

Lead Transport into Bayou Trepagnier Wetlands in Louisiana, USA

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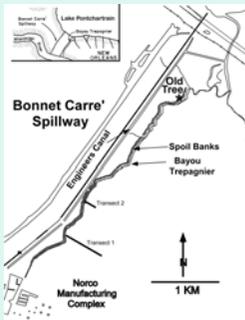


Fig. 1. Map of Bayou Trepagnier near New Orleans, LA, showing the spoil banks and the Norco Manufacturing Complex. Bayou Trepagnier merges with Bayou LaBranche a short distance from the lake.



Coring a baldcypress tree on Stinking Bayou

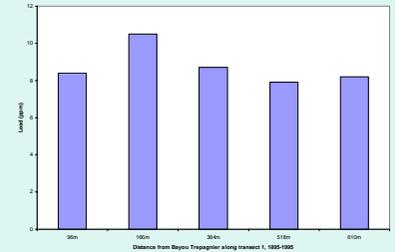


Fig. 4. Pb in tree rings of 16 cores from baldcypress trees, 1893-1997 along transect 1 running perpendicular to Bayou Trepagnier into the adjacent baldcypress-tupelo community; distance from the edge of the spoil bank on the east side of the bayou indicated by numerals under bars.

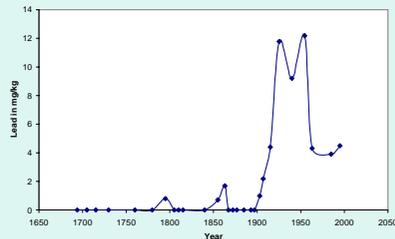


Fig. 2. Lead (1687-1995) in the tree rings of a 300+ year old baldcypress tree growing along Bayou Trepagnier, downstream from the pollution point. The sharp increase of Pb beginning around 1920 correlates with the establishment of a petroleum plant, its subsequent expansion and several dredging episodes.

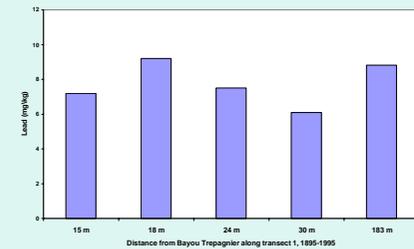


Fig. 5. Pb in tree rings of 12 cores from baldcypress trees, 1893-1997 along transect 2 running perpendicular to Bayou Trepagnier into the adjacent baldcypress-tupelo community; distance from the spoil bank on the east side of the bayou indicated by numerals under bars.

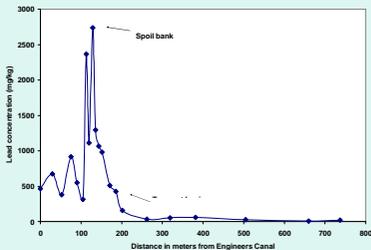


Fig. 3. Levels of Pb in top 10 cm of soil along transect 1, eastward from Engineer's Canal (0 m), which is west of Bayou Trepagnier. Soil organic material was scraped from 21 randomly located sites along a line beginning west of transect 1, starting at Engineers Canal west of Bayou Trepagnier and extending east into the swamp, and a 0.5 liter sample of soil was collected at each site and analyzed.

Introduction: Establishment of a petroleum refinery in 1916 near the headwaters of Bayou Trepagnier in Louisiana, with subsequent dredging of the bayou, resulted in spoil banks containing high levels of Pb. This study documents the concentration of Pb by baldcypress trees of the surrounding cypress-tupelo (*Taxodium distichum-Nyssa aquatica*) swamp which abuts the eastern bank of the bayou.

Methods: We cored baldcypress trees growing in the swamp away from the spoil bank, along a 610 m transect and a 183 m transect perpendicular to Bayou Trepagnier. Both these transects extend west to east from the base of the spoil bank, transect 1 approximately 912 m downstream from the point source and transect 2 1642 m from the point source (fig. 1). For baseline information we also cored a 300 year old baldcypress tree near the bayou and baldcypress trees growing along Stinking Bayou, 35 km north of Bayou Trepagnier. The cores were crossdated, annual rings were measured, and five year segments of the cores were prepared and analyzed for heavy metals using an energy-dispersive ED-XRF Spectro X-Lab fluorescent spectrometry with Mylar film ultra-thin window. A 0.5 liter sample of soil was collected from 21 randomly located sites along a line beginning west of transect 1 and extending east and was analyzed for concentration of Pb, Zn, Cr and Cu using standard methods.

Results and Discussion: The wetland soils adjacent to Bayou Trepagnier spoil banks have been contaminated with Pb, Zn, Cr, and to a lesser degree Cu. Maximum observed values for these metals significantly exceed values given for the average shale. Pb is significantly enriched in both wetland soils and spoil banks because of its high concentration as tetraethyl lead in the refinery waste stream prior to the passage of the Clean Water Act in 1972. Pb concentration in a single baldcypress tree presents an example of changes in Pb levels in recent years (fig. 2). Pb in the soil along transect 1 decreases from >2700 mg/kg on the spoil bank to 10 mg/kg at the east end of the transect (fig. 3). In contrast, there was no trend in Pb concentration in the growth rings of baldcypress trees along this transect (fig. 4). There was very low correlation (0.03-0.14) between mg/kg lead and ringwidth for trees growing along the transect, indicating that the Pb was not affecting radial growth. Along transect 2, Pb concentration in tree rings averaged 7.8 mg/kg (fig. 5). The level of Pb in trees along Stinking Bayou (control, 2.6 mg/kg) was significantly different from the levels in trees along the two transects. Figure 6 shows Pb pollution during the last century in trees of transects 1 and 2 and Stinking Bayou. Trees in transects 1 and 2 display the highest Pb concentration during the 1950s and 1960s after major dredging of the bayou occurred. Polluted soil was probably more easily washed into the swamp when the spoil banks were recently formed. The highest Pb levels of Stinking Bayou occurred during the late 1920s and may be associated with soil disturbance due to harvest of timber in the area and perhaps some accumulated Pb in the soil. Why is there greater uptake of Pb in baldcypress trees growing in the cypress-tupelo swamp adjacent to the spoil banks, with 10-424 mg/kg Pb in the soil (fig. 2) versus trees growing on the bank containing >2700 mg/kg Pb? Bayou Trepagnier is a brackish bayou and precipitates formed of acid volatile sulfides and dissolved heavy metals from the water are very insoluble as long as reducing conditions are maintained, but when sulfides in the sediments are oxidized, sulfuric acid is generated and Pb is released into the water column. Flowers et al. (1996, 1997) demonstrated with elutriate tests performed with bayou water and spoil bank soil that Pb is easily released from the spoil banks in storms, flooding, hurricanes, etc. into the adjoining plant communities, causing periodic shock loads to the swamp, where the soil is flooded most of the year. Environmental parameters on the spoil bank and in the cypress-tupelo swamp are different and may favor greater Pb uptake by the roots of the baldcypress trees in the swamp. Lead may be much more mobile in baldcypress-tupelo swamps than in other forested ecosystems. We plan to analyze more cores from the Bayou Trepagnier ecosystem and other areas in order to test this hypothesis further.

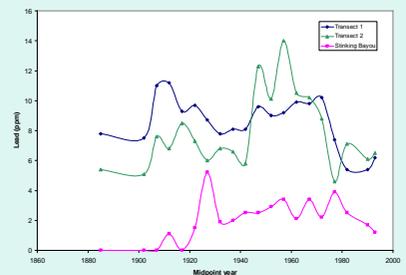


Fig. 6. Profile of Pb in tree rings of baldcypress along transects 1 and 2 running perpendicular to Bayou Trepagnier into the adjacent cypress-tupelo community, and Stinking Bayou, a bayou that empties into Lake Pontchartrain 35 km north of Bayou Trepagnier.