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Study of selected metal concentrations in sediments by inductively coupled plasma-optical emission spectrometry from a metropolitan and more pristine bayou in Southwest Louisiana, United States

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ABSTRACT

This study presents the results of selected metals in sediments determined by inductively coupled plasma-optical emission spectrometry from fourteen sampling sites along approximately 12 km from Bayou Contraband (metropolitan bayou), which runs through the city of Lake Charles in Southwest Louisiana and three sediments along Bayou Black located in a more pristine area of the city. The concentrations of two of the three sediments from Bayou Black are in close agreement to one another. These two sites give average concentrations of 2370 ppm Al, 1760 ppm Fe, 555 ppm Mg, 35 ppm Mn and 14 ppm Zn. Sediment 3 was also able to detect 6 ppm Cr, 5 ppm Cu and 11 ppm V. The remaining metals that were examined at these two sites were below their detection limits. Using the above values from the two Bayou Black sites, there are noticeably higher values in the Contraband Bayou sites which is most likely due to anthropological effects. Sites 13 and 7 seem to have the greatest contrasts with respective concentrations of 6090 ppm and 6520 ppm Al, 3320 ppm and 5360 ppm Mg and 120 ppm and 83 ppm Zn. These value were about an order of magnitude lower than previous results from Bayou d'Inde.

1. Introduction

Southwest Louisiana, United States is a pristine environment with much recreational fishing and hunting as well as commercial fishing (crawfish, oysters, and shrimp). It is also the final land destination for birds migrating from North America in winter to a warmer climate in South and Central America. They need to forage for food and build up a reserve before they cross over 700 km across the Gulf of Mexico. However, since the 1940s it has also become a major industrial area with a large number of petroleum and associated petrochemical industries. If you consider accidental chemical spillage and natural weather phenomena such as hurricanes, then pollution is a fact of life. Of particular interest in this laboratory has been increased concentrations of metals entering the bayous (a body of water moving at less than 0.5 cm/s) and settling in sediments and has resulted in a number of studies in the last 30 years. [1–5]. Bayou d'Inde is a well documented area polluted with elevated concentrations of many metals [2–4].

This work reports on a continued study in selected metal concentrations but with the emphasis on Bayou Contraband which runs through the metropolitan town of Lake Charles in Southwest Louisiana and sediments from the nearby Bayou Black located in a more pristine area.

2. Materials and methods

2.1. Sampling sites

Bayou Contraband is a slow moving stream that bisects the southern portion of the city of Lake Charles, Louisiana and provides for most of that area's drainage. The bayou begins in the southeastern edge of the city as a small shallow ditch about two-meters wide. It traces a westward meandering path of about 12 km through the southern part of the city gradually increasing in width and depth until it empties into Prien Lake. This lake is part of the Calcasieu River Estuarine system that carries water to the Gulf of Mexico, approximately 50 km south. At its mouth, Contraband Bayou is about 100 m wide. Along the bayou's path are mostly homes, apartments, small businesses and McNeese State University. The bayou also runs adjacent to and intersects many of the roads and thoroughfares including Interstate 210 near the mouth and it is fed by countless canals, ditches and storm culverts. Most of Contraband Bayou is navigable by small boats and watercraft. This study involved sampling sediments in Bayou Contraband from fourteen different sites along a 5 km stretch ranging from its eastern origin at Louisiana Highway 14 to about half kilometer west of where it intersects Ryan Street. The location (GPS) and brief description of each sampling site is given in Table 1. An addendum provides a pictorial view of Bayou Contraband including location of sampling sites.

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Table 1
Sampling sites along Contraband Bayou going west to east.

Site	Latitude	Longitude	Description
9	30°10′37.84″N	93°13′29.12″W	250 m south of Contraband Bayou from a feeder canal running through a residential neighborhood
8	30°10′49.09″N	93°13′24.50″W	Intersection of above canal and Contraband Bayou
10	30°10′46.07″N	93°13′14.64″W	South of parking lot
12	30°10′41.50″N	93°13′06.32″W	Ryan Street overpass (heavy automobile traffic area)
11	30°10′37.93″N	93°13′00.66″W	Pedestrian bridge for university
14	30°10′37.08″N	93°12′53.96″W	University maintenance shop
13	30°10′38.43″N	93°12′49.27″W	Common Street overpass (heavy automobile traffic area) and fast food restaurant parking lot
7	30°10′36.63″N	93°12′38.58″W	Carwash drainage and small business parking lot
5	30°10′47.87″N	93°12′34.12″W	Kirkman Street overpass (moderate automobile traffic)
6	30°10′47.92″N	93°12′31.16″W	85 m east of Kirkman Street overpass
4	30°10′47.29″N	93°11′47.42″W	Apartment complex on north bank Legendre Street (low automobile traffic) 160 m south
3	30°10′47.38'N	93°11′18.22″W	5th Avenue overpass (moderate automobile traffic) and apartment
2	30°10′47.43″N	93°10′50.67″W	70 m west of LA Highway 14
1	30°10′47.33″N	93°10′48.36″W	LA Highway 14 (heavy to moderate automobile traffic)

In order to establish a basis for the anthropological effects, Bayou Black was chosen. It is similar to Contraband Bayou in every way except its proximity to substantial human activity. Bayou Black's origin is about 3 km south of Contraband Bayou's and follows a southwesterly path to the Intercoastal Waterway just north of Calcasieu Lake. It traverses through rural marsh and agricultural areas. Although it intersects several roads and highways, the traffic flow on these are minimal compared to the roads along the path of Contraband Bayou. Three sampling sites were chosen from Bayou Black. The location (GPS) and brief description of each sampling site is given in Table 2.

2.2. Sample collection and preparation

Sediment samples were collected on March 14, 2014 using a 10-ft long section of 1.5 in PVC pipe fitted with a 90° joint at the end to form a scoop. This scoop allowed sediment depths to be no deeper

Table 2
Sampling sites along Black Bayou going south to north.

Site	Latitude	Longitude	Description
Sed.1	30°06′36.87″N	93°10′56.44″W	64 m south of East Lincoln Road bridge (low automobile traffic) adjacent to farm house property
Sed.3	30°06′37.69″N	93°10′55.82″W	23 m south of East Lincoln Road bridge (low automobile traffic)
Sed.2	30°06′41.20″N	93°10′51.07″W	120 m north of East Lincoln Road in a cultivated field

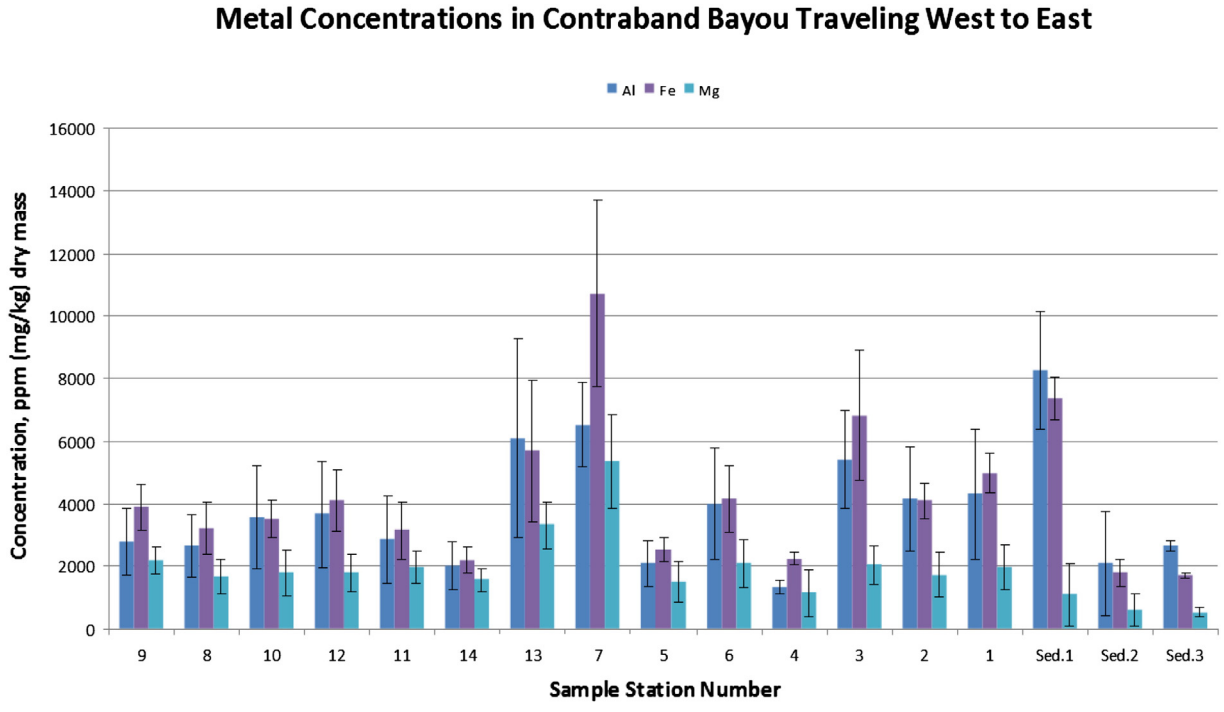

Fig. 1. Metal concentration in Contraband Bayou traveling from east to west.