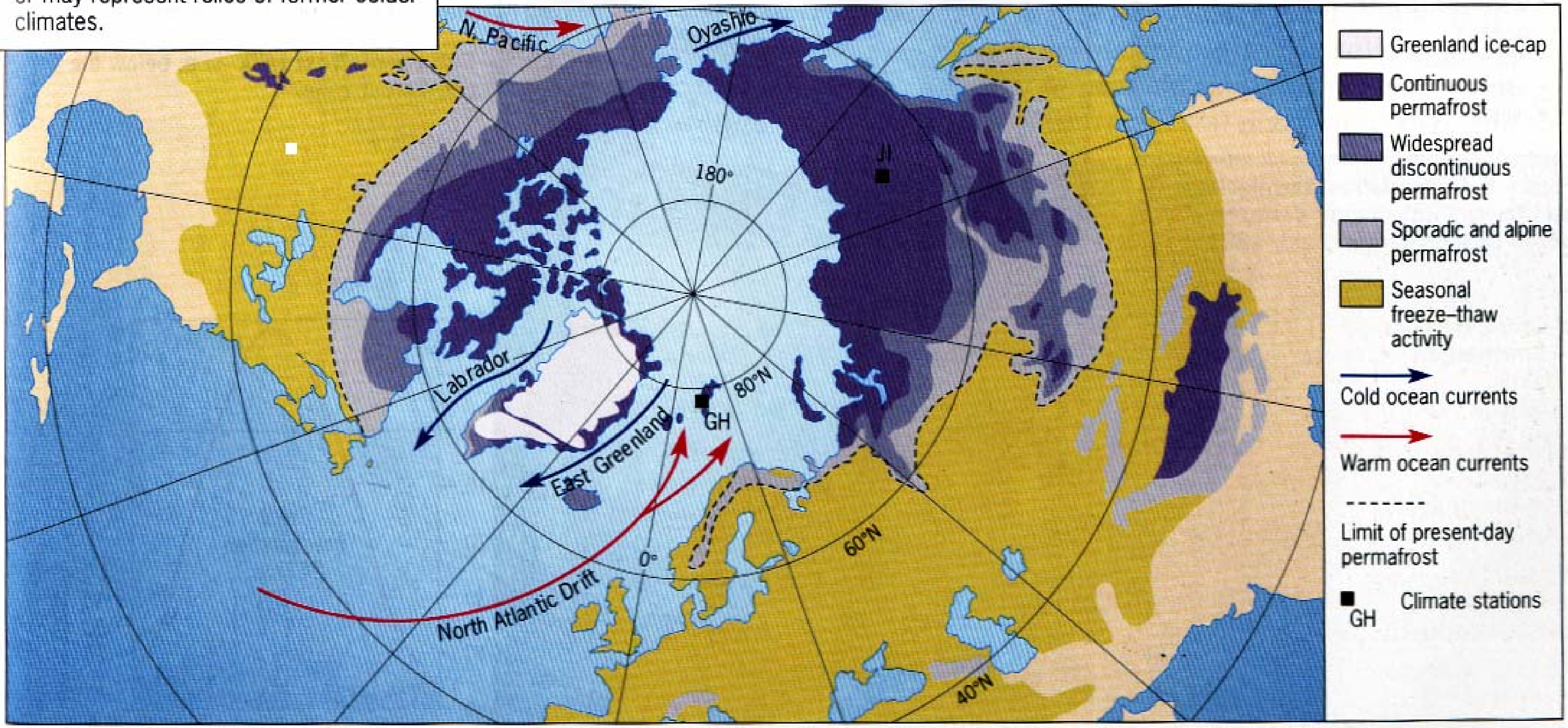
Periglacial Features

The Distribution of Permafrost in the Northern Hemisphere

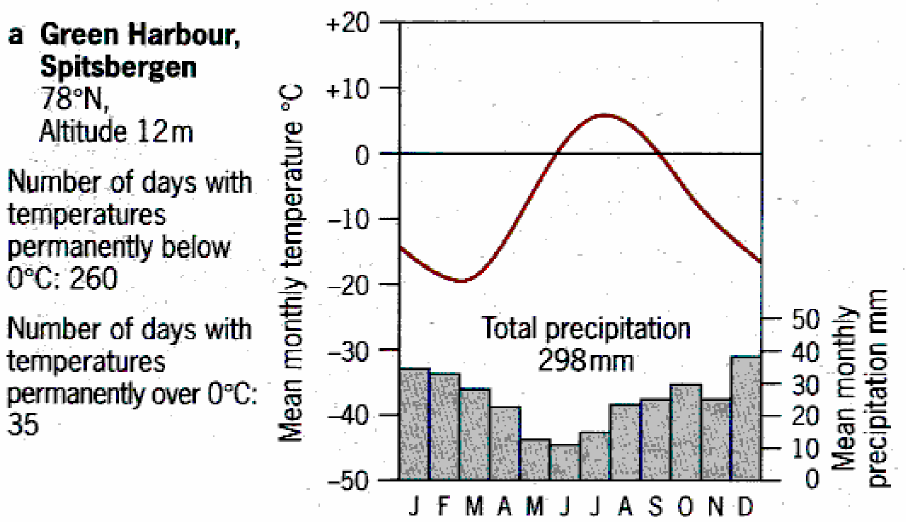
Permafrost is divided into three main groups:

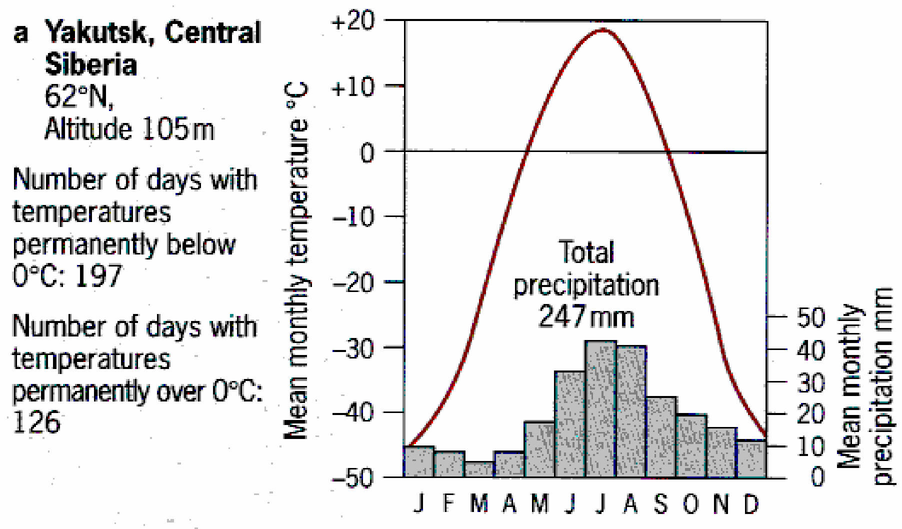
1. Continuous permafrost has a mean annual temperature at 10–15m deep of less than –5°C, and the permafrost table is less than 0.6m below the surface.
2. Discontinuous permafrost has a lower permafrost table because temperatures are higher and there is more seasonal surface thawing. The mean annual temperature at 10–15m deep is between –5° and –1.5°C.
3. Sporadic permafrost – areas of small islands of permafrost in a generally unfrozen area. These are mountain regions or may represent relics of former colder climates.



The distribution of permafrost and related phenomena in the northern hemisphere (*Source:* Cooke and Doornkamp, 1990)

Climate Graphs for two Periglacial areas

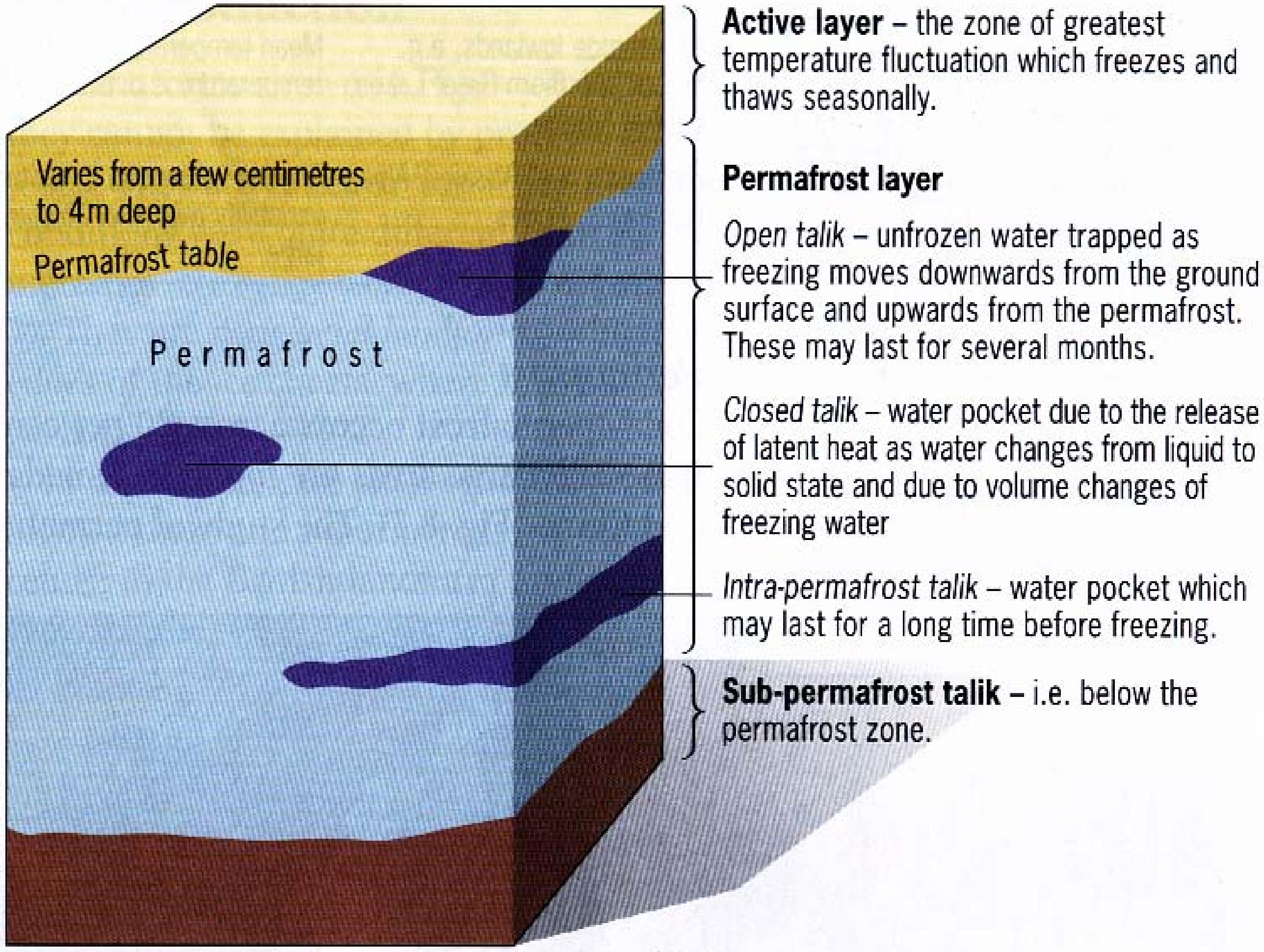




The characteristics of Permafrost

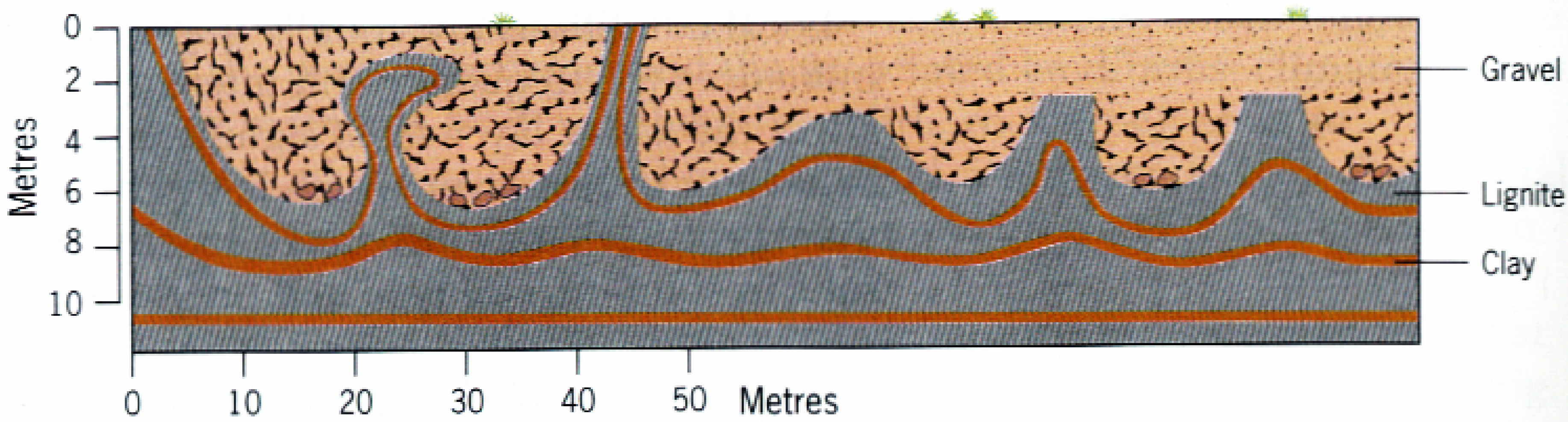
Permafrost depth – maximum thickness of 1500 m in Siberia. Most areas are less than 600 m. In areas of discontinuous permafrost, depths are less than 60 m. Locally depth of permafrost varies due to:

- present climatic conditions
- past climate (may take thousands of years to develop)
- soil type (if any)
- vegetation cover
- water bodies, i.e. rivers, lakes, oceans
- snow cover
- aspect
- wind.

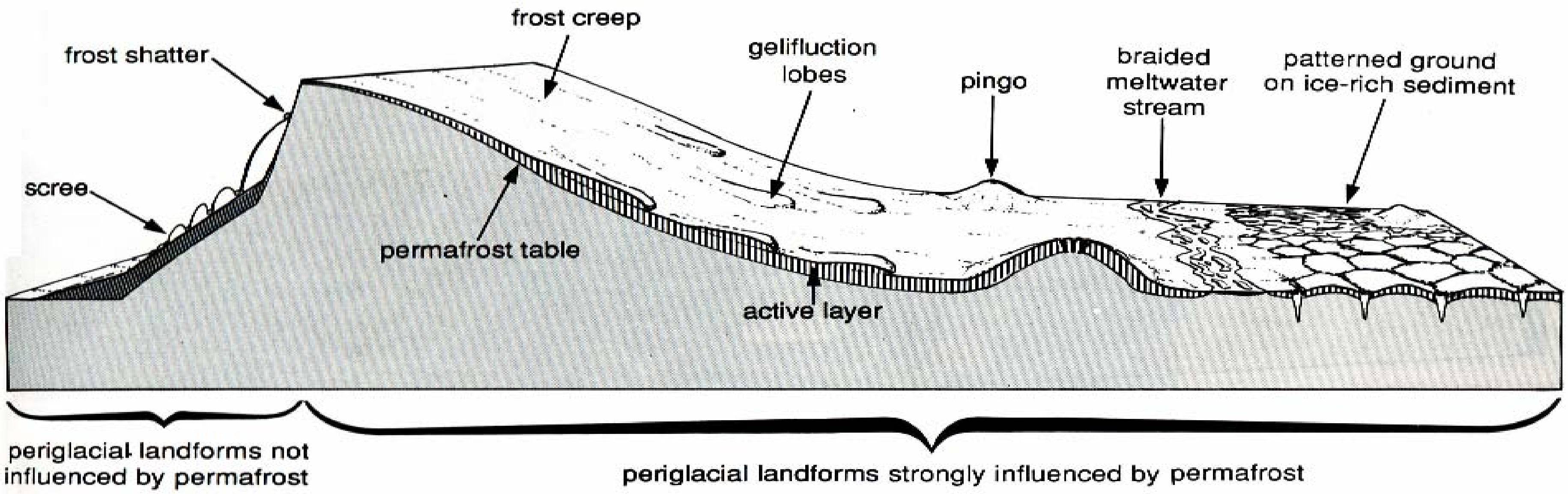


Permafrost terminology, and factors influencing permafrost depth (*After:* Summerfield, 1991)

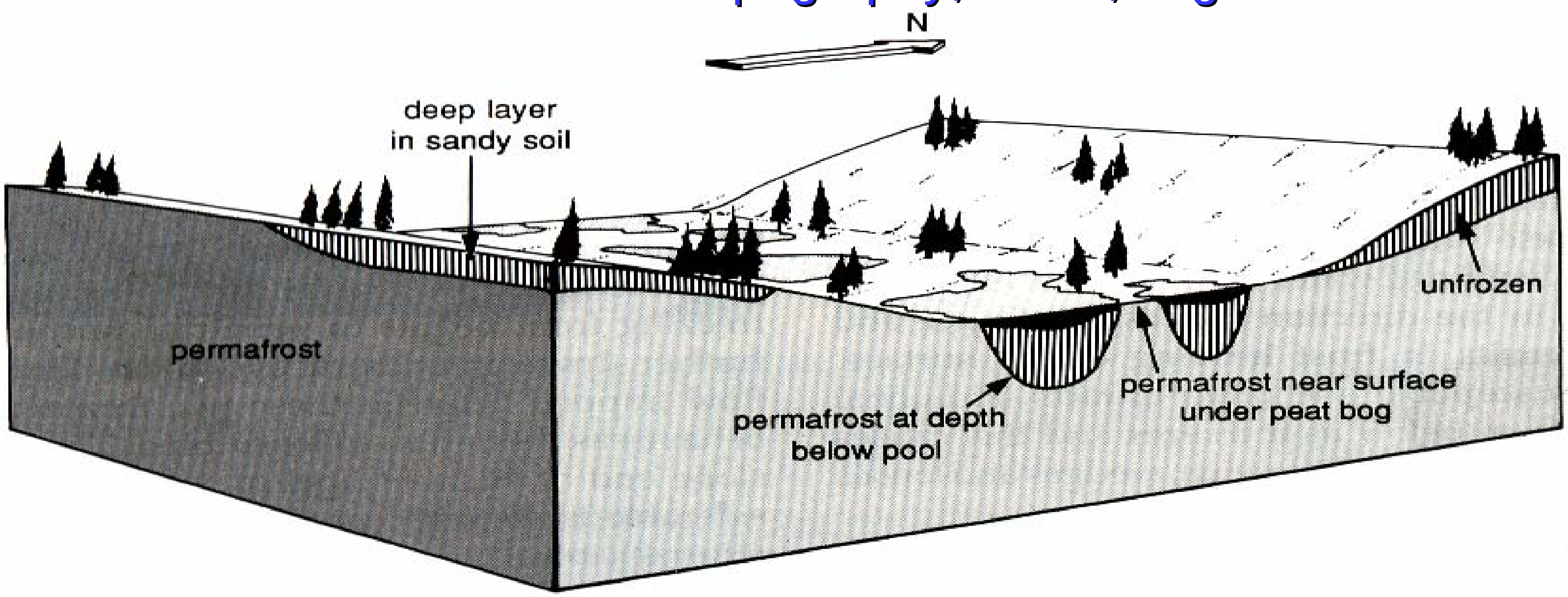
Deformation of gravel, lignite and clay deposits in a clay pit in the Rhineland in Germany. These periglacial involutions are caused by cryoturbation. They can be used to determine the depth of permafrost in central Europe during the Pleistocene.



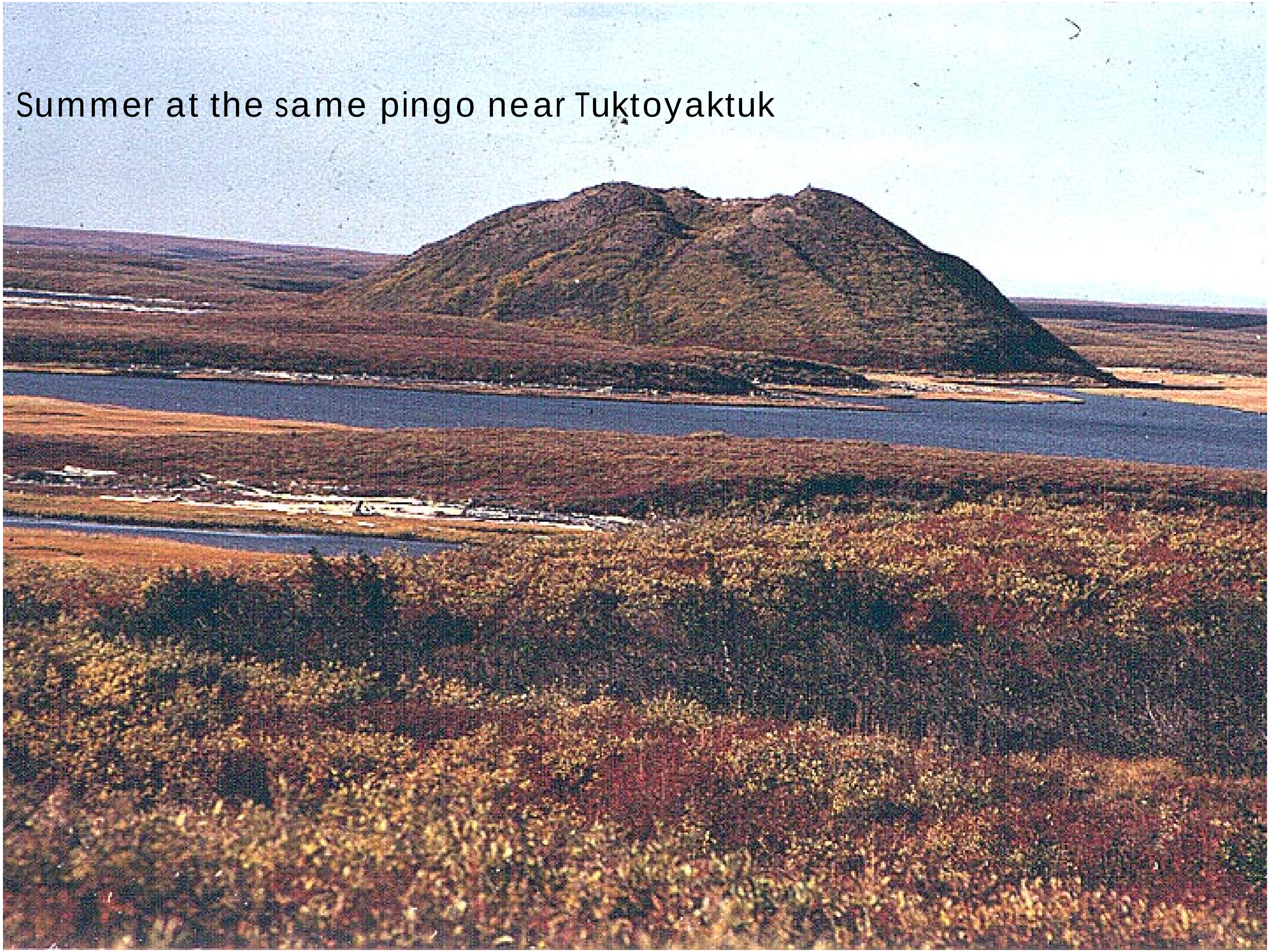
A Range of Periglacial Landforms



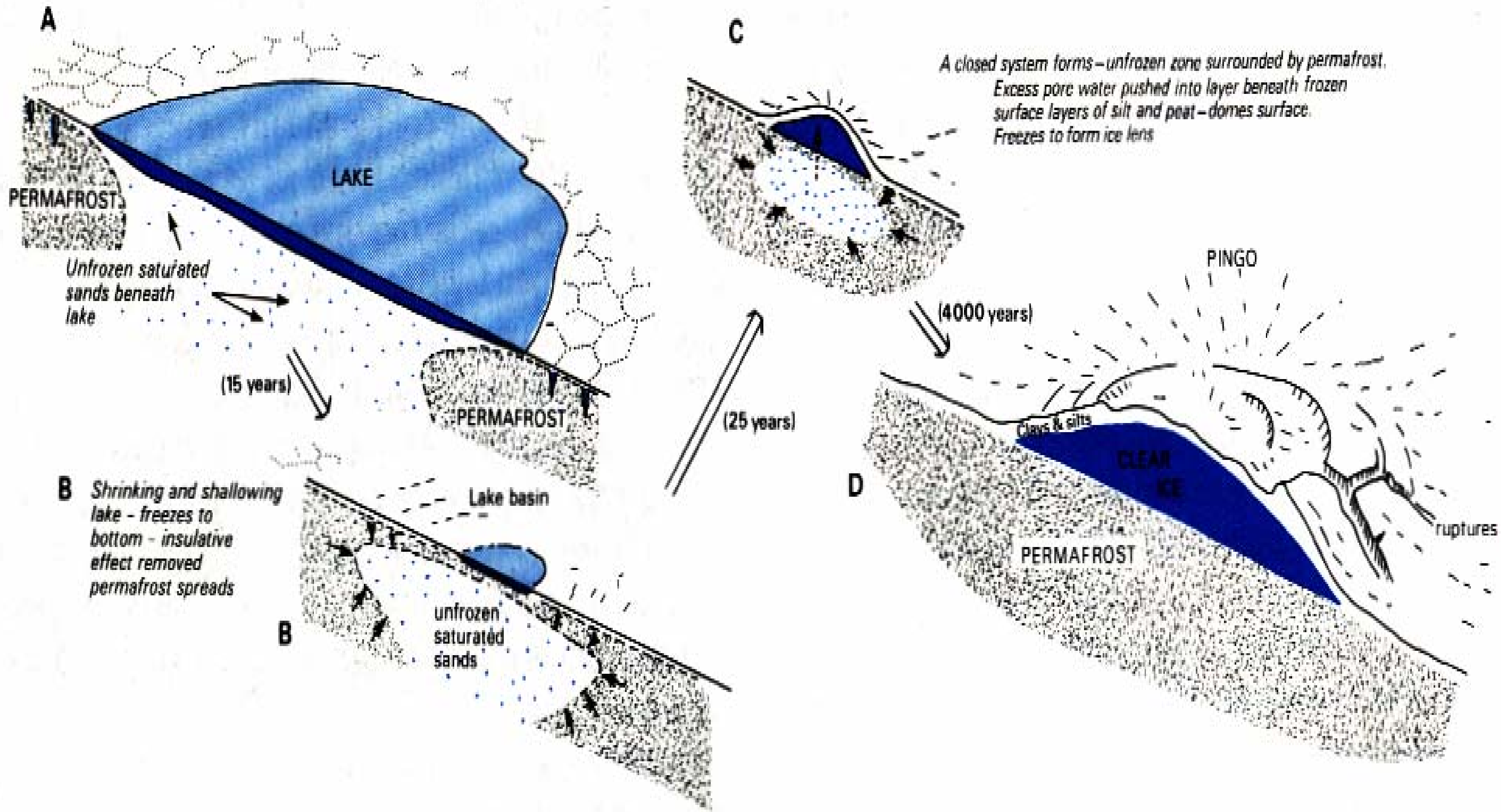
The Pattern of Permafrost with topography, water, vegetation and soil



Winter at Canada's large pingo near Tuktoyaktuk, western Arctic coast. The pingo summit rises 49 m above the surrounding drained lake flat.



Summer at the same pingo near Tuktoyaktuk

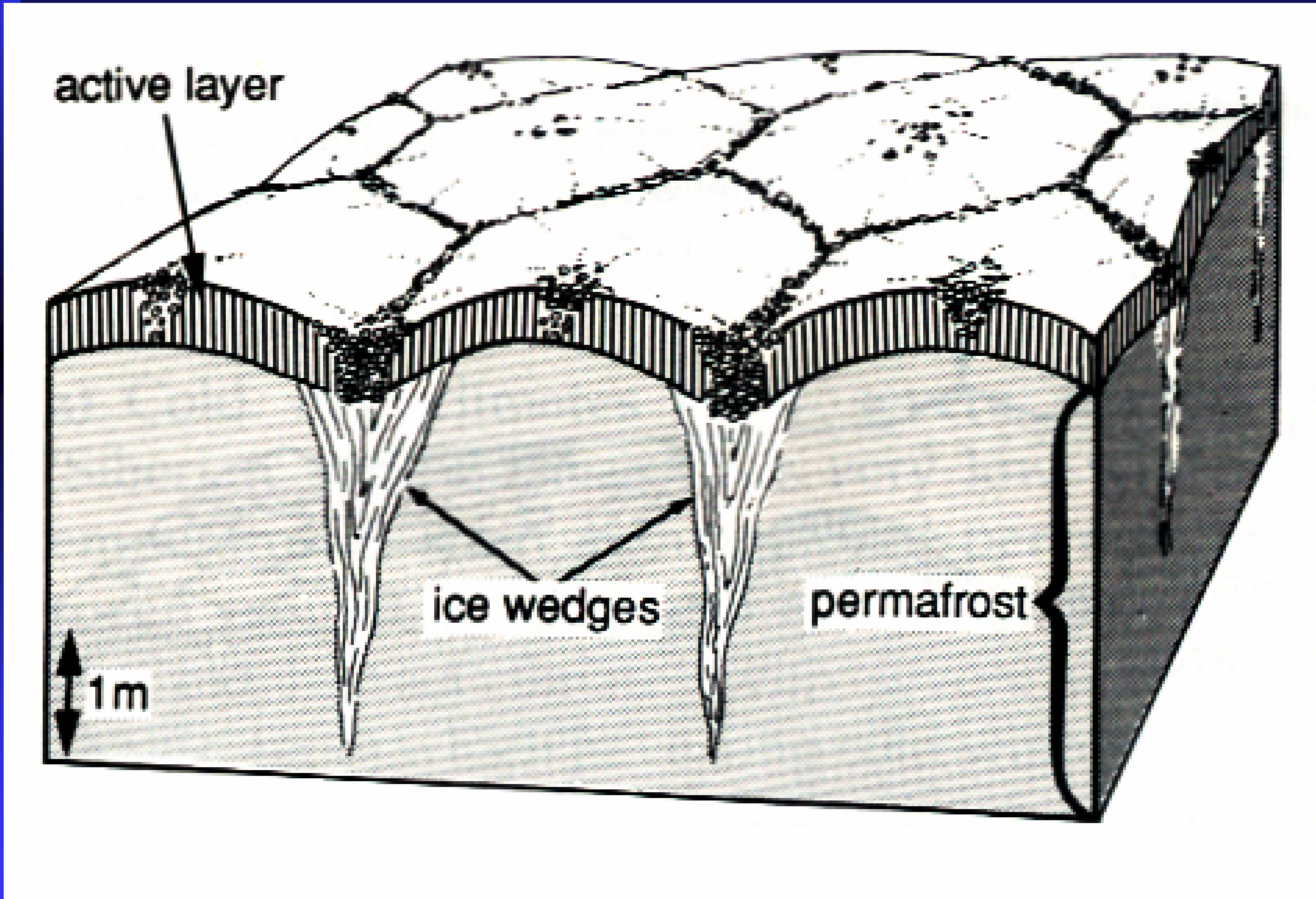


6.33 The growth of a closed system Mackenzie pingo

Zurich Pingo 1 (highest part of pingo is 13 m high), Traill Island, east Greenland, July 1993.

The subtle ring-shaped features occur in a never-glaciated part of South Dakota. They may be relics of *pingoes*, mounds that form now in the Arctic when ice trapped underground expands.

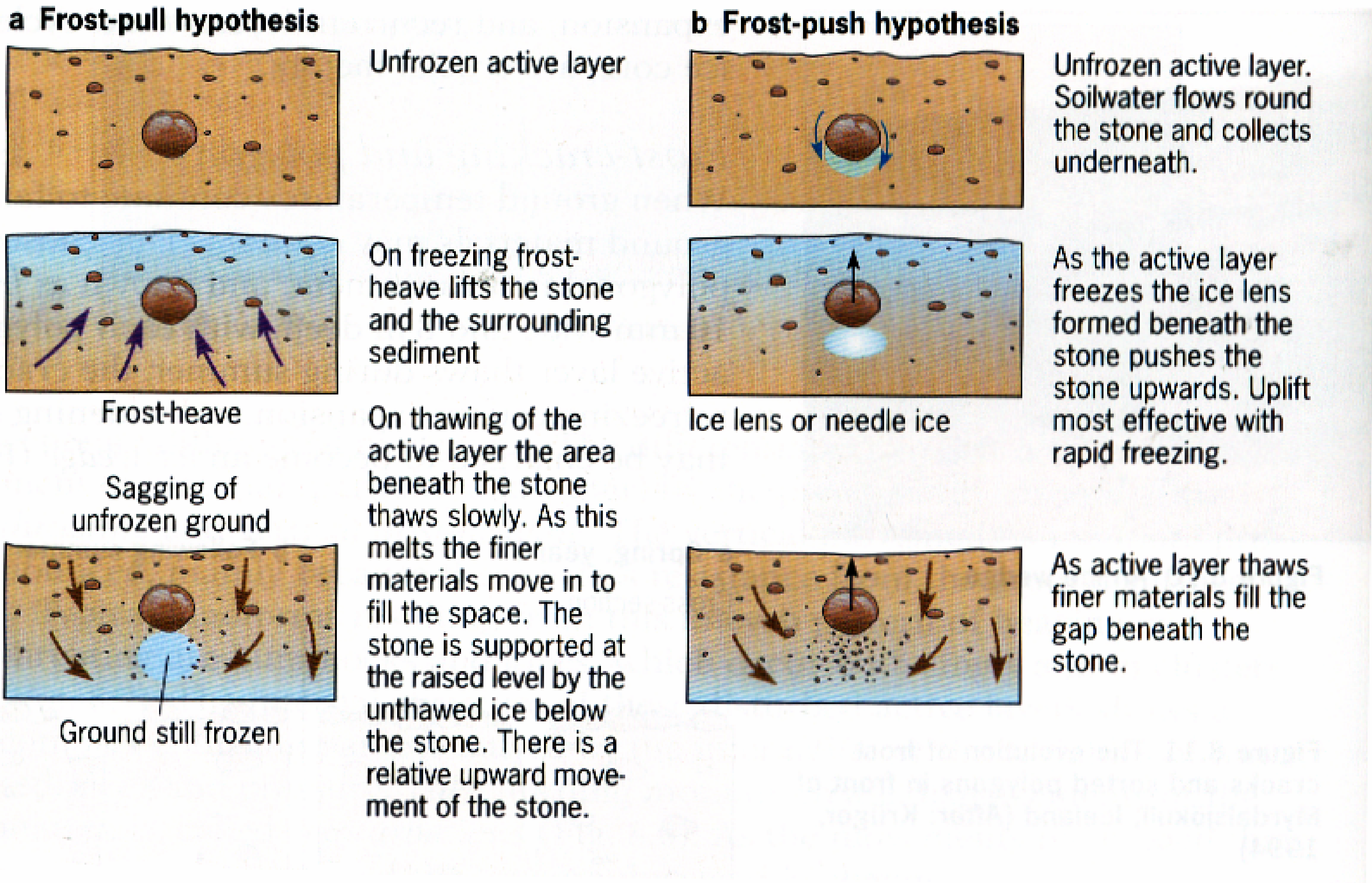
The development of ice wedges beneath the active layer occurs on gently sloping or flat land in the ice rich sediments



A cross-section of permafrost shows an ice wedge hiding just below the surface. The active layer is soil that will thaw in summer and refreeze in winter. Below that is permafrost - soil which is too deep for the warmth of a brief summer to reach. This sample is in the Arctic National Wildlife Refuge in northeast Alaska.

(U.S. Fish and Wildlife Service).

The two hypotheses for the upward movement of stones in permafrost.



Patterned ground (stone circles) in the Scandinavian Arctic (Spitsbergen).

Stone stripes are common features on sloping terrain.

Stripes commonly develop by the downslope extension of sorted polygons or the linear alignment of soil buds occupying level areas

Stripes are found on gradients of more than 3° but rarely on slopes steeper than 30°

Stripes curve around blocks and outcrops

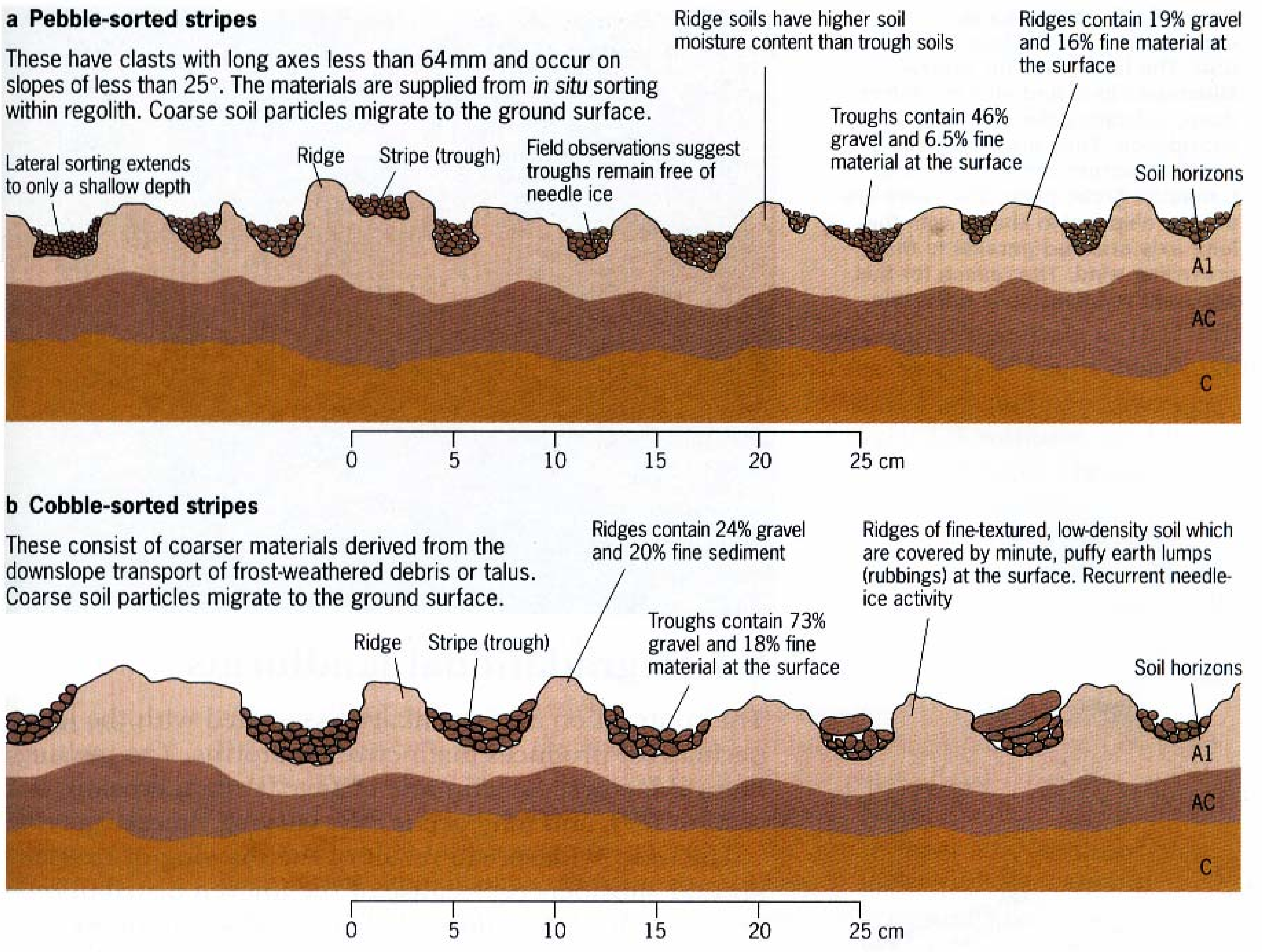
Stone stripes have a shallow depth of sorting, with the largest stones near the surface

Bands of fine sediments between the stripes are wider than the stony stripes

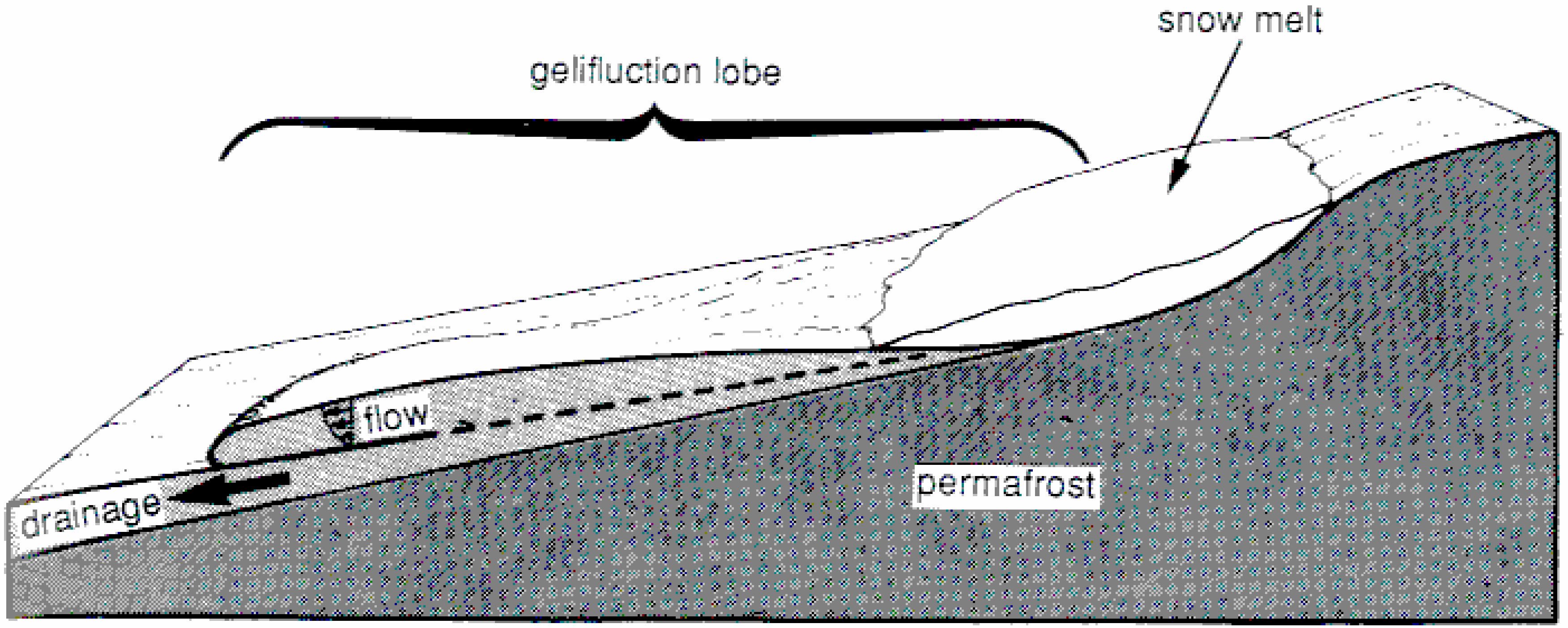
The size of stripe increases with stone size

Stone stripes. Sorted stone stripes are common features on sloping terrain in periglacial regions.

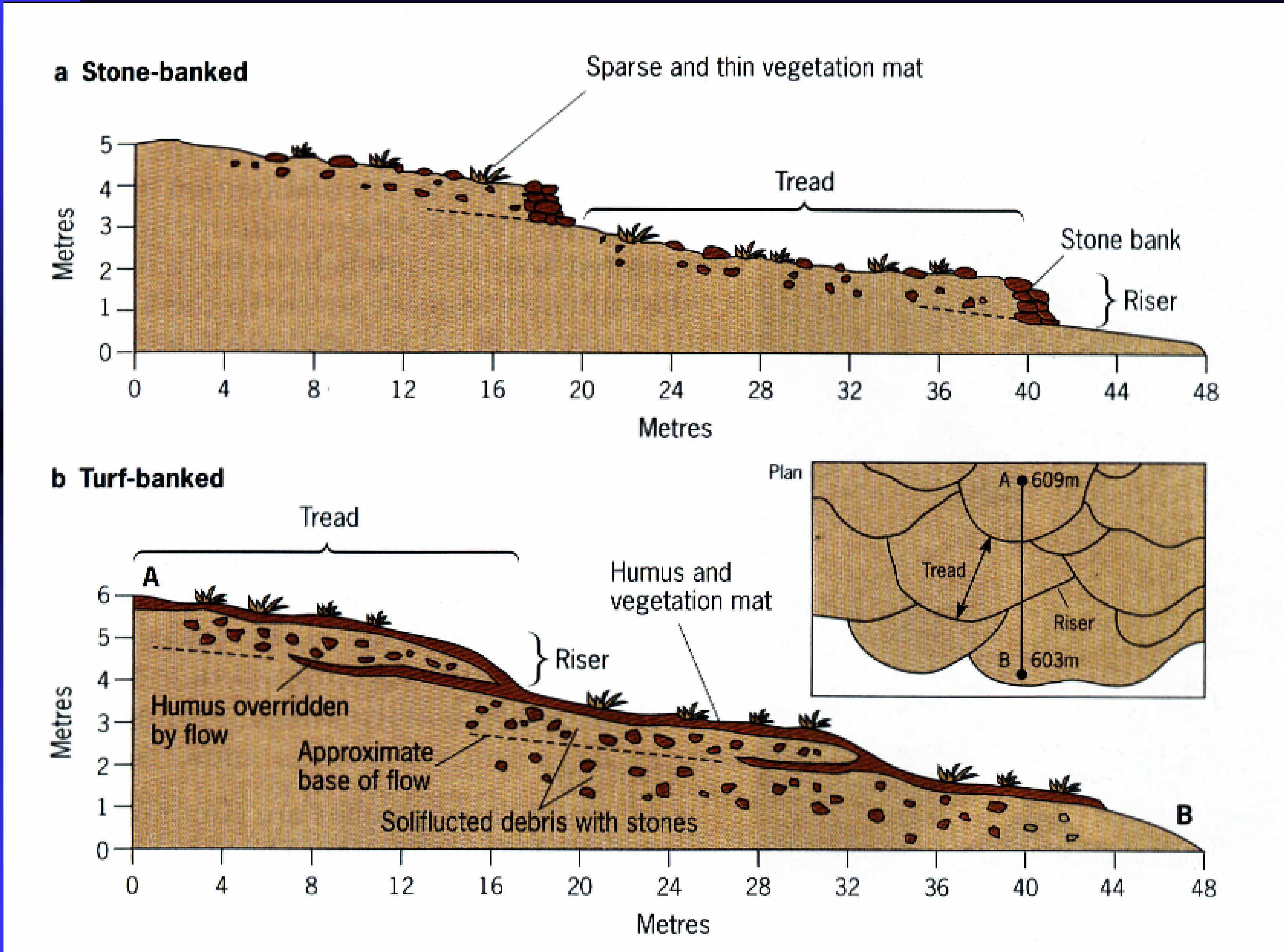
Cross-sections of two types of stone stripes in the Venezuelan Andes



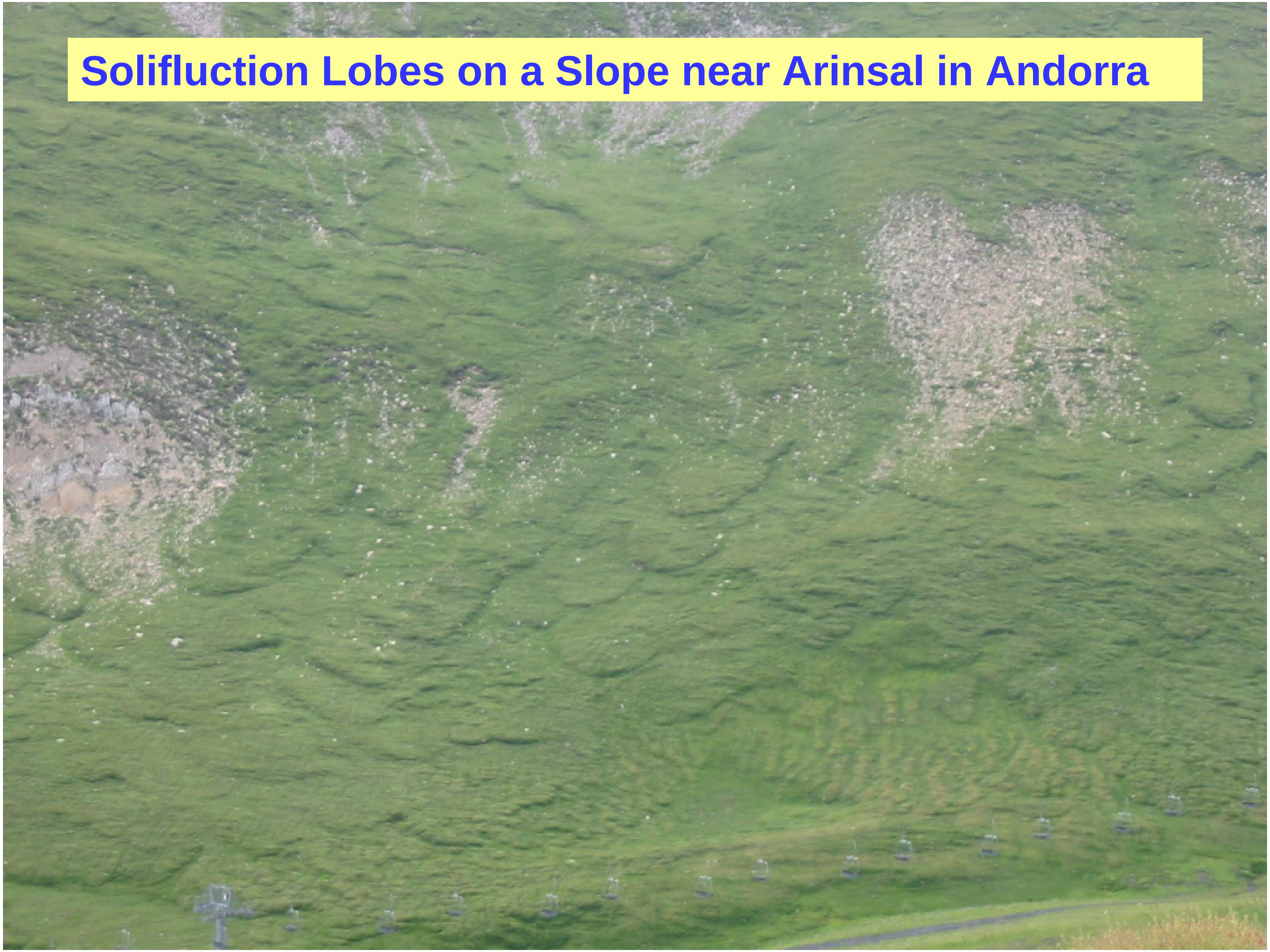
Solifluction on slopes. Note the snow patch feeding water into the solifluction (of gelifluction) lobe.



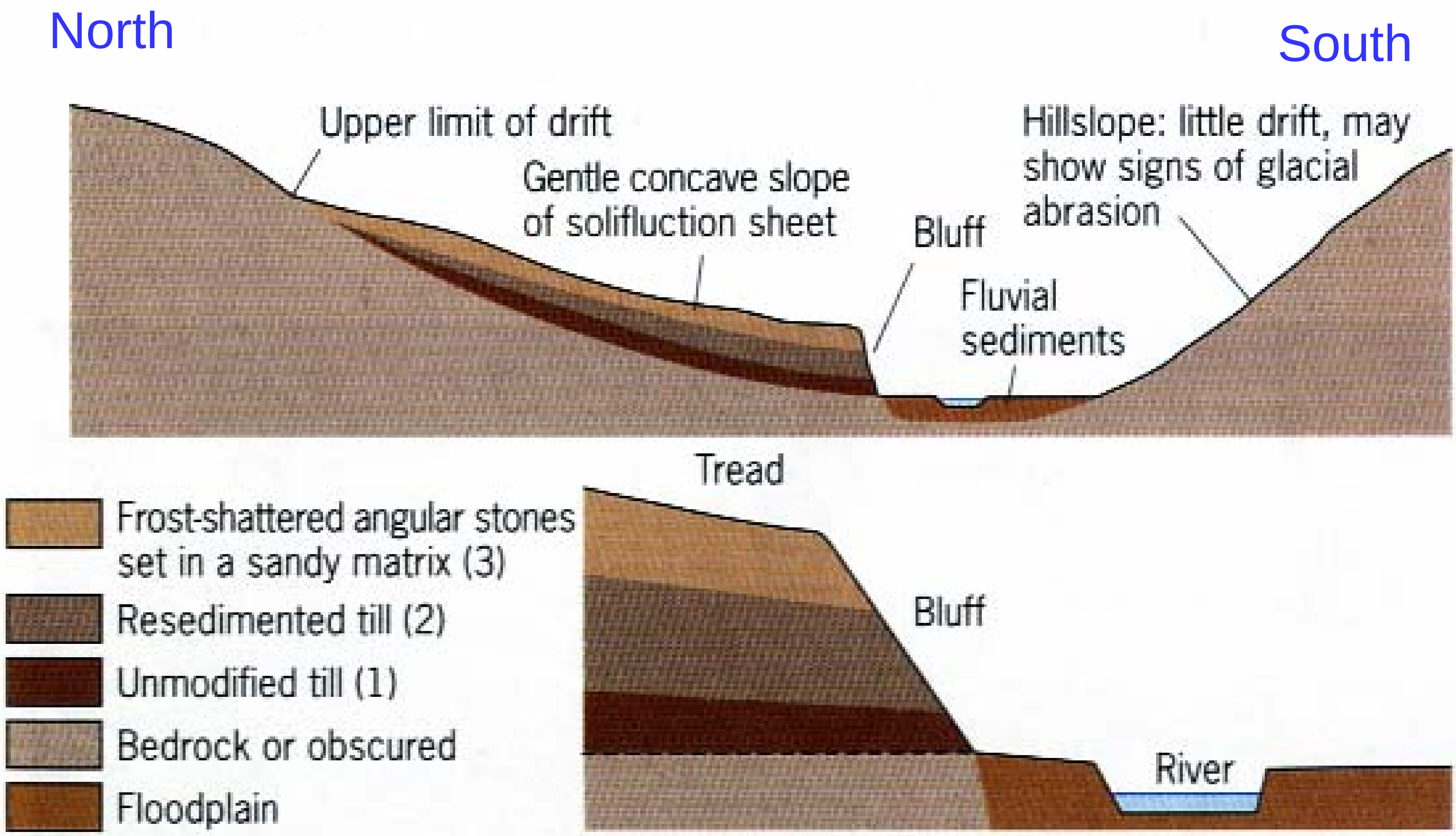
Stone-banked and turf-banked solifluction lobes.



Solifluction Lobes on a Slope near Arinsal in Andorra

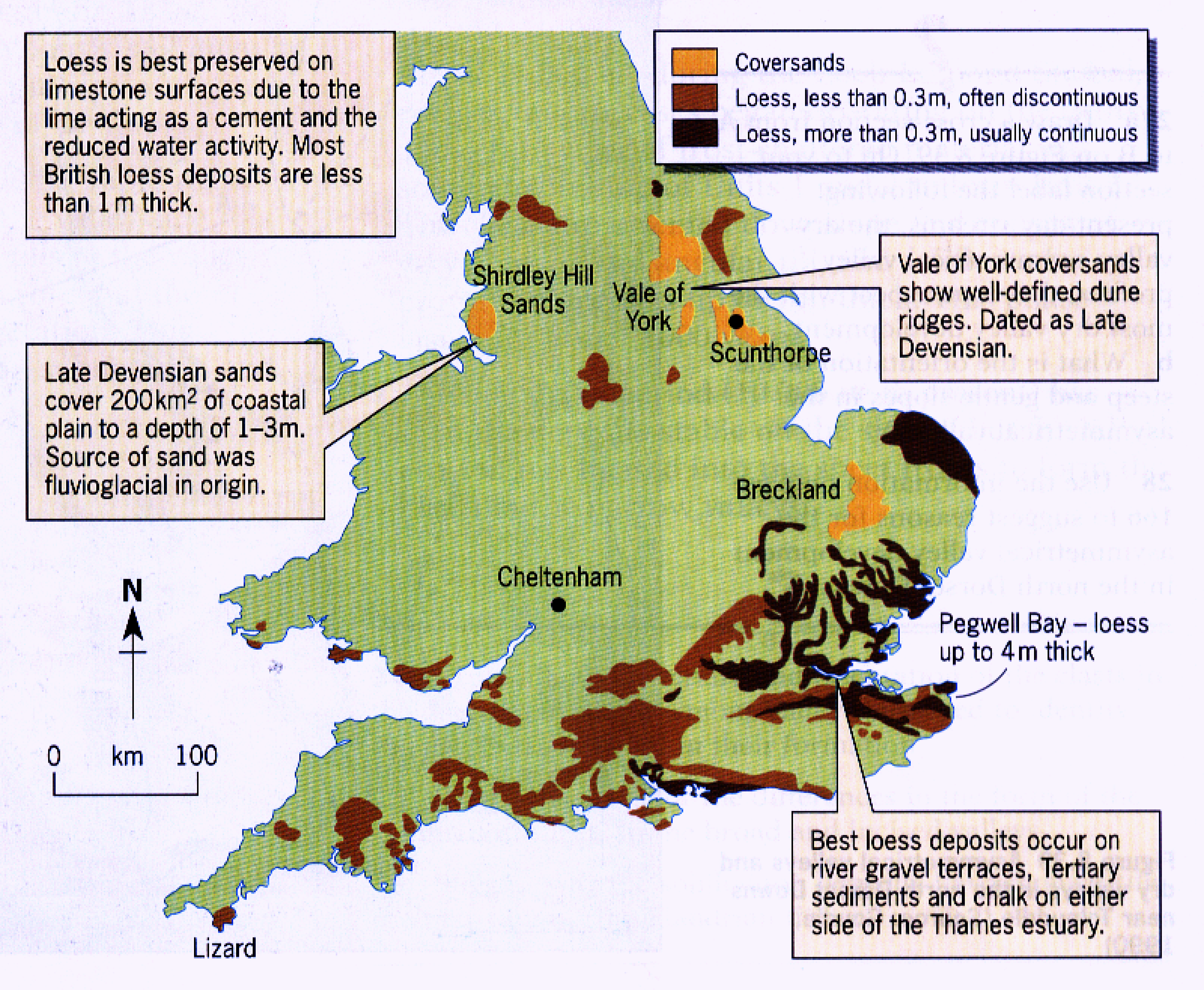


Asymmetrical valleys resulting from solifluction on south facing slopes in the Cheviot Hills (English/Scottish borders)

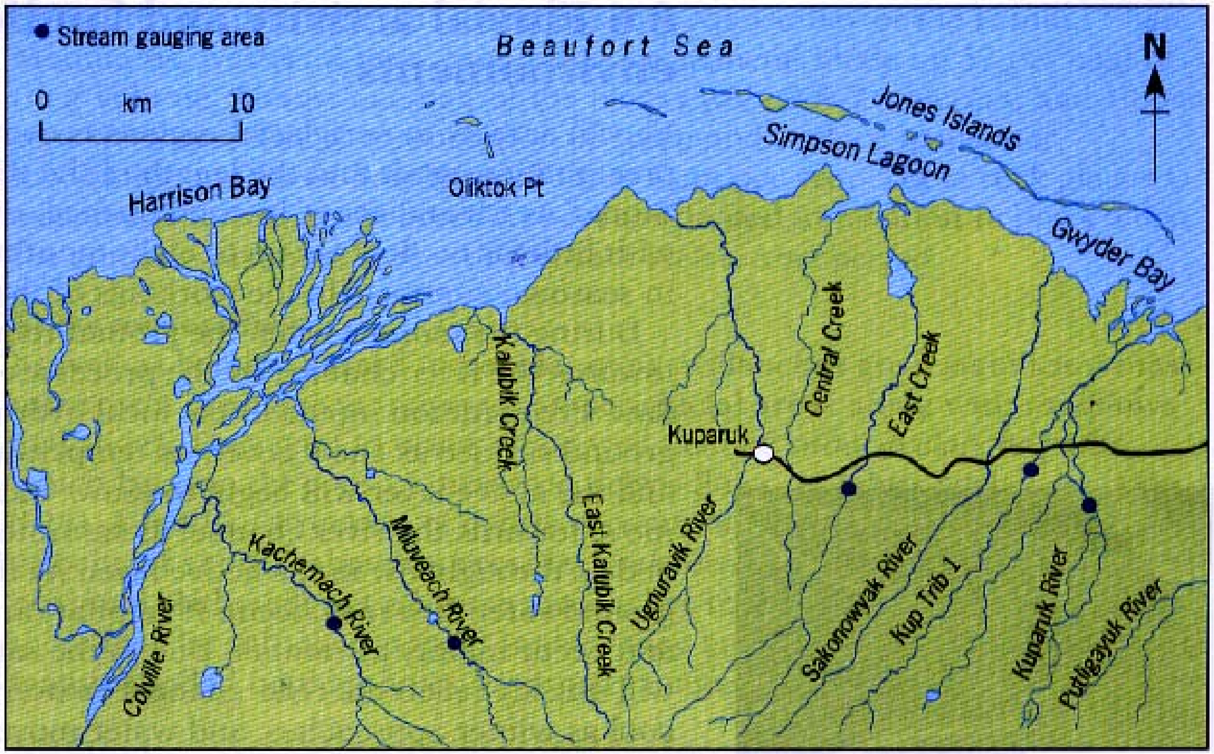


Cheviot solifluction sheet, showing characteristic morphology (*Source:* Harrison, 1993)

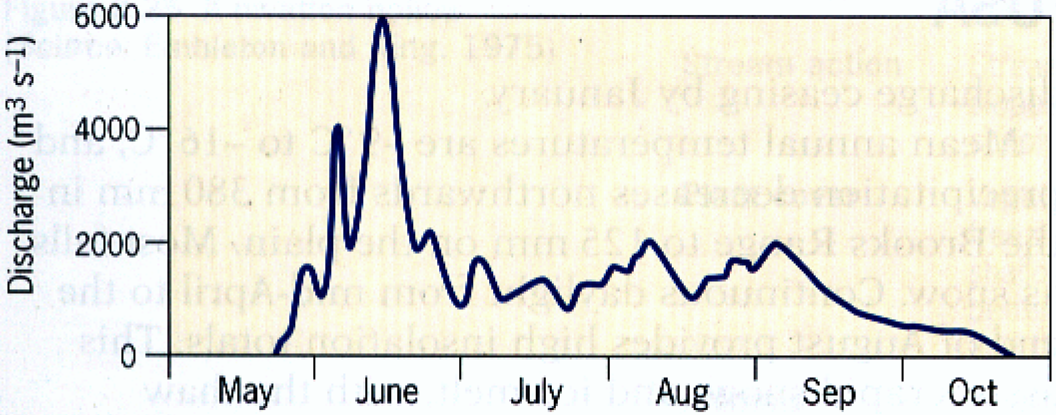
Wind blown periglacial deposits in southern Britain



River erosion in periglacial areas such as the North Slope of Alaska is influenced by both permafrost and extreme hydrographs.



Hydrology of the North Slope, Alaska, USA (*Source:* Drage et al., 1983)



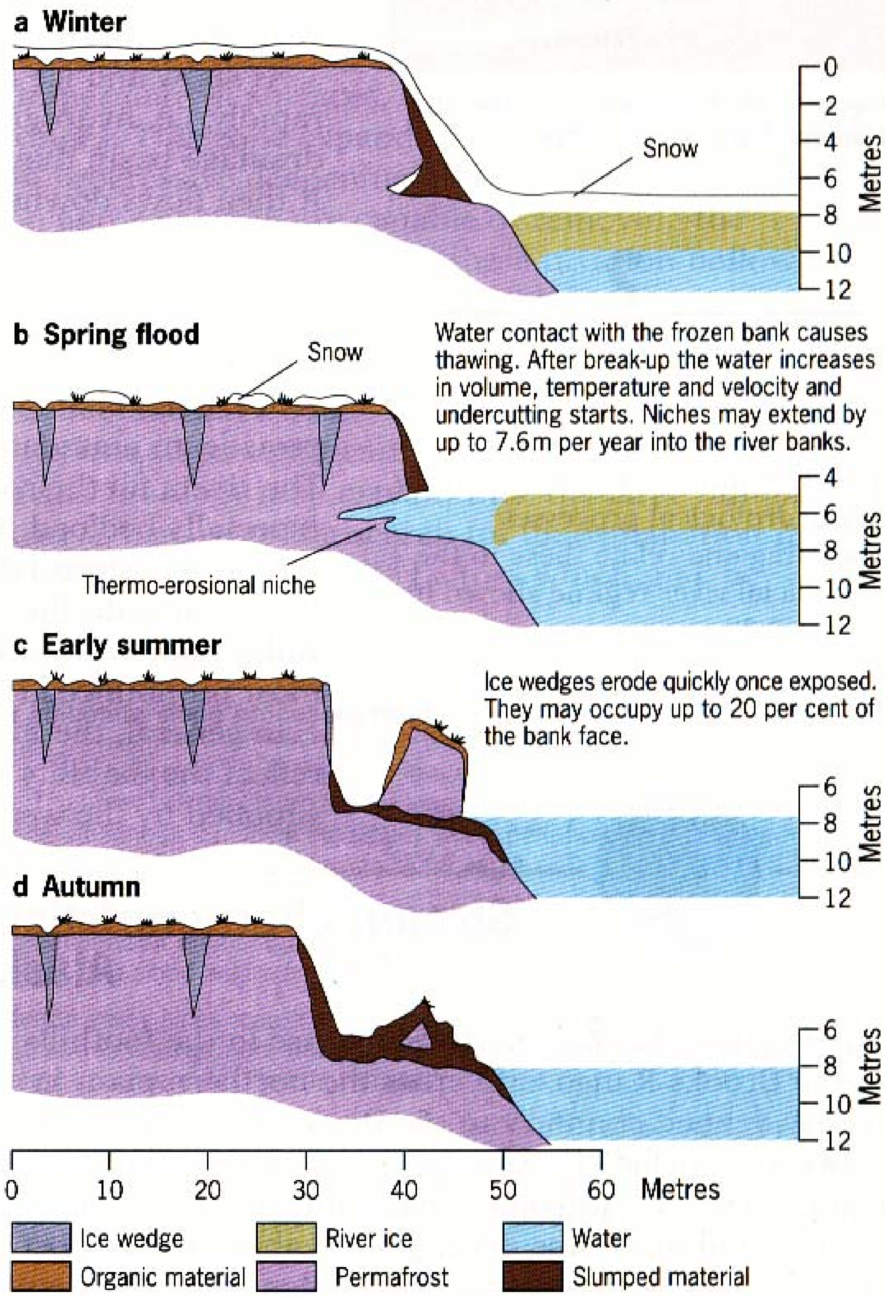
Colville River hydrograph, 1962
(*Source:* Summerfield, 1991)

Rapid thawing in the spring leads to flood water and the thawing of the active layer.

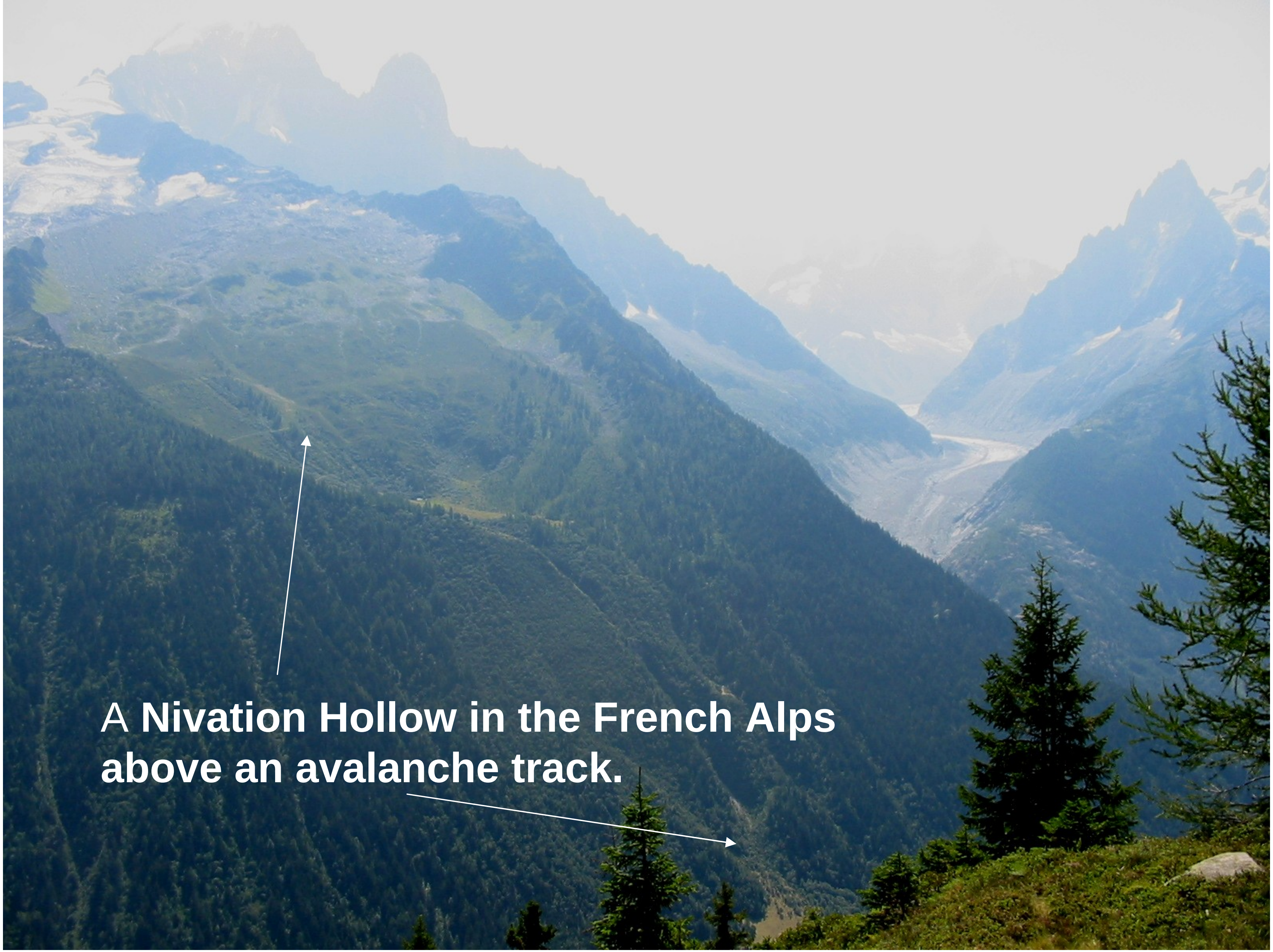
From mid-May, the river ice breaks up and water levels rise 5m in less than 10 days. The active layer thaws. The bulk of the erosion takes place in June. Sudden collapse can occur when melting ice-wedges are exposed.

Bank failures can occur when the water level begins to drop.

Erosion rates can exceed 2m a year.



Riverbank erosion on the Colville River
(*Source:* Richie and Walker)


A Nivation Hollow in the French Alps
above an avalanche track.