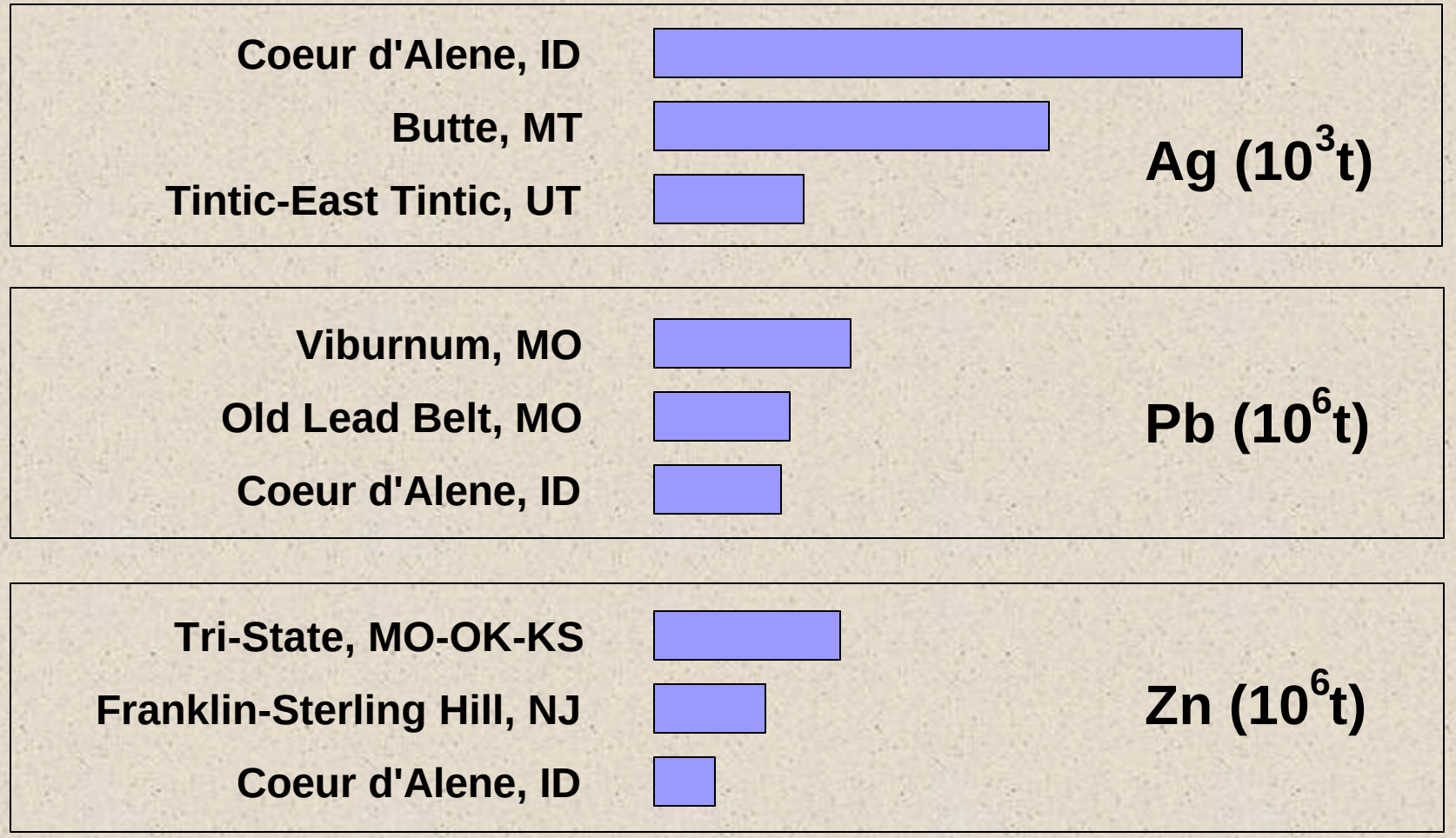
Fate of historic metal releases from the Coeur d'Alene mining district Northern Idaho

Stephen E. Box

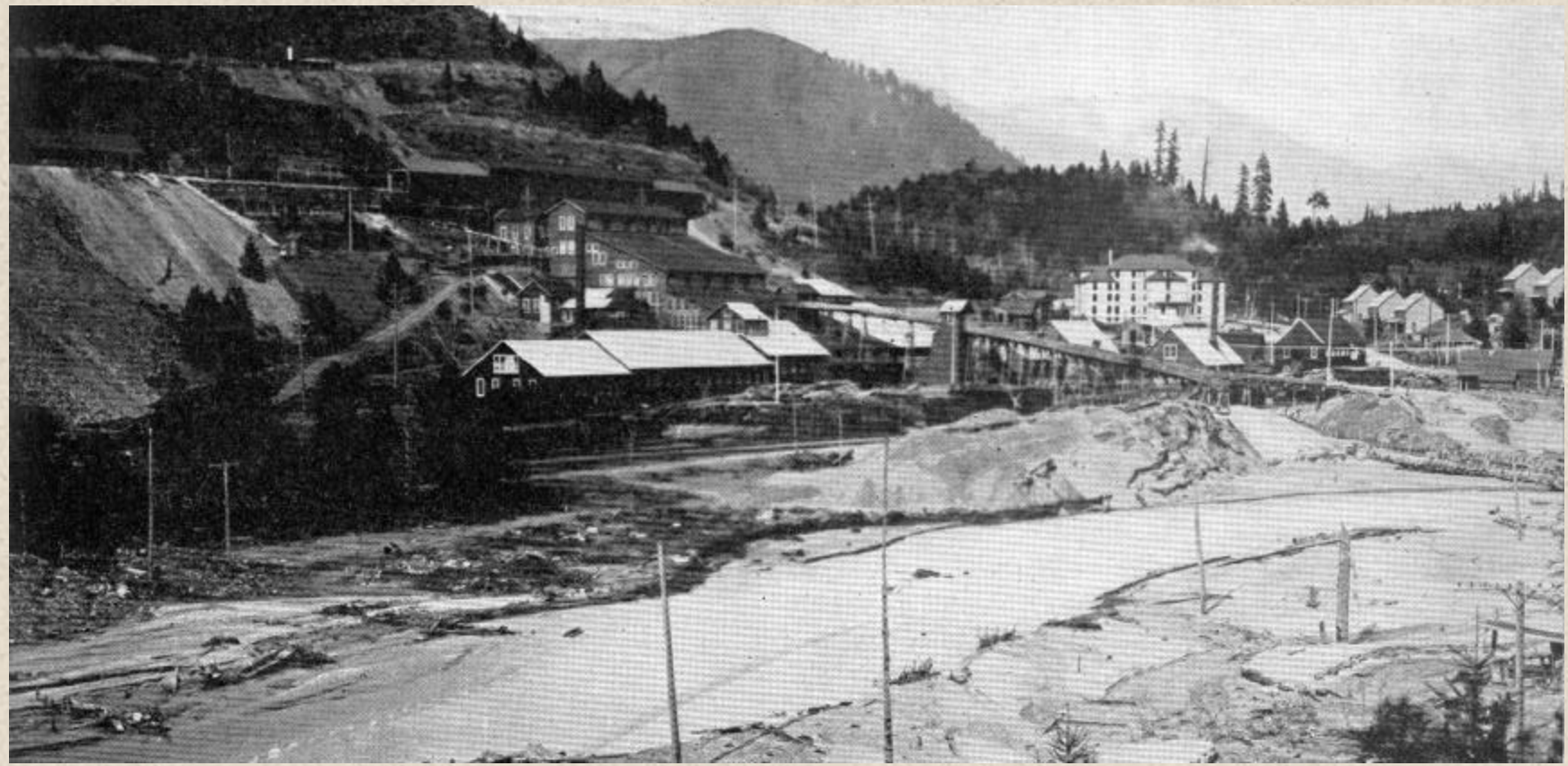
US Geological Survey

U.S. Metal Production



From Long et al, 2000

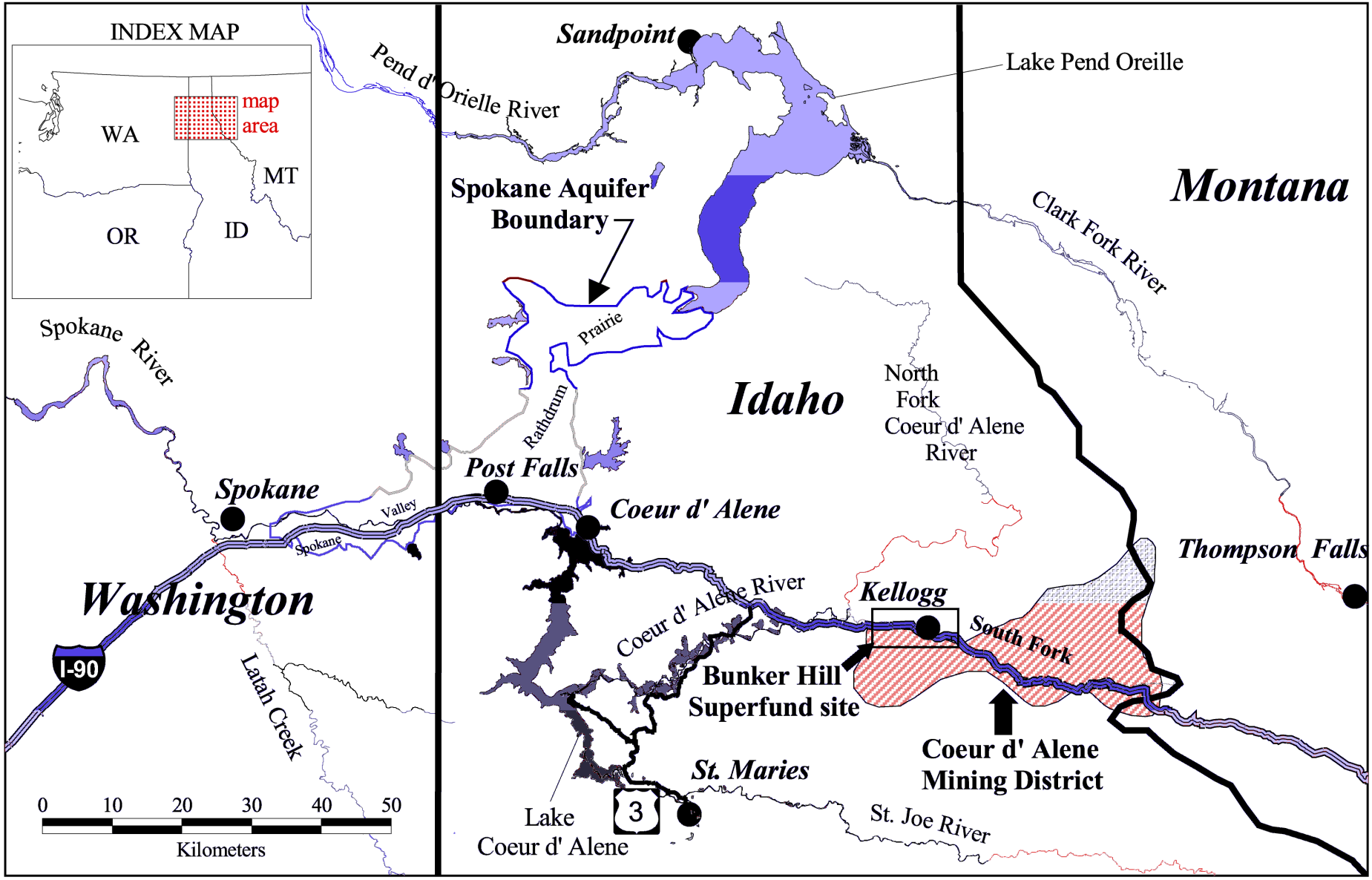
Morning Mill on South Fork below Mullan --- 1915



Tailings released to streams

(from Long, 1998)

- 56 million metric tons of tailings released to streams from 1894-1968
- 0.8 million tons of lead (Pb)
- 0.65 million tons of zinc (Zn)
- Equivalent to a pile 100 km long, 50 m wide and 6 m tall with grade of 1.4% Pb and 1.1% Zn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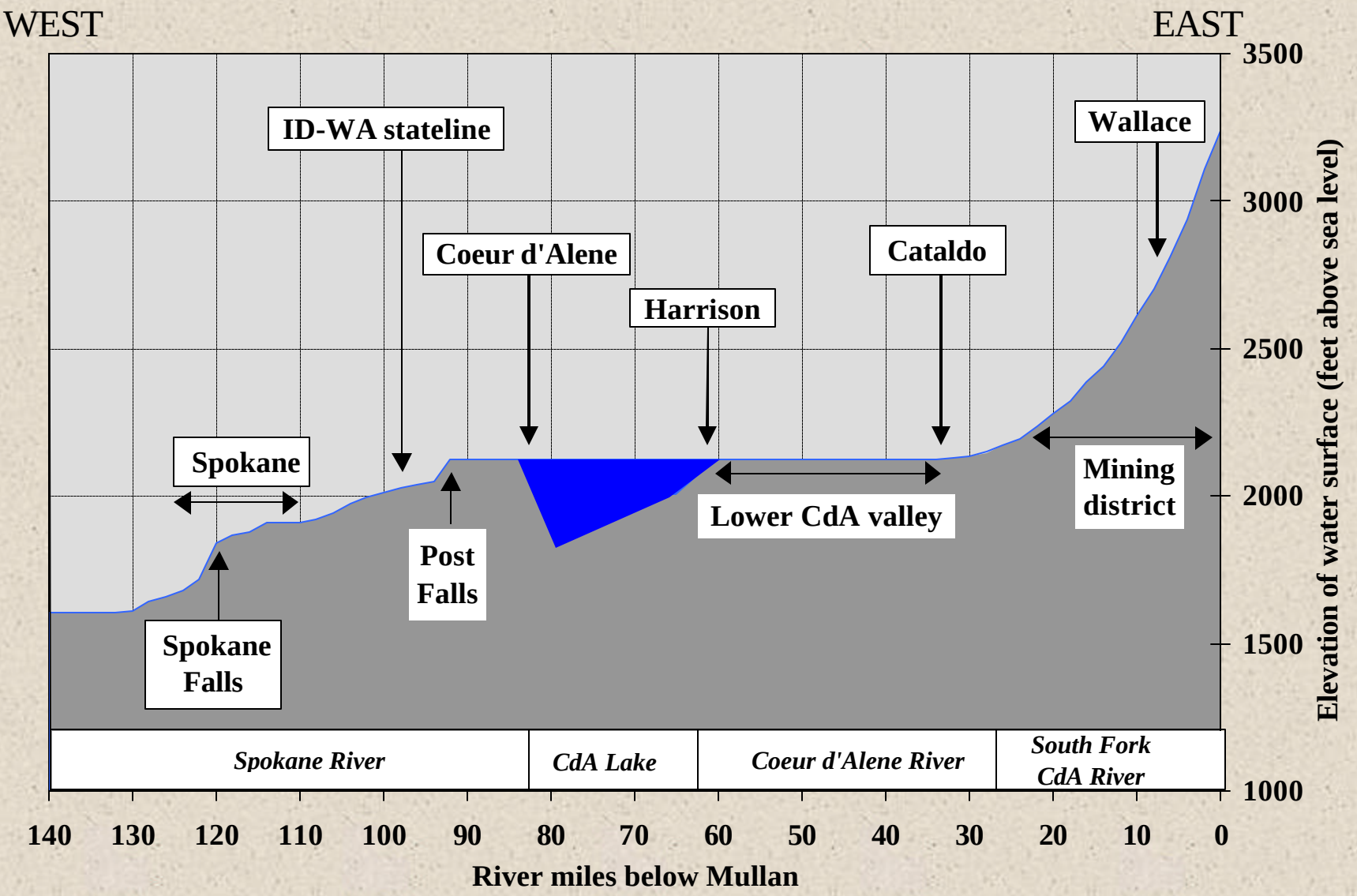
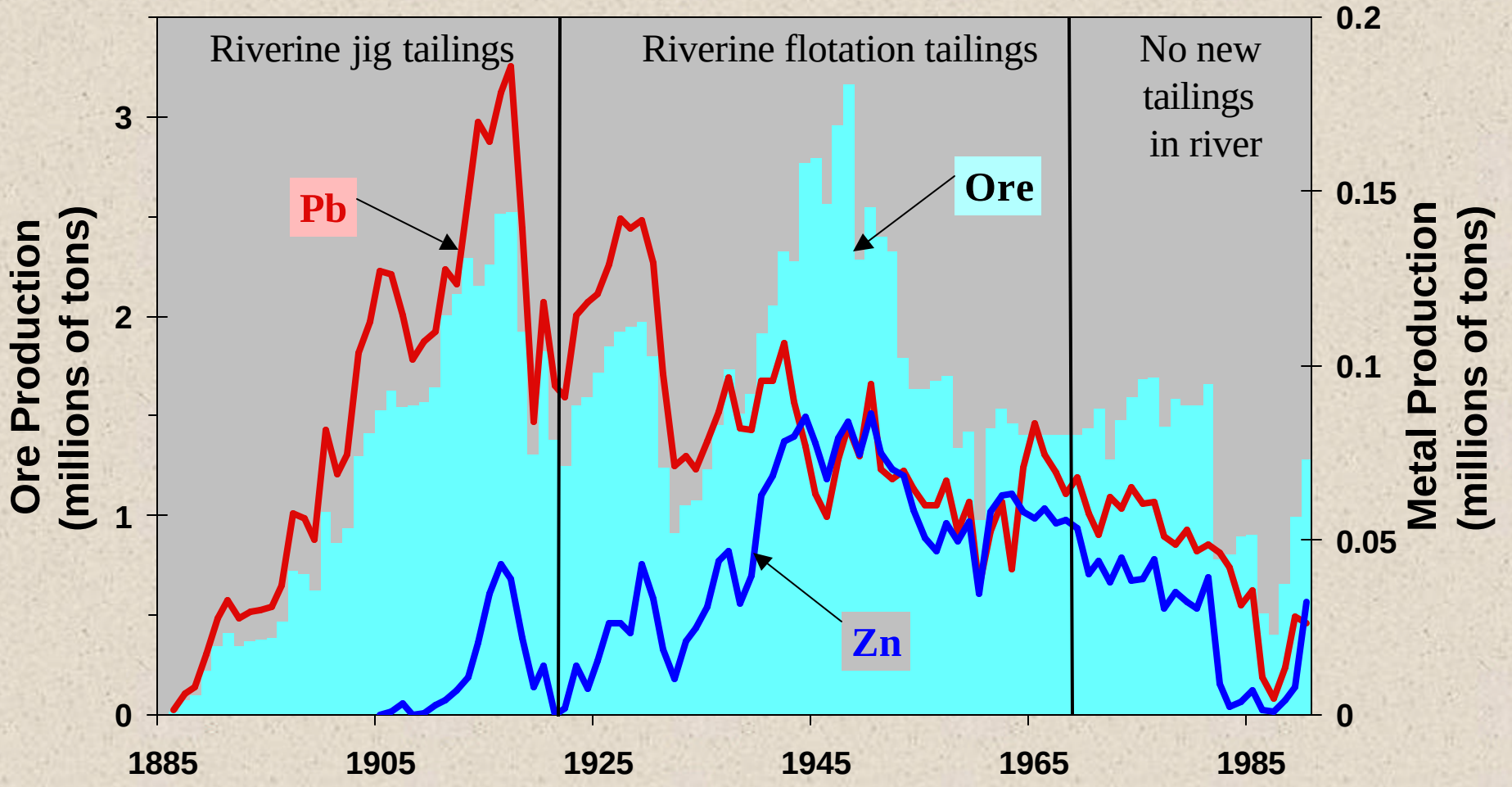
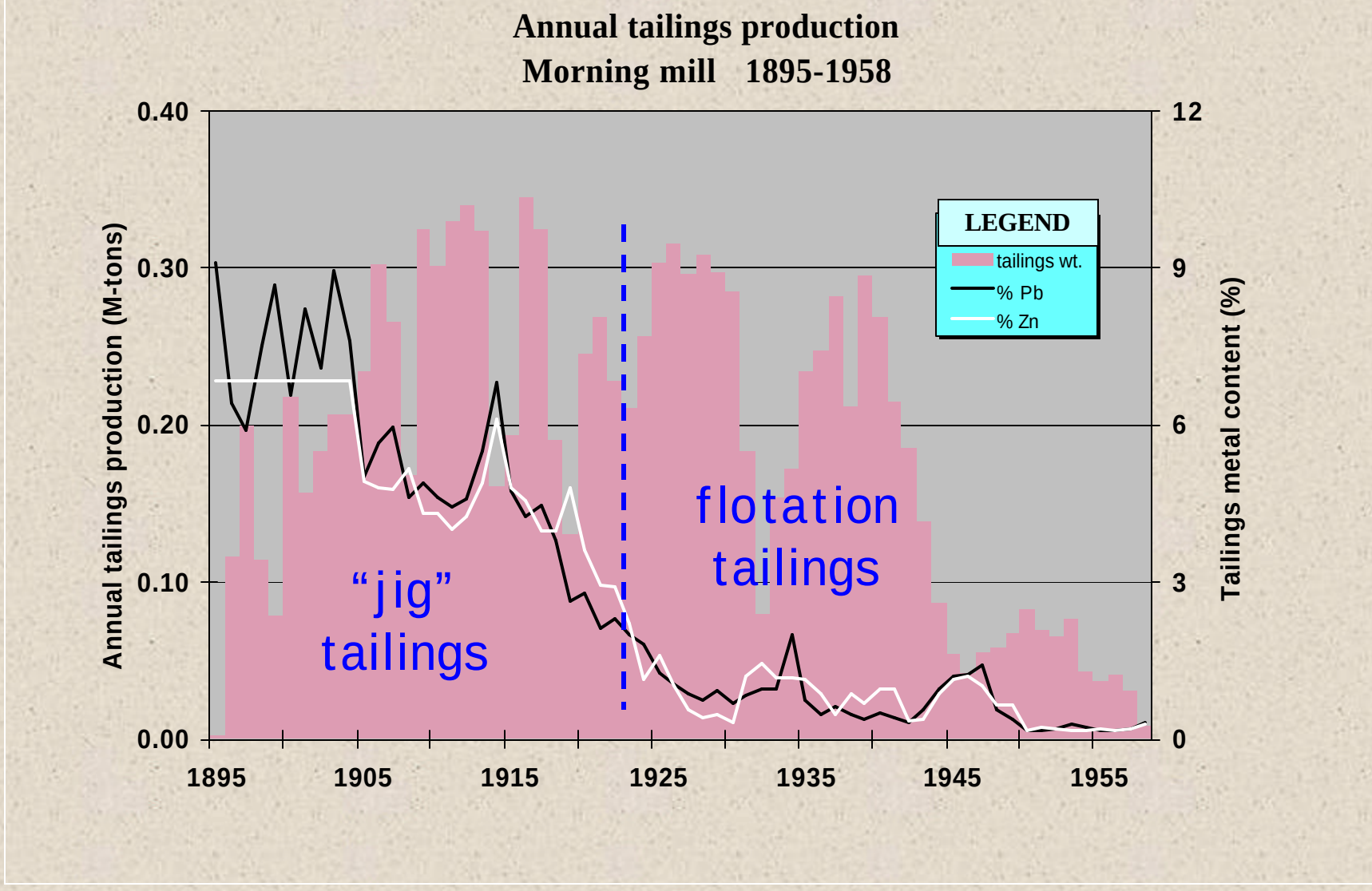


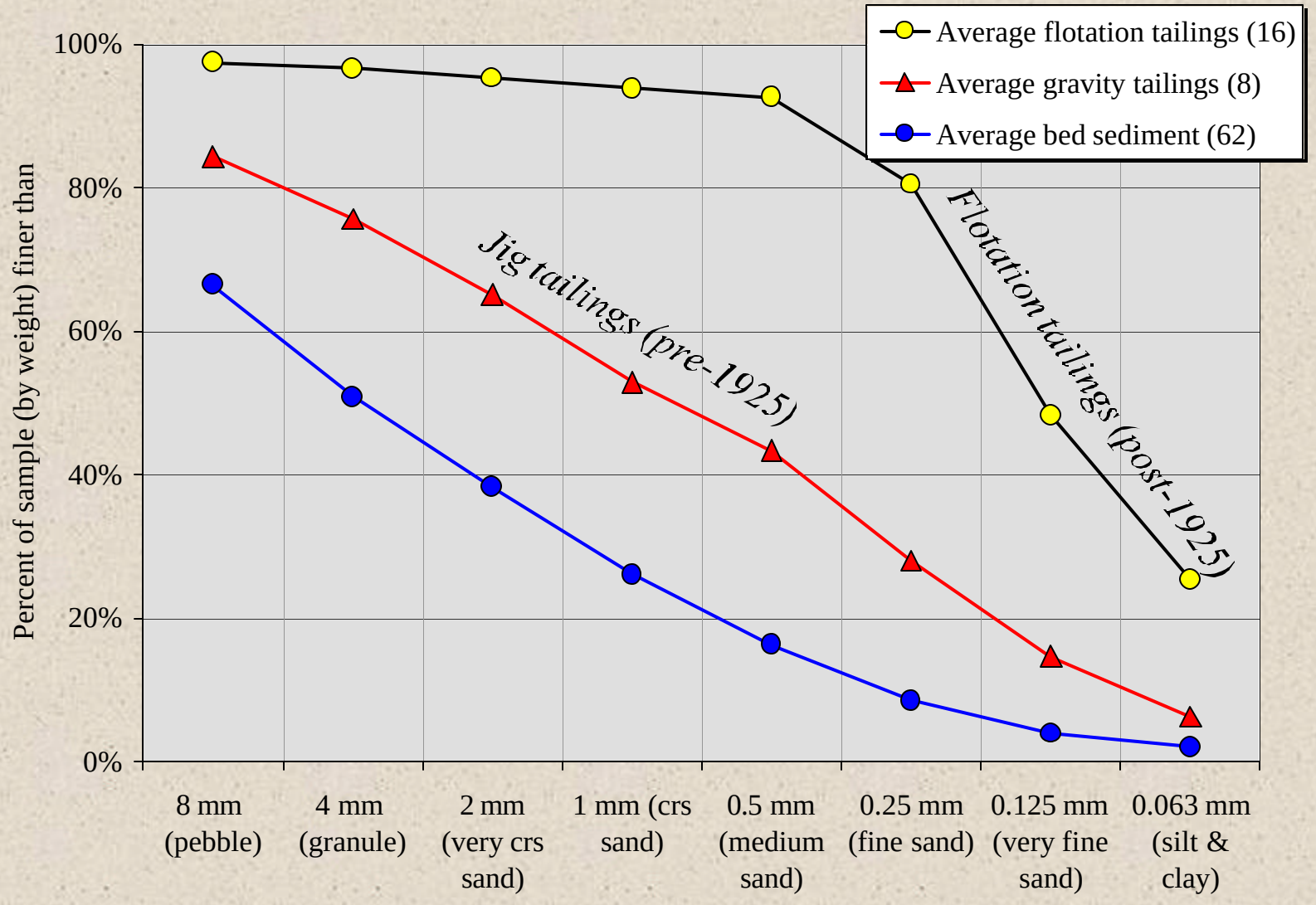
Longitudinal profile of Coeur d'Alene-Spokane River drainage

Annual production in the CdA Mining District 1885-1990

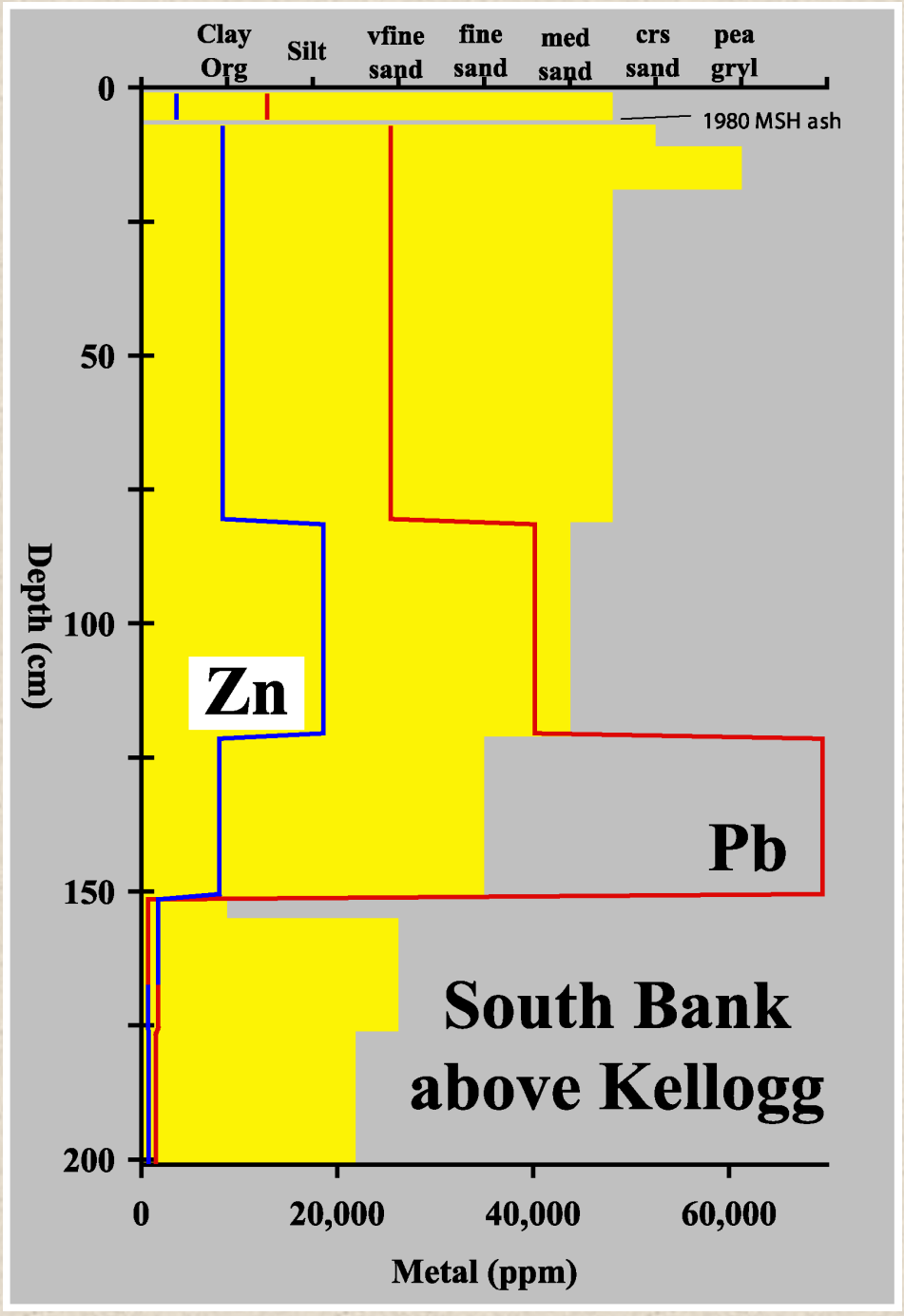



Annual tailings production
Morning mill 1895-1958
Annual tailings production (M-tons)
Tailings metal content (%)
0.40
0.30
0.20
0.10
0.00
12
9
6
3
0
1895
1905
1915
1925
1935
1945
1955
LEGEND
tailings wt.
% Pb
% Zn
"jig" tailings
flotation tailings

Gravity ("jig") tailings range from pebble to clay-sized, while flotation tailings mostly range from fine sand to clay-sized

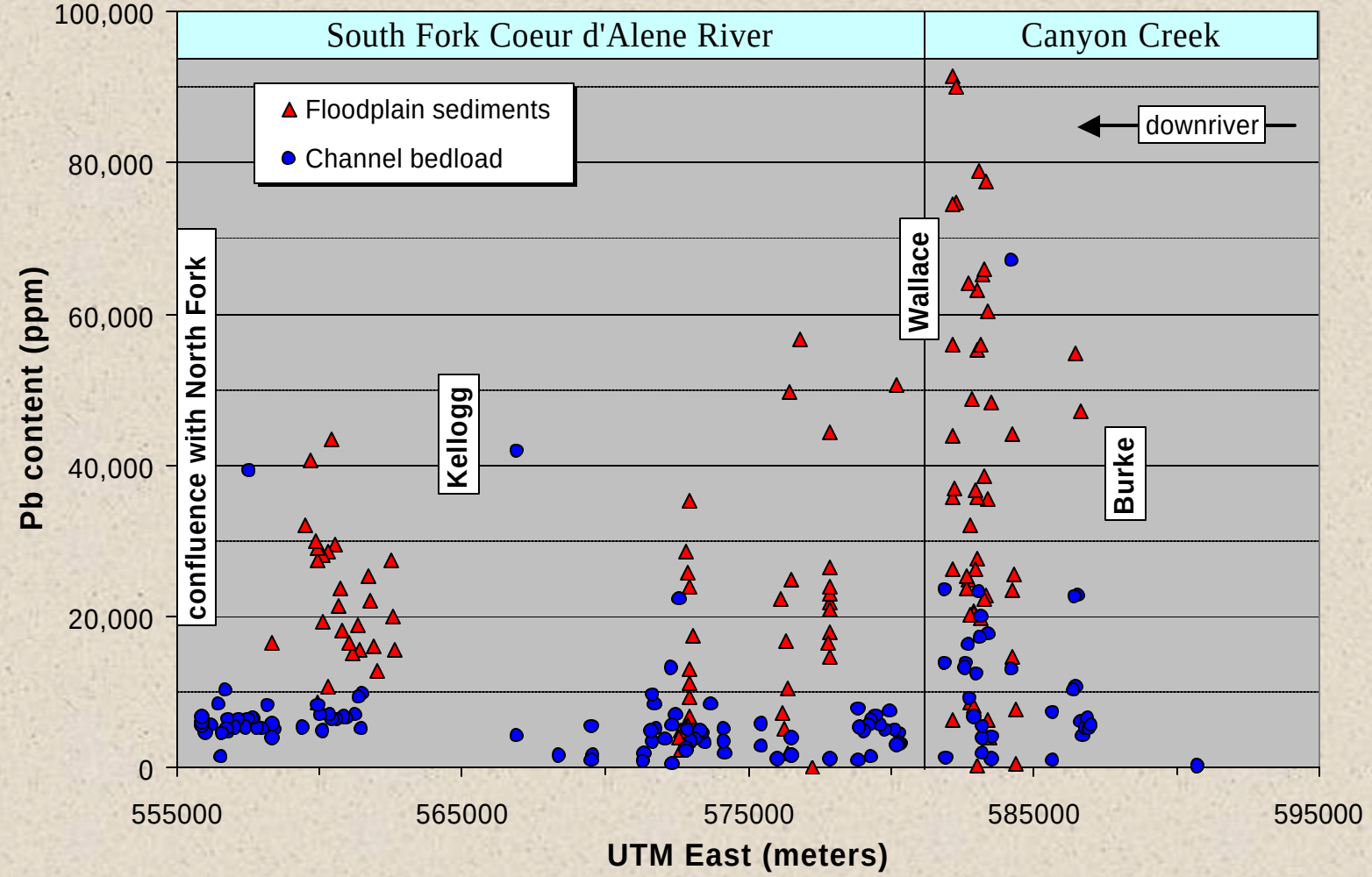


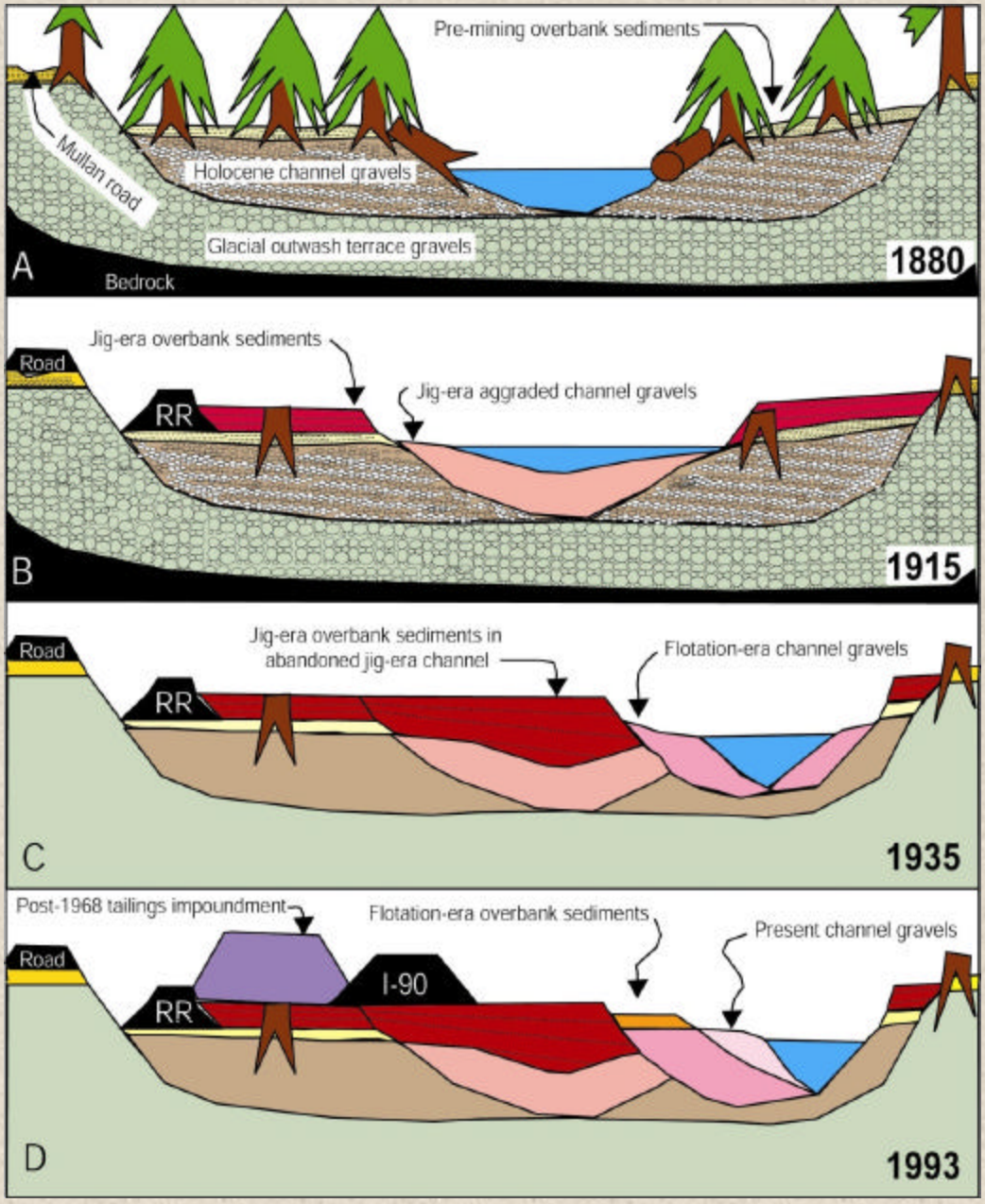
Osburn: Peak of December, 1933 Flood



Floodplain section aggraded with jig-tailings with extremely high metal contents

Pb content of floodplain sediments vs channel bedload on Canyon Ck and South Fork



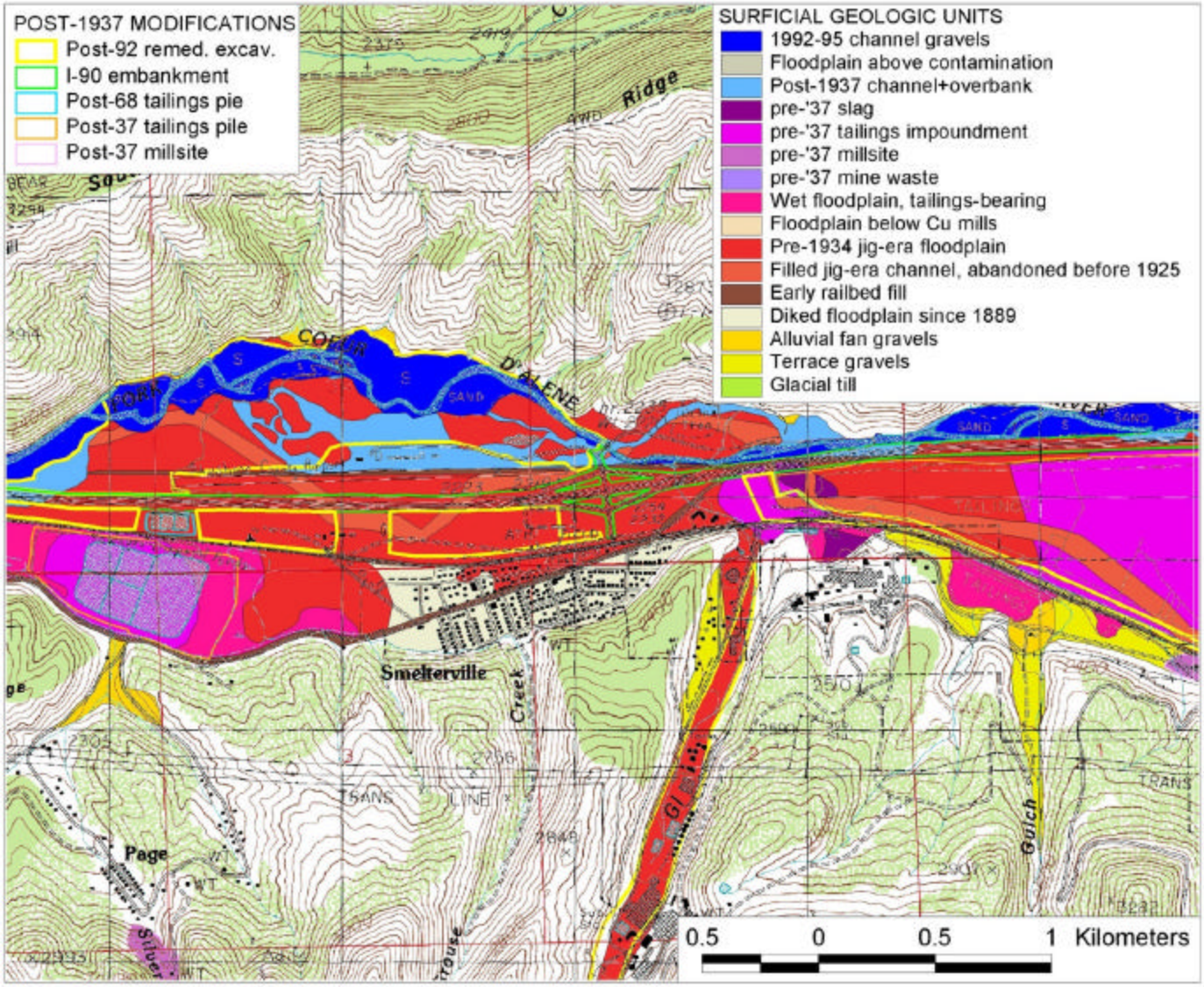


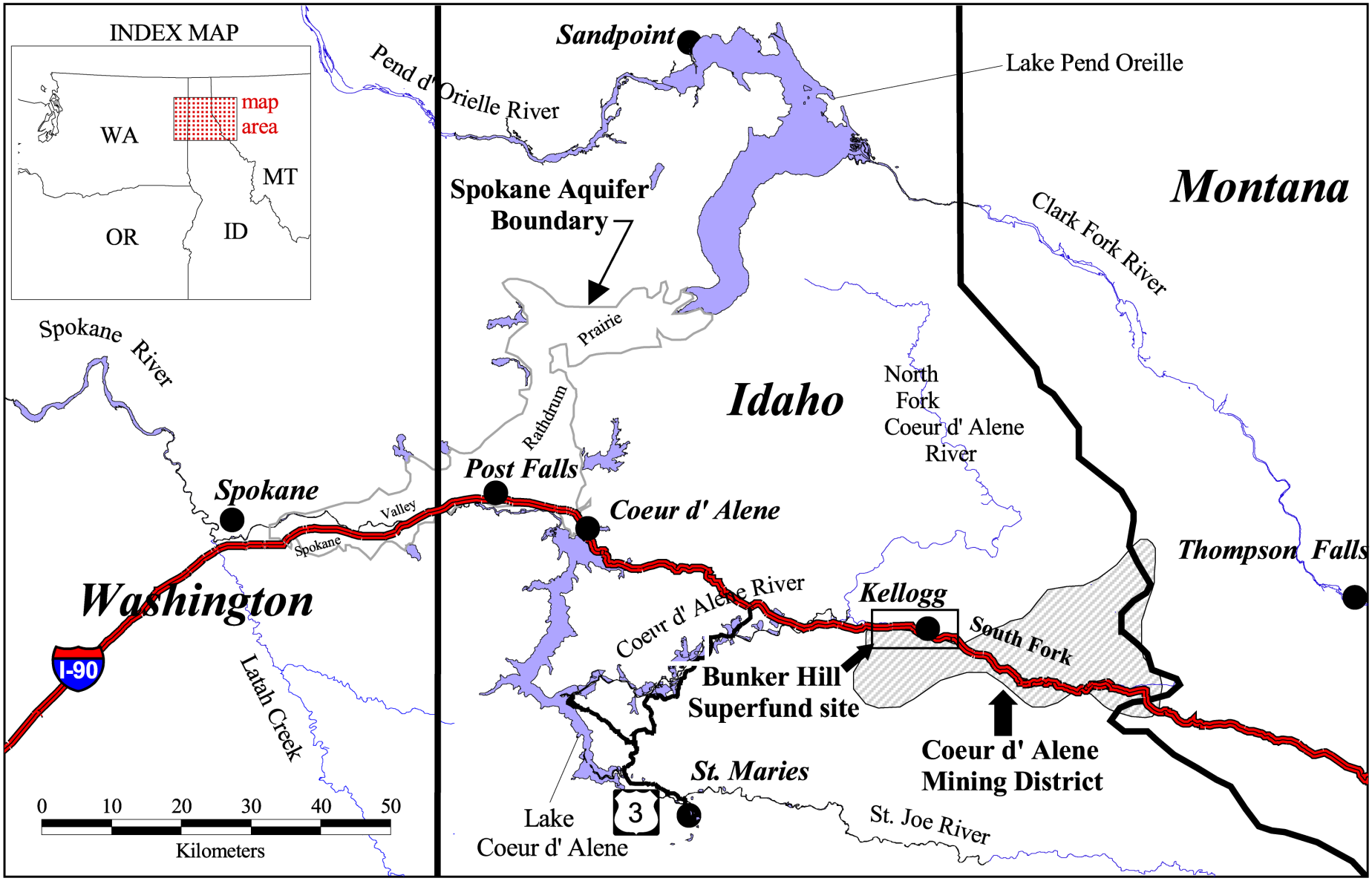
Valley cross-section before mining began.

Coarse jig tailings clog channel and aggrade floodplain.

Fine flotation tailings allow re-deepening of channel and abandonment of floodplain.

Cessation of riverine tailings dumping and highway construction narrow channel.


POST-1937 MODIFICATIONS
Post-92 remed. excav.
I-90 embankment
Post-68 tailings pie
Post-37 tailings pile
Post-37 millsite
SURFICIAL GEOLOGIC UNITS
1992-95 channel gravels
Floodplain above contamination
Post-1937 channel+overbank
pre-'37 slag
pre-'37 tailings impoundment
pre-'37 millsite
pre-'37 mine waste
Wet floodplain, tailings-bearing
Floodplain below Cu mills
Pre-1934 jig-era floodplain
Filled jig-era channel, abandoned before 1925
Early railbed fill
Diked floodplain since 1889
Alluvial fan gravels
Terrace gravels
Glacial till
Ridge
COEUR D'ALENE
Smelterville
Creek
Page
Gulch
0.5 0 0.5 1 Kilometers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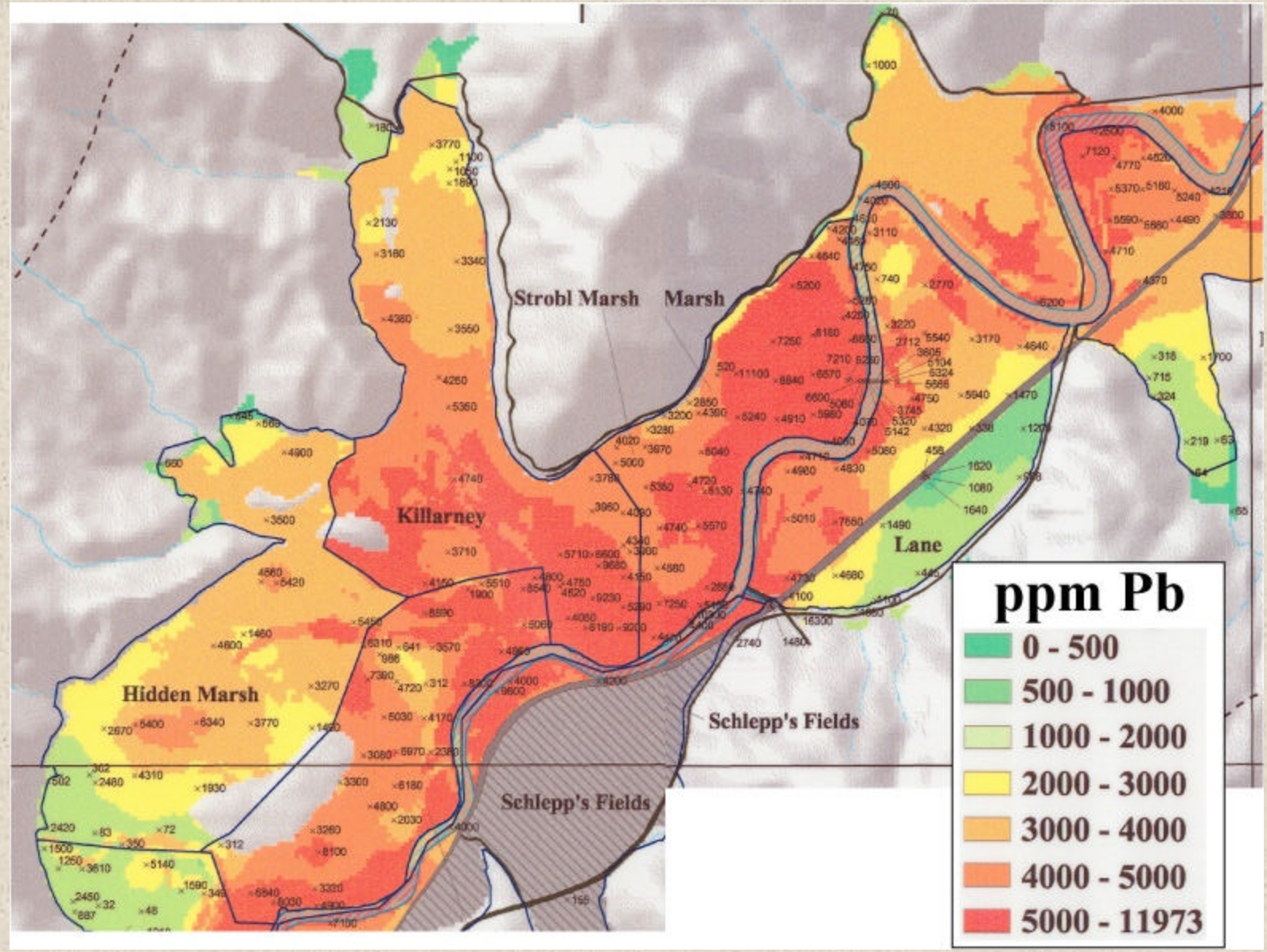
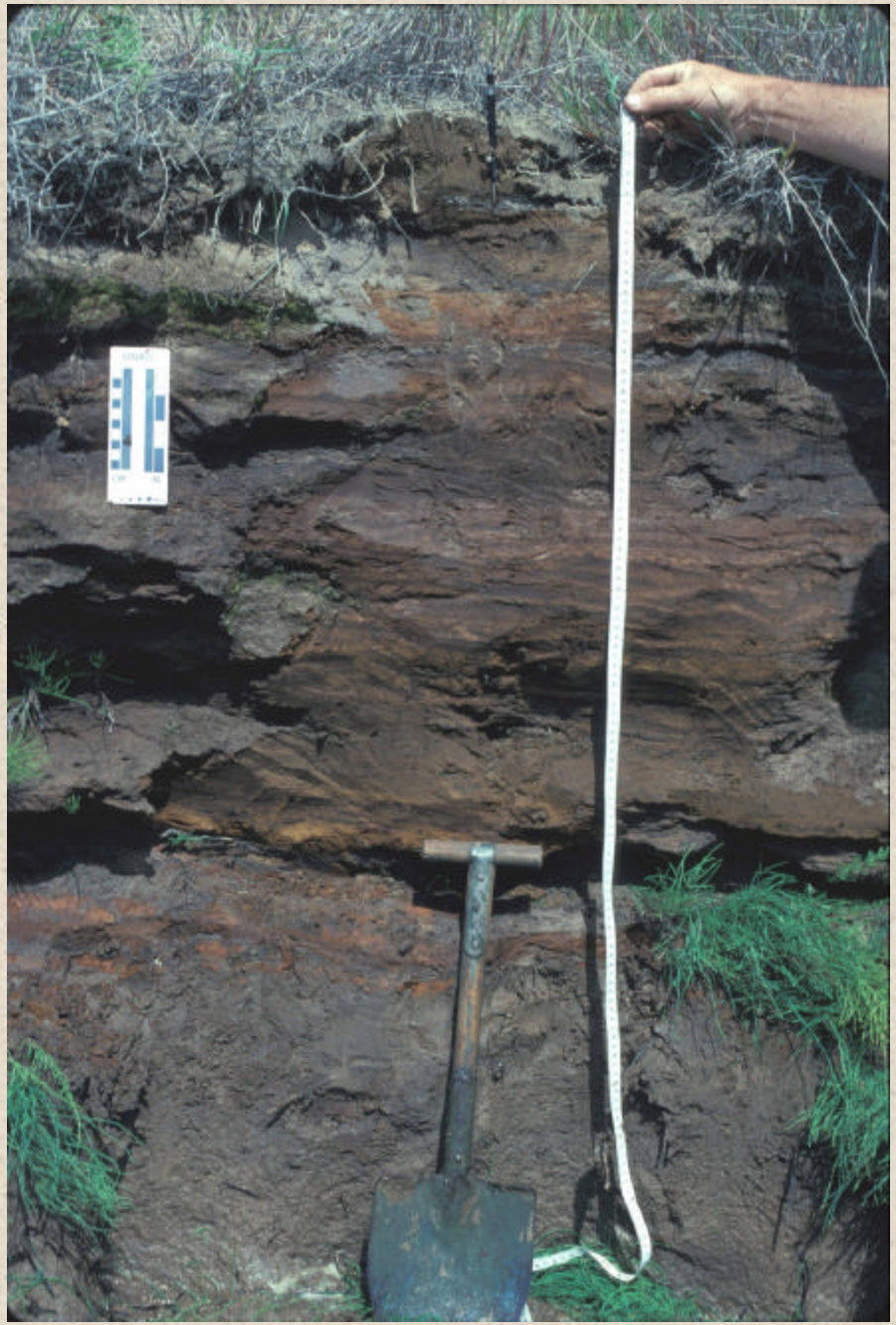
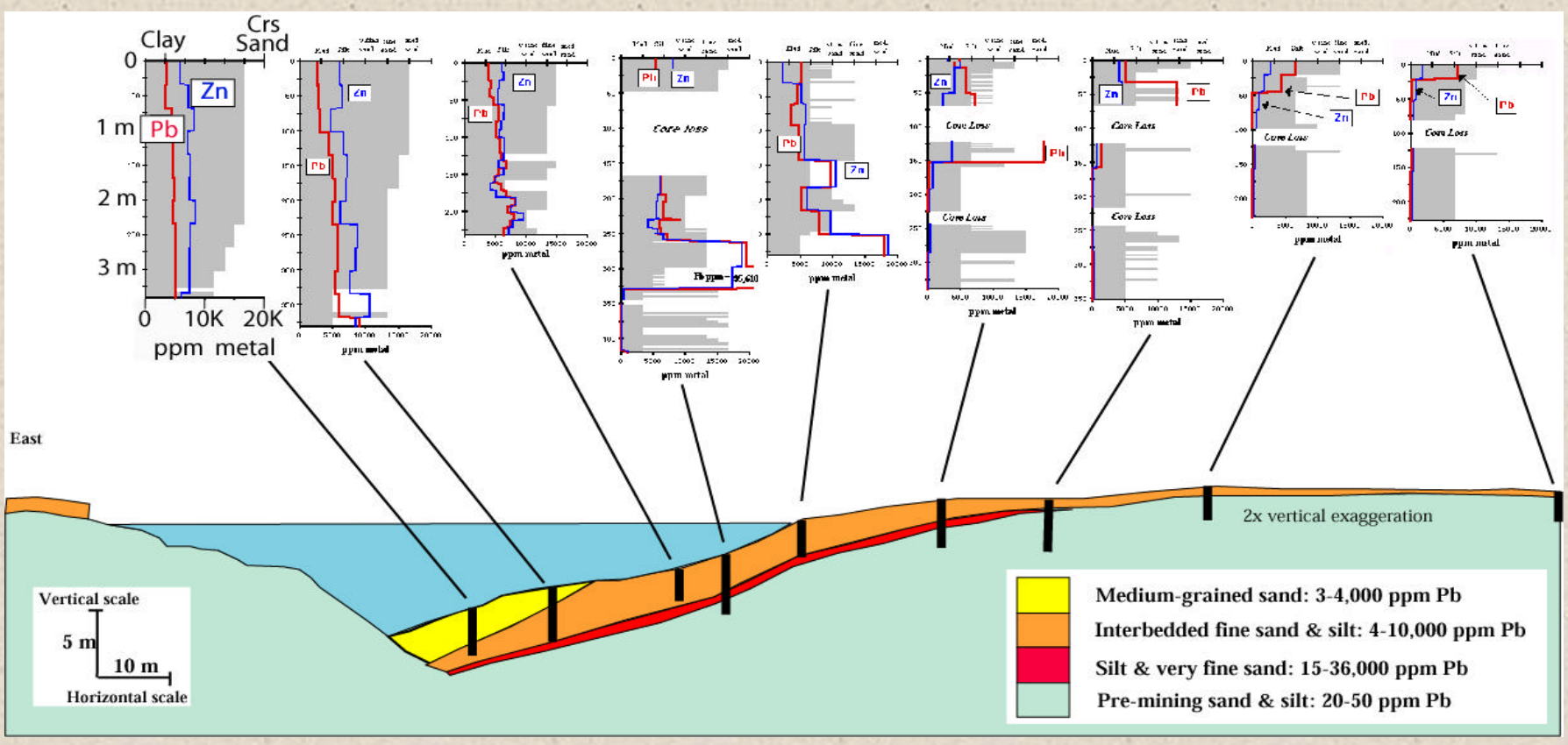
Floodplain blanketed by sediment enriched in lead (Pb)
(background Pb concentrations about 25 ppm)





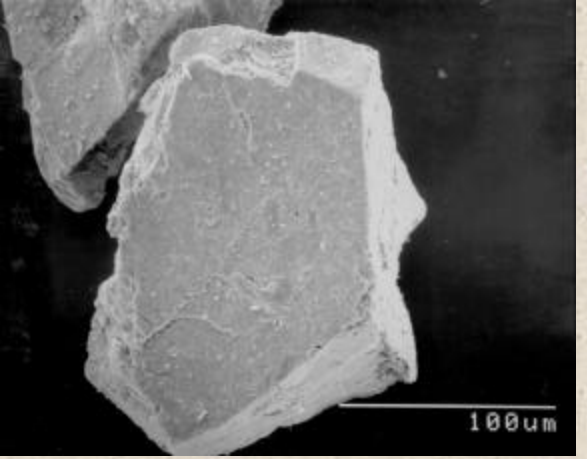
Erosional banks of the Lower CdA River River

Oxidized riverbank sediments typically a meter thick and average 4000 ppm Pb. Cm-thick 1980 Mt St Helens ash at 11 cm (1993 photo).



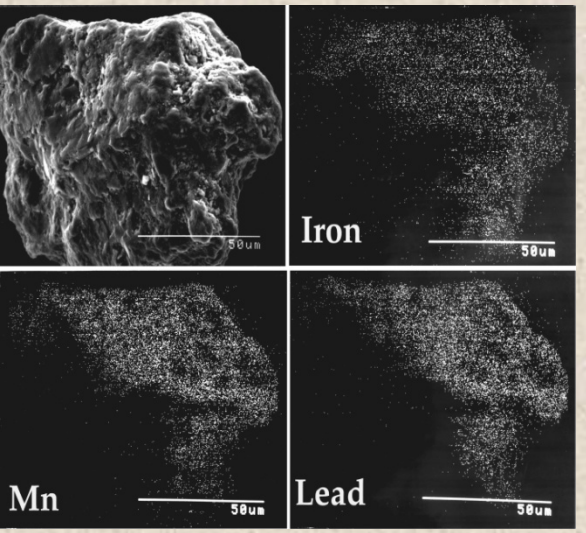
CdA River channel near Killarney Lake

- River bed underlain by 50 m wide, 3-5 m thick wedge of Pb-rich sediment for 30 river miles
- Deposit thins to 0.5 m over natural levee



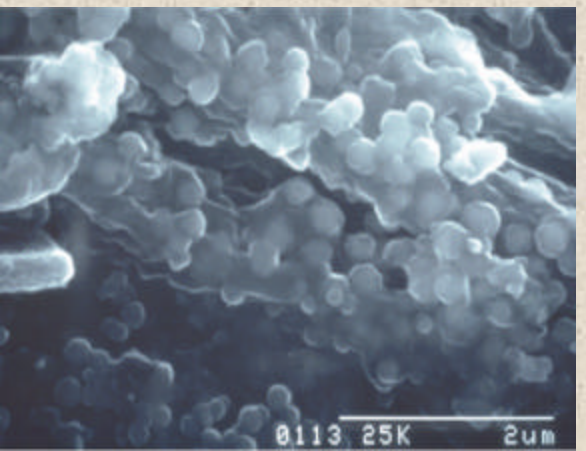
Submerged channel sediments

Detrital sphalerite grain. Rapid burial and reduced subbottom conditions preserve original Pb and Zn sulfides from released tailings.



Subaerial floodplain sediments

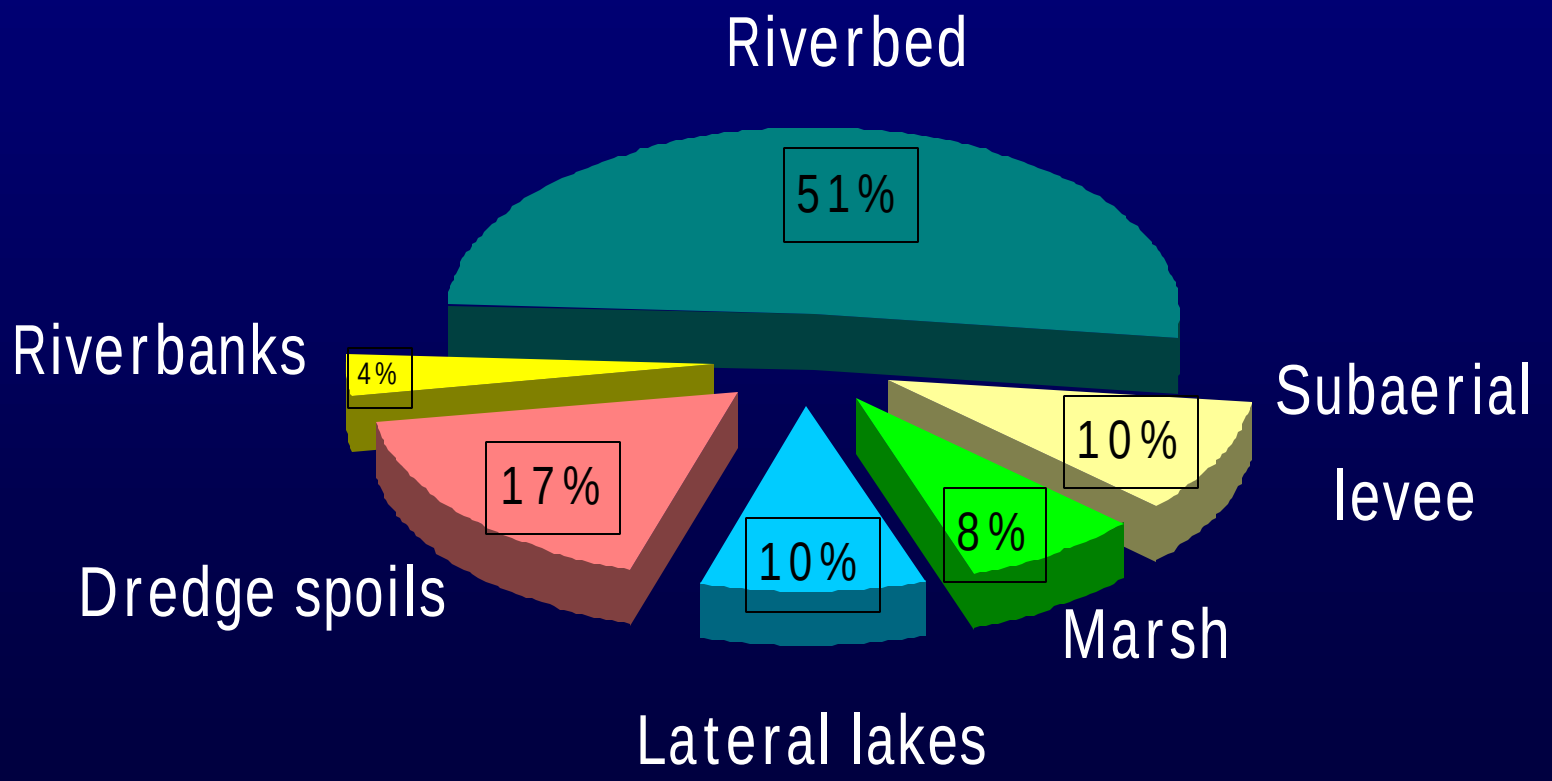
Pb, Mn, Fe oxy-hydroxide coating a detrital silicate grain. Oxidation breaks down detrital sulfides. Much of Zn stays in solution and returns with groundwater to river.



Reduced marsh sediments

Zn-rich sulfidic nodules with organic bio-coatings. Bio-mediated reduction of oxyhydroxides to sulfides.

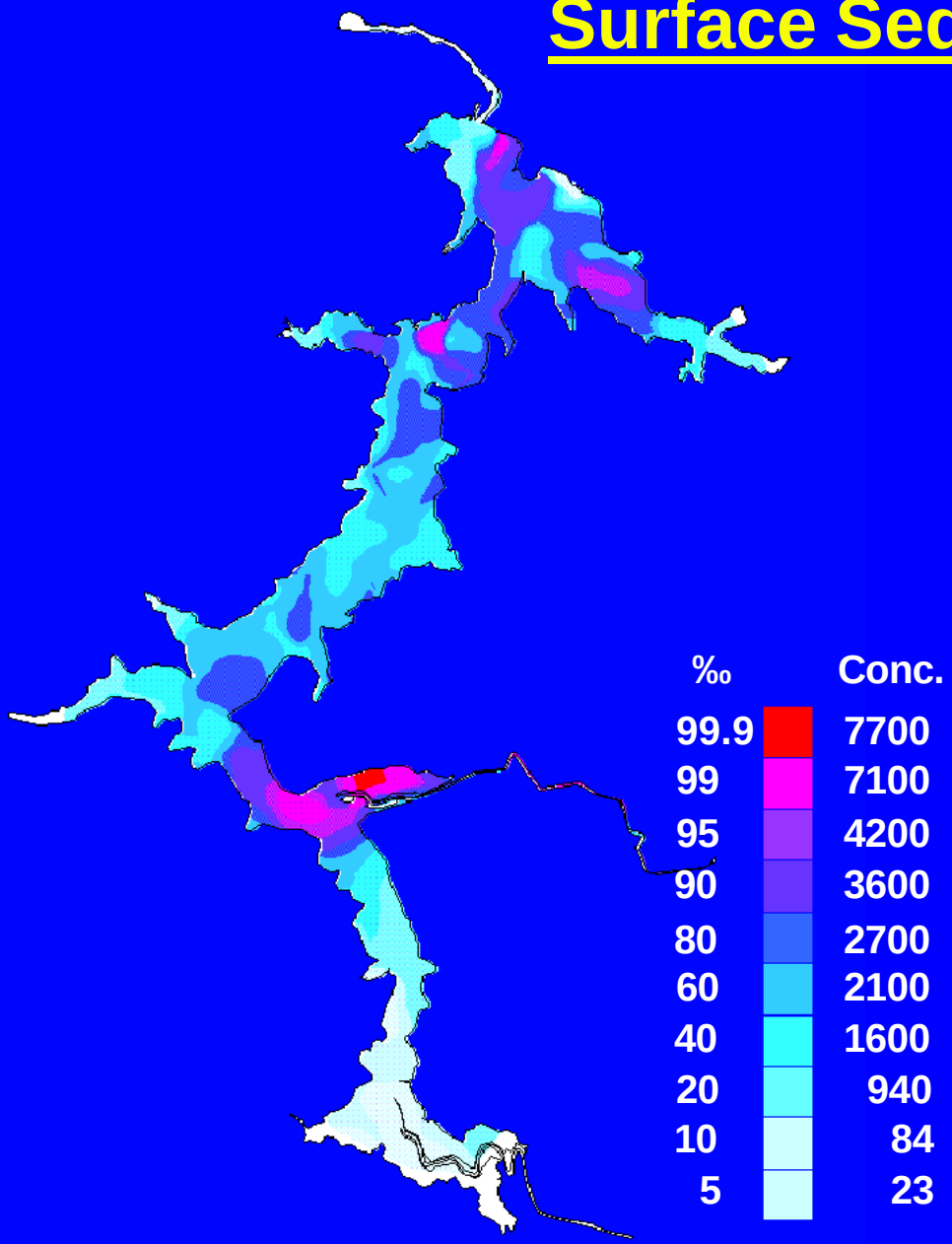
Distribution of Pb by depositional environment in lower CdA valley



From Bookstrom and others, 2001


Spokane River
Lake Coeur d'Alene
Coeur d'Alene River

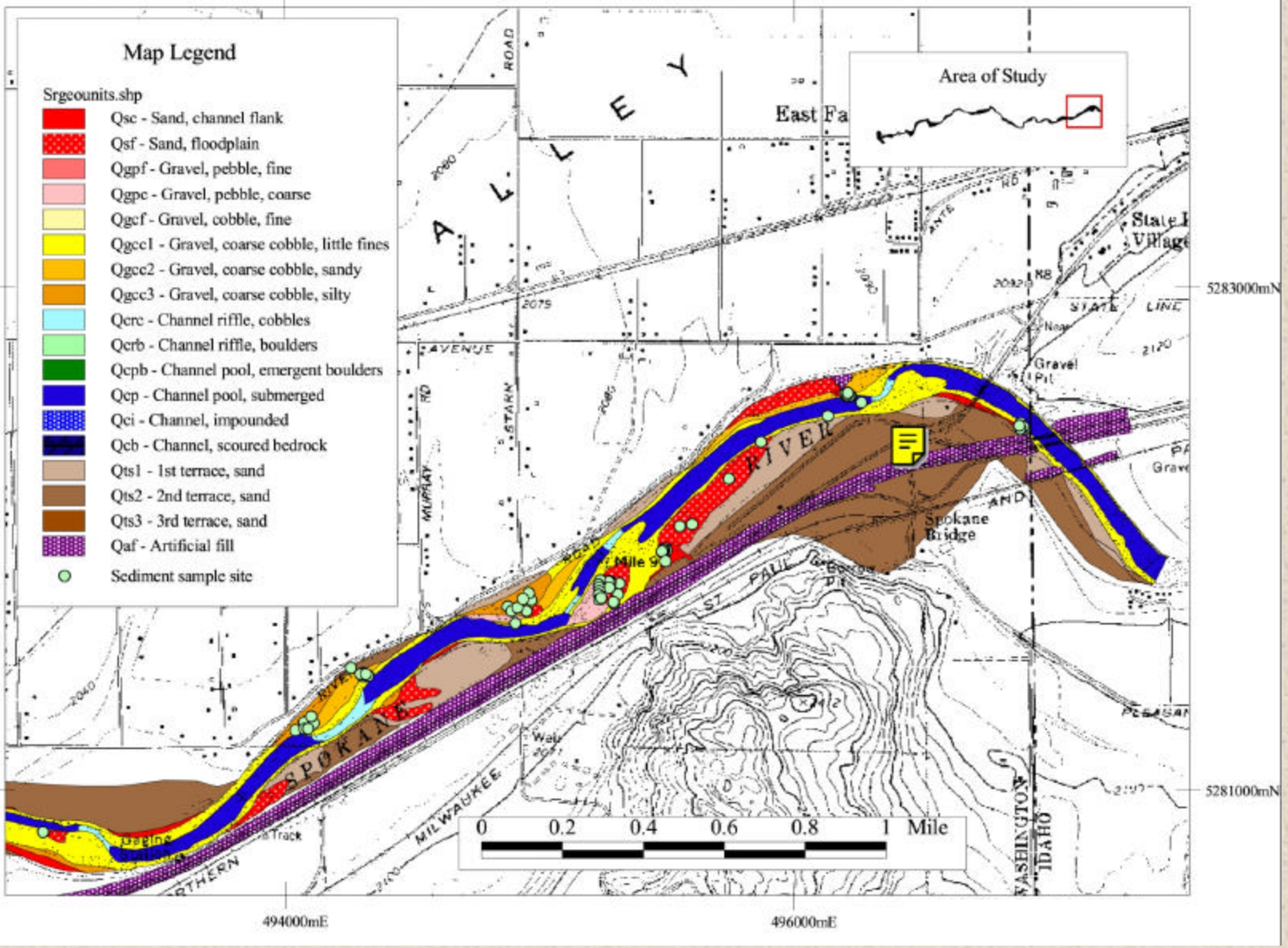
Distribution of Lead in Lake Coeur d'Alene Surface Sediments



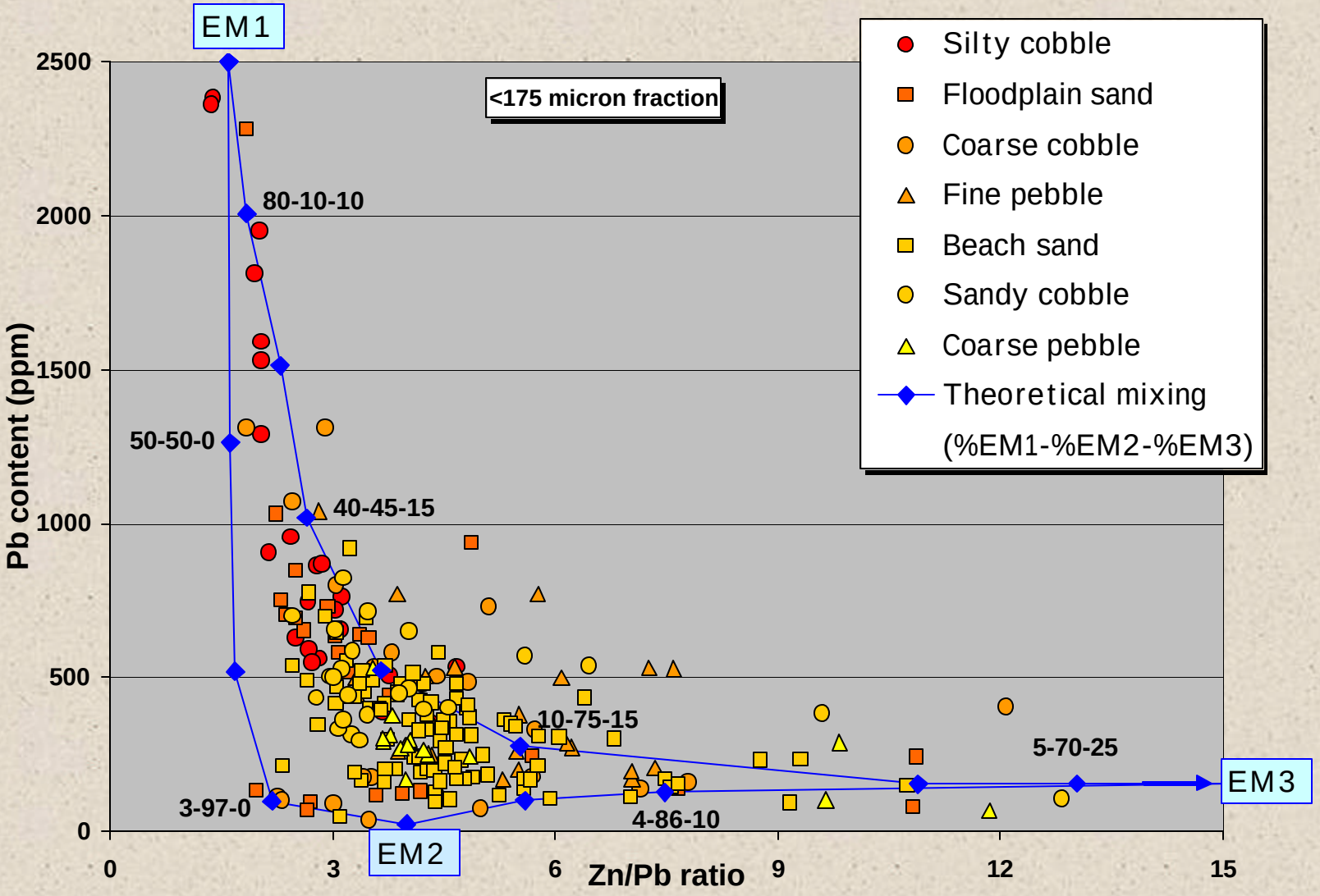
(courtesy of Art Horowitz, USGS)

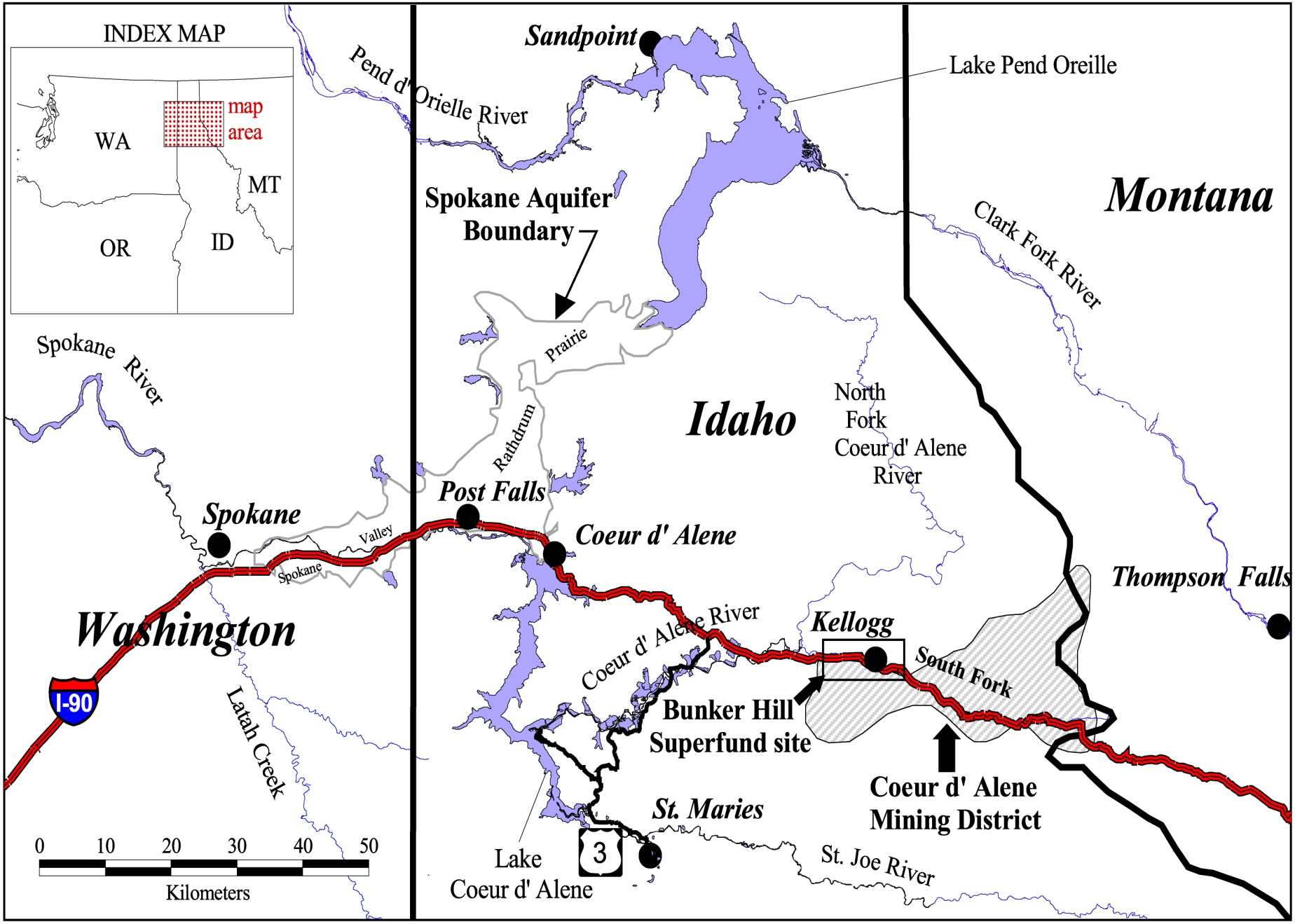
Spokane River channel: Coarse lag deposits of Quaternary glacial outburst floods. Lack of native fine sediment allows local pockets of undiluted metal-rich fines from lake-transitting sediment plumes during high-flow runoff.

Plate 1. Spokane River surficial geology: east half of Liberty Lake quadrangle, WA (scale 1:24,000).



Spokane River sediment mixing model

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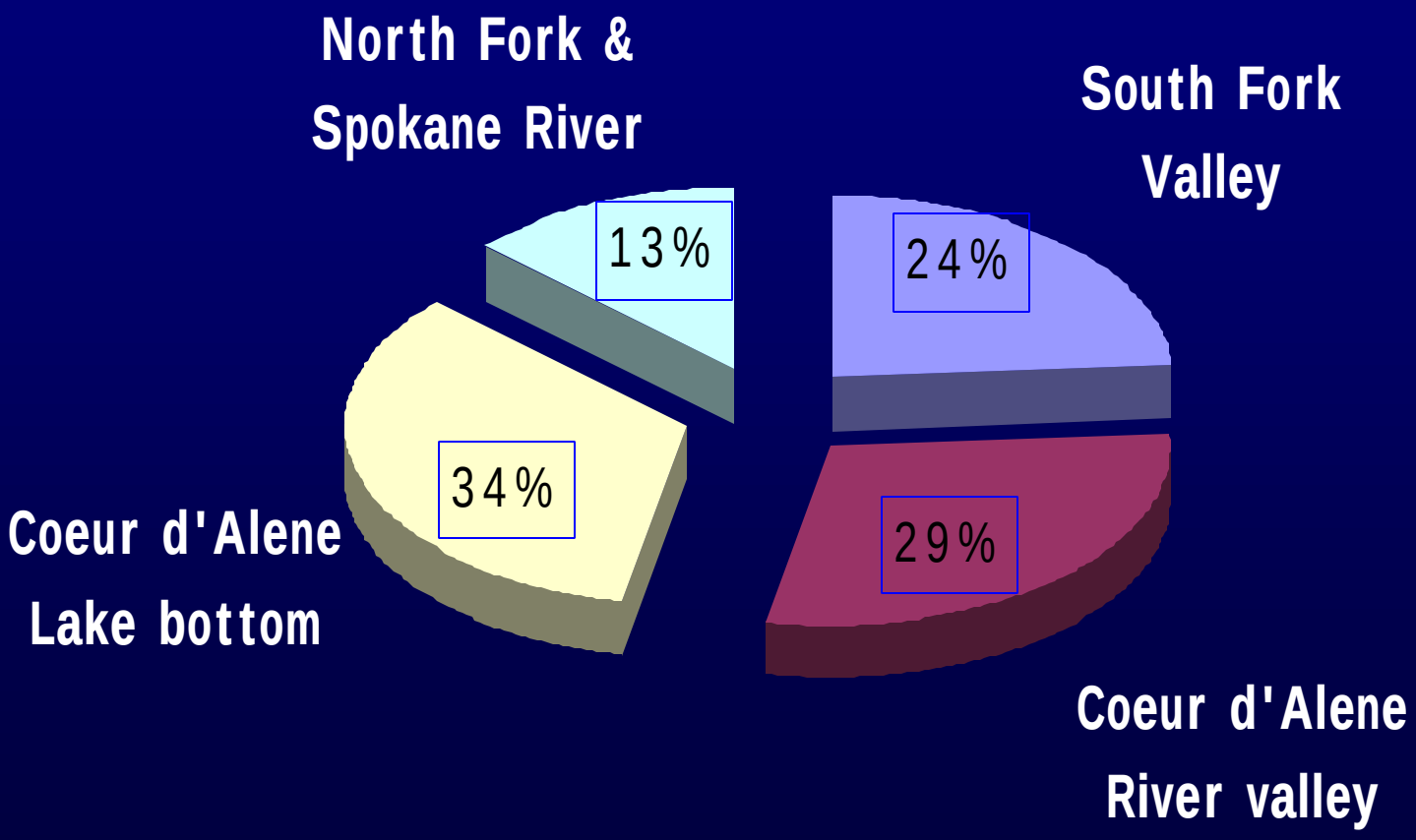
Residence of Pb from released mill tailings



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