friday, oct 31, 2008

1. 5 cr cruise reports due today
2. Olympic peninsula ft nov. 15-16
   think about gear (sleeping bag, tent, rain gear)
3. on to rivers!

why?
water and nutrients
habitat to diverse
flora and fauna
routes for commerce
recreation, electricity
major downstream trends

discharge $\uparrow$
width $\uparrow$
depth $\uparrow$
velocity $\uparrow$
grain size $\downarrow$
river systems
can be subdivided into major segments:
1. bedrock/mountain
2. alluvial
3. deltaic
alluvial rivers

erodible channel boundaries (alluvial banks and bed)
transport capacity \( \leq \) sediment supply

**Input \( \geq \) Output**
sed. storage can be big

channel forms/patterns reflect self-organization to deal with this...
channel types

Colluvial (sediment from hillslope)
Alluvial (fluvial sediment)
  A. Cascade
  B. Step-pool
  C. Plane-bed
  D. Pool & riffle
  E. Dune – ripple (most common)

ordered by decreasing gradient
and degree to which everyday flow can carry sediments

[Montgomery & Buffington 1997]
Colluvial Channels

Small headwater channels at the tips of the channel network where sediment transport is dominated by landslide processes.
Cascade Channels

The steepest of mountain channels, characterized by tumbling flow around individual boulders; disorganized streambed structure.
Step-Pool Channels

Channels displaying full-width-spanning accumulations of coarse sediment that forms a sequence of steps.
Plane-Bed Channels

Channels lacking well-defined bedforms and instead displaying long reaches lacking pools.
Pool-Riffle Channels

The most common mountain river morphology; characterized by alternating sequence of pools and bars.
Riffles, pools, and cascades

Riffles and pools alternate in somewhat predictable patterns associated with optimal flow organization to move sediment.
Pool - riffle sequence

Riffle to riffle = 5 - 7 channel widths
a few river terms
Bankfull Discharge

bankfull discharge typically equates to a roughly 2-year recurrence interval flow.
Channel Patterns

Three basic map-pattern forms of streams:

- Straight
- Meandering
- Braided
straight channels

relatively rare

• represent a relatively immature channel form
• straight channels common where streams are confined by topography or follow geologic structures
• often mountain streams
alternate bars

why are straight channels uncommon?

recall: input ≥ output → river needs to manage sediment

interaction between flow & eroding/depositing bed causes organized periodic bar deposition

bar → local width↓ → local velocity ↑ → local erosion → excess sediment → new bar … rivers don’t want to be straight!

Naka R., Japan
meandering

what if the banks are erodible?
  higher velocity near bars $\rightarrow$ erosion
  erosion $\rightarrow$ deposition …
flow & sedimentation patterns self-reinforcing
meandering leads to formation of:

- cut banks
- point bars

Note velocity patterns:

- highest on outside of bends
monday, nov 3, 2008
1. go vote!
2. 5 cr lab on wed: return & discuss cruise reports
3. Olympic peninsula ft nov. 15-16
   think about gear (sleeping bag, tent, rain gear)

today:
recap meandering & continue alluvial rivers
mountain/bedrock rivers
meandering

erosion on outside of bends (cut banks) where velocity is greatest
deposition on the inner sides of bends where velocity is slower
meanders grow through time
meandering

Point Bars

Cut Banks
meandering

progressive growth of meanders leads to formation of meander belts
Growing meanders can intersect each other and cut off a meander loop, forming an **oxbow lake**.
meandering

most characteristic of large, low-gradient, fine-grained rivers

continuous, gradual change in channel course create floodplains wider than the channel

very fertile soil
seasonal flooding
Holden Crater, Mars
Channel Patterns

Three basic map-pattern forms of streams:

• Straight
• Meandering
• Braided
braiding

multiple converging & diverging channels separated by mid-channel bars
braiding

high sediment load (relative to water Q)
constantly changing course
floodplain generally completely occupied by channels
many small islands called mid-channel bars
usually coarse sand and gravel (bedload grain sizes)
braiding

why not a single channel?

amount of bedload grossly disproportionate to transport capacity of water leads to frequent deposition of coarsest sediment – often in bars that locally divide the flow

Braided channels typical in regions with:

easily erodible banks and/or a high sediment load common near mountains & glaciers (not exclusively)
broad patterns
four dimensions:
  longitudinal
  lateral
  time (temporal)
  vertical
Sinuosity: Gradient and substrate

Big meanders
- low gradient
- fine substrates

Small meanders
- high gradient
- coarse substrates
longitudinal profile

typical mountain stream
Rakaia R. NZ
long. channel pattern variation
mississippi
channel maturity →
sinuosity (degree of meandering)
longitudinal & temporal
nisqually -
longitudinal variation (pattern, gs, gradient, Q)