

Fig. 7 Location and ages of charcoal samples at the Pedra site. The bases of debris-flow layers are clearly erosive, suggesting that the stratigraphic record may not be complete. Thus, we can suppose that more debris-flow layers were deposited (e.g. layer 4') and afterwards eroded

		DEPOSITIONAL PROCESSES			
		rockfall/debrisfall	debrisflow	snowflow	waterflow
SEDIMENTARY FEATURES	TYPE/GEOMETRY OF DEPOSITS	AVALANCHES			
		rockfall/debrisfall Fresh rock debris Resedimented gravel Varied runoff Scattered clasts Upward fining Lobate or "patchy" accumulations of debris; scattered large "outrunners"	debrisflow Relatively broad lobes Highly elongate, tongue-shaped lobes (upslope lining) Levees Spill-over lobes "Debris shadow" "Debris horn" Longitudinal grooves, debris ridges & clast-thick levees One clast-thick levee Small "digitated" lobe with frontal wash-out sand Toolmark grooves "Patchy" lobes	snowflow Drier snowflows Scattered clasts Indistinct boundaries Melt-out clasts in precarious positions Stratified waterlain infill of larger interstices Redeposited humic soil Waterlain infill	waterflow Narrow, gully-type channels; or shallow channels with braid bars Levees of bypassing debrisflows Overbank sand Remnant debrisflow deposits Tractional infill Isolated channel-fills (up to 1.5 m thick)
vertical cross-section	TEXTURE AND STRUCTURE	High-viscosity debrisflow Tabular beds Large "floating" clasts	Low-viscosity/watery debrisflow "Imbricate" beds	Drier snowflows Melt-out clasts in precarious positions Stratified waterlain infill of larger interstices Redeposited humic soil Waterlain infill	Slushflow Lens with sandy downslope "tail" Waterlain infill
		Matrix-rich to clast-supported. Sandy/muddy matrix. Common "coarse-tail" inverse grading and outsized cobbles or boulders.	Clast-supported, bouldery to cobbly "heads" and clast-to matrix-supported, pebbly upslope "tails". Common normal grading.	Unsorted, scattered clasts and gravel "patches" infilled with waterlain sand or pebbly sand. The sand in large interstices shows stratification, but is massive, very fine/silty and possibly shell-bearing in submarine deposits.	Clast-supported, pebbly to cobbly gravel interlayered with poorly sorted/stratified sand. Matrix-supported gravel occurs as debrisflow remnants.
CLAST FABRIC	DEBRIS SOURCE	Large clasts mainly aligned downflow, $\alpha(p)$ or $\alpha(p)$, but showing $\alpha(l)$ orientation along the lobe front.	Common "rolling" fabric $\alpha(l)$ in the frontal and top part of the debrisflow head; common "shear" fabric $\alpha(p)$ or $\alpha(p)$ in the flow's tail.	Mainly disorderly (chaotic "melt-out" fabric). Boulders and cobbles deposited from turbulent snowflows may have "rolling" fabric $\alpha(l)$, but the scattered debris is vulnerable to rotation by subsequent avalanches. Dense snowflows and slushflows may create "shear" fabric $\alpha(p)$, but this loses order during the melt-out.	Common tractional fabric; poorly developed in gullies due to clast pivoting and adjustment to banks. Many large clasts are rotated <i>in situ</i> to $\alpha(p)$ position by less competent waterflow.
		Weathered bedrock. Glacial till and valley-side kame terraces.	Glacial till, kame terraces and upper-slope colluvium.	Glacial till and upper-slope colluvium, including fresh bedrock. Common slope-soil erosion.	Upper-slope colluvium and glacial till.

Fig. 6. Summary of the main depositional processes and facies of colluvial fans/aprons, with special reference to the postglacial colluvium in western Norway.

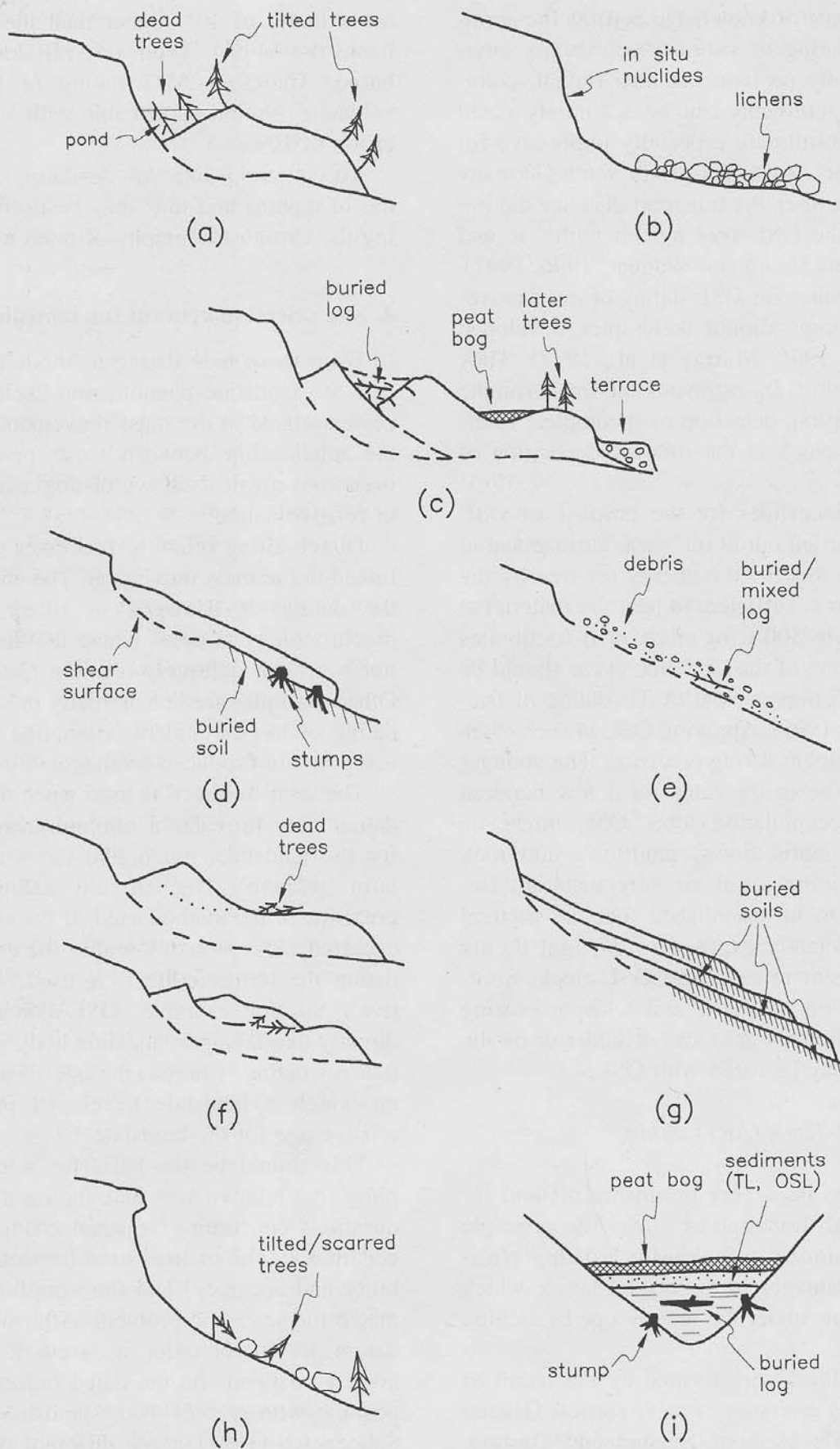


Fig. 3. Location of datable elements relative to the landslide body (see explanations in the text).

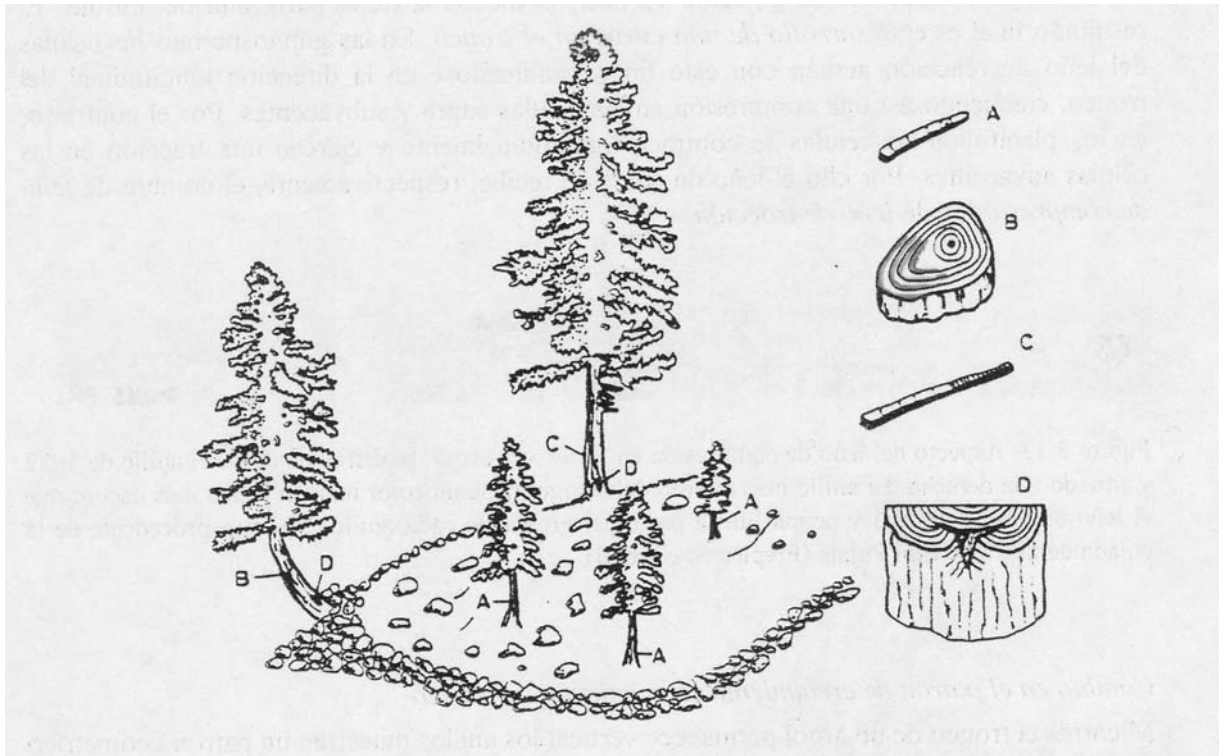


Figura 3.12. Criterios dendrogeomorfológicos para la datación de un movimiento de ladera: a) colonización de la nueva superficie del terreno, estos árboles proporcionan la edad mínima del movimiento; b) crecimiento con leño de reacción (en color más oscuro) y excéntrico (en árboles inclinados); c) aumento de la tasa de crecimiento por eliminación de árboles competidores; y d) herida causada por la erosión (asociada, por ejemplo, a una corriente de derrubios) o al impacto de un bloque (modificada de Osterkamp y Hupp, 1987).

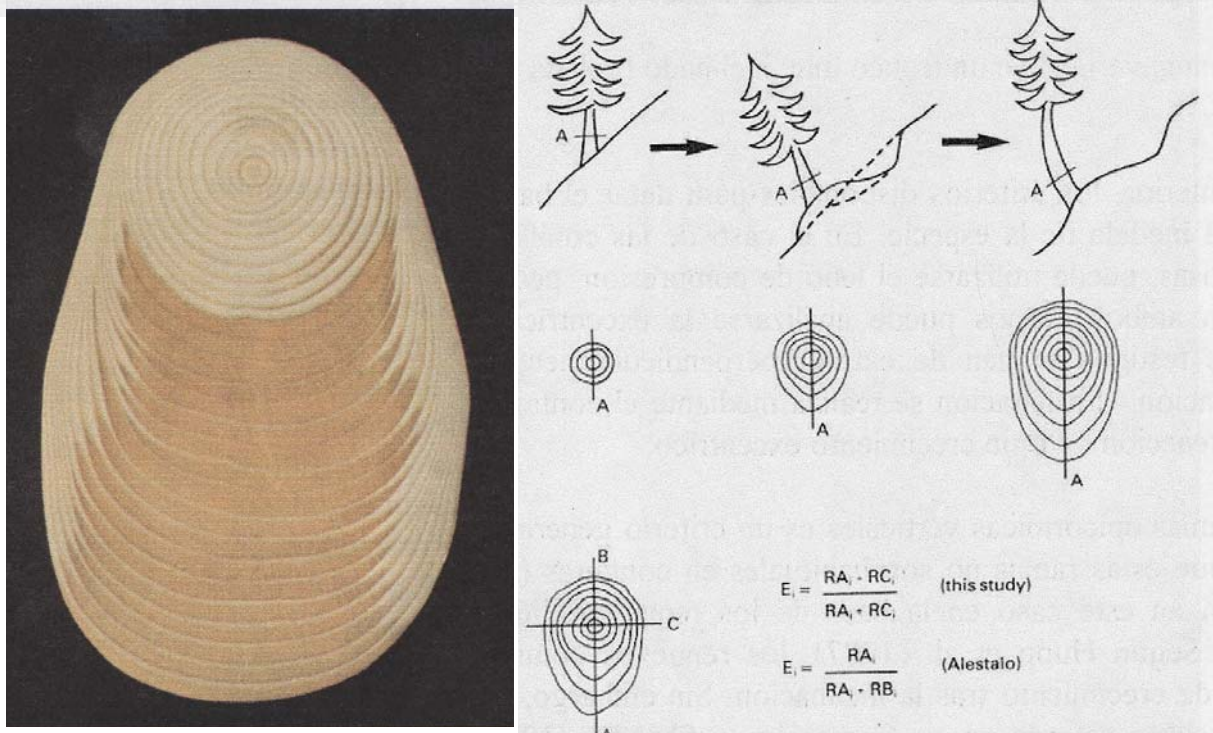


Figura 4.1. Sección transversal de una conífera inclinada. Puede distinguirse claramente el crecimiento concéntrico en los primeros anillos y el posterior crecimiento excéntrico y con leño de compresión (Timell, 1986).

Figura 3.15. Orientación de las muestras para el cálculo de la excentricidad, según Alestalo (1971) y según Braam et al. (1987a) (extraída de Braam et al., 1987a).

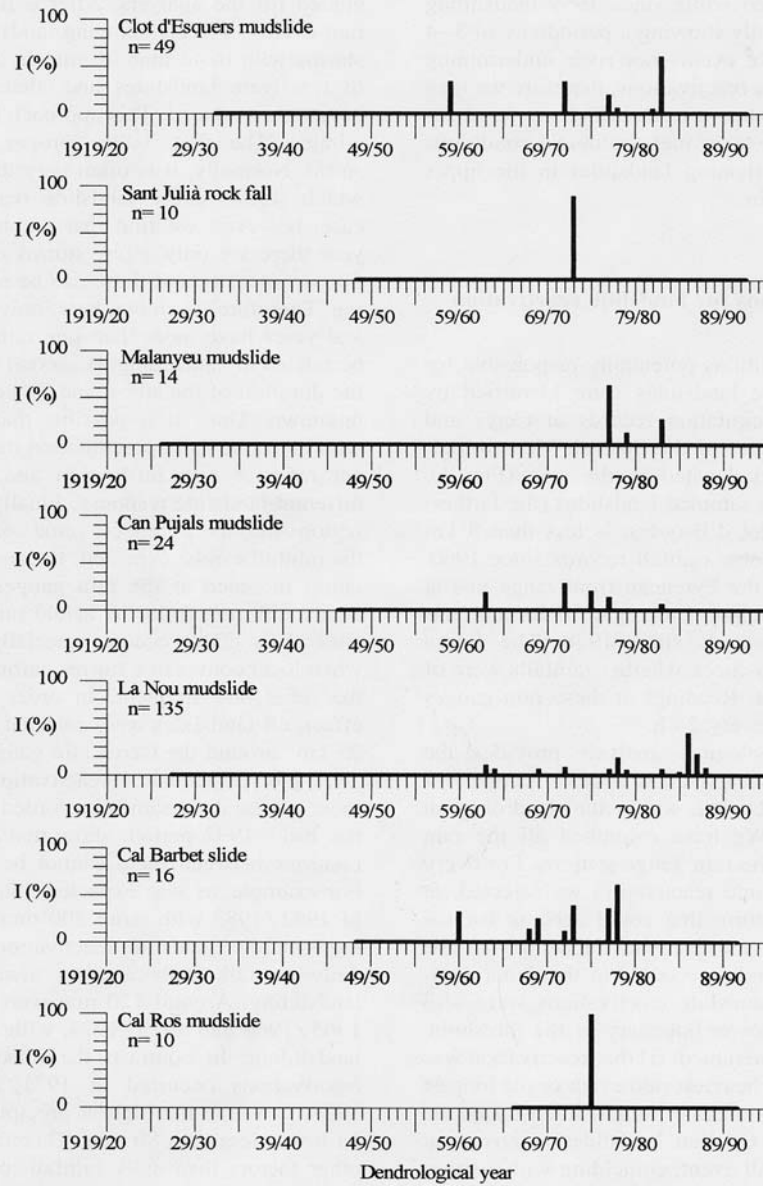


Fig. 4. Landslide reactivations deduced by dendrogeomorphological analysis at the seven landslide sites sampled at the upper Llobregat River basin. *I*: activity index (percentage of trees showing tree-ring response to landsliding); *n*: number of sampled trees; thick solid line indicates the span of time covered by the sampled trees.

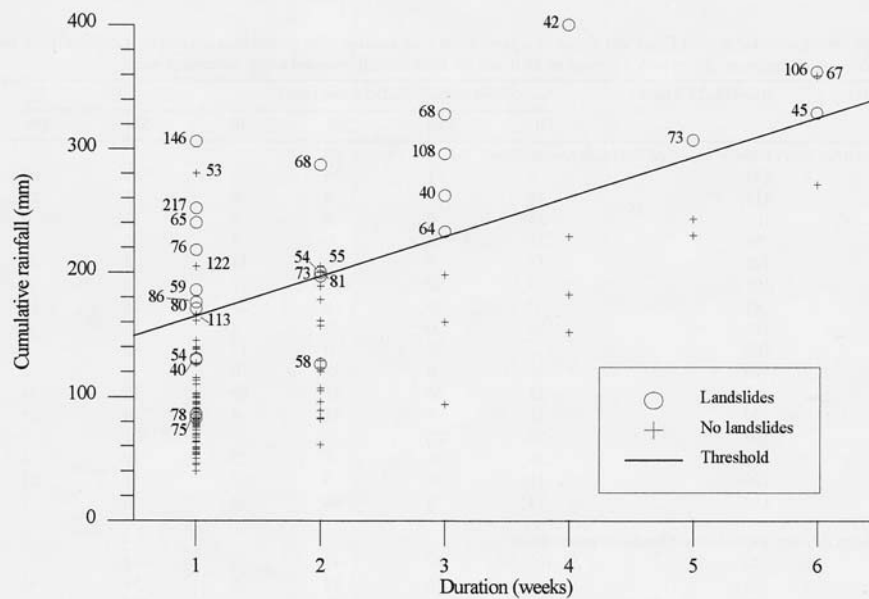


Fig. 7. Cumulative rainfall-duration threshold for reactivation of landslides in the upper Llobregat river basin obtained from all the events with a daily rainfall total greater than 40 mm. Precipitation recorded during the last day of the rain event is indicated in the plot for all the rains associated with landsliding and for those located above the threshold line.

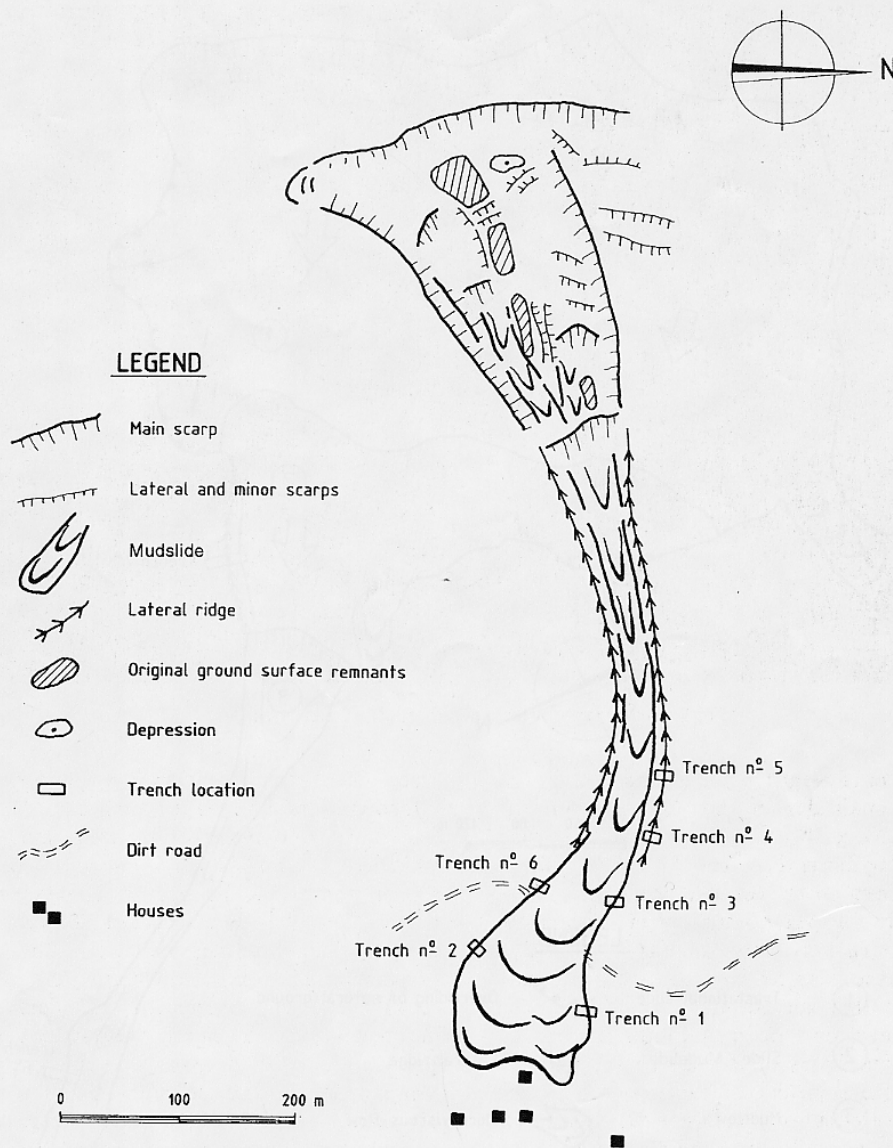


Fig. 10. Map of the La Coma mudslide showing the location of the trenches and some morphological features (modified from Corominas and Moreno, 1988).



Fig. 15. Partial view of trench 5 at the La Coma mudslide. Undisturbed natural ground (a) is visible below the outer edge of the ridge; then the contact becomes a steeply dipping shear surface to the left (b). An adjacent ridge (r), deposited during a second surge of the flow is backed against clasts without matrix (c) on top of the first surge. The lateral shear surface (b) extends more than 2 m below the original ground surface.

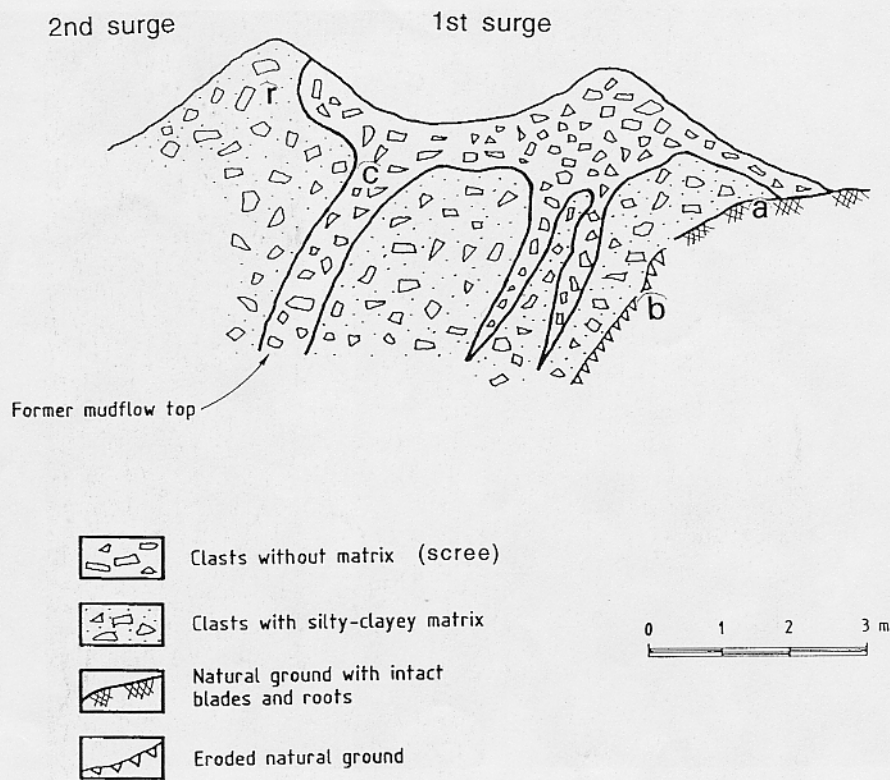


Fig. 16. Cross-section of trench 5 of the La Coma mudslide. The two adjacent lateral ridges were formed during two surges; the main body of the flow is to the left (from Corominas and Moreno 1988). (a, b, c and r are the points described in Fig. 15.) The clasts without matrix are scree deposit that were covering the original slope surface at the mudslide head.

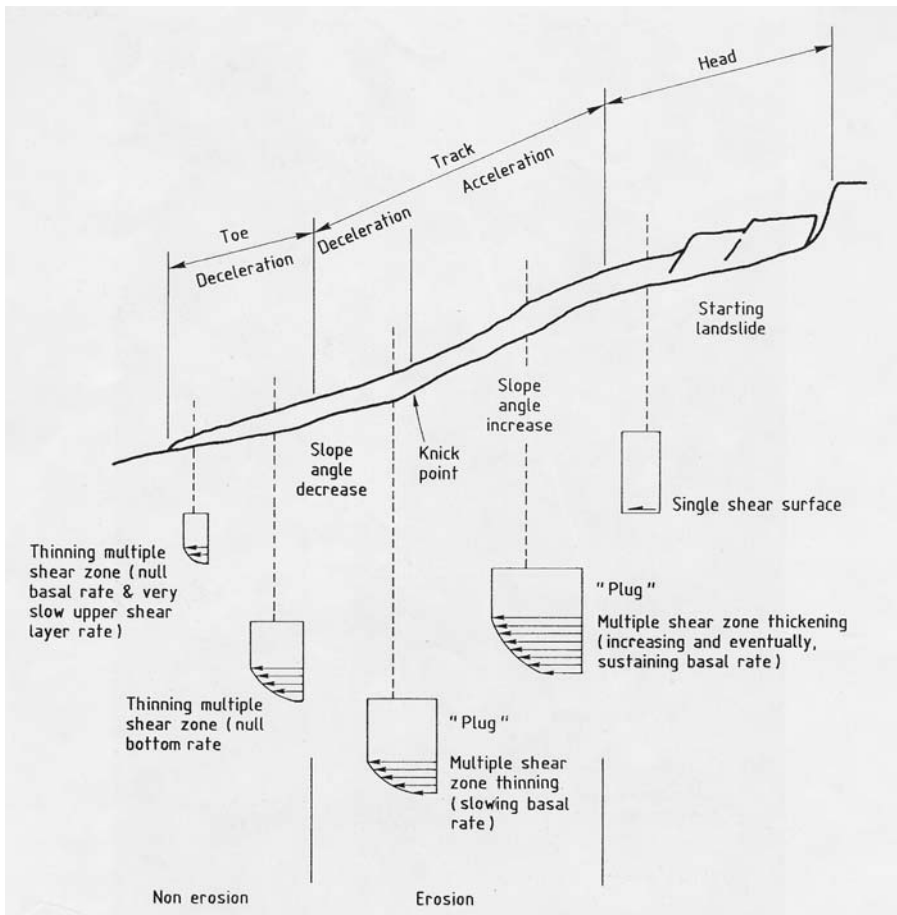


Fig. 23. Idealized velocity distribution along the shear surfaces in a mudslide.

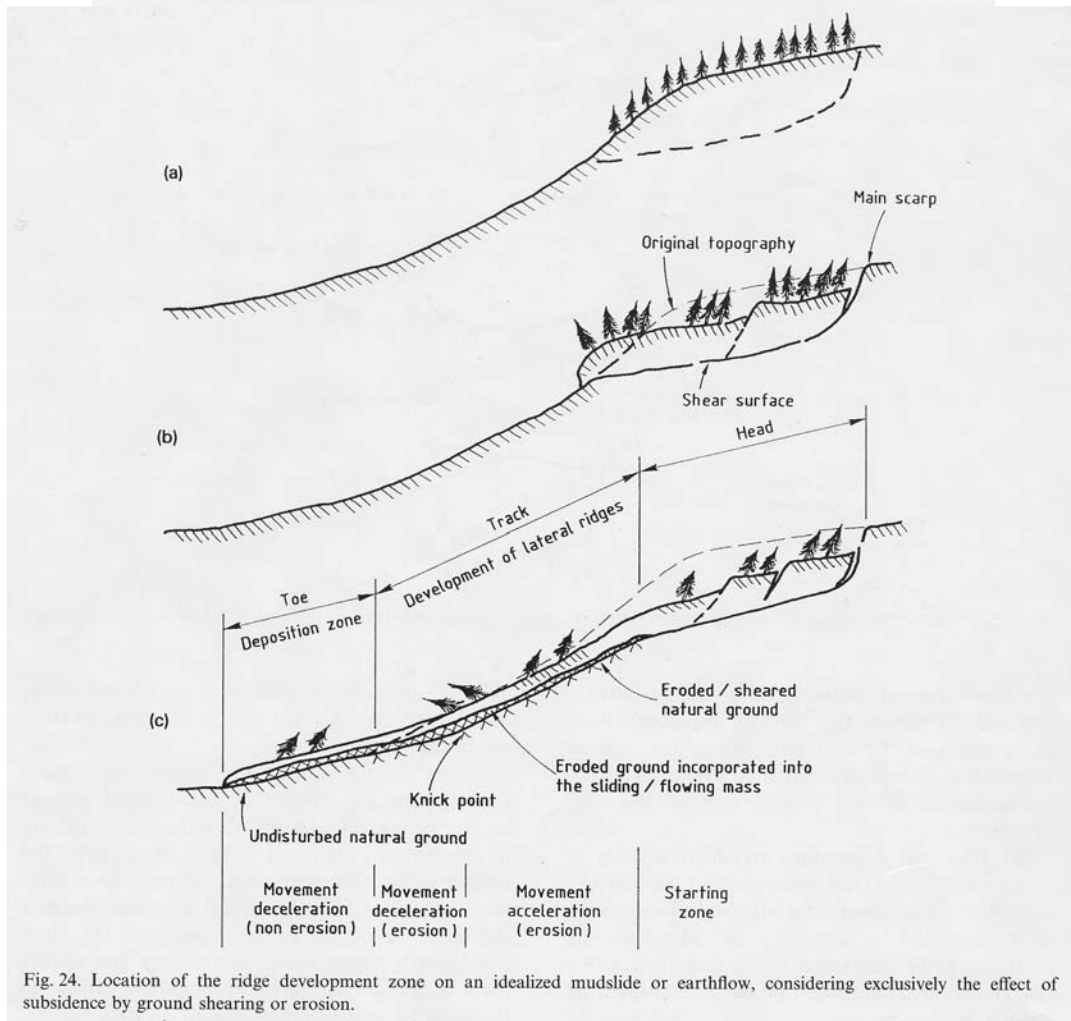


Fig. 24. Location of the ridge development zone on an idealized mudslide or earthflow, considering exclusively the effect of subsidence by ground shearing or erosion.

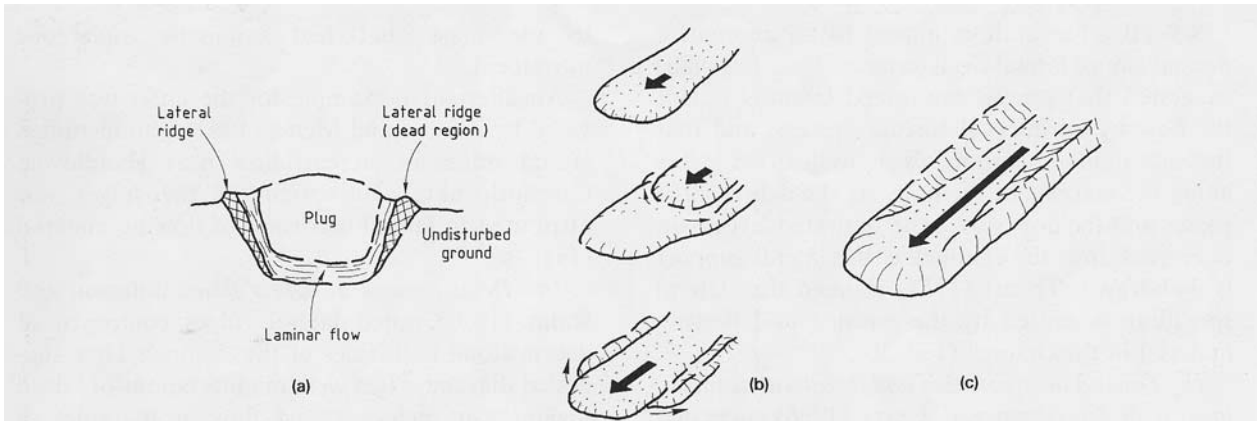


Fig. 4. Suggested mechanisms of lateral ridge development. (a) Lateral ridges as a "dead regions" of flow (Johnson and Rahn, 1970). (b) Overriding of former flows (Keefer and Johnson, 1983). (c) Subsidence of debris surface by diminishing of debris discharge (Johnson and Rodine, 1984). (b) and (c) are interpretive drawings based on descriptions and suggested mechanisms in the above references.

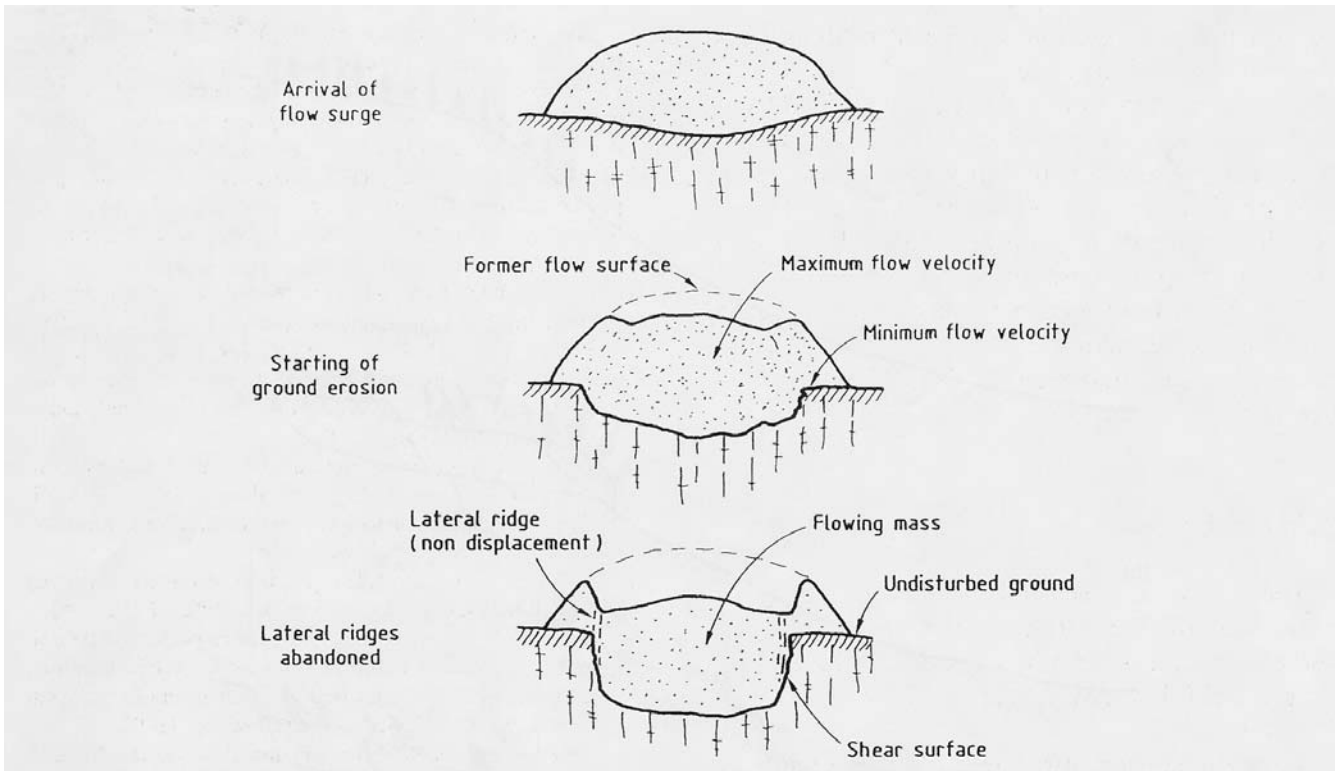


Fig. 25. Cross-section showing the development of lateral ridges by progressive shearing and erosion of the underlying materials.