

Equilibrium Phosphorus Concentrations and Phosphorus Forms of Sediments in Walnut Creek, Iowa



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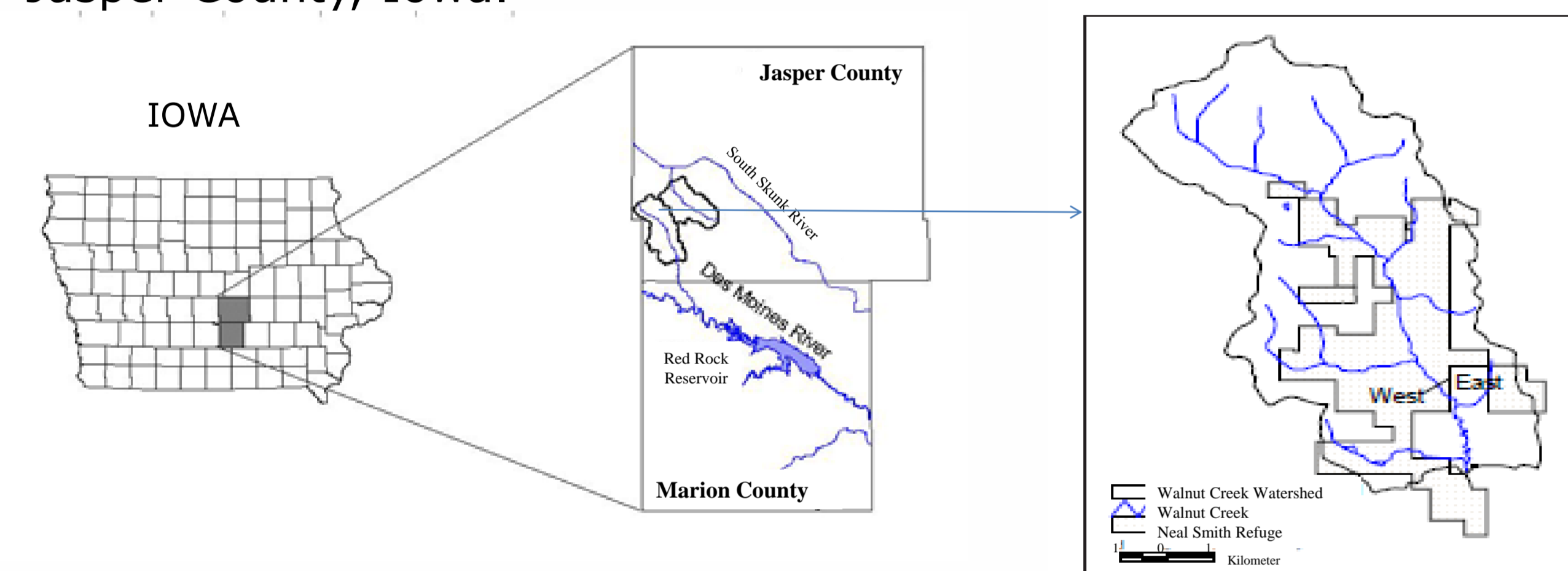
Introduction

- Stream sediments that are derived from various sources might release different forms of P (organic and inorganic) into stream water.
- The Equilibrium Phosphorus Concentration (EPC) is the value of the liquid-phase P concentration at which adsorption and desorption processes are in equilibrium. P adsorption is favored when $EPC < DRP$ (Dissolved Reactive P) in the stream water. Conversely, P desorption is favored when $EPC > DRP$.
- Exploring the relationship between EPC and sediment P fractions is an important first step to better predict the dynamics of P in the interface of solid and solution phases.

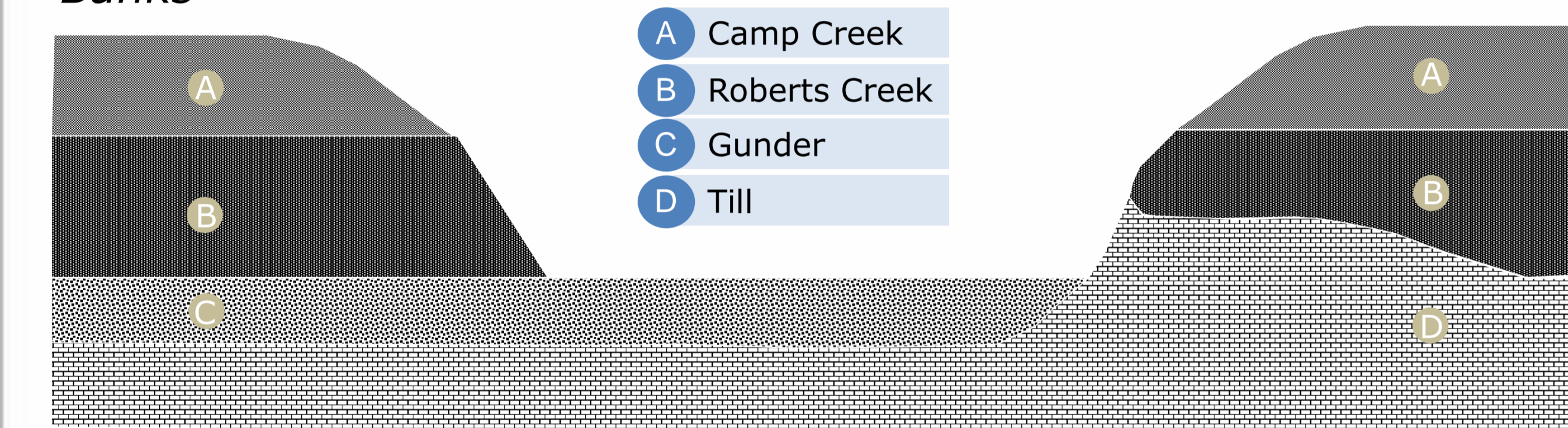
Materials and Methods

Sampling

- 12 sediment samples (code A to L) from 3 groups (banks, in-stream deposit, floodplain) were collected from Walnut Creek, Jasper County, Iowa.



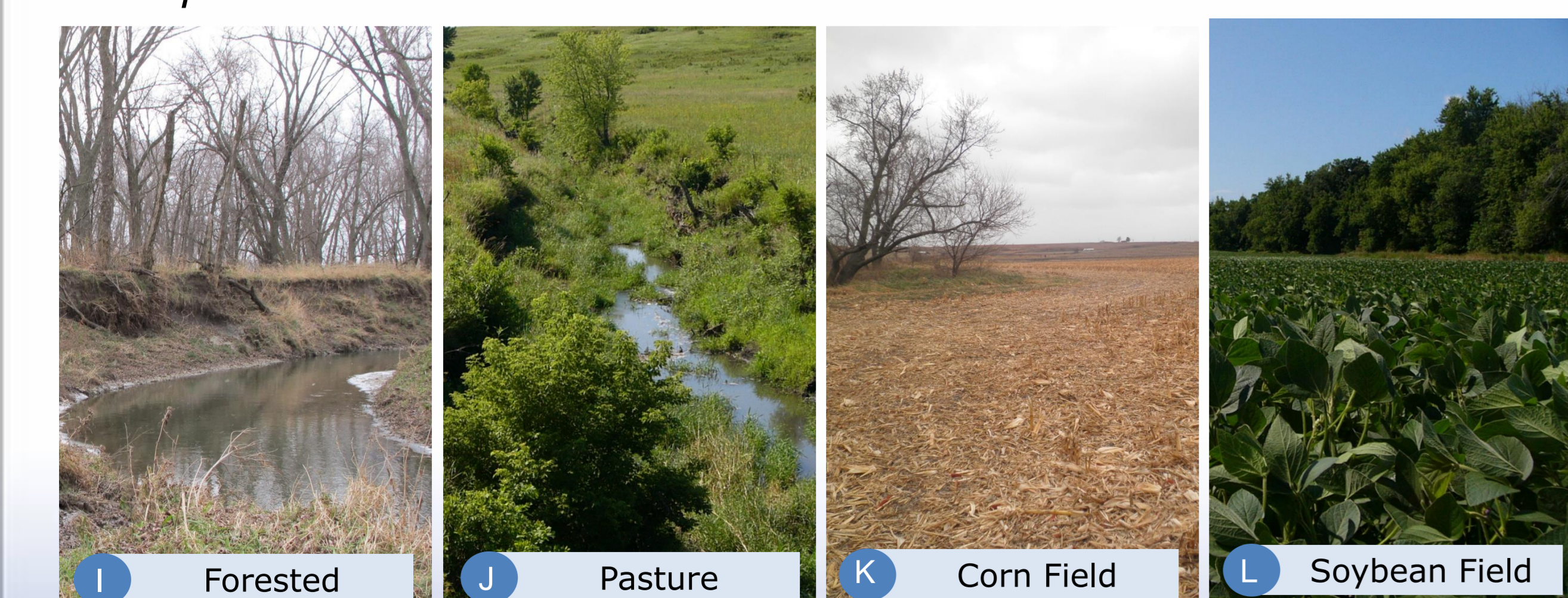
Banks



In-stream deposit



Floodplain



Fractionation study

- Organic and inorganic P were sequentially extracted using different extractants.

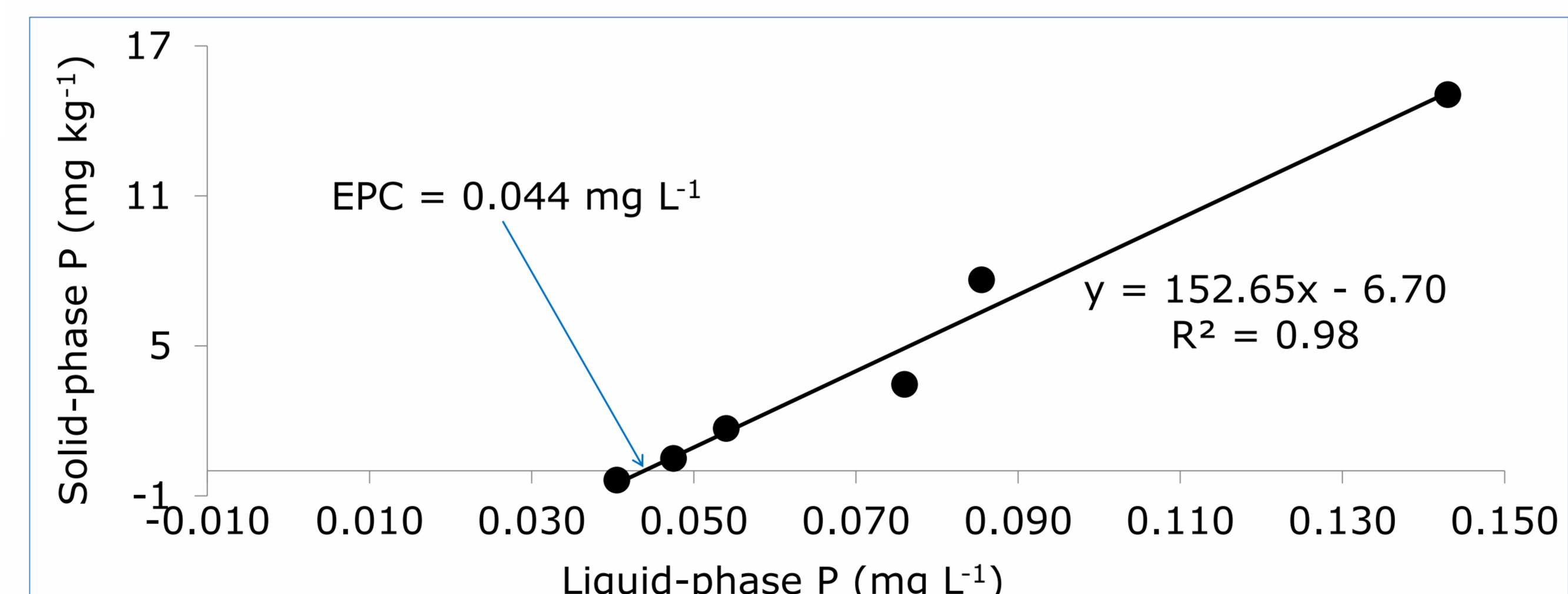
Inorganic P (Pi)		Organic P (Po)	
Extractant	Pi Fraction	Extractant	Po Fraction
1.0 M NH ₄ Cl	Soluble	0.5 M NaHCO ₃	Labile
0.5 M NH ₄ F	Al associated	1.0 M HCl	Moderately soluble
0.1 M NaOH	Fe associated	0.5 M NaOH	Fulvic & Humic acid associated
CBD	Reductant soluble	1.0 M H ₂ SO ₄	Non labile

Isotherm adsorption study

- Filtered stream water from Walnut Creek was used as a base solution, spiked with 0, 0.05, 0.10, 0.20, 0.40, and 0.80 mg P L⁻¹.
- Three settings of physicochemical aspects.

Physicochemical aspects	Setting 1	Setting 2	Setting 3
Solid to solution ratio of 1:20	√	√	√
Shaking speed	Slow	Fast	Slow
30 days anaerobic incubation	X	X	√
24 hours shaking	√	√	√

- EPC was determined by plotting solid and liquid phase-P after equilibrium.



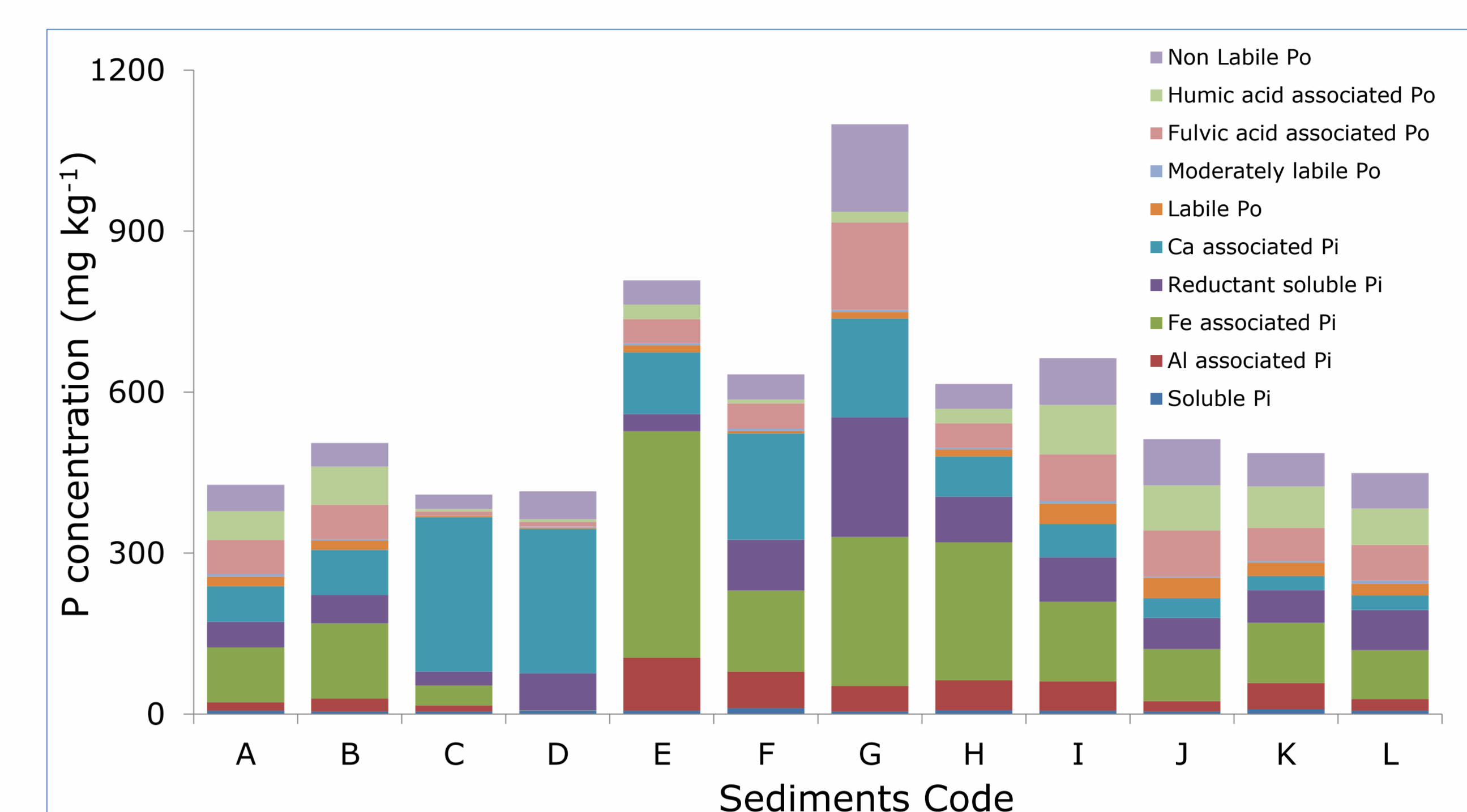
Results

Sediment characteristics

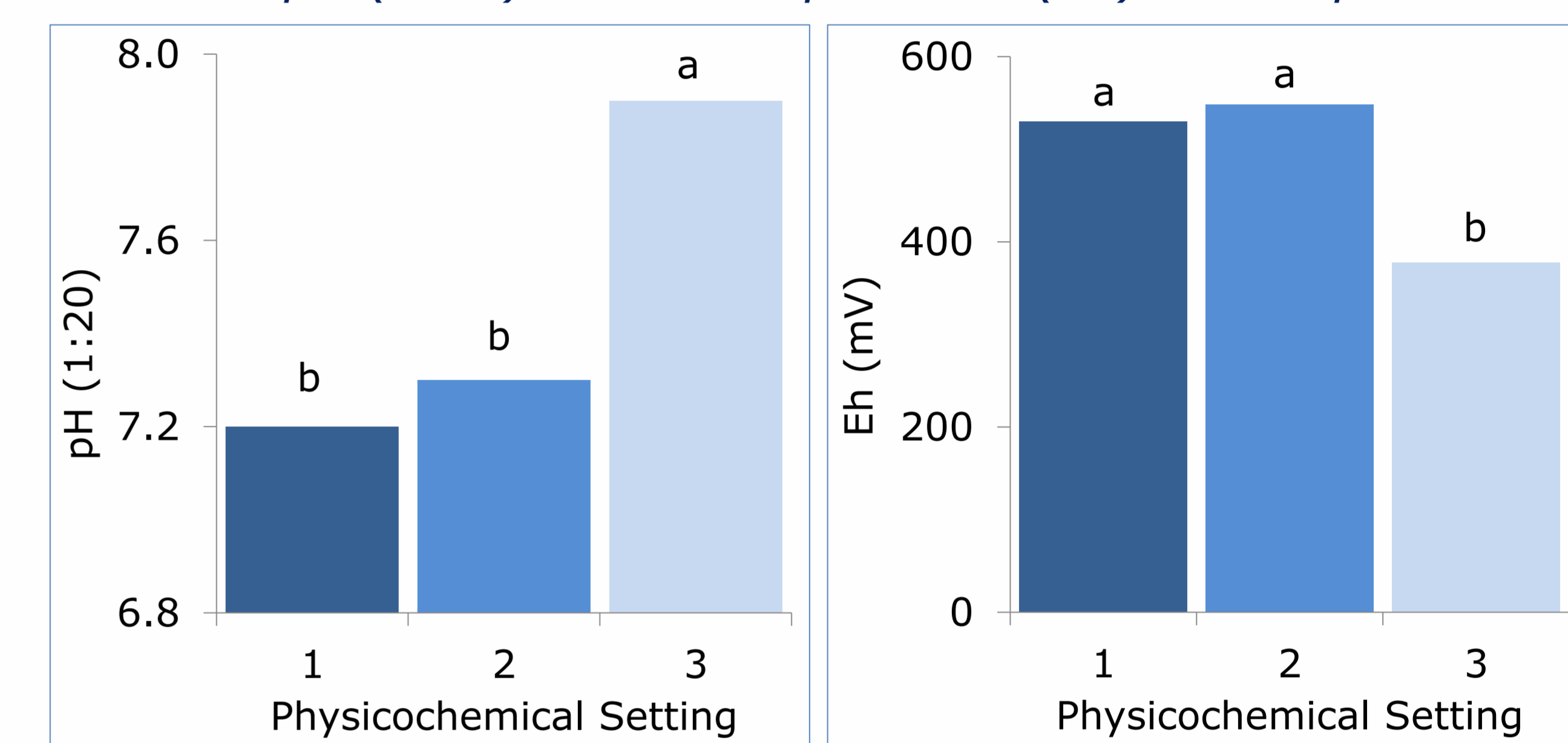
Sediments	Code	pH H ₂ O (1:1)	OM (%)	% Sand/Silt/Clay	Total P (mg kg ⁻¹)	CBD-Fe (mg kg ⁻¹)	DPS (%)	
							M3	Ox.
Banks								
Camp Creek	A	6.2	3.4	11/63/25	491	6,824	1.2	3.6
Roberts Creek	B	6.3	4.5	13/60/27	588	5,862	1.0	3.8
Gunder	C	7.4	1.5	6/72/22	484	3,813	1.0	5.7
Till	D	8.1	1.5	49/31/21	473	10,124	0.0	10.8
In-stream deposit								
Slump	E	6.5	4.3	6/63/31	1,134	8,426	1.5	11.9
Stream bottom	F	6.7	3.2	9/59/32	666	5,095	1.3	12.8
Debris dam	G	7.2	3.6	22/53/25	966	15,571	1.4	6.0
Sand bar	H	7.2	3.0	52/33/15	566	6,888	2.6	7.7
Floodplain								
Forested floodplain	I	6.1	6.4	4/70/26	730	8,615	1.4	5.3
Pasture	J	5.6	5.2	1/81/18	567	7,341	1.1	3.0
Corn field	K	6.2	4.7	23/57/21	617	9,195	2.5	4.1
Soybean field	L	6.5	4.4	17/61/21	505	8,876	1.0	2.3

Note = OM: Organic Matter, CBD: Citrate Bicarbonate Dithionite, DPS-M3: Degree of Saturation based on Mehlich-3 extraction; DPS-Ox: DPS based on ammonium oxalate extraction.

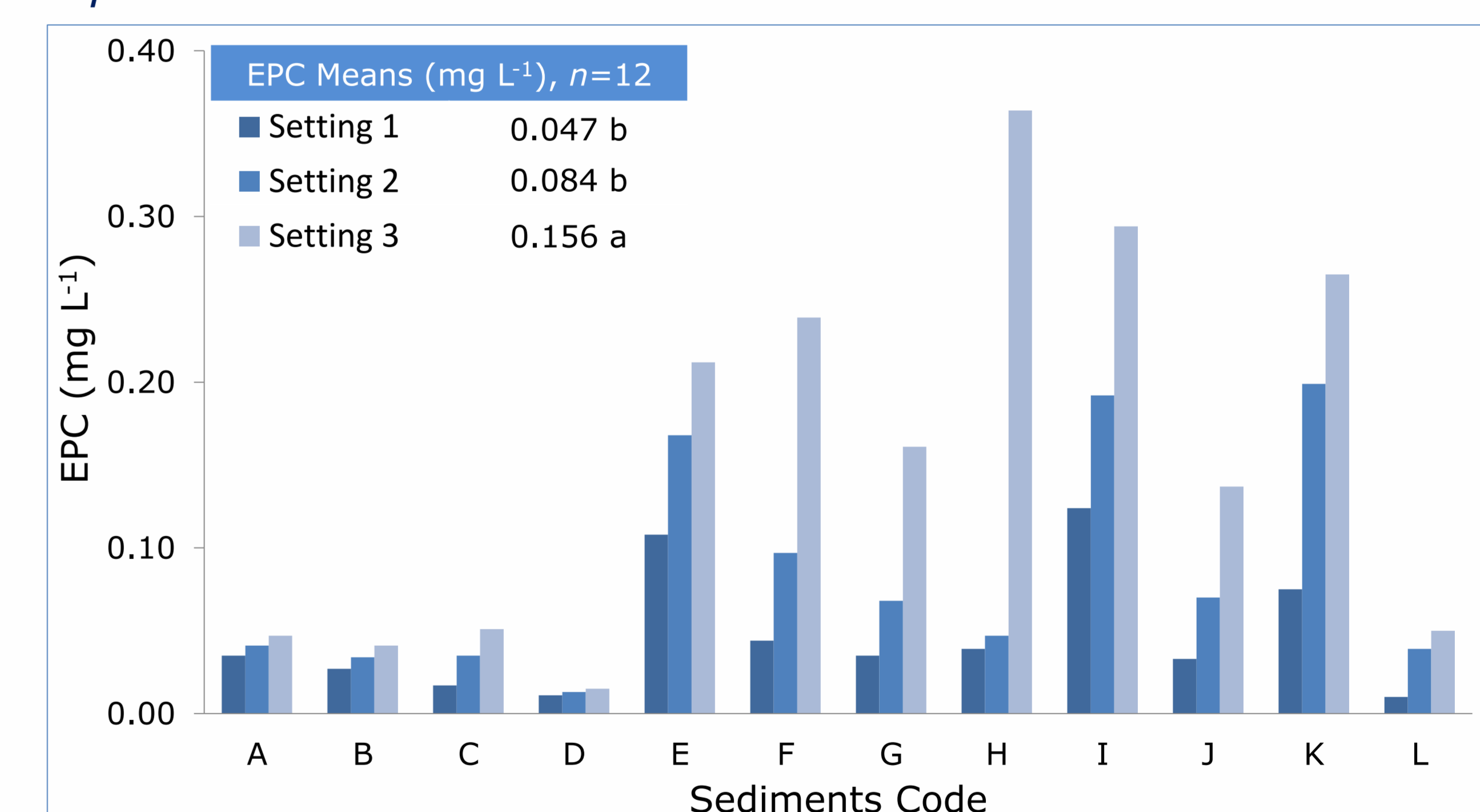
P fractionation



Means of pH (1:20) and redox potential (Eh) after equilibrium



Equilibrium P Concentration



Conclusions

- Sediment characteristics varied among the sampling locations.
- Distribution of P among different organic and inorganic solid phases varied among the stream sediments.
- Anaerobic incubation decreased redox potential and increased pH of the system after equilibrium.
- Lowering redox potential significantly increased Equilibrium Phosphorus Concentration (EPC). EPC also tended to increase by increasing shaking energy. The higher the EPC value, the more likely stream sediments can act as a P source by favoring phosphate desorption into stream water.