G422/522 Alluvial Fans Mid-Term Study Guide

Key Words / Concepts

Overview of Fluvial Processes

(source notes: Review of Fluvial Processes from Ritter et al., 1995; Taylor Fluvial Geomorph. Review Notes)

Critical Equations:
- Manning's
- Stream Power
- Continuity
- Discharge / Velocity

Channel Geometry
- width
- depth
- gradient

Recurrence Interval
Magnitude-Frequency Relations
Reynold's Relationships
- Laminar Flow
- Turbulent Flow
- Reynold's No.

Velocity Profiles
Climate-Sediment Yield
- (Langbein and Schumm)

Fluvial Response - Energy
- Aggradation
- Degradation

Fluvial Landforms
- floodplain
- terrace
- channel
- levee
- strath terraces
- cut-fill terraces

Paleohydrology
- slackwater deposits
- competence relations

Debris Flow Processes

(source of information: Costa, 1984 (notes on web, paper on CD), In-Class Video, Taylor class discussion, bench-scale models)

debris flow defined
normal streamflow
hyperconcentrated flow
lahar
deposits / diamicton
- poor sorting

sources
- slope failure
- bulking / fire-hose effect

newtonian vs. non-newtonian
sediment-water mixtures
surging flows
boulder levees
woody debris
percent solids vs. percent liquid
cohesive vs. non-cohesive
bouyancy, dispersive force
debris flow processes on fans

Alluvial Fan Overview

(source of information: Blair and McPherson, 1994; Taylor summary notes on web page; Ritter et al. 1995 reading)

alluvial fan
- debris-flow dominated
- fluvial-dominated

cone segment
apex
accommodation space
piedmont
source drainage
fan-receiving area
feeder channel
mountain front
incised channel
distributary channels
fan lobe
fan lobe shifting
fan gradient
feeder channel gradient
fault-bounded mountain front
tributary junctions
tectonic-climate variables
triggering meteorological events
weathering limited slopes
transport limited slopes
transport power
energy expenditure
rock fall
debris flow
sheet floods
channel floods
sieve processes
fan infiltration
fan-head trenching
drainage basin / lithology
fan storage
vegetative cover / sed. production
fault-bounded basins
fan faulting neotectonics
fan segmentation
fan morphometry
fan area-basin area relations
tectonic accommodation
basin relief
fan profiles
fan slope
fan-lobe shifting

<u>Fan-Related Neotectonics</u>

(source of information: Derek Ryter class presentation; Gerson et al, 1993 reading / summary notes)

Basin-Fill Model
    slow subsidence vs. fast
fan faulting / fault scarps
fan offset
beheaded watersheds
strike-slip faulting
normal faulting
off set drainages
abandoned fan surfaces
boulder-armored fan surfaces
active vs. inactive mountain fronts
fault saddles
compression ridges
fault scarp angles
fault scarp heights
diffusive mass wasting
diffusive scarp degradation
soil-profile development
relative soils dating
colluvial degradation of scarps
fault rates vs. fan morphometry

<u>Mountain-Front Geomorphology / Fault Morphometry</u>

(source of information: introduction from Taylor / Steens exercise, Keller and Rockwell, 1984 Reading)

fault-scarp morphology
fan morphology
mountain front morphology
mountain front sinuosity index
valley-width index
fault slip / slip rates
active mountain fronts vs. inactive mountain fronts
Basin and Range tectonics
fault-scarp degradation
    scarp crest
    scarp toe
    offset
    slope
    diffusion equation

<u>Surficial Mapping Criteria</u>

(source of information: Taylor, 1999 notes and reading)

Type 1, 2 and 3 map units
Type 1 units
    material
    process
    landform
    age
processes
    residuum
    colluvial
    alluvial
    debris flow
    hypercon. flow
landforms
    hillslope
    sideslope
    nose
    hollow
    veneer
    blanket
    fan
    terrace
    floodplain
    fan-terrace
soil survey applications

Lab Exercise Summary / Concepts and Skills

Exercise 1 - Intro to fan morphometry

Can you measure / observe the following: fan area, drainage area, fan profiles, fan gradient, channel gradient, derive empirical relationships via graphing variables?

Morals to the Story

(1) drainage basin area is related to fan area and volumes via power-function relationships
(2) assumptions: climate is such that weathering will produce sediments to feed fans
(3) watershed drainages typically display steep slopes compared to fans
(4) bedrock lithology in the source basin influences style of sediment production, in turn, influencing fan area and volumes
(5) fans form because of: decreased gradients, expansion of flow from confined feeder channels, infiltration o discharge into permeable fan deposits, overall loss of stream power
(6) Arid and semi-arid climates are favorable to fan deposition, as hillslopes are poorly vegetated. Climate change that produces de-vegetation over time, should trigger active deposition on fan surfaces. Excess strear power, relative to sediment load encourages fan entrenchment.

Exercise 2 - Fan Morphometry Part 2.

critical skills: log-log plots of fan morphometric parameters, line-fitting and equation determination using Excel, determination of power-function relationships.

Morals of the Story

(1) The size of fans are controlled by drainage basin size, available accommodation space, and rate of sedime delivery
(2) Small drainage basins are capable of producing fans greater in area, than the drainage area themselves.
(3) classic arid fans are preserved in closed, tectonically active basins
(4) The larger the drainage basin, the increase in the available storage space within the basin, and likely decrease in total delivery of sediment to fan per meteorological event. Smaller drainage basins will more effectively deliver sediment to fans per any given transport event.
(5) small watersheds have steep slopes, higher rates of erosion, and more effective delivery of sediment to fa areas (in general), larger watersheds have lower slopes
(6) requirements for fan deposition: loss of stream power, sediment-storage accommodation space (tectonic o erosional in origin), sediment transport, geomorphic events to transport.
(7) greater stream power relative to sediment load, promotes fan trenching / incision

Exercise 3 - Steens / Neotectonic Lab

Critical skills: measuring and calculating mountain front morphometric indices, measuring and plotting fault-scarp morphometric parameters

Morals of the Story

(1) Inactive mountain fronts display eroded topography, sinuous fronts, and wide low-relief valleys
(2) Active mountain fronts display steep, "fresh" topography, straight mountain fronts, and narrow high-relief valleys.
(3) Fault scarps degrade over time via diffusive mass wasting and colluviation

Exercise 4 - Surficial Mapping / Soils Survey Applications

Critical Skills: reading and writing

Morals of the Story

(1) Soil surveys provide a ready source of geomorphic information
(2) An organized surficial mapping protocol is helpful in analyzing geomorphic components of the landscape
(3) Simple-minded exercises are useful nonetheless.