Glossary of terms

This section provides very brief definitions of some of the geological/palaeontological and biological/biogeographical terms used by the authors in this book. The intention of the glossary is to make the book comprehensible to the non-specialist reader rather than to provide a comprehensive discussion of, in some cases, controversial terms.

**Geological, including palaeontological, terms**

*agnostid:* type of Lower Palaeozoic trilobite.

*allochthon:* body of rock tectonically displaced from its place of formation.

*andesite:* volcanic rock of intermediate composition typical of island arcs.

*anitarch:* primitive Palaeozoic fish.

*APWP:* apparent polar wander path. Diagram used in palaeomagnetic work displaying a series of palaeo-poles for a fixed continent to represent the relative motion of the continent with respect to magnetic north. It is of course the continent that moves, but it is simpler to display a series of palaeo-poles on a diagram than plot diagrams showing moving continents with a fixed magnetic pole; APWPs for different continents can then be more easily compared.

*backarc basins:* small basins floored by oceanic crust formed above subduction zones behind island arcs by poorly understood mechanisms.

*basalt:* volcanic rock of basic composition typical of oceanic crust.

*basement:* the underlying or deeper rocks. Typically basement rocks are thought of as the deeper igneous and metamorphic rocks found beneath a sedimentary cover. The term is used to distinguish cover rock sequences from underlying rocks. However, the term is relative, and there is no implied age for the underlying rocks, and can be used to distinguish older sedimentary rocks from younger sedimentary rocks.

*bioclastic:* character of fragmental material in rocks which is organic debris, typically calcium carbonate shells and skeletons.

*biofacies:* characteristic assemblage of fossil fauna.

*blueschist:* rock type formed at high pressures and low temperatures in subduction zone settings, and characterised by the presence of the blue amphibole glaucophane.

*calcalkaline:* range of igneous rock compositions typical of volcanic arcs, including basalt, andesite and dacite.

*carbonates:* sedimentary rocks formed of carbonate minerals, principally calcite and dolomite, sometimes with aragonite.

*chert:* rock formed of fine-grained silica, typically the remains of organisms with siliceous skeletons and commonly found in deep marine environments.

*clastic:* type of sedimentary rock formed of fragments of rocks and minerals.

*conodont:* oral apparatus of primitive Palaeozoic craniates (vertebrates).

*cratons:* continental region that has been tectonically stable for a long period, typically for more than several hundred million years.

*cyclopygid:* type of trilobite.

*dacite:* volcanic rock of intermediate composition typical of island arcs, especially those underlain by continental crust.

*depocentre:* site of deposition of sedimentary rocks, in principle the place of the thickest sequence, although the term is often used generally to include the whole area of deposition as a synonym of sedimentary basin.

*diamictite:* fragmental rock with angular clasts in a mud matrix interpreted as having a glaciomarine origin.

*dicynodont:* Permian mammal-like reptile.

*dikelokephalimid:* type of trilobite.

*East India letter classification:* biostratigraphic scheme for subdivision of Tertiary rocks of SE Asia based on large benthic foraminifera.

*eclogite:* rock of basic composition which consists essentially of a high density garnet-pyroxene mineralogy indicating metamorphism under high pressures typical of the lower crust or deeper.

*Euler pole:* the pole of rotation of two tectonic plates on a sphere. Definition of the pole and the angular motion of one plate relative to another fully describes their relative motion.

*eustasy:* concept of sea level change which affects the whole globe, and is not caused by local tectonics. Causes of eustatic sea level change could include changes in volume of polar ice caps, changes in volume of ocean basins due to displacement of water by sediment, or changes in volume of the mid-ocean ridge system.

*extrusive:* igneous rocks that are erupted at the surface.
flysch: term of Alpine origin for clastic rocks, typically thick sequences of deep marine sandstones and mudstones, deposited during the early stages of development of a mountain belt and said to be ‘syn-orogenic’. These rocks are often deposits of continental slopes formed by turbidity currents.

forearc: region between island arc and trench.

fusulinid: large foraminifera of Carboniferous–Permian age.

glyptomened: type of brachiopod.

graben: fault-bounded elongate depression characterised by steep and straight bounding faults at the margins with a central subsided block.

granitoid: igneous rocks of granitic composition dominated by quartz and feldspars.

graptolite: order of marine hemichordates of (mainly Lower) Palaeozoic age.

imbricate thrust slices: slices of rocks stacked together by contraction, separated by low angle and sub-parallel thrust faults.

intrusive: igneous rocks intruded within the crust and slowly cooled.

island arc: chain of volcanic islands formed above a subduction zone where oceanic lithosphere is thrust into the mantle.

lithosphere: the outer rigid part of the Earth, including the crust and part of the mantle to depths of about 100 km, forming the tectonic plates.

lowstand: period when eustatic sea level was relatively low.

lytocid: group of articulate brachiopods of Permian age.

magmatic: igneous material of dark colour. As applied to rocks usually indicates a basic composition with relatively low silica content and is often incorrectly used as a synonym of basic.

magmatism: igneous activity as a result of melting of the crust or mantle.

magnetic anomalies: lineations within the ocean crust formed by igneous activity at linear mid-ocean ridges and alterations in the polarity of the Earth’s magnetic field. The anomalies can be mapped and dated and provide the means to trace the motions of plates during the past 200 million years.

marl: calcareous mudrock with more than 25% carbonate.

melange: rock composed of a mixture of blocks in a fine-grained matrix. This mixture may have been formed by sedimentary processes (such as submarine debris flows) or by tectonic mechanisms. Rock of this type are common in active orogenic settings.

molasse: term of Alpine origin for clastic rocks, typically sequences of continental and shallow marine conglomerates and sandstones, deposited late in the development of a mountain belt and often said to be ‘post-orogenic’.

nano fossils: fossils of ultramicroscopic size, representing the remains of zooplankton and phytoplankton.

nappe: large thrust body of rock, typically with basal thrust that is sub-horizontal and has a displacement of several tens of kilometres.

obduction: poorly understood process by which rocks of broadly oceanic character known as ophiolites are thrust onto land.

ophiolite: association of rocks similar to those representative of oceanic crust and mantle but now found on land in orogenic belts. In the ideal ophiolite there are peridotites, gabbros, basalts and pelagic sedimentary rocks in a layered sequence. Some ophiolites may have formed at mid-ocean ridges of major ocean basins but most represent lithospheric fragments from arc-related settings such as backarc basins or forearc regions.

orogeny: process of mountain-building.

orbid: type of brachiopod.

palaeomagnetism: the Earth’s magnetic field as recorded in rocks. Palaeomagnetic studies can determine palaeo-latitudes of rocks at the time of their deposition or formation, and can determine rotations since formation. This type of information can contribute to reconstructing the history of plate movements.

palynology: study of microscopic plant material.

palynomorphs: microscopic remains of plant origin, such as pollen grains and spores.

plectambonitoid: type of articulate brachiopod.

pluton: large igneous body intruded into the crust.

rhyolite: volcanic rock of acid composition typical of volcanic arcs formed on continental crust, and commonly erupted explosively.

ripping: process of breaking the crust and lithosphere by extension.

rudist: reef-building bivalve with coral-like appearance of late Mesozoic age.

schist: metamorphic bivalve with closely spaced planar fabric (schistosity), commonly due to preferred orientation of mica, produced by metamorphic recrystallisation accompanied by directed stress.

siliciclastic: type of sedimentary rock formed of clastic grains of silicate rocks and minerals.

sinolepid: type of Devonian armoured fish.

slab-pull: force exerted by a sinking lithospheric slab at a subduction zone.
**splays:** strands of a fault, typically in the zone where the fault terminates.

**stratigraphy:** geological discipline concerned with the description, organisation and classification of stratified rocks, fundamental to our understanding of the history of the Earth.

**strike-slip:** type of fault or motion in which two block of rocks move past one another with essentially horizontal motion.

**strophomenoid:** type of articulate brachiopod.

**subduction:** process by which lithosphere, mainly oceanic, is thrust deep into the mantle at convergent plate boundaries. The principal surface expressions of subduction are the deep oceanic trenches and the volcanic arcs of active margins.

**syntaxis:** region of abrupt change in orientation of an orogenic belt.

**tectonic block:** fault-bounded fragment of crust or lithosphere with its own characteristic sequence of strata. Size is not implied, but in many cases the term block as used in regional geology implies microcontinent or island arc scale fragments.

**tectonostratigraphy:** study of the stratigraphy of terranes recognising that normal stratigraphic principles need to be applied with caution because of the important tectonic influence on sequences. Relative ages of events within and across terranes can be identified by conventional stratigraphic methods and the sequence of both strata and tectonic events can be displayed on composite diagrams.

**terranie:** fault-bounded fragment of the crust or lithosphere with its own characteristic stratigraphic sequence. Many mountain belts are now interpreted to be composed of large numbers of terranes which have become fragmented and amalgamated by tectonic processes including plate rifting, subduction, collision and strike-slip faulting.

**till:** deposit of glacial origin.

**trachyanedelse:** volcanic rock of intermediate composition, but with a more alkaline composition than a normal andesite, common in island arcs.

**transform fault:** originally defined as type of fault which offsets a mid-ocean ridge but now commonly used for a strike-slip fault which penetrates deep into the lithosphere and forms a plate boundary.

**transpression:** combination of strike-slip motion and contraction.

**transension:** combination of strike-slip motion and extension.

**trilobite:** Palaeozoic marine arthropod.

**turbidites:** clastic sedimentary rocks deposited in deep water on or below the continental slopes by currents containing dense mixtures of sediment and water.

**ultramafic:** material of very dark colour. As applied to rocks normally refers to peridotites or serpentinites, their hydrated equivalents, containing minerals such as olivine and pyroxene, representing mantle material.

**unconformity:** fundamental discordance in a stratified sequence of rocks representing a break in deposition and time.

**yunnanoepid:** armoured fish of Late Silurian-Devonian age.

**zircon U-Pb ages:** absolute ages determined by a method of dating using the mineral zircon (zirconium silicate) which contains radioactive uranium isotopes which decay to lead isotopes.

### Biological and biogeographical terms

**allopatric:** distributions of taxa which are separate, not coincident, overlapping or abutting.

**allozymes:** enzyme alleles at genetic loci used in electrophoretic analysis of genetic variation between organisms.

**anagenesis:** transformation in an evolutionary lineage. The transformed states of genes or chemical or morphological characters serve to identify the descendants of the lineage subsequent to the transformation. See also apomorphy.

**apomorphy:** derived (transformed by anagenesis) character or character state. See also plesiomorphy.

**aril:** fleshy, edible surround to a seed.

**assumptions 0, 1 and 2:** in biogeography, methods of overcoming problems of widespread taxa and redundancy in areas of endemism, given the goal of every area only occurring once in an area cladogram. Assumption 0 treats widespread taxa as monophyletic and allows no manipulation of areas. The other assumptions also allow the area relationships of widespread taxa to be paraphyletic (1) or polyphyletic (2) in order to retrieve information about general area relationships.

**autapomorphy:** apomorphy that is restricted to a single taxon: that taxon is defined by autapomorphies.

**autecology:** ecology of a single species.

**benthic:** aquatic, bottom-living.

**bottleneck, genetic:** drastic reduction in genetic diversity of an organism by a period of ex-
tremely low population, for example, during a colonisation event. See also founder effect.

branch-and-bound: algorithm for cladogram construction that starts with a cladogram from a heuristic search (q.v.) and then searches for cladograms with topologies of progressively shorter lengths than that of the original, discarding all those that exceed it.

branch swapping: procedure for moving clades (branches) around a cladogram in a search for a more parsimonious solution or topology.

CAPCA: computer program for cladistic analysis.

cladistics: method of classification that groups taxa hierarchically on the basis of homologies (shared apomorphies-synapomorphies) into nested sets, conventionally represented as a cladogram.

cladogenesis: splitting of an evolutionary lineage into discrete daughter lineages.

cladogram (taxon or area): branching diagram indicating hierarchical relationships amongst taxa (or areas) based upon the sharing of apomorphies (or related taxa).

cluster analysis: method of classification that groups items hierarchically into nested sets or non-hierarchically (overlapping clusters that can share items) in terms of overall similarity of their attributes.

coding: in cladistics, conversion of observations on characters and character states into alpha-numerical format for cladistic analysis.

COMPONENT: computer method for comparing, and identifying common features (congruence) in, the structure of cladograms where the terminal items of each are the same (areas in area cladograms from different groups of organisms) or related (e.g., parasites and their hosts).

component (of tree): group of taxa (or areas) related by the branching structure in a cladogram.

component analysis: method of identifying the degree of commonality of components (congruence) between trees (e.g., COMPONENT).

congruence (of trees): agreement in tree topology. See also component analysis and COMPONENT.

consensus tree (strict, Adams, Nelson): tree (cladogram) produced by a consensus method. Methods of cladistic analysis can yield several trees of different topology but the same minimum length. Consensus methods combine the grouping information in these into a single topology known as the consensus tree.

consistency index (CI): strictly the ensemble consistency index. Measure of the amount of homoplasy (repeated changes in characters) in a data matrix relative to a cladogram derived from it. CI has an upper bound value (no homoplasy) of 1 and a theoretical lower bound of 0 (though this cannot be attained in practice).

contact zone: meeting zone of parapatric (q.v.) species.

dendrogram: tree diagram derived in application of a hierarchical method of cluster analysis.

depauperate: biota with fewer taxa than expected (for example, in relation to area, representation of higher groups, etc.).

diploid: organism with a standard pairing of chromosomes. See also polyploid.

disjunction: major geographical gap in distribution of an organism that may not necessarily be caused by the absence of suitable habitat.

endemic: found only in the area under consideration.

euphotic zone: stratum near surface of water where sufficient light penetrates to permit photosynthesis.

eurythermal: tolerant of wide variations in temperature.

founder effect: reduction in genetic diversity in an initial colonising population, often followed by genetic drift. See also bottleneck.

general area cladogram: cladogram of areas where the topology represents the most parsimonious summary of information in a set of area cladograms for individual taxonomic groups, in some ways a consensus cladogram.

generalised tracks: significantly coincident distribution patterns in panbiogeography.

genetic drift: enhanced, stochastic changes in genetic diversity of small, colonising populations of organisms. See also founder effect.

Hennig86: computer program used for cladistic analysis.

heuristic search: method of constructing cladograms that is not guaranteed to find the most parsimonious solution.

homoplasy: any derived character that is not a synapomorphy in relation to a particular tree (cladogram) topology.

ingroup: group of taxa under study in a cladistic analysis. See also outgroup.

introgression, genetic: infiltration of genetic material of one species into the genotype of another.

length of cladogram/tree: minimum number of character changes or steps on a cladogram required to account for the data.
lineage: all descendant taxa through time of a
common ancestor.

massing centres: concentrations of species
within a panbiogeographic track.
megabenthivore: large plant-eating vertebrate.
metapopulations: populations of species occu-
pying discrete patches of suitable habitat and
interacting through migration.
monophyly (-etic group): clade defined by
synapomorphies; a group that includes all,
and only all, of the descendant taxa of a com-
mon ancestor.
monotypic: higher taxon consisting of only a sin-
gle lower taxon (usually a species).
mDNA: mitochondrial DNA.
node, cladistic: branching point on a cladogram.
node, panbiogeographic: intersection point of
two or more generalised tracks.
non-metric multidimensional scaling: method of
summarising the distribution of points in
multidimensional space in a smaller number of
dimensions by minimising disturbance to
the rank order of distances between the
points.
outgroup: taxon used in cladistic analysis for
comparison with group under study (ingroup) to
determine character polarisation.
pandemic: taxon distributed universally through
the geographical area being studied.
paralogy: (as in paralogy-free subtree analysis)
term borrowed from genetics to denote repeti-
tion of information in area cladograms.
parapatric: distributions that abut at a contact
zone but do not overlap, usually of closely
related or sister species.
paraphyly (-etic group): group of taxa in a
monophyletic group from which one or more
components are excluded.
parsimony: choosing the hypothesis that ex-
plains the data most simply. In cladistic anal-
ysis this is achieved by minimising the number
of character changes inherent in a cladogram
topology.
PAUP: A computer program for cladistic analysis.
PeeWee (PIWE): a computer program for
cladistic analysis.
phanerogam: seed-plant (conifers and angio-
perms).
phenetics: classification of organisms and other
items based on overall similarity of their at-
tributes. See also cluster analysis.
phylogeny: hypothesis of genealogical relation-
ships of taxa, imposing concepts of ancestry
and a time axis on a cladogram.
planktonic: organisms that drift almost passively
in bodies of water, usually in the surface layers.
plesiomorphy: ancestral or primitive character
state, which may also be an apomorphy of a
more inclusive hierarchical level than that un-
der consideration.
polarisation (of characters): determination
of the apomorphic and plesiomorphic states of a
character, often by outgroup comparison.
polymerase chain reaction (PCR): method of
multiplying extracted DNA to facilitate its
analysis and comparison.
polyploid: organism with multiples above two
(diploid) of the haploid number of chromo-
somes.
polytomy: node in a tree or cladogram which has
three or more distal branches. See also resolution.
Q-mode analysis: in a two-way table, classifica-
tion/comparison of the columns in respect of
values in the rows.
R-mode analysis: in a two-way table, classifica-
tion/comparison of the rows in respect of val-
ues in the columns.
redundancy: in trees, refers to repeated infor-
mation about the relationships of constituent
items.
relict: localised remnant of a previously much
wider distribution pattern.
resolution (cladistic): extent to which the
branching in a tree or cladogram approaches
the fully dichotomous.
retention index (RI): strictly the ensemble reten-
tion index. For a given cladogram, this mea-
sures the amount of similarity in the original
data matrix that can be interpreted as
synapomorphy, by comparing the actual
amount of homoplasy as a fraction of the
maximum possible homoplasy. The RI equals
1 for a data set comprising only unique and
unreversed synapomorphies (no homoplasy),
whereas a value of 0 implies no grouping in-
formation at all in the data.
sibling species: closely related species only re-
cently diverged from a common ancestor,
probably showing close sister relationship.
sister relationship: shown by two taxa that are
more closely related to each other than either
is to a third taxon.
subtree: branch of a tree or cladogram.
successive approximation weighting: procedure
for a posteriori weighting of characters ac-
cording to their cladistic consistency, for ex-
ample as indicated by the (rescaled) consist-
cy index for the characters.
sympathy: co-occurrence of taxa in an area.
synapomorphy: apomorphy shared by taxa in a
monophyletic group.
synecology: the study of associations or communities of species.

three-item statements (TAS): expression of the relationship between three taxa or areas where two are more closely related to each other than either is to the third.

track: in panbiogeography, the distribution of a taxon, often depicted by lines (representing the shortest distances) linking the localities where it occurs.

ultrametric: distance measures between items being classified form, for any three, an isosceles triangle. In a phylogenetic tree, each terminal taxon would show (if this could be measured precisely) an equal amount of divergence in characters from those of the common ancestor of all the taxa.

vicariance: fragmentation of ancestral species ranges by the appearance of physical (or ecological) barriers.


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