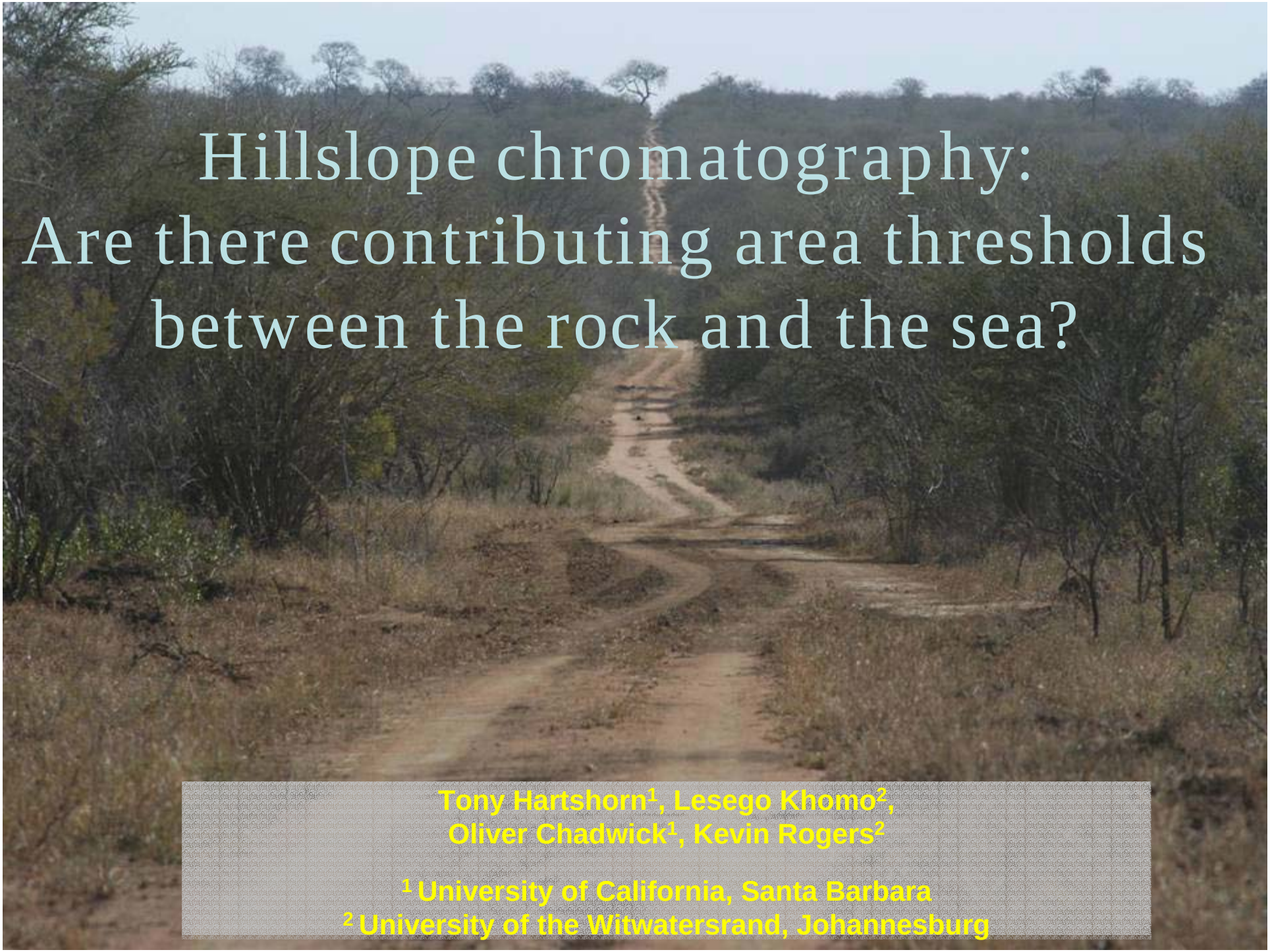
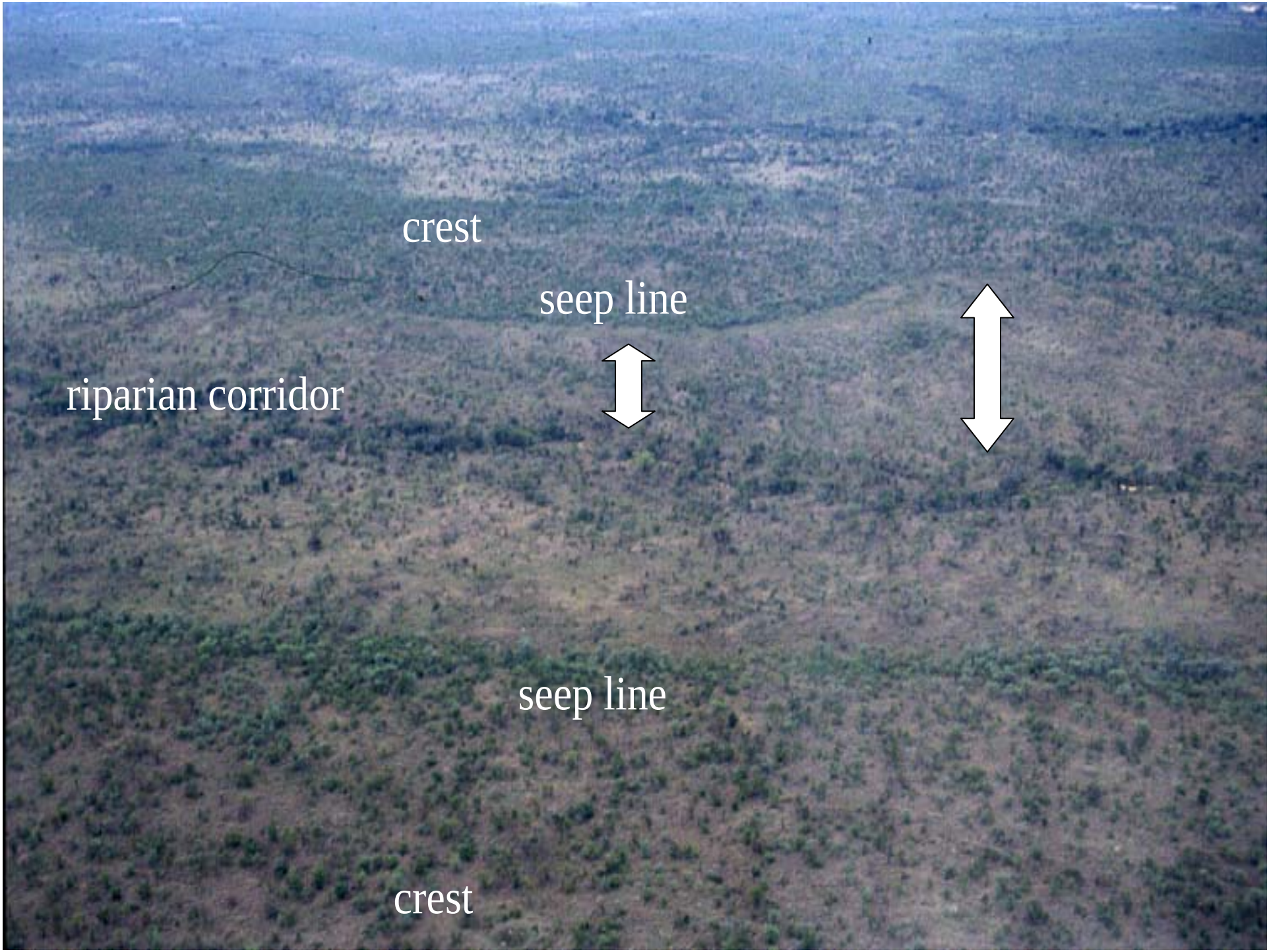


Hillslope chromatography: Are there contributing area thresholds between the rock and the sea?

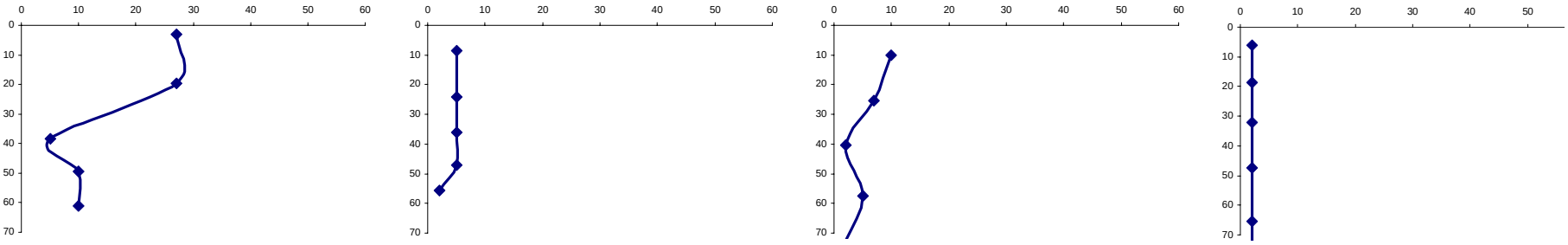
Tony Hartshorn[1], Lesego Khomo[2], Oliver Chadwick[1], Kevin Rogers[2]

[1] University of California, Santa Barbara
[2] University of the Witwatersrand, Johannesburg

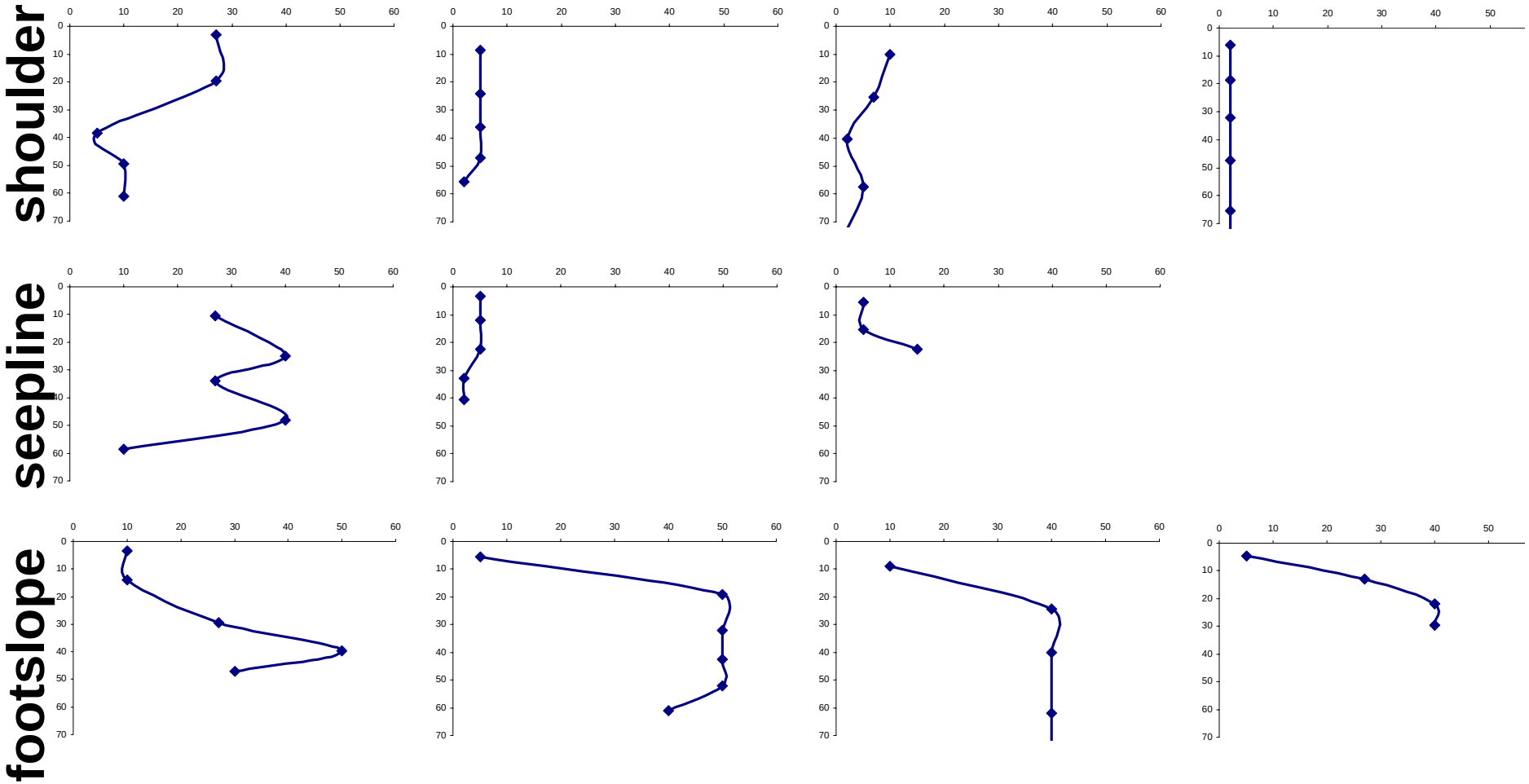

crest
seep line
riparian corridor
seep line
crest

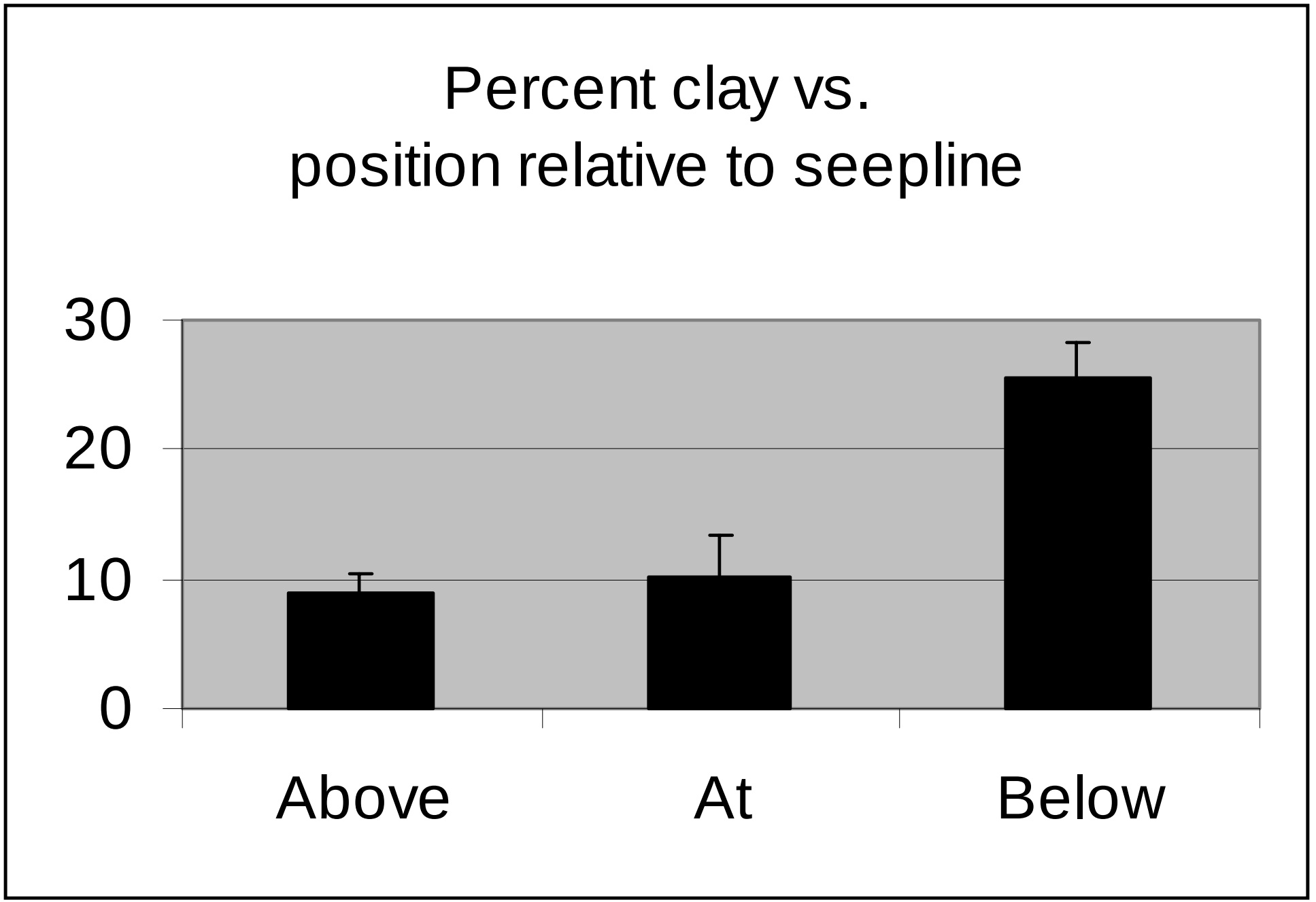
Percent clay

shoulder

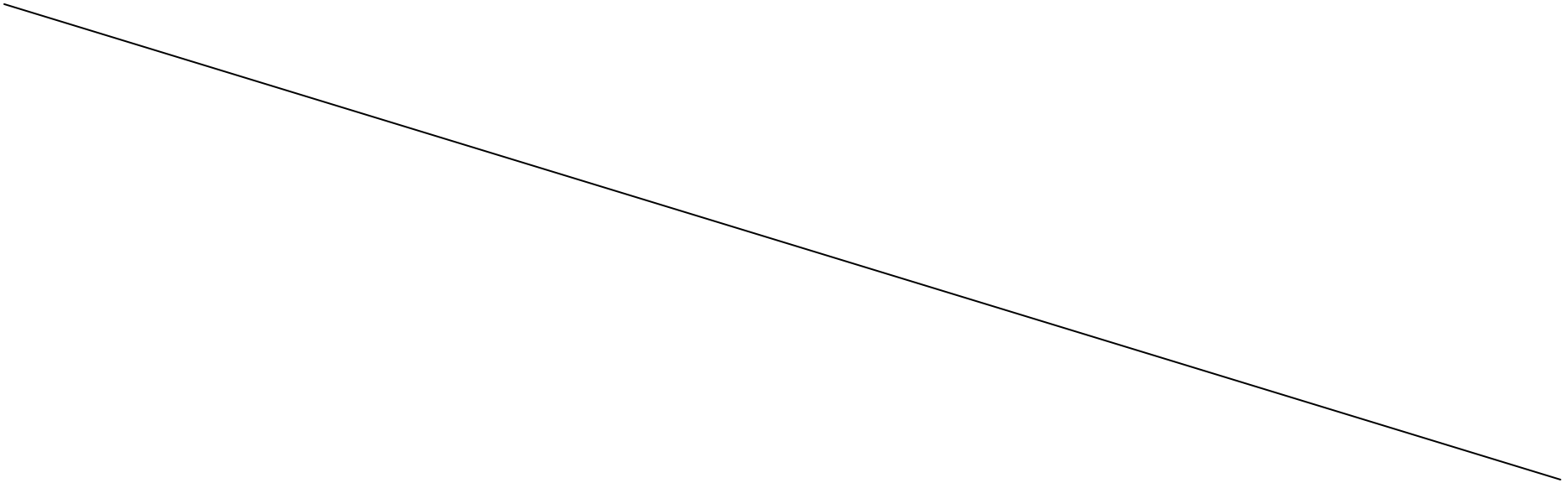


Percent clay



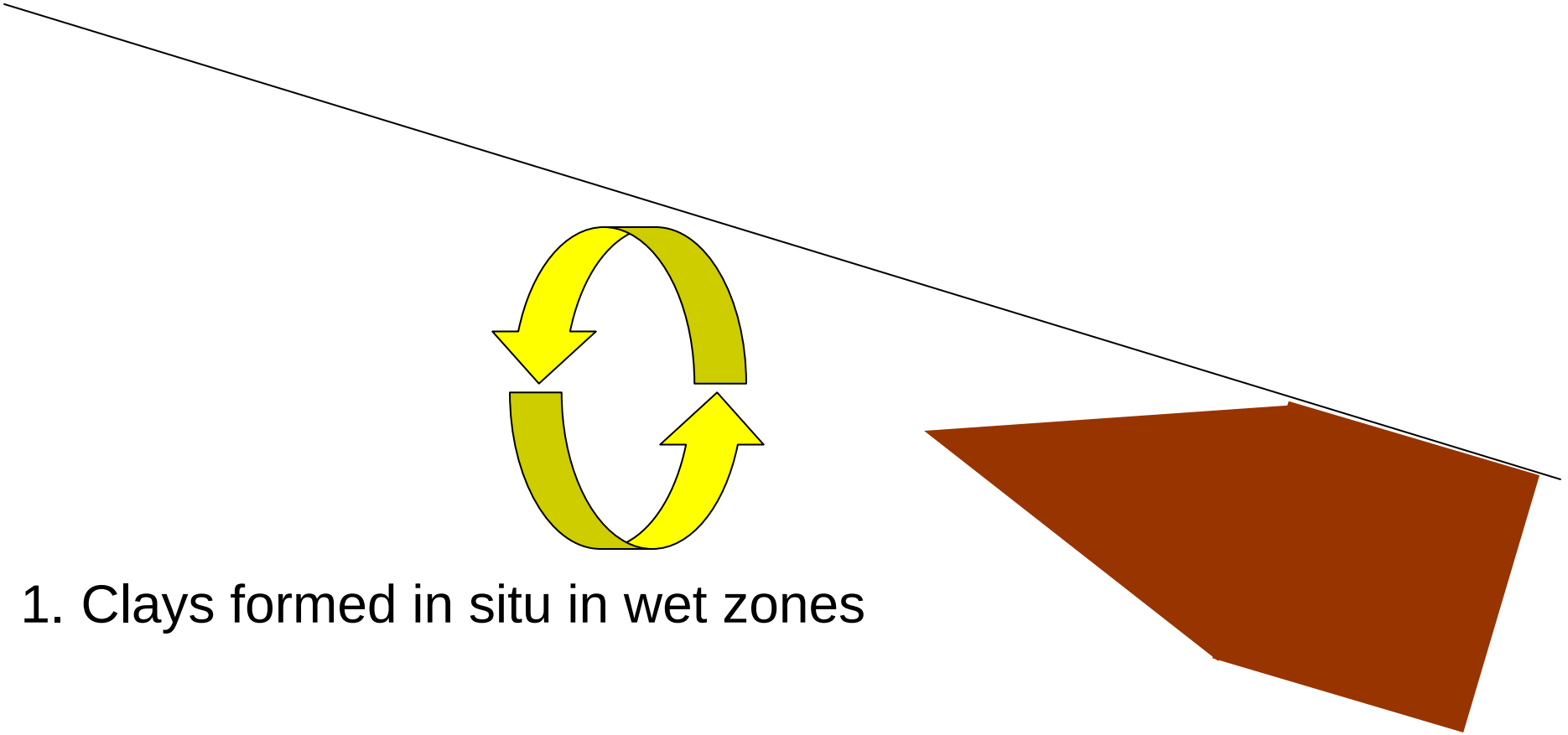

Percent clay vs.
position relative to seepline
30
20
10
0
Above
At
Below

Model for clay front



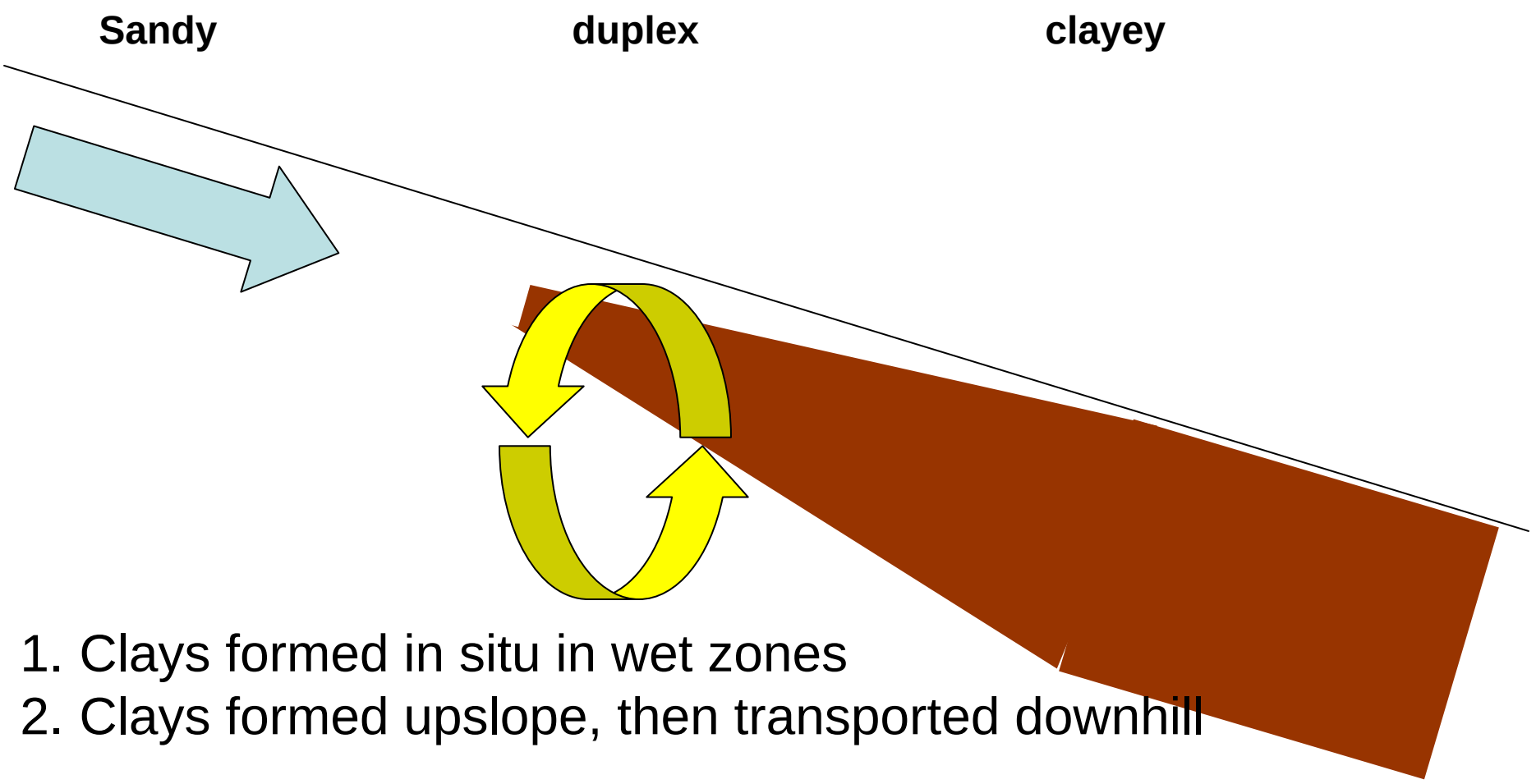
Model for clay front

Sandy **duplex** **clayey**



1. Clays formed in situ in wet zones

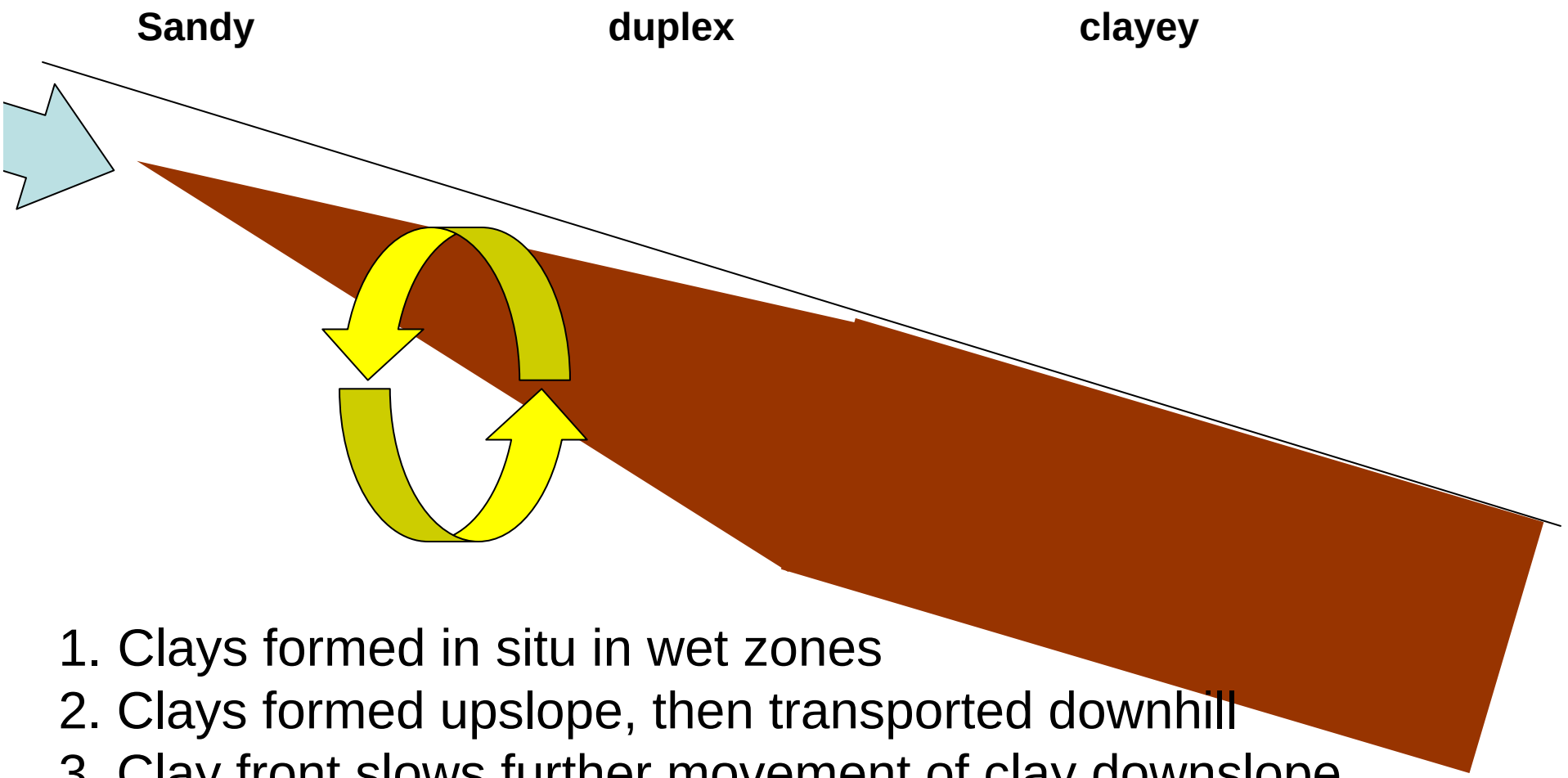
Model for clay front



1. Clays formed in situ in wet zones
2. Clays formed upslope, then transported downhill

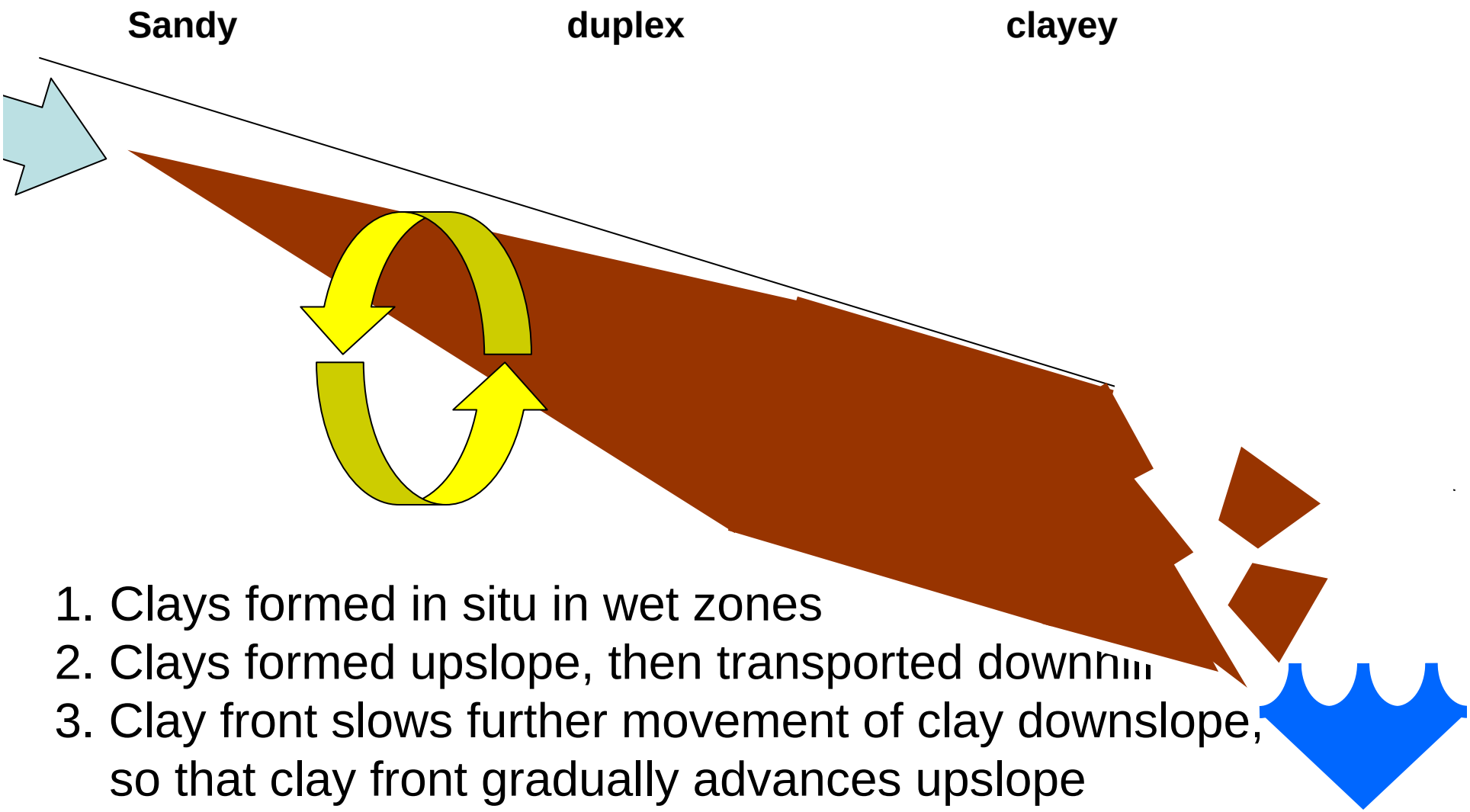

5 cm

Model for clay front

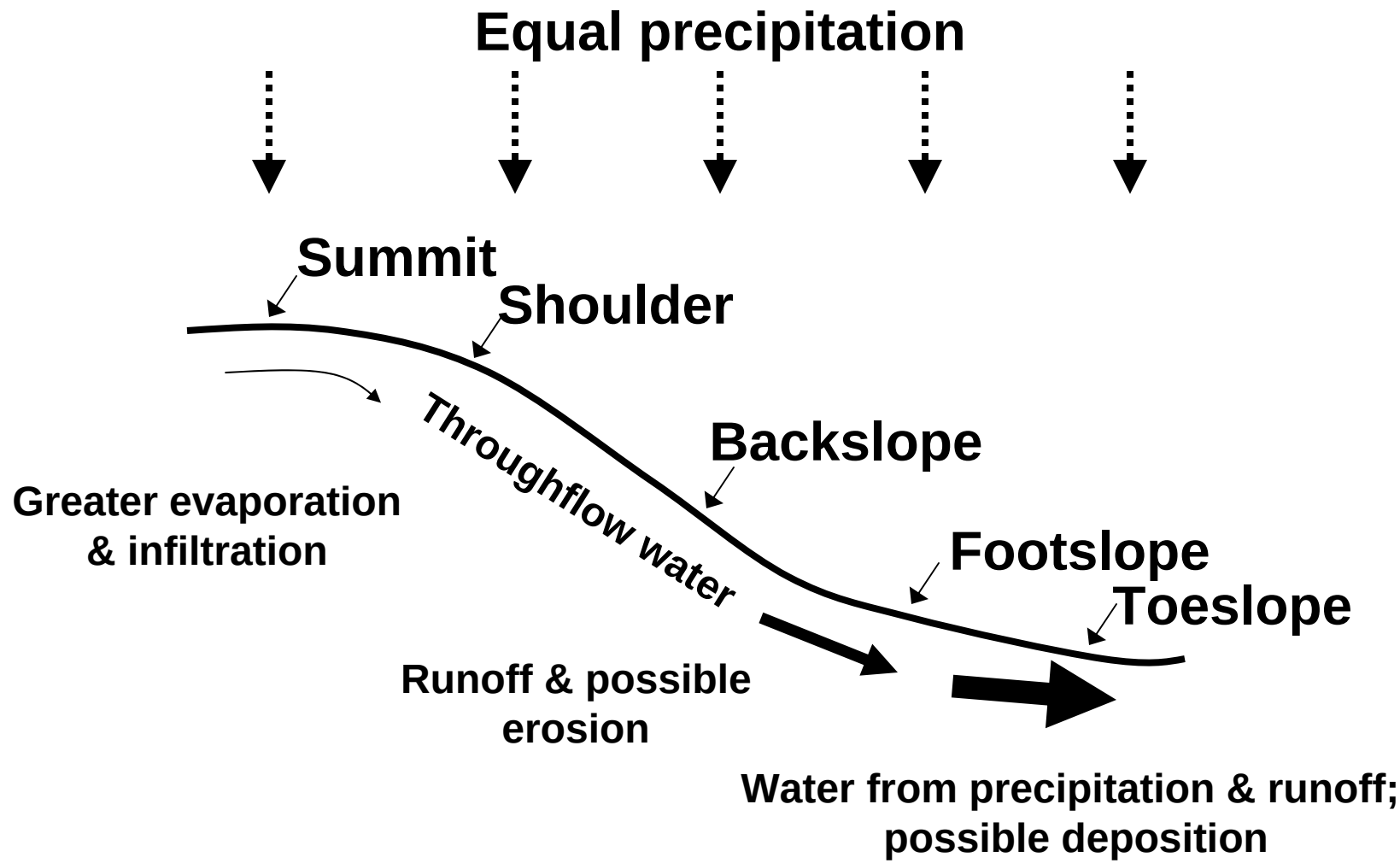


1. Clays formed in situ in wet zones
2. Clays formed upslope, then transported downhill
3. Clay front slows further movement of clay downslope, so that clay front gradually advances upslope

Model for clay front

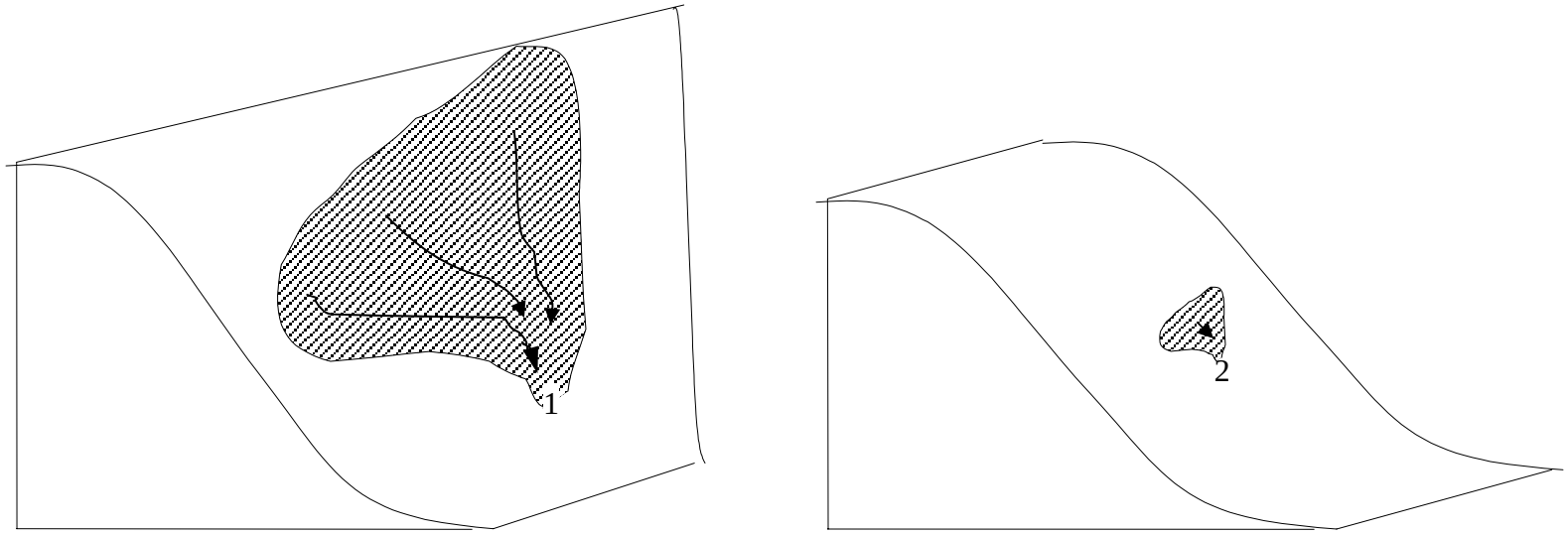


1. Clays formed in situ in wet zones
2. Clays formed upslope, then transported downhill
3. Clay front slows further movement of clay downslope, so that clay front gradually advances upslope
4. With sufficient overland flow, downslope clays eroded



Holliday 2004

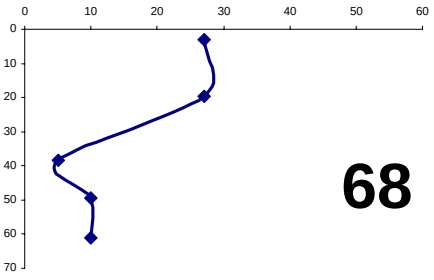
Compound topographic index or wetness index = ln (contributing area/tan(m))



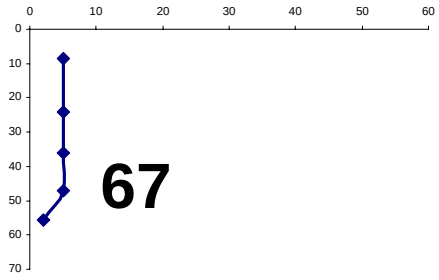
Percent clay

Contributing area (m^2)

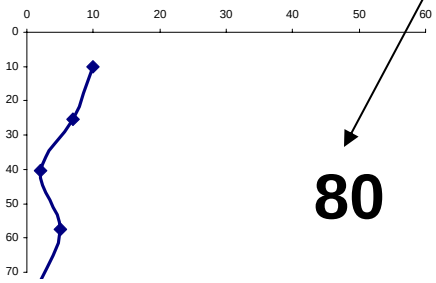
shoulder



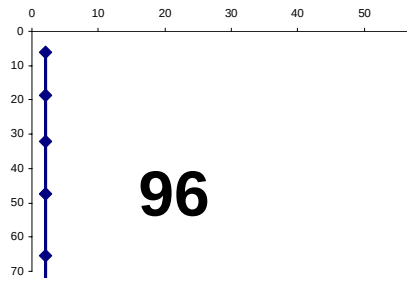
68



67



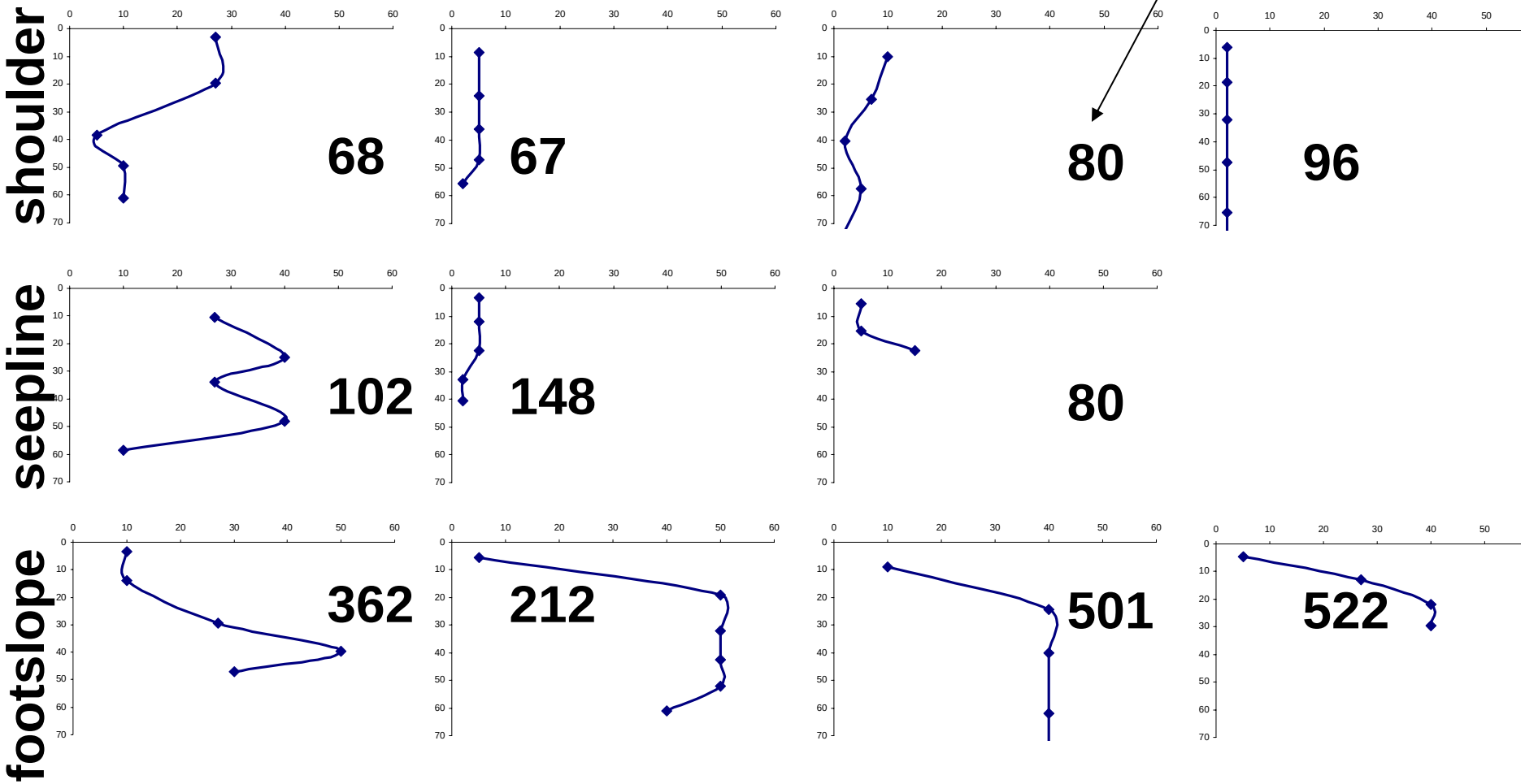
80

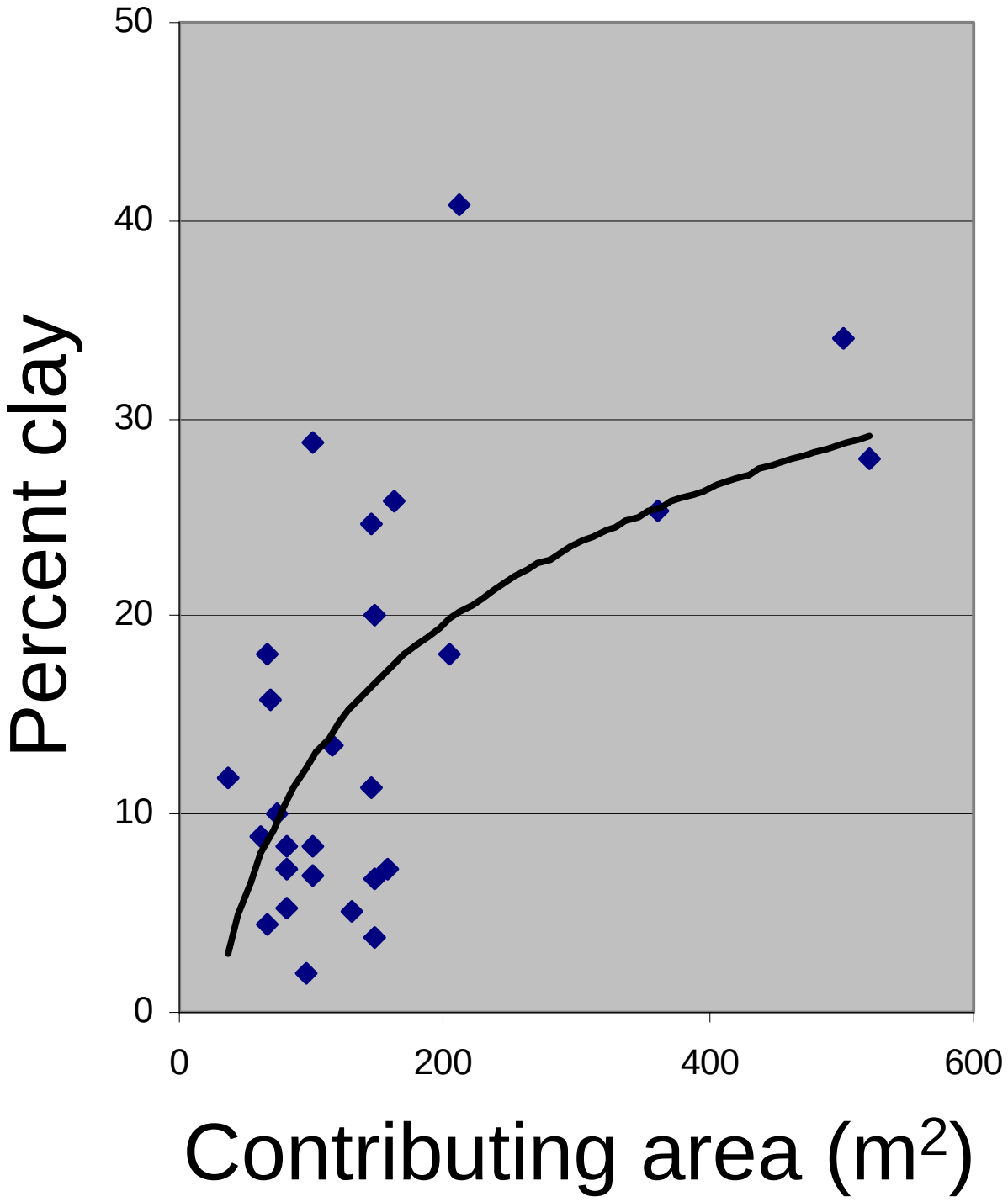


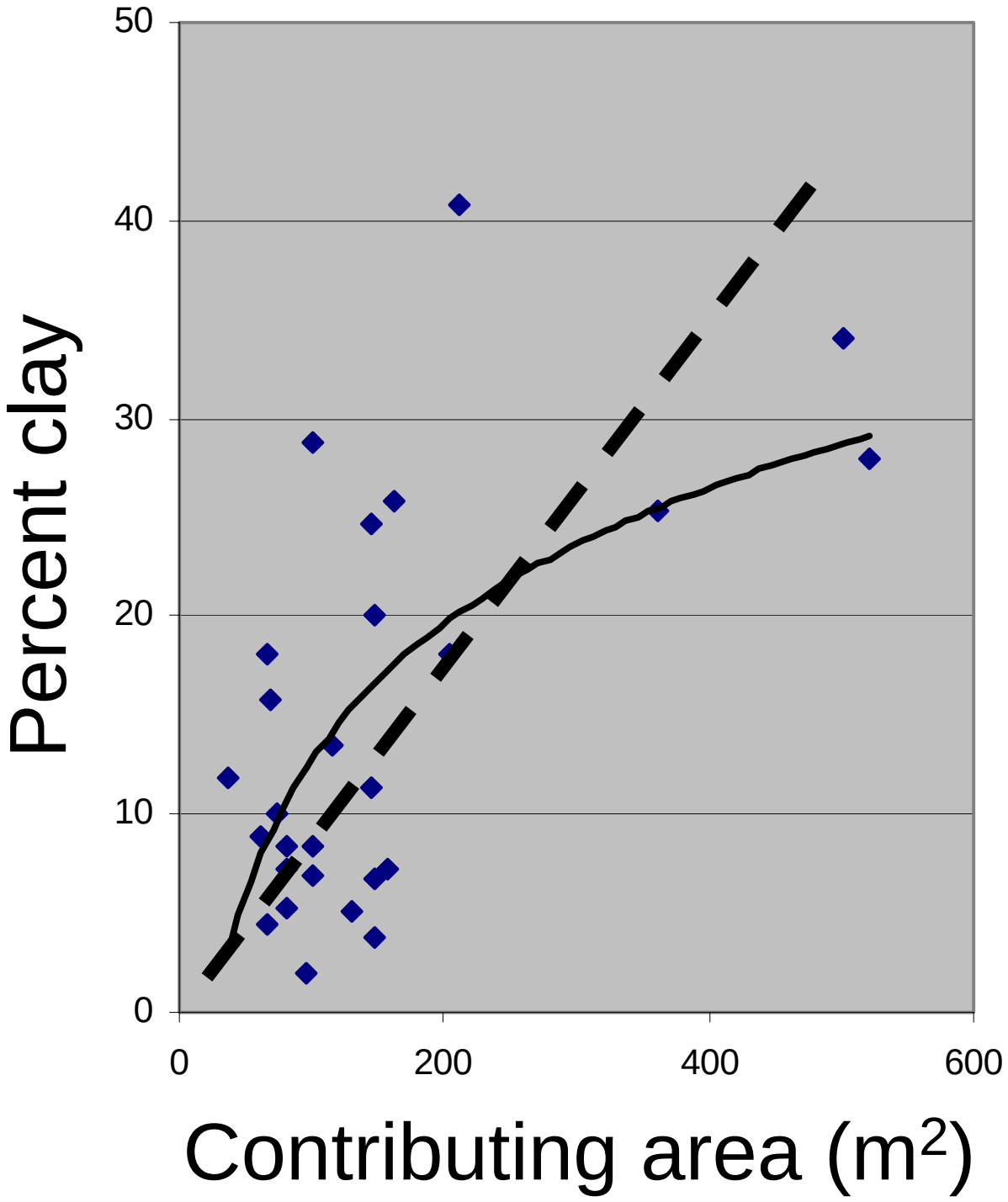
96

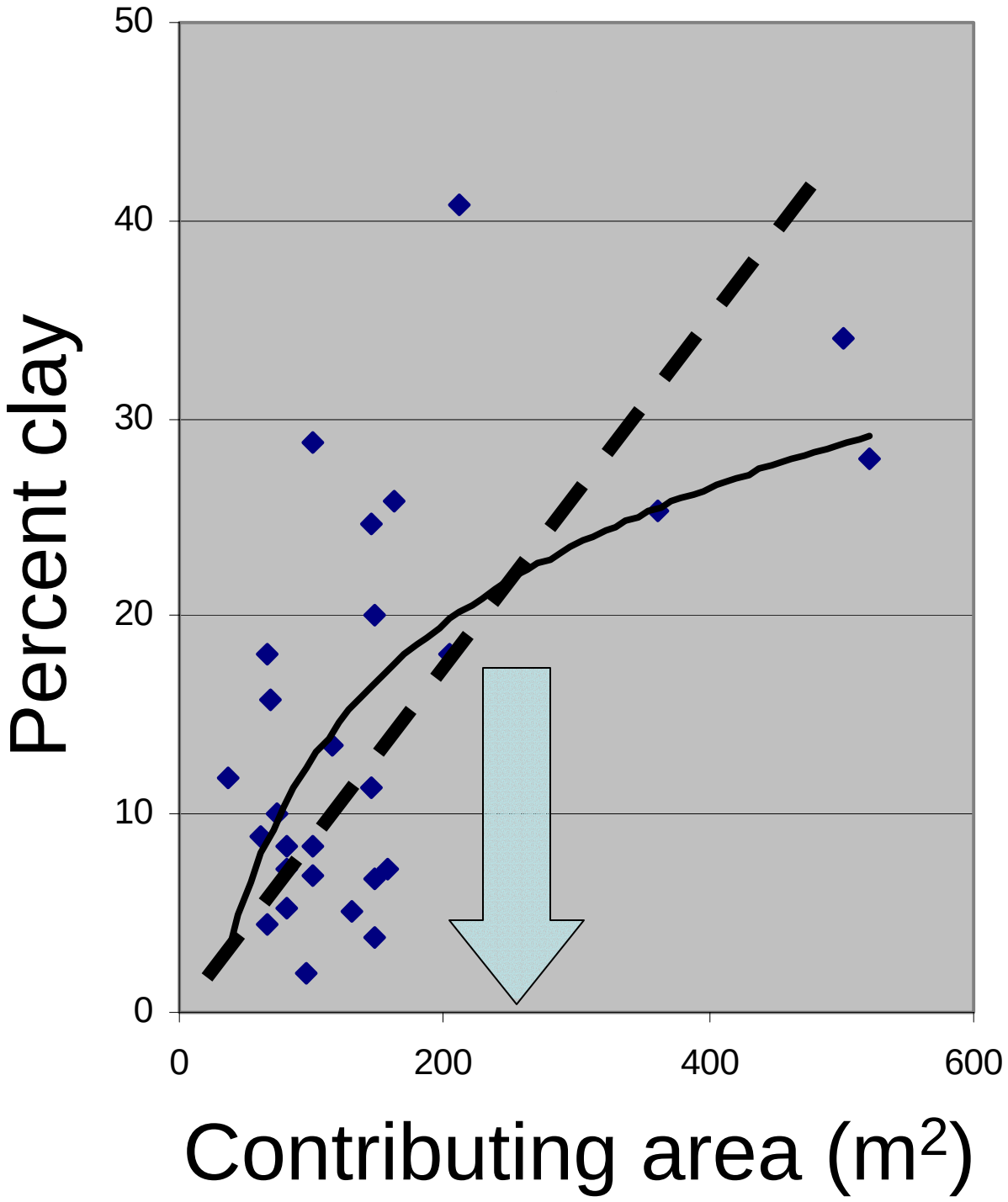
Percent clay

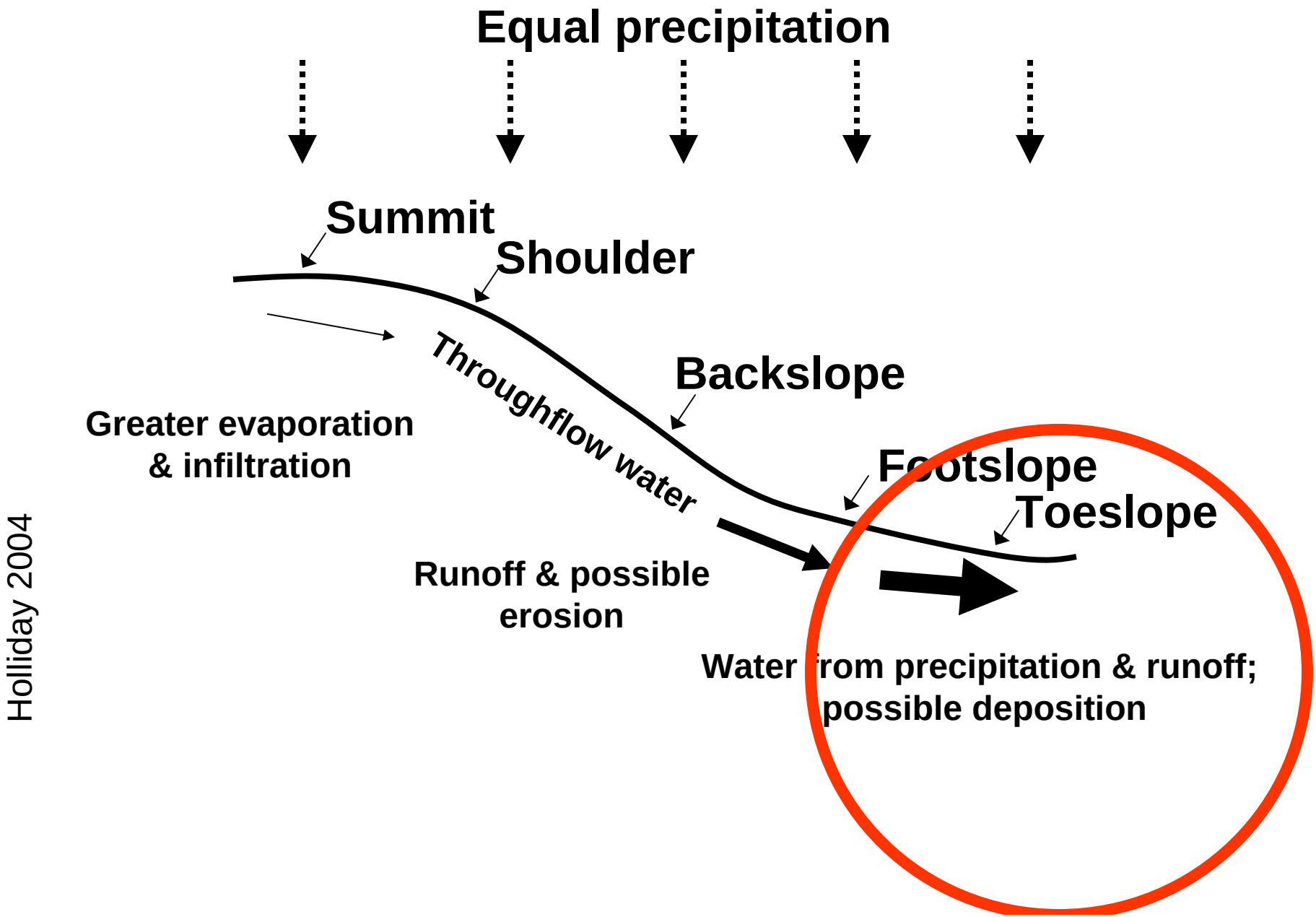
Contributing area (m^2)

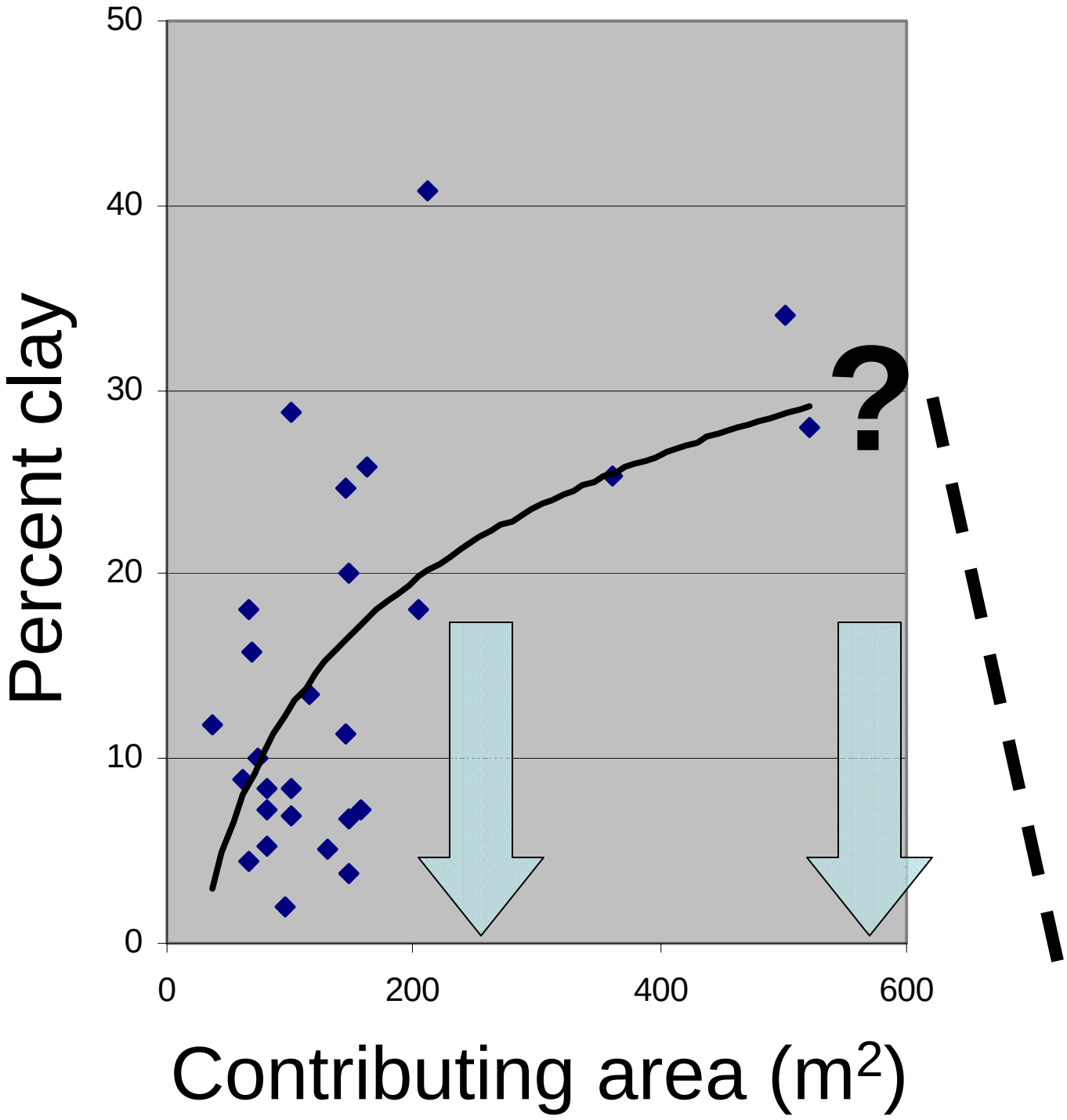



Percent clay
50
40
30
20
10
0
0
200
400
600
Contributing area (m2)


Percent clay
50
40
30
20
10
0
0
200
400
600
Contributing area (m2)

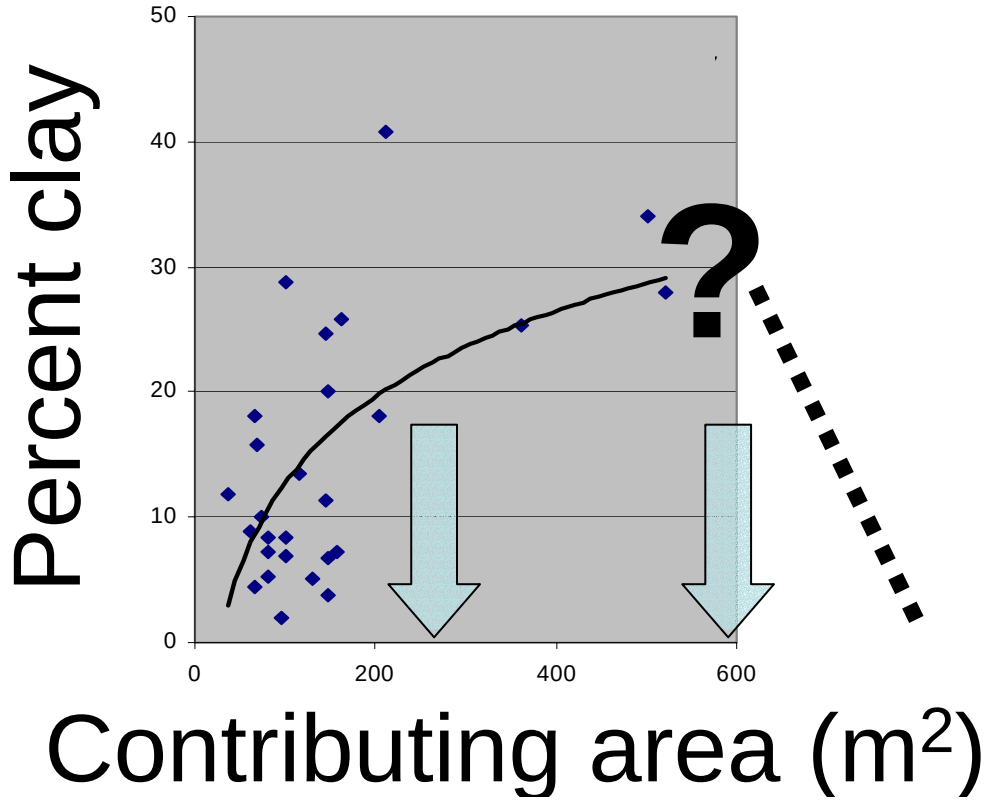

50
40
30
20
10
0
Percent clay
0
200
400
600
Contributing area (m2)


Equal precipitation
Summit
Shoulder
Backslope
Throughflow water
Greater evaporation
& infiltration
Footslope
Toeslope
Runoff & possible
erosion
Water from precipitation & runoff;
possible deposition
Holliday 2004


50
40
30
20
10
0
Percent clay
0
200
400
600
Contributing area (m2)
?

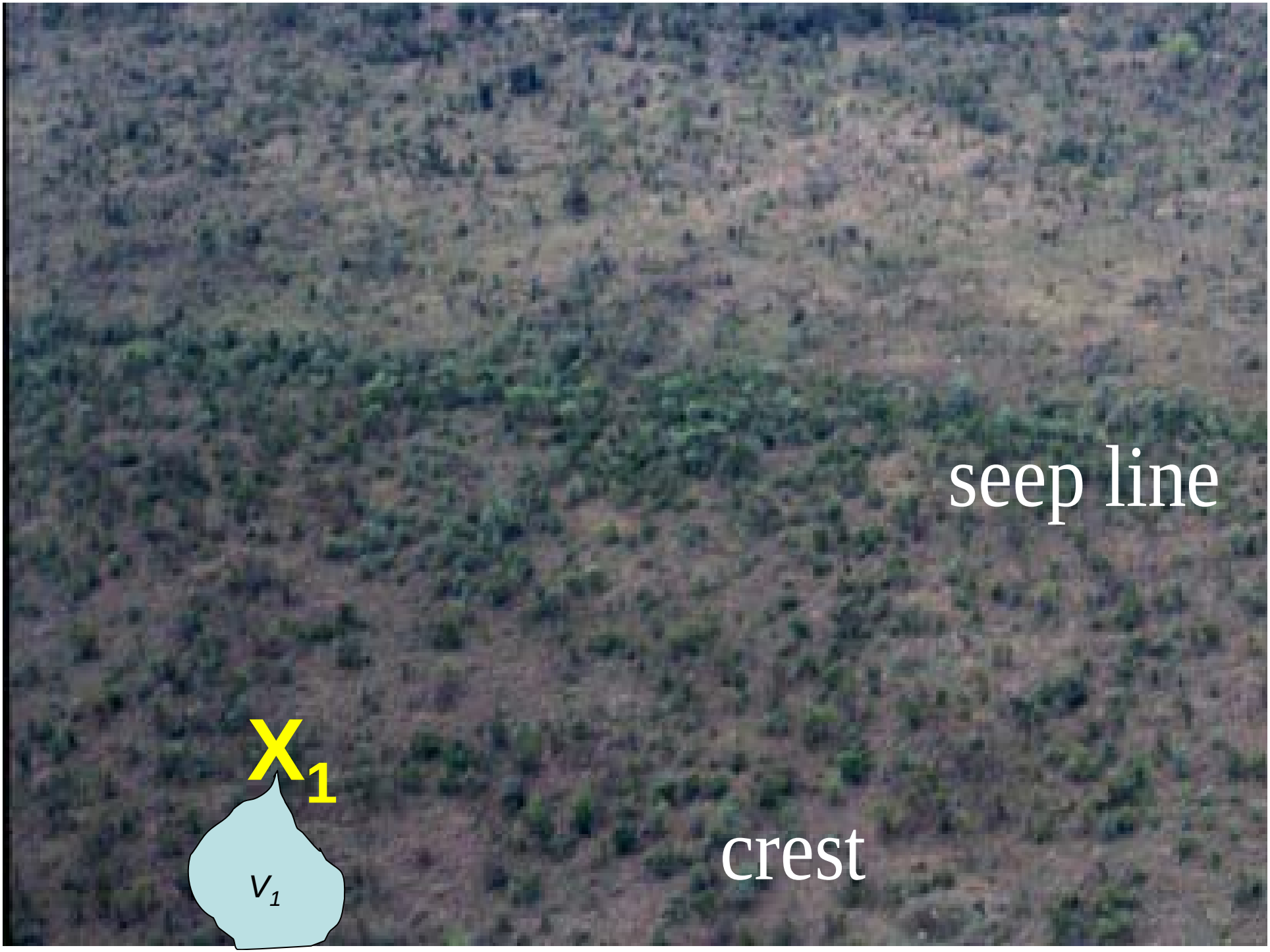
Future work

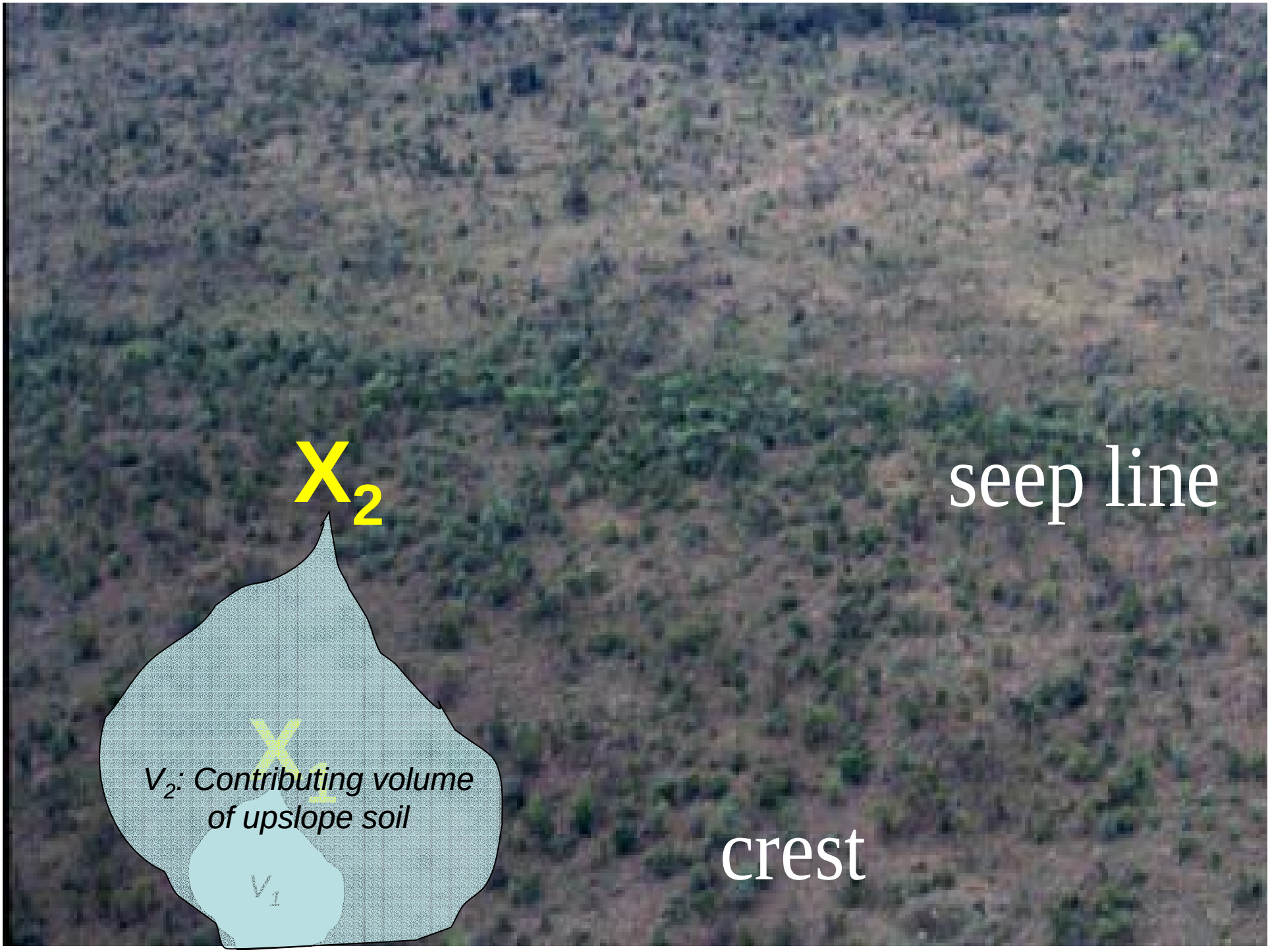
- Mass balances for
  - -water
  - -clay
- Non-planar slopes

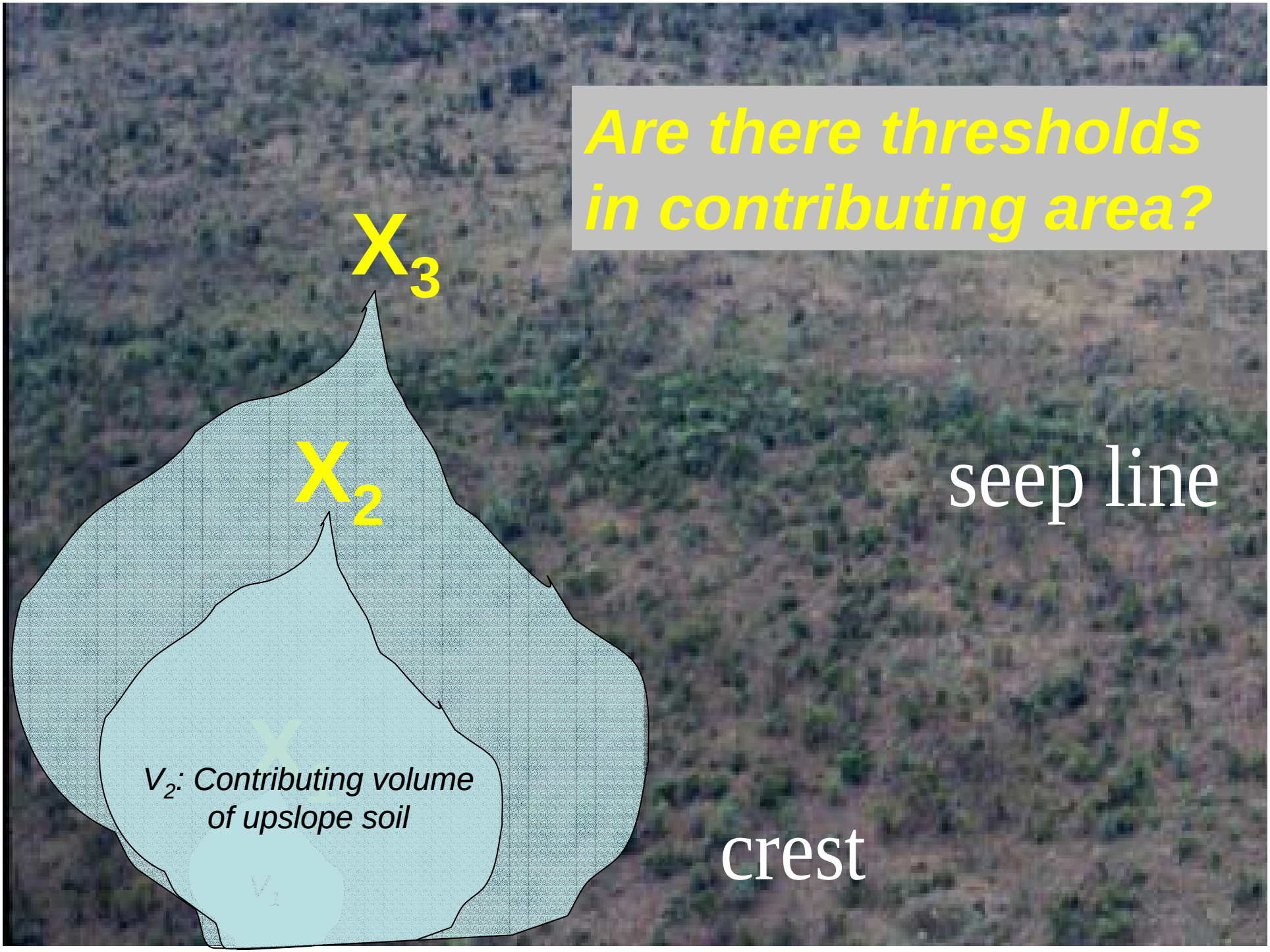


Acknowledgments

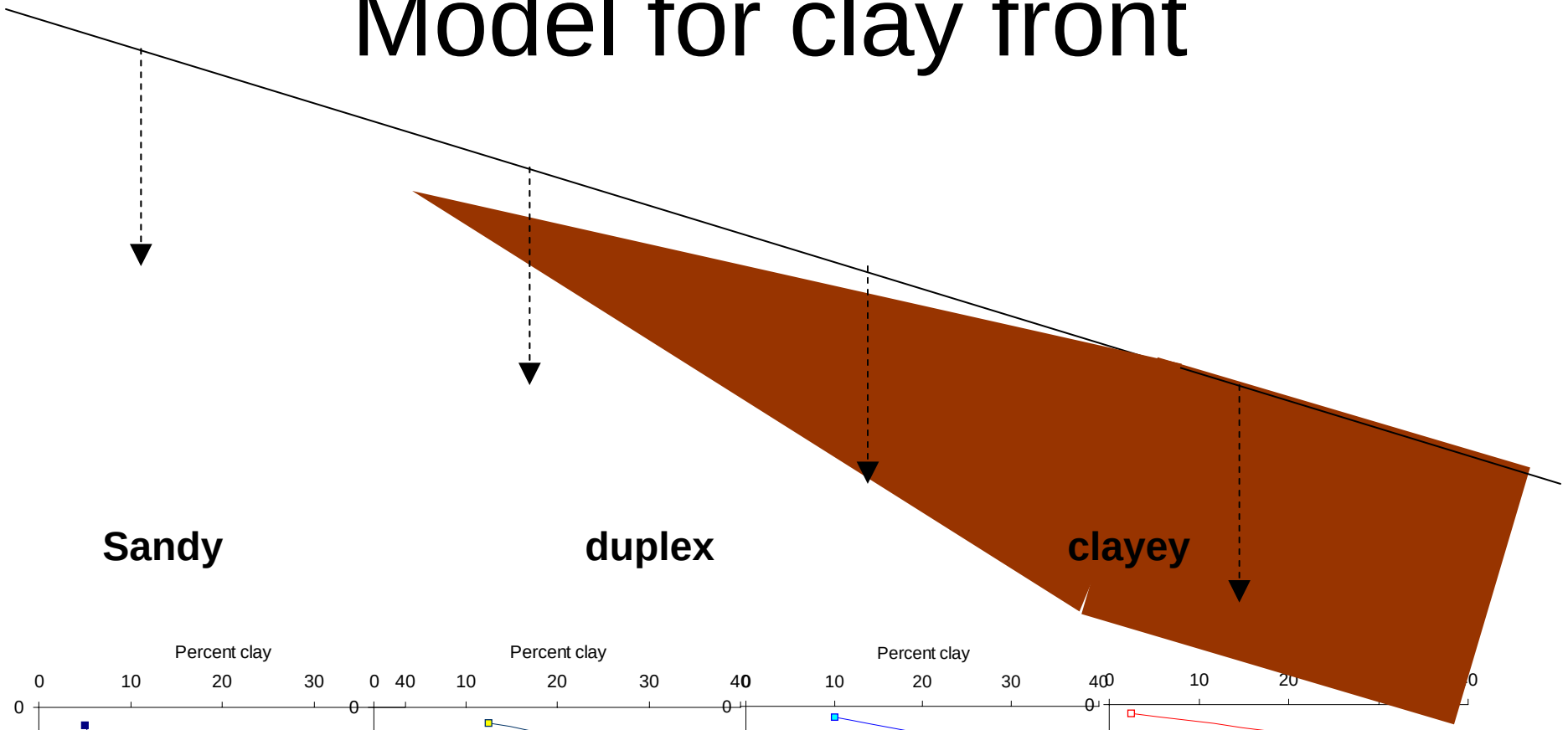
- Andrew Mellon Foundation
- SANParks & Papas Dinda, Million, & Samuel
- Kevin, Katie, & Nathalie for lab help
- Sarah & Shaun for GIS help
- OTS-2006'ers

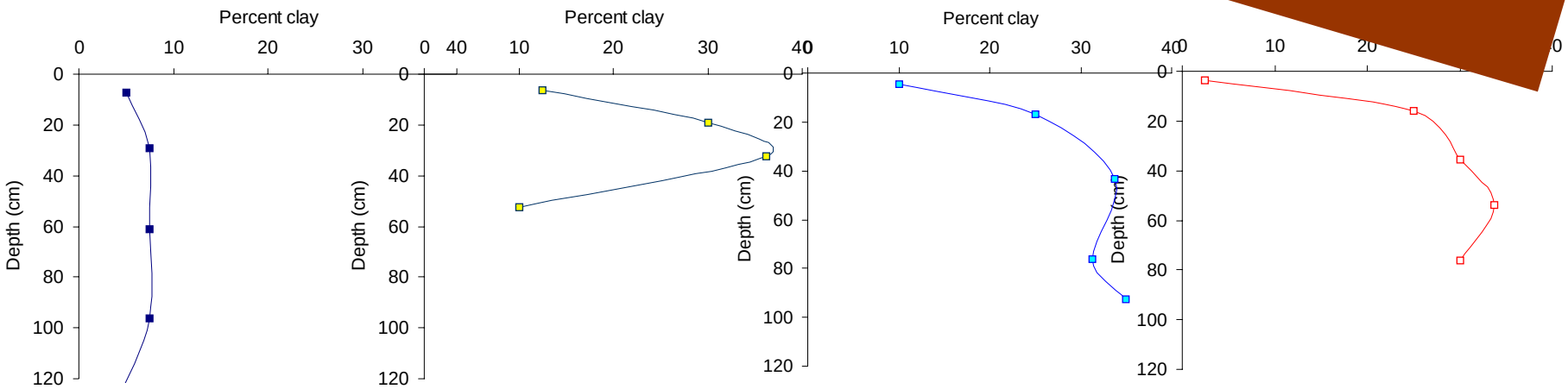

seep line
X_1
V_1
crest


X_2
seep line
X_1
V_2: Contributing volume of upslope soil
V_1
crest


Are there thresholds in contributing area?
X_3
X_2
seep line
V_2: Contributing volume of upslope soil
crest

Model for clay front





SB8 Terrain attribute: Wetness index

Hillslope position	Wetness
Above seepline	1.7
At seepline	3.3
Below seepline	3.8

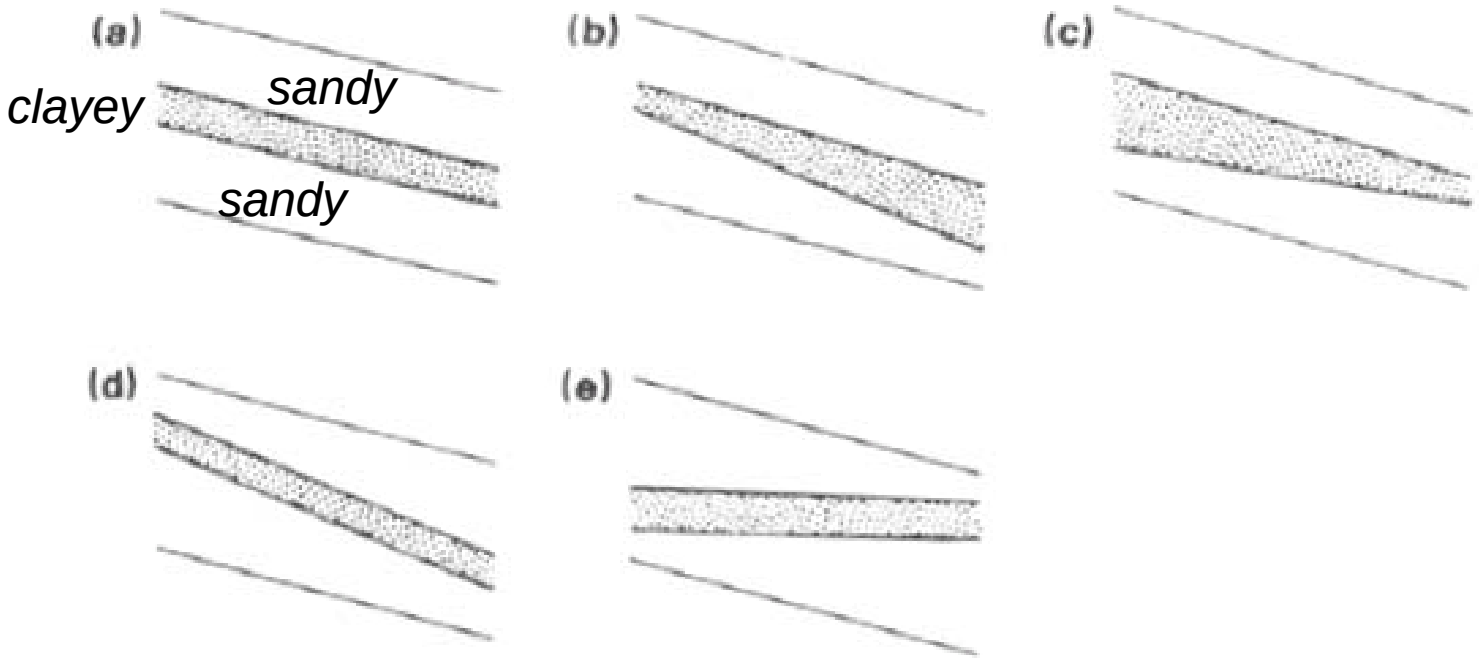
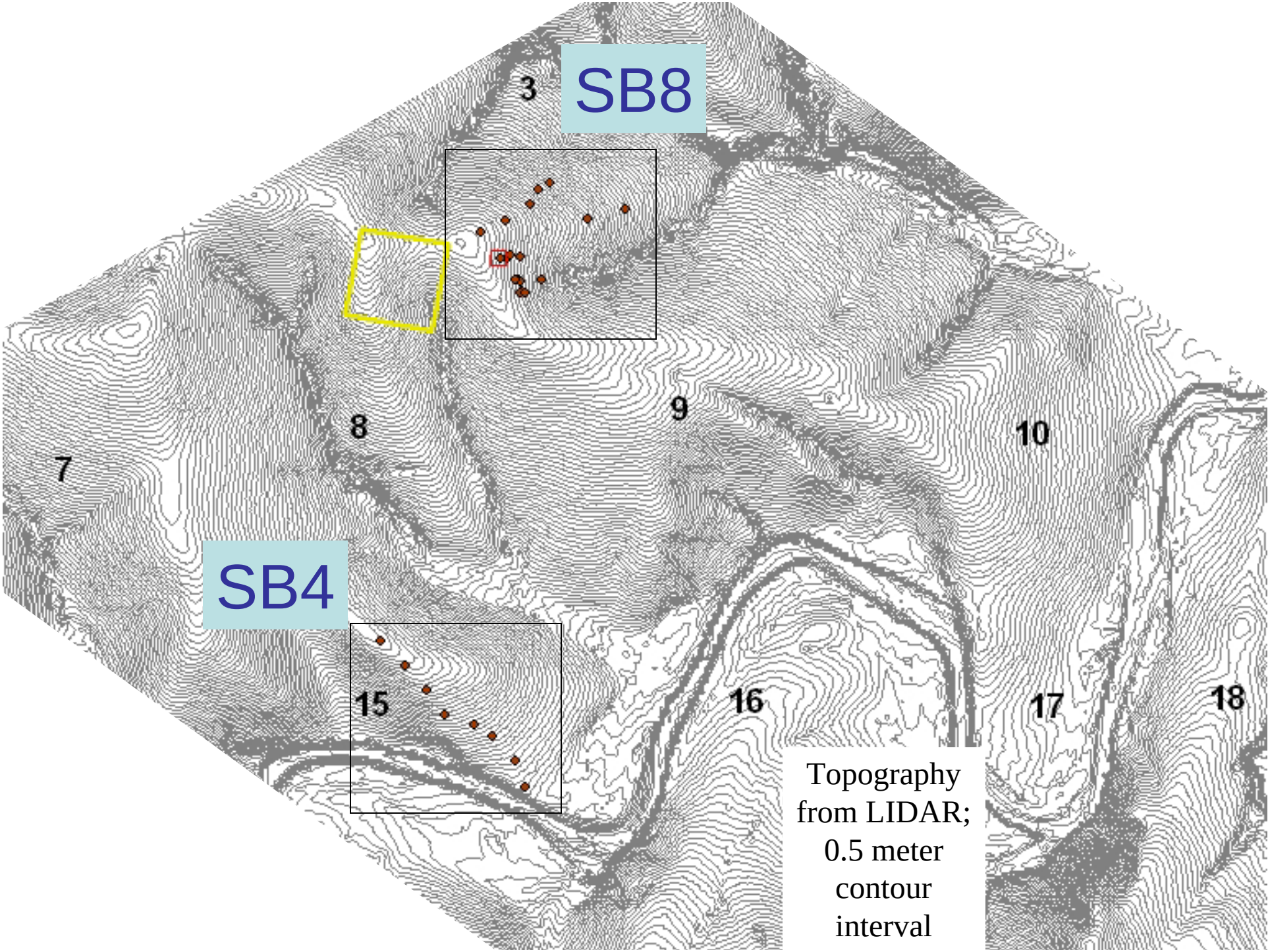
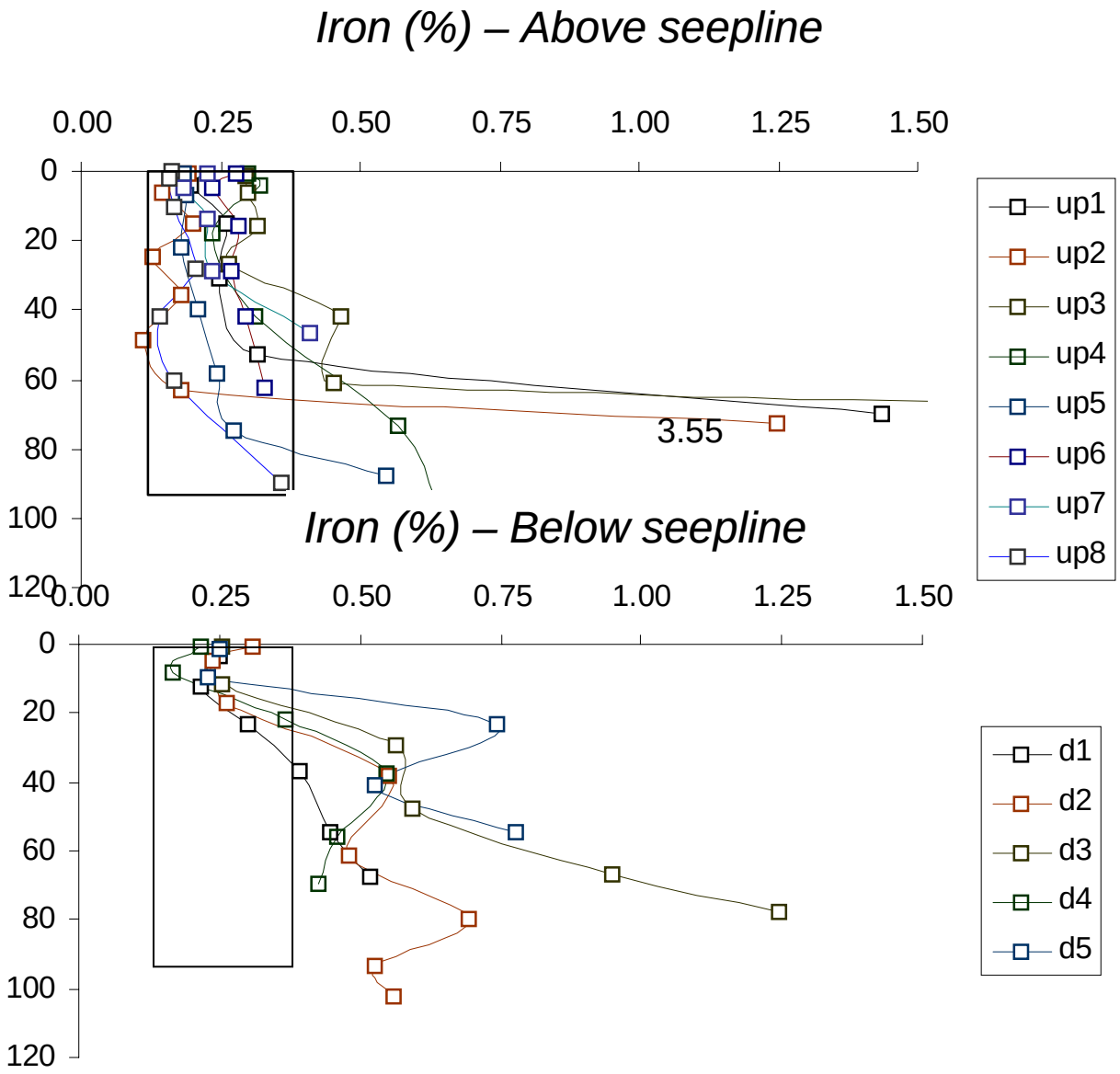


Figure 3.4 Possible horizon changes in a catenary sequence (from Young, 1976).

in Gerrard 1992


SB8
SB4
3
7
8
9
10
15
16
17
18
Topography from LIDAR; 0.5 meter contour interval

SB8 Catena

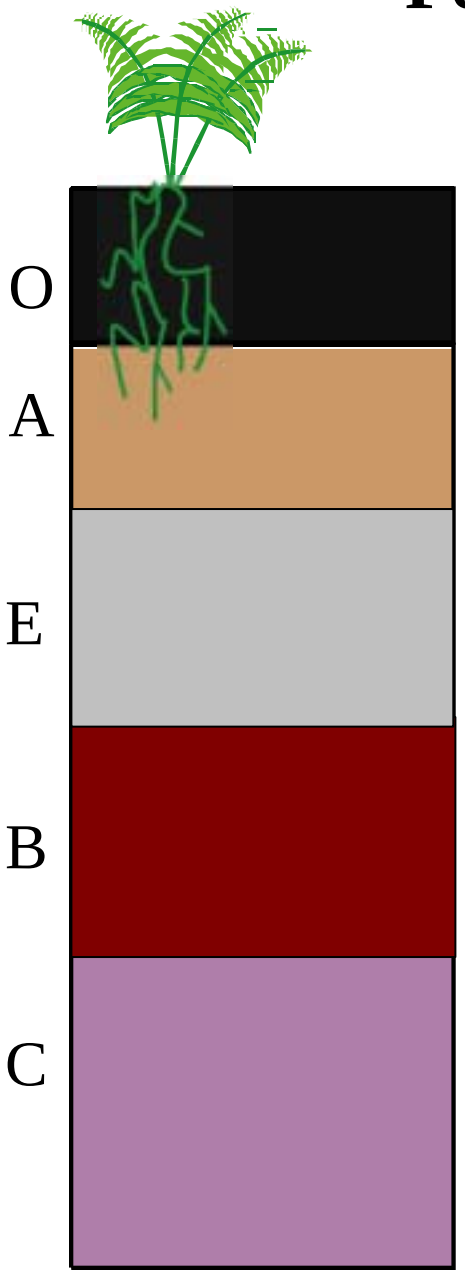


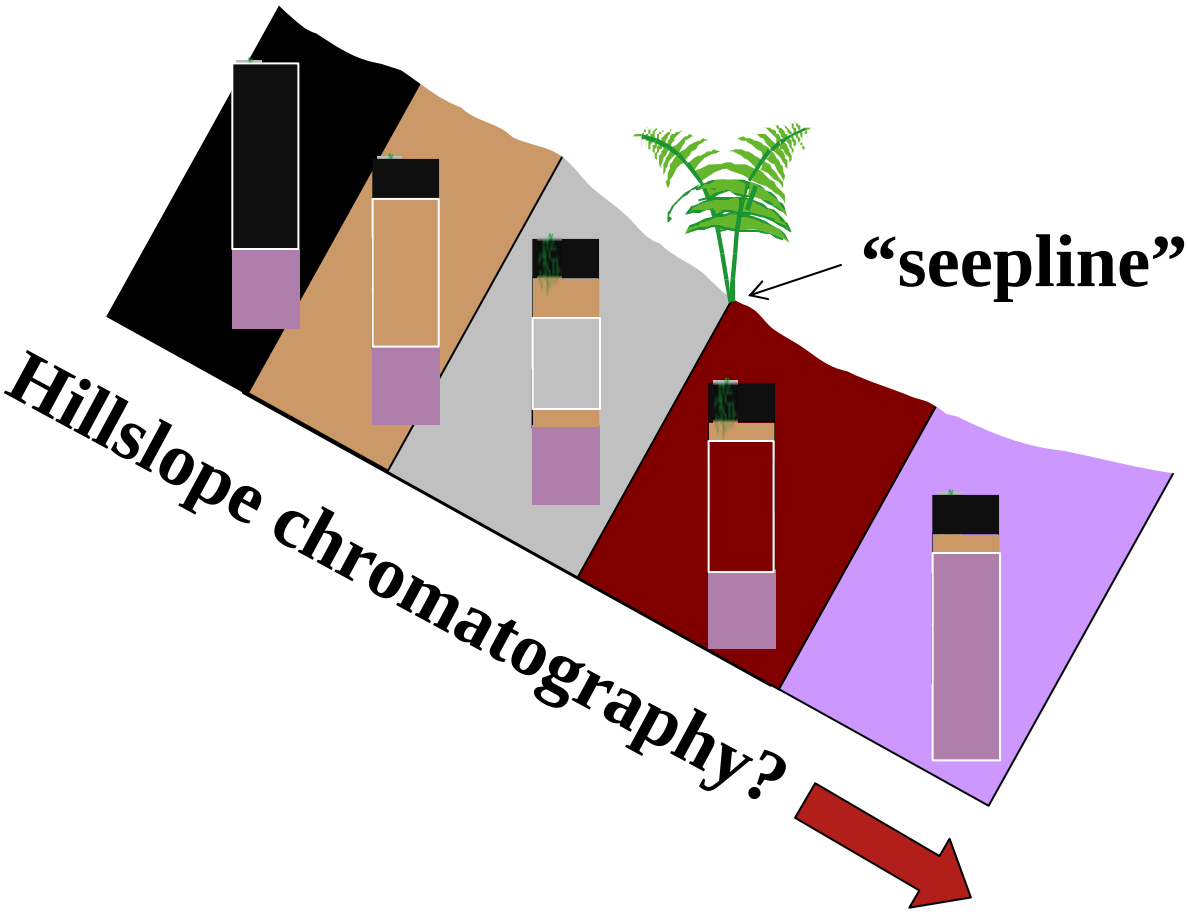
Eluvial Illuvial Coefficient for Fe = $(Fe_{soil}/Zr_{soil})/(Fe_{rock}/Zr_{rock})$
Muir and Logan 1982 J. Soil Sci. 33:295-308

SB4 Terrain attribute: Wetness index

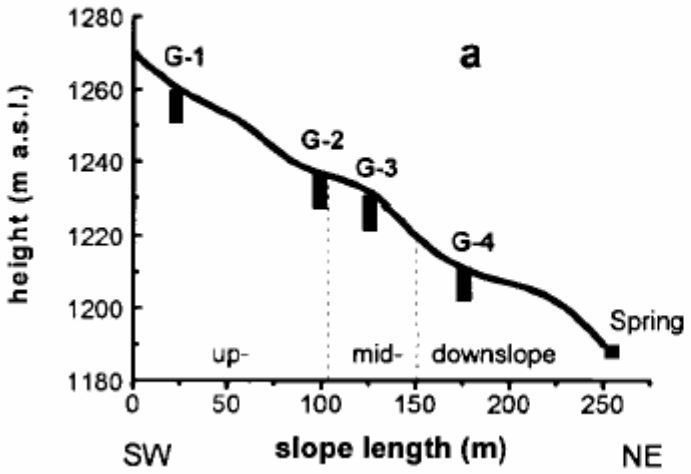
Hillslope position	Wetness (/1000)
Above seepline	2.2±1.9
At seepline	3.3
Below seepline	1.1±1.2

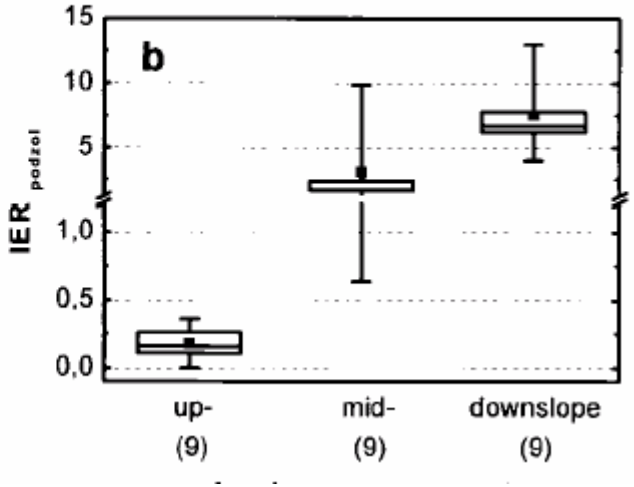
Formation and translocation of clays are key pedogenic processes

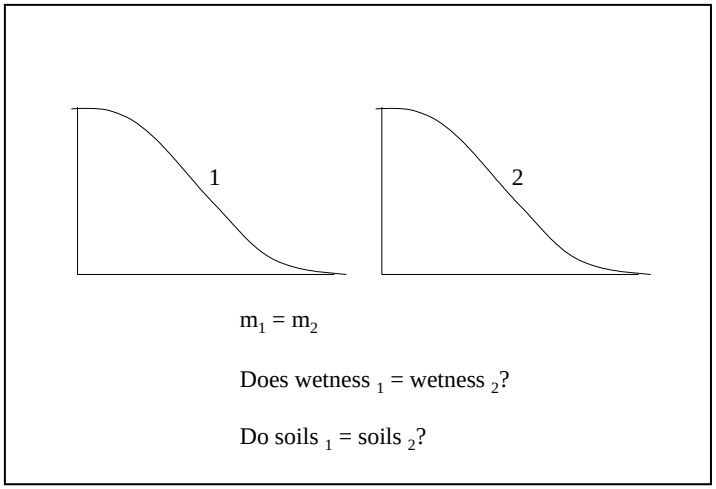




SOMMER ET AL.: LATERAL PODZOLIZATION IN A GRANITE LANDSCAPE



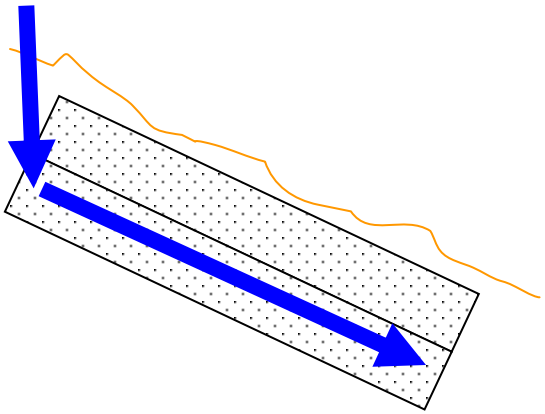




Granite

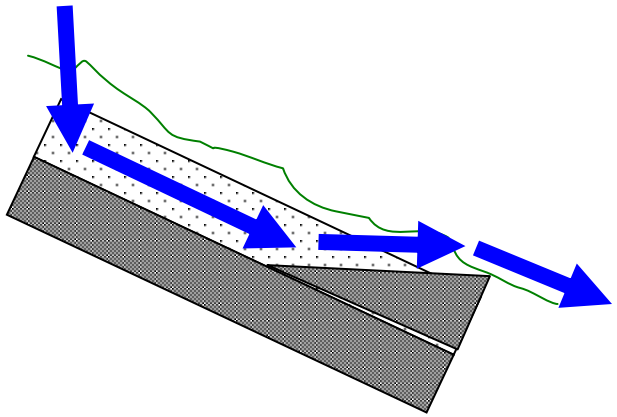
relatively low water inputs

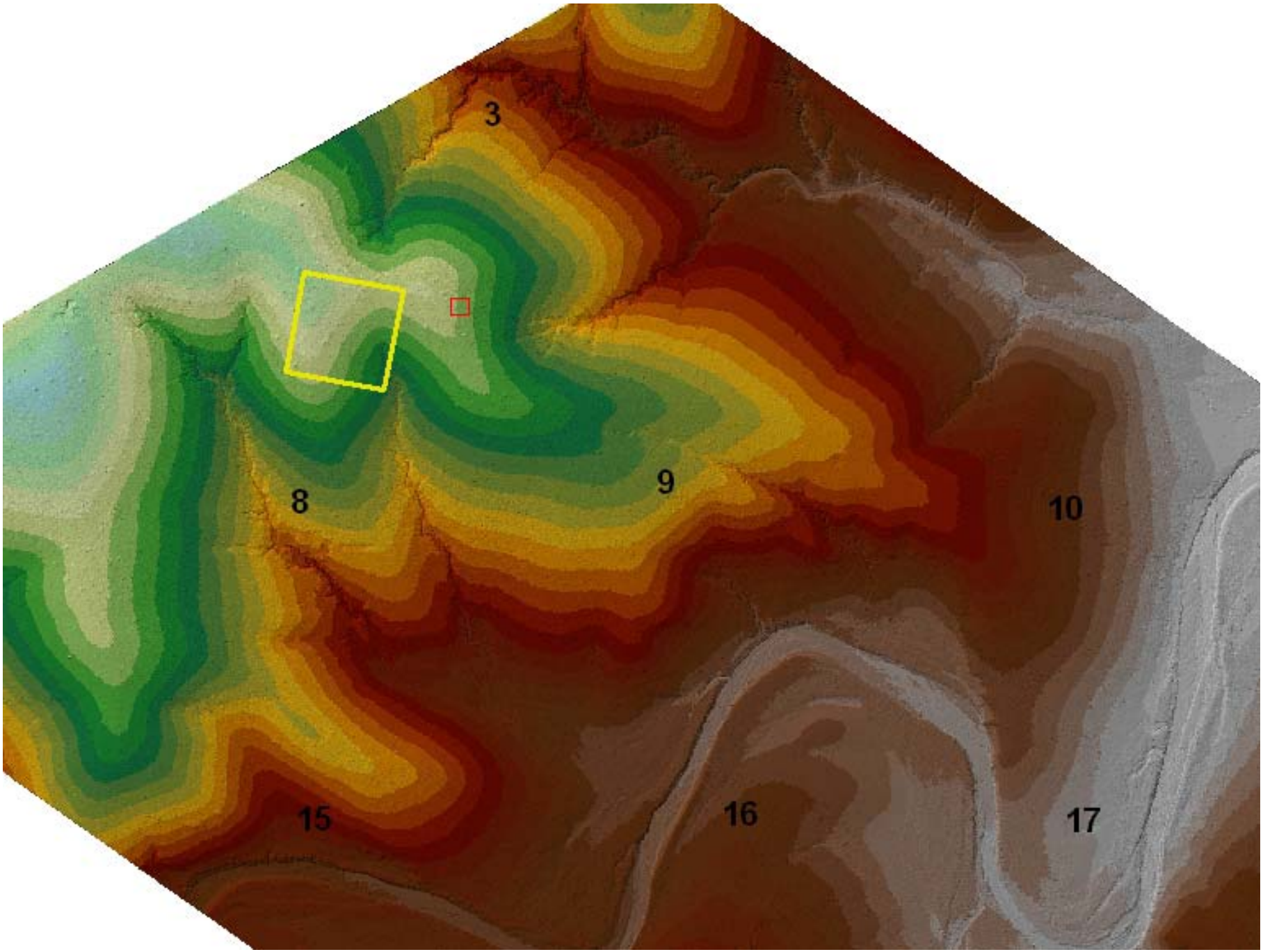
- Lower clay
- Kaolinite?
- Coarse textured
  - Higher infiltration
  - Vertical, subsurface flow

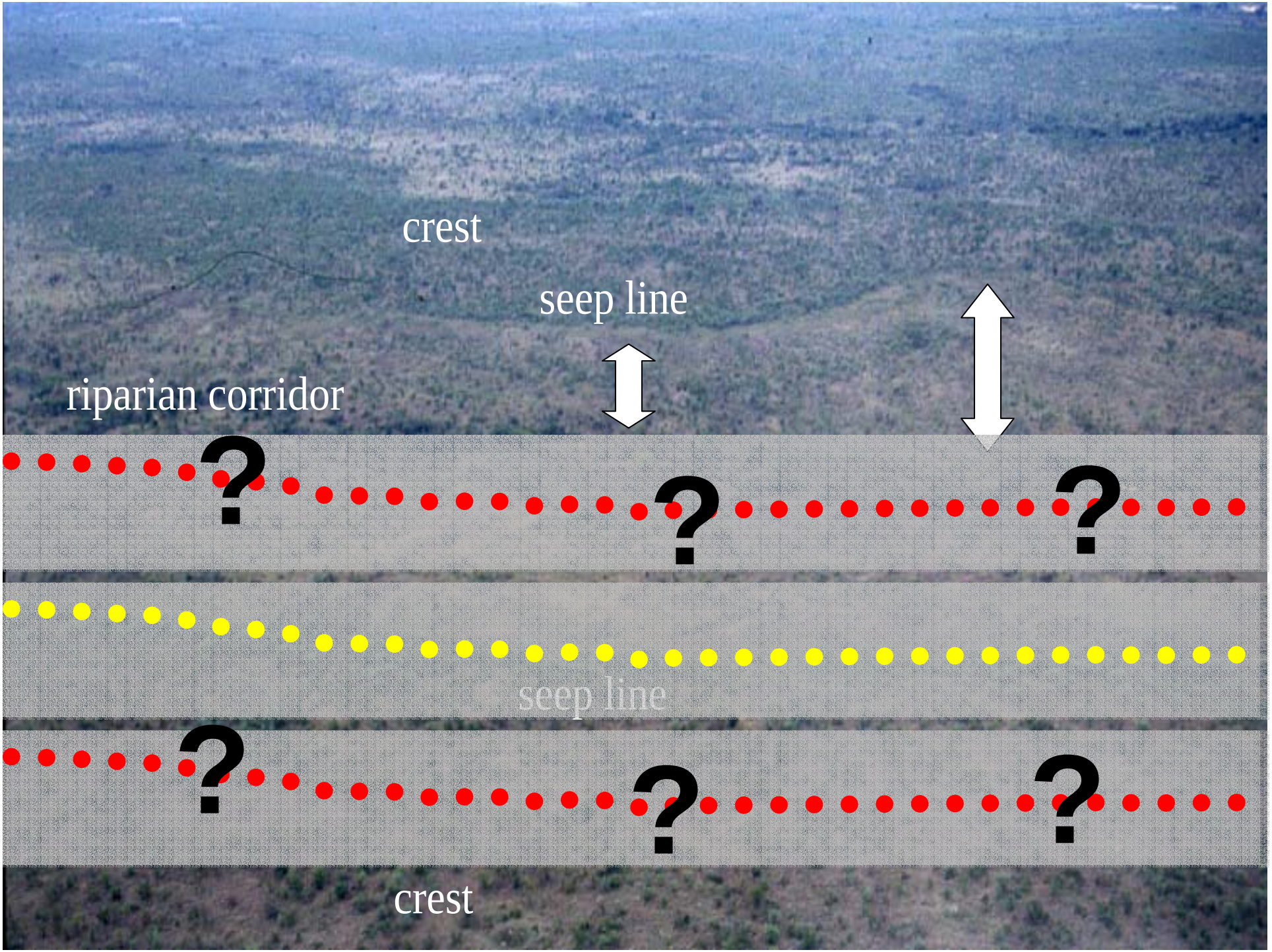


relatively high water inputs

- Higher clay
- Smectite?
- Fine textured
  - Lower infiltration
  - Diversion to surface




3
8
9
10
15
16
17


crest
seep line
riparian corridor
?
?
?
seep line
?
?
?
crest