T

table mountain. A flat topped mountain (mesa)[16].

tafoni. Roughly hemispherical hollows weathered in rock either at the surface or in caves[25].

tagging. Affixing a metal tag bearing a cave number near its entrance, normally by means of rock drill and a small nail[25].

tailwater. The lower course of a river with respect to a given point of structure[16].

talus cone. A cone-like collection of disintegrated rock material originating from and adjacent to a steeper slope[16].

tape. 1. In survey, a graduated tape of steel, plastic, wire-reinforced cloth, or fibreglass, used for measuring distance. 2. Strips of woven synthetic fibre used for slings and waist bands[25].

taranakite. A cave mineral — $KAl_3(PO_4)_3(OH)\cdot 9H_2O$[11].

tarbuttite. A cave mineral — $Zn_2(PO_4)(OH)$[11].

taylorite. A cave mineral — $(K,NH_4)_2SO_4$[11].

tectokarst. Karst formed under the strong influence of tectonic disturbances. The term is indefinite and its use is not generally recommended[20]. Synonyms: (French.) *tectokarst*; (German.) *Tektonischer Karst*; (Greek.) *tektonikon karst*; (Russian.) *karst zon tektoniceskih razlomov*; (Spanish.) *tectokarst*; (Turkish.) *tektonik karst*; (Yugoslavian.) *tektokrş tektokras, tektokarst.*

tectonic. Pertaining to structural features due to the deformation of the crust[16].

tectonic cave. A cave formed by some form of ground movement. The most common is due to landsliding in a jointed rock, leaving an open fissure cave parallel to the line of the hillside along the back of the slipped block. Tectonic caves can form in any rock, as they do not depend on dissolution. Well known examples are the windypit fissures of north-east Yorkshire, England some of which are hundreds of meters long and up to 60m deep[9].

tectonic valley. A valley formed by tectonic forces[16].

temperature efficiency. An efficiency factor defined by Thornthwaite for different climates. See also Thornthwaite.

temperature log. A recording curve of ground-water temperature in a well[16].

temporary hardness. See carbonate hardness.

tenorite. A cave mineral — CuO[11].

tensiometer. A device used to measure the moisture tension in the unsaturated zone[22].

terminal moraine. A glacial deposit accumulated in front of a glacier[16].

terra rossa. 1. Reddish-brown soil mantling limestone bedrock; may be residual in some places[10]. 2. Insoluble residuum of a reddish-brown color left behind when carbonate rocks weather under Mediterranean or allied climatical conditions[20]. Synonyms: (French.) *terra rossa*; (German.) *Kalksteinroterde*; (Greek.) *erythroghi*; (Italian.) *terra rossa*; (Russian.) *terra-rossa*; (Spanish.) *terra rossa*; (Turkish.) *kızıl toprak, terrarosa*; (Yugoslavian.) *crvenica, jerina, jerovica*.

terrace. A flat surface bounded by steplike steep slopes[16].

terraced flowstone. Shallow rimstone pools on outward-sloping walls[10]. See also rimstone barrage; rimstone barrier; rimstone dam; constructive waterfall.

terrain. An area with some specific characteristics. Reserved for surficial features only. Contrast with terrane.

terrane. An area with some specific characteristics[16]. Includes both surface and subsurface features. Contrast with terrain.

terrestrial. Living on land. Not to be confused with "epigean." Terrestrial cave animals include blind beetles, rnillipedes, spiders, and crickets[23]. See also *aquatic*.

tertiary porosity. See porosity, tertiary.

test hole. A hole to test the depth of ground water, water quality, or geological conditions[16].

texture. The arrangement in space of the components of a rock body and of the boundaries between these components[16].

thalweg. A line of maximum depth of stream cross section[16].

Theis equation. The nonequilibrium equation of radial flow towards a well[16].

thenardite. A cave mineral — Na_2SO_4[11].

thermal spring. See spring, thermal.

thermal stratification. The stratification of water in reservoirs due to thermal-density differences[16].

thermocline. An intermediate layer in stratified water[16].

thermocouple. A temperature measuring device based on the proportionality between thermoelectric current and temperature difference between thermojunctions[16].

thermokarst. 1. A pitted periglacial or former periglacial surface in superficial deposits, produced by settling or caving of the ground after melting of ground ice[10]. 2. A term applied to topographic depressions in karstic terranes resulting from the thawing of ice. See cryokarst.

thermokarst pit. Steep-walled depression formed by thermokarst processes[10].

thickness. The perpendicular distance between bounding surfaces such as bedding or foliation planes of a rock.

thief zone. The zone through which drilling fluid is lost into a formation through the borehole wall[16].

Thiem equation. The equation that describes steady-state equilibrium radial flow into a well[16].

thixotropy. The property of a gel to become fluid under application of shear stresses[16].

thread. A natural hole through a rope, tape or wire can be passed to create an anchor[25].

threshold. That part of a cave system to which light penetrates in some degree[10].

threshold saturation. Saturation below which no flow occurs[16].

through cave. Cave through which a stream runs from entrance to exit or formerly did so[10]. Synonym: (German). *Durchgangshöhle*.

throughfall. A part of precipitation that reaches ground by falling through vegetative cover[16].

throw. The vertical displacement of stratum along a fault plane[16].

thrust; thrust fault. A generally gently dipping or subhorizontal fault plane where the relative movement has been essentially horizontal, with one rock sequence being pushed across and above another. Some cave development in the Traligill area of north-west Scotland has been guided by thrust planes[9].

tidal river. A river strongly influenced and subject to tidal currents[16].

tidewell. See spring, ebb-and-flow.

tightest packing. An arrangement of particles allowing only minimum void space a unit cell of a sample[16].

till. Predominantly unsorted and unstratified drift, generally unconsolidated, deposited directly by and underneath a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, and boulders ranging widely in size and shape[6].

tilted aquifer. A dipping aquifer[16].

time base. The sum of storm duration time and concentration time in a hydrograph[16].

time-drawdown curve. A plot of drawdown variation with time[16].

time lag. The time elapsed between the onset of a certain event and the reaction to this event[16].

time of concentration. The time required for surface runoff produced in the farthest part of a basin to reach a concentration point under consideration[16].

time of rise. The time between the first arrival of runoff and arrival of the peak flow[16].

tinajita. (Spanish.) See solution pan.

tinticite. A cave mineral — $Fe_6(PO_4)_4(OH)_6 \cdot 7H_2O$[11].

toadstone. Local term in the Peak District, England for lavas, tuffs and igneous intrusions within the local Carboniferous carbonate sequence.

topofil. A mechanical cave survey device that uses a roll of thread and a distance counter, a protractor to measure inclination and a compass to measure the bearing[25].

topographic divide. A crest line dividing one drainage basin from another[16]. See also divide.

topographic map. A map representing the land surface via the use of contour lines which are lines of equal elevation on the earth's surface. Synonym: topo map.

topography. The physical features of a geographical area[16].

topsoil. The topmost portion of a soil profile[16].

torca. (Spanish.) Large closed depression, more or less circular; a doline[10].

torricellian chamber. A submerged air--filled chamber of a cave at a pressure below atmospheric pressure, sealed by water, having an air-water surface above that of adjacent free air-water surfaces[10].

tortuosity. The ratio of actual length of pore channel to over all length of sample. The sinuosity of actual flow path in a porous medium[16].

total dissolved solids, TDS. 1. The total concentration of dissolved constituents in solution, usually expressed in milligrams per liter[22]. 2. The total concentration of dissolved material in water [as] ordinarily determined from the weight of the dry residue remaining after evaporation of the volatile portion of an aliquot of the water sample[22].

total hydraulic head. See head, total.

total pore space. The sum of interconnected and noninterconnected pore space[16].

total runoff. The sum of all components of runoff into a stream[16].

total soil-water potential. The sum of the energy-related components of a soil-water system; i.e., the sum of the gravitational, matric, and osmotic components[22].

tourelle. (French.) A little tower; applied to small flat-topped buttes of limestone in karst areas. Contrasted with pitons, which have pointed tops, and with coupoles, which have rounded tops[10].

tower karst, towerkarst, turmkarst. 1. A spectacular variety of karst landscape dominated by steep or vertical sided limestone towers each 30–300m high. By far the most extensive and best developed tower karst is the Guangxi province of southern China. Towers originate as residual cones and are then steepened by water table undercutting from surround alluviated plains. Tectonic uplift matched by karst erosion then increases tower heights, but if uplift exceeds surface lowering the towers are raised to hillside

locations and the landscape is rejuvenated to form a new generation of dolines and cone karst. Many towers are riddled with relict caves at high levels, and with active caves through their bases[9]. 2. Karst topography characterized by isolated residual limestone hills displaying numerous shapes (e.g., cone shaped, steep-sided) separated by areas of alluvium or other detrital sand; towers are generally forest-covered hills, and many have flat tops. They may form as isolated hills or in groups. 3. A type of karst topography, common in the tropics, in which the residual hills rise in steep-sided but flat-topped mounds (resembling towers) from intervening depressions or dolinas (sinkholes)[20]. Synonyms: (French.) *karst à tourelles, karst à tours*; (German.) *Turmkarst, Kegelkarst*; (Italian.) *carsismo con forme residuali a torre*; (Spanish.) *karst de torres*; (Turkish.) *kuleli karst*. See also cone karst; cupola karst; pinnacle karst; fengcong; fenglin.

trace. A short length of wire with fasteners used for attaching ladders and ropes to an anchor[25].

tracers. Materials, such as chemicals, dyes, radioactive salts, and light insoluble solids introduced into underground waters to determine points of egress of the water and its velocity[10].

tracer-flow method. A method of determining flow velocities and directions by introducing tracers or indicators into ground water[16].

tracer gaging. Determining stream discharge by inserting a known quantity of dye and measuring its concentration after mixing[25]. Consists of either the tracer-dilution method or the tracer-velocity method (salt-velocity method). Synonym: dye gaging.

traction load. See bed load.

tranquil flow. Open channel flow with Froude number smaller than unity[16].

transgression. The spreading of the sea over level areas[16].

transient. A pulse dampened oscillation or other temporary phenomena occurring in a system prior to reaching a steady-state condition[22]. See flow, unsteady.

transition zone. 1. Portion of bedrock in the vadose zone that is between the epikarst zone and the phreatic zone, is relatively waterless and unfractured, but is locally breached by discrete percolation points (vadose shafts.) 2. The zone in which the properties of two adjacent units change gradually (freshwater/saltwater). See also epikarst zone; subcutaneous drain; subcutaneous flow; subcutaneous zone; vadose caves; vadose shafts.

transit time; travel time. The travel time of a sonic impulse through a given length of rock[16].

transmission capacity. The property of a porous medium to conduct fluid[16].

transmissibility coefficient. The use of the term transmissibility has been replaced by transmissivity[22]. See transmissivity.

transmissivity. The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of an aquifer under a unit hydraulic gradient[6]. Though spoken of as a property of the aquifer, it embodies the saturated thickness and the properties of the contained liquid as well. It is equal to an integration of the hydraulic conductivities across the saturated part of the aquifer perpendicular to the flow paths[22].

transpiration. The process by which water absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface[6].

transpiration depth. The depth of water consumed annually by plants[16].

transpiration ratio. The ratio of water weight transpired to weight of dry matter produced[16].

transport. Conveyance of solutes and particulates in flow systems. See also solute transport; particulate transport[22].

transportational process. All processes contributing to the transport of eroded material[16].

transverse permeability. See permeability, transverse.

transverse wave. A wave generated by shearing displacement where wave motion is perpendicular to direction of propagation[16].

trap. See siphon; sump; water trap.

traverse. 1. The commonest form of cave survey in which direction, distance and vertical angle between successive points are measured. 2. A way along ledges above the floor of a cave. 3. To move along such a way[25].

travertine. 1. Hard calcareous mineral deposited by flowing water, that is the same as the calcareous variety of sinter and comparable to the softer tufa. The term is normally used only for deposits formed outside caves, where plants and algae cause the precipitation by extracting carbon dioxide from the water and give travertine its porous structure. Travertine forms most commonly on waterfalls that build up like gour dams. Famous examples include those at Plitvice in Croatia, Dunn's River Falls in Jamaica, and, largest of all, Band-I-Amir in Afghanistan[9]. 2. Calcium carbonate, $CaCO_3$, light in color and generally concretionary and compact, deposited from solution in ground and surface waters. Extremely porous or cellular varieties are known as calcareous tufa, calcareous sinter, or spring deposit. Compact banded varieties, capable of taking a polish, are called onyx marble or cave onyx[10]. 3. Generally compact calcium carbonate rock formed by precipitation of soluble bicarbonates when equilibrium is lost due to changes in temperature and chemical characteristics. Soft, porous variety is called calcareous tufa[20]. Synonyms: (French.) *travertin*; (German.) *Kalktuff, Sinter, Travertin*; (Greek.) *travertinis/asvestolithikos toffos*; (Italian.) *travertino*; (Russian.) *travertin*; (Spanish.) *travertino, toba*; (Turkish.) *traverten, sutaşı*; (Yugoslavian.) *sedra, travertin, bigar, lehnjak*. Related to sinter and tufa.

travertine terraces. Terraces and related forms covered or composed of carbonates precipitated from water. Such precipitation is usually from saturated bicarbonate waters (as from karst) when they enter a zone of turbulent flow[20]. Synonyms: (French.) *terrasse de travertin*; (German.) *Travertin-Terraße*; (Greek.) *anavathmos travertinou*; (Italian.) *spianata di travertino*; (Spanish.) *terrazas travertínicas*; (Turkish.) *sutaşı traçaları*; (Yugoslavian.) *slapovi*. See also constructive waterfall.

trellis. A geometrical arrangement of an interwoven pattern[16].

trellis drainage pattern. A arrangement of stream and tributaries in a rectangular fashion[16].

tributary. A stream contributing its waters to another stream of higher order[16].

tributary river. A smaller stream entering and contributing to the flow of a larger river[16].

tributary valley. A less important valley joining a larger valley[16].

tri-cam. A metalic devise placed in holes or cracks for use as an anchor[25]. Compare chock

triple point. A point at which the solid, liquid, and vapor phases are in equilibrium[16].

tripoly. A very fine grained silica sand[16].

tritium. A short-lived isotope of hydrogen (λ = 12.43 y) that is directly incorporated into the water molecule as $^{1}H^{3}HO$ or ^{1}HTO [24]. Commonly used for tracing ground water and for age dating of ground water[16]. See also radioisotope; radioactive tracer; tracers.

Trittkarren. (German.) These are best described as *heel-print karren* because they resemble the imprint of a heel. They are nearly connected with subhorizontal, adjacent, flat plains and migrate upslope by cutting 'steps' through the process of retrogressive corrosion. The semi-circular form is preserved by the 'horseshoe falls effect' which concentrates the main amount of water on the innermost part of the heel-print. At the upper rim the water gain speed. The thickness of the film of water is indirectly proportional to the speed of the flow. A higher rate of flow results in a greater effectiveness of fresh precipitation added to the flow on the ground, but it also causes the diffusion of atmospheric CO_2 and more extensive corrosion. Most Trittkarren originate at the rim of a grike lying below and have moved upward to the surface through retrogressive corrosion. At the base of steep slopes where snow collects, nearly funnel-shaped Trittkarren appear and are of subnival origin. They are common in the Alps[3]. Synonym: heel-print karren.

trough. A depression usually on the land surface, but can be found to occur in ground water.

troglobite. 1. An animal living permanently underground in the dark zone of caves and only accidentally leaving it[10]. 2. A

creature that is fully adapted to life in total darkness and can only complete its life cycle underground[13]. 3. A creature that lives permanently underground beyond the daylight zone of a cave. Many troglobitic species are adapted in some way to living in a totally dark environment. Synonyms: (French.) *troglobie*; (German.) *Troglobiont*; (Greek.) *troglothitis*; (Italian.) *troglobio*; (Russian.) *troglobiont*; (Spanish.) *troglobio*; (Turkish.) *troglobit, kör balık*.

troglodyte. A human cave-dweller[10]. Examples would be early 'cave man'.

troglomorphy. The physical characteristics of a troglobite or stygobite; e.g., reduced eyes and pigment, elongated appendages, well-developed tactile and olfactory organs, etc[23].

troglophile. 1. "Cave lover." An animal that can complete its life cycle in caves, but may also do so in suitable habitats outside caves[23].

troglophobe. An animal or person unable physically or psychologically to enter the dark zone of a cave or other underground area[10].

trogloxene. 1. "Cave visitor." An animal that habitually enters caves, but must return periodically to the surface for certain of its living requirements, usually food[23].

trophic levels. Feeding levels in a food chain, such as producers, herbivores, and so on. Most food chains include a maximum of four or five trophic levels[23].

true velocity. Ground-water flow velocity in porous interstice or cavernous opening[16].

True North. The direction of the geographical north pole at a place[25].

truncation. A horizontal or vertical clean cut through a topographic feature[16].

tsingi. Type of pinnacle karst found on limestone in Madagascar[9].

tube, lava. See lava cave.

tubular passage; tube; tube passage. 1. Cave passage formed by approximately equal dissolution all round when full of flowing water within the phreas. Relict tubes, abandoned as the water table was lowered, are common in old caves, and may be partially filled by sediment, breakdown or stalagmite, or entrenched to form keyhole passages. Tube sizes range to over 15m in diameter, but the larger ones are rarely of uniform section. Peak Cavern in Derbyshire is well known for its fine circular phreatic tubes. Some of the trunk passages of Mammoth Cave, Kentucky, are spectacular tubes of elliptical section, formed by dissolution rates that were higher along the bedding than across[9]. 2. These are nearly horizontal cave passages (tunnels) with round or elliptical cross sections and are either straight or winding. At Mammoth Cave they vary in size up to 30 feet high and nearly 100 feet wide. They are formed while completely filled with flowing water. Whereas they are typically wider than high as a result of dissolution along horizontal cracks and bedding-plane partings, they may also form as

high, narrow, straight fissures along major vertical or near vertical fractures[15]. See also canyon passage; keyhole passage; passage; vertical shaft.

tubular spring. See spring, tubular.

tufa. Soft, porous concretions of carbonate reprecipitated from saturated karst water, often around plants[22]. See also sinter; travertine.

tunnel. See natural tunnel.

turanite. A cave mineral — $Cu_5(VO_4)_2(OH)_4$[11].

turbidity. A diminishing of light penetration through a water sample due to suspended and colloidal materials.

turbulence. An irregular motion of fluid particles in an inertia dominated flow regimen[16].

turbulent flow. 1. Type of flow that begins to develop in a dissolutional sub-conduit as its diameter increases to the point where differences between flow velocity at the bounding wall (slowed due to friction and adhesion) and the maximum velocity in the tube's center are sufficient to cause development of eddies within the flowing water[9]. 2. The flow condition in which inertial forces predominate over viscous forces and in which head loss is not linearly related to velocity[22]. It is typical of flow in surface-water bodies and subsurface conduits in karst terranes provided that the conduits have a minimum diameter of approximately 2–5mm although some research has suggested that 5–15 mm may be more appropriate. See also laminar flow; Reynolds Number; turbulent threshold.

turbulent threshold. The limiting value of sub-conduit size, below which water flow is essentially laminar and above which water flow includes a significant turbulent component. Sub-conduit diameters between 5mm and 15mm have been suggested as the minimum for turbulent flow, but the value depends upon a variety of factors, including the flow velocity; at low flow velocities laminar flow conditions may persist in tubes up to 500mm in diameter[9]. See also laminar flow; Reynolds Number; turbulent flow.

turlough. (Irish.) 1. A karst depression that may be dry or flooded according to season or prevailing weather conditions; derived from the Irish term for 'dry lake'. Oscillations in the general ground-water level, including variations in response to local or more distant tidal effects are the probable mechanism for water level changes in the true turloughs. Effects that appear similar can be produced by high surface runoff into a closed depression with only restricted capacity for the drainage to sink underground[9]. 2. A depression in limestone or in glacial drift over limestone that is liable to flood either from excess surface runoff or from rising ground water. From the Irish words tuar loch, meaning dry lake[10].

Turmkarst. (German.) See tower karst.

twilight zone. The area of a cave where light penetrating through the entrance is sufficient to permit human vision[23]. See also *zonation*.

type curve. A plot of the theoretical well function verses the lower limit of the integral in Theis' graphical solution method[16]. Numerous variations of Theis' original work have been developed for which type curves readily exist.

tyuyamunite. A cave mineral — $Ca(UO_2)_2(VO_4)_2 \cdot nH_2O$[11].

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