

Introduction

There are various industrial activities along the Jordan Creek area in the downtown area of Springfield, Missouri. Metal concentrations from this activity could be draining into Jordan Creek and concentrating in the drainage sediments. There are various studies which have used stream sediments to determine the effects of emissions from industrial point and non-point sources. In this study, the concentrations of copper, lead, zinc, cadmium nickel, phosphorous, arsenic, silver and chromium in the sediments of Jordan Creek were determined. The concentrations of these elements in the sediments from the north branch of the stream were compared to those downstream in the more industrialized area along the stream. This study was initiated and completed by the Geochemical Techniques class (GLG 581) in the Department of Geography, Geology and Planning at Southwest Missouri State University during the Spring Semester of 2003.

Procedure

Collection of Samples

Thirty five drainage sediment samples were collected along Jordan Creek. The samples were numbered increasingly from the mouth to near the head of the stream. Eighteen samples were collected from the mouth of the Creek to the stream intersection with Washington Street. The sample at the Washington Street intersection was collected below the surface. These 18 samples comprised the “Test Samples” in this study since they were located in the more industrialized area along the stream. The remaining 17 samples collected upstream comprised the “Control” in this study.

All drainage samples were collected within a 3 week period during February to March, 2003. The samples were wet sieved in the stream and only the *coarse silt-fine sand* size fraction was saved for analyses in small labeled bottles. The pH of the water was taken at each collection site. To obtain accurate locations of each sample site a GPS unit was used. [The sample locations were plotted on maps using GIS.](#)

Physical and Chemical Preparation of the Samples and Chemical Analyses

The following procedures to prepare samples for chemical analyses are those used often in other

researches;

All samples were taken to the lab and added to beakers containing double de-ionized water, swirled and the unwanted suspended finer sediment discarded to further purify the desired sediment fraction size. The samples were dried. A 1.000 gram portion of each sample was placed in a labeled centrifuge bottle to which 20 milliliters of acid was added. The acid was comprised of 3N nitric and 0.5 hydrochloric. The samples were placed in a hot shaker bath at 80 degrees C for 24 hours. The samples were then centrifuged and the aqueous portion of each was added to labeled analyses bottles.

Appropriate standards and a blank solution were prepared for chemical analysis. The ICP machine was programmed and the concentrations of each element in the study were ascertained.

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Results

[Click here to see a table](#) representing the individual concentrations of all the elements in all the test and control samples. Also included is the pH of the stream water at each sample site. Significant concentrations at specific locations along the stream are shown in bold type.

Trend charts for the concentrations of each element in the sediments along the stream course were prepared. [The concentrations trends for Cu, Pb, Zn, Cd, Ni and P are shown](#). Mean element concentrations in the sediments of the Test and Control Samples are shown to the right of the trend charts. The mean concentrations of Cu, Pb, Zn, Cd, Ni and P are higher in the Test Samples (samples 19-1) than in the Control Samples (samples 20-35). However, the mean concentration of P is only slightly higher. The concentrations of all 6 elements peak at samples 18 and 19 and would seem to represent an area of higher industrial activity. Samples 18 and 19 were collected near the confluence of the north and south branches of Jordan Creek. Sample # 18 was collected in the tunnel below Washington Street. Cadmium, Zn and to a lesser degree Pb concentrations show an increase trend in the North Branch downstream to the confluence. This could reflect emissions from increasing industrial activity from the upper area of the North Branch Jordan to the confluence. The Cu, Pb, Zn and Cd concentrations show a decreasing trend downstream from the peaked area. This trend would be expected as the concentration of the elements in the sediments would decrease because of dilution effects. However, the concentrations of Ni and P do not show this trend. The reason is not clear. Possibly, there is a continual emission of these elements from other sources downstream. The high

concentrations in the drainage sediments located around the Washington Street and Main Street areas could be from emissions from activities by metal recycling, electrical and refrigeration companies.

[Trend charts for the concentrations of As, Cr and Ag are shown.](#) These elements do not show peaked concentrations at Samples 18-19 as those on Page 6. The mean concentrations of the Test and Control Samples for each metal are shown to the right of each trend chart. The concentration of As and Cr are slightly higher in the Test Samples as compared with the same in the Control Samples. The concentration of Ag is higher in the Control Samples because of the presence of 2 significant peaks.

Interesting element concentration peaks in the sediments occur along the stream. Near Mount Vernon Street a significant Cr peak occurs in one sample downstream from a printing company and a large lumber supply business. It was noted that during the collection of the sample an orange leach- ate-like material was observed oozing into the stream. Immediately downstream from Catalpa Street, there appears to be small concentration peaks of P and Cr and larger peaks of Ni and Ag. These samples were located downstream from a metal recycling company. Two very high concentration peaks for Ag exist in the Control area. One peak is located downstream from Barnes Street and the other downstream from Glenstone Street. The emission source for silver could be from a solvents and chemical manufacturing company located upstream from these sample sites.

The trends of element concentrations along the stream could be affected by the variance of the pH of the stream water. The pH values of the water along Jordan Creek at the collection sites are shown in a table. The trend of the pH values along the stream course and the mean concentration of the pH in the Test and Control Areas are shown below. The trend patterns for the pH along the stream would not explain the trend pattern for the element concentrations. Also, the mean pH is very similar in both the Test and Control Areas. In addition, [the correlation coefficient tables](#) indicate there is no [dependency of element concentration on pH](#)

[According to the correlation coefficient tables](#) there seems to be a high correlation between concentrations of Cu, Pb, Zn and Cd. An especially high correlation exists between Zn and Cd. The

high correlations between the 4 elements are present in the Test and Control Samples. A reason for this dependency between the 4 elements could be that they share a common type of emission source in both the Test and Control Areas. As mentioned before activities of metal recycling and electrical and supply companies could be the emission source.

Element Concentrations in the Sediments of Jordan Compared to Other Local Streams

[This table compares the element concentrations in this study with that of other local streams.](#)

The concentrations of the elements in sediments from other streams were taken from studies by other researches.

The mean element concentrations in the drainage sediments in the Test (downstream from Washington Street) and Control samples (upstream from Washington Street) in Jordan Creek are substantially higher than the same in the sediments of other local streams. The only element which is similar is the P in Wilson's Creek.

Toxic Concentrations or Preliminary Remediation Goals (PRG)

The EPA has not established safe levels for elements in stream sediments. However, they have done so for soils. If the same PRG's values for elements in soils were applied to stream sediments, some of the concentrations of elements in this study may be considered toxic or close to toxic. The PRG's reported for As and Pb are 22 ppm and 400 ppm, respectively. One lead sample (Washington Street) contained over 679 ppm and 2 samples downstream from Main Street contained 379 and 348 ppm. The mean As concentration in the sediments are well above the 22 ppm limit. However, the concentrations of As may be affected by iron interference during the chemical analysis with the ICP machine. A method to eliminate the interference is available but was not used because of the time restraints for the GLG 581 course. It is interesting to note that just downstream from Main Street is the area where some fish-kills were observed. It is known that smaller life forms which reside at the bottom of the stream may uptake concentrations of elements from the sediments. Fish, in turn will consume the smaller life forms and the higher concentrations of elements possibly causing "a Kill". There are other possible reasons for the "kill".

Conclusion

The drainage sediments in Jordan Creek appear to be affected by industrial activities along the path of the stream. Some concentrations of Pb and many for As in the samples may be considered dangerous.

A further extension of the research on sediments in Jordan Creek might include the determination of the same elements in the South Branch of Jordan Creek. Also, other metals which might be considered for further studies are Ba, Hg, Fe and Mn. A study of harmful organics in the sediments may yield some interesting results.