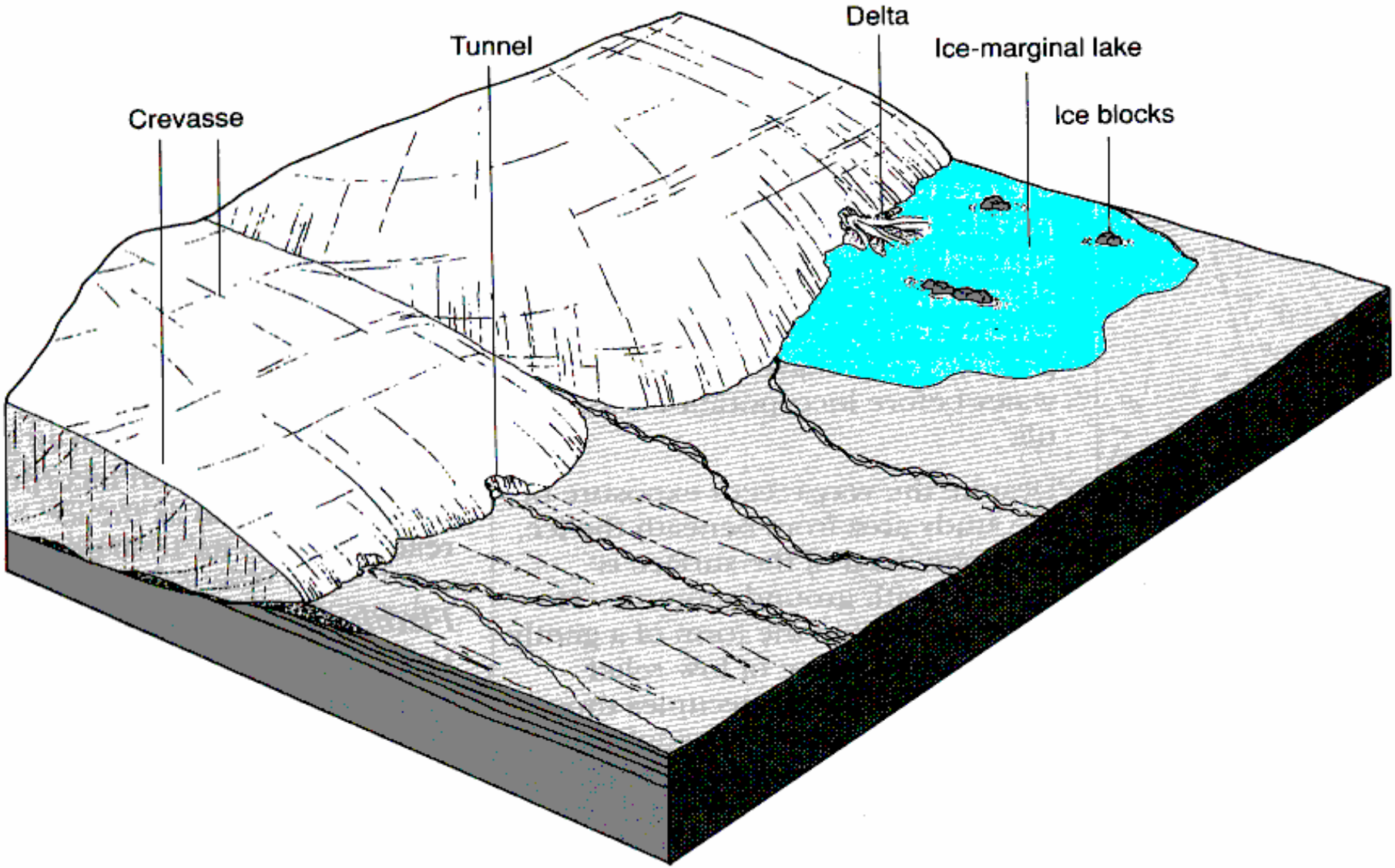
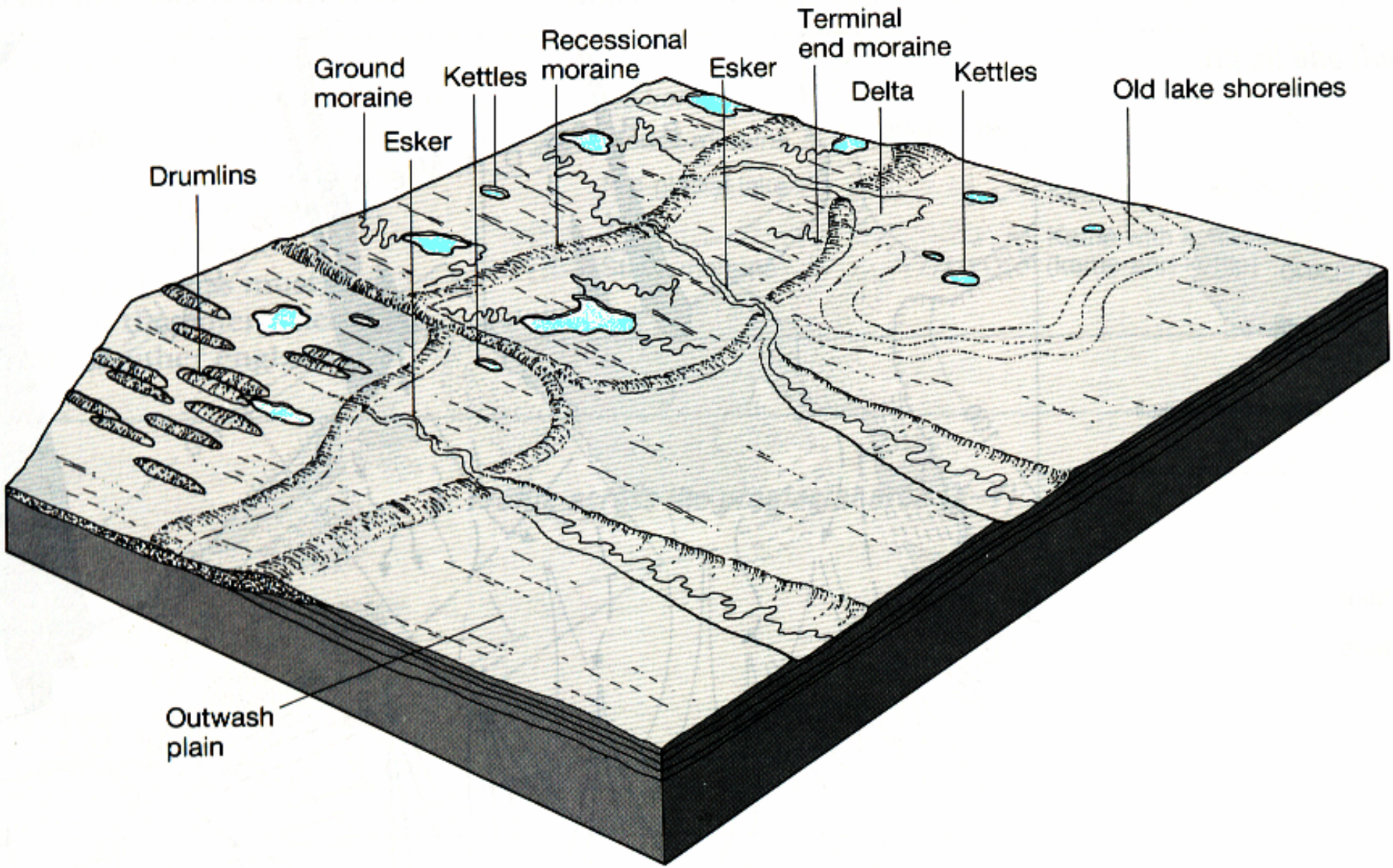
Fluvio-Glacial & Meltwater Features



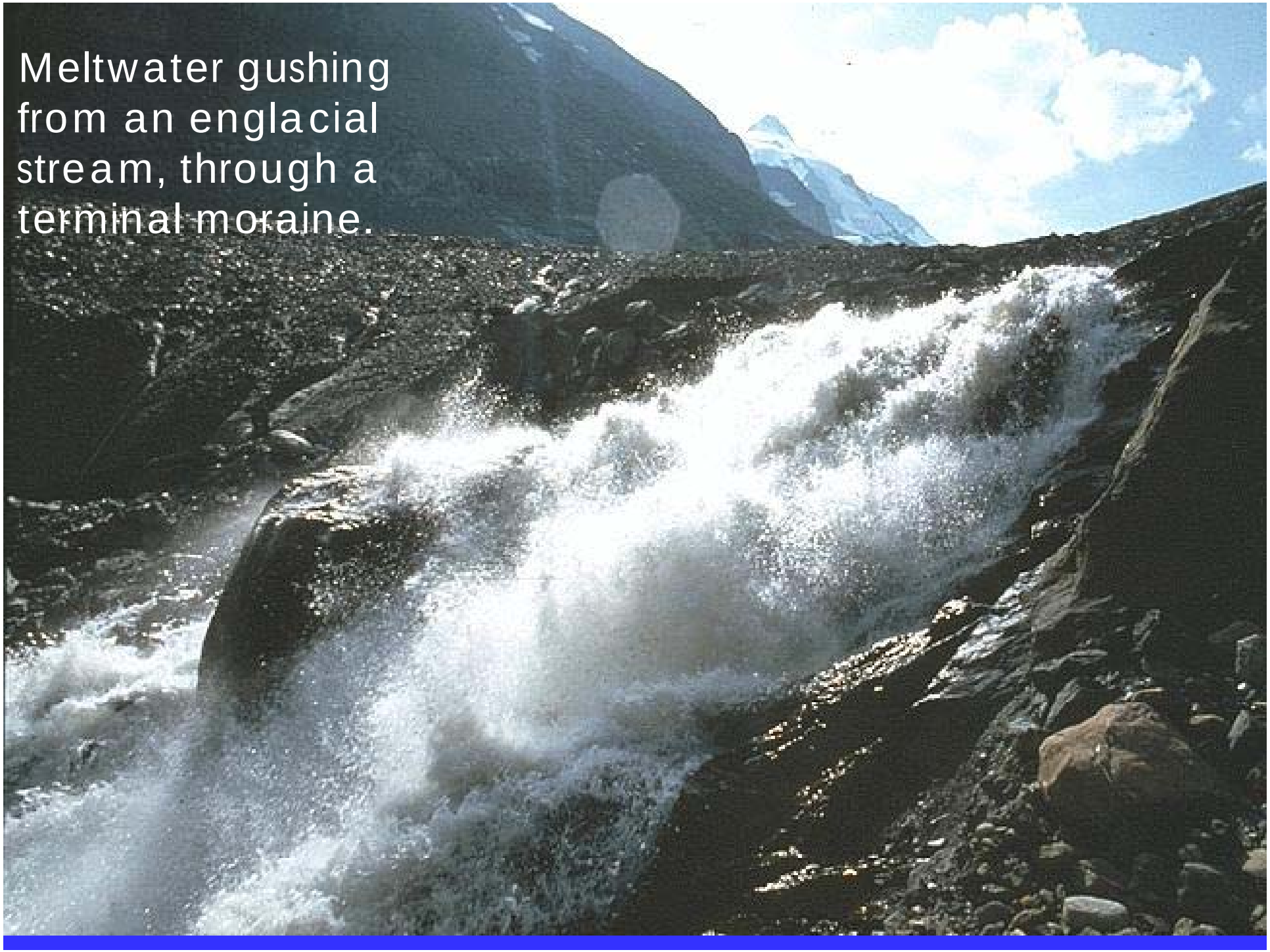
The locations of landforms that develop as a result of a continental glacier depend on the position of the ice margin. Some features form beneath the ice, others as a result of temporary ice-dammed lakes. A further group of landforms result from meltwater extending well beyond the snout of the glacier.



After the ice has receded, a range of landforms is left. Some landforms are a result of direct glacial deposition (such as moraines and drumlins), some relate to former ice-marginal lakes, (such as kame deltas) and others result from deposition and erosion on the outwash plain.

Water in the ablation zone can rise to the surface through crevasses under great pressure.

Braided stream on an outwash deposit. Note the “milky” quality of the water.


Meltwater gushing
from an englacial
stream, through a
terminal moraine.


Outwash deposits accumulating in the Arve valley near Chamonix in the French Alps.

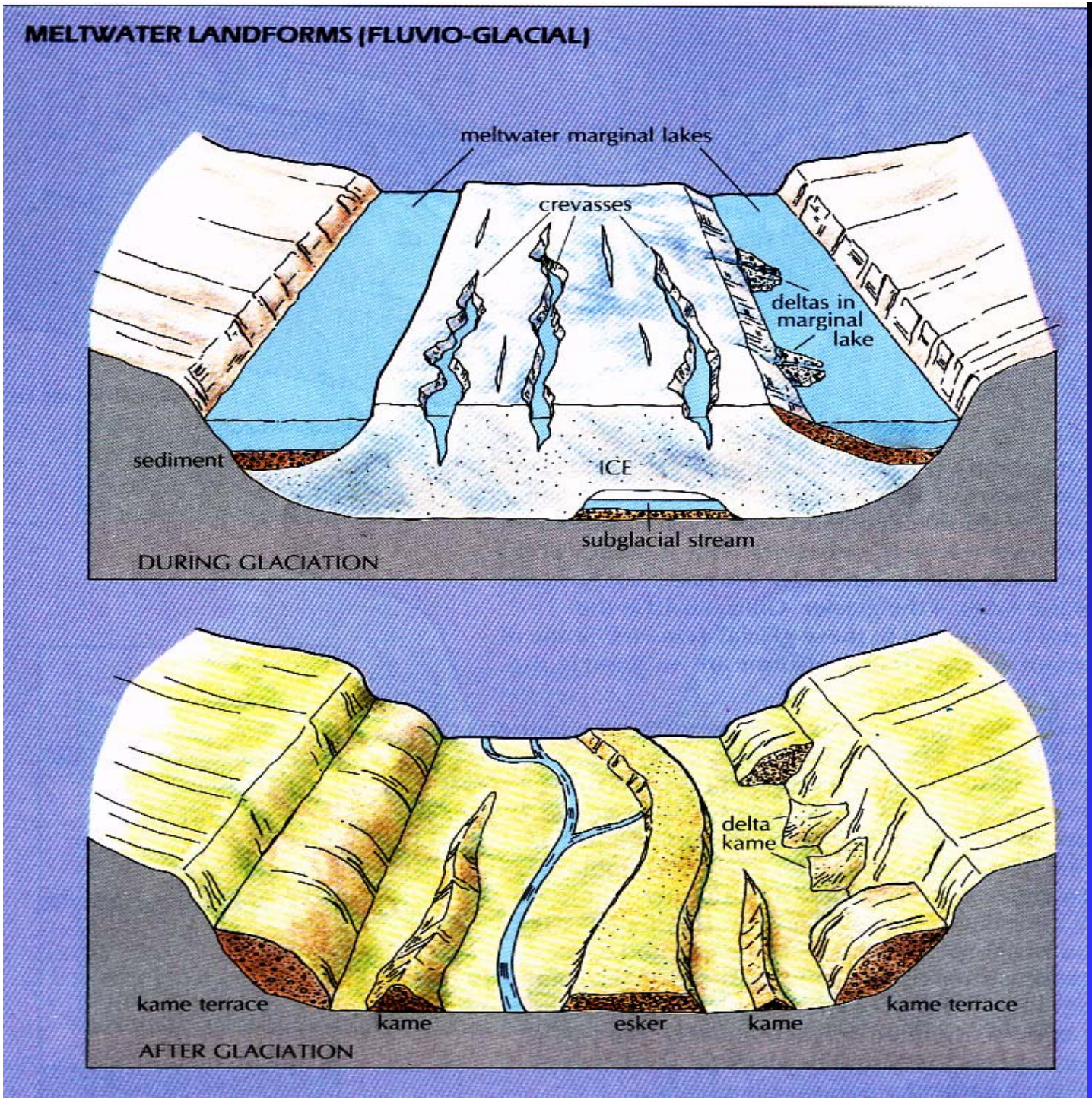
Differences between Glacial and fluvio-glacial deposits

Glacial deposits are generally:

- **unsorted,**
- **angular and**
- **unstratified.**

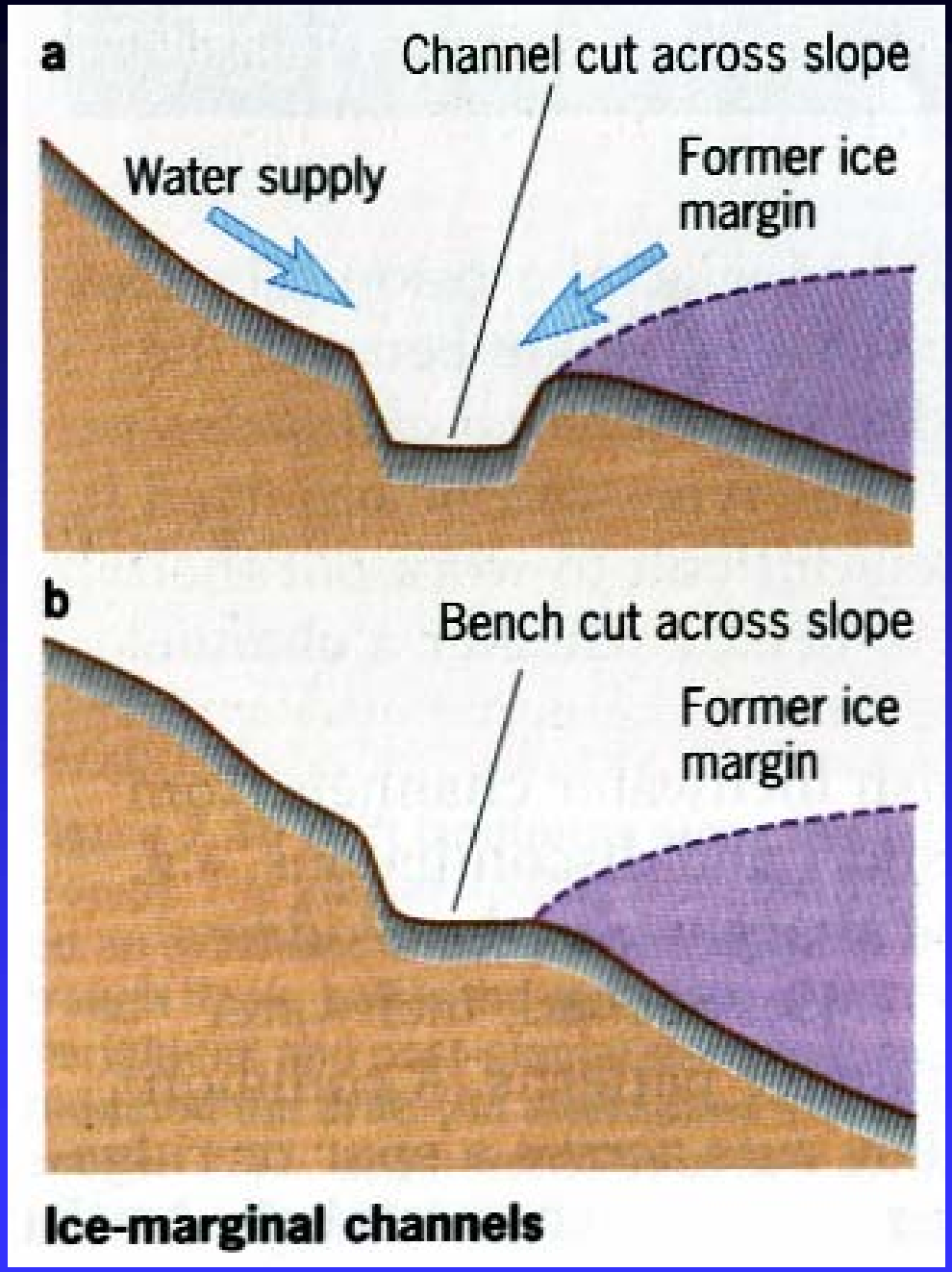
However fluvio-glacial deposits are generally:

- **sorted**
- **rounded and**
- **stratified.**



Landforms resulting from fluvio-glacial activity.

Slochd Mhor in The Cairngorms - moraines and kame terraces formed during deglaciation



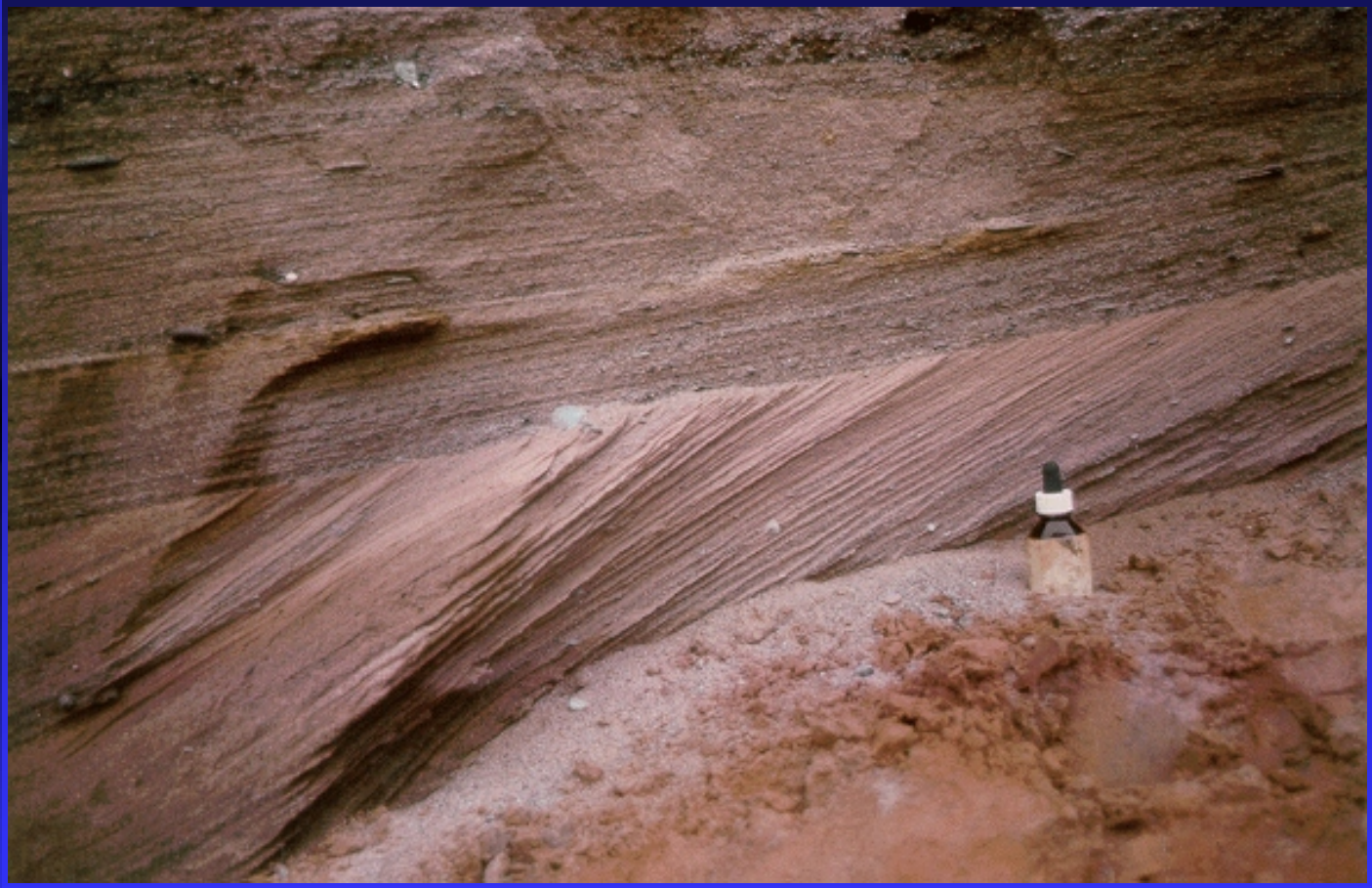
The formation of Ice-marginal channels

Esker

A long narrow ridge, often sinuous, composed of stratified sediment and marking the former location of a glacial tunnel.

Exposure in these eskers is often confined to shallow scrapes. The typical sediments in an esker are seen on the left.

Sorting and stratification of sediments in an Esker in SW Nova Scotia, USA



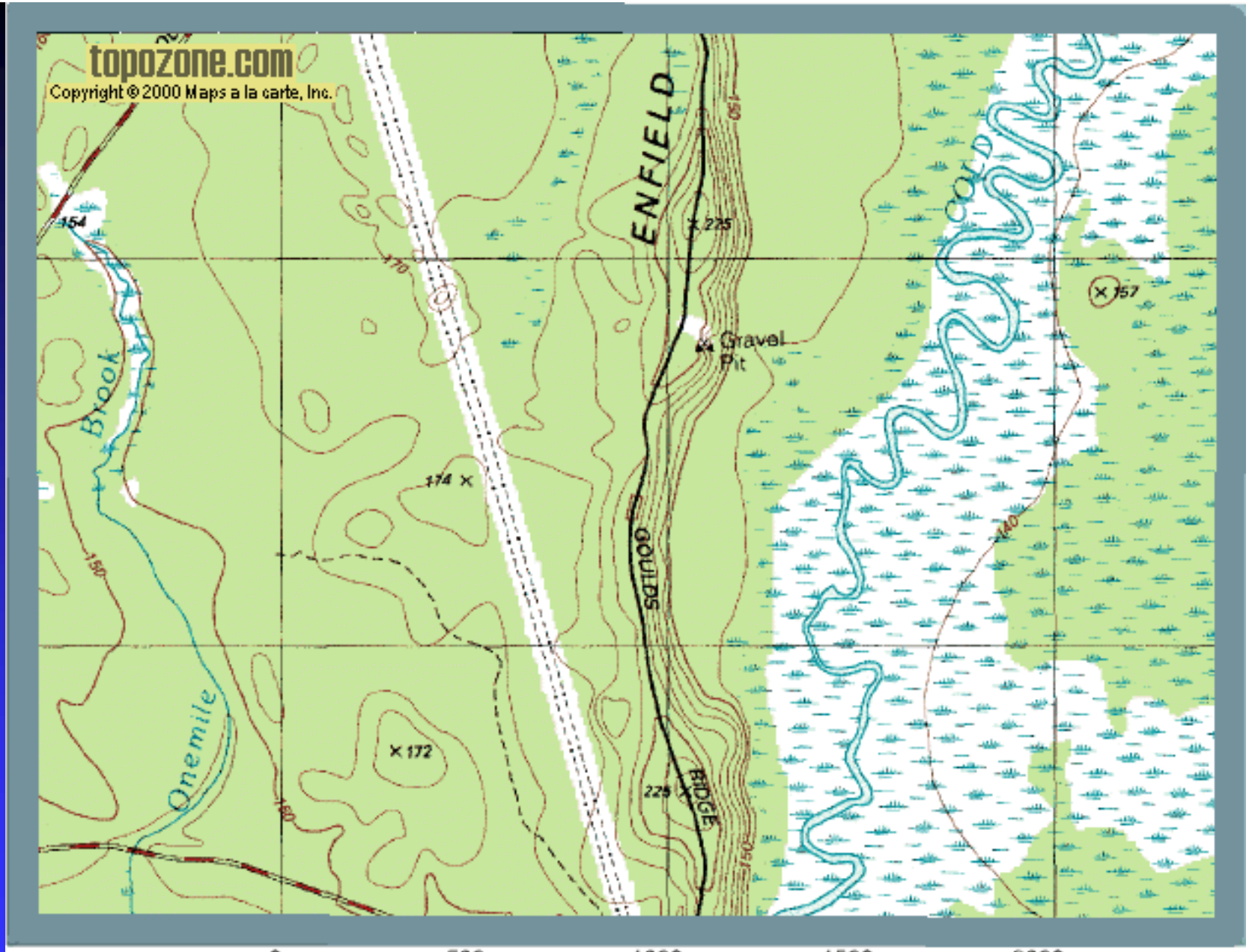
Eskers showing evidence of rounded, sorted and stratified debris.

From the photos you have just seen, note the sinuous form of the ridges.

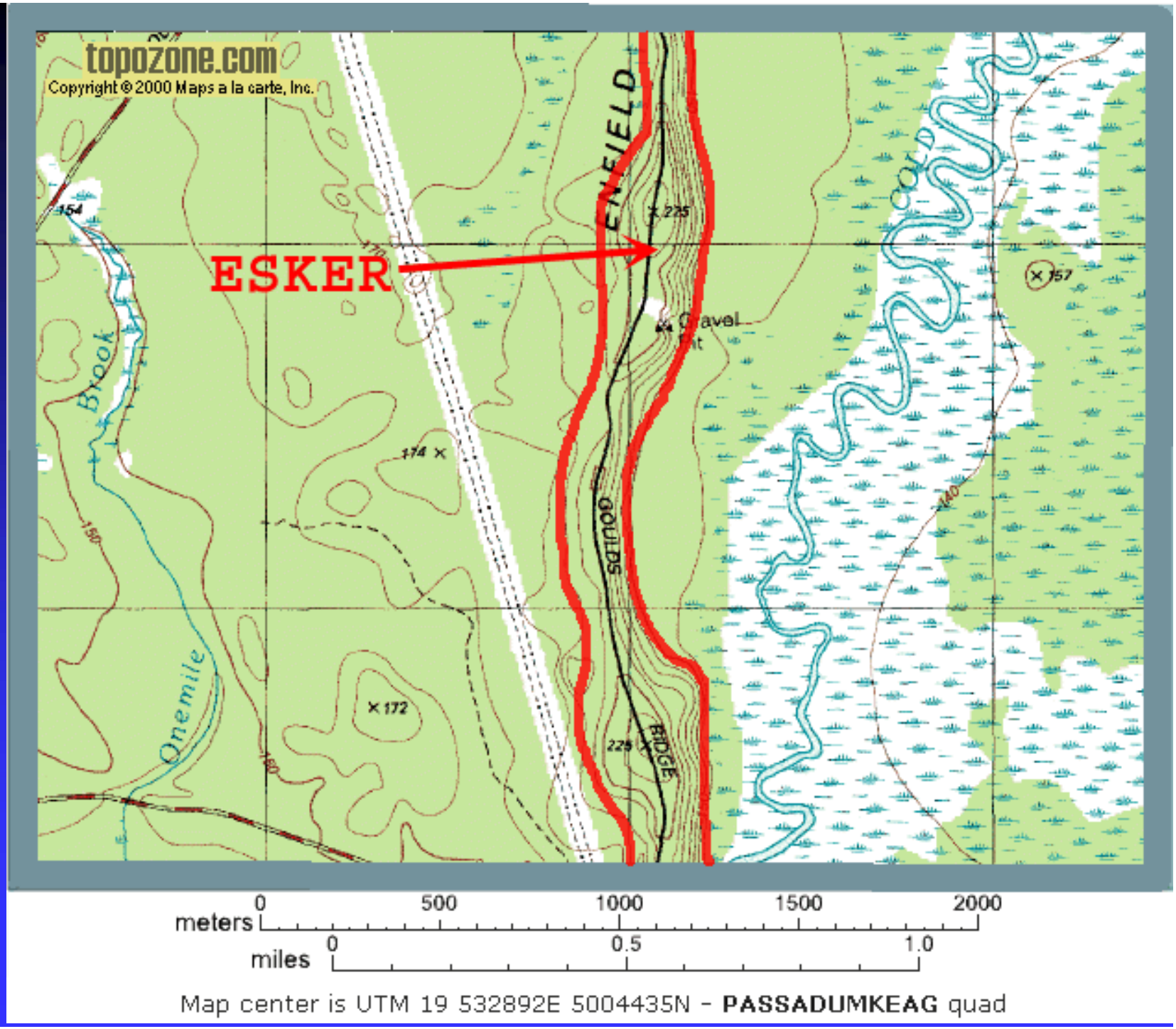
The esker is composed mainly of bedded sand and gravel, with the beds conforming in a general way to the shape of the ridge.

The bedding, together with the rounded nature of the gravel, demonstrates movement by water. The presence of both large blocks and sand shows that meltwater discharge in the former ice tunnel must have varied markedly.

The sediments may be locally faulted, perhaps due to ice-push or simply to the withdrawal of lateral support as the ice melted.



Map center is UTM 19 532892E 5004435N - **PASSADUMKEAG** quad



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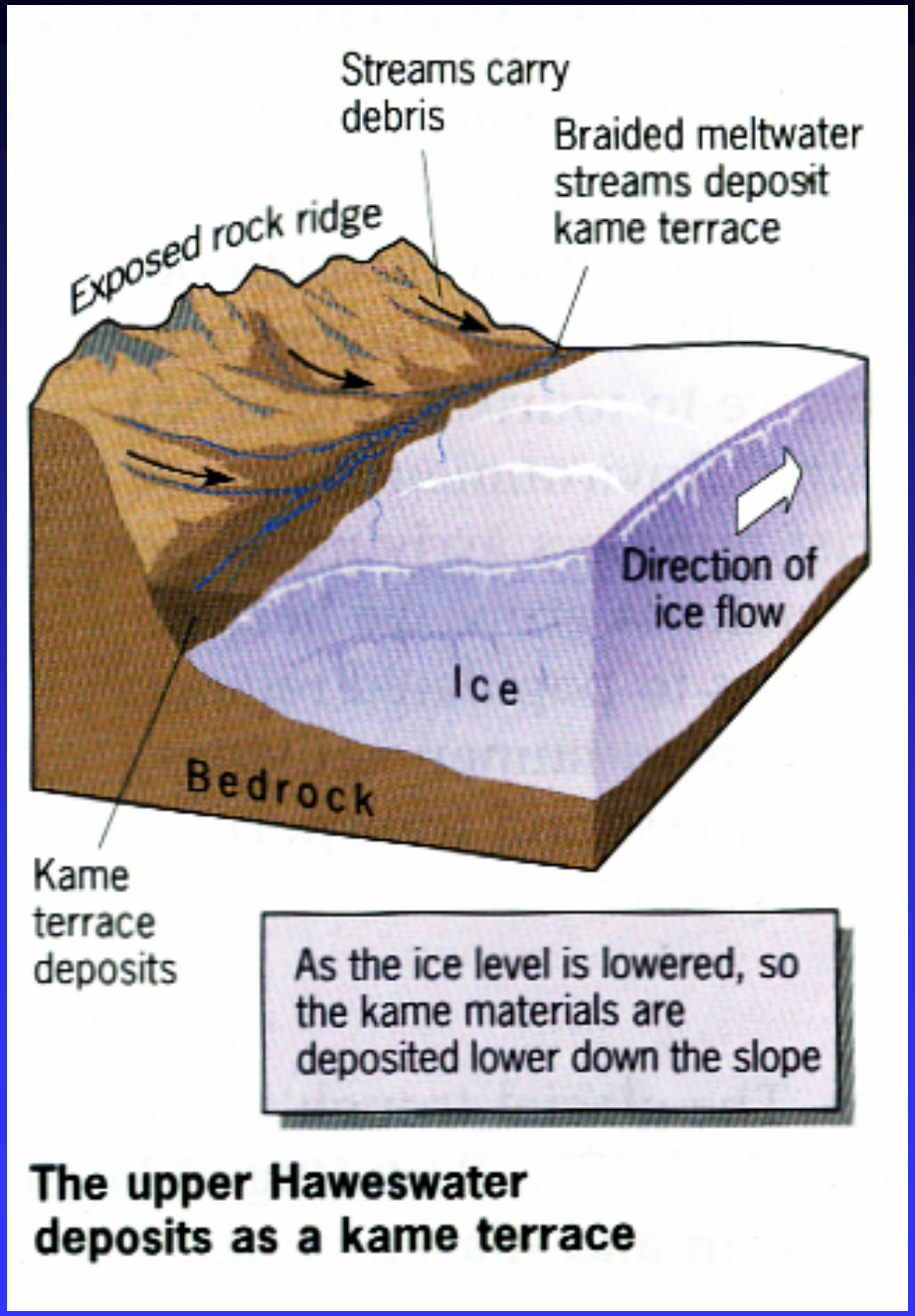

The upper Haweswater deposits as a kame terrace

The formation of kame terrace deposits.

Kame

Gravel in a Kame

Aligned Kames

Kame Terraces in the Cairngorms

The advance of ice across the mouth of Glen Einich at around 14,000 years ago dammed a large glacial lake. This lake received sediments from the ice masses lying to the north and south and began to fill up. On the lake floor, fine-grained sands accumulated in the still water. Drop stones fell into the sand from floating ice bergs. Lake drainage was sudden and rapid flow left coarse gravels on top of the lake floor. Post-glacial river erosion has cut down into the former lake floor to leave a fine series of kame terraces.

Outwash terraces

Outwash is the meltwater that flows from the glacier. It is often highly charged with sediment and this may accumulates down valley. River incision shapes this stratified sand and gravel into sequences of terraces.

Glacial sand and gravel that washed into lakes or the ocean often built up flat-topped deltas. This delta marks the former level of a ice-dammed glacial lake in Weld.

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Most of Maine's commercial sand and gravel deposits are the product of melting glacial ice. This gravel pit was opened in a glacial-marine delta in Dayton. The deeper portions of these deposits commonly contain large quantities of ground water, and thus are important aquifers.

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Kettle Hole

Definition: a hollow created when buried blocks of glacier ice melt out. The name derives from an old meaning of 'kettle', as in a deep iron basin for heating water over a fire. The term survives in 'kettle drum' also.

Kettle holes are formed by blocks of ice that are separated from the main glacier - perhaps the ice front stagnated or retreated or perhaps ice blocks were washed out from the glacier during a glacier flood or *jökulhaup*. If conditions are right, the isolated blocks of ice then become partially or wholly buried in outwash. When the ice blocks eventually melt they leave behind holes or depressions that fill with water to become kettle hole lakes.

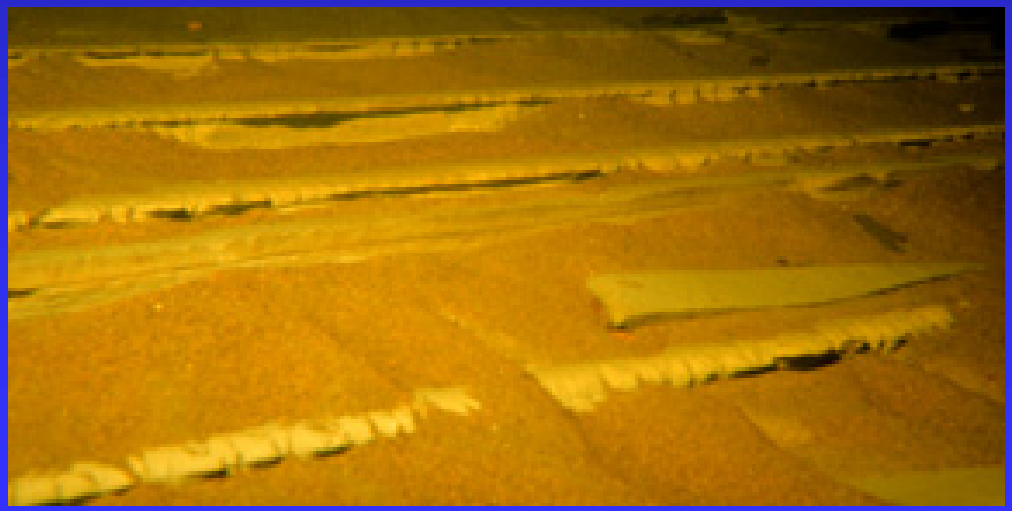
Kettle hole near Skeiðarajokull in Iceland

A kettle hole on the proglacial area of Skeiðarajokull near the jokullhaup portal.

The city of Madison, Wisconsin lies between several glacial **kettle lakes**. The lakes formed when glacial ice remained behind in a former river valley and was buried by outwash deposits.

Varves in cross-section, note alternating clay and sandy layers; knife haft = 10cm

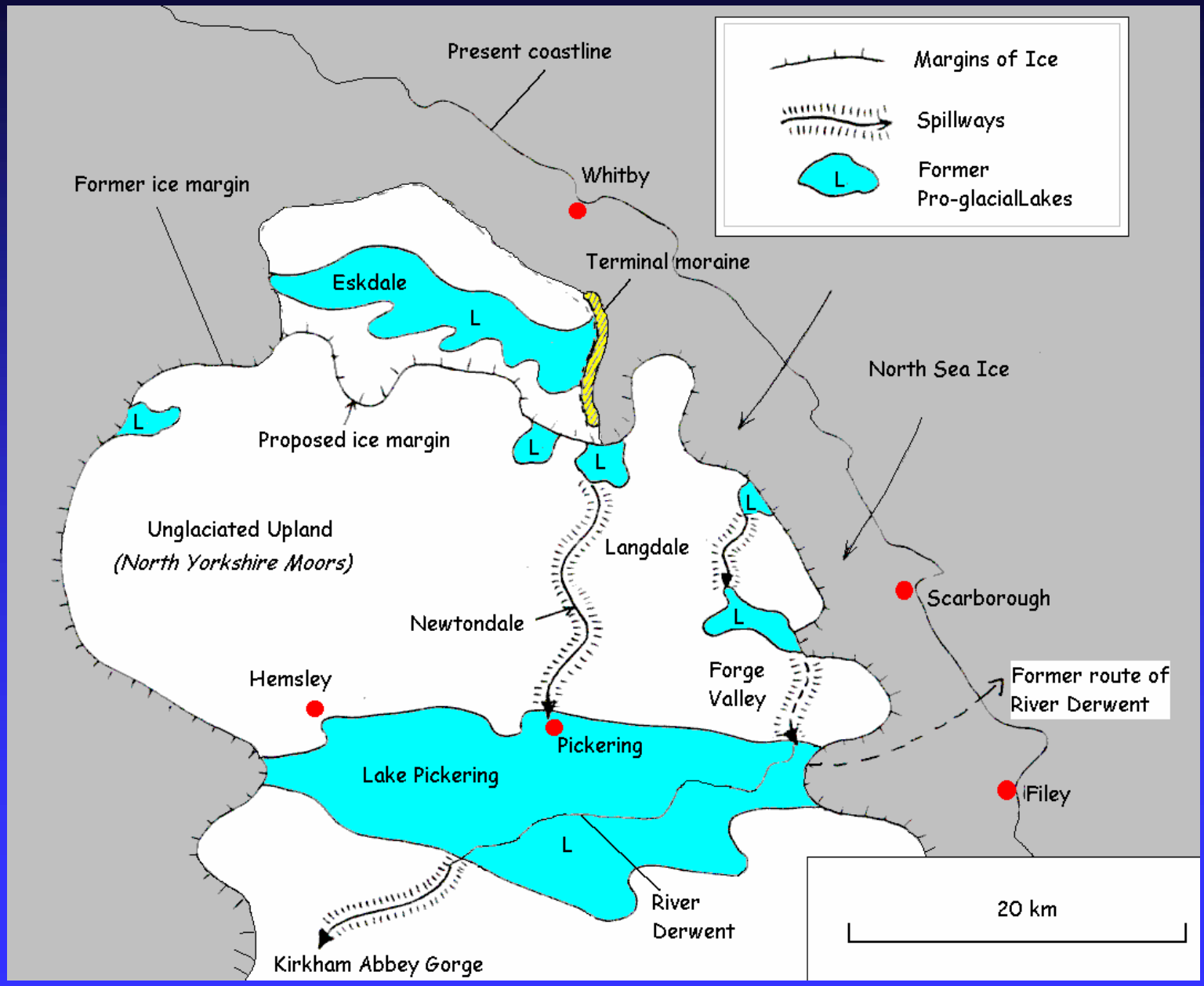
Clay surfaces of varves



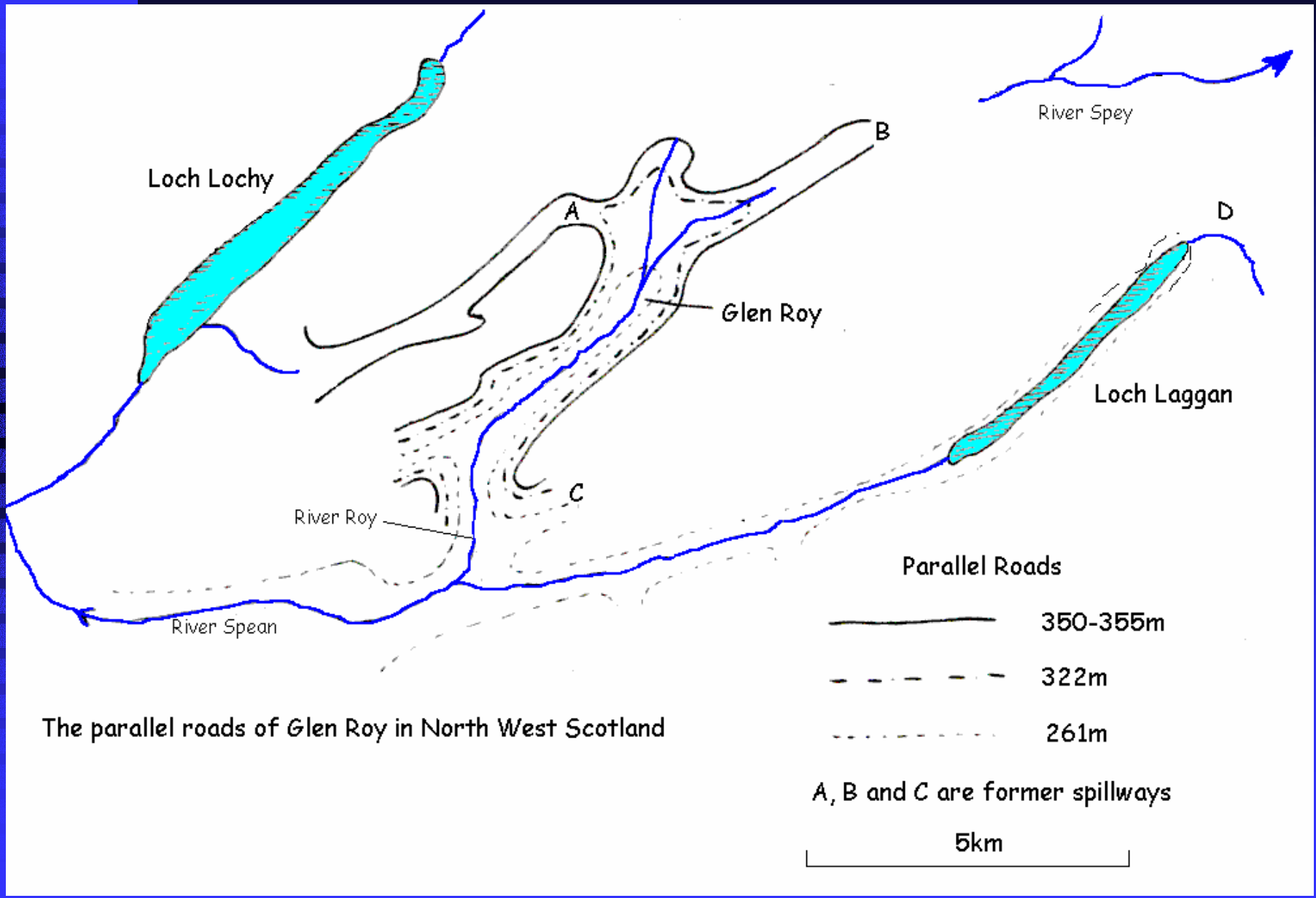
This sculpted outcrop in Ontario is typical of glacial sculpting and abrasion. Increasingly, high-pressure melt water beneath glaciers is being shown to play a role in sub-glacial erosion as well.

Braided Channel on the River Arve in the French Alps

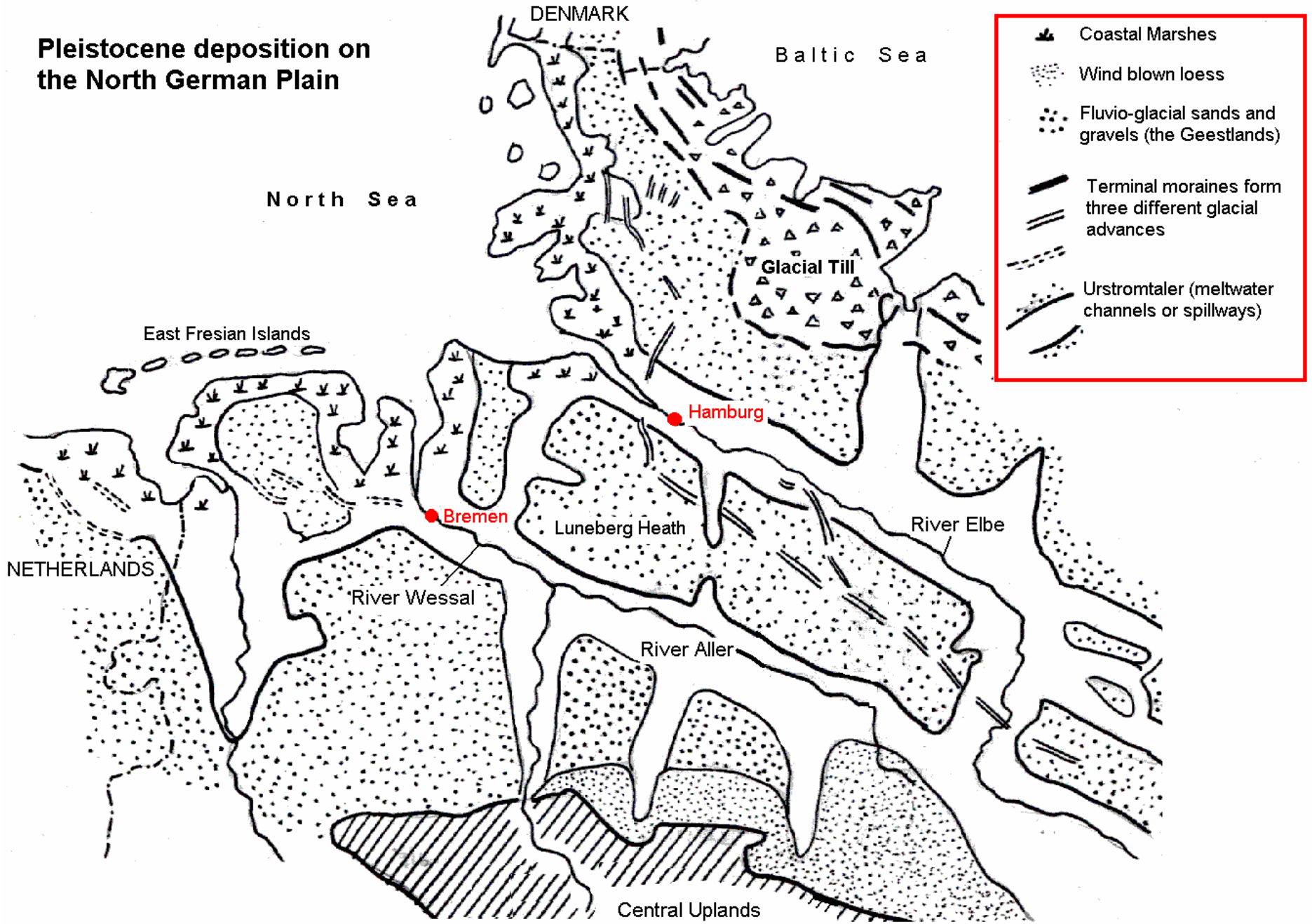
Overflow channels (spillways), former pro-glacial lakes and drainage diversion in North Yorkshire



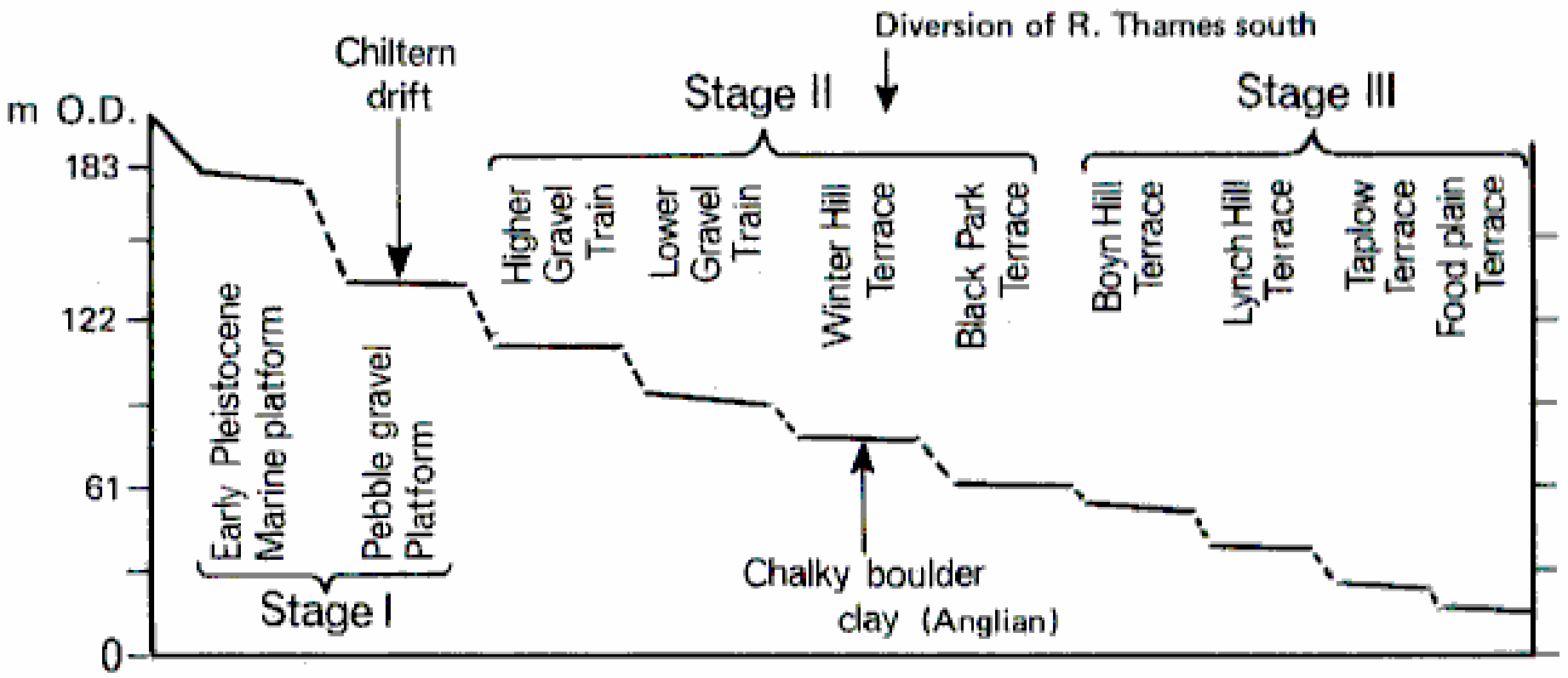
Scars of former pro-glacial lakes: the Parallel Roads of Glen Roy



The parallel roads of Glen Roy in North West Scotland

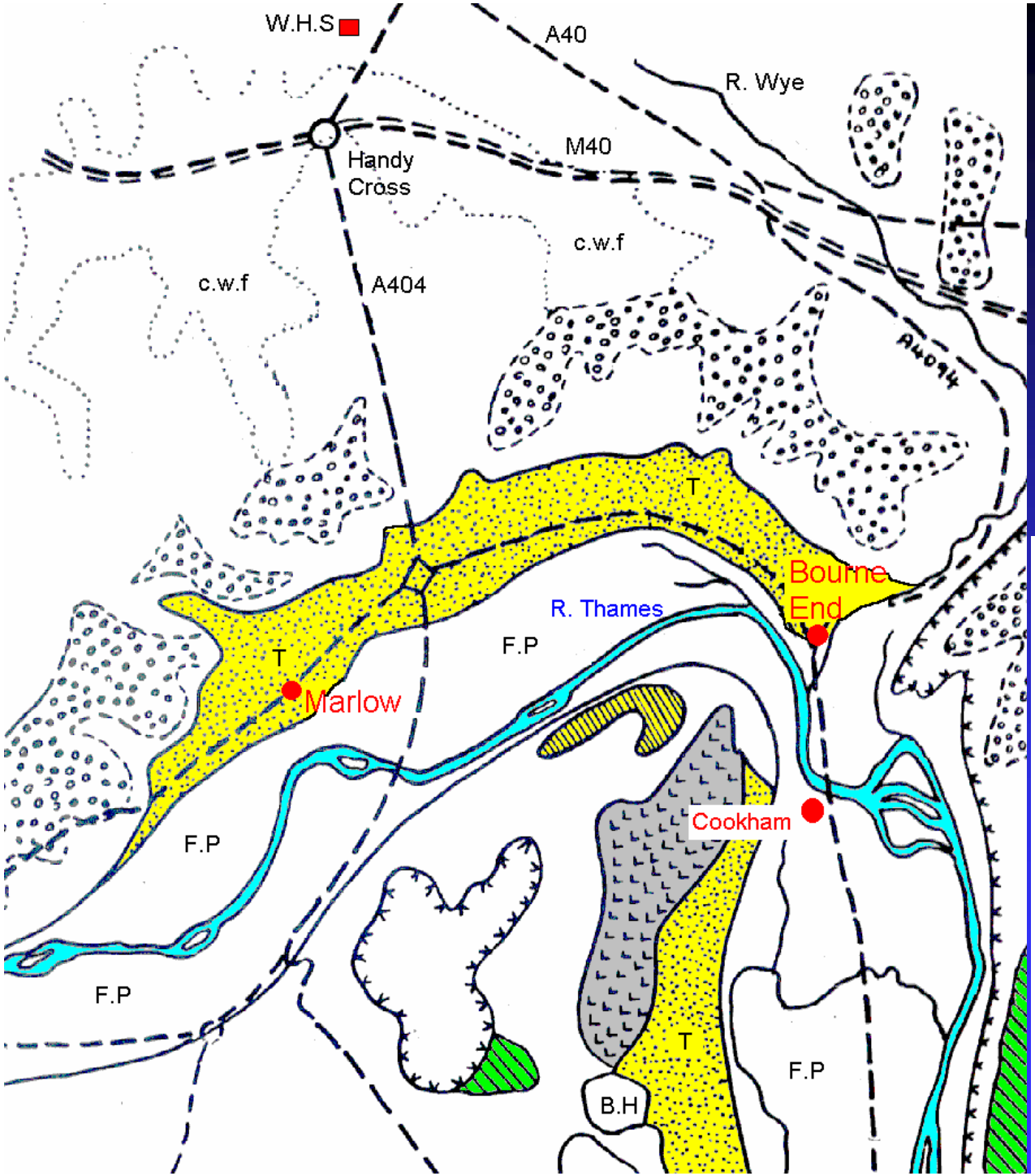

Pleistocene deposition on the North German Plain
DENMARK
Baltic Sea
North Sea
Coastal Marshes
Wind blown loess
Fluvio-glacial sands and gravels (the Geestlands)
Terminal moraines form three different glacial advances
Urstromtaler (meltwater channels or spillways)
Glacial Till
East Fresian Islands
Hamburg
Bremen
Luneberg Heath
River Elbe
NETHERLANDS
River Wessal
River Aller
Central Uplands

The Terraces of the River Thames



Some of the gravels of the terraces of the River Thames were deposited under periglacial conditions. The **Anglian** and **Wolstonian** glaciers, further north in Britain, supplied large quantities of meltwater. The final glacial (Devensian) did not extend far enough south to supply the Thames with meltwater.

Thames Terraces in the Marlow and Bourne End area



Late Tertiary (Eocene) Outliers

c.w.f. Clay-with-flints deposits

High and Low gravel trains (ancient outwash deposits from early Pleistocene

Winter Hill Terrace (Anglian Glacial - 230,000-300,000 b.p)

Black Park Terrace

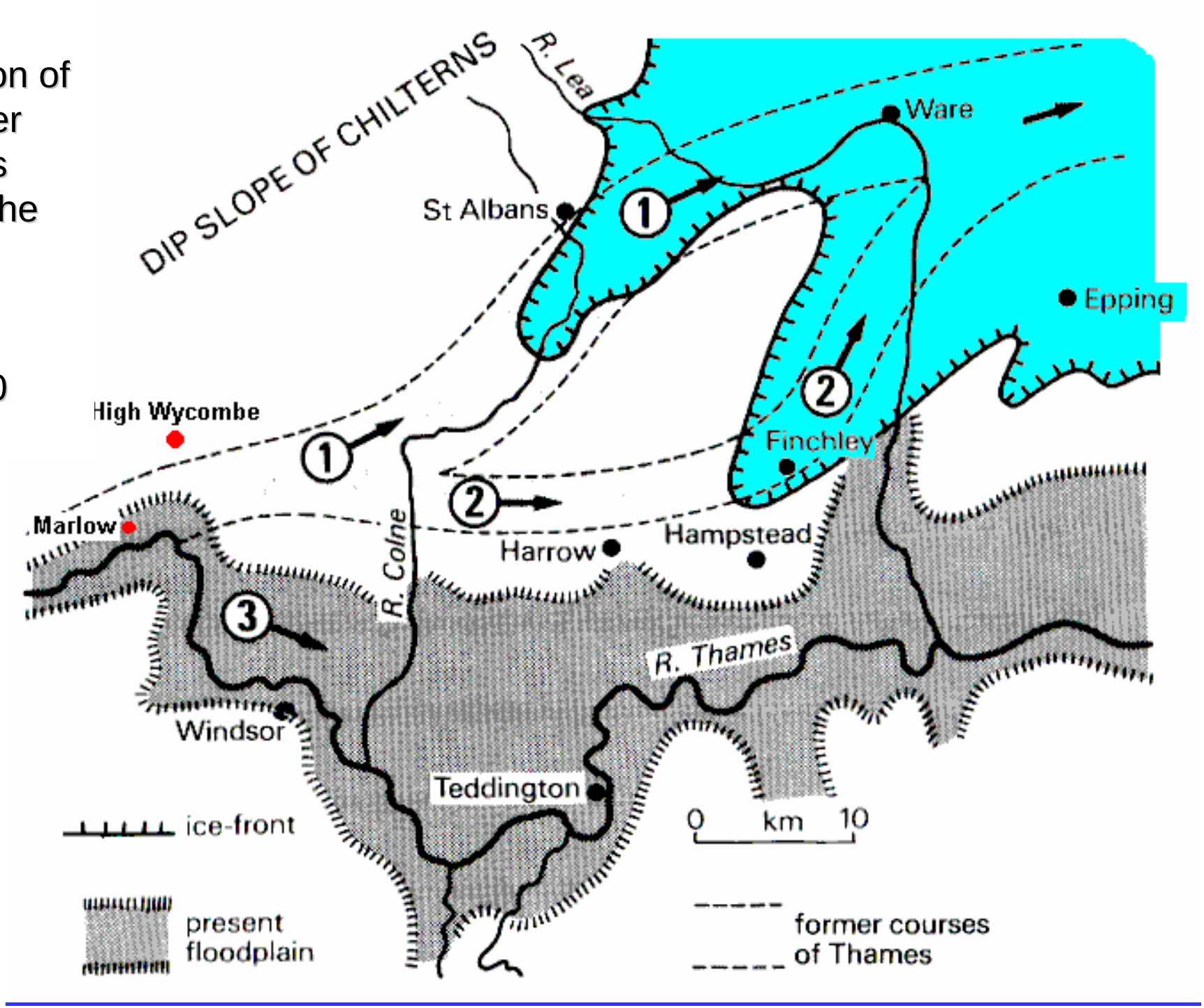
B.H. Boyn Hill Terrace (Hoxnian Interglacial)

Lynch Hill Terrace

T. Taplow Terrace (Wolstonian Glacial 128,000 - 180,000 b.p.)

F. P. Flood plain and flood plain terraces

The Diversion of the River Thames during the Anglian Glacial (about 400,000 B.P)



In North-eastern Wisconsin, the main glacial retreat was followed by a quick re-advance that deposited a thin layer of distinctive red till. This pit west of Oshkosh shows red till on top of cross-bedded outwash sands.

Human Activity in Areas subject to Fluvio-**Glacial Activity**:

Consider the impact of the landscape on:

- Agriculture
- Settlement & Communications
- Mineral extraction

Agriculture

Advantages

Meltwater streams that flowed southwards from the Cromer Ridge terminal moraine carried fine silt and sand which they deposited over a wide area. These Goodsands have been improved with fertilisers and organic matter and now support root vegetables, peas, cabbage and grain. These lighter soils also have the advantage of warming quickly in the spring. These particularly favour root crop such as carrots.

In north Norfolk, fertile loam soils have also formed from outwash deposits and are used for sugar beet and vegetables for the frozen food industry.

Disadvantages

Outwash sands and gravels are freely drained and prone to leaching. This leads to nutrient depleted, acidic soils. Extreme leaching or "*podzolization*" may lead to iron-pan formation which eventually impedes drainage.

Such soil can be found in the Breckland region of East Anglia and in Lüneburg Heath in North Germany. The soils, unless improved, can only support heathland, forestry and rough sheep grazing.

Settlement & Communications

Advantages

Spillways or overflow channels, carved by meltwater, can create important routeways. For example Newtondale in North Yorkshire was adopted by a rail route form Pickering to Whitby.

In Finland and Maine, eskers have been followed by road and rail routes as dry points across landscapes dominated by lakes.

Meltwater channels in North Germany called "*urstromtäller*", now followed by the rivers such as the Elbe and Aller form major routeways for road and rail links.

Disadvantages

Fluvio-glacial landforms are usually low in relief and provide few exceptional restrictions on settlement locations and communication routes.

Mineral extraction

Advantages

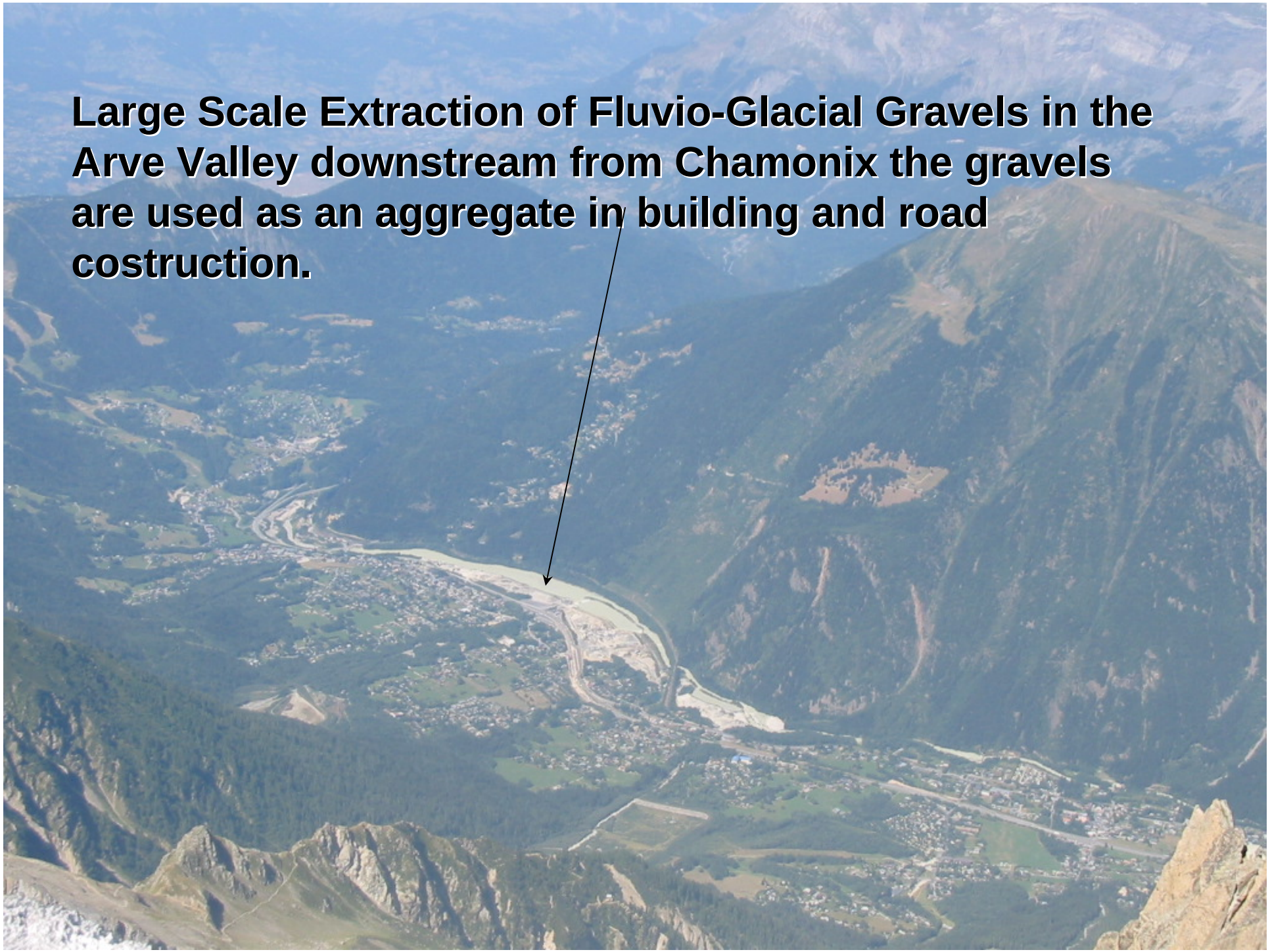
Outwash sands and gravels are important sources of aggregates for the construction industry. Ancient meltwater gravels in the Thames and Kennett Valley (e.g around Reading) and Colne Valley (between Staines and Rickmansworth) are extracted for this purpose.

In Maine (USA) most of the commercially extracted sand and gravel is of fluvio-glacial origin.

Disused gravel pits are useful sites for watersport development, fishing, wetland wildlife sites or landfill waste sites.

Disadvantages

Once gravel has been extracted it is difficult and expensive to return the land to its former use, particularly if the excavation extends below the water table.


Large Scale Extraction of Fluvio-Glacial Gravels in the Arve Valley downstream from Chamonix the gravels are used as an aggregate in building and road costruction.