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Ma. Internationally accepted abbreviation for million years, commonly applied to measurements of geological time. This abbreviation is currently used in preference to My^[9].

macrokarst. Karst area with large morphological features. The term is not easily defined because it lacks limits^[20]. Synonym; (Italian.) *merocarsismo*. Compare microkarst.

macropore. A pore with dimensions such that capillary forces become less important during flow^[16].

magnesian limestone. Common but loose synonym for dolomitic limestone or dolomite rock. The magnesian limestone of northern England is a rock sequence of Permian age that includes a locally variable number of beds of dolomitic limestone^[9].

magnesite. A cave mineral — MgCO_3 ^[11].

magnetic north. The direction to the north magnetic pole at a given place and time. This differs from the direction towards which the north end of a compass points by a small individual compass error and by the effect of any local magnetic attraction^[25].

malachite. A cave mineral — $\text{Cu}_2(\text{CO}_3)(\text{OH})_2$ ^[11].

mammals. The class of animals that includes bats, mice, man, and many others. They typically have a body covering of hair and give birth to living

young, which are nursed on milk from the mother's breast^[23].

manatial. (Spanish.) Spring. See also spring.

Manning equation. An equation used to compute the velocity of uniform flow in open channel: $V=1.486/n R^{2/3} S^{1/2}$, where V is the mean velocity of flow (in cfs units), R is the hydraulic radius in feet, S is the slope of the channel or sine of the slope angle, and n is the Manning roughness coefficient^[1]. See also Chézy equation; Froude number; Reynolds number.

manometer. A pressure measuring device for determining the hydraulic head developed by a flowing fluid^[16].

mantled karst. Karst topography that is wholly or partly covered by a relatively thin veneer of post-karst rock or sediment and is part of the contemporary landscape^[17]. See also buried karst; covered karst.

marble. 1. Metamorphosed and recrystallized carbonate rock that is generally capable of supporting cave development. For example much of the Antro del Corchia in Italy and many caves in the South Nordland area of Norway have formed in marble^[9]. 2. Limestone recrystallized and hardened by heat and pressure. 3. Commercially, any limestone that will take a high polish^[10].

marine relict. An animal whose presently extinct ancestors lived in salt water but became adapted to life in fresh water

when an area formerly covered by the sea became dry land^[23].

marine water. Ocean water having invaded coastal aquifers^[16].

marginal polje. 1. Flat plain surrounded by higher limestone country on all except one side which consists of impermeable ridges or hills. Such a feature is normally found on the edge of a karst area or region^[20]. 2. Flat limestone plain which is surrounded by higher country but is bordered on one side by impervious rock^[10]. Synonyms: (French.) *polje marginal*; (German.) *Randpolje*, *Semipolje*; (Greek.) *perithoriakón 'polje'*; (Italian.) *polje marginale*; (Spanish.) *polje marginal*; (Turkish.) *kenar gölova*; (Yugoslavian.) *rubno polje*, *robno polje*. See *Randpolje*. Compare blind valley.

marker bed. A bed with characteristic features that can be followed over large areas for identification purposes^[16].

marl. Unconsolidated sedimentary rock consisting largely of calcium carbonate and clay; usage varies from calcareous clay to earthy limestone, and in some parts of the United States, the term has been used for any unconsolidated sedimentary rock containing fossil shells^[10].

mass curve. A graph of cumulative values of a hydrological quantity against time^[16].

mass density. Mass per unit volume of a substance^[16].

mass flowmeter. A measuring device for mass flow rates^[16].

massive structure. A homogenous structure without any oriented features^[16].

master cave. Best defined as a low level trunk streamway cave with many tributaries. The old concept of the master cave being formed at the water table should be disregarded. The Leck Fell Master Cave, in the Yorkshire Dales, is 2km long, partly a vadose canyon, partly a drained phreatic tube and partly a submerged tube. Part of it therefore lies below the water table while elsewhere its presence controls the water table. The French equivalent, 'collecteur', is more descriptive of the master cave's true role. The depth to a currently active master cave is dictated by interactions between local topography, stratigraphical factors and geological structure. In the low hill karst of England and Kentucky, active master caves lie at depths of around 100m, but in Monte Canin, Italy, and the Hautla Plateau, Mexico, they lie at depths of 1000m. The collecteur of the Gouffre Berger, France, is met just 250m down but can be followed to a depth of over 1000m, down the dipping limestone beds, thus emphasizing the local dominance of stratigraphical over topographical factors^[9].

match point. A common point in the superposition of a type curve over measured data in aquifer test analyses.

matric potential. The energy required to extract water from a porous medium to overcome the capillary and adsorptive forces^[22].

matrix. The solid framework of a porous system^[22].

maximum basin relief. The elevation difference between basin mouth and highest point within a basin perimeter^[16].

maze cave. A cave with an essentially horizontal network of interconnecting and mainly contemporaneous passage loops. Three broad types of maze cave have been described — anastomotic, network and spongework — and these may be subdivided on the basis of how they developed by slow-moving water, restricted to a confined, artesian aquifer, or by water that is ponded due to backflooding. A mechanism of potentially great importance, particularly in the context of the inception of network maze caves, is multiple, diffuse input from adjacent, permeable but non-cavernous rocks. Spectacular joint-guided maze caves such as Knock Fell Caverns and the Devis Hole Mine Caverns occur in the thin Yoredale limestones of the northern Pennines, but the most extensive mazes are in the Black Hills of Dakota, USA (including Jewel Cave) and in the Ukrainian gypsum karst (including Optimisticeskaja)^[9]. See also maze cave pattern.

maze cave pattern. A cave system which consists of a labyrinth of intersecting passages of rather uniform character that form closed loops. See also anastomotic cave pattern; maze cave; network cave pattern; spongework cave pattern.

mean deviation. A linear mean of absolute deviations^[16].

mean value. The statistical average or measure of central tendency^[16].

meander. 1. Overdeveloped and self-exaggerated bend is a stream course either on the surface or underground, caused by more erosion on the outside than on the inside of a bend due to natural wash of the flow. Underground meanders commonly originate within bedding plane guided elements of the phreas, where a single dominant tube has gathered drainage from the surrounding area. Following uplift and the onset of vadose conditions any stream that utilizes the meandering tube incises rapidly and the imposed meander course is entrenched into the underlying rocks. Such incision or entrenchment produces characteristic tall, narrow, twisting vadose canyons, to such an extent that the French describe them as ‘meandres’. Canyons may meander more at their lower levels, due to enlargement during incision^[9]. 2. A loop-like bend in a river due to lateral erosion activities^[16]. 3. In a cave, an arcuate curve in a channel formed by lateral shifting of a cave stream^[10]. See ceiling meander; meander niche.

meander belt. A zone within which meandering of a stream occurs^[16].

meandering karren. These are small grooves cut directly into the rock surface, generally a few centimeters wide and deep. Their size remains the same or decreases downslope and usually exhibit small meanders with typical undercut slopes and slip-off slopes. They frequently appear in the bottom of larger grooves such as rinnenkarren^[3]. See also

wall karren; humus-water grooves.
Synonym: (German.) *Mäanderkarren*.

meander niche. A conical or crescent-shaped opening in the wall of a cave, formed by the downward and lateral erosion of a stream on the floor of a passage^[10].

measuring flume. An artificial channel used for discharge measurements.

measuring weir. A device used to measure flow rates indirectly through a weir head.

mechanical ascender. A mechanical device that is the same as an ascender, but is used to clarify the use of a mechanical device instead of a rope ascender knot^[13]. See also ascender.

mechanical cover. A mechanical covering of a free water surface to prevent evaporation.

mechanical dispersion. The process whereby solutes are mechanically mixed during advective transport caused by the velocity variations at the microscopic level. Synonymous with hydraulic dispersion^[22].

mechanical dispersion, coefficient. The component of mass transport flux of solutes caused by velocity variations at the microscopic level. Synonymous with convective diffusion^[22].

median. A value dividing frequency of varieties into two equal portions^[16].

medicinal spring. See spring, medicinal.

medium sand. Grain particle with a diameter of 0.25 to 0.5 mm^[16].

Meinzer unit. A measure of hydraulic conductivity as gpd/ft² under a unit hydraulic gradient^[16].

melanterite. A cave mineral —
 $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ ^[11].

melting. The passage from the solid to the liquid state due to temperature increases^[16].

melting point. The temperature at which a solid substance is transformed into its liquid state^[16].

meltwater. Water derived from the melting of snow pack or of a glacier^[16].

meniscus. A free surface or interface formed by liquid in a capillary tube^[16].

mercury column. A cylindrical bore in a manometer filled with mercury^[16].

mercury injection method. A measurement of porosity by mercury injection into a sample^[16].

merokarst. 1. Defined by Cvijić to indicate imperfect karst topography as found on thin, impure, or chalky limestone where surface drainage and dry valleys are present in addition to some karstic features^[10]. 2. Karst developed in soluble rocks retaining considerable surface drainage. Synonyms: (French.) *merokarst*; (Turkish.) *yarı karst*. Contrast perfectly formed Holokarst. Compare cause.

mesh. 1. An opening in a sieve screen^[16]. 2. Number of openings per inch^[16].

mesophyte. A plant growing under intermediate moisture conditions^[16].

metabolic rate. The rate at which a living thing transforms food into energy and body tissue. The higher its metabolic rate, the more food it must consume. Most cave animals live at a reduced metabolic rate^[23].

metabolism. The sum of the chemical activities taking place in the cells of a living thing; the sum of the processes by which a living thing transforms food into energy and living tissue^[23].

metamorphosis. A change in the form of a living thing as it matures, especially the drastic transformation from a larva to an adult^[23]. See also *pupa*.

meteoric water. Water recently involved in atmospheric circulation^[16].

meteorology. The science dealing with all physical phenomena occurring in the atmosphere^[16].

mexican onyx. See onyx marble.

micrite. A microscopic texture. An abbreviation of 'microcrystalline calcite ooze' which refers to precipitated finely crystalline carbonate sediments in grains from 1 to 4 microns in diameter^[20]. Synonyms: (French.) *micrite*; (Greek.) *micrite*; (Italian.) *micrite*; (Spanish.) *micrita*; (Turkish.) *mikrit*; (Yugoslavian.) *mikrit*. See biomicrite, peloid.

microclimate. "Little climate." The environmental conditions, such as temperature; humidity, and air movement, in a very restricted area, such as a sheltered nook in a cave wall^[23].

microgour. Miniature rimstone dams with associated tiny pools of the order of 1cm wide and deep on flowstone^[25].

microhabitat. A miniature habitat within a larger one; a restricted area where environmental conditions differ from those in the surrounding area. A sheltered nook in a cave wall is an example of a microhabitat within the cave^[23].

microkarren. Very small dissolutional channels, commonly 1–3mm across; parallel, convergent or randomly intersecting on a limestone surface. Though found in all climatic regions they are most conspicuous in semi-arid and periglacial environments, where dissolutional processes are minimal and very slow. The random patterns of some microkarren may be due to the effects of condensation water^[9].

microkarst. 1. Karst area with small morphological features. Term is not easily applied because it lacks limits^[20]. 2. Karst topography in which all surficial features are small; an area dominated by minor karst features^[10]. Compare macrokarst.

microspar. A microscopic texture. Mosaic of tiny (4 to 10 micron diameters) clear calcite crystal^[20]. Synonyms: (French.) *microsparite*; (Greek.) *mikrosparítis* (*mikroskopikón*, *mosaikón kristállon*);

(Italian.) *microsparite*; (Spanish.) *microesparita*; (Turkish.) *mikrospar*.

middens. Accumulations of animal droppings other than guano and often found in caves; may be solidified^[13]. See also cave guano; guano cave; coprolite.

migration. The movement of water, contaminants, or other fluids in the geologic substratum, mostly by natural causes^[16].

mine drainage. Waters coming from or passing through surface or subsurface mine workings^[16].

mine water. Water accumulating in a mine.

minerals. Mineral components of a rock, often in macrocrystalline form^[16].

mineral spring. See spring, mineral.

mining of ground water. The permanent depletion of ground-water reserves^[16].

minor karst features. See karren; rill; solution pan.

mirabilite. The natural white mineral form of hydrated sodium sulfate, $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ ^[9], which may grow as cave flowers or in various other forms similar to those of gypsum.

Mischungskorrosion. (German.) Dissolution of calcite (and hence of limestone) by ground water that is derived from the mixing of two different waters that were originally saturated with carbon dioxide but had reached saturation under differing carbon dioxide partial pressures.

The resultant mixture is undersaturated and capable of further calcite dissolution, because the relationship between calcite solubility and carbon dioxide partial pressure is non-linear^[9].

miscible. 1. Two or more liquids that are mutually soluble (i.e. they will dissolve in each other^[22]). 2. The chemical property of two or more phases that, when brought together, have the ability to mix and form one phase^[22].

miscible displacement. 1. The mutual mixing and movement of two fluids that are soluble in each other^[22]. 2. The displacement of a fluid saturating a porous medium by another fluid completely miscible with the first fluid^[16]. Synonymous with miscible-phase displacement.

mixing length. The length over which mixing occurs, especially of momentum in turbulent flow^[16].

mixture corrosion. See Mischungskorrosion.

mode. The most frequently occurring variate in a frequency distribution^[16].

model. 1. A conceptual, mathematical, or physical system obeying certain specified conditions, whose behavior is used to understand the physical system to which it is analogous in some way^[22]. 2. A conceptual description and the associated mathematical representation of a system, subsystem, components, or condition that is used to predict chances from a baseline state as a function of internal and/or external stimuli and as a function of time

and space^[22]. 3. A simplified system bearing some physical similarity to a prototype^[16].

model technique. A method of solving complex physical problems through the application of simplified models^[16].

mogote. A steep-sided hill of limestone, generally surrounded by nearly flat alluviated plains: *karst inselberg*. Originally used in Cuba in referring to residual hills of folded limestone in the Sierra de los Organos but now used internationally for karst residual hills in the Tropics^[10]. Differs from cone, cupola, pinnacle and tower karst in its shape which reflects its karstification history^[20]. Synonyms: (French.) *mogote*; (German.) (*Karstinselberg*), *Mogote*; (Greek.) '*moghotis*' (*apókrimnos, asvestólofos perikliómenos apó proschomatikas pediadas*); (Italian.) *mogote, rilievo carsico residuo*; (Spanish.) *mogote*; (Turkish.) *karst kalıntı tepesi*; (Yugoslavian.) *hum*. See also *hum*; *karst inselberg*; *pepino hill*.

moisture content. 1. The ratio; expressed as a percentage, of either (a) the weight of water to the weight of solid particles expressed as *moisture weight percentage* or (b) the volume of water to the volume of solid particles expressed as *moisture volume percentage* in a given volume of porous medium^[22]. 2. The gravimetric water vapor content of air^[16]. See also *water content*.

moisture deficiency. The quantity of water required to restore moisture to field capacity in a desiccated soil^[16].

moisture equivalent. The percentage of water retained in a soil sample 1 cm thick after it has been saturated and subjected to a centrifugal force 1000 times gravity for 30 min. *Centrifuge moisture equivalent* is the water content of a soil after it has been saturated with water and then subjected for 1 hour to a force equal to 1000 times that of gravity^[22].

moisture tension. The equivalent negative pressure of water in an unsaturated porous medium equal to the pressure that must be applied to the medium to bring the water to hydraulic equilibrium through a porous permeable material with a pool of water of the same composition. Synonym: *capillary tension*^[22].

moisture volume percentage. The ratio of the volume of water in a soil to the total bulk volume of the soil^[22].

moisture weight percentage. The moisture content expressed as a percentage of the oven-dry weight of a soil^[22].

mold. A microscopic form of fungus responsible for much food spoilage and, in caves, for conspicuous tufts quickly covering scats, dead insects and bats, and even wooden structures such as ladders^[23].

molecular diffusion (diffusion.) The process whereby solutes are transported at the microscopic level due to variations in the solute concentrations within the fluid phases^[22]. The kinetic energy generated by the transport of ionic or molecular constituents results in some dispersion of a chemical.

molecular diffusion, coefficient of. The component of mass transport flux of solutes (at the microscopic level) due to variations in solute concentrations within the fluid phases. Synonymous with diffusion coefficient^[22].

molecule. A stable configuration of atomic nuclei and electrons bound together by electrostatic and electromagnetic forces. It is the simplest structural unit that displays the characteristic physical and chemical properties of a compound^[6].

mollisol. A soil layer subject annual thawing and freezing, often becoming mobile upon thawing^[16].

monetite. A cave mineral — CaHPO_4 ^[11].

monohydrocalcite. A cave mineral — $\text{CaCO}_3 \cdot \text{H}_2\text{O}$ ^[11].

monomolecular film. A layer of monomolecular thickness of a polar substance spread over a free water surface to prevent evaporation.

montgomeryite. A cave mineral — $\text{Ca}_4\text{MgAl}_4(\text{PO}_4)_6(\text{OH})_4 \cdot 12\text{H}_2\text{O}$ ^[11].

montmorillonite. A clay mineral containing magnesium oxide (MgO) in its structure^[16].

moonmilk. 1. A white plastic calcareous cave deposit composed of calcite, huntite, or magnesite. From Swiss dialect moonmilch, elf's milk. Corrupt spelling mondmilch is common^[10]. 2. Deposits consisting mainly of very fine particles of calcium and magnesium carbonate precipitated from water in caves and

caverns. When in suspension, they give the water the appearance of milk. Name originated in 1714 by M. B. Valentini (Fénelon)^[20]. 3. Moonmilk consists of a variety of hydrocarbonates some of which are associated with particular species of bacteria. A common mineral in moonmilk from temperate caves is hydromagnesite; cold caves yield moonmilk of calcite after hydrocalcite^[20]. Synonyms: (French.) *mondmilch*; (German.) *Bergmilch*, *Montmilch*; (Greek.) *speleogala*; (Italian.) *latte di monte*; (Russian.) *kamennce moloko*; (Spanish.) *mondmilch*, *leche de luna*; (Turkish.) *dik karstik kalıntı*; (Yugoslavian.) *gorsko mlijeko* (mleko). Also mountain milk.

moor. A wet peat bog^[16].

moulin. The French word for 'mil', moulin has been used to describe partially dissolutional, partially scoured pockets cut in rock, particularly the potholes formed in the beds of surface and underground streams. In some areas sinkholes in the surface of glaciers, which may provide access to glacier caves, are also referred to as moulins^[9].

mountain milk. See moonmilk.

moraine. A mound, ridge, or other distinct accumulation of unsorted, unstratified glacial drift, predominantly till, deposited chiefly by direct action of glacier ice^[6].

morphometric analysis. A geodetic and geometric description of basin and stream network or to a sinkhole plain^[16].

mud. Water saturated fine clayey earth material^[16].

My. See Ma.

mud crack. Desiccation cracks appearing in drying mud surfaces due to shrinkage^[16].

mud pendulite. A pendulite with the knob coated in mud^[25].

mud stalagmite. 1. Stalagmitic column made of mud or clay with about 30% calcium carbonate cement. There may be some coarse noncalcareous detritus in the core of such a column^[20]. 2. Stalagmite composed principally of clay or sandy clay and commonly less than 30% calcium carbonate^[10]. Synonyms: (French.) *stalagmite d'argile*; (German.) *Stalagmit aus Tonschlamm*; (Greek.) *pilostagmitis*; (Italian.) *stalagmite di fango*; (Spanish.) *ostalagmita de barro*; (Turkish.) *çamur dikiti*. Related to stalagmite.

mudflow. A flow of water saturated unconsolidated debris^[16].

multiaquifer formation. A formation with several aquifers overlying each other^[16].

multiaquifer well. A well completed and tapping several aquifers^[16].

mutation. A sudden change in the genetic material of an organism's germ cells, resulting in offspring that possess characteristics markedly different from those of either parent. Mutations generally are harmful, but occasionally may improve an organism's chances for survival^[23]. See also *adaptation*; *evolution*.

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