

Comparative Study of Iron (Fe) & Mercury (Hg) from the Sediments of the Weija & Kpong Reservoirs, Ghana.

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Abstract

Trace metals (Fe and Hg) levels were determined in the sediments from the Weija and Kpong reservoirs between the months of December 2013 to March 2014 and the occurrences were compared. Temperature, pH, and electrical conductivity were measured as hydrographic factors. The primary objective of the study was to establish the pollution status of these reservoirs based on the levels of Fe and Hg in the sediment compared to recommended values of sediment pollution (GESAMP, 1982) and (USEPA, 1986). From the results (Table 4.3) the mean concentration of Fe ($195.25 \pm 12 \text{ mg/l}$) and Hg ($0.0018 \pm 0.0056 \text{ mg/l}$) in the Weija reservoir. The mean concentration of Fe ($6.158 \pm 0.28 \text{ mg/l}$), Hg ($0.0031 \pm 0.00092 \text{ mg/l}$) in the Kpong reservoir. The highest levels of Fe and Hg were recorded in Weija reservoir with values of (210.2 mg/l) and (0.025 mg/l) respectively in the third site (Machigeni), a town close to the reservoir. It was therefore concluded that the highest levels of Fe and Hg in the Weija reservoir was an indicative of anthropogenic activities around the Weija reservoir. It is possible that the activities of Aglo Bullions Gold Miners Gh Ltd around the Weija province could introduce traces of metals into the reservoir through percolation and erosional activities. Farming activities through the use of chemical fertilizers around the Weija was also a contributing factor to the high levels of Fe and Hg in Weija than the Kpong. Despite the Weija reservoir had highest concentration of Fe than the Kpong, it is still within the recommended value (41000 mg/l) of unpolluted sediments (GESAMP, 1982). The levels of Hg were also within the recommended value ($< 1 \text{ mg/l}$) of polluted sediments (USEPA, 1986). The study showed that both Fe and Hg levels were generally higher in the Weija reservoir sediments than the Kpong and therefore the Weija reservoir could be described as relatively more polluted based on the levels of the two trace metals.

Keyword: Concentration of Fe, Concentration of Hg, Elements in Bottom Sediments.

1.0 INTRODUCTION

Sediments are important sink of a variety of pollutants, particularly trace metals and may serve as an enriched source for benthic organisms (Wang et al., 2002) especially in estuarine ecosystems. Monitoring programmes and research on trace metals in aquatic environments have become widely important due to concerns over accumulation and toxic effects in aquatic organisms and to humans through the food chain (Otchere, 2003). Trace metals contaminants have been reported to persist for many years in sediments in both freshwater and marine systems where they hold the potential to affect human health and the environment (Mackevičiene et al., 2002). For instance the presence of toxic metals such as lead (Pb) and Cadmium (Cd) in environmental matrices is one of the major concerns of pollution control and environmental agencies in most parts of the world. This is mainly due to the health implications of these toxic metals since they are non-essential metals of no benefit to humans (Borgman, 1983). For instance high exposure to organic mercury may result in damage to the gastrointestinal tract, the nervous system and the kidneys. The presence of trace metals in aquatic ecosystems is mainly due to anthropogenic influences and has far-reaching implications directly to the biota and indirectly to humans. Trace metals have been referred to as common pollutants which are widely distributed in the environment with sources mainly from weathering of minerals and soils (Merian, 1991). However the level of trace metals in the environment has increased tremendously during the past decades as a result of human inputs and anthropogenic activities (Prater, 1975, Merian 1991).

Trace metals are elements such as chromium, cobalt, copper, iron, magnesium, selenium, and zinc that normally occur at relatively very low levels in the environment. Living things need very small amount of some trace metals, but high levels of these same metals can be toxic. For instance, iron is an essential element for many living things. In human blood, iron transports oxygen around the body. If too much iron is consumed, however, there can be negative effects on human health leading to diabetes, liver problems, and heart diseases. Trace metals are known to play a dual role in living organisms. Many of these elements are essential for the sustenance of life, although required only in very small quantities. At higher levels of uptake, most of these metals turn toxic. The difference between the nutritive function and toxicity in trace metals is only a matter of variations in concentration of the metals in the organisms and generally the difference is large enough to cause any practical concern (Waldichuk, 1985).

However, there are some metals like cadmium and lead whose essentiality is not yet known but toxicity is well established even at very low concentrations.

Trace metals are dangerous to human health because they tend to bioaccumulate. (i.e an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment). Compounds accumulate in living things any time they are taken up and stored faster than they are broken down (metabolized) or excreted. Trace metals may enter the water body through natural processes like rainfall washing traces of metals which are left behind as tailings scattered in open and partially covered pits during mining processes or even from acidic rain breaking down soils and releasing heavy metals in streams, lakes, rivers, estuaries, lagoons and ground water. Trace metals may occur in aquatic environments from natural processes and from discharges or leachates from several anthropogenic activities (Connell et al., 1999; Franca et al., 2005). The contamination of natural waters by trace metals negatively affects aquatic biota and poses considerable environmental risks and concerns (Cajaraville et al., 2000; Ravera, 2001).

1.1 Justification of Study

Mercury in elemental form is a silver-coloured metal that exists as a thick liquid at room temperature, familiar to most people as the silver liquid inside mercury thermometers. Hg is a nonessential trace element that can be toxic to aquatic biota at high concentrations. Under Schedule (I) of the Canadian Environmental Protection Act (CEPA, 1985), Hg is considered a toxic. Hg is a highly toxic metal because of its affinity to thiol groups which reacts with proteins, affecting cellular membranes, inhibiting enzymes or damaging DNA and RNA helices. It is characterised by high bioaccumulation, and its organic species (i.e. methyl mercury) may be subject to biomagnification in food chains (Boeing 2000). Hg exist generally in three chemical forms namely elemental mercury, organic mercury, which is predominantly methylmercury found in foods, some vaccine preservatives and some antiseptics. The last chemical form of mercury is non-elemental forms of inorganic mercury (USEPA, 2002).

All these chemical forms of mercury have specific effects on human health. The primary Methylmercury health effect is neurological development. Elementary or metallic mercury causes health effects when it is breathed as vapour where it can be absorbed through the lungs. The non-elemental forms of mercury affects the gastrointestinal tract, the nervous system and the kidneys. The organic mercury compounds are more readily absorbed through ingestion than the inorganic mercury compounds. On the other hand, Fe is an essential element for the formation of protein haemoglobin which transports oxygen to all parts of the cells of the body. Iron also helps in cellular metabolism. However while consuming large amounts of Fe can lead to conditions known as Iron overload which is usually as a result of gene mutation (Analytical research labs, 1989).

Fe overload and untreated Fe can lead to hemochromatosis, a severe disease that damage the body's organs. When hemochromatosis is not treated early will lead to heart disease, liver problems and diabetes. When the trace metals are concentrated in the sediments, the finally find their through the food chain to the human system which then poses the effects mentioned above to human. Fe in the body is very essential but the over consumption and its untreatment is what brings the bad side of iron in the human system and fishery resources. Generally reservoirs are influenced by anthropogenic activities that transport traces of metals into the reservoirs thereby finding their way into the human system through a food web link. For instance, there is a massive farming activities all around the Weija and Kpong reservoirs by the use of chemicals fertilizers which find their way into these reservoirs through percolation and erosion activities, and these reservoirs serve several people and communities within the province of Accra and immediate towns. It will be necessary to assess the level of pollution by these trace metals in these two reservoirs which are major sources of drinking water for communities in and around Accra city.

2.0 LITERATURE REVIEW

2.1. General Classification of Sediments

Sediment is particles of organic or inorganic matter that accumulate in a loose, unconsolidated form. Sediments may be classified by their grain size or by the origin of the majority of their particles. For instance base on grain size, sediment may be classified as boulder, cobble, pebble, granule, sand, silt, clay. On the other hand sediments are classified as terrigenous, biogenous, hydrogenous, and cosmogenous base on the origin of particles (Garrison 4th edition). The terrigenous sediments as the name implies (terra means earth) originate on the continents or islands from erosion, volcanic eruption, and blown dust. Biogenous sediments are accumulation of hard parts of some organisms, for instance organisms with calcareous and siliceous oozes.

The contents of Fe in the biogenous components are originally low (Turekian et al.,1973; Masuzawa et al., 1988) because the concentration of iron in surface seawater is extremely low (Martin et al., 1989). Hydrogenous sediments originate from the precipitation of dissolved minerals from water often by bacteria. These sediment consist

chiefly of iron-manganese oxides dispersed as micronodules in the sediments and present as coatings on sedimentary particles. Cosmogenous sediments are of extra-terrestrial origin, mainly from dust of space and meteorite debris.

2.2 Trace Metals Concentration in Water Bodies in Ghana

Trace metals can be emitted into the environment by both natural and anthropogenic activities. The major causes of the emission are basically the anthropogenic sources specifically mining operations (Hutton and Symon, 1986; Battarbee et al., 1988). In some cases, even long after mining activities have ceased, the emitted metals continue to persist in the environment. Hard rock mines operate from 5-15 years until the minerals are depleted, but metal contamination that occurs as a consequence of hard rock mining persist for hundreds of years after the cessation of mining operations (Peplow, 2000). Apart from mining operations, mercury is introduced into the environment through cosmetic products as well as manufacturing processes like making of sodium hydroxide. Trace metals occur naturally in the environment but in very minute in micro-organisms (Vandecasteele and Block, 1993). Trace metals are used in the mining industry for the extraction of minerals for instance the use of (As) in gold mining industry (Asante et al., 2006). Trace metals are emitted both in elemental and compound (organic and inorganic) forms. Anthropogenic sources of emission are the various industrial point sources including former and present mining sites, foundries and smelters, combustion by-products and traffics (UNEP /GPA, 2004).

Cadmium is released as a by-product of zinc refining; lead is emitted during its mining and smelting activities, from automobile exhausts by combustion of petroleum fuels treated with tetraethyl lead antiknock and from old lead paints; mercury is emitted by the degassing of the earth's crust. In Ghana, one of the earliest studies (Amasa, 1975) examined various matrices, including drinking water, from the Obuasi gold mining area and found that arsenic concentrations occurred above normal values. A more recent study (Bamford et al., 1990) in which trace metal pollution from gold mining activities was assessed by analyzing gold ore, tailings, sediments and water for Chromium (Cr), Manganese (Mn), Iron (Fe), Copper (Cu), zinc (Zn), Arsenic (As), Lead (Pb), Rubidium (Rb), Strontium (Sr), Yttrium (Y), Zirconium (Zr) and Neodymium (Nb), the study revealed the presence of all the elements in sediments within a concentration range of 0.08 to 49 000 $\mu\text{g/g}$, whereas only iron and zinc were detected in water at levels of 0.08-2.4 ($\mu\text{g/g}$). Total mercury concentrations in commercial fish from different coastal sites of Ghana have been determined by Ntow and Khwaja, (1989) who concluded that all values were below the 0.5 $\mu\text{g/g}$ action level adopted in many countries. Biney and Beeko, (1991) conducted a survey of metals in fish and sediments from the River Wiwi in Kumasi and found a positive correlation between mercury concentration and body weight of fish. They also reported higher levels of cadmium and mercury in fish than in sediment. Studies on the distribution of Hg, Cd, Pb, Cu, Zn and Fe in water, finfish and shellfish, macrophytes and sediments from Kpong headpond and lower Volta River (Biney, 1991) showed the highest concentration of iron and lead in sediments and of manganese and cadmium in macrophytes.

The concentrations of Ba, Pb, Cd, Cu, Cr, Hg and Zn were determined in deep-sea sediments of the Jubilee oil field of Ghana along three transects to assess the levels of contamination prior to the commencement of large scale oil and gas production in the Jubilee oil field. Concentrations of all metals were determined using Instrumental Neutron Activation Analysis (INAA) except Pb, which was determined by Atomic Absorption Spectrophotometry (AAS). The metal concentration ranges were 1.5 - 171 $\mu\text{g/g}$ for Ba; 1.5 - 5.8 $\mu\text{g/g}$ for Pb; 0.01 - 0.23 $\mu\text{g/g}$ for Cd; 0.50 - 17.8 $\mu\text{g/g}$ for Cu; 9.5 - 56.9 $\mu\text{g/g}$ for Cr; 0.002 - 0.05 $\mu\text{g/g}$ for Hg; and 10.0 - 58.4 $\mu\text{g/g}$ for Zn. Ba concentrations at all the sampling stations exceeded the Considine (1976) background concentration of 0.006 $\mu\text{g/g}$ in marine sediment while Cd concentrations exceeded the OSPAR Commission (2008) background concentration of 0.2 $\mu\text{g/g}$ in marine sediment at three sampling stations. A recent research was carried out to determine the levels of trace metals (Cu, Zn, Pb, Mn, Fe and Cd) in sediment and water from the Sakumo II and Muni lagoons and the Mamahuma and Agbagbla Ankonu feeder streams. The aim of the research was to establish the pollution status of the two lagoons and investigate whether the feeder streams have any influence in terms of trace metal pollution (Ruby and C.A Biney 2009). The results showed that the mid-section of the Sakumo II lagoon had higher trace metals concentration than the southern and northern sections; there was an influence of intense anthropogenic activities in this section of the Sakumo II lagoon. The Mamahuma and the Agbagbla Ankonu streams which feeds the Sakumo II lagoon serves as potential sources of trace metal pollution. The study also showed that trace metals detected from both water and sediment from the Sakumo II were relatively than in the Muni lagoon.

Thus the Sakumo II lagoon could be described as relatively more polluted with trace metal loads. The concentrations of Mn, Zn, Fe (essential trace metals) and Hg (non-essential trace metal) were determined in sediments and in whole soft tissue of the clam *Galatea paradoxa* (Obiri, 2010) from two clam fishing locations, Ada and Aveglo at the Volta Estuary in Ghana over an 18-month period. A comparative evaluation of the metal concentrations in the clams and sediments from the two stations, however revealed significant variations in concentrations for Zn, Fe and Hg. Concentration of Fe in the Ada sediment samples for June was as much as 18 times higher than the concentration

in the clams and Hg concentrations were approximately five (5) times higher in the clam tissues than in the sediments during the study period. On the basis of calculation the metal enrichment in the tissues of the clams rank in the following order Zn>Hg>Mn>Fe. The calculation indicated a significant accumulation of Zn and Hg in the clam tissues relative to the concentrations of these metals in the sediments although no clear relationships were established between the concentrations of the studied metals in the clam tissues and sediments.

2.3 Global perspective of trace metals concentration in water bodies

The chemical states of iron in near-shore and deep-sea sediments were investigated by means of ^{57}Fe Mossbauer spectroscopy in combination with selective and nonselective chemical leachings from Penrhyn Basin in Japan and Okinawa Trough. As far as a limited number of the sediments analysed are concerned, the $\text{Fe}^{2+}/\text{Fe}^{3+}$ ratios of deep sea sediments are much smaller than those in near-shore sediments, while the total contents of iron in the former are much higher than those in the latter. This is principally due to the high contents of authigenic ferric oxides in deep-sea sediments.

Further, in the aluminosilicate fraction, the $\text{Fe}^{2+}/\text{Fe}^{3+}$ ratios of deep-sea sediments are also smaller than those of near-shore sediments. This was probably attributed to high contents of clay minerals and authigenic aluminosilicate in deep-sea sediments relative to near-shore ones. The concentration of trace metals in suspended sediment and the top few centimeters of bottom sediment is far greater than the concentration of trace metals dissolved in the water column. The strong association of numerous trace metals (for example, As, Cd, Hg, Pb, Zn) and bottom sediments means that the distribution, transport, and availability of these constituents cannot be intelligently evaluated solely through the sampling and analysis of the dissolved phase (Arthur, 1991).

Additionally, because bottom sediments can act as a reservoir for many trace metals, they must, for several reasons, be given serious consideration in the planning and design of any water-quality study. The spatial distribution of metals in streambed sediment and surface water of Silver Creek, McLeod Creek, Kimball Creek, Spring Creek, and part of the Weber River, near Park City, Utah, U.S was examined from the mid-1800s through the 1970s. The Concentrations of silver, cadmium, copper, lead, mercury, and zinc in the streambed sediment of Silver Creek greatly exceeded background concentrations. The trace metal concentration also exceeded established aquatic life criteria at most sites. In the Weber River, downstream of the confluence with Silver Creek, concentrations of cadmium, lead, zinc, and total mercury in streambed sediment also exceeded aquatic life guidelines; however, concentrations of metals in streambed sediment of McLeod and Kimball Creeks were lower than Silver Creek. Water-column concentrations of zinc, total mercury, and methylmercury in Silver Creek were high relative to unimpacted sites, and exceeded water quality criteria for the protection of aquatic organisms (Giddings, 1970).

3.0 METHODOLOGY

3.1 Collection of sediment sample

Four samples of sediments of about 500g were collected from the two reservoirs, Kpong and Weiya reservoirs between December 2013 and March 2014 using the Orange Peel Grab Sediment Sampler. The sediment samples were taken to a depth of about 25cm. The sediments were then put on white polythene bag kept on ice chest to maintain a constant temperature, and were transported using a vehicle to the Ecological Laboratory, University of Ghana Legon, Accra. In the laboratory the sediments were kept in a refrigerator at temperature 4°C for a period of one week before the commencement of the analysis.

- **Physical Parameters:** Temperature, pH, and Electrical conductivity were also determined as hydrographic factors. This is because some of these parameters might have the capability of affecting the abundance of the trace metals.
- **Measurement of temperature, pH and electrical conductivity:** All the physical parameters were measured using the Multiparameter water quality meter. The Multiparameter meter can be used for monitoring up to thirteen different water quality parameters. The sensor was inserted into the water for some time and readings for temperature were taken in degree Celsius (°C) at accuracy of ($\pm 0.2^\circ\text{C}$), pH was also at accuracy of (± 0.2 units) and electrical conductivity in ds/m at accuracy of (± 0.001 ds/m).

3.2 Sample Analysis

- **Preparation of glassware and other materials:** All glassware (pipette, glass vials, desiccator, measuring cylinder, volumetric flask, ceramic mortar, plastic bottles, knives, forceps were washed in detergent, rinsed and soaked with about 2% of nitric acid for about 48 hours. This was done to ensure all binding particles and metal traces are get rid of. The materials were then removed and rinsed in deionised water and oven dried.

After drying, the glass vials and bottles were labelled and placed in the desiccator together with the materials well protected from dust and other contaminants.

- **Preparation of sediment for analysis:** The shells of organisms were picked up and the sediments were displaced on a watch glass to dry under a room temperature for 96 hours. The dried sediments were pounded and homogenized using the mortar and pestle, the powdered sediment were passed through a sieve of pore size 0.5mm using granulometer. The powdered sieve sediments were then kept in a labelled transparent polythene bag for analysis.

3.3 Digestion

Sample at constant mass of (0.2g) were taken and weighed to obtain the final mass. The mass of the empty vials were then subtracted from the final mass to obtain actual mass of sediments. The 'open digestion' method (Vandecasteele and Block, 1993), was used. 10ml of concentrated nitric acid (HNO₃) and perchloric (HClO₄) acids with 65% analytical grade was added to each sample and digested under pressure with by slow heating to 115oC for 1 hour, followed by rapid heating to 155oC for 7 hours. The samples were kept under sunbath kept at about 90 oC until digestion was complete. The digestion of samples were necessary to enable reduce the organic matter content and make it available for instrumental reading. The samples were then allowed to cool under room temperature of 25 oC. The digested samples were then transferred into polypropylene graduated tubes and made up to 25ml with double-distilled water for analysis (Canadian National Laboratory for Environmental testing, 1994). Mercury and iron concentrations in sediment were determined by using the flame atomic absorption spectrometer, AAS measured in milligram per litres (mg/l).

4.0 DATA ANALYTICAL PROCEDURE

Mercury and iron reading were undertaken using flame atomic absorption spectrometer, Perkin Elmer analyst 400 at the ecological laboratory (ECOLAB) University of Ghana. This instrument works by aspirating samples into vapour form by the aid of the flame, the readings are taken from a computer that is connected to the AAS. The AAS was first calibrated with standards after which samples reading are taken on the computer. Mercury and Iron samples were analysed and readings were taken in mg/l.

4.1 Quality assurance

Quality and accuracy of the data obtained were assured through the use of appropriate certified and reference material at the Ecological Laboratory, University of Ghana. Results from blanks were also subtracted from sample result to eliminate errors that may have been acquired from the acid and deionised water. The Analytical Control Facility Division of Environmental Quality, Trace Element Research Laboratory analytical methods namely codes 001, 002, and 008 were used as guidelines.

4.2 Statistical analysis of data

After readings from the AAS, the data were subjected to variety of transformation in order to obtain meaningful deductions. The Microsoft excel 2010 was used to plot graphs while SPSS Inc. V20 was used make statistical analysis, analysis of variance (ANOVA) was performed, to find the differences, relationship in the concentrations of the Iron and Mercury in the samples, the differences were quite significant. Comparing the concentrations of Iron and Mercury in the two reservoirs, Kpong and Weija. The amount of Iron varied more significantly than the Mercury.

5.0 DISCUSSION

Comparing Fe concentrations in Weija and Kpong sediments Fe has frequently been used as an indication of natural changes in the trace metal carrying capacity of sediments (Rule, 1986), and its concentration has been related to the abundance of metal reactive compounds supposedly not significantly affected by man's action (Luoma, 1990). Fe is found in natural fresh and groundwater, but have no health-based guideline value, although high concentrations give rise consumer complaints due to its ability to discolour aerobic concentrations above 0.3mg/l (WHO, 2004). The mean concentration of Fe was 195.3mg/l in the Weija bottom sediments been higher than the mean concentration of Fe in the Kpong bottom sediments 6.2mg/l.

The highest concentration of Fe in the Weija reservoir was recorded in the third site called Machigeni. This could be attributed to the proximity to human settlement and hence the deposition of waste into that end of the reservoir. The factors that might contribute to the high concentration of iron and mercury in the Weija sediments than the Kpong sediments could be attributed to anthropogenic activities. Farming activities with the use of chemical fertilizers is a prominent factor but could not account to be the only reason why the Weija sediments contained more Fe and Hg than

the Kpong bottom sediments since there are massive farming activities around both reservoirs with the use of chemical fertilizers. But a more concrete reason that could lead to the high amount of Iron concentration in the Weija bottom sediments could be the activities gold mining operations around the Weija province by the Aglo Bullions Gold Miners Gh Ltd.

This is because in some cases, even long after mining activities have ceased, the emitted metals continue to persist in the environment. Hard rock mines operate from 5-15 years until the minerals are depleted, but metal contamination that occurs as a consequence of hard rock mining persist for hundreds of years after the cessation of mining operations (Peplow, 2000). The source of the Weija reservoir is the Densu River, the Densu River takes its source from a high mineral ground that is the Atewa-Atwiredu mountain range. The Densu river transverse the upper Birimian rocks (phylites, schists, tuffs and grey wacke) in the upper reaches, the middle Birimian rocks (granites and granodiorites) and quartzite, shale, phylites in the lower portion. (Water Resources Commission, 2011). The rocks contain traces of metals which are find their way into the reservoir through percolation into the bottom sediments.

5.1 Comparing Hg concentrations in Weija and Kpong sediments

Hg in sediment is generally found in association with organic matter or sulphides (D'Itri 1990; Suzuki et al., 1991). In anoxic sediments, Hg readily binds with available sulphides to form mercuric sulphide (HgS), a relatively stable compound that remains unreactive under anoxic conditions. Hg bound to sulphur is largely unavailable for uptake by organisms (Langston, 1982). In oxic sediments, HgS can oxidize to sulphate, which is more soluble, rendering the mercuric ion available for biological uptake or binding with dissolved organics (e.g., humic and fulvic acids) (Environment Canada, 1997). The mean concentration of Hg in Weija sediment outweighed that of the mean concentration of Hg in Kpong sediments (Table 4.3). This may be attributed to natural occurrences since both reservoirs are fresh waters which are produced from aquifers within which geochemical processes take place to release Hg (WHO, 2004). Mercury is found in rocks; therefore the presence of the high levels of Hg in the Weija reservoir could be attributed to the fact that the Weija reservoir takes its source from a mineral rich high-ground. The results (Table 4.3) showed that the Hg levels in both reservoirs were within the recommended values (<1 mg/l) of polluted sediments (USEPA, 1986).

5.2 Hydrography of the reservoirs

The hydrographic parameters measured were temperature, pH and electrical conductivity, among all these parameters the highest values were recorded at Weija reservoir except for electrical conductivity which was higher in the Kpong reservoir. From the results (Table 4.4), Weija reservoir the measured mean temperature was 30.2 °C, meaning the Weija reservoir is warmer than the Kpong reservoir. The pH values for both reservoirs were in the range of less acidic to neutral. The mean electrical conductivity 380 dS/m was higher in the Kpong reservoir that could be attributed to the fact that Kpong is sourced from the Volta Lake which is used for generating hydro electrical power.

6.0 CONCLUSION

6.1 Conclusion

The study showed that the Weija reservoir contained high levels of Fe and Hg than the Kpong reservoir, which was an indicative of anthropogenic activities within the Weija province. Despite the Weija reservoir had highest concentration of Fe than the Kpong, it is still within the recommended value (41000mg/l) of unpolluted sediments (GESAMP, 1982). The concentrations of Hg were also within the recommended value (<1 mg/l) of polluted sediments (USEPA, 1986). The highest levels of Fe and Hg were recorded in the third site (Machigeni) was an indicative of the proximity to human settlements hence the deposition of waste substances into that end of the reservoir and thus could have contributed to the higher levels of Fe and Hg in the sediment. From this comparative study, thus the Weija reservoir could be described as relatively more polluted with Fe and Hg loads.

6.2 Recommendations

Anthropogenic activities such as farming using chemicals fertilizers around the Weija and Kpong reservoirs must be avoided, by regulatory rules preventing farmers not to farm close to the reservoirs. The fact that the Weija reservoir takes its source from a mineral rich ground should not be a hesitation but rather good treatment must be done to the water from the Weija reservoir before distribution for human use. Gold activities mining within the Weija province must be avoided by the environmental protection agency (EPA), Ghana.

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