Lewisian, Torridonian and Moine Rocks of Scotland

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References

In this reference list the arrangement is alphabetical by author surname for works by sole authors and dual authors. Where there are references that include the first-named author with others, the sole-author works are listed chronologically first, followed by the dual author references (alphabetically) followed by the references with three or more authors listed *chronologically*. Chronological order is used within each group of identical authors.

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Glossary

This glossary aims to provide simple explanations of all but the most elementary geological terms used in Chapter 1 and in the 'Introduction' and 'Conclusions' sections of site descriptions. It also includes many of the more important terms encountered in other sections of the volume. ***The explanations are not intended to be comprehensive definitions, but concentrate instead on the way in which the terms are used in this volume.*** Bold type indicates a further glossary entry.

Chronostratigraphical names relating to periods described in this volume are given in Figure 1.2. Names of the main tectonic events are also shown on Figure 1.2, and are described in the 'Introduction' to this volume (Chapter 1); they are not included in the glossary.

Certain other terms, including igneous, metamorphic and structural classifications, are also most easily described in figures. The names of most common crystalline igneous rocks are explained by means of classification diagrams similar to those given by Le Maitre *et al.* (2002) (Figures G.1 to G.4, simplified after Gillespie and Styles (1999) to include only rock names encountered in this volume). These names, prefixed by meta-, are also used to describe many metamorphosed igneous rocks. Names of igneous and metamorphic rocks that do not fit easily into these classification diagrams *are* included in the glossary. Local names for distinctive rock-types and obsolete names are explained where they occur in the main text. Figure G.5 illustrates the classification of metamorphic facies. Structural classifications are shown on Figures G.6 and G.7, which illustrate some of the terminology associated with folds and thrusts. For the names of minerals, the reader is referred to standard text-books.

Acid: describes igneous rocks rich in silica (SiO_2 more than 63%).

Accretionary complex: a body of continental or oceanic rocks that forms adjacent to the margin of a craton or pre-existing **terrane**.

Acritarch: a hollow organic-walled **microfossil** of uncertain biological affinity, but most may be algal cysts.

Aeolian: referring to sediments or landforms formed by the action of the wind.

Agmatite: a term used to describe rocks that have a 'brecciated' appearance due to a network of igneous veins (usually of **felsic** composition) that is pervasive throughout the rock. Most commonly used for a type of **migmatite**, but may also be used for entirely igneous rocks.

Alkaline: describes igneous rocks that contain more sodium and/or potassium than is required to form feldspar, and hence contain, or have the potential to contain (i.e. in the **norm**), other alkali-bearing minerals such as feldspathoids, alkali pyroxenes and alkali amphiboles.

Allochthon: a body of rock that has been transported to its present position from where it was originally formed by tectonic processes, normally by thrusting.

Glossary

Alluvial: related to rivers; generally referring to river deposits.

Alluvial fan: a fan-shaped wedge of sediment, usually developed adjacent to a steep slope, with the apex of the fan at the mouth of a canyon or other channel down which sediment can be carried.

Amphibolite: a dark-green rock composed largely of amphibole, typically hornblende, possibly with some plagioclase. Most amphibolites are metamorphosed **mafic** igneous rocks, but some may be metamorphosed calcareous sediments.

Anatectite: a partially melted rock.

Anatexis: partial melting of a pre-existing rock.

Annealing: recrystallization resulting in an equigranular texture and destruction or diminution of any pre-existing grain fabric or texture.

Anticline: a fold in which the oldest strata lie in the core of the fold. When an anticline is an upright fold the limbs converge upwards and the beds are convex upwards.

Antiform: a fold with limbs that converge upwards in strata where the direction of younging in the stratigraphical sequence is not known.

Aplite: a relatively finer-grained vein or area within an igneous rock (contrast with **pegmatite**).

Appinite: a member of a heterogeneous suite of coarse-grained **ultramafic**, **mafic** and intermediate igneous rocks, characterized by the presence of abundant hydrous minerals, particularly amphibole.

Arkose: a type of **sandstone** with a high content of feldspar grains.

Augen granite: a foliated granitic rock that contains large crystals ('augen'). The **foliation** wraps around the 'augen' to give a characteristic texture.

Augen gneiss: a metamorphic rock that contains large, generally ovoid crystals known as 'augen' within a foliated matrix. The **foliation** wraps around the 'augen' to give a characteristic texture.

Autochthon: a body of rock that formed approximately in its present position in contact with its **basement**.

Axial planar cleavage or **foliation**: a **cleavage** or **foliation** that is orientated parallel to the axial plane of a fold or set of folds.

Back-thrust: a thrust that has developed in the opposite direction to the direction of transport in a thrust zone, i.e. towards the centre of the orogen (see Figure G7).

Balanced cross-section: a cross-section through a thrust or fold belt that has been constrained by the construction of a 'restored' cross-section, showing the relationships of the rocks prior to thrusting or folding.

Banded-iron formation: a rock that consists of alternating layers of **chert** and iron-oxide minerals (usually haematite), normally with a high enough iron-oxide concentration to be of economic value.

Basement: The oldest rock units recognized in a given area; a complex of metamorphic and/or igneous rocks that underlies a sedimentary or metasedimentary succession.

Basic: describes igneous rocks relatively rich in the 'bases' of early chemistry (MgO, FeO, CaO, Fe_2O_3); silica (SiO_2) is relatively low (nominally 45–52%).

Bedding: a feature of sedimentary rocks, in which planar or near-planar surfaces known as bedding planes indicate successive depositional surfaces formed as the sediments were laid down.

Blastomylonite: a type of **mylonite** in which **porphyroclasts** and matrix have undergone recrystallization, normally synchronous with the deformation.

Boudinage: the term used for structures that form when a competent bed or layer surrounded by less-competent layers is subject to extension. The competent layer forms 'boudins', which have the cross-section appearance of a 'string of sausages', separated by the less competent material.

Breaching: development of thrusts that ramp up through the overlying **thrust sheets**, thus placing younger rocks over older. See Figure G7.

Breccia: rock composed of angular and subangular broken fragments greater than 2 mm in diameter; can be volcanic, sedimentary or **fault**-related.

Brittle fault: a **fault** that has developed at low enough temperatures and pressures that the rocks adjacent to the **fault** have become broken and ground up by **cataclasis**, rather than undergoing recrystallization (contrast with **ductile**).

Buckle fold: fold formed in response to end loading of a competent layer, e.g. bed, vein or igneous sheet.

Calc-alkaline: describes a suite of igneous rocks characterized chemically by the steady decrease in iron content relative to silica during evolution of the **magma**; typical of magmas generated at destructive plate margins during **orogenesis**.

Calc-silicate: referring to calcium- and/or magnesium-silicate minerals, or to metamorphic rocks that are rich in those minerals but contain little or no carbonate.

Camptonite: a type of **lamprophyre** with phenocrysts of Ti-rich amphibole and clinopyroxene, and with a groundmass dominated by plagioclase feldspar.

Cataclasis: fine-scale brecciation, fracturing, crushing and rotation of mineral grains under brittle conditions, without significant chemical reconstitution. A cataclastic rock has no **foliation**.

Chert: a microcrystalline or cryptocrystalline sedimentary rock composed dominantly of interlocking quartz crystals.

Chevron fold: a fold with an angular hinge and near-planar limbs, the limbs commonly being of approximately equal length (symmetrical).

Chilled margin: the marginal part of an igneous intrusion, which has a finer grain-size than the rest of the intrusion, due to rapid cooling (chilling) along its contact with the country rock.

Cleavage: plane of incipient parting in a rock, produced by the preferred alignment of platy crystals such as mica in response to confining pressure during deformation and accompanying low-grade metamorphism.

Coaxial deformation: type of deformation in which the principal and incremental strain axes do not rotate (also called 'pure shear').

Coaxial refolding: primary and secondary folding of strata that combine to give a complex three-dimensional structure in which the axes of the two fold phases are parallel, plunging by the same amount and towards the same direction.

Collisional/convergent/compressional tectonics: terms used for tectonic processes occurring in a region where the rock succession is placed under compression.

Concretion: a hard, compact mass, commonly spheroidal or ovoid, in a sedimentary rock, formed by precipitation of a cementing mineral (commonly carbonate) around a nucleus during deposition or more commonly during subsequent burial and **diagenesis**.

Conglomerate: a coarse-grained sedimentary rock with a significant proportion of clasts greater than 2 mm in diameter, set in a finer-grained groundmass (normally **sandstone** or **siltstone**). The clasts are typically rounded to sub-angular pebbles, cobbles and boulders.

Crenulation cleavage: a type of **spaced cleavage** developed by the microfolding (crenulation) of an earlier **cleavage** or **schistosity**.

Cross-bedding: a structure in sedimentary rocks, notably **sandstones**, that was formed due to current action by the migration of ripples or dunes on the sediment surface. Cross-bedding can be formed in **alluvial**, tidal or **aeolian** environments.

Crustal shortening: compression of the crust resulting in the shortening of a body of rock, normally in the plane of the Earth's surface.

Culmination: highest point on a structural feature. A major domal fold developed in a **thrust sheet** due to continued movement of thrusts beneath it ('thrust culmination').

Cumulate: an igneous rock formed by the accumulation of crystals in a **magma** chamber.

Cyclothem: series of beds of differing lithology deposited during a single sedimentary cycle.

Detrital zircon: a zircon crystal within a sedimentary deposit or rock. Detrital zircons can be dated by **isotopic dating** methods to provide information about the age of their source rocks. Hence, they can provide a maximum age-limit for deposition of the sedimentary unit.

Devitrification: conversion of originally glassy material (melt) to a microcrystalline rock.

Dextral: the sense of **strike-slip** displacement along a **fault** that has had right lateral movement; i.e. to an observer standing on one side of the **fault**, the rocks on the other side appear to have been displaced laterally to the right.

Diagenesis: the process of consolidation, mineral growth, recrystallization and other processes leading to lithification of unconsolidated sediment to form rock.

Diamictite: a sedimentary rock that consists of fine-grained sediments with much coarser clasts, such as pebble-bearing **mudstones** and matrix-supported **conglomerates**. Diamictites show poor or no sorting and are commonly, but not exclusively, of glacial origin.

Diatexite: rock that is almost, but not completely, melted.

Dolerite: medium-grained basaltic rock normally composed of plagioclase feldspar, pyroxene and opaque minerals, but may additionally contain quartz, olivine, etc; used herein as a synonym of 'microgabbro' (see Figure G1).

Dolostone: a carbonate-rich sedimentary rock largely composed of the mineral dolomite.

Ductile: a type of deformation that occurs at relatively high temperature and/or pressure, where the rocks deform by distributing the strain smoothly throughout the deforming mass, typically by recrystallization and grain-boundary migration processes.

Duplex: a series of stacked thrust-bounded slices, commonly bounded by a roof thrust and a floor thrust.

Dyke: a body of igneous rock emplaced as a steep, generally near-vertical sheet, and normally discordant to the structure of its host rocks.

Eclogite: a metamorphosed **mafic** rock consisting of garnet and sodic clinopyroxene (omphacite), indicative of high-pressure metamorphism.

Enclave: an inclusion; one rock-type enclosed within another – typically used for igneous rocks.

Extensional tectonics: the term used for tectonic processes where the crust is under extension, for example in an orogenic collapse or continental **rift** setting.

Facing: the direction towards which a rock unit or layer youngs. Facing can be applied to folds, **cleavages** and even **faults**. A fold faces in the direction normal to its axis, along the axial plane (surface) and towards the younger beds.

Fault: a fracture or zone of fractures in the Earth's crust across which the rocks have been displaced relative to each other.

Felsic: describes light-coloured minerals (*fe*ldspar/*fe*ldspathoid and *si*lica) or an igneous rock containing abundant proportions of these minerals; the opposite of **mafic**.

Fluvial (fluviatile): referring to a river environment and the sediments deposited therein.

Fold axial plane: the planar surface that joins the hinge lines of a fold occurring in successive folded surfaces.

Fold axis: the trace of the **fold axial plane** on the folded surface.

Fold hinge: the line along which a change occurs in the amount and/or direction of dip of a fold; the area with the smallest radius of curvature.

Fold limb: the part of the fold between one hinge and the next; the area with a larger radius of curvature.

Fold interference pattern: the complex geometry created where early folds have themselves been deformed and re-orientated by later folds.

Foliation: the planar arrangement of textural and mineralogical components within a rock, generally formed during deformation and metamorphism of the pre-existing **bedding** or other primary fabric.

Footwall: the block of rock immediately below any non-vertical **fault** plane.

Foreland: the stable region in front of an orogen, which has not been significantly affected by the penetrative deformation and metamorphism associated with the mountain-building event. The rocks in the orogen are normally thrust and overfolded towards the foreland.

Foreland basin: a sedimentary basin developed by depression of a convergent continental margin due to the weight of sediment accumulating in front of the orogen.

Foreland-propagating: the term used to describe a **thrust belt** in which younger thrusts have successively developed towards the **foreland**.

Glide: term used to signify thrust movement generally localized along weaker stratigraphical units.

Gneiss: a coarse-grained metamorphic rock with a compositional layering known as 'gneissic layering', typically defined by paler-coloured quartz- and feldspar-rich layers and darker-coloured layers of **mafic** minerals. Gneisses are formed by segregation and mineral growth during metamorphism at high grades.

Graben: an elongate down-faulted crustal block commonly bounded by two **normal faults** or

fault systems and with a marked topographic expression. A half-graben is bounded on one side by a **fault** or fault system.

Graded bedding: a term describing a bed in a sedimentary rock that has a progressive change in particle size from top to bottom. Most common is a sequence with coarse grains at the bottom and fining upwards, which is typically caused by a declining current velocity within the depositional environment.

Granofelsic: refers to a recrystallized, medium- to coarse-grained quartzofeldspathic rock, commonly a **psammite**, with little or no **foliation** or **lineation**.

Greywacke: a coarse-grained and poorly sorted sedimentary rock composed of angular to sub-angular sand and rock fragments in a sandy, silty or clayey matrix. Note that a proportion of the clay may be of **diagenetic** origin. Normally deposited from **turbidity currents**.

Hangingwall: the block of rock immediately above the **fault** plane of any non-vertical **fault**.

Hinge zone: the zone around a **fold hinge**.

Imbricate: within a **thrust belt**, the slices of rock displaced by successive thrusts are termed 'imbricate slices'. They commonly form a structure like stacked roof tiles which can be termed an 'imbricate stack'. If the slices have common roof and floor thrusts, the stack is termed a '**duplex**'.

Inlier: an area of older rocks enclosed within a sequence of younger rocks.

Intrafolial: literally 'within the **foliation**'; a term used to describe isolated, tight to **isoclinal folds** that typically have axial planes parallel to the **foliation** of the rock. The folds generally affect only a few layers of the rock succession and may even be confined to a single layer.

Isoclinal fold: a fold with parallel limbs.

Isotopic dating: measuring the age of rocks using the rate of decay of radioactive isotopes contained within minerals in the rock. Also referred to as 'radiometric dating'.

Kink fold: a fold with planar limbs and a markedly angular hinge.

Klippe: an isolated thrust-bound structural unit that is an erosional remnant of a large **thrust sheet** or **nappe**.

LA-MC-ICP-MS: refers to 'Laser Ablation MultiCollector Inductively Coupled Plasma Mass Spectrometry'. An in-situ method of measuring isotope concentrations carried out on thick polished thin-sections of the rock.

Lamination: very fine layering.

Lamprophyre: the name used for a distinctive group of largely medium-grained igneous rocks characterized by abundant phenocrysts of **mafic** minerals, with **felsic** minerals largely confined to the groundmass.

Leuco-: light-coloured.

Leucocratic: describes light-coloured igneous rocks, i.e. containing few **mafic** minerals.

Leucosome: lighter-coloured, igneous-looking layers composed of **felsic** minerals in a **migmatite**, formed by segregation from, or partial melting of, the original rock.

Limestone: a carbonate sedimentary rock consisting largely of the mineral calcite (calcium carbonate).

Lineation: a linear structure that occurs in a sample of rock; any linear fabric element. It can result from a number of processes including aligned mineral growth, intersection of **cleavage** and **bedding**, minor folding, stretching, or **fault** movement.

Listric: referring to a **fault** whose dip decreases downwards.

Lithostratigraphy: the organization of rock units according to their lithology, age, stratigraphical position and affinity. The fundamental unit in sedimentary or volcanic rock sequences is the formation.

Mafic: describes dark-coloured minerals, rich in *ma*gnesium and/or iron (*Fe*), or an igneous rock containing substantial proportions of these minerals, mainly amphibole, pyroxene or olivine; the opposite of **felsic**.

Magma: molten rock beneath the Earth's surface.

Megacryst: a large crystal, occurring within an igneous rock or more rarely a metamorphic rock, which is notably larger than the surrounding minerals in the groundmass or matrix.

Melanocratic: describes dark-coloured igneous rocks that are rich (> 60%) in **mafic** minerals. The opposite of **leucocratic**.

Meta-: prefix added to any rock name (lithology) to indicate that it has been metamorphosed; e.g. metabasalt is a metamorphosed basalt.

Glossary

Metamorphic aureole: an area of rocks around an igneous intrusion that has undergone metamorphism due to the increased temperatures created by the intrusion of **magma** (*see also* **thermal aureole**).

Metasomatism: the process of chemical change and mineralogical replacement during metamorphism, normally due to the introduction of different elements through fluid circulating in the rocks.

Micro-: prefix meaning 'small'; used in rock names to indicate a finer-grained variety; e.g. microgabbro – a medium-grained gabbro.

Microfossil: a fossil that is of such a size that it can only be identified by use of a microscope.

Migmatite: a partially melted layered rock; generally consisting of light-coloured layers (**leucosomes**) of igneous-looking **felsic** minerals, and darker layers, richer in **mafic** minerals and having a metamorphic appearance.

Minette: a type of **lamprophyre** with phenocrysts of biotite and augite in a groundmass dominated by alkali feldspar.

Monchiquite: a type of **lamprophyre** with phenocrysts of Ti-rich amphibole and clinopyroxene, and with a groundmass dominated by feldspathoid minerals and glassy material.

Monoform: a large- or medium-scale fold with one steeply and one shallowly dipping limb in a sequence in which the way-up of the beds is not known. Similar to 'monocline', where the way-up is known.

Mudstone: a type of sedimentary rock composed of very fine-grained clay and silt particles (grain size < 0.032 mm).

Mullion: a type of **lineation** and folding, appearing as a series of centimetre- to metre-scale columnar structures on the surface of a bed or layer.

Mylonite: a coherent, thinly layered rock, formed in a zone of intense **ductile** deformation where pre-existing grains in the rock have been deformed, recrystallized, and reduced to a grain size of 0.05 mm or less.

Nappe: a coherent body of rock, with its margins bounded by thrusts or **shear zones**, and which has been moved a considerable distance from its original location by thrusting. Broadly synonymous with **thrust sheet** (*see also* **allochthon**).

Norm: a re-calculation of the chemical composition of an igneous rock to obtain a theoretical mineralogical ('normative') composition; useful for classification purposes and for comparison with experimental studies of **magma** crystallization.

Normal fault: a high-angle **fault** (dip > 45°) on which the **hangingwall** has moved downwards relative to the **footwall**.

Orogenesis: crustal thickening following the collision of tectonic plates and resulting in magmatism, folding, thrusting and accretion, leading to regional uplift and mountain building. A period of orogenesis may be referred to as an 'orogenic event' or as an 'orogeny', and the resulting area of rocks affected by these processes constitutes an 'orogen'.

Orogenic front: the line marking the extent of penetrative deformation associated with a particular orogenic event.

Orthogneiss: a **gneiss** with an igneous **protolith**.

Orthogonal refolding: primary and secondary folding of strata that combine to give a complex three-dimensional structure in which the axes of the two fold phases **plunge** at approximately right angles to one another.

Orthoquartzite: a clastic sedimentary rock composed originally almost exclusively of quartz sand (> 90% quartz).

Outlier: an area of younger rocks completely surrounded by older rocks.

Palaeocontinent: a continental mass, composed of a particular configuration of one or more continental plates, which has existed at some time in the past.

Palaeocurrent: a wind or water current direction that existed at the time of deposition of sedimentary rocks, and that can now be inferred from sedimentary structures and textures within those rocks.

Palaeogeography: the study of the configurations of continents and oceans and their physical geography during geological history.

Palaeomagnetism: the study of the Earth's magnetic field over time. When rocks that contain magnetic minerals are deposited, the character (vertical and horizontal orientation) of the Earth's magnetic field is locked within the rocks. This gives rise to a natural

remanent magnetization whose inclination and declination can be used to study changes in the Earth's magnetic field as well as the movement of plates over time.

Palaeosol: an ancient soil preserved within a rock sequence.

Paragneiss: a **gneiss** with a sedimentary **protolith**.

Passive margin: a continental margin formed following rifting and continental rupture that is not the site of convergent tectonic processes. Passive margins generally contain marine sedimentary sequences.

Pegmatite: a very coarsely crystalline igneous intrusion, typically a vein or sheet.

Pelite: a metamorphic rock, rich in mica, which formed by metamorphism of a sediment rich in clay minerals (**mudstone** or **siltstone**).

Peneplain: a low-relief, near-featureless, gently undulating land surface of considerable area produced by long-standing erosional processes, most commonly of sub-aerial nature. The surface may have been subsequently uplifted and dissected.

Phosphorite: a sedimentary phosphate deposit, typically composed mainly of carbonate fluorapatite.

Phyllite: a rock with a strong **cleavage**, intermediate between slate and **schist**, characterized by growth of new sericite, chlorite and locally biotite.

Phyllonite: a very platy type of **mylonite**, formed by deformation and recrystallization of rocks rich in mica and chlorite.

Picrite: a magnesium-rich igneous rock, generally appearing as an olivine and/or pyroxene-rich equivalent of a gabbro, **dolerite** or basalt.

Pillow lava: sub-aqueously erupted lava, usually basaltic in composition, comprising an accumulation of smooth pillow shapes produced by rapid chilling.

Plane strain: a type of deformation in which a rock is shortened (compressed) in a specific direction, and extension only occurs along one axis of the plane perpendicular to the shortening direction. The third direction remains constant during deformation.

Plunge: the dip (in degrees) of a **fold axis**, **fold hinge** or other linear structure as measured in the vertical plane.

Pluton: a body of intrusive igneous rock, generally of kilometre-scale or larger and with a cylindrical, lenticular or tabular shape, that has been emplaced at depth in the Earth's crust.

Porphyritic: textural term for an igneous rock in which larger crystals (phenocrysts) are set in a finer-grained or glassy groundmass.

Porphyroblast: a newly grown mineral in a metamorphic rock that is significantly larger than most minerals in the matrix.

Porphyroclast: a relict, resistant, large crystal within a foliated rock. Common in **mylonites** where the rock has had its overall grain-size reduced by deformation processes.

Protolith: the source rock from which a new rock was formed, either by metamorphism to form a metamorphic rock, or by melting to form an igneous rock.

Protomylonite: a rock in which some minerals have undergone grain-size reduction and recrystallization as per **mylonite** formation, but in which the majority of grains have resisted deformation.

Psammite: a metamorphic rock, rich in quartz and feldspar with some micas, formed by metamorphism of a **sandstone** (*see also* **granofelsic**).

Pseudomorph: a mineral grain that has been replaced by another mineral or minerals, but without changing the original crystal shape.

Pseudotachylite: a grey to black glassy rock, formed by melting of the immediately adjacent country rocks due to frictional heating during seismic movement along **fault** planes. Pseudotachylite normally occurs in thin seams and patches in **fault** zones developed in relatively dry rocks.

Ptygmatic fold: normally a single layer or vein, tightly folded in a lobate manner in a less competent schistose matrix. A type of fold that occurs mainly in **migmatites**.

Quartz c-axis: long axis of the quartz crystal; measurements of the orientations of a large number of quartz c-axes in a rock give an indication of the type of **ductile** deformation that has occurred.

Quartzite: a sedimentary or metasedimentary rock composed largely of quartz grains.

Rapakivi: a term used to describe a certain type of granitic or granodioritic rock, which contains large crystals of potassium feldspar that are mantled by sodic plagioclase.

Recumbent fold: an overturned fold with a near-horizontal axial plane.

Retrogression: metamorphism in which minerals that formed at high grades of metamorphism are converted to those characteristic of lower grades.

Rift: a defined area of crustal extension and thinning, typically bounded by **normal faults**. A rift may eventually widen, through the development of new oceanic lithosphere, into an ocean. A failed rift is one in which extension has been insufficient to produce oceanic material.

Rift basin: a depositional basin resulting from crustal extension.

Rift–drift succession: a rock succession formed as a continental **rift** evolves into a **passive margin** following the development of new oceanic lithosphere.

Rodding: a type of **lineation**, formed by elongate structures that are monomineralic and not formed from the original rock, most commonly of quartz.

Sandstone: a sedimentary rock made up of siliciclastic grains, mainly quartz and feldspar, between 0.032 mm and 2 mm in grain size.

Schist: a foliated metamorphic rock with a **schistosity**. A textural term that can be combined with compositional or mineralogical terms to specify the type of schist.

Schistosity: the parallel alignment of grains, most commonly of micas, but also of other minerals, e.g. hornblende, talc, that enables the rock to split readily into thin flakes or laminae.

Selvedge (or selvage): the marginal zone to a rock mass having a distinctive feature or composition. Commonly refers to the fine-grained margin of an intrusion or to a concentration of **mafic** minerals adjacent to **leucosomes** in **migmatites** and migmatic rocks.

Semipelite: a metamorphic rock, with roughly equivalent amounts of siliciclastic grains (quartz and feldspar) and micas, which formed by metamorphism of a sedimentary rock dominantly composed of silt.

Serpentinization: the hydrothermal replacement of original magnesium-rich minerals (olivine, pyroxene, amphibole) by serpentine group minerals. Most common in **ultramafic** rocks.

Serpentinite: a rock dominantly composed of serpentine-group minerals.

Shearing: deformation of a rock body by the sliding or translation of one part relative to another part, in response to an applied differential stress. The deformation can be brittle or **ductile**, dependent on the **strain rate**, temperature, pressure, presence of fluids, rock mineralogy. Shearing can occur across a single **fault** plane, across **shear zones**, or it can affect kilometre-thick rock sequences.

Shear zone: a near-planar zone of intense **shearing**, with deformation generally by **ductile** processes.

Sheath fold: a fold with a tubular shape in three dimensions, resulting from the marked variation in the **plunge** of the **fold axis** through some 180°. In cross-section on two-dimensional surfaces sheath folds are commonly manifest as closed ovoid structures.

SHRIMP: refers to 'Sensitive High Resolution Ion MicroProbe'. An in-situ method of measuring isotope concentrations on polished sections of rock.

Sill: a gently dipping to horizontal sheet of intrusive igneous rock, normally broadly concordant with the **bedding** or **foliation** in the country rocks.

Siltstone: a clastic sedimentary rock made up of fine-grained, silt-sized grains (between 0.004 mm and 0.032 mm).

SIMS: refers to 'SeCondary Ion Mass Spectrometry'. Can be carried out *in situ* on polished sections of rock.

Sinistral: the sense of **strike-slip** displacement along a **fault** that has had left lateral movement; i.e., to an observer standing on one side of the **fault**, the rocks on the other side appear to have been displaced laterally to the left.

Skolithos: a type of **trace fossil**, having the appearance of simple vertical pipes, commonly found in Cambrian-age **quartzite** and **sandstone**. They represent the fossilized remains of worm burrows in the sediment layer.

Spaced cleavage: a type of **foliation** defined by closely spaced **cleavage** surfaces or less commonly fractures that divide the rock into a series of fine-scale tabular bodies. Includes **crenulation cleavage**. In rocks of low metamorphic grade, spaced cleavage is commonly the result of pervasive pressure solution processes.

Steatite: a massive, typically pale grey-green, fine-grained rock consisting largely of the mineral talc.

Strain rate: the rate at which a body of rock changes shape or volume as a result of applied stress. Geological strain rates are generally very low, typically ranging from 10^{-12} to 10^{-15}/sec.

Strike-slip: a term used to describe a **fault** on which the sense of movement is parallel to the strike of the **fault**. In many **faults** the movement is oblique but a lateral offset occurs in the plan view.

Subduction: the process of one lithospheric plate descending beneath another during plate convergence. Subduction occurs along a narrow belt, termed a 'subduction zone'. In the case of subduction of an oceanic plate beneath a continental plate a trench is formed.

Subduction–accretion complex: admixture of an island arc, microcontinent and turbiditic and other sediments at the margin of a continental mass adjacent to a **subduction** zone.

Supercontinent: a large landmass that forms from the convergence of multiple continents. Such supercontinents have formed at various periods in the geological record, e.g. Pangaea in Permian times.

Supracrustal: a term used to describe rocks that were originally formed at the Earth's surface.

Surge zone: a **fault**-bounded zone in a collapsing orogen where a package of rock is displaced downwards along arcuate extensional **faults**, creating a large-scale 'avalanche' structure.

Syncline: a fold in which the youngest strata lie in the core of the fold. Where a syncline is an upright fold, its limbs converge downwards and the beds are concave downwards.

Synform: a fold with limbs that converge downwards in strata where the direction of younging of the stratigraphical sequence is not known.

Tectonothermal event: an event in which rocks are heated and metamorphosed at depth in the crust due to tectonic processes; most commonly as a result of **orogenesis**.

Terrane: a **fault**-bounded body of oceanic or continental crust having a geological history that is significantly distinct from that of contiguous bodies.

Tholeiitic: describes a suite of silica-oversaturated basaltic rocks, characterized chemically by strong iron enrichment relative to magnesium during the early stages of evolution of the **magma**; formed in extensional within-plate settings, at constructive plate margins, and in island arcs.

Thermal aureole: a zone around an igneous intrusion in which the rocks have been metamorphosed by heat from the intrusion during and immediately following its emplacement.

Thermal relaxation basin: in a zone of rifting, upwelling mantle rises beneath the base of the crust, which becomes stretched and thinned. Following the end of rifting, this hot mantle material will gradually cool and contract (thermal relaxation), causing subsidence over a wider area, and generating a thermal relaxation basin.

Thrust belt: a zone where a series of thrusts outcrop at the Earth's surface marking a major area of translation linked to an orogen.

Thrust fault: a low-angle (< 45°) reverse **fault** that places older rocks over younger rocks. Where the dip of the **fault** is low (< 10°) it can be termed a 'thrust plane'. Typically it is a product of compressional forces during **orogenesis**.

Thrust flat: the part of a thrust surface that is near-horizontal at the time of **fault** initiation. It commonly lies parallel to the **bedding** surface.

Thrust ramp: a relatively steep part of a thrust surface, which climbs up through the stratigraphical or structural section in the direction of transport.

Thrust sheet: the body of rock lying above a **thrust fault** or thrust plane (*see also* **nappe**, **allochthon**).

TIMS or **ID-TIMS**: refers to 'Isotope Dilution Thermal Mass Spectrometry'. A method of accurately measuring isotope concentrations involving grain selection (normally zircon or monazite), and dissolution in acid.

Trace fossil: a sedimentary structure that was formed by a living organism.

Transcurrent: a term used to describe a large-scale, steeply dipping **fault** or **shear zone**, across which the relative movement is predominantly horizontal (*see also* **strike-slip**).

Transgression: the spread or extension of the sea over land areas, commonly due to a relative sea-level rise. Recognized in the marine sedimentary record by an upwards progression at any one locality to sediments deposited in a more distal environment.

Transpression: a term used to describe a tectonic situation where **strike-slip** movement is coincident with compressional forces acting across the region.

Transport direction: the direction of movement of **thrust sheets**.

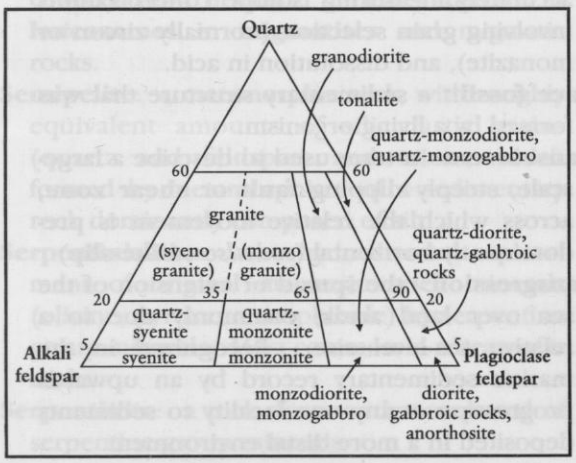
TTG: 'tonalite-trondhjemite-granodiorite' – an association of **felsic** igneous rocks that is common in Archaean crust. These lithologies are commonly intruded at deep crustal levels and subsequently converted to **orthogneisses**, e.g. in the Lewisian Gneiss Complex. Note that the term 'trondhjemite' has now been replaced by 'leucotonalite'.

Tuff: a pyroclastic igneous rock made up of volcanic fragments, with average grain-size less than 2 mm.

Turbidity current: an underwater, gravity-controlled, density-flow laden with suspended sediment, which produces a characteristic graded sedimentary unit showing a range from sand and gravel at the base to silt and mud at the top.

U-Pb dating: measurement of the amounts of Pb daughter products that result from the decay of various isotopes of U. As the decay constants are known an age can be calculated for the rock. Zircon and monazite contain U and Pb and are the common minerals dated. **TIMS**, **SIMS**, **SHRIMP** and **LA-MC-ICP-MS** are acronyms referring to the different methods used to process the minerals and obtain isotopic ages.

Ultramafic: describes an igneous rock in which dark-coloured minerals (amphibole, pyroxene, olivine) comprise more than 90% of the rock.



◂**Figure G1** The classification of coarse-grained crystalline felsic and mafic igneous rocks based on their felsic mineral content. The distinction between gabbroic and dioritic rocks is based on the composition of the plagioclase feldspar present. Medium-grained rocks are named by attaching the prefix 'micro', for example microgranodiorite. However, in this volume and commonly elsewhere dolerite is used as a synonym for microgabbro.

Ultramylonite: a **mylonite** in which virtually all the grains have been recrystallized to a fine grain-size, and < 10% of relict coarser grains (**porphyroclasts**) remain. The parallel layered structure characteristic of **mylonites** is commonly muted or absent.

Unconformity: a contact between two rock units of significantly different ages. An unconformity represents a significant gap in the geological time record and may juxtapose horizontal rock layers over an older eroded, tilted and deformed succession ('angular unconformity').

Underplating: the addition of primary material to the base of the crust. This normally involves the generation of igneous rocks and links to **subduction** processes. Where continental material is carried down a **subduction** zone it can subsequently rise buoyantly and also underplate continental material.

Vergence: direction of relative movement or rotation of layers in an asymmetrical fold pair. Also the direction of overturning of folded layers, e.g. towards the south.

Volcanic arc: a chain of volcanic islands developed above a **subduction** zone.

Volcaniclastic: generally applied to a clastic rock containing mainly material derived from volcanic activity, but without regard for its origin or environment of deposition (includes rocks formed directly by explosive eruption from a volcano, and sedimentary rocks containing transported volcanic debris).

Xenolith: a rock fragment that is alien to the igneous rock in which it is found. Commonly refers to blocks of country rock included within igneous intrusions, particularly **plutons**.

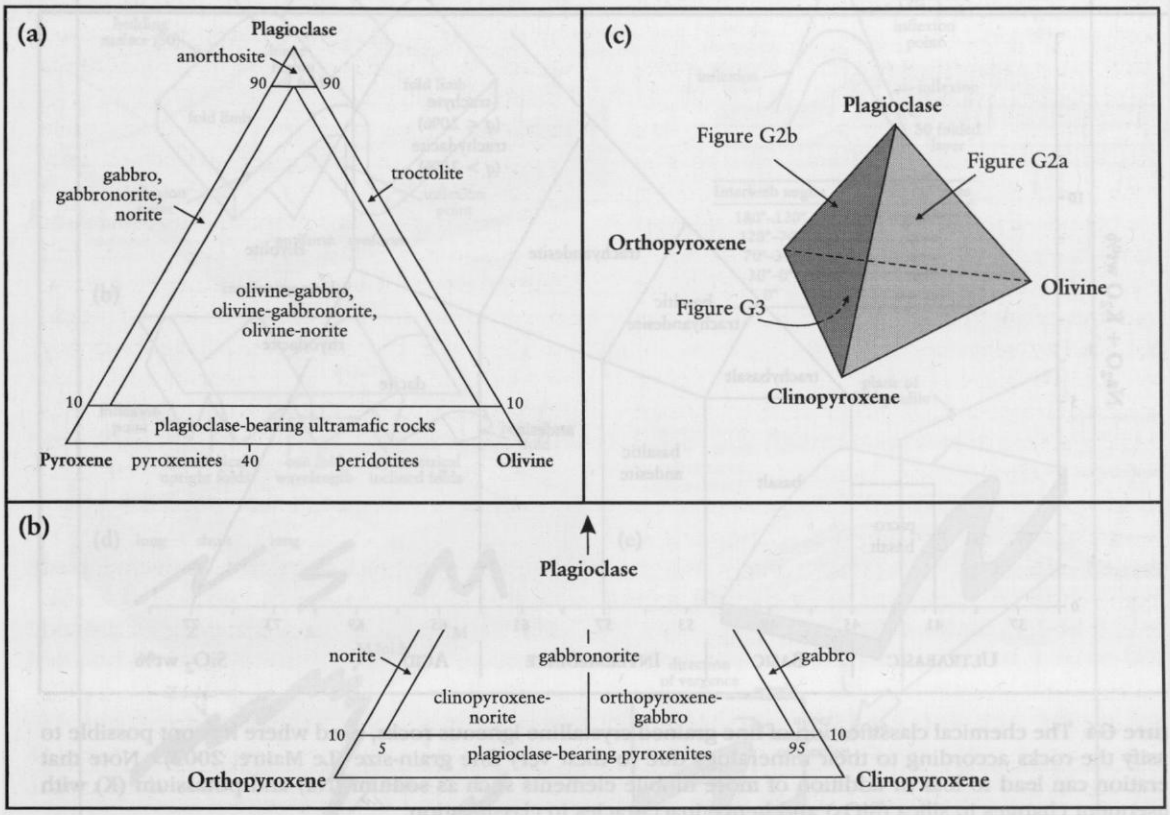


Figure G2 The more detailed classification of coarse-grained mafic crystalline igneous rocks falling in the gabbroic rocks field in Figure G1. (a) Based on the plagioclase, total pyroxene and olivine content; (b) based on the plagioclase, orthopyroxene and clinopyroxene content; (c) shows how the triangular sections (a) and (b) combine in three dimensions to form a tetrahedron (see also G3).

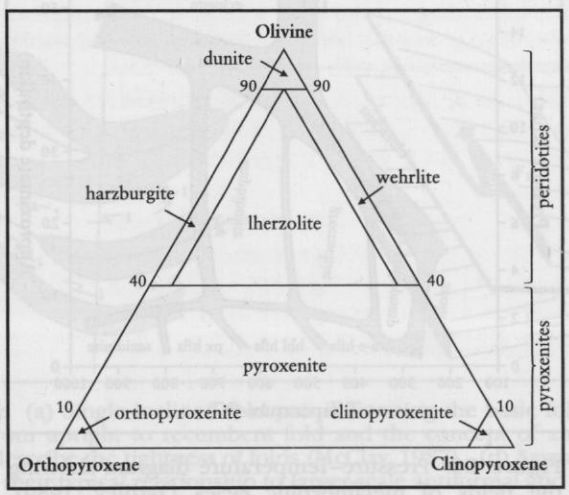


Figure G3 The classification of coarse-grained crystalline ultramafic rocks, based on their olivine, orthopyroxene and clinopyroxene content.

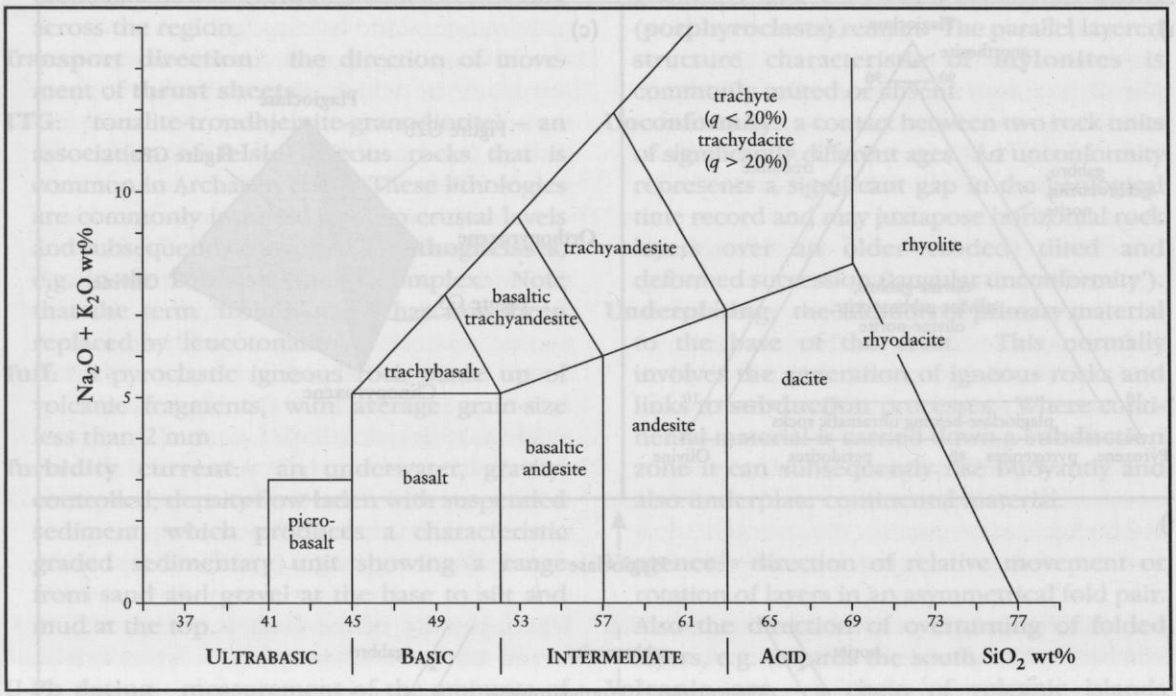


Figure G4 The chemical classification of fine-grained crystalline igneous rocks, used where it is not possible to classify the rocks according to their mineralogy due to their very fine grain-size (Le Maitre, 2002). Note that alteration can lead to loss or addition of more mobile elements such as sodium (Na) and potassium (K) with consequent changes in silica (SiO_2) and hence inaccuracies in classification.

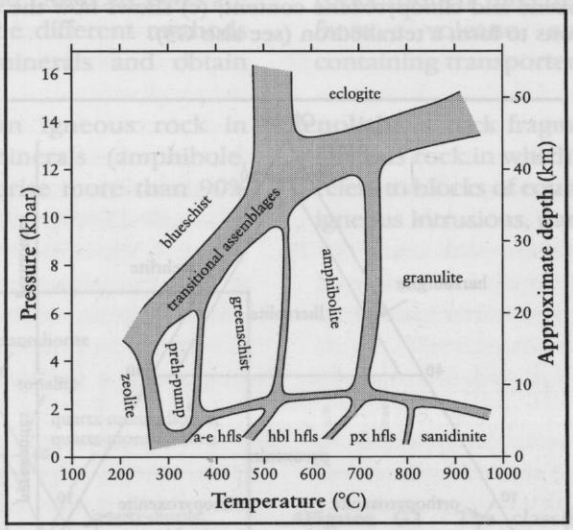


Figure G5 Pressure–Temperature diagram showing the fields of metamorphic facies (Yardley, 1989). Abbreviations used: hfls – hornfels; a-e – albite-epidote; hbl – hornblende; px – pyroxene; preh – prehnite; pump – pumpellyite.

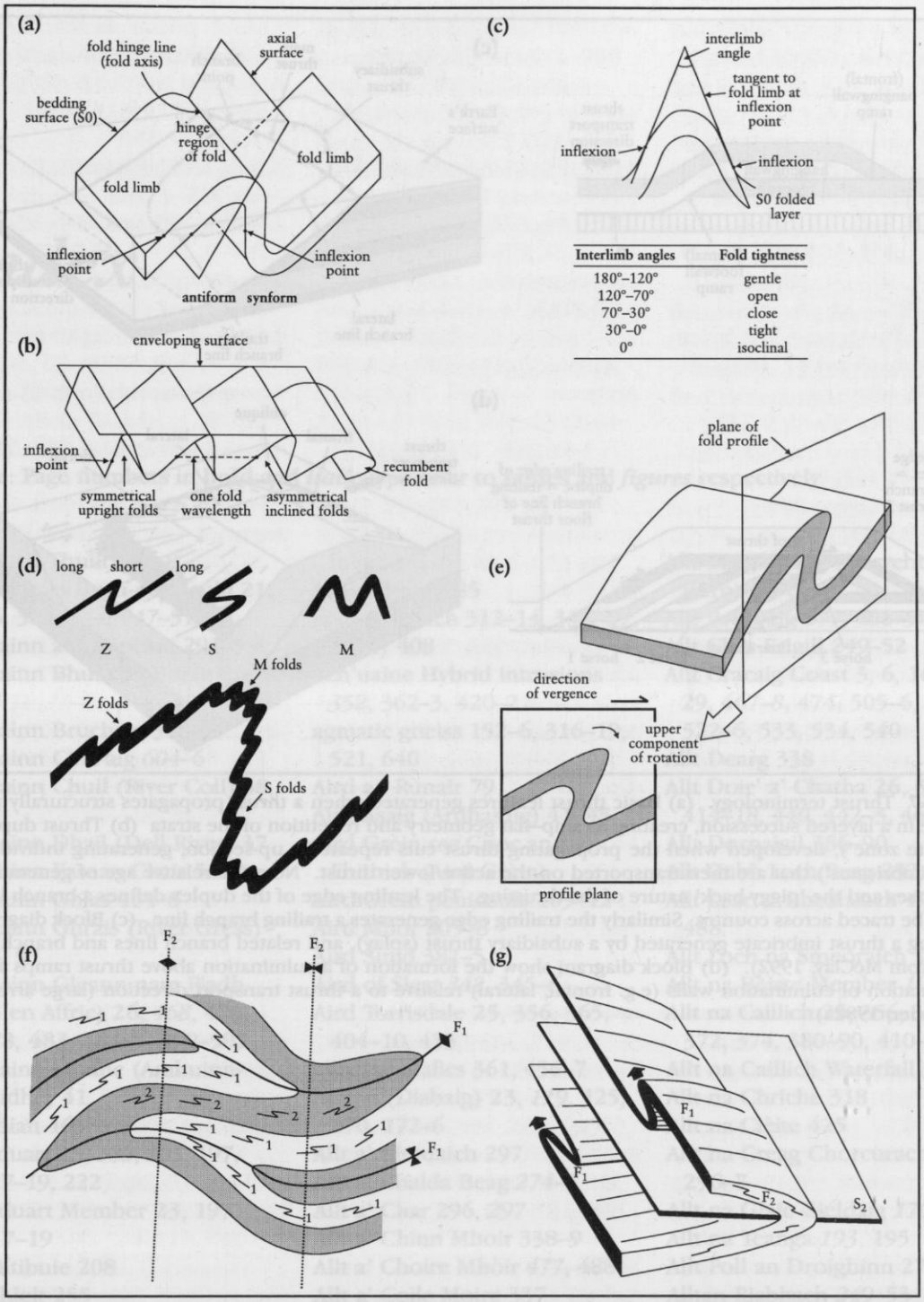


Figure G6 Fold terminology. (a) Single inclined fold pair illustrating the basic fold nomenclature. (b) Fold strain showing the change from upright to recumbent fold and the concept of an enveloping surface (from McClay, 1987). (c) Terms to describe the tightness of folds (McClay, 1987). (d) Asymmetrical minor folds showing Z, S and M symmetry and their typical relationship to larger-scale antiformal and synformal structures (from McClay, 1987). (e) Fold profile showing direction of vergence of an asymmetrical fold (from Bell, 1981). (f) Geometry of coaxially refolded folds showing F1 and F2 major folds and related minor fold structures. Note that minor F1 folds maintain a consistent vergence across the F2 fold axial traces but change their facing direction from upwards to downwards. However, they do change vergence across F1 fold axial traces. Minor F2 folds change their vergence across the F2 axes (after Bell, 1981). (g) Geometry of orthogonally refolded folds. Note that both F1 and F2 folds change vergence across F2 fold axes but not facing direction (arrows indicate facing direction of F1 folds) (after Bell, 1981).

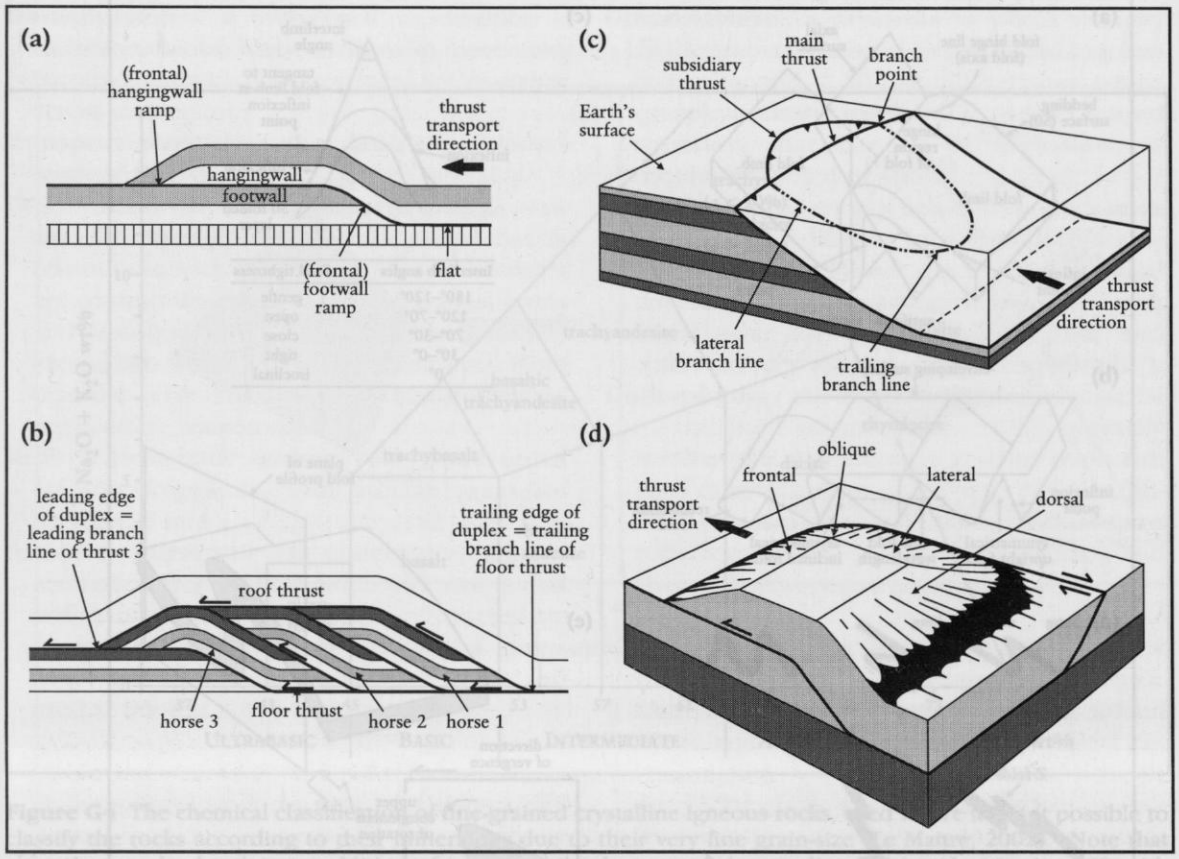


Figure G7 Thrust terminology. (a) Basic thrust features generated when a thrust propagates structurally up-sequence in a layered succession, creating a ramp–flat geometry and repetition of the strata (b) Thrust duplex ('imbricate zone'), developed when the propagating thrust cuts repeatedly up-section, generating individual horses ('imbricates') that are then transported on the active lower thrust. Note the relative age of generation of the horses and the 'piggy-back' nature of the thrusting. The leading edge of the duplex defines a branch line than can be traced across country. Similarly the trailing edge generates a trailing branch line. (c) Block diagram illustrating a thrust imbricate generated by a subsidiary thrust (splay), and related branch lines and branching points (from McClay, 1992). (d) Block diagram show the formation of a culmination above thrust ramps and the orientation of culmination walls (e.g. frontal, lateral) relative to a thrust transport direction (large arrow) (from Butler, 1982a).

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