Pierson, T.C., 1980, Erosion and deposition by debris flows at Mt. Thomas, North Canterbury, New Zealand: Earth Surface Processes, Vol. 5, p. 227-247.

I. Introduction

   A. storm event: 4/16/78 N. Canterbury New Zealand
      1. debris flow in hollow fed onto alluvial fan
         a. fan head entrenchment
         b. lower fan deposition
            (1) 3m accretion

      2. Case study description

II. Physical and Geologic Setting

   A. Geology
      1. triassic greywacke ss
      2. fault blocks and alluvial fan seds.
      3. intense shear deformation
      4. drainages aligned with fault traces
         a. tectonically active landscape
      5. veg. forests on stable slopes
         a. transition to grasses in active, geomorphically disturbed areas
      6. upper hillslope mass wasting, destabilized slopes

III. History of Debris-flow Activity and Fan Building

   A. old fan deposits: Pleistocene
      1. oxidized gravel clasts
      2. inactive and active fan surfaces
      3. radiocarbon dates in hundreds of years under 6 m of seds.

   B. historic storms and debris flow activity
      1. 1923,1941,1945,1951, 60's and 70's
      2. seismic activity known and appears to modify landscape

IV. Storms of April 14-23, 1978

   A. 3 high intensity storms in succession
      1. about 45 cm in 3 days
      2. R.I. on order of 10-20 years
      3. intensities apparently not the high for region

V. Description of Debris Flows

   A. transport
      1. 10-20 cu. m/sec. over distance of 3-5 km
   B. fan-head entrenchment by flows up to 10 m

C. process
   1. surging flow, 10-20 min apart
   2. intersurge slurries more dilute, turbulent flow
      a. surge front
         (1) 3 m high, > viscosity to that of cement
         (2) smooth surface indicated laminar flow
   3. Boulders forced to edge of flow to form boulder levees
   4. levees collapsed back into flow as surge died down
      a. localized boulder dams, and breechment

VI. Characteristics of Fluid Debris (samples collected)

A. density and water content

   1. D = 1.5 g/cu. cm between surges in slurry, 2.2 g/cu. cm during surges
   2. solids range from 57-84% respectively

B. Particle size

   1. clay to boulders, poorly sorted
   2. gravel up to 70% of surge material; more loamy between surges in slurry flow
      a. sieve analysis and stats. given

C. strength and viscosity

   1. internal coulomb strenght of debris flow (source of strength)
      a. cohesive clay
      b. internal friction by interlocking boulders

   2. Floating boulders in flow, density contrasts/buoyancy; and clay-slurry strength

   3. good summary table of engineering properties of material

VII. Flow Initiation in the Source Area

A. critical factors for debris flow initiation

   1. unvegetated ravine concentrating large quantities of runoff
   2. steep ravine sideslopes, undercutting and oversteepened
   3. low clay content?
   4. steep gradients in hollows and on fan
   5. narrow confining channels feeding and containing debris flow to lower fan area.

VIII. Fan-Head Entrenchment

A. 10 m entrenchment
   1. result of debris flow corrasion
   2. mainly during surge phase

3. eroded material added to debris mass

IX. Conclusions

A. rainstorm generated debris flows, fed to fans, surging behavior
B. debris flow entrenches, undercuts and self-feeds
C. similar to other debris flow events in other cases
D. boulder levees constructed during surges
E. boulders transported in suspensions on slopes as low as 6 degrees
F. fan-head entrenchment by debris corrasion
G. history of entrenchment and subsequent aggradation of fan head during recovery period
H. tectonic and landuse control of instable hillslopes.