# CLASSIFICATION OF ALBERTA LANDFORMS

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## Classification of Alberta Landforms

Landforms are those "recurrent topographic shapes" and relief forms that range in size from mountains to sand dunes, eskers, moraines, sandy beaches, and floodplains (Mollard 1972). Alberta has a wide variety of landform features, some being among the most outstanding ones found in Canada. As Campbell (1997) states, Alberta is a province that "has a large and important geomorphological heritage which is both a memory store of its geomorphic evolution, and a key to understanding its present and future landscapes. Because of its size, geographical location, and geological history, its landscapes are extremely diverse and many of its landforms are outstanding examples of their types."

To provide a means to systematically identify Alberta's landforms and to facilitate the collection of data, it was necessary to develop a classification scheme covering the field of geomorphology. Landform classification, as defined by Whittow (1984), is "the arrangement of landforms into various categories based on their various properties, e.g., structure, composition, configuration, genesis or age." The classification scheme chosen to aid in the identification of special landform features for Alberta was one based on genesis. That is, features are classified according to the processes that formed them. This was done for a number of reasons (after Hebrank 1989 and Spicer 1987):

- "landforms, features, or geologic materials are always the result of some geologic process, thus all features can be accommodated by the system,
- "since it is the process that produces the feature of interest, the true significance of a geologic feature is the mechanism by which it was formed,
- "the process approach provides a hierarchical structure from general process, to more specific process, to ultimately the specific landform,
- "classification by process is least susceptible to duplication or overlap,
- "processes operating in similar geologic environments are readily grouped for a 'clean' classification" (e.g., glaciation, wind, tectonic, fluvial).

In addition, "the classical method is to arrange landforms according to the main geomorphological processes that are recognized as responsible for their genesis" (Campbell 1997). A classification system based on genesis, however, is not without its problems. Different schemes by different "experts" are often presented for the same process. Further, there are "terminological variations due to language differences and the perspectives of different viewers" as well as the "constantly changing interpretations of the forms themselves as new evidence, analytical techniques and paradigm shifts take place" *(ibid.).*

One of the major problems that is repeatedly encountered is "in classifying features resulting from not one, but a combination of processes" (Hebrank 1989). It is recognized that many landforms are complex and result from "synchronous and successive processes acting in various combinations over time" (Campbell 1997). Where there is a combination of processes in action, Hebrank (*ibid.*) assigned a feature to the process that was the most critical or important to its development. As much as possible, that approach was also used for this project.

As described by Campbell (1997) and used for this project, the term 'process' refers to "the dynamic actions or effects of the application of forces over gradients - such as wind, rain, waves, etc. Where the applied forces exceed the resistance of the earth's materials (e.g., soil, rocks), deformation or change occurs. Therefore, landforms are the result of the operation of various processes. Some changes can be dramatic (e.g., landslides), others, such as the chemical, physical, or biological breakdown of rocks into soil, may be barely perceptible even over several human life spans. Processes vary in space and time in both intensity and type. For example, less than 20,000 years ago, Alberta was almost entirely covered by glacial ice over one kilometre thick and it is impossible to understand the present landscape without considering the effects of glaciation and glacial meltwater processes.

One of the main tasks in geomorphology is to understand the relationships between form and process (cause and effect) - but because these relationships are highly variable so are the resulting landforms. And, what is viewed as the dominant process depends on the spatial scale (or size) of the area of the earth's surface which is seen. A satellite view of the Alberta Rockies shows the effects of the complex processes of mountain building (tectonism) on structural forms; a single small mountain valley may show only the effects of running water. Therefore, geomorphology considers not only the process or processes which create individual landforms, but also the processes which are involved in producing entire landscapes, i.e., composite landforms created by complex interactions of different processes acting over very long periods of time."

The following landform-forming processes (i.e., landform genesis) were identified:

- running water
- lake waves and currents
- glacial ice and meltwater
- glaciotectonism
- winds
- ground water: karst terrain
- ground water: springs
- ground water: geothermal
- gravity: mass movements
- weathering and differential erosion
- frozen ground and snow
- movements of the earth's crust
- meteorite falls
- volcanism
- peat accumulation: non-permafrost
- peat accumulation: permafrost

All landform feature types present or expected to occur in the province were listed beneath one of the processes shown above. According to Campbell (1997), "this approach of categorization presents many advantages", one of which is that it allows for "the inventory of a complete range of geomorphological forms from the simplest to the most complex." All landform features of actual or potential significance can also be accommodated by this approach. In addition, entries from standard geological dictionaries (e.g., Bates and Jackson 1984; Whittow 1984), or other geomorphological literature sources will fit within the scheme.

A wide variety of sources from the geomorphological literature were used to determine accepted feature names and/or current process classifications. Although attempts were made to provide a fairly representative list of the landform feature types found in Alberta, it is not a complete list. It does, however, provide guidance relative to the types of features that should be considered in a protected area's system. The classification scheme probably never will be complete. It will be modified as new features are identified or process classifications change. Future modifications are made easier by the scheme's hierarchical framework, open-endedness and flexibility.

**References**

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| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Asymmetric valley | | Frozen ground & snow | A valley in areas affected by permafrost (present or past), and that has one valley side commonly much steeper than the other. The steeper slope generally faces north or northwards. The most probable explanation for this asymmetry is the greater solifluction activity that occurs on south-facing slopes plus the asymmetric lateral stream corrasion that occurs in such areas. These valleys usually occur in parallel sets with fairly regular spacing between them (Brierley 1988; French 1996). |
| Avalanche chute | | Frozen ground & snow | The confined or unconfined route followed down a steep mountainous slope of a large mass of snow, ice, soil, or rock, or mixtures of these materials that fall, slide, or flow very rapidly under the force of gravity (A.G.I. 1984). |
| Earth hummock | | Frozen ground & snow | A perennial frost mound of silty or clayey material with varying amounts of organic matter. The mound is generally circular, oval or dome-shaped. Elongated hummocks occur on gentle slopes if their angle is less than 6E. Their height varies from 20 cm to 100 cm, and averages around 50 cm. Their basal diameter is between 50 cm and 150 cm, with the majority close to 100 cm. Earth hummocks usually occur closely spaced in distinct fields, although they may be found on occasion as scattered individuals. When closely spaced, they are separated from each other by narrow grooves or somewhat wider troughs. Earth hummocks occur on flat or gently sloping areas of fine-grained soils where the internal drainage is imperfect but there is no excess of surface water. They invariably develop in fine-grained, stone-free or sparingly stony soils of volcanic-aeolian, lacustrine or glacial origin, and consist of fine-grained mineral soil. The individual mounds are usually covered with vegetation. Most earth hummocks are underlain by permafrost where the seasonally-thawed layer freezes every winter (Clark 1988). |
| Felsenmeer | | Frozen ground & snow | A continuous and chaotic assemblage of moderate-sized to large-sized blocks of broken, jagged rock, mainly the result of intense frost-action on well-jointed rocks; found particularly in high altitudes and high latitudes on flat or gently-sloping surfaces. Some of the blocks are formed in place; others may have been derived from glacially transported boulders. Some may be stabilized in position but others show downstream movement by solifluction. When they become concentrated into stream-like masses moving downslope, they become "stone rivers". Felsenmeer are also known as "blockfields" (French 1996; Mollard 1972; Thornbury 1969; Whittow 1984). |
| Gelifluction forms | | Frozen ground & snow | Landforms that are produced by the slow mass movement of soil and rock debris moving down gentle to steep mountain and hill slopes, primarily under the influence of gravity but facilitated by saturation with water and by alternate freezing and thawing, or by alternate swelling and contraction. The mass of material may flow above perennially or seasonally-frozen ground, as in most polar regions and in many high mountain ranges. Soil flow can occur on slope gradients as little as 1° or 2° and can be classified as: (1)*gelifluction sheets*, with a smooth surface and large lateral extent, (2) *gelifluction benches*, with a pronounced terrace form due to different distributions of snow moisture, bedrock and vegetation, (3) *gelifluction lobes*, characterized by their tongue-like appearance downslope, and (4)*gelifluction streams*, characterized by very pronounced linear form downslope (Parker 1997; Whittow 1984). Gelifluction benches or terraces can range from simple staircase-like "terracettes" to complex larger features having steep fronts up to 3 m in height. They occur in most periglacial environments, but are probably best developed in alpine regions (Fairbridge 1968; French 1996; Mollard 1972). |
| Ice wedge cast | | Frozen ground & snow | A wedge-shaped feature that is a cast of a former ice wedge that has been filled by sand or other materials. Depending upon the degree of deformation during thaw, the feature is either a cast (i.e., bears some resemblance to the original form), or a psuedomorph (i.e, bears little resemblance to the original form) (Berg 1969; French 1996; Whittow 1984). |
| Nivation hollow | | Frozen ground & snow | A semi-circular hollow filled with lingering snowdrifts. A combination of processes, including frost-action, mass-wasting, chemical weathering, and erosion by meltwaters at the edges of, and beneath, a melting snowdrift, causes the snowdrift to countersink into a hillside, creating the nivation hollow. Also termed a "nivation cirque" (Whittow 1984). |
| Patterned ground | | Frozen ground & snow | A term for the minor and microrelief land features of more or less symmetrical form (e.g., circles, polygons, nets, steps, stripes) that are characteristic of but not confined to surficial materials that now or at some previous time were subject to intense frost action. In some of these features, the finer and coarser materials are sorted into various polygonal forms of varying dimensions with angular stones around the perimeter and finer materials in the centre. This action also applies to sorted or stone circles, nets, steps and stripes (A.G.I. 1984; Mollard 1972). |
| Rockglacier | | Frozen ground & snow | A lobate or tongue-shaped body of frozen debris, with interstitial ice or an ice core that is not visible at the surface. It moves slowly down slope or down valley by deformation of the ice contained within it (ice makes up about 50-60% of a rockglacier). A rockglacier has the general appearance and slow movement of a small valley glacier. It has a steep front slope, steep side slopes and a surface relief of arcuate ridges and furrows aligned, in general, perpendicular to the direction of flow. Rockglaciers generally occur in mountainous terrain and are looked upon as true periglacial features. Many rockglaciers are 100 to 200 m wide, several hundred meters long and often thicker than 50 m. Two types of rockglaciers are generally recognized: talus rockglaciers that form below talus slopes and debris rockglaciers that form below glaciers (A.G.I. 1984; Clark 1988; French 1996; Potter 1972; Whittow 1984). |
| Thermokarst lake | | Frozen ground & snow | A lake or pond (generally circular or oval-shaped) usually in a perennially frozen peatland, and contained within a subsidence depression (e.g., a collapse scar) created by the thawing of permafrost (A.G.I. 1984; CCELC 1987; Veatch and Humphrys 1964). |
| Arête | | Glacial ice & meltwater | A sharp-edged rock ridge or spur, commonly present above the snowline in mountains sculptured by glaciers, and resulting from the continued backward growth of the walls of adjoining cirques. It is also termed a "serrated ridge" (A.G.I. 1984; Campbell 1997/1998). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Biscuit board topography | | Glacial ice & meltwater | Topography, usually on rolling uplands or plateaus, that consists of glacial cirques which have been eroded headward in horizontally stratified sedimentary rocks. The cirques have not yet coalesced and the resultant topography has the appearance of large "bites" being removed from it similar to dough that has had biscuits cut out and removed (Smith 1987; Whittow 1984). |
| Cirque | | Glacial ice & meltwater | A deep steep-walled recess or hollow, horseshoe-shaped or semicircular in plan view, situated high on the side of a mountain and produced by the erosive activity of a mountain glacier (A.G.I. 1984). |
| Col | | Glacial ice & meltwater | A high, sharp-edged pass in a mountain range, especially one formed by the headward erosion of two cirques (A.G.I. 1984). |
| Crag-and-tail | | Glacial ice & meltwater | A streamlined hill or ridge, resulting from glaciation and consisting of a knob of resistant bedrock (the "crag") on the up-ice side, with an elongate body (the "tail") of more erodible bedrock, till, or both, on its lee side (A.G.I. 1984). |
| Crevasse filling | | Glacial ice & meltwater | A relatively straight ridge of stratified sand and gravel, till or other sediments, formed by the filling of a crevasse in a stagnant glacier which later melted. Crevasse fillings may resemble eskers but are not generally as winding or branching. Most crevasse fillings are much wider and have more nearly level tops compared to narrower eskers, whose top surface generally undulates. Bends in crevasse fillings tend to be angular and crossings of different generations of crevasse fillings are not uncommon (Mollard 1972). |
| Drift basin | Holm lake | Glacial ice & meltwater | A body of water that is dotted with islands (Veatch and Humphrys 1964). |
| Drift basin | Kettle lake | Glacial ice & meltwater | A body of water occupying a depression in glacial drift or outwash material, the depression being formed by the melting of a detached block of stagnant ice that was buried in the drift or outwash (A.G.I. 1984). Kettle lakes occur in a variety of situations, including: within outwash or till in pre-existing valleys (often forms a series of lakes which lie along the valley stream), within outwash plains thus forming pitted outwash and within glacial till thus forming knob and kettle topography (Hutchinson 1957). |
| Drift basin | Morainal lake | Glacial ice & meltwater | A lake occupying a depression resulting from irregular deposition of drift in an end moraine or ground moraine of a continental glacier (A.G.I. 1984). |
| Drift basin | Moraine-dammed lake | Glacial ice & meltwater | A lake held by the terminal, recessional or lateral moraines of an existing or former glacier (Hutchinson 1957). |
| Drift basin | Saline/Alkaline lake | Glacial ice & meltwater | A body of water containing high concentrations of alkalies (e.g., sodium carbonate, sodium sulphate, potassium carbonate) or salts (e.g., sodium chloride); alkali or salt deposits can be extensive; lakes are often intermittent, drying up and forming alkali or salt flats during the summer (Macdonald 1982; Veatch and Humphrys 1964). |
| Drift basin | | Glacial ice & meltwater | A basin formed within the rock and till material that has been transported by glaciers and deposited directly from the ice or through the agency of meltwater (A.G.I. 1984). |
| Drumlin | | Glacial ice & meltwater | A streamlined, oval to elongated hill composed of a variety of constituents (e.g., till, bedrock). A drumlin's long axis is parallel to the direction of ice movement. The end facing the direction of the ice front is blunter and steeper than the downstream tail end, which tapers in plan and profile. Drumlins vary in height from 6 to 60m, commonly 15 to 24m, and in length from a 100m to several kilometres. Drumlins usually occur in groups termed a field or a swarm. The formation of drumlins has been attributed to: (a) the product of subglacial deformation, (b) the product of subglacial lodgement, (c) the product of melt-out of debris-rich ice, or (d) the product of fluvial infills or erosional remnants of subglacial floods (A.G.I. 1984; Bennett and Glasser 1996; Mollard 1972; Whittow 1984). Recent work by Shaw et al. (1989, 1996) and Rains et al. (1993) provide evidence that formation of drumlins is attributable to erosion and deposition by subglacial meltwater flows. |
| Erratic | | Glacial ice & meltwater | A transported rock fragment different from the bedrock beneath it. The agent of transport is most commonly glacial ice. Erratics can be deposited at considerable distances from where they were derived. They range in size from a pebble to a house-size block (A.G.I. 1984; Mollard 1972). |
| Esker | | Glacial ice & meltwater | A serpentine ridge of roughly stratified gravel and sand that was deposited by a stream flowing in or beneath the ice of a stagnant or retreating glacier and was left behind when the ice melted (A.G.I. 1984). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Fluting | Giant fluting | Glacial ice & meltwater | Very large subglacial meltwater features. Giant flutings are considered to have been formed by longitudinal vortices in subglacial meltwater sheets flowing at high velocities. Gian flutes, separated by remnant ridges, form discontinuous fields in central and southern Alberta (Shaw et al. 1989, 1996). |
| Fluting | | Glacial ice & meltwater | Smooth straight parallel furrows, usually fairly small, that have been worn in the surface of rocks by glacial erosion (Mollard 1972). Grooves and ridges in till that are parallel to the direction of ice movement have also been termed flutes (A.G.I. 1984). According to Bennett and Glasser (1996), flutes are typically low (<3m), narrow (<3m), regularly spaced ridges which are usually less than 100m long and are aligned parallel to the direction of ice flow. |
| Friction crack | Chattermark | Glacial ice & meltwater | A small, curved scar made by vibratory chipping of a bedrock surface by rock fragments carried in the base of a glacier. Each mark is roughly transverse to the direction of ice movement, and usually convex toward the direction from which the ice moved (A.G.I. 1984). |
| Friction crack | Crescentic fracture | Glacial ice & meltwater | A crescent-shaped mark on a glaciated rock surface, in the form of a hyperbolic crack, of larger size (up to 10-12 cm long) than a chattermark; it is convex toward the direction from which the ice moved and consists of a single fracture without removal of any rock (A.G.I. 1984). |
| Friction crack | Crescentic gouge | Glacial ice & meltwater | A crescent-shaped mark in the form of a groove or channel with a somewhat rounded bottom, formed by glacial plucking on a bedrock surface; it is concave toward the direction from which the ice moved and it consists of two fractures from between which rock has been removed (A.G.I. 1984). |
| Friction crack | Lunate fracture | Glacial ice & meltwater | A crescent-shaped mark in the form of a groove or channel with a somewhat rounded bottom, formed by glacial plucking on a bedrock surface; it is convex toward the direction from which the ice moved and it consists of two fractures from between which rock has been removed (D313). |
| Friction crack | | Glacial ice & meltwater | A family of small cracks, gouges, chattermarks and indentations created in bedrock as larger boulders or clasts beneath a glacier are forced into contact with the bed (Bennett and Glasser 1996). |
| Glacial groove | | Glacial ice & meltwater | These features are similar in morphology to striations, except for their greater size and greater depth. They range in size from tens of metres to hundreds of metres in length and may be up to several metres wide and a metre deep. They are probably the product of glacial abrasion although the flow of glacial meltwater may be important in the expansion of the groove once formed (Bennett and Glasser 1996). According to Rains (1997), glacial meltwater erosion can also produce these features. |
| Glacial tunnel lake | | Glacial ice & meltwater | A lake occupying a basin formed by glacial meltwater running under the main ice sheet and that excavated the underlying tills. These lakes are often elongated and form chain-like configurations (Hydrogeological Consultants Ltd. 1974). |
| Glacier | Cirque glacier | Glacial ice & meltwater | A small glacier occupying a glacially eroded armchair-shaped hollow (i.e., a cirque). It may be contained entirely within the rock basin or it may estend outwards byond the lip of the cirque as a small glacier tongue. |
| Glacier | Hanging glacier | Glacial ice & meltwater | A glacier, generally small, protruding from a basin or niche on a mountainside above a cliff or very steep slope, from which ice may break off occasionally and abruptly to form an ice avalanche (A.G.I. 1984). |
| Glacier | Outlet glacier | Glacial ice & meltwater | A lobe of glacier ice issuing from an ice sheet or ice cap and flowing through a mountain pass or down a peripheral valley (A.G.I. 1984; Whittow 1984). |
| Glacier | Valley glacier | Glacial ice & meltwater | A glacier in mountainous terrain. It often originates in one or more cirques and may flow down a valley previously made by a stream (A.G.I. 1984). |
| Glacier | | Glacial ice & meltwater | A large mass of ice formed on land by the compaction and recrystallization of snow, creeping downslope or outward due to the stress of its own weight, and surviving from year to year (A.G.I. 1984). |
| Hanging valley | | Glacial ice & meltwater | A tributary glacial valley whose mouth is high above the floor of the main valley, the discordance being due to the greater erosive power of the trunk glacier in the main valley. A river flowing down the hanging valley will, therefore, descend to the main valley as a waterfall or a series of cataracts (A.G.I. 1984; Whittow 1984). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Horn | | Glacial ice & meltwater | A high pyramidal peak with steep sides formed by the intersecting walls of three or more cirques. Sharp, hornlike or pyramid-shaped mountains that somewhat resemble the Matterhorn in the Alps have been termed "matterhorn mounains" (A.G.I. 1984). |
| Ice field | | Glacial ice & meltwater | An extensive area of interconnected glaciers in a mountain region (A.G.I. 1984). |
| Ice scour lake | | Glacial ice & meltwater | A lake formed in a basin after the scouring action of ice moves loose material or carves a depression either in softer rocks or in zones of fractures and joints (Hutchinson 1957). |
| Kame | Kame delta | Glacial ice & meltwater | A small or large, conspicuous, mesa-like landform created when debris-laden meltwater streams discharge gravels and sands into a temporary glacial lake or pond lying on, in, under, or against stagnant glacier ice. Kame deltas tend to comprise better bedded and sorted sediments than kames built on land. They have a distinctive flat top and a uniformly inclined frontal margin that is commonly lobate in outline (Kupsch and Rutter 1982; Whittow 1984). |
| Kame | Kame moraine | Glacial ice & meltwater | A type of moraine comprised of groups or elongate strings of hummocky mounds of irregularly bedded sand and gravel with subordinate till, deposited unevenly from meltwater flowing along or near a moving or decaying stagnant glacier. The inner faces of the kames represent slumped sediments that rested against the ice (Mollard 1972). |
| Kame | Kame terrace | Glacial ice & meltwater | A terrace-like body of stratified silt, sand, and gravel along with slumped ablation till laid down by meltwater streams that discharged into the trough between a glacier and its enclosing valley walls. It is sometimes called an ice-contact terrace. Kame terraces resemble alluvial terraces except that they are more irregular in outline and form. Commonly they contain many kettle depressions and show highly disturbed irregular bedding. Kame terraces are common in mountain and foothill valleys formerly occupied by valley glacier (Mollard 1972). |
| Kame | Moulin kame | Glacial ice & meltwater | An irregular circular hill, or mound of mainly stratified drift deposited by glacial meltwaters draining into a moulin a vertical or steeply inclined shaft or circular hole in a glacier (Mollard 1972; Whittow 1984). |
| Kame | | Glacial ice & meltwater | A short, irregular ridge, hill, or mound of mainly stratified drift deposited in contact with glacier ice by meltwater. Kames may form in holes and fissures on, in, and under stagnant glacier ice as well as, more commonly, at the margin of a the glacier on the adjoining deglaciated land surface (Mollard 1972). |
| Kettle | | Glacial ice & meltwater | An enclosed depression or hollow in glacial drift or in outwash that is formed by the melting of a detached block of stagnant ice that was buried in the drift or outwash deposits (A.G.I. 1984). |
| Knob and kettle terrain | | Glacial ice & meltwater | An undulating landscape in which a disordered assemblage of knolls, mounds, or ridges of glacial drift is interspersed with irregular depressions, pits, or kettles that are commonly undrained and may contain swamps or ponds (A.G.I. 1984). |
| Lake basin group | Chain of lakes | Glacial ice & meltwater | A local group consisting of a relatively small number of lakes tied together by live connecting streams or natural channels. The lakes are not restricted to any definite pattern of arrangement, or uniformity in size and spacing (Veatch and Humphrys 1964). |
| Lake basin group | Train of lakes | Glacial ice & meltwater | A small number of lakes (usually less than 12), arranged in a linear pattern, relatively small in size, and more or less uniformly spaced and tied together by sections of a stream or narrow channels (Veatch and Humphrys 1964). |
| Meltwater channel | Ice-marginal channel | Glacial ice & meltwater | A type of meltwater channel cut by glacial meltwaters at the junction of the ice surface and the surrounding rock or other materials, i.e., marginal or parallel to the glacier front. They tend to start and end abruptly. These channels may have a complete channel cross-section or may consist of a channel floor and one wall, the other wall having been formed by the glacier. A marginal bench may have survived the disappearance of the ice (Bennett and Glasser 1996; Whittow 1984). These channels have also been referred to as "one-walled" and "perched bedrock channels". |
| Meltwater channel | Ice-walled channel | Glacial ice & meltwater | A type of channel that originated from meltwaters downcutting and moving through tunnels in the ice or through open ice-walled trenches, probably along crevasses or lines of weakness in stagnant ice. After the channels were cut they were often infilled with drift, depending on the amount of debris contained in the ice walls (Gravenor et al. 1960). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Meltwater channel | Subglacial channel | Glacial ice & meltwater | A steep-sided meltwater channel cut into bedrock or till by glacial meltwaters beneath a glacier or ice-sheet. Subglacial channels may cut across or be orientated transverse to the surface contours and drainage patterns of the present-day topography. Most subglacial channels are now streamless or occupied by tiny watercourses which clearly were not responsible for their formation (Whittow 1984). These features have also been termed "tunnel valleys". Tunnel valleys, however, are usually regarded as being considerably large than subglacial channels and of increasing significance in terms of the current work in Alberta on meltwater effects vis-a-vis the 'megaflood hypothesis' (Campbell 1997/1998; Evans 1994). |
| Meltwater channel | | Glacial ice & meltwater | A form of channel, perhaps no longer carrying a stream, cut into solid rock or drift deposits in areas of former glaciation, and mostly unrelated to the present drainage system. It frequently cuts across current drainage divides, has very steep sides and remains of fairly constant width (Whittow 1984). |
| Meltwater channel lake | | Glacial ice & meltwater | A lake occupying a basin formed in a meltwater or overflow (i.e., spillway) channel. |
| Micro crag and tail | | Glacial ice & meltwater | Small tails of rock which are preserved from glacial abrasion in the lee of resistant grains or mineral crystals on the surface of a rock. These features provide clear evidence of both the orientation and direction of ice flow (Bennett and Glasser 1996). |
| Moraine | de Geer moraine | Glacial ice & meltwater | A type of moraine comprised of successions of small parallel to subparallel, subequally spaced, often sharp-crested, narrow, subangular bouldery, sandy to silty till ridges up to 12m high. They may be either straight to broadly curvilinear (arcuate) in plan and are interpreted to have formed underwater where the glacier terminated in a former deep lake and subsequently retreated. The individual ridges are often covered with large subangular boulders and separated by varved silt and clay (Mollard 1972; Smith 1987). |
| Moraine | End moraine | Glacial ice & meltwater | A ridgelike accumulation of till that marks a stillstand position of a present or past glacier front. End moraines that typically form a series of subparallel ridges, sometimes up to 15m thick, have been termed ridged end moraines. End moraines that have been formed during a pause in the retreat of a glacier have been termed recessional moraines. End moraines that mark the maximum limits of a glacial advance have been named terminal moraines (A.G.I. 1984; Shetson 1987; Whittow 1984). |
| Moraine | Fluted moraine | Glacial ice & meltwater | A ground moraine with a distinct lineation parallel to the direction of former ice movement, perhaps formed by processes similar to those which form drumlins. Flutes or ridges are straight, closely spaced, parallel and narrow, 1.5 to 9m high alternating with flat, evenly-bottomed furrows. The ridges have accordant tops and are mainly developed in till, but may be found less commonly on other glacial drift sediments, called fluted drift (Mollard 1972; Whittow 1984). |
| Moraine | Lateral moraine | Glacial ice & meltwater | A ridge of glacial debris flanking a glacier side or lying along the sides of a valley formerly occupied by a glacier (Whittow 1984). |
| Moraine | Medial moraine | Glacial ice & meltwater | A linear accumulation of rubbly material extending down the centre of a glacier. It is often ice-cored and varies in width from a narrow ridge to a broader spread of morainic material. The feature is caused by the merging of two lateral moraines from the point at which two glaciers unite (Whittow 1984). |
| Moraine | Rogen moraine | Glacial ice & meltwater | A type of moraine characterized by the presence of rogens. Rogens are drumlinized ridges that are transverse to the direction of ice flow. In plan, rogens often have a lunate form, with the concave elements pointing in a down-ice direction. Drift ridges or large drumlins created from an earlier direction of ice flow have been deformed into a rogen moraine by a new ice flow direction (Bennett and Glasser 1996). |
| Moraine | Washboard | Glacial ice & meltwater | A type of moraine in which the relatively low ridges of till are closely spaced and parallel to each other, i.e., resembling a washboard. This type of moraine is probably formed from thrust plane development near the ice margin, and the ridges parallel to ice-movement are related to longitudinal crevasses or lines of stress in the ice (Gravenor et al. 1960; Whittow 1984). It has been used loosely as a general term to encompass De Geer moraines, minor recessional moraines, ribbed moraines, corrugated moraines and others (Mollard 1972). Because "washboard moraine" is a general term and somewhat vague, it is not a popular term (Campbell 1997/1998). |
| Moraine | | Glacial ice & meltwater | A mound or ridge of unstratified glacial drift, chiefly till, deposited by direct action of glacial ice (A.G.I. 1984). |
| Moraine plateaux | | Glacial ice & meltwater | Generally subcircular, flat-topped mesa-like mounds composed of till and/or stratified drift (Mollard 1972). According to Shaw et al. (1996), moraine plateaux are thought to be mainly residuals from incomplete sheetflood erosion of previously deposited sediment. |
| Mountain pass | | Glacial ice & meltwater | A natural passageway through high, difficult terrain, as between two peaks (A.G.I. 1984). |
| Nunatak | | Glacial ice & meltwater | An isolated knob or peak of bedrock that projects prominently above the surface of a glacier and is surrounded by glacier ice (A.G.I. 1984). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Outwash delta | | Glacial ice & meltwater | A delta composed of outwash materials (Kupsch and Rutter 1982). |
| Outwash plain | | Glacial ice & meltwater | A body of outwash that forms a broad plain at and beyond the margin or former margin of a shrinking glacier and commonly consisting of a number of coalescing outwash fans tha may have been crossed by braided streams. Varieties are called outwash terraces, fans, aprons, or trains. Typically, materials are carried away from the front of a glacier by meltwater rivers and streams. Gravel is deposited closest to the glacier margin and grades downstream into more extensive areas of sand. Non-pitted outwash plains are nearly level, have gentle gradients, and may or may not have channel scars. Changes in the relative position of the ice front may create terraces, ridges or steps across the outwash surface parallel to the ice front. An outwash plain has also been termed "sandur", an Icelandic term (Kupsch and Rutter 1982; Whittow 1984). |
| Overflow channel | | Glacial ice & meltwater | A channel, often streamless, cut in solid rock or in drift, having been carved out by the overflow of an ice-dammed lake. They are characteristically flat-floored and steep-sided, with sharp edges at both top and bottom. They can only be recognized with certainty where they are associated with deltas, lake shorelines and lake-bottom deposits formed in the formerly impounded pro-glacial lake. Overflow channels should be distinguished from glacial meltwater channels. These types of channels have also been referred to as "glacial spillways" (Whittow 1984). |
| Paternoster lakes | | Glacial ice & meltwater | A linear series of small lakes occupying rock basins in a glacial valley, connected by steams, rapids, or waterfalls (A.G.I. 1984; Hutchinson 1957). |
| Pitted delta | | Glacial ice & meltwater | A delta characterized by numerous depressions such as kettles, shallow pits, and potholes, produced by the partial or complete burial of glacial ice by alluvium and the subsequen thaw of the ice and collapse of the surficial materials (A.G.I. 1984; Parker 1997). |
| Pitted outwash | | Glacial ice & meltwater | Outwash with pits or kettles, produced by the partial or complete burial of glacial ice by outwash and the subsequent thaw of the ice and collapse of the surficial materials (A.G.I. 1984). |
| Proglacial lake | | Glacial ice & meltwater | A body of water that accumulates in a basin just beyond the frontal margin of an advancing or retreating glacier; the lake water is generally in direct contact with the ice. The ice front will form one of the lake margins but elsewhere the waters will be impounded by drainage divides (ridges, scarps, etc.) (A.G.I. 1984; Whittow 1984). |
| Roche moutonnée | | Glacial ice & meltwater | A glacially sculptured knob of bedrock exhibiting an asymmetrical form, with its long axis oriented in the direction of ice movement, an up-ice (stoss) side that is gently inclined, rounded and abraded (e.g., striated), and a down-ice (lee) side that is steep, rough and ice-plucked. These landforms often occur in clusters or fields and may vary in size from several metres to tens or hundreds of metres (A.G.I. 1984; Bennett and Glasser 1996; Whittow 1984). |
| Rock basin | | Glacial ice & meltwater | An individual depression carved in bedrock. They are often found in association with roche moutonnées and may fill with water on deglaciation. Rock basins range in size from several metres to hundreds of metres in diameter. The size and density of the basin is usually a function of the spacing of joints, or other lines of weakness within the rock mass (Bennett and Glasser 1996). |
| Striations | | Glacial ice & meltwater | One of a series of fine and usually straight lines cut on bedrock by rock fragments embedded at the base of a moving glacier, or cut on the rock fragments themselves. They are oriented paralled to local ice movement. Striations are usually not more than a few millimetres in depth, but may be over several metres long. Striations formed by different ice flow directions may be superimposed in a cross-cut pattern to form cross-cut striations (A.G.I. 1984; Bennett and Glasser 1996; Rains 1997). |
| Tarn | | Glacial ice & meltwater | A small, deep, commonly circular glacial lake occupying a cirque; it is fed by runoff from the surrounding slopes and dammed by a lip of bedrock or by a small moraine. Also called a "cirque lake" (A.G.I. 1984). |
| Trim line | | Glacial ice & meltwater | A line on a valley side that marks the former extent of the glacier margin, above which glacial ice action ceased. It gives some indication of the former ice thickness (Campbell 1997/1998; Whittow 1984). |
| Truncated spur | | Glacial ice & meltwater | A valley-side spur which has been abruptly cut off at its lower end by the erosive action of a valley glacier, thus creating a sudden steepening. Many truncated spurs are precipitous cliffs (Whittow 1984). |
| U-shaped valley | | Glacial ice & meltwater | A valley that has been deepened, widened and partially straightened by glacial erosion, thereby severely modifying its preglacial form. These valleys have a pronounced parabolic cross profile suggesting the form of a widened letter "U". The slopes of the former fluvial valley, or former structural valley according to Rains (1997), are considerably over-steepened by the glacier, which occupied much of the valley depth rather than merely the channel on the floor of the former river valley. In addition, the overlapping spurs have been planed-off by glacial ice to become truncated spurs, thereby straightening the line of the valley as it is transformed into a "glacial trough" (A.G.I. 1984; Whittow 1984). |

| Landform Element | Subelement | Genesis | Definition |
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| Valley train | | Glacial ice & meltwater | A long, narrow body of outwash, deposited by meltwater streams far beyond the terminal moraine or the margin of an active glacier and confined within the walls of a valley below the glacier (A.G.I. 1984). |
| Whaleback | | Glacial ice & meltwater | A streamlined landform comprised of bedrock knolls that have been smoothed and rounded on all sides by glacial abrasion. Striations are often continuous along the entire length of the whaleback. These features are also termed rock drumlins, tadpole rocks and streamlined hills. Individual whalebacks may be slightly elongated in the direction of ice flow, being relatively high (1-2m) in comparison to their length (1.5-3m). The up-ice side of a whaleback is blunter and steeper than the down-ice end, which tapers in plan and profile (Bennett and Glasser 1996). |
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| Hill/Hole pair | | Glaciotectonism | A discrete hill of ice-thrust material, often slightly crumpled, situated a short distance down-glacier from a depression of similar size and shape. The hill and associated depression are usually next to each other, but may be separated in some instances by as much as 5 km. Both pre-existing drift or bedrock may be involved in the dislocated hills. The depression represents the source of material now in the hill. In some instances the hole is bounded by tear-faults, and the resulting depression has quite straight sides (Aber et al. 1989). |
| Ice-thrust block | | Glaciotectonism | Bedrock, till and water-sorted material translocated by ice as a more or less intact entity or block. The block can form the "hill" component of a hill-hole pair in situations where a depression remains after translocation of the block (Shetsen 1987). |
| Ice-thrust moraine | | Glaciotectonism | Mixed and contorted bedrock, till and water-sorted material translocated by ice in a more or less intact state as thrust blocks, or deformed into thrust slabs and folds; topography consists of ridges, irregularly shaped hills and depressions (Shetsen 1987). |
| Ice-thrust ridges | | Glaciotectonism | Broadly arcuate, subparallel ridges, commonly high (up to 60m), large and long (up to several kilometres), resembling moraines but composed mostly of detached blocks of bedrock and/or glacial drift that have been folded and thrusted by glacial pressure. The blocks of bedrock are often thrust over one another on shear planes like shingles. Ice-thrust ridges are often covered by ablation till, forming hummocky knobs and knolls on the surface of large areas of subparallel arcuate ridges (Mollard 1972; Rowe 1980). |
| Megablock | | Glaciotectonism | Enormous masses of material, principally bedrock, that have been moved to their present location by glaciers. Megablocks are more-or-less horizontal, slightly deformed, and are often buried under or within thick drift. Most are exposed along the banks of modern rivers (Aber et al. 1989; Stalker 1976). |
| Murdlin | | Glaciotectonism | A special variety of "hill-hole pair" consisting of an elongated loop with a central trough. The hill resembles a drumlin when viewed from the side, but has its highest crest at the distal end and has a longitudinal central depression. The lateral ridges and distal mound are formed of debris shoved from the trough. Murdlins are believed to have formed during the final stages of glaciation in places where a narrow tongue of active ice pushed through a marginal belt of dead ice (Aber et al. 1989). |
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| Landslide lake | | Gravity (mass movement) | A lake formed behind rockfalls, mudflows, debris slides or other kinds of slides that may fill valley floors and dam streams (Hutchinson 1957). |
| Mass fall | Debris fall | Gravity (mass movement) | The relatively free collapse of debris, and weathered mineral and rock material, from a steep slope or cliff. Debris falls are especially common along the undercut banks of streams (A.G.I. 1984, Varnes 1978). |
| Mass fall | Earth fall | Gravity (mass movement) | The more-or-less free descent of masses of soil from steep slopes or cliffs (Fairbridge 1968; Varnes 1978). |
| Mass fall | Protalus rampart | Gravity (mass movement) | A linear or curvilinear ridge formed from the accumulation of frost-shattered debris at the lower margin of a snow patch. The broken rock fragments from the backwall of a nivation cirque fall on to the top of the snow bank whence they slide down to its lower edge. Its appearance and composition is similar to that of a moraine, although it has a tendency to form a convex-in-plan ridge facing towards the backwall of the hollow, in contrast to that of a glacier-formed cirque moraine which produces a feature curving in the opposite direction when seen in plan (Whittow 1984). |

| Landform Element | Subelement | Genesis | Definition |
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| Mass fall | Rock fall | Gravity (mass movement) | Newly detached pieces of bedrock of any size that are detached from a steep slope or cliff, along a surface on which little or no shear displacement takes place, and that descend mostly through the air by free fall, bounding, or rolling. Movements are very rapid to extremely rapid (Mollard 1972, Varnes 1978). |
| Mass fall | Talus cone | Gravity (mass movement) | A cone-shaped accumulation of rock debris formed at the base of a mountain wall or cliff as a result of repeated small rockfalls. Slope of the talus is straight or very slightly curved and its inclination is generally 30E to 40E. The blocks of gravity debris are typically angular in shape, with the bigger boulders falling to the talus base, where they form a base fringe of larger sizes. Also known as scree, although scree sometimes refers only to the debris constituent of talus (Mollard 1972; Whittow 1984). |
| Mass fall | | Gravity (mass movement) | Masses of any size that are detached from a steep slope or cliff, along a surface on which little or no shear displacement takes place, and descends mostly through the air by free fall, bounding, or rolling. Movements are very rapid to extremely rapid (Varnes 1978). |
| Mass flow | Debris flow | Gravity (mass movement) | A rapid flowage of debris, often the result of additional surface water being added to a debris avalanche, in which the mixture becomes extemely fluid and flows considerable distances (Whittow 1984). |
| Mass flow | Earth flow | Gravity (mass movement) | An existing or former flow of water-saturated earth materials in the form of a viscous stream of mud. The rate of movement may be either slow or fast, depending on the gradient down which the material flowed, among other factors. Earthflows terminate in lobelike forms. They may grade into mudflows (A.G.I. 1984; Mollard 1972). |
| Mass flow | | Gravity (mass movement) | Mass movements of unconsolidated materials in the plastic or semifluid state. It is the movement of material with significant variations in velocity and water content which exhibit spatially continuous deformations. Flows usually begin as slides, falls or topples on slopes which rapidly disintegrate with the loss of cohesion of the displaced material (A.G.I. 1984; Cruden and Varnes 1993; Spangenberg 1993). |
| Mass slide | Debris avalanche | Gravity (mass movement) | The sudden downslope movement of rock debris on steep slopes, commonly caused by saturation of the material as a result of protracted heavy rains or thaw of snow. The typical debris avalanche has a long and relatively narrow track, and often leaves a serrate or V-shaped scar tapering uphill at the head. They occur on steep mountain slopes or hillsides, and are almost invariably preceded by heavy rains that increase the weight of the flowing debris and reduce shear strength. After initial movement, the saturated mass quickly loses shape and flows downward, commonly following a stream channel (Mollard 1972, Varnes 1978). |
| Mass slide | Debris slide | Gravity (mass movement) | The downward movement of predominantly unconsolidated and incoherent earth and rock debris in which the mass usually does not show backward rotation but slides or rolls forward, forming an irregular hummocky deposit resembling a moraine. The materials in these movements are relatively dry. Where much water is present, the slide develops the characteristics of a debris avalanche. Debris slides with a backward rotation have been termed "debris slumps" (A.G.I. 1984; Mollard 1972; Varnes 1978). |
| Mass slide | Earth slide | Gravity (mass movement) | A downhill movement of a mass of superficial material due to slope failure, often as a result of water reducing the friction along a shear plane in the soil mantle. With an increasing addition of water the slide will probably turn into an earth flow. The movement only affects the soil cover. Earth slides with a backward rotation have been termed "earth slumps" (Varnes 1978; Whittow 1984). |
| Mass slide | Rock slide | Gravity (mass movement) | The downward and usually rapid movement of newly detached segments of bedrock, sliding on a surface of bedding, jointing, or faulting. The moving mass usually breaks up into many small units. Rock slides with a backward rotation have been termed "rock slumps" (A.G.I. 1984; Varnes 1978). |
| Mass slide | | Gravity (mass movement) | The downslope movement of a soil or rock mass occurring dominantly on surfaces of rupture or on relatively thin zones of intense shear strain. The displaced mass may slide beyond the original surface of rupture onto what had been the original ground surface. Slides can be further described as either rotational or translational movements. The former involves material movement along a concave upwards surface; the latter consists of movement along a relatively planar surface. Slides with a backward rotation are often termed "slumps" (Cruden and Varnes 1993; Spangenberg 1993; Varnes 1978). |
| Mass topple | Debris topple | Gravity (mass movement) | The forward rotation out of the slope of a mass of debris about a point or axis below the center of gravity of the displaced mass (Cruden and Varnes 1993). |
| Mass topple | Earth topple | Gravity (mass movement) | The forward rotation out of the slope of a mass of earth about a point or axis below the center of gravity of the displaced mass (Cruden and Varnes 1993). |
| Mass topple | Rock topple | Gravity (mass movement) | The forward rotation out of the slope of a mass of rock about a point or axis below the center of gravity of the displaced mass (Cruden and Varnes 1993). |
| Mass topple | | Gravity (mass movement) | The forward rotation out of the slope of a mass of soil or rock about a point or axis below the center of gravity of the displaced mass (Cruden and Varnes 1993; Spangenberg 1993). |

| Landform Element | Subelement | Genesis | Definition |
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| Rock labyrinth | | Gravity (mass movement) | A regular arrangement on a slope of large, joint-bounded and translated bedrock blocks, separated by "streets" of varying width (some up to 15m wide). The labyrinth style of block movement involves slippage of intact blocks along a weaker surface, without appreciable rotation. Processes (apart from downdip gravitational components) capable of producing such a separation are likely to be settling of the underlying weak material, wedging developed by freezing of water, or expansion during chemical alteration of certain minerals. These landforms have also been called "rock cities" (Simmons and Cruden 1980). |
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| Blue-hole spring | | Ground water (cold springs) | A spring that issues from the bottom of lakes; the water having a bluish or greenish appearance (Borneuf 1983). |
| Iron depositing spring | | Ground water (cold springs) | A spring that deposits iron or oxides of iron. Iron-depositing springs frequently originate in surficial deposits; however, iron staining is quite common in other types of springs. Iron staining is common in spring outlets from fractures in sandstones, shales, and coals, as well as in colluvial and alluvial sediments. Springs having a high concentration of iron oxide often have deposits of ochre in the vicinity of the spring. Ochre is an earthy or powdery iron oxide mineral that is usually red, yellow or brown in color (A.G.I. 1984; Allan 1920; Borneuf 1983). |
| Marl lake | | Ground water (cold springs) | A waterbody characterized by quantities of marl in its bottom sediments. Marl is an old term loosely applied to a variety of materials, mostly unconsolidated earthy deposits consisting chiefly of an intimate mixture of clay and calcium carbonate, usually including shell fragments and sometimes glauconite. It is formed under marine but especially under freshwater conditions. Where the marl lake bottom is white, not covered by organic muds, the water is often remarkably clear, or the water may be "milky" where shallows are subject to wave action (A.G.I. 1984; Veatch and Humphrys 1964). |
| Salt depositing spring | | Ground water (cold springs) | A spring containing water of high salinity (principally sodium chloride), and that leaves salt deposits on the surface of the ground through evaporation and precipitation (Borneuf 1983). |
| Salt flat | | Ground water (cold springs) | The dried up bed of a former salt lake, sometimes referred to as a salt prairie; also, an extensive and fairly level tract of land where surface water has evaporated leaving a whitish efflorescence of precipitated salts such as sodium chloride (A.G.I. 1984; Smith 1987; Whittow 1984). |
| Soaphole | | Ground water (cold springs) | A part of the land surface that is characterized by a local weakness of limited extent underlain by a viscous admixture of sand, silt, clay and water. The weakened area is commonly circular or slightly enlongated and has well-defined boundaries. A soaphole may be several meters in depth and is covered by a thin, fragile crust through the cracks of which mud and water oozes to the surface. Where there is sufficient flow of water from the soaphole, a soaphole spring may occur (Toth 1966). |
| Spring issuing from pools | | Ground water (cold springs) | A spring that issues from the bottom of small ponds and pools of water (Borneuf 1983). |
| Sulphur depositing/odor spring | | Ground water (cold springs) | A spring containing high concentrations of dissolved hydrogen sulphide gas, thus giving the spring water a distinctive "rotten-egg" odor. Hydrogen sulphide is related to the presence of bacteria, which are observed in numerous springs. The bacteria can be white, pale yellow, and pale brown and sometimes form filamentous colonies that float gently in the spring waters. Associated with hydrogen sulphide gas is sulphur, which can be observed either in suspension in spring water, giving it a milky appearance, or as sulphur deposits around the spring orifice (Borneuf 1983). |
| Tufa depositing spring | | Ground water (cold springs) | A spring that has an encrustation or other deposit of calcium carbonate, precipitated from the spring water either adjacent to its orifice or along a stream below the spring . The tufa can form bars, mounds, terraces and dams, especially around hot springs (Borneuf 1983). |
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| Hot spring | | Ground water (hot springs) | A spring whose water has a higher temperature than that of the human body, that is, above 98°F or 37°C. Often associated with the springs are deposits of tufa or travertine. These form as an encrustation around the mouth of a hot spring by evaporation and chemical precipitation from highly impregnated water. The hard, dense variety is travertine, a concretionary deposit of white, tan, or cream color that is generally deposited at the mouth of the spring. The spongy or less compact variety is tufa. Both tufa and travertine are chemical sedimentary rocks composed of calcium carbonate. High concentrations of hydrogen sulphide gas also generally occur in the spring waters. Hydrogen sulphide is related to the presence of bacteria, which are observed in numerous springs. The bacteria can be white, pale yellow, and pale brown and sometimes form filamentous colonies that float gently in the spring waters. Associated with hydrogen sulphide gas is sulpfur, which can be observed either in suspension in spring water, giving it a milky appearance, o as sulphur deposits around the spring orifice (A.G.I. 1984; Borneuf 1983; Parker 1997). |

| Landform Element | Subelement | Genesis | Definition |
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| Warm spring | | Ground water (hot springs) | A spring whose temperature is at least 5°C above the mean annual air temperature. A warm spring may contain deposits of tufa and have hydrogen sulphide gas within its waters (Borneuf 1983). |
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| Disappearing stream | | Ground water (karst terrain) | A surface stream that disappears underground, either partially or totally, in sinks or swallow holes (A.G.I. 1984; Sweeting 1973). |
| Doline | Collapse | Ground water (karst terrain) | A closed depression formed as a result of the collapse of cavern roofs relatively near to the surface. The sides of the depression are cliff-like and the floor is composed of the irregular limestone/gypsum blocks from the fragmented roof. It has an oval or irregularly shaped near-circular form. Though they are relatively shallow they usually have a high depth:diameter ratio (Sweeting 1973). |
| Doline | Solution | Ground water (karst terrain) | A small enclosed depression formed by the solutional enlargement of joints and consequent settling of the surface. The level floor is usually a jumble of small blocks dislocated by subsidence. Enlargement is either circular in plan, if there is one dominant vertical joint, or otherwise irregular if there are several, and can achieve dimensions of up to 1000m in diameter and 100m deep. Where the karst limestone possesses a cover of superficial deposits, solutional enlargement permits the latter to subside into vertical fissures, whose slopes are unstable because of the unconsolidated nature of the surface material (Sweeting 1973). |
| Doline | Suffosion | Ground water (karst terrain) | Depressions created by the removal of fine materials, through a combination of solution and downwashing, from thick unconsolidated regoliths or detritus that are present over karst rocks. Infiltrating water beneath regolith can create sub-soil karren and widened joints that are connected with deeper cavities. Suffosion then causes a dimpling of the surface and dolines are formed (Ford and Williams 1989). |
| Doline | | Ground water (karst terrain) | A sinkhole or closed depression of small or moderate dimensions in an area of karst topography. They can be cone- or bowl-shaped, with rocky or vegetated sides and of a circular or elliptical plan; their diameter is usually greater than their depth. They can occur isolated or in groups in close proximity to one another. Dolines are formed either by the solution of the surficial limestone/gypsum or by the roof collapse of near-surface caverns (Parker 1997; Sweeting 1973). |
| Dry valley | | Ground water (karst terrain) | A valley with little or no running water; a streamless valley that is the result of stream capture. Usually occurs in karst type terrain (A.G.I. 1984; Parker 1997). |
| Estevella | | Ground water (karst terrain) | A hole in karst terrain that functions at one time of the year as a sink or swallow hole and at another time as a spring (Sweeting 1973). |
| Ice cave | Cold trap cave | Ground water (karst terrain) | A cave having a shape that permits the accumulation of cold dense air at the lowest point of the cave and maintains a temperature below freezing for over a year (Rollins 1992). |
| Ice cave | Cold zone cave | Ground water (karst terrain) | A cave having a shape and configuration that permits the formation of a cold zone near the cave entrance. Unequal cooling and warming of air caused by the effects of evaporation creates the cold zone where ice deposits will collect (Rollins 1992). |
| Ice cave | Perennial ice cave | Ground water (karst terrain) | A high altitude alpine cave, where the average annual temperature of the surface is less than 0EC and, depending on its size and configuration of entrances and chambers, may contain permanent ice (Rollins 1992). |
| Ice cave | Relict permafrost cave | Ground water (karst terrain) | An ice cave that is situated in an area of relict permafrost (Rollins 1992). |
| Ice cave | Snow trap cave | Ground water (karst terrain) | A cave having shaft configurations that collect and hold winter snow. The snow accumulates, and through partial melting and subsequent re-freezing, becomes compacted into ice (Rollins 1992). |

| Landform Element | Subelement | Genesis | Definition |
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| Ice cave | | Ground water (karst terrain) | A cave that is cool enough to hold ice through all or most of the warm season; they contain seasonal or perennial ice or both (Ford and Williams 1989; Parker 1997). |
| Karren | Kluftkarren | Ground water (karst terrain) | Cleft-like ruts, cut into rock, normally caused by solution along joints, bedding planes and fissures. The clefts range from a few centimetres to 4 metres deep, up to 4 metres wide and from 1 to 10 metres in length. The walls are often smooth or sometimes fluted and runnelled (Ford and Williams, 1989; Sweeting 1973). |
| Karren | Rillenkarren | Ground water (karst terrain) | Finely chiselled runnels or grooves with rounded troughs and sharp fine ridges; they are usually about 1 to 2 cm deep, 1 to 3 cm wide and usually less than 50 cm long. They normally occur in groups and most often on slopes of from 40E to 80E. They are rainfall generated (Ford and Williams 1989; Sweeting 1973). |
| Karren | Rinnenkarren | Ground water (karst terrain) | Runnels that are bigger than rillenkarren, normally being about 3-30 cm wide, 1-10 m long and up to 40 cm deep. Though the troughs are generally rounded, the limestone is frequently roughened and pitted and scalloped; the crests between are sharp. Rinnenkarren usually occur on steep slopes (Ford and Williams 1989; Sweeting 1973). |
| Karren | | Ground water (karst terrain) | The furrows that occur from solution by rain wash on limestone in karst areas. They range in width from a few millimetres to more than a meter, and are commonly separated by sharp ridges. Rillenkarren are typically 1-2 cm deep and up to 50cm long; kluftkarren can reach up to 4m deep and 4m wide (A.G.I. 1984; Sweeting 1973). |
| Karst cave | Bedding cave | Ground water (karst terrain) | A natural, hollow chamber or series of chambers and galleries developed between two layers of similar, soluble rock (e.g., limestone, dolomite or gypsum). The chamber occurs beneath the earth's surface, or in the side of a mountain or hill, with an opening to the surface and large enough for a person to enter (A.G.I. 1984; Bogli 1980; Parker 1997). |
| Karst cave | Joint cave | Ground water (karst terrain) | A natural, hollow chamber or series of chambers and galleries created along joints and faults in soluble rock (e.g., limestone, dolomite or gypsum). The chamber occurs beneath the earth's surface, or in the side of a mountain or hill, with an opening to the surface and large enough for a person to enter (A.G.I. 1984; Bogli 1980; Parker 1997). |
| Karst cave | | Ground water (karst terrain) | A natural, hollow chamber or series of chambers and galleries developed within limestone, dolomite or gypsum beneath the earth's surface, or in the side of a mountain or hill, with an opening to the surface and large enough for a person to enter (A.G.I. 1984; Parker 1997). |
| Karst dome | | Ground water (karst terrain) | A dome or an anticline in gypsum terrain thought to be formed either by hydration processes operating during the postglacial period or to the injection of gypsum during times of rapidly changing glacial ice loading. These features range from 10 to 1000 m or more in length or diameter, and up to 25 m in height. Many are highly fractured, with individual blocks being displaced by heaving and sliding. At the extreme, they become mega-breccia, an upthrust jumble of large blocks (Ford and Williams 1989). |
| Karst spring | | Ground water (karst terrain) | Any natural appearance of a watercourse originating from a karst area (Borneuf 1983). |
| Limestone pavement | | Ground water (karst terrain) | A glacio-karstic landform, produced on a glacially planed limestone surface which has subsequently become dissected into blocks by solution-enlargement of vertical joints; these areas are often dominated by regular patterns of blocks and clefts so that they appear like artificial paving (Ford and Williams 1989; Sweeting 1973). |
| Sinking lake | | Ground water (karst terrain) | A lake formed where sinks or swallow holes are not able to absorb all of the stream or river water flowing into them. Lake levels usually fluctuate dramatically over the course of a year (Sweeting 1973). |
| Solution lake | Doline lake | Ground water (karst terrain) | A waterbody occupying a bowl or circular deepening due to solution of limestone or gypsum by ground water at intersecting joint planes (Veatch and Humphrys 1964). |
| Solution lake | Uvala lake | Ground water (karst terrain) | A waterbody occupying a depression formed by the fusion of several dolines (Hutchinson 1957). |
| Solution lake | | Ground water (karst terrain) | A body of water in a basin created by the underground solution of limestone or gypsum by water and the subsequent collapse of the surface, or in a basin formed by solution on the surface (Hutchinson 1957, p161; Veatch and Humphrys 1964). |

| Landform Element | Subelement | Genesis | Definition |
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| Solution subsidence trough | | Ground water (karst terrain) | An elongated surface depression formed by the collapse of rock into subterranean caverns; the collapse often the result of the interstratal solution of salt deposits. Larger troughs may be infilled and obscured by sediments or other materials and so lack topographic expression. In Canada, troughs may be 5-100 km long, 5-250 km wide and with 100-500 m of subsidence (Ford and Williams 1989; Olive 1957). |
| Speleothem | | Ground water (karst terrain) | A mineral deposit formed in caves by the action of water, and includes such forms as stalactites, stalagmites, columns, pillars, cave pearls, flowstone, needles, etc. (A.G.I. 1984; Sweeting 1973). |
| Subsidence depression | | Ground water (karst terrain) | An area of the earth's surface where the ground and underlying beds gradually sag downwards, generally as a result of solution or compaction of underlying karst rocks. There is no significant faulting of the rocks although folding always occurs. Subsidence is not restricted in rate, magnitude or area involved (A.G.I. 1984; Ford and Williams 1989). |
| Uvala | | Ground water (karst terrain) | A closed depression formed by the coalescence of several dolines. Its drainage is subsurface, and it usually has an irregular floor and a scalloped margin inherited from the dolines (A.G.I. 1984). |
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| Diatreme | | Igneous activity | A general term for a volcanic vent that has been drilled through crustal rocks by the highly pressurized gases associated with magma. If it ultimately becomes blocked by pyroclastic materials it will form a pipe (Whittow 1984). |
| Dike | | Igneous activity | A sheet-like body of intrusive igneous rock that cuts across the structure of adjacent rocks or cuts through massive rocks. The majority of dikes are formed from basic igneous rocks which may be either more or less resistant to erosion than the host rock itself. Thus, a dike's surface outcrop may form either a wall-like feature or, if considerably eroded, it may create a topographic trench or gully (A.G.I. 1984; Whittow 1984). |
| Pluton | | Igneous activity | A cylindrical mass of granitic rock emplaced or intruded at high level and at low temperatures in a near-solid state (Whittow 1984). |
| Sill | | Igneous activity | An intrusive body of solidified magma that has been injected as a near-horizontal sheet between the bedding-planes of the crustal rocks (Whittow 1984). |
| Stock | | Igneous activity | An igneous intrusion that is less than 100 square kilometres in surface exposure, is usually but not always discordant, and resembles a batholith except in size (A.G.I. 1984). |
| Volcanic rock | | Igneous activity | A finely crystalline or glassy igneous rock resulting from volcanic action at or near the earth's surface, either ejected explosively or extruded as lava. The finely crystalline and glassy forms of the rock result from the rapid cooling of the lava when it appeared at the surface(A.G.I. 1984; Whittow 1984). |
| Aeolian beach ridge | | Lake waves & currents | A low, essentially continuous mound of beach and dune material heaped up by the action of waves and currents in conjunction with wind on the backshore of a beach beyond the present limit of storm waves, and occurring singly or as one of a series of approximately parallel deposits. The ridges can represent former positions of a shoreline (A.G.I. 1984; Smith 1998). |
| Baymouth bar | | Lake waves & currents | A bar of sand or gravel extending partially or entirely across the mouth of a bay (A.G.I. 1984). |
| Beach | | Lake waves & currents | The gently sloping shore of a body of water which is washed by waves, especially the parts covered by sand or pebbles. Beaches can also be comprised of cobbles, boulders, silt marl or clay (A.G.I. 1984). |

| Landform Element | Subelement | Genesis | Definition |
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| Beach scarp | | Lake waves & currents | An almost vertical slope fronting a berm on a beach, caused by wave and swash erosion. It may range in height from several centimetres to a few meters, depending on the character of the wave/swash action and the nature and composition of the beach (A.G.I. 1984; Rains 1997). |
| Ice-push ridge | | Lake waves & currents | A conspicuous ridge of coarse material along a lake shore, produced by shoreward movement of lake ice, as by winds, waves, or currents, and especially by expansion of ice against yielding lake-shore deposits. Ice can also have similar effects along the banks of frozen rivers (A.G.I. 1984; Campbell 1997/1998). |
| Lagoon | | Lake waves & currents | A shallow body of fresh water cut off from a lake by a barrier such as a sand bar, a shore dune or beach ridge (A.G.I. 1984; Veatch and Humphrys 1964). |
| Lake island | | Lake waves & currents | An elevated piece of land surrounded by lake waters (A.G.I. 1984). |
| Peninsula | | Lake waves & currents | A body of land nearly surrounded by water, and connected with a larger body by a neck or isthmus; also, any tract of land jutting out into the water (A.G.I. 1984). |
| Raised beach | | Lake waves & currents | An ancient beach occurring above the present shoreline, having been elevated either by local uplift of the land or by lowering of the lake level (A.G.I. 1984). |
| Shoal | | Lake waves & currents | A submerged ridge, bank, or bar of sand or other unconsolidated material, rising from the bed of a body of water to near the surface (A.G.I. 1984). |
| Shoreline cliff | | Lake waves & currents | A high, steep rock face or precipice, or a steep face in unconsolidated deposits located along lakeshores (A.G.I. 1984; Whittow 1984). |
| Spit | | Lake waves & currents | A narrow and elongated accumulation of sand or gravel projecting from the shore into a body of water. It grows out from the shoreline as a result of longshore drift (A.G.I. 1984; Whittow 1984). |
| Tombolo | | Lake waves & currents | A type of sandy or shingly spit which links an island to the mainland or to a neighbouring island. They are produced by longshore drift of beach material along a shoreline. Double tombolos occur where two separate spits connect an island to the mainland (Kupsch and Rutter 1982; Whittow 1984). |
| Wave-cut notch | | Lake waves & currents | A deep cut along the base of a shoreline cliff near the high-water mark, formed by wave erosion, over which the cliff hangs (A.G.I. 1984). |
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| Impact structure | | Meteorite falls | A saucer-shaped pit or crater-like depression of variable size on the earth's surface, produced by the impact of a moving body, most commonly a meteorite. This feature has also been termed an 'astrobleme' (A.G.I. 1984; Kupsch and Rutter 1982). |
| | | | |
| Anticlinal mountain | | Movements of the earth's crust | A mountain formed by convex flexure of bedrock strata (Parker 1997). |
| Anticlinal valley | | Movements of the earth's crust | A valley that follows the axis of an anticline (A.G.I. 1984). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Anticline | | Movements of the earth's crust | An arched fold or upfold in the strata of the earth's crust, generally convex upward, whose core contains the stratigraphically older rocks The two sides or limbs of the fold dip in opposite directions away from a crestline or central axis (A.G.I. 1984; Whittow 1984). |
| Cuesta | | Movements of the earth's crust | An asymmetrical ridge, with a long gentle slope on one side conforming with the dip of the underlying strata, and a steep or clifflike face on the other side formed by the outcrop of the resistant beds (A.G.I. 1984; Mollard 1972). |
| Fault valley | | Movements of the earth's crust | A linear depression produced by faulting (A.G.I. 1984). |
| Fault-line scarp | | Movements of the earth's crust | A scarp that is the result of differential erosion that has occurred on either side of a fault-line when rocks of contrasting hardness are brought into juxtaposition. Also, a scarp or cliff formed originally by fault movement and subsequently eroded backward from its original position, which may be coincident with a fault plane, parallel to, or in line with it (Mollard 1972; Whittow 1984). |
| Hogback | | Movements of the earth's crust | A ridge with a narrow summit and steep slopes of nearly equal inclination, specifically a sharp-crested ridge formed by the outcropping edges of steeply inclined resistant rocks, and produced by differential erosion (A.G.I. 1984). |
| Klippe | | Movements of the earth's crust | An isolated overthrust mass of folded rocks, usually a nappe, cut off from the main fold structure by erosion. It is an erosional remnant or outlier of a nappe, a large-scale tectonic overfold in the earth's crustal rocks that has moved forward as a recumbent fold sometimes for tens of kilometres along a thrust plane (A.G.I. 1984; Whittow 1984). |
| Monocline | | Movements of the earth's crust | A gentle bend or flexure with a step-like form in horizontally bedded or gently dipping rock strata (Whittow 1984). |
| Mountain | Castellated mountain | Movements of the earth's crust | A mountain form that resembles a castle. They are comprised of more or less flat-lying sedimentary rocks, and commonly have profiles in which vertical steps alternate with flat or sloping terraces. They are developed in areas underlain by great thicknesses of rocks in which beds or layers of massive limestone and sandstone or quartzite alternate with less resistant beds of shale or slate. The castellated form is developed from erosional processes exploiting joint systems (Baird 1977; Campbell 1997/1998). |
| Mountain | Dogtooth mountain | Movements of the earth's crust | A mountain form that contains a tall spine or rock wall resembling a canine tooth. Sharp, jagged mountains sometimes result from the erosion of masses of vertical- or near-vertical rock (Baird 1977). |
| Mountain | Plateau mountain | Movements of the earth's crust | A mountain with a relatively flat summit area that is separated from adjacent mountains and hills by escarpments and steep slopes (Fairbridge 1968). |
| Mountain | Sawtooth mountain | Movements of the earth's crust | A mountain form that resembles the teeth in a saw. These mountains have also been termed "sierra". The rows of angular mountains are produced by the erosion of long ridges containing vertical- or near-vertical strata (Baird 1977). According to Cruden (n.d.), the term "flatirons" has priority rather than "sawtooth" for a series of short, triangular hogbacks terminating a spur or ridge on the flank of a mountain. |
| Mountain | | Movements of the earth's crust | A portion of the land surface rising considerably above the surrounding country either as a single eminence or in a range or chain (Whittow 1984). |
| Normal fault | | Movements of the earth's crust | A fault in which the hanging wall appears to have moved downward relative to the footwall. The angle of dip is usually 45-90° (A.G.I. 1984). |
| Reverse fault | | Movements of the earth's crust | A fault along which the hanging wall has been raised relative to the footwall. Low angle reverse faults are often termed thrust faults. These have a dip of 45E or less over much of their extent, on which the hanging wall appears to have moved upward relative to the footwall. Horizontal compression rather than vertical displacement is a characteristic feature of thrust faults (A.G.I. 1984). |
| Synclinal mountain | | Movements of the earth's crust | A mountain whose underlying structure is that of a syncline (A.G.I. 1984). |

| Landform Element | Subelement | Genesis | Definition |
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| Synclinal valley | | Movements of the earth's crust | A valley that follows the axis of a syncline (A.G.I. 1984). |
| Syncline | | Movements of the earth's crust | A downfold or basin-shaped fold of crustal rocks in which the strata dip inwards towards a central axis (Whittow 1984). |
| Tectonic cave | | Movements of the earth's crust | A cavity created by tectonic processes (e.g., deformation of the earth's crusted rocks by warping or fracturing). Subsequent changes to these caves as a result of corrosion and erosion are usually negligible (Bogli 1980). |
| Tectonic lake basin | Fault lake | Movements of the earth's crust | A lake contained within a basin on tilted fault blocks that are the result of movements of the deeper parts of the earth's crust (Hutchinson 1957). |
| Tectonic lake basin | | Movements of the earth's crust | A lake basin formed by movements of the deeper parts of the earth's crust, except those in which manifest volcanic activity has played a major part (Hutchinson 1957). |
| | | | |
| Bog | | Peat accumulation (non-permafrost) | An acidic, peat-forming wetland that receives its surface moisture from precipitation. They are characterized by a level, raised or sloping peat surface with hollows and hummocks In continental western Canada, bogs are forested exclusively with black spruce (Vitt et al. 1996). Various terms, such as "open pool", "carpet", "lawn", and "hummock" are used to describe the relative height of the ground-layer surface to the water surface in bogs. "Lawns" have wet, flat areas of little relief with vegetation extending from well-consolidated underlying peat. Internal lawns in bogs form due to melting of an area in the bog that contained permafrost (Halsey et al. 1995; Vitt et al. 1994). |
| Bog lake | | Peat accumulation (non-permafrost) | A lake or small open body of water surrounded completely or nearly so by characteristic bog vegetation, growing either on a relatively firm substrate or a semi-floating mat of peat (Veatch and Humphrys 1964). |
| Fen | | Peat accumulation (non-permafrost) | Peatlands with the water table usually at or just above the surface. The waters in fens are usually nutrient-rich. Vegetative patterns that result from the presence of surface water flow allow for the distinction of fens from bogs. The dominant materials are moderately to well decomposed sedge and/or brown moss peat of variable thickness. The vegetation consists predominantly of sedges, grasses, reeds, and brown mosses with some shrubs and, at times, a sparse tree layer. Internal lawns can be found in wooded fens (CCELC 1987; Halsey et al. 1995). |
| Marl bog | | Peat accumulation (non-permafrost) | A peatland that now occupies the site of a former, or extinct lake and that contains deposits of marl in its underlying sediments (Veatch and Humphrys 1964). |
| Non-patterned fen with internal lawns | Basin fen | Peat accumulation (non-permafrost) | A fen occupying a topographically defined basin. However, the basins are not part of a major regional drainage system and the waters reaching a basin fen are, therefore derived from its surrounding area. The depth of peat increases towards the centre (CCELC 1987, 1988). |
| Non-patterned fen with internal lawns | Horizontal fen | Peat accumulation (non-permafrost) | A fen with a very gently sloping, featureless surface that slopes gently in the direction of drainage. They occupy broad, often ill-defined depressions, and may be interconnected with other fens. They are generally wooded and contain wetter areas that are slightly depressed (i.e., lawns), the lawns being somewhat circular in form. In such lawns, dead trees, partially buried in peat and often tilted in random direction, are common. These fens represent a relatively dry form of fen and peat accumulation is generally uniform (CCELC 1987; Vitt et al. 1994). |
| Non-patterned fen with internal lawns | | Peat accumulation (non-permafrost) | A wooded fen containing wetter areas that are slightly depressed (i.e., lawns), the lawns being somewhat circular in form. In such lawns, dead trees, partially buried in peat and often tilted in random direction, are common. These lawns indicate the former existence of small but densely treed "bog islands" that had a permafrost core (e.g., peat plateaus, palsas). In some cases, remnants (i.e., trees that grew at the outer edge) of such wooded "islands" are still present in the lawns giving a "ghost" or "shadow image" of the "island's" former extent. Such internal lawns are often observed near the periphery of peat plateaus, indicating thermal subsidence (Vitt et al. 1994). |
| Non-patterned fen without internal lawns | Basin fen | Peat accumulation (non-permafrost) | A fen occupying a topographically defined basin. However, the basins are not part of a major regional drainage system and the waters reaching a basin fen are, therefore derived from its surrounding area. The depth of peat increases towards the centre (CCELC 1987, 1988). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Non-patterned fen without internal lawns | Channel fen | Peat accumulation (non-permafrost) | A fen occurring in a topographically well-defined channel which at present does not contain a continuously flowing stream. The depth of peat is usually uniform (CCELC 1987). |
| Non-patterned fen without internal lawns | Floating fen | Peat accumulation (non-permafrost) | A fen occurring adjacent to ponds or lakes, forming a floating mat, underlain by water or fluid, loose peat. The fen surface is less than 0.5m above the level of the lake and the rooting zone is affected by lake water (CCELC 1987). |
| Non-patterned fen without internal lawns | Horizontal fen | Peat accumulation (non-permafrost) | A fen with a very gently sloping, featureless surface that slopes gently in the direction of drainage. It is usually uniformly vegetated by herb, shrub, and tree species. This fen represents a relatively dry form of fen. It occupies broad, often ill-defined depressions, and may be interconnected with other fens. Peat accumulation is generally uniform (CCELC 1987). |
| Non-patterned fen without internal lawns | Slope fen | Peat accumulation (non-permafrost) | A fen occurring mainly on slowly draining, nutrient-enriched seepage slopes. Pools are usually absent, but wet seepage tracks may occur. Peat thickness seldom exceeds 2m (CCELC 1987). |
| Non-patterned fen without internal lawns | Spring fen | Peat accumulation (non-permafrost) | A wetland form that is fed predominantly by groundwater discharge sources such as springs. The surface of a spring fen is gently sloping, although there may be a series of pools dammed by peaty ridges. Spring fens may be located immediately below upland recharge areas or may be several tens of kilometres from the associated uplands, depending on the hydrology of the aquifer formations. Spring fens are characteristically long and narrow, originating from a point source. Small "islands" may develop on them in those parts of the fen that receive less spring water and, therefore, develop a less minerotrophic vegetation with trees and shrubs. This results in a pattern of treed islands in these generally sedge-dominated wetlands. Such fens can be highly minerotrophic if the spring water contains large amounts of dissolved minerals; in such cases, marl deposits may be encountered (CCELC 1988). |
| Non-patterned fen without internal lawns | Stream fen | Peat accumulation (non-permafrost) | A fen located in the main channel or along the banks of permanent or semi-permanent streams. This fen is affected by the water of the stream at normal and flood stages (CCELC 1987). |
| Non-patterned fen without internal lawns | | Peat accumulation (non-permafrost) | A fen that is dominated by a continuous cover of vegetation and that has a relatively flat, homogeneous surface (Vitt et al. 1996). |
| Patterned fen | Net fen | Peat accumulation (non-permafrost) | A fen with a broad net pattern of low, interconnected peat ridges ("strings"), enclosing wet hollows or shallow pools. The wetland surface is almost completely level; greater slopes result in the formation of northern ribbed fens (CCELC 1987). |
| Patterned fen | Northern ribbed fen | Peat accumulation (non-permafrost) | A fen characterized by the development of narrow (1-5m wide), low (5-75cm high) peaty ridges (also called "strings") oriented at right angles to the direction of water movement. These ridges may stretch across he fen in a smooth arc or in sinuous arcs that may divide and rejoin. Wet peaty depressions, called "flarks", occur between the ridges. Northern ribbed fens have a slightly sloping surface (0.1-1.0% slope). These fens are distinguished from other patterned fens by the presence of sharply defined, narrow ridges separated by narrow flarks. Northern ribbed fens are usually underlain by peat that is in excess of 1m in thickness (CCELC 1988). |
| Patterned fen | Spring fen | Peat accumulation (non-permafrost) | A wetland form that is fed predominantly by groundwater discharge sources such as springs. The surface of a spring fen is gently sloping, although there may be a series of pools dammed by peaty ridges. Spring fens may be located immediately below upland recharge areas or may be several tens of kilometres from the associated uplands, depending on the hydrology of the aquifer formations. Spring fens are characteristically long and narrow, originating from a point source. Small "islands" may develop on them in those parts of the fen that receive less spring water and, therefore, develop a less minerotrophic vegetation with trees and shrubs. This results in a pattern of treed islands in these generally sedge-dominated wetlands. Such fens can be highly minerotrophic if the spring water contains large amounts of dissolved minerals; in such cases, marl deposits may be encountered (CCELC 1988). |
| Patterned fen | | Peat accumulation (non-permafrost) | A fen that has a heterogeneous surface characterized by open, wet flarks, and drier shrubby to wooded strings and margins. Strings are oriented perpendicular to the surface water flow, forming sinuous ribs on gently sloping terrain, and nets on more level terrain where surface water is multidirectional, resulting in the development of flow interference patterns. In Alberta, the development of strings and flarks is restricted to fens (Vitt et al. 1996). |
| Wooded bog with internal lawns | Basin bog | Peat accumulation (non-permafrost) | A bog situated in a basin that has an essentially closed drainage, receiving water from precipitation and from runoff from the immediate surroundings. They have a flat surface, bu the peat is generally deepest at the center. They are usually treed with black spruce (CCELC 1988). |
| Wooded bog with internal lawns | Flat bog | Peat accumulation (non-permafrost) | A bog having a flat, featureless surface. They occur in broad, poorly defined depressions. The depth of peat is generally uniform. They are usually treed with black spruce and have open, wet Sphagnum-Carex-dominated lawns often containing partially buried stands of dead trees. The internal lawns are characteristically less than 50 cm lower than the surrounding wooded bog surface (CCELC 1988; Vitt et al. 1994). |

| Landform Element | Subelement | Genesis | Definition |
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| Wooded bog with internal lawns | Northern plateau bog | Peat accumulation (non-permafrost) | A raised bog elevated 0.5-1m above the surrounding fen, often occurring as a "bog island". The surface is generally flat. The plateau bog is usually teardrop-shaped, with the pointed end oriented in the downslope direction. The thickness of the peat is commonly in excess of 2m, but is seldom greater than 5m. They are usually treed with black spruce and have open, wet Sphagnum-Carex-dominated lawns often containing partially buried stands of dead trees. The internal lawns are characteristically less than 50 cm lower than the surrounding wooded bog surface (CCELC 1988; Vitt et al. 1994). |
| Wooded bog with internal lawns | | Peat accumulation (non-permafrost) | A bog characterized by the presence of open, wet Sphagnum-Carex-dominated lawns often containing partially buried stands of dead trees within a uniformly wooded bog island o peninsula. The internal lawns are characteristically less than 50 cm lower than the surrounding wooded bog surface and may occur in extensive patterns radiating from the bog island center or in indistinct, nonradiating patterns. Permafrost is absent (Vitt et al. 1994). |
| Wooded bog without internal lawns | Basin bog | Peat accumulation (non-permafrost) | A bog situated in a basin that has an essentially closed drainage, receiving water from precipitation and from runoff from the immediate surroundings. They have a flat surface, bu the peat is generally deepest at the center. They are usually treed with black spruce (CCELC 1988). |
| Wooded bog without internal lawns | Flat bog | Peat accumulation (non-permafrost) | A bog having a flat, featureless surface. It occurs in broad, poorly defined depressions. The depth of peat is generally uniform. The vegetation of these bogs consists mostly of stunted black spruce and ericaceous shrubs (CCELC 1988). |
| Wooded bog without internal lawns | Northern plateau bog | Peat accumulation (non-permafrost) | A raised bog elevated 0.5-1m above the surrounding fen, often occurring as a "bog island". The surface is generally flat, characterized only by small wet depressions. The plateau bog is usually teardrop-shaped, with the pointed end oriented in the downslope direction. These bogs are usually treed with stunted black spruce. The thickness of the peat is commonly in excess of 2m, but is seldom greater than 5m (CCELC 1988). |
| Wooded bog without internal lawns | | Peat accumulation (non-permafrost) | A bog that is uniformly wooded (with black spruce) and that has a flat, homogeneous surface. They can occur as islands within large complex fens or as peninsulas protruding into large fens. They can also be confined to small basins associated with hummocky terrain or in broad, poorly defined depressions as well as along drainage divides. Permafrost is not present (Vitt et al. 1996). |
| Fen lake | | Peat accumulation (non-permafrost) | A lake or small open body of water surrounded completely or nearly so by characteristic fen vegetation, growing either on a relatively firm substrate or a semi-floating mat of peat. |
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| Palsa | | Peat accumulation (permafrost present) | A circular or elongated peaty permafrost mound that has a perennially frozen core of alternating layers of segregated ice and peat or mineral soil material. The peat is relatively dry, but permafrost occurs within about 0.5 m of the surface. Palsas are typically 1-7 m in height and less than 100 m in diameter. Near the southern limit of their distribution, they usually occur as elevated wooded islands or peninsulas that rise abruptly above the surface in large, very sparsely wooded, non-frozen fens. Their surface can be highly uneven, often containing collapse scars. Palsas form by freezing from above and permafrost usually penetrates into the underlying mineral soil (CCELC 1988; Clark 1988; French 1996; Zoltai 1971). |
| Palsa bog | | Peat accumulation (permafrost present) | A bog composed of individual or coalesced palsas, occurring in an unfrozen peatland (CCELC 1988). |
| Palsa fen | | Peat accumulation (permafrost present) | A fen composed of individual or coalesced mounds of perennially frozen peat (sedge and brown moss peat). The mounds can reach up to 5m in height and 100m in diameter although they can be much smaller. Palsa fens generally occur in unfrozen peatlands. Their surface is highly uneven, often containing collapse scars (CCELC 1987, 1988). |
| Peat plateaux | | Peat accumulation (permafrost present) | Flat-topped elevated expanses of relatively dry peat that are dominated by a ground layer of lichens. They can occur as small, isolated, irregular to nearly circular-shaped islands within fens to complex networks of coalescing plateaus with only minor areas of fens. Peat plateaux contain a perennially frozen core of segregated ice that usually does not extend downwards into the underlying mineral soil. This is probably the main difference, genetically, between them and palsas. Peat plateaux seldom exceed 120 cm in height above the general surface of the peatland but may be several square kilometers in area. They result from the freezing of peat with the formation of segregated ice lenses and the consequent uplift of the peaty surface. Permafrost is generally found within about 0.5 m of the surface. At the southern fringe of their occurrence the permafrost is melting out of the plateaux, forming collapse scars. "Collapse scars" are depressions in a peatland caused by the thawing of permafrost within or beneath the peat. The peat surface subsides, sometimes to a depth of about 100 cm (CCELC 1988; French 1996; Halsey et al. 1995; Vitt et al. 1994, 1996; Zoltai 1971). |

| Landform Element | Subelement | Genesis | Definition |
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| Snowpatch fen | | Peat accumulation (permafrost present) | A fen occurring on uniform slopes underlain by permafrost. These fens are fed by the gradual melting of persistent snowpatches on the slopes above the fens. The thickness of peat is usually less than 0.5m (CCELC 1987). |
| Veneer bog | | Peat accumulation (permafrost present) | A permafrost dominated bog with a ground cover dominated by feathermosses and scanty tree cover. The bog may contain circular to irregularly shaped collapse scars that have a sharp boundary with the surrounding bog. The collapse scars have no permafrost. Veneer bogs may be found on low angle slopes (CCELC 1988; Vitt et al. 1996). |
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| Alluvial fan | Coalescing fan | Running water | An alluvial plain formed as a result of lateral growth of adjacent alluvial fans until they finally coalesce to form a continuous inclined deposit, particularly along a mountain front. These fans, also called "bajadas", have an undulating character due to the convexities of the component fans (A.G.I. 1984; Campbell 1997/1998; Parker 1997). |
| Alluvial fan | | Running water | A fan-shaped gently sloping mass of material, usually sand and gravel, deposited by a stream where it emerges from a narrow mountain valley onto a plain or broad valley. Viewed from above, it has the shape of an open fan, the apex being at the valley mouth pointing upstream (A.G.I. 1984; Parker 1997). According to Campbell (1997), some of the fans in Alberta have been described as "paraglacial". |
| Anastomosing stream | | Running water | A stream pattern in which, owing to excessive deposition in the main stream, the channels bifurcate, branch and rejoin irregularly to create a net-like formation (Whittow 1984). |
| Badlands | | Running water | An intricately stream-dissected topography characterized by a very fine drainage network with high drainage densities and short, steep slopes. Badlands have little or no vegetative cover generally overlying unconsolidated or weakly cemented clays or silts, sometimes with soluble minerals such as gypsum or halite (A.G.I. 1984; Driscoll 1984). |
| Bar-and-swale topography | | Running water | A term used to describe that part of a river floodplain in which the micro-relief of the alluvial surface is characterized by bars (e.g., scroll bars) and troughs (swales) formed in earlier depositional phases in an area of meander growth (Whittow 1984). |
| Braided stream | | Running water | A stream that divides into an interlacing network of branching and reuniting shallow channels separated from each other by islands or channel bars, resembling in plan the strands of a complex braid (A.G.I. 1984). Braided channels are the most common form in periglacial regions (French 1996). |
| Cliff | | Running water | A high, steep rock face or precipice, or a steep face in unconsolidated deposits (A.G.I. 1984; Whittow 1984). |
| Coulee | | Running water | Any steep-sided gulch or water channel (Fairbridge 1968). |
| Crevasse splay | | Running water | The forms created in the floodplain from the deposits resulting from a breach in a natural levee (Thornbury 1969). |
| Delta | Braid delta | Running water | A laterally estensive, sheet-like sand body dominated by trough and planar, tabular cross-bedding, underlain by lacustrine mud. Trough and planar cross-bedding is associated with braided river deposition. Braided deltas are coarse-grained and are formed by progradation of a purely fluvial, braided alluvial plain. They usually lack a fan-shape and have shallow receiving basin (Smith 1991). |
| Delta | Delta lake | Running water | A lake formed along the margin of or within a delta, as by the building of bars across a shallow embayment or by the enclosure of part of another waterbody by the growth of deltai deposits (A.G.I. 1984). |
| Delta | Fan-delta | Running water | A high-energy delta formed by a stream where it emerges from a mountain valley and into a nearby waterbody. They are most common in deep mountain lakes. They are generally formed by streams with small watersheds. The delta is usually fan-shaped and contains a gently sloping mass of material, usually sand and gravel (A.G.I. 1984; Campbell 1997/1998; Smith 1991). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Delta | Stable channel-Mouth bar delta | Running water | A delta generally consisting of a "muddy plain" incised by deep and sometimes long distributary channels that may be levee-bordered. Abandoned distributary channels are commonly filled with sand, sometimes sand and mud or entirely with mud. The mouth bars at the front of the delta usually contain large volumes of sand. The projecting distributary channels may branch outward like the outstretched toes or claws of a bird. This pattern of channels has given rise to the name birdsfoot delta which is one form of a stable channel-mouth bar delta (A.G.I. 1984; Parker 1997; Smith 1991). |
| Delta | Unilobate delta | Running water | A single-channel delta created in lakes where wave action is restricted (generally small lakes), with the result that the momentum of the incoming stream carries it well out into the lake; deposition of river sediments occurs mainly at the sides of the stream, usually forming a pair of bars projecting into the lake (Hutchinson 1957). |
| Delta | | Running water | The nearly flat alluvial tract of land at the mouth of a river, commonly forming a triangular or fan-shaped plain. It is crossed by many distributaries, and results from the accumulation of sediment supplied by the river (A.G.I. 1984). |
| Erosional remnant | | Running water | An elevated upland area that is distinct and that has been separated, by the action of erosion (especially by running water), from the surrounding landscape. These features are usually large in areal extent but can be much smaller in size. They can be expressed as flat-topped isolated buttes and plateaus or as elevated uplands with ridges and ravines. Erosional remnants may be capped by gravels (e.g., Swan Hills) or by a resistant layer of rock (e.g., buttes) (A.G.I. 1984). |
| Escarpment | | Running water | A long, more or less continuous cliff or relatively steep slope facing in one general direction, separating two level or gently sloping surfaces. Many escarpments are faulted or tectonic in origin and are not 'classically' a water-produced form (A.G.I. 1984; Campbell 1977). |
| Floodplain | | Running water | That portion of a river valley, adjacent to the channel, which is built of sediments deposited during the present regimen of the stream and is covered with water when the river overflows its banks at flood stages (A.G.I. 1984). |
| Floodplain scour route | | Running water | A shallow channel in a floodplain that may be used only during floods or other periods of high water flow. They represent either abandoned courses or initial stages in the development of new courses. They are often associated with "gravelly rivers" (Smith 1998; Thornbury 1969). |
| Fluviatile lake | Alluvial fan dammed lake | Running water | A body of water held in the valley of a main river course, either temporarily or perennially, by the conelike or fanlike deposits at the mouth of a lateral tributary. The deposits contain more sediment than the main stream can remove. If the lateral tributary discharges at the middle of one side of a lake, it may build a delta of sufficient size to cut the basin in half (Hutchinson 1957; Smith 1998). |
| Fluviatile lake | Oxbow lake | Running water | The crescent-shaped, often ephemeral, body of standing water situated in the abandoned channel (oxbow) of a meander after the stream formed a neck cutoff and the ends of the original bend were silted up (A.G.I. 1984). |
| Fluviatile lake | | Running water | A lake formed in the floodplain of a river, or other water bodies formed as a result of stream erosion and deposition (Veatch and Humphrys 1964). |
| Gorge/Canyon | | Running water | A stream-cut chasm, the sides of which are composed of cliffs or a series of cliffs rising from its bed; a narrow, deep valley with nearly vertical walls (A.G.I. 1984). |
| Levee dammed lake | | Running water | A lake related in their origin to river bank levees. Where levees act as barriers or enclosures to hold water other than from the primary river, levee dammed lakes can form (Campbell 1997/1998; Hutchinson 1957; Veatch and Humphrys 1964). |
| Meander scar | | Running water | A crescentic stream-made cut, usually shallow, in the floodplain bordering a stream, produced by the sideward cutting of a meandering stream and indicating its former route (A.G.I. 1984; Mollard 1972). |
| Meandering stream | | Running water | A mature stream winding freely on a broad floodplain; a stream channel whose curves exhibit a notable symmetry (A.G.I. 1984; Thornbury 1969). |
| Natural bridge | | Running water | Any archlike rock formation created by erosive agencies (e.g., stream erosion) and spanning or occurring within a ravine or valley (A.G.I. 1984). |
| Natural levee | | Running water | A ridge or embankment of sand and silt, built by a stream on its flood plain along both banks of its channel, especially in time of flood when water overflowing the normal banks is forced to deposit the coarsest part of its load (A.G.I. 1984). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Neck cutoff | | Running water | The remnant of a meander spur, formed when a vigorously downcutting stream breaks through the narrow strip of land between adjacent curves in the stream course; it usually stands as an isolated hill enclosed by stream meanders. This feature is also termed a meander core (A.G.I. 1984; Smith 1998; Whittow 1984). |
| Pediment | | Running water | A broad gently sloping erosion surface or plain of low relief, typically developed by running water in an arid or semi-arid region at the base of an abrupt and receding upland front and extending down towards a river or alluvial plain; it is underlain by bedrock that may be bare but is more often mantled with a thin discontinuous veneer of alluvium derived from the upland masses and in transit across the surface. Pediment surfaces often occur in miniature form in areas such as badlands (A.G.I. 1984; Barendregt and Ongley 1979). |
| Pipes and related phenomena | | Running water | Tubular underground channels or conduits created by subterranean erosion from surface runoff waters that percolate into desiccation cracks or fissures and which remove solid particles from clastic (fragmental) rocks and other materials. Pipes are generally long and narrow, connecting a series of collapse features and vertical shafts. The size and morphology of the pipes vary greatly but diameters may exceed several meters. The collapse features vary from a few centimeters to 9 meters in diameter and may extend to a depth of 15 meters below the surface. Piping where tubes are preserved occurs either along the margins of recently gullied flats such as floodplains and terraces, or in the crowns, slopes and channels of badland hills. Pseudokarsts produced by piping display disappearing streams, sinkholes, blind and hanging valleys, natural bridges, residual hills and caves (Barendregt 1977, Fairbridge 1968). |
| Playa lake | | Running water | A shallow, intermittent lake in an arid region, occupying a playa in the wet season but often drying up in summer. A playa is a low, essentially flat part of a large undrained basin in an arid region. Playas variously show sheetwash stains, giant contraction polygons and stripes, salt pressure polygons, and/or white salt flats (A.G.I. 1984; Kupsch and Rutter 1982; Parker 1997; Thornbury 1969). |
| Plunge pool lake | | Running water | Bodies of water that occur in basins scoured in the bed of a stream at the foot of a former waterfall by the force and eddying effect of the falling water (Hutchinson 1957; Parker 1997). |
| Rapids | | Running water | A part of a stream where the current is moving swiftly and where the water surface is broken by obstructions (e.g., rocks), as where the stream descends over a series of small steps (A.G.I. 1984). |
| River island | Alluvial island | Running water | An elevated piece of land within the channel of a river or near its mouth and formed of alluvial deposits (A.G.I. 1984). |
| River island | Bedrock island | Running water | An elevated piece of land within the channel of a river or near its mouth and formed of bedrock (A.G.I. 1984). |
| River island | | Running water | An elevated piece of land within the channel of a river or near its mouth (A.G.I. 1984). |
| River meander | Incised meander | Running water | Meanders that are carved markedly downward into the surface of the valley in which they originally formed. Incised meanders are closely bordered or enclosed by the valley walls. The walls are often comprised of rock. Two types of incised meanders are generally recognized: (a) entrenched meanders which show little or no contrast between the slopes of the two valley sides of a meander curve, and (b) ingrown meanders which exhibit pronounced asymmetry of cross profile with undercut slopes on the outside of the meander curve and slipoff slopes on the inside (A.G.I. 1984; Thornbury 1969). |
| River meander | | Running water | One of a series of sinuous curves or loops in the course of a channel, produced as the stream swings from side to side in flowing across its floodplain or shifts its course laterally toward the convex side of an original curve (A.G.I. 1984). |
| River terrace | Rock-cut terrace | Running water | A river terrace comprised almost entirely of bedrock except, in some cases, for a thin alluvial veneer. It is sometimes called a strath terrace (Campbell 1997/1998; Rains 1997; Whittow 1984). |
| River terrace | | Running water | One of a series of benches above the level of the river, flanking and more or less parallel to the river channel. They are the dissected remnants of an abandoned flood plain, river bed, or valley floor produced during a former stage of erosion or deposition (A.G.I. 1984; Rains 1997). |
| Stack | | Running water | An isolated, pillar-like rocky island, detached from a shore by water erosion. It is sometimes referred to as a pillar, chimney rock, column, needle, "flower-pot rock", etc. (Fairbridge 1968; Parker 1997). |
| Underfit stream | | Running water | A stream that appears too small to have eroded the valley in which it flows (A.G.I. 1984). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Valley | V-shaped valley | Running water | A valley whose form is largely created by fluvial erosion and which is characterized by evenly sloping sides and a V-shaped cross-profile (Rains 1997; Whittow 1984). |
| Valley | | Running water | An elongate, relatively large, depression of the earth's surface that is usually traversed by a stream or river which receives the drainage of the surrounding heights. It can be created by fluvial erosion, faulting or other agents but may have been subsequently modified by, for example, glacial erosion (A.G.I. 1984; Campbell 1997/1998; Driscoll 1984; Rains 1997; Whittow 1984). |
| Water gap | | Running water | A deep pass in a mountain ridge, through which a stream flows; especially a narrow gorge or ravine cut through resistant rocks by stream erosion (A.G.I. 1984). |
| Waterfall | | Running water | A perpendicular or steep descent of a stream, as where it crosses an outcrop of resistant rock overhanging softer rock that has been eroded (A.G.I. 1984). |
| | | | |
| Burning sulphur<br>Burning gas | | Spontaneous combustion | The process whereby the oxidation of sulphides or pyrites within bedrock creates enough heat to keep sulphur molten or to spontaneously combust through the chemical action of oxidation. Natural gas or methane seeps may also spontaneously combust where conditions are suitable, such as at the the Lutose Creek Hot Pot (A.E.P. no date). |
| | | | |
| Concretion exposure | | Weathering and differential erosion | An exposure of an irregular, subspherical concentration of resistant material which is harder than the rock strata in which it occurs or previously occurred. If the surrounding rock in which they occur erodes, the concretions gradually emerge and become visible. Initially, only part of the concretion, such as the distinctive ringed tops, will be visible. Others that are completely exposed may be perched on slopes or ridge-tops. Concretions are thought to have been formed around a central nucleus, such as a shell or bone, by localized deposition of a cementing material (e.g., calcite, silica) during the consolidation of the sedimentary or pyroclastic rocks. Concretions are generally different in composition from the rock in which they occur, and represent a concentration of some minor constituent of that rock (AEP n.d.; A.G.I. 1984; Whittow 1984). |
| Earth pillar | | Weathering and differential erosion | A column or pinnacle of clay (often till) or relatively soft earthy material, capped by a boulder, which serves to protect it from erosion by rain. Once the boulder falls from the pinnacle the pillar will rapidly be destroyed. It is found in areas of moraine and is also typical of the badlands (Whittow 1984). |
| Exfoliation forms | | Weathering and differential erosion | Rock forms created by the removal, through successive spalling or stripping, of concentric scales, plates, or shells of rock, from less than a centimeter to several meters in thickness, from the bare surface of a large rock mass. On a smaller scale, spheroidal boulders can be created as a result of jointed rock masses becoming slowly rounded by the gradual removal of their concentric outer shells (A.G.I. 1984; Fairbridge 1968; Whittow 1984). |
| Flatiron | | Weathering and differential erosion | One of a series of short, triangular spurs or ridges on the flank of a mountain, having a narrow apex and a broad base, resembling a huge flatiron; it usually consists of a plate of steeply inclined resistant rock between deep valleys. A flatiron is commonly associated with the erosion of a dome structure. Flatirons are erosional forms which develop on tectonically disturbed masses (A.G.I. 1984; Campbell 1997/1998; Whittow 1984). |
| Frost pocket | | Weathering and differential erosion | A joint or bedding plane surface exposure that has been enlarged by weathering, especially freeze-thaw action. Frost pockets take on the appearance of cave entrances, but rarely go back far enough to lose daylight (Rollins 1992). |
| Honeycomb weathering | | Weathering and differential erosion | A type of chemical weathering in which innumerable pits, hollows and niches are produced on a rock exposure. The pitted surface resembles an enlarged honeycomb and is characteristic of finely granular rocks, such as tuffs and sandstones (A.G.I. 1984). Also termed "alveolar weathering" or "taffoni weathering" (Campbell 1997/1998; French 1996). |
| Hoodoos | | Weathering and differential erosion | A column, pinnacle, or pillar of rock or cemented conglomerates produced in a region of sporadic heavy rainfall by differential weathering or erosion of horizontal strata (e.g., undercutting by wind), facilitated by joints and by layers of varying hardness, and occurring in varied and often eccentric or grotesque forms (A.G.I. 1984; Whittow 1984). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Pinnacle | | Weathering and differential erosion | A tall, slender pillar of rock or conglomerate materials (A.G.I. 1984). |
| Rock-shelter | | Weathering and differential erosion | A shallow cave or alcove created by the differential erosion of the matrix. The cave may be located beneath an overhanging rock ledge and the cave bottom can be more or less flat (Bogli 1980). |
| Sandstone dike | | Weathering and differential erosion | A near-vertical, sheet-like body of sandstone or lithified sand, usually less than 10 cm in thickness, that cuts through bedrock in the manner of an igneous dike. They are thought to be formed by the infilling of a bedrock fissure from above or by injection from below. Where the dike's surface outcrop is more resistant to erosion than the host rock itself, it may form a wall-like or ridge-like feature (Parker 1997; Whittow 1984). |
| | | | |
| Aligned coulee | | Wind | Coulees generally located along the windward side of stream and river valleys, and that are aligned parallel with the prevailing winds. The mean trend of such coulees in parts of southern Alberta is 70E east of north, the direction of the strongest and most persistent winds. Most coulees are located on valley walls with a southwesterly, or windward, exposure (i.e., facing west). Aligned coulees are restricted geographically in Alberta to the major stream valleys that are found from Lethbridge to the mountains (e.g., Oldman, St. Mary, Belly, Castle) (Beaty 1975). Campbell (1997/1998) suspects that these coulees are structurally-controlled water channels, however, the exact mechanisms responsible for coulee alignment remain poorly documented (Lemmen et al. 1997). |
| Blowout | | Wind | A general term for various saucer- or trough-shaped hollows formed by wind erosion on a dune or other sand deposit, especially when the protective vegetation cover has been removed or destroyed (A.G.I. 1984; Whittow 1984). |
| Buried forest | | Wind | Part of a forest that has been slowly inundated and in which trees are eventually killed by the accumulation of sand from advancing sand dunes (Landals 1978). |
| Deflation lake | | Wind | A lake or pond that occupies a basin formed mainly by wind erosion. Ponds or small lakes may occur in blowouts as well as in deeper valley depressions or hollows that are enclosed by dune ridges (Veatch and Humphrys 1964). The damp or wet hollows that occur on the flat interdunal areas or troughs between sand ridges, where ground water reaches or approaches the surface of the sand have been termed "dune slacks" (Raup and Argus 1982). |
| Dune | Dome dune | Wind | A low, rounded mound of sand which lacks, or has a poorly developed slip face. Dome dunes vary in height from 1 to 7 m and are 15 to 200 m in maximum length. The dunes have rounded, smooth, upper surfaces, without deflation hollows. Steeper slopes are usually present on the eastern part of the dunes. They often occur as part of a dune field containing other dune forms (Greeley and Iversen 1985; Halsey and Catto 1994; David 1998). |
| Dune | Parabolic dune | Wind | Typically, a type of curved sand dune, having the horns pointing upwind. It is usually formed by the process known as a "blowout" in which the centre of the dune is partly removed and carried downwind, leaving the horns behind and drawn out in an elongated form. The steepest slope of the redistributed sand is located on the convex side of the dune. Parabolic dunes form a group that has been called the "parabolic dune association". Within this association are several dune forms (e.g., blowout dunes, shield dunes) that have developed the same way as an 'ordinary' parabolic dune but which have certain characteristic features that make them different from the others in the association (A.G.I. 1984; David 1998; Lemmen et al. 1997; Mollard 1972; Whittow 1984). |
| Dune | Shadow dune | Wind | A tapering accumulation of sand formed in the lee of an obstacle (e.g., vegetation, boulder) where the wind velocity is locally reduced (Pye and Tsoar 1990). |
| Dune | Silt/Clay dune | Wind | Dunes formed from dessication and deflation of materials from saline flats and saline intermittent lakes. Materials are usually saline aggregates of sand and silt with clay. Dunes usually form on the flanks and lee margins of intermittent lakes and saline flats, and are often vegetated by salt-tolerant species (Fairbridge 1968). |
| Dune | Transverse dune | Wind | A strongly asymmetrical ridge of sand extending transverse to the direction of the prevailing winds, having a gentle windward slope and a steep leeward slope (A.G.I. 1984). |
| Dune | | Wind | A mound, ridge, or hill of wind-blown sand, either bare or covered with vegetation, capable of movement from place to place through the development of a slipface, but always retaining its own characteristic shape for an extended period of time (A.G.I. 1984; David 1977). |
| Dune ridge | Blowout ridge | Wind | A low, arcuate and concave-upwind ridge, occurring in areas of limited sand supply. Although they may develop a low slipface, it generally is not preserved due to the low ridge height and deforming side winds. Blowout ridges are dominant aeolian features in areas where surficial material is a thin veneer of sand (Lemmen et al. 1997). |
| Dune ridge | Border ridge | Wind | An elongate sand ridge, most frequently irregular in plan view, forming at the edges of deflation areas (David 1977). |

| Landform Element | Subelement | Genesis | Definition |
|---|---|---|---|
| Dune ridge | Cree Lake ridge | Wind | Very long, most frequently very straight sand ridges, characteristically passing over topographical irregularities formed by bedrock or glacial deposit (David 1977). |
| Dune ridge | Dune-track ridge | Wind | Relatively rare features that mark the former position and shape of the back base line of a parabolic dune head. The ridges are arcuate, sometimes slightly sinuous or irregular. They always occur in groups connecting the two wings across the blowout depression. They often form when the base of dunes are stabilized by vegetation (Lemmen et al. 1997). |
| Dune ridge | Lacadena ridge | Wind | A relatively short and somewhat wide dune ridge having a low central axis along its center line and having slipface-like slopes along both sides (David 1977). |
| Dune ridge | Lake Claire ridge | Wind | A very straight ridge having a characteristic zigzag pattern on it at one or more locations along its course (David 1977). |
| Dune ridge | North Battleford ridge | Wind | An elongate ridge with a slightly sinuous crest-line, formed by the "transverse" deflation of the southern wing of a former parabolic dune. The resulting ridge has a strongly asymmetrical transverse profile. These ridges always lie parallel to one another (David 1977). |
| Dune ridge | | Wind | A generalized term to describe elongate or curvilinear ridges of wind-blown sand formed either by deposition of aeolian sand or by erosion via deflation of former dunes (David 1977; Mulira 1986). Some dune ridges have been described as "...to fit quite well the description of seif dunes..." (David 1977). David (ibid.) believes that the "vague and very superficial resemblance of these dune ridges to seif dunes is not a valid reason to call them such or even as longitudinal dunes. These elongate dune ridges did not form the same way, nor do they occur presently or at one time, in the same type of environment as seif dunes do. While seif dunes develop under the influence of a particular wind pattern in a truly desertic environment, the predominant presence of parabola type dunes...are indicative of a phytogenic or parabolic dune environment." |
| Lag gravel | | Wind | A residual accumulation of coarse rock fragments on a surface after the finer material has been blown away by winds (A.G.I. 1984). |
| Sand ripples | | Wind | Small-scale subparallel ridges and troughs formed in loose sand by wind. Small ripples have wavelengths of <1 cm up to 25 cm; larger ripples can have wavelengths of up to 20m and heights of up to 1 m (A.G.I. 1984; Pye and Tsoar 1990). |
| Ventifact | | Wind | A stone or pebble whose shape, wear, faceting, cut, or polish is the result of sandblasting and/or snow crystal blasting (Parker 1997; Rains 1997). |

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LANDFORM ELEMENTS IN ALBERTA

Process: Running Water

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Alluvial fan | Coalescing fan | Y | | 3 | 2 | 1 | 1 | 0 |
| Anastomosing stream | | Y | | 1 | 1 | 0 | 0 | 0 |
| Delta | Braid delta | Y | | 0 | 0 | 0 | 0 | 0 |
| Delta | Fan-Delta | Y | | 5 | 5 | 0 | 0 | 0 |
| Delta | Unilobate delta | Y | | 1 | 0 | 1 | 1 | 0 |
| Fluviatile lake | Alluvial fan dammed lake | Y | | 5 | 3 | 2 | 2 | 0 |
| Levee dammed lake | | Y | | 4 | 3 | 1 | 1 | 0 |
| Natural bridge | | Y | | 6 | 6 | 0 | 0 | 0 |
| Playa lake | | Y | | 4 | 1 | 3 | 3 | 0 |
| Plunge pool lake | | Y | | 3 | 2 | 1 | 1 | 0 |
| Stack | | Y | | 3 | 1 | 2 | 2 | 0 |
| | | | | | | | | |
| Alluvial fan | | | Y | 32 | 10 | 22 | 0 | 0 |
| Badlands | | | Y | 20 | 3 | 17 | 0 | 3 |
| Bar-and-swale topography | | | Y | 17 | 3 | 14 | 2 | 0 |
| Braided stream | | | Y | 19 | 8 | 11 | 3 | 0 |
| Cliff | | | Y | 12 | 4 | 8 | 0 | 0 |
| Coulee | | | Y | 1 | 1 | 0 | 0 | 0 |
| Delta | | | Y | 15 | 3 | 12 | 0 | 0 |
| Delta | Delta lake | | Y | 1 | 1 | 0 | 0 | 0 |
| Delta | Stable channel-Mouth bar delta | | Y | 4 | 1 | 3 | 1 | 1 |
| Erosional remnant | | | Y | 40 | 9 | 31 | 2 | 3 |
| Escarpment | | | Y | 10 | 4 | 6 | 0 | 0 |
| Floodplain | | | Y | 0 | 0 | 0 | 0 | 0 |
| Floodplain scour route | | | Y | 6 | 2 | 4 | 0 | 0 |
| Fluviatile lake | | | Y | 10 | 0 | 10 | 0 | 0 |
| Fluviatile lake | Oxbow lake | | Y | 47 | 10 | 37 | 1 | 0 |
| Gorge/canyon | | | Y | 48 | 19 | 29 | 4 | 1 |
| Meander scar | | | Y | 23 | 5 | 18 | 0 | 0 |
| Meandering stream | | | Y | 23 | 1 | 22 | 0 | 0 |
| Natural levee | | | Y | 2 | 2 | 0 | 0 | 0 |
| Neck cutoff | | | Y | 5 | 0 | 5 | 5 | 0 |

Running Water: continued

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Pediment | | | Y | 5 | 3 | 2 | 0 | 0 |
| Pipes and related phenomena | | | Y | 6 | 3 | 3 | 0 | 1 |
| Rapids | | | Y | 20 | 3 | 17 | 3 | 0 |
| River island | | | Y | 7 | 2 | 5 | 0 | 0 |
| River island | Alluvial island | | Y | 5 | 5 | 0 | 0 | 0 |
| River island | Bedrock island | | Y | 4 | 0 | 4 | 4 | 0 |
| River meander | | | Y | 2 | 1 | 1 | 0 | 0 |
| River meander | Incised meander | | Y | 17 | 5 | 12 | 4 | 0 |
| River terrace | | | Y | 22 | 8 | 14 | 2 | 0 |
| River terrace | Rock-cut terrace | | Y | 6 | 1 | 5 | 2 | 0 |
| Underfit stream | | | Y | 10 | 3 | 7 | 0 | 1 |
| Valley | | | Y | 0 | 0 | 0 | 0 | 0 |
| Valley | V-shaped valley | | Y | 5 | 0 | 5 | 0 | 1 |
| Water gap | | | Y | 9 | 3 | 6 | 3 | 0 |
| Waterfall | | | Y | 49 | 25 | 24 | 2 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Lake Waves and Currents

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Baymouth bar | | Y | | 3 | 3 | 0 | 0 | 0 |
| Lagoon | | Y | | 1 | 1 | 0 | 0 | 0 |
| Spit | | Y | | 10 | 8 | 2 | 2 | 0 |
| Tombolo | | Y | | 2 | 0 | 2 | 0 | 1 |
| | | | | | | | | |
| Aeolian beach ridge | | | Y | 22 | 9 | 13 | 1 | 1 |
| Beach | | | Y | 13 | 11 | 2 | 1 | 0 |
| Beach scarp | | | Y | 4 | 4 | 0 | 0 | 0 |
| Ice-push ridge | | | Y | 2 | 1 | 1 | 0 | 0 |
| Lake island | | | Y | 26 | 6 | 20 | 2 | 0 |
| Peninsula | | | Y | 15 | 6 | 9 | 0 | 0 |
| Raised beach | | | Y | 8 | 2 | 6 | 5 | 1 |
| Shoal | | | Y | 1 | 0 | 1 | 0 | 0 |
| Shoreline cliff | | | Y | 3 | 2 | 1 | 1 | 0 |
| Wave-cut notch | | | Y | 0 | 0 | 0 | 0 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Glacial Ice and Meltwater

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Biscuit board topography | | Y | | 2 | 0 | 2 | 1 | 1 |
| Crag-and-tail | | Y | | 3 | 0 | 3 | 3 | 0 |
| Drift basin | Moraine-dammed lake | Y | | 10 | 9 | 1 | 1 | 0 |
| Fluting | Giant flutings | Y | | 8 | 0 | 8 | 7 | 0 |
| Glacial tunnel lake | | Y | | 9 | 0 | 9 | 6 | 0 |
| Glacier | Outlet glacier | Y | | 12 | 12 | 0 | 0 | 0 |
| Ice field | | Y | | 8 | 8 | 0 | 0 | 0 |
| Kame | Moulin kame | Y | | 3 | 0 | 3 | 3 | 0 |
| Moraine | de Geer moraine | Y | | 7 | 1 | 6 | 6 | 0 |
| Moraine | Rogen moraine | Y | | 5 | 2 | 3 | 2 | 0 |
| Nunatak | | Y | | 2 | 2 | 0 | 0 | 0 |
| Paternoster lakes | | Y | | 5 | 3 | 2 | 2 | 0 |
| Pitted delta | | Y | | 3 | 0 | 3 | 1 | 2 |
| Proglacial lake | | Y | | 1 | 1 | 0 | 0 | 0 |
| Roche moutonnée | | Y | | 5 | 3 | 2 | 1 | 0 |
| | | | | | | | | |
| Arête | | | Y | 7 | 7 | 0 | 0 | 0 |
| Cirque | | | Y | 13 | 8 | 5 | 0 | 0 |
| Col | | | Y | 2 | 2 | 0 | 0 | 0 |
| Crevasse filling | | | Y | 30 | 3 | 27 | 1 | 0 |
| Drift basin | Holm lake | | Y | 4 | 0 | 4 | 1 | 0 |
| Drift basin | Kettle lake | | Y | 32 | 17 | 15 | 0 | 0 |
| Drift basin | Morainal lake | | Y | 32 | 12 | 20 | 0 | 0 |
| Drift basin | Saline/Alkaline lake | | Y | 50 | 2 | 48 | 3 | 0 |
| Drumlin | | | Y | 50 | 7 | 43 | 0 | 2 |
| Erratic | | | Y | 71 | 15 | 56 | 2 | 0 |
| Esker | | | Y | 171 | 9 | 162 | 3 | 0 |
| Fluting | | | Y | 60 | 3 | 57 | 1 | 0 |
| Friction cracks | Chattermark | | Y | 0 | 0 | 0 | 0 | 0 |
| Friction cracks | Crescentic fracture | | Y | 0 | 0 | 0 | 0 | 0 |
| Friction cracks | Crescentic gouge | | Y | 1 | 0 | 1 | 0 | 0 |
| Friction cracks | Lunate fracture | | Y | 0 | 0 | 0 | 0 | 0 |
| Glacial groove | | | Y | 4 | 1 | 3 | 0 | 0 |
| Glacier | | | Y | 2 | 2 | 0 | 0 | 0 |
| Glacier | Cirque glacier | | Y | 14 | 14 | 0 | 0 | 0 |

Glacial Ice & Meltwater: continued

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences Inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Glacier | Hanging glacier | | Y | 6 | 6 | 0 | 0 | 0 |
| Glacier | Valley glacier | | Y | 2 | 2 | 0 | 0 | 0 |
| Hanging valley | | | Y | 18 | 14 | 4 | 1 | 0 |
| Horn | | | Y | 15 | 15 | 0 | 0 | 0 |
| Ice scour lake | | | Y | 27 | 4 | 23 | 1 | 0 |
| Kame | | | Y | 58 | 12 | 46 | 0 | 0 |
| Kame | Kame delta | | Y | 1 | 0 | 1 | 1 | 0 |
| Kame | Kame moraine | | Y | 21 | 0 | 21 | 2 | 0 |
| Kame | Kame terrace | | Y | 21 | 5 | 16 | 3 | 0 |
| Kettle | | | Y | 3 | 1 | 2 | 1 | 0 |
| Knob and kettle terrain | | | Y | 9 | 3 | 6 | 0 | 0 |
| Lake basin groupings | Chain of lakes | | Y | 1 | 0 | 1 | 0 | 0 |
| Lake basin groupings | Train of lakes | | Y | 1 | 1 | 0 | 0 | 0 |
| Meltwater channel | | | Y | 31 | 4 | 27 | 0 | 0 |
| Meltwater channel | Ice-marginal channel | | Y | 5 | 1 | 4 | 0 | 0 |
| Meltwater channel | Ice-walled channel | | Y | 8 | 0 | 8 | 2 | 0 |
| Meltwater channel | Subglacial channel | | Y | 5 | 0 | 5 | 4 | 1 |
| Meltwater channel lake | | | Y | 11 | 1 | 10 | 0 | 0 |
| Micro crag and tails | | | Y | 1 | 0 | 1 | 0 | 0 |
| Moraine | End moraine | | Y | 27 | 7 | 20 | 0 | 0 |
| Moraine | Fluted moraine | | Y | 7 | 1 | 6 | 0 | 0 |
| Moraine | Lateral moraine | | Y | 17 | 8 | 9 | 0 | 0 |
| Moraine | Medial moraine | | Y | 0 | 0 | 0 | 0 | 0 |
| Moraine | Washboard moraine | | Y | 3 | 0 | 3 | 0 | 0 |
| Moraine plateaux | | | Y | 17 | 0 | 17 | 2 | 1 |
| Mountain pass | | | Y | 5 | 4 | 1 | 0 | 0 |
| Outwash delta | | | Y | 4 | 0 | 4 | 0 | 0 |
| Outwash plain | | | Y | 0 | 0 | 0 | 0 | 0 |
| Overflow channel | | | Y | 11 | 0 | 11 | 1 | 0 |
| Pitted outwash | | | Y | 19 | 6 | 13 | 0 | 0 |
| Rock basin | | | Y | 0 | 0 | 0 | 0 | 0 |
| Striations | | | Y | 19 | 6 | 13 | 0 | 0 |
| Tarn | | | Y | 29 | 21 | 8 | 0 | 0 |
| Trim line | | | Y | 0 | 0 | 0 | 0 | 0 |
| Truncated spur | | | Y | 4 | 4 | 0 | 0 | 0 |
| U-shaped valley | | | Y | 27 | 13 | 14 | 0 | 0 |
| Valley train | | | Y | 19 | 5 | 14 | 0 | 0 |
| Whalebacks | | | Y | 5 | 0 | 5 | 0 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Glaciotectonism

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Megablock | | Y | | 10 | 0 | 10 | 9 | 0 |
| Murdlin | | Y | | 4 | 0 | 4 | 4 | 0 |
| | | | | | | | | |
| Hill-hole pair | | | Y | 18 | 0 | 18 | 4 | 1 |
| Ice-thrust block | | | Y | 22 | 0 | 22 | 0 | 0 |
| Ice-thrust moraine | | | Y | 82 | 0 | 82 | 2 | 0 |
| Ice-thrust ridges | | | Y | 75 | 3 | 72 | 1 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Winds

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Buried forest | | Y | | 1 | 1 | 0 | 0 | 0 |
| Dune | Transverse dune | Y | | 13 | 4 | 9 | 4 | 5 |
| Dune ridge | Cree Lake ridge | Y | | 1 | 0 | 1 | 0 | 1 |
| Dune ridge | Dune-track ridge | Y | | 1 | 0 | 1 | 1 | 0 |
| Dune ridge | Lacadena ridge | Y | | 2 | 0 | 2 | 2 | 0 |
| Dune ridge | Lake Claire ridge | Y | | 4 | 2 | 2 | 1 | 1 |
| Dune ridge | North Battleford ridge | Y | | 4 | 1 | 3 | 2 | 1 |
| | | | | | | | | |
| Aligned coulees | | | Y | 4 | 0 | 4 | 4 | 0 |
| Blowout | | | Y | 15 | 2 | 13 | 1 | 0 |
| Deflation lake | | | Y | 0 | 0 | 0 | 0 | 0 |
| Dune | | | Y | 20 | 7 | 13 | 0 | 0 |
| Dune | Dome dune | | Y | 1 | 0 | 1 | 0 | 0 |
| Dune | Parabolic dune | | Y | 73 | 11 | 62 | 3 | 3 |
| Dune | Shadow dune | | Y | 0 | 0 | 0 | 0 | 0 |
| Dune ridge | | | Y | 4 | 1 | 3 | 0 | 0 |
| Dune ridge | Blowout ridge | | Y | 0 | 0 | 0 | 0 | 0 |
| Dune ridge | Border ridge | | Y | 2 | 1 | 1 | 0 | 0 |
| Lag gravel | | | Y | 1 | 1 | 0 | 0 | 0 |
| Sand ripples | | | Y | 0 | 0 | 0 | 0 | 0 |
| Ventifact | | | Y | 1 | 0 | 1 | 0 | 1 |

LANDFORM ELEMENTS IN ALBERTA

Process: Ground Water—Karst terrain

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Estevella | | Y | | 1 | 1 | 0 | 0 | 0 |
| Ice cave | Perennial ice cave | Y | | 5 | 2 | 3 | 3 | 0 |
| Ice cave | Relict permafrost cave | Y | | 2 | 1 | 1 | 1 | 0 |
| Ice cave | Snow trap cave | Y | | 1 | 1 | 0 | 0 | 0 |
| Ice cave | Cold trap cave | Y | | 2 | 1 | 1 | 1 | 0 |
| Ice cave | Cold zone cave | Y | | 2 | 0 | 2 | 2 | 0 |
| Karst cave | Bedding cave | Y | | 10 | 7 | 3 | 3 | 0 |
| Karst dome | | Y | | 0 | 0 | 0 | 0 | 0 |
| Solution lake | Uvala lake | Y | | 4 | 4 | 0 | 0 | 0 |
| Solution subsidence trough | | Y | | 0 | 0 | 0 | 0 | 0 |
| Uvala | | Y | | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | |
| Disappearing stream | | | Y | 6 | 4 | 2 | 1 | 0 |
| Doline | | | Y | 2 | 0 | 2 | 0 | 0 |
| Doline | Suffosion | | Y | 1 | 1 | 0 | 0 | 0 |
| Doline | Solution | | Y | 13 | 9 | 4 | 3 | 0 |
| Doline | Collapse | | Y | 13 | 11 | 2 | 2 | 0 |
| Dry valley | | | Y | 1 | 1 | 0 | 0 | 0 |
| Karren | Rillenkarren | | Y | 2 | 2 | 0 | 0 | 0 |
| Karren | Rinnenkarren | | Y | 2 | 2 | 0 | 0 | 0 |
| Karren | Kluftkarren | | Y | 3 | 3 | 0 | 0 | 0 |
| Karst cave | Joint cave | | Y | 54 | 34 | 20 | 4 | 0 |
| Karst spring | | | Y | 15 | 8 | 7 | 1 | 0 |
| Limestone pavement | | | Y | 2 | 1 | 1 | 1 | 0 |
| Sinking lake | | | Y | 2 | 2 | 0 | 0 | 0 |
| Solution lake | Doline lake | | Y | 0 | 0 | 0 | 0 | 0 |
| Speleothem | | | Y | 11 | 5 | 6 | 3 | 0 |
| Subsidence depression | | | Y | 2 | 1 | 1 | 1 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Ground Water—Cold Springs

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Blue-hole spring | | Y | | 5 | 3 | 2 | 2 | 0 |
| Marl lake | | Y | | 8 | 3 | 5 | 3 | 0 |
| Salt flat | | Y | | 4 | 4 | 0 | 0 | 0 |
| | | | | | | | | |
| Iron depositing spring | | | Y | 16 | 5 | 11 | 3 | 0 |
| Salt depositing spring | | | Y | 23 | 10 | 13 | 3 | 0 |
| Soaphole | | | Y | 8 | 0 | 8 | 2 | 0 |
| Spring issuing from pools | | | Y | 2 | 2 | 0 | 0 | 0 |
| Sulphur depositing/odor spring | | | Y | 21 | 11 | 10 | 1 | 0 |
| Tufa depositing spring | | | Y | 28 | 6 | 22 | 4 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Ground Water—Hot Springs

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Hot spring | | Y | | 5 | 5 | 0 | 0 | 0 |
| Warm spring | | Y | | 4 | 2 | 2 | 2 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Gravity—Mass movements

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Landslide lake | | Y | | 6 | 5 | 1 | 1 | 0 |
| Rock labyrinth | | Y | | 4 | 0 | 4 | 4 | 0 |
| | | | | | | | | |
| Debris avalanche | | | Y | 0 | 0 | 0 | 0 | 0 |
| Debris fall | | | Y | 0 | 0 | 0 | 0 | 0 |
| Debris flow | | | Y | 10 | 2 | 8 | 0 | 0 |
| Debris slide | | | Y | 59 | 4 | 55 | 1 | 0 |
| Debris topple | | | Y | 0 | 0 | 0 | 0 | 0 |
| Earth fall | | | Y | 1 | 0 | 1 | 1 | 0 |
| Earth flow | | | Y | 4 | 0 | 4 | 1 | 0 |
| Earth slide | | | Y | 62 | 4 | 58 | 3 | 0 |
| Earth topple | | | Y | 0 | 0 | 0 | 0 | 0 |
| Protalus rampart | | | Y | 0 | 0 | 0 | 0 | 0 |
| Rock fall | | | Y | 15 | 9 | 6 | 1 | 0 |
| Rock slide | | | Y | 60 | 16 | 44 | 4 | 0 |
| Rock topple | | | Y | 2 | 2 | 0 | 0 | 0 |
| Talus cone | | | Y | 11 | 8 | 3 | 0 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Weathering and Differential Erosion

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Honeycomb weathering | | Y | | 3 | 1 | 2 | 2 | 0 |
| | | | | | | | | |
| Concretion exposures | | | Y | 4 | 2 | 2 | 0 | 0 |
| Earth pillar | | | Y | 1 | 0 | 1 | 0 | 0 |
| Exfoliation forms | | | Y | 0 | 0 | 0 | 0 | 0 |
| Flatiron | | | Y | 7 | 2 | 5 | 2 | 0 |
| Frost pocket | | | Y | 2 | 1 | 1 | 1 | 0 |
| Hoodoo | | | Y | 19 | 11 | 8 | 2 | 0 |
| Pinnacle | | | Y | 1 | 1 | 0 | 0 | 0 |
| Rock-shelter | | | Y | 9 | 7 | 2 | 2 | 0 |
| Sandstone dike | | | Y | 3 | 1 | 2 | 2 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Frozen Ground and Snow

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Asymmetric valley | | Y | | 1 | 0 | 1 | 1 | 0 |
| Earth hummock | | Y | | 0 | 0 | 0 | 0 | 0 |
| Thermokarst lake | | Y | | 1 | 0 | 1 | 1 | 0 |
| | | | | | | | | |
| Avalanche chute | | | Y | 3 | 3 | 0 | 0 | 0 |
| Felsenmeer | | | Y | 3 | 2 | 1 | 1 | 0 |
| Gelifluction forms | | | Y | 20 | 14 | 6 | 0 | 0 |
| Ice wedge cast | | | Y | 7 | 0 | 7 | 1 | 0 |
| Nivation hollow | | | Y | 3 | 3 | 0 | 0 | 0 |
| Patterned ground | | | Y | 20 | 9 | 11 | 11 | 0 |
| Rockglacier | | | Y | 25 | 18 | 7 | 1 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Movements of the Earth's Crust

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Cuesta | | Y | | 3 | 2 | 1 | 1 | 0 |
| Hogback | | Y | | 6 | 0 | 6 | 5 | 1 |
| Klippe | | Y | | 6 | 4 | 2 | 2 | 0 |
| Mountain | Castellated mountain | Y | | 11 | 10 | 1 | 1 | 0 |
| Mountain | Plateau mountain | Y | | 1 | 1 | 0 | 0 | 0 |
| Tectonic cave | | Y | | 1 | 0 | 1 | 0 | 0 |
| Tectonic lake basin | Fault lake | Y | | 6 | 1 | 5 | 5 | 0 |
| | | | | | | | | |
| Anticline | | | Y | 21 | 4 | 17 | 0 | 0 |
| Anticlinal mountain | | | Y | 4 | 1 | 3 | 1 | 0 |
| Anticlinal valley | | | Y | 3 | 2 | 1 | 1 | 0 |
| Fault-line scarp | | | Y | 1 | 0 | 1 | 1 | 0 |
| Fault valley | | | Y | 0 | 0 | 0 | 0 | 0 |
| Monocline | | | Y | 0 | 0 | 0 | 0 | 0 |
| Mountain | Dogtooth mountain | | Y | 2 | 2 | 0 | 0 | 0 |
| Mountain | Sawtooth mountain | | Y | 2 | 2 | 0 | 0 | 0 |
| Normal fault | | | Y | 4 | 2 | 2 | 0 | 0 |
| Reverse fault | | | Y | 16 | 8 | 8 | 1 | 0 |
| Syncline | | | Y | 12 | 3 | 9 | 0 | 0 |
| Synclinal mountain | | | Y | 5 | 3 | 2 | 0 | 0 |
| Synclinal valley | | | Y | 1 | 1 | 0 | 0 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Meteorite Falls

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Impact structure | | Y | | 3 | 0 | 3 | 1 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Igneous Activity

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Diatreme | | Y | | 1 | 1 | 0 | 0 | 0 |
| Dike | | Y | | 9 | 5 | 4 | 4 | 0 |
| Pluton | | Y | | 1 | 0 | 1 | 1 | 0 |
| Sill | | Y | | 2 | 2 | 0 | 0 | 0 |
| Stock | | Y | | 2 | 0 | 2 | 2 | 0 |
| Volcanic rock | | Y | | 3 | 0 | 3 | 3 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Peat accumulation (non-permafrost)

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Marl bog | | Y | | 6 | 4 | 2 | 2 | 0 |
| Non-patterned fen without internal lawns | Slope fen | Y | | 3 | 0 | 3 | 3 | 0 |
| Non-patterned fen without internal lawns | Spring fen | Y | | 6 | 1 | 5 | 4 | 0 |
| Patterned fen | Net fen | Y | | 6 | 2 | 4 | 4 | 0 |
| Patterned fen | Spring fen | Y | | 5 | 2 | 3 | 3 | 0 |
| | | | | | | | | |
| Bog lake | | | Y | 0 | 0 | 0 | 0 | 0 |
| Fen lake | | | Y | 1 | 0 | 1 | 0 | 0 |
| Non-patterned fen with internal lawns | Basin fen | | Y | 2 | 0 | 2 | 1 | 0 |
| Non-patterned fen with internal lawns | Horizontal fen | | Y | 4 | 0 | 4 | 1 | 1 |
| Non-patterned fen without internal lawns | Basin fen | | Y | 17 | 2 | 15 | 2 | 0 |
| Non-patterned fen without internal lawns | Stream fen | | Y | 1 | 0 | 1 | 1 | 0 |
| Non-patterned fen without internal lawns | Channel fen | | Y | 3 | 0 | 3 | 1 | 1 |
| Non-patterned fen without internal lawns | Horizontal fen | | Y | 18 | 0 | 18 | 2 | 0 |
| Non-patterned fen without internal lawns | Floating fen | | Y | 3 | 1 | 2 | 1 | 0 |
| Patterned fen | | | Y | 4 | 0 | 4 | 0 | 0 |
| Patterned fen | Northern ribbed fen | | Y | 26 | 2 | 24 | 4 | 0 |
| Wooded bog with internal lawns | Basin bog | | Y | 1 | 0 | 1 | 1 | 0 |
| Wooded bog with internal lawns | Flat bog | | Y | 3 | 0 | 3 | 2 | 0 |
| Wooded bog with internal lawns | Northern plateau bog | | Y | 7 | 0 | 7 | 3 | 0 |
| Wooded bog without internal lawns | Basin bog | | Y | 6 | 2 | 4 | 2 | 0 |
| Wooded bog without internal lawns | Flat bog | | Y | 6 | 1 | 5 | 2 | 0 |
| Wooded bog without internal lawns | Northern plateau bog | | Y | 7 | 0 | 7 | 2 | 0 |

LANDFORM ELEMENTS IN ALBERTA

Process: Peat accumulation (permafrost present)

| Element | Sub-Element | <20 locations | >20 locations | Total no. occurrences | No. occurrences inside PAs | No. occurrences outside PAs | No. priority occurrences (completely outside PAs) | No. priority occurrences (partially outside PAs) |
|---|---|---|---|---|---|---|---|---|
| Palsa | | Y | | 2 | 2 | 0 | 0 | 0 |
| Palsa bog | | Y | | 1 | 0 | 1 | 1 | 0 |
| Palsa fen | | Y | | 1 | 1 | 0 | 0 | 0 |
| | | | | | | | | |
| Peat plateaux | | | Y | 16 | 0 | 16 | 3 | 0 |
| Veneer bog | | | Y | 3 | 0 | 3 | 1 | 0 |