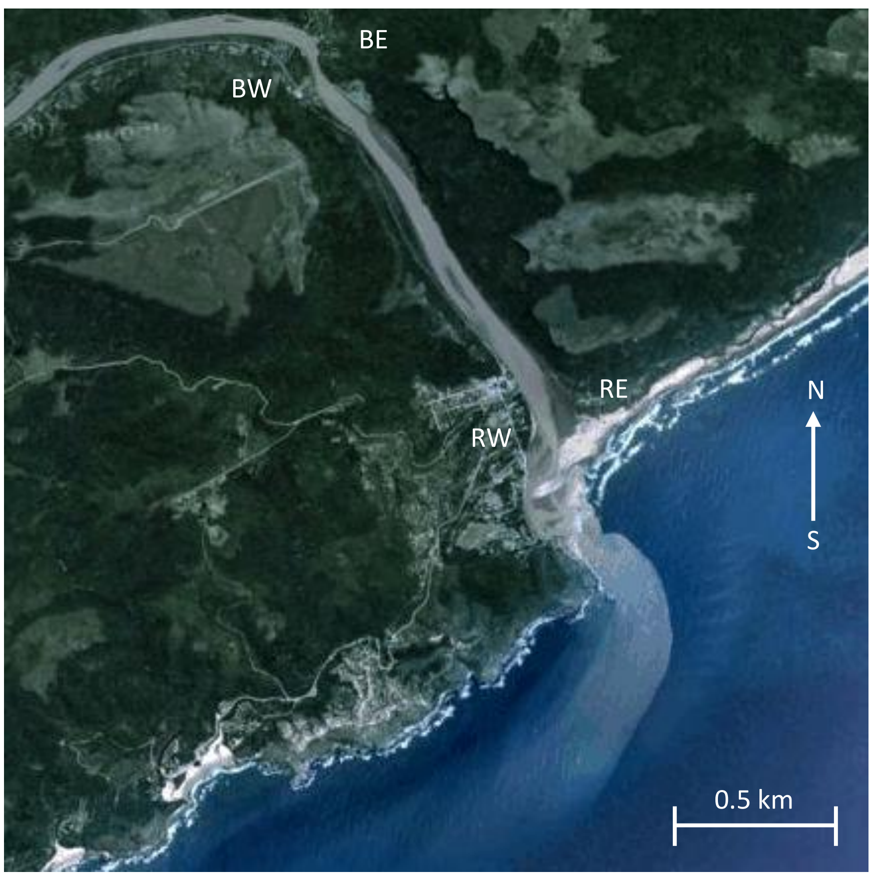

Figure 2. Sampling locations along the Umzimvubu River at the mouth RE and RW and at the bridge BE and BW.

photosynthesis. Water plants, in turn, photosynthesize and provide life-supporting oxygen and other food sources for water organisms that interact in a complex web of life (Eaton, 1994). High quality water is defined as water which is safe, drinkable and appealing to all life on earth (Young, 1992). As the human population increases, there is an increase in pollution and catchment destruction (Olade, 1987). First world countries have been investigated to detect the initial signs of decreasing water quality, to prevent increasing water pollution at an early stage (Robinson, 1996). Organisms in aquatic environment are considered biologically sensitive, due to their ability to respond to changes that occur in water. The biotic integrity of an ecological system is therefore reflected in the health of its fauna (Robinson, 1996).

The Swartkops River catchment contains almost the entire municipal area of Uitenhage and Kwanobuhle, Despatch and Ibhayi and also half of the Port Elizabeth municipal area. It is estimated that approximately one million people live and work presently in the Swartkops River catchment. High-density, low-income housing is developing in the catchment with a concomitant increase in industry, and in the quality and quantity of storm water runoff. These developments will necessitate road, rail, telecommunication and power supply infrastructure over the river and these developments are a source of heavy metals which will lead to physical challenges to humans (Horenz, 1988). Comparison of the concentration of chrome, lead, zinc, titanium, manganese, strontium, copper and tin in the estuary with those obtained in a similar survey made about 20 years ago revealed some remarkable increases. This raises concern over the long-term health of the Swartkops River ecosystem (Binning and Baird, 2001). The distribution of the heavy metals zinc, cadmium, copper, iron, manganese and lead was investigated in seawater directly, and in sediments, using the total digestion method from the East London and Port Elizabeth harbours. Ship repair activities are suspected to be responsible for elevated concentrations reported in this study in the upper reaches of these harbours (Fatoki and Mathabatha, 2001).

The aim of this research was to detect and measure the concentration of the heavy metals Cd, Zn, Ni and Pb in the water and silt of the Mzimvubu River at Port St Johns in the Eastern Cape. The water from this river estuary is used by the people and animals of that area and is suspected to cause several health conditions. To the best of our knowledge, no studies have been reported on the detection and quantification of heavy metals in the Mzimvubu river waters and sediments. However, Moses (2006) makes reference to a study conducted by Van Niekerk (2000), which cites cases of faecal pollution, because of lacking sanitation infrastructure to settlements surrounding the Mzimvubu and other rivers. Furthermore, apart from anthropogenic sources, evidence exists to suggest that heavy metals such as nickel, copper and platinum group metals may be collecting into Mzimvubu river from as far upstream as Mount Ayliff at Intsizwa (Sander and Cawthorn, 1995; Cawthorn and Kruger, 2004).

MATERIALS AND METHODS

A Varian Spectra AA 100 atomic absorption spectrophotometer equipped with a single slot burner was used. Measurements were carried out in triplicate. All glass and propylene ware used were first soaked in dilute HNO_3, thoroughly washed with liquid soap and then rinsed with double distilled de-ionised water and acetone. Thereafter, all the glassware were dried in the oven at 100°C for 24 h, while the plastic ware were left to dry at room temperature and later used for water sample collection. All reagent stock solutions: 1000 mg/mL of the metals cadmium, nickel, lead and zinc used were of analytical reagent grade supplied by Total Laboratory Technology c.c.

Collection of the samples and preparation for testing

The mouth of the Umzimvubu River is situated 31.63° south and 29.55° East, near the Open Africa Route at Port St John in the South East of South Africa in the Eastern Cape province, in an area that was previously known as the Transkei homeland. The river estuary is situated about 96 km from Umthatha along the R61. Water and sediment samples were collected once from the east and west of the river mouth (RE and RW) and then again collected at about 1.5 km from the river mouth near the R61 bridge, east and west side of the river (BE and BW) in August 2010 (Figure 2). The propylene containers were used for sample collection. Before use the propylene containers (500 ml) were first rinsed with the water samples and thereafter immersed about 15 cm below the surface. Water and sediment samples were collected again in January, February and March 2013, from the sampling points used for the August 2010 sample collection.

The samples were transported to WSU Potsdam Campus Laboratory and stored in a refrigerator until analysed. The samples for total metal concentrations were acidified in the lab with grade HNO_3 so that the metals could not be entrapped in other species present in the samples.

Determination of concentrations

Numerous instrumental methods are used to determine heavy metals in natural water and its sediments, mainly with preconcentration, since the sensitivity of direct analysis is often insufficient. But in this research these digestion methods were not employed during the investigation of cadmium, nickel, zinc and lead in water. The reason for this is that the availability of these heavy metals was already observed when the samples were analysed without digestion using the AAS.

Analysis of water

The water samples were taken out of the refrigerator and allowed to warm up to room temperature for about 15 – 20 min before analysis with the AAS. The detection limits for each of the elements were determined using the lowest concentration of each of the elements that gave the least detectable signal using flame AAS for cadmium, nickel, zinc and lead. Three of each of these samples were prepared and analyzed.

Analysis of sediments

Sediment samples were analysed using the total digestion method.

Sediment (0.5 g) was weighed into a 100-ml beaker. Concentrated HNO_3 (5 ml) was added and this was boiled gently for 30 min on a hot-plate without splattering. The beaker was cooled and 2 ml $HClO_4$, 5 ml concentrated HNO_3 and 5 ml HF were added. The mixture was heated to near dryness without splattering. The corners and walls of the beakers were washed with about 5 ml triple-distilled water, and the solution was again heated until dense white fumes developed. The beaker was cooled and 10 ml HNO_3 was added to dissolve the salts. The solution was transferred into a 50 ml standard flask and then diluted with triple-distilled water. The solution was analysed by means of AAS. A blank determination using the same procedure was performed (Fatoki and Mathabatha, 2001).

RESULTS

The average of heavy metal concentrations in µg/l, in the waters of Umzimvubu River are compared to national and international guidelines for drinking water, including the South African guideline for drinking water, the World Health Organisation guideline for drinking water and the World Average of trace elements in unpolluted rivers (Helmer and Meybeck, 1989; Boyle and Schiller, 1987). The results are summarised in Table 1.

In addition, the average of heavy metal concentrations in µg/g, in the sediments of Umzimvubu River is compared to South African Guidelines (Maritz and Swanopoel, 1998). The results are summarised in Table 2. Tables 1 and 2 show the results for four sampling points including the two river mouth sampling points RE and RW and the two sampling points near the bridge BE and BW, the average of the four sampling points as well as the national and international guidelines, SA, WHO, WA and proposed SA.

DISCUSSION

The lead concentrations in water samples from the river shown in Table1 were significantly higher than the values for the other metals except of Zn. The high levels shown by lead may be attributed to the deposition of lead particulates on the road next to the river. Other investigations (Quinche and Zube, 1969; Chow, 1970; Motto, 1970; Fatoki and Hill, 1994) have demonstrated that lead emissions from motor vehicles produce elevated concentrations of the element in roadside water, vegetation and soil. A study by Okonkwo et al. (2003) showed high levels of lead on vegetation and soil as a result of the use of leaded petrol. The same argument is made in this research since gas stations in Port St John's are very close to the river, and farmers near the river have big tanks for the storage of petrol which can contribute to the abundance of lead in river waters through tank leakage. Table 1, BW (29.8 mg/kg) and BE (39.5 mg/kg) shows high concentrations of lead as compared to RW (10.5 mg/kg) and RE (19.3 mg/kg). This is probably because at this location near the bridge it was where the road construction was in progress.

Possible contributors to the high levels of lead include sewage effluent and leaching from the nearby dumping site. Also the agricultural activities around the rivers may have contributed to the observed high levels of lead and cadmium levels, and since these metals can occur as impurities in fertilizers and in metal-based pesticides and compost and manure. With respect to cadmium, contribution from roadside contamination is very unlikely since the contamination of roadside soil and vegetation by cadmium is usually less anomalous than that of lead. The lead mean of sample collection sites exceed the WHO and South African water quality guidelines of 15, as shown in Table 1 (WHO, 1991; SADWAF, 1996). As for cadmium the values shown are well within the guidelines of WHO and South African Department of Water Affairs and Forestry. This comparison is important since the river is used daily by the locals for domestic purposes without further treatment. There is therefore, cause for concern with regards to lead since with respect to human health the effects of lead are the same irrespective of whether it is inhaled or ingested (ATSDR, 1997). Lead can cause irreversible central nervous system damage and decreased intelligence at extremely low doses (ATSDR, 1997). At higher levels of exposure anaemia may result, along with severe kidney damage (ATSDR, 1997). Children are especially susceptible to lead poisoning because they absorb and retain more lead in proportion to their weight than adults (ATSDR, 1997).

Sediment levels of lead can range from 10 to 500 mg/kg. Levels over 500 mg/kg are classified as contaminated, and thus unfit for agricultural or recreational use (South African Guidelines Maritz and Swanopoel, 1998). Therefore, compared to these environmental levels that of the mean of lead which is 662.3 mg/kg in Table 2 is indicative of severe contamination which is very toxic and unfit for human assumption. Figure 3 also shows very high levels of lead in the sediment compared to water samples. The lowest levels were found for cadmium; RW (11.6 mg/kg) and BW (5.6 mg/kg). Background levels of cadmium in the environment are extremely low (Bryan and Langston, 1992). Sediment levels can range from 0.2 to 10 mg/kg, with levels over 3 mg/kg classified as contaminated, and thus unfit for agricultural or recreational use (South African Guidelines, Maritz and Swanopoel, 1998). Therefore, compared to these environmental levels the mean of the Cadmium which is 7.2 mg/kg in Table 2, is indicative of severe contamination which is very toxic and unfit for human assumption. Cadmium has no biological function, and is highly toxic to both animals and plants. The low concentrations of cadmium usually encountered in the environment do not cause acute toxicity, however elevations above background concentrations can have deleterious effects on plant and animal health (Bryan and Langston, 1992; Alloway, 1990). This raises a concern since the river is in constant use by man and animals habituating near the river waters.

The value of the mean concentration of zinc in the sam-

Table 1. Mean of heavy metal concentration (ds/m) in the waters of Umzimvubu River (AAS) compared to international guidelines for drinking water.

RW	RW	RE	BW	BE	Mean
Metal = Cd. SA(5), WHO(3), WA(1)					
August 2010	0.5	0.2	3.0	1.0	1.2
January 2013	0.7	0.3	2.8	1.2	1.3
February 2013	0.5	0.4	2.9	0.9	1.2
March 2013	0.4	0.1	3.1	1.1	1.2
Mean	0.5	0.3	3.0	1.1	1.2
Metal = Zn. SA(2000), WHO(~), WA(200)					
August 2010	29.9	30.0	19.0	12.4	22.8
January 2013	33.0	28.0	19.5	12.6	23.3
February 2013	32.9	29.4	19.1	11.6	23.3
March 2013	29.4	32.o	18.0	12.0	22.9
Mean	31.3	29.9	18.9	12.2	23.1
Metal = Ni. SA(150), WHO(20), WA(0.4)					
August 2010	5.5	7.8	9.2	9.1	7.9
January 2013	5.0	7.7	9.0	9.0	7.7
February 2013	4.8	7.9	9.4	8.8	7.7
March 2013	5.0	7.8	9.5	8.9	7.8
Mean	5.1	7.8	9.3	9.0	7.8
Metal = Pb. SA(10), WHO(10), WA(40)					
August 2010	10.0	20.0	30.0	40.0	25.0
January 2013	12.1	20.2	30.2	37.8	25.1
February 2013	9.9	18.2	33.0	44.0	26.3
March 2013	9.8	18.8	26.1	36.1	22.7
Mean	10.5	19.3	29.8	39.5	24.8

SA = South Africa (Department of Water Affairs and Forestry) guideline for drinking water; WHO = World Health Organisation guideline for drinking water; WA = World Average of trace elements in unpolluted rivers (Helmer and Meybeck, 1989; Boyle and Schiller, 1987); RW = River mouth west side; RE = River mouth east side; BW = West side of the river near the bridge; BE = east side of the river near the bridge.

ples shown in Table 1 is well within the guidelines of South African Department of Water Affairs and Forestry (SADWAF, 1996). This comparison is important since the river is used daily by the locals for domestic purposes without further treatment. The concentrations of zinc at RW and RE are 31.3 and 29.9 µg/l respectively and they are significantly higher than the concentrations of zinc observed at BW and BE which are 18.9 and 12.2 µg/l respectively. These higher concentrations at RW and RE are probably due to the high concentration of low cost houses, roofed with zinc coated corrugated iron sheets. These may have contributed to the higher levels of zinc at RW and RE, since these houses are found in larger numbers near RW and RE. It is therefore possible that zinc may have been leached out from the roofs into the surrounding environment.

Background levels of zinc in sediment are usually quoted as being less than 100 mg/kg (Goncalves, 1990; Bryan and Langston, 1992; Licheng and Kezhun, 1992; ATSDR, 1997). Sediments levels can range from 10 to 750 mg/kg, with levels greater than this being indicative of contamination (Maritz and Swanopoel, 1998). The mean of the zinc concentration for the sediments samples was nearly 61.7 mg/kg as shown in Table 2. The values of RW, RE, BW and BE shown in Table 2 are well within the guidelines of South African Department of Water Affairs and Forestry (SADWAF, 1996). And this data is indicative of the presence of zinc but without any severe contamination. Although zinc is not regarded as being especially toxic, it is sometimes released into the environment in large quantities, and can thus have deleterious effects on certain species at these concentrations. For example, effects on fertilisation and embryonic development have been observed in species of fish and harpacticoid copepods (Ojaveer et al., 1980; Verriopoulos and Hardouvelis, 1988). In terms of human health, zinc exposure via inhalation can cause a specific short-term disease called metal fume fever. Not much is known about the long-term effects of ingesting too much zinc, through food, water or dietary supplements. It is an

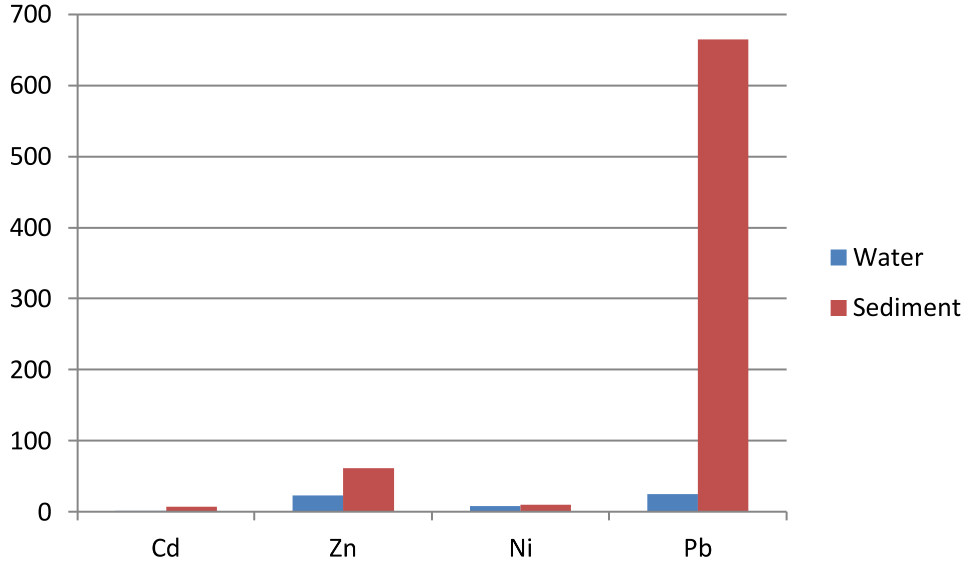

Figure 3. Comparison between sediment and water levels of the heavy metals Cd, Zn, Ni and Pb in Mzimvubu river estuary.

Table 2. Mean of heavy metal concentration in the sediments (mg/kg) of Umzimvubu River (AAS) compared to South African Guidelines.

RW	RW	RE	BW	BE	Mean
Metal = Cd. SA(5), WHO(3), WA(1)					
August 2010	12.1	10.2	5.2	1.3	7.2
January 2013	11.0	10.9	6.0	1.0	7.2
February 2013	13.0	9.2	6.2	1.1	7.4
March 2013	10.3	10.8	4.9	1.7	6.9
Mean	11.6	10.3	5.6	1.3	7.2
Metal = Zn. SA(2000), WHO(~), WA(200)					
August 2010	83.2	61.2	62.1	40.4	61.7
January 2013	77.7	67.0	60.5	42.2	61.9
February 2013	79.2	60.9	61.9	44.0	61.5
March 2013	83.0	59.2	63.7	40.9	61.7
Mean	80.8	62.1	62.1	41.9	61.7
Metal = Ni. SA(150), WHO(20), WA(0.4)					
August 2010	17.8	8.6	10.1	2.1	9.7
January 2013	18.8	9.4	9.8	1.9	10.0
February 2013	20.0	8.5	9.4	2.5	10.1
March 2013	15.8	8.1	10.3	2.0	9.1
Mean	18.1	8.7	9.9	2.1	9.7
Metal = Pb. SA(10), WHO(10), WA(40)					
August 2010	330.2	881.2	741.0	696.7	662.3
January 2013	300.7	890.0	730.1	729.9	662.7
February 2013	340.1	799.3	790.9	669.5	650.0
March 2013	350.2	901.2	778.3	710.2	685.0
Mean	330.3	867.9	760.1	701.6	665.0

Proposed South African Guidelines (Maritz and Swanopoel, 1998); RW = River mouth west side; RE = RIVER mouth east side; BW = West side of the river near the bridge; BE = East side of the river near the bridge.

essential trace element, but ingestion of quantities higher than the recommended levels can have adverse effects on health. The recommended Dietary Allowances for zinc are 15 mg/day for men and 12 mg/day for women. If doses 10 –15 times higher than these recommendations are taken by mouth, even for a short period of time, stomach cramps, nausea and vomiting may occur (ATSDR 1997). Ingesting high levels for several months may cause anaemia, damage to the pancreas, and decreased levels of high-density lipoprotein (HDL) cholesterol (ATSDR, 1997).

The value of the mean concentration of nickel in the samples shown in Table 1 is well within the guidelines of WHO and South African water quality guidelines (WHO, 1991; SADWAF, 1996). The concentrations of RW and RE are 5.1 and 7.8 µg/l respectively and they are significantly lower than those observed in BW and BE which are 9.3 and 9.0 µg/l respectively. This is due to the fact that BW and BE are close to the farms which are suspected to contribute to the availability of Nickel in the river water since these farms use and deposit phosphate fertilizers containing traces of nickel. Another possible contributor may be the anthropogenic sources of nickel including scrap metal waste, notably alloyed metals including stainless steel. Where BW and BE samples collected, it was noted that there were rusted cars beneath the river which can also be a source of the metal in the river.

Background concentrations of nickel are usually quoted as being less than 50 mg/kg (Bryan and Langston, 1992; Solomans and Forstner, 1984). Sediment levels range from 10 to 20 mg/kg, with levels above 50 mg/kg being indicative of contamination (Maritz and Swanopoel, 1998). The concentrations of the sediment samples from RW, RE, BW, and BE are 5.1, 7.8, 9.3 and 9.0 mg/kg, respecttively, falling within the recommended standards by WHO and South African water quality guidelines (WHO, 1991; SADWAF, 1996). Hence it is concluded that Nickel in these river waters is not in severe contamination. Nickel is considered an essential trace element at very low concentrations. It does bioaccumulate in aquatic systems, and as such elevations above normal concentrations can result in deleterious effects on aquatic life. The most common adverse health effects of nickel in humans are an allergic reaction and cancer (ATSDR, 1997).

CONCLUSION AND RECOMMENDATIONS

Throughout the research it was evident that there are heavy metals such as lead, cadmium, zinc and nickel in the Umzimvubu River, where the availability of lead is a serious concern since it is in higher concentrations than recommended standards by WHO and South African water quality guidelines. Cadmium was found in low concentrations. Zinc and Nickel were also found but they are not available in severe contaminations since both are within the WHO and SADWAF guidelines. This study was a preliminary pilot, aimed at detecting and determining levels of some of the heavy metals of common concern. It has shown that the concentrations of heavy metals in this river cannot be ignored any more. It is therefore recommended that a monitoring and evaluation study is conducted for a considerable period of time and a substantial distance upstream, in order to fully characterize the heavy metal load. It is further recommended that bioaccumulation studies are also conducted.

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