How Sediment Deposition Establishes a Template for Floodplain Ecosystem Development

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Floodplains are ecological hotspots:

- high productivity and biodiversity
- mediate terrestrial-aquatic exchanges
How do floodplain soils change over time?
How long to become productive?
How long do they stay productive?
Ecosystem Development Relative to Disturbance Interval

Particle size distribution is a master variable

The size of pore spaces controls the movement of liquids and gases

Reactive surface area affects adsorption of microbes, nutrients and organic matter

Surface area affects weathering of parent material
Fluvial sorting creates temporal and spatial patterns in sediment size distribution.

1962 2002
Hypothesis: Fine particle distribution constrains organic matter dynamics in floodplain soils

Distribution of soil OM relative to particle size

Mineralization of C and N relative to particle size, site age/history and environmental variables
Queets River

1,153 km² watershed
~ 3 m annual precip
Uplifted marine sediments
Recently glaciated

Chronosequence approach

27 "patches" ranging in age from 4 to ~1000 years.
Isolation of ecologically meaningful pools

Size
- Particulate OM
- Sand
- Silt
- Clay

Incubation
- Fast-cycling
- Slow-cycling
- Stable

Particle size distribution

0-10 cm depth

10-30 cm depth

30-50 cm depth
C:N ratios in particle size fractions

<table>
<thead>
<tr>
<th>Fraction</th>
<th>C:N Ratio</th>
<th>SE</th>
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</thead>
<tbody>
<tr>
<td>Sand</td>
<td>30.1</td>
<td>6.4</td>
</tr>
<tr>
<td>Silt</td>
<td>15.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Clay</td>
<td>12.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

C mineralization relative to soil C

- Sand: $r^2 = 0.70$
- Silt: $r^2 = 0.71$
- Clay: $r^2 = 0.90$

0-10 cm
10-30 cm
30-50 cm
N mineralization relative to clay fraction N

$R^2 = 0.65$

![Graph showing the relationship between net Nmin (g/g soil) and clay fraction N (g/g soil)]

![Diagram illustrating the flow of CO₂, NH₄⁺, and C/N ratios through sand, silt, and clay fractions, with export indicated]

- CO₂
- NH₄⁺
Summary

Organic matter was strongly associated with silt and clay particles in soils and fluvial sediments.

Fine-textured soils have more C and N and more efficiently retain N.
Implications

Sediment distribution acts as a template constraining organic matter dynamics

Alteration of sedimentation regimes due to human activity may have far reaching implications for soil biogeochemistry
Acknowledgments

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