

GLOSSARY OF TERMS IN ENGINEERING GEOLOGY AND ROCK MECHANICS

Updated February 2015

The definitions are largely based on:

- ISRM Terminology (1975)
- *Handbook in Engineering geology and rock mechanics*, issued by the Norwegian Rock Mechanics Group (NBG), (2000);
- *Geoguide 3* (1988), issued by the Geotechnical Engineering Office, Hong Kong;
- Common textbooks in rock mechanics, rock engineering and engineering geology;
- *Webster's dictionary*;
- *Dictionary of geological terms*, issued by American Geological Institute;
- *Encyclopædia Britannica*.
- *Wikipedia*

1. *abutment* The point in a tunnel or cavern where the wall and roof (back) meet.
2. *access tunnel* Tunnel from surface to underground work site.
3. *accessory* A term applied to minerals occurring in small quantities in a rock, and whose presence or absence does not affect its mechanical properties.
4. *acid* Chemical term for an igneous rock containing more than 62% silica and usually less than 20% dark minerals. (Contrast with "intermediate" and "basic").
5. *actinolite* Mineral. A monoclinic variety of amphibole.
6. *activity (of a soil)* Ratio of plasticity index to clay fraction.
7. *adit* Tunnel (gallery) driven from a surface portal to an underground working place. Used for drainage, ventilation, transportation, or giving access to an ore body or working place. Also used as a term for a small investigation tunnel.
8. *aegirine* Mineral. A variety of monoclinic pyroxene.
9. *aeolian* A term applied to deposits whose constituents have been carried by, and laid down from, the wind.
10. *agglomerate* Pyroclastic rock composed predominantly of rounded bombs of material of greater than 60mm average dimension. (Contrast with "pyroclastic breccia").
11. *aggregate* 1) A mixture of different materials which may be separated mechanically.
2) Mineralogic material (i.e. sand gravel, crushed rock etc) which may be mixed with cement, bitumen or epoxy to form concrete or asphalt.
12. *aggregate abrasion value* A measure of the resistance of an aggregate to abrasion; the lower value, the more resistant to abrasion is the aggregate.
13. *aggregate soundness test* A chemical test to measure the relative resistance of rocks to repeated wetting and drying and crystallisation of salts within pores.
14. *albite* Mineral. The most sodium rich variety of pyroxene feldspar ($\text{NaAlSi}_3\text{O}_8$).
15. *alkali feldspar* Group of feldspars composed of mixtures, or mixed crystals, of potassium feldspar (KAlSi_3O_8) and sodium feldspar ($\text{NaAlSi}_3\text{O}_8$). (See "feldspar").
16. *allochthonous rocks* Rocks having been thrust in connection with mountain range formation.
17. *alum schist* A black shale variety containing pyrrhotite.
18. *alluvium* Detrital material of any grain size transported and deposited during comparatively recent geological time by a river or stream.
19. *alteration* Change of the mineralogical composition of a rock, typically brought about by the action of hydrothermal solutions. The term joint alteration includes both weathering and alteration. It is included in the description of joint alteration in the following main categories:
 - the alteration of the rock in the joint wall/surface;
 - the coating on the joint surface when it occurs; and
 - the filling in joints with separation.

20. *amorphous* Term for a mineral or other substance that lacks crystalline structure and has no characteristic external form.
21. *amphiboles* A group of rock-forming minerals.
22. *amphibolite* Homogeneous to slightly schistose, dark, metamorphic rock with 20 - 50 % plagioclase, 20 - 80 % amphibole, 0 - 50 % mica, minor amounts of quartz, garnet and epidote.
23. *amphibolitic gneiss* Gneiss with > 20 % amphibole.
24. *andalusite* Brown, yellow, green, red or grey silicate mineral which occurs in thick, nearly square prisms in schists, gneisses and hornfelses.
25. *andesite* A fine-grained igneous rock formed essentially of plagioclase, together with the mafic minerals biotite, hornblende, and pyroxene (the effusive rock of diorite).
26. *angular* Shape term for a rock particle with sharp edges and corners.
27. *anhydrite* White or light-coloured mineral consisting of calcium sulphate (CaSO₄). Essentially a slightly harder and less soluble form of gypsum.
28. *anisotropy* Characterises a material which has different properties in different directions.
29. *anorthite* Mineral. The most calcium rich variety of plagioclase feldspar
30. *anorthosite* A plutonic rock composed almost entirely of plagioclase.
31. *anthophyllite* Mineral. A variety of rhombic amphibole.
32. *anticline* Fold in the form of an arch whose core contains the stratigraphically older rocks.
33. *antiform* Fold with the convex side up (may be inverted, as opposed to anticline).
34. *anthracite* Pure, high quality coal.
35. *aperture* Perpendicular distance between adjacent rock walls of a discontinuity, in which the intervening space is air or water filled.
36. *aphanitic* Textural term for a rock in which the individual constituents are not visible to the naked eye.
37. *aplite* Light-coloured, fine-grained igneous rock of granitic composition. Very uniform and smooth-textured appearance. Commonly occurs in the form of narrow dykes.
38. *aquiclude* A (relatively) impermeable barrier to groundwater flow.
39. *aquifer* Permeable layer of water bearing ground.
40. *arenaceous* Applied to rocks that have been derived from sand or that contain sand.
41. *arenite* 1) Consolidated rock of the texture of sand, irrespective of composition; see psammite.
2) Arenaceous sedimentary rock containing less than 15% silt and clay material. (Contrast with "wacke").
42. *argillaceous* Applied to all rocks composed of clay or having notable portion of clay in their composition, as roofing slate, shale, etc.
43. *arkose* Sedimentary rock. Sandstone with 0 - 75 % quartz, 10 - 90 % feldspar and rock fragments, 0 - 20 % clay minerals.
44. *arkosite* Schistose to slightly schistose, metamorphic rock with 0-70 % quartz, 10 - 90 % feldspar, 0 - 30 % mica and chlorite. (Metamorphic variant of arkose).
45. *artesian* Relating to a confined aquifer (usually one for which the pressure surface is above ground level)
46. *ash* Pyroclastic rock material of sand-, silt- and clay-size (i.e. < 2mm), subdivided into coarse ash for sand-size and fine ash for silt- and clay-size. Descriptive term for tuff composed wholly or predominantly of these grain sized.
47. *asthenosphere* The part of the Earth's mantle beneath the lithosphere.
48. *augen gneiss* Gneiss with feldspar appearing as eyes in the bedrock.
49. *augite* Dark-coloured silicate mineral in the pyroxene group often found in basic igneous rocks.
50. *aureole* Zone surrounding an igneous intrusion in which the country rock shows the effects of thermal or contact metamorphism.
51. *authigenic* Formed where found (used of mineral particles of rocks formed by crystallisation in the place they occupy)
52. *autochthonous rocks* Rocks not having been thrust in connection with mountain range formation.

53. *axial plane* Plane that connects the points of maximum curvature of the bedding planes or other structural rock surfaces in a fold.
54. *banded* Structural term for a rock with alternating layers of material of differing colour or texture, possibly of differing mineral composition also.
55. *bar block* See columnar block
56. *basal* Pertaining to, situated at, or forming the base of a geological structure. "Basal layer" refers to the lowest layer in a layered rock or soil.
57. *basalt* Dark coloured, fine-grained igneous rock composed mainly of plagioclase feldspar and mafic minerals. Often occurs in the form of lava flows. (The fine-grained equivalent of gabbro.)
58. *basic* Chemical term for an igneous rock containing 44 to 54% silica and usually more than 30% dark minerals. (Contrast with "acid" and "intermediate").
59. *batholith* A body of plutonic igneous rock, usually greater than 80 km² (sometimes many thousand km² in surface area)
60. *bauxite* Residual soil layer relatively rich in aluminium oxide, which is formed in tropical area of high rainfall.
61. *bedded* Structural term for a sedimentary rock or superficial deposit formed, arranged or deposited in layers or beds > 20 mm thick.
62. *bedding joint* Joint along bedding plane in a sedimentary rock.
63. *bedrock* Solid rock underlying soil, sand and other unconsolidated material.
64. *bentonite* An expansive clay formed from the decomposition of volcanic ash.
65. *bias* The difference between the estimated value and the true value based on statistically random sampling.
66. *bit wear index* A number representing the wear on drill bits during boring. It is found from laboratory tests by combining the drilling rate value (DRI) and the abrasion-value.
67. *biotite* Black, dark brown or dark green mineral of the mica group. Forms distinctive shiny thin prisms or flakes. Very common in crystalline, igneous and metamorphic rocks.
68. *black cotton soil* A dark clay soil which shrinks and cracks in dry weather.
69. *blastability* Index value of the resistance of a rock mass to blasting.
70. *black shale* Sedimentary or slightly metamorphic, schistose rock containing graphite.
71. *block* 1) Rock fragment derived from the sides of a volcanic vent. Commonly angular or subangular. Restricted to pyroclasts > 60mm diameter.
2) General term for individual pieces of rock bounded by discontinuities in a rock mass.
72. *block angles* The angles between the sides of the block (orthogonal, oblique, acute, rhomboedric etc.).
73. *block shape factor* A number (β) expressing the relative differences in the dimensions of a rock block.
74. *blocky* Shape term for a rock mass with three approximately orthogonal and equally-spaced joint sets, such that individual rock blocks tend to be roughly equidimensional.
75. *blocky blocks* Approximately equidimensional blocks.
76. *bomb* Partly molten material from a volcanic vent which solidifies in flight or shortly after landing. Restricted to pyroclasts > 60mm diameter.
77. *borrow pit* An excavation to provide material usually for fill elsewhere / A test pit
78. *boulder clay* Local British term for till; considered inaccurate because neither boulders nor clay are essential constituents.
79. *boulders* Rock fragments greater than 200mm in size.
80. *break* A general term used in mining geology for any discontinuity in the rock, such as fault, fracture, or a small cavity.
81. *breccia* Coarse-grained rock composed of angular broken rock fragments held together by a mineral cement or in a fine-grained matrix. (Contrast with "conglomerate"). May be of sedimentary or pyroclastic origin, or may be formed by crushing of any type of rock in a fault zone.
82. *brittle failure* Failure characterised by sudden loss of strength.
83. *brittleness* 1) A material condition characterised by reduced ability to carry load as the strain increases.
2) The parameter resulting from the brittleness test.

84. *buckling* The breaking out of fragments along the surface of a column or tunnel wall under sufficiently high load due to deflection of the rock structure.
85. *calcrete* Calcium carbonate concentrated by water movement and precipitated into a hard cement of soil matrix.
86. *caliche* See "calcrete".
87. *cataclastic* Term for the structure of a rock which has been broken up severely by strong dynamic metamorphism or faulting. Common features are bent, broken or ground-up minerals. "Cataclasite" is the name for any rock showing cataclastic structure.
88. *calcareous* Term applied to a rock containing an appreciable amount of calcium carbonate, e.g. calcareous sandstone.
89. *calcite* White, light grey, yellow or blue, common carbonate mineral: the carbonate of calcium (CaCO₃). Glassy appearance. Effervesces in hydrochloric acid. The principal constituent of chalk and most limestones.
90. *Cambrian - Silurian* Abbreviation for Cambrian, Ordovician and Silurian. Commonly used also for rocks of that age.
91. *carbonate* Term applied to a mineral compound characterised by an ionic structure of CO₃²⁻. Calcite and dolomite are examples of carbonate minerals. Also applied to a rock consisting chiefly of carbonate minerals. Limestone and dolomite are examples of carbonate rocks. (See also "calcareous").
92. *cataclastic* Texture with the original mineral grains crushed and/or deformed, and often occurring as bands or stripes.
93. *cave-in* Downfalls of larger volumes (> 10 m³) of rock debris into a tunnel or cavern.
94. *cemented* Term for a sedimentary rock whose grains are bound together in a coherent mass by mineral cements. Most cements are chemically precipitated. The most common cement are iron oxides, silica (quartz, opal, chalcedony), carbonates (calcite, dolomite) and clay minerals.
95. *chalcedony* Silica mineral which is the cryptocrystalline variety of quartz. Has a wide range of colours. Several varieties used as semi-precious stones (e.g. jasper, carnelian, agate, onyx).
96. *chalk* A soft, usually white, fine-textured limestone.
97. *character of the joint surface* The nature of the joint wall, which can be fresh, weathered, coated, stained, etc.
98. *charnockite* Massive, igneous or metamorphic rock. Rich in feldspar and with some pyroxene.
99. *chert* Hard, dense, dull to slightly shiny, cryptocrystalline sedimentary rock consisting of organic or inorganic precipitates of silica. Occurs commonly as small irregular lumps in limestones and dolomites, but may also form extensive bedded deposits.
100. *chlorite* Group of platy micaceous minerals, usually green in colour and containing much ferrous iron. Often associated with and resembling biotite; crystals cleave into small thin flakes. Widely distributed in low-grade metamorphic rocks, or found as alteration products of ferromagnesian minerals in any rock type.
101. *chroma* Brilliance or intensity of a colour.
102. *clastic* Term for a rock composed of broken fragments that are derived from pre-existing rocks or minerals and that have been transported from their places of origin.
103. *clay* 1) Soil term for particles smaller than 0.002mm in size.
2) A fine-grained unconsolidated material which has the characteristic property of being plastic when wet and which loses its plasticity and retains its shape upon drying or when heated.
104. *clay fraction* The fraction by weight of particles of size less than 0.002 mm effective spherical diameter; mineral composition is variable.
105. *clay minerals* A group of aluminosilicate minerals with characteristic sheet structure. Characterised by small particle size and the ability to absorb large quantities of water and of exchangeable cations.
106. *claystone* Sedimentary rock composed predominantly of clay-size particles. Texture and composition similar to shale, but lacks fine lamination or fissility. (See also "mudstone").
107. *clean joint* Joint surface without filling or coating.

108. *cleavage* Property or tendency of a rock to split easily along aligned, usually closely-spaced fractures produced by a metamorphism or deformation. Cleavage planes are secondary features and may differ in spacing and orientation from primary rock structures such as bedding.
109. *coated joint* The joint surface has a thin layer or 'paint' with some kind of mineral.
110. *cobbles* Rock fragments 60 to 200 mm in size.
111. *coefficient of permeability (k)* The parameter represents the coefficient of proportionality in Darcy's equation $v = Q/A = k \times i$ where v = flow velocity (m/s), Q = flow rate (m^3/s), A = flow area (m^2), and i = hydraulic gradient.
112. *coherent* Descriptive of two or more similar parts or organs of the same series touching one another more or less adhesively but not fused.
113. *cohesive* Term for a soil which possesses cohesion. (Contrast with "granular").
114. *collapse* To fall down or inward suddenly; cave in
115. *colluvium* Deposits formed by the down slope movement of earth materials essentially under the action of gravity.
116. *columnar* Shape term for rockmass with typically five to seven joint sets of similar dip that combine to form parallel columns of rock blocks.
117. *columnar blocks* Long or bar block with one dimension considerably larger than the other two.
118. *common ground conditions* The ground has its most frequent properties, values or ratings.
119. *competent* Having the capacity to function or develop in a particular way.
120. *competent rock* Rock which is stronger than adjacent rock and relatively less liable to deformation. It therefore tends to fracture when the load exceeds a certain limit.
121. *competent ground* Rock mass strength is higher than the ground stresses imposed, see incompetent ground.
122. *conchoidal* A term used originally in descriptive mineralogy to describe the shell-like surface produced by the fracture of a brittle substance.
123. *concordant* Describes various strata with bedding planes more or less parallel and probably conformable.
124. *concretions* Nodular or irregular concentrations of certain authigenetic constituents in sedimentary rocks and tuffs.
125. *conductivity* Parameter used for characterising hydrogeological conditions, more precisely expressed as "hydraulic conductivity". It is often referred to as the "coefficient of permeability".
126. *conformable* Describes sedimentary rocks succeeding one another without signs of intervening tectonism or erosion.
127. *conformal* Parallel beds/layers in unbroken order.
128. *conglomerate* Coarse-grained sedimentary rock composed of rounded to subangular fragments larger than 2mm average dimension set in a sand or finer-grained matrix which is often cemented. (Contrast with "sedimentary breccia").
129. *conjugate joints* Two sets of joints nearly at right angles to one another, produced by the same process.
130. *connate water* Water (often saline) trapped for long periods in rock pore-space, usually beneath the present or a pre-existing sea.
131. *contact metamorphism* Metamorphism due to high temperature close to the contact of intruding magma.
132. *continental crust* Less dense, more siliceous and thicker crust under continents; contrasted with oceanic crust.
133. *continuity factor* The ratio between tunnel diameter (D_t) and block diameter (D_b), $CF = D_t/D_b$.
134. *continuous ground* Can either be massive ground, in which the properties of the intact rock dominate behaviour, or highly jointed (or particulate) ground in which the ground behaves as a bulk material.
135. *cooling joint* Joint formed by the cooling of an igneous, pyroclastic or other heated rock body.
136. *core* 1) Part of the Earth more than 2900 km beneath ocean surface, with a relatively density of more than 10 as interpreted from the records of seismic waves.
2) Cylinder of rock obtained by drilling.

137. *core barrel* A length of pipe next to the cutting bit of a core drill and which contains the core. A double core barrel is a core barrel with two concentric pipes so arranged that in very soft rock the inner tube does not rotate and so damage the core.
138. *core recovery* 1) The percentage of a length of drilling which is represented by solid core samples recovered from the drill.
2) The retrieval and storing of rock cores from a core drilling machine.
139. *corundum* A hard aluminium oxide mineral. Sapphire and ruby are the gem varieties.
140. *country rocks* The rocks surrounding an igneous body.
141. *crack* A small, partial or incomplete defect.
142. *creep* Continuous (very slow) deformation under load.
143. *cross bedding* Structure formed by a series of bedding planes inclined at an angle to the main planes of stratification in a sedimentary deposit. Planes are usually curved and truncated in cross-section by overlapping sets. See current bedding
144. *crumble* To fall into small pieces; disintegrate.
145. *crushed rock* Heavily jointed to "sugar cube".
146. *crust* Outermost part of the solid Earth, of relative density 3.0 or less, with a maximum thickness of about 50 km.
147. *cryptocrystalline* Textural term for a rock consisting of crystals that are too small to be recognised and distinguished separately under an ordinary microscope. (i.e. glass and chert).
148. *crystal* Homogeneous solid chemical element or compound having a regular atomic structure expressed by symmetrically-arranged external plane faces. Term for pyroclastic rock composed predominantly of pyroclasts in the form of crystals or crystal fragments.
149. *crystallinity* Degree to which crystals are developed in a rock, especially in igneous rocks.
150. *cubical blocks* Block with six equal square sides.
151. *current bedding* Bedding which is formed at an angle to the horizontal by the action of swift local currents of water or air (syn.: cross bedding). Known also as false-bedding because observed inclination cannot be used as an indication of the nature of Earth movements subsequent to deposition.
152. *cut-off drain* A drain which collects and discharges surface water across the natural drainage slopes.
153. *dacite* Medium-coloured, very fine-grained, acid igneous rock. The fine-grained equivalent of granodiorite. Often contains megacrysts of quartz and feldspar.
154. *dappled* Term for non-uniform colour distribution of a rock or soil where the secondary colour constituent forms irregularly-shaped blotches or marks of widely differing size.
155. *decomposed rock* The rock is weathered to the condition of a soil in which the original material fabric is still intact, but some or all of the mineral grains are decomposed.
156. *deformation* Alteration of shape and/or volume.
157. *density of joints* The amount of joints occurring within a volume (area, or line).
158. *denudation* The erosion of mountain ranges and flattening of the land surface.
159. *detrital* Term for a rock or sediment formed of fragmental material which is derived from older rocks and moved from its place of origin by weathering and erosion.
160. *dextral* Pertaining to the right (e.g. dextral slip is right slip)
161. *diabase* The dyke rock variant of gabbro ("fine-grained gabbro"). (Equivalent to dolerite).
162. *diapiric* Describing an anticline or dome whose rocks have become ruptured by the upward movement of less dense plastic material, i.e. salt.
163. *diastrophism* The process or processes by which the crust of the earth is deformed, and by which continents and ocean basins, plateaus and mountains, flexures and folds of strata, and faults are produced.
164. *dilatancy* Tendency of a volume increase under increasing shear stress.
165. *dilation angle* The second order angle (i) in Patton's expression for friction angle of joints, expressed as:
 $\phi = \phi_b + i$ where ϕ_b = the basic friction angle.
166. *diopside* Mineral. A variety of monoclinic pyroxene.

167. *diorite* A coarse-grained igneous rock. Typically 0 - 5 % quartz, 0 - 10 % alkali feldspar, 30 - 50 % hornblende, biotite, augite, 30 - 60 % plagioclase.
168. *dip* The angle at which stratum or other planar feature is inclined from the horizontal.
169. *dip slope* Slope is parallel to the bedding or foliation of the rock.
170. *discoloured rock* The colour of the original fresh rock material is changed.
171. *discontinuous joints* Joints that terminate in solid rock.
172. *discordant* Describes relationships of a separate rock body to an organised sequence of rock layers with which the body is in contact.
173. *disintegrate* to break or decompose into constituent elements, parts, or small particles.
174. *disintegrated rock* The rock is weathered to the condition of a soil, in which the original material fabric is still intact. The rock is friable, but the mineral grains are not decomposed.
175. *dolerite* Dark-coloured, medium-grained, basic igneous rock with the same composition as basalt and gabbro, but with a texture of inter-grown plagioclase and pyroxene.
176. *dolomite* 1) Mineral. Generally white, sometimes slightly yellow, brown, pink or grey: the carbonate of calcium and magnesium ($\text{CaMg}(\text{CO}_3)_2$). Forms curved, saddle-like crystals.
2) Sedimentary rock with more than 50% of the mineral dolomite.
177. *dolostone* A sedimentary rock composed chiefly of magnesium/calcium carbonate.
178. *dome* A dome-shaped structure, usually associated with igneous or other diapiric cause.
179. *drift* 1) A horizontal tunnel. A drift follows the vein, as distinguished from a crosscut, which intersect it, or a level or gallery, which may do either.
2) Any rock material, such as boulders till, gravel, sand silt, or clay, transported by a glacier and deposited by or from the ice or by or in water derived from the melting of the ice. Generally used of the glacial deposits of the Pleistocene epoch. Detrital deposits.
180. *drillability* An index value of the resistance of a rock to drilling.
181. *drilling rate index (DRI)* A number expressing the drillability of a rock, compiled from the brittleness value and the Siever's J-value.
182. *ductility* A material condition characterised by ability to resist permanent strain without losing the ability to carry load.
183. *durability* The resistance of a rock against slaking or disintegration when exposed to weathering processes
184. *dunite* Ultrabasic, metamorphic rock consisting mainly of olivine.
185. *dyke* Sheet- or table-like body of intrusive igneous rock which cuts across the bedding or other structural planes of the country rock.
186. *earthquake* Sudden fracturing and release of energy from stresses built up over a long time.
187. *eclogite* Highly metamorphic, ultrabasic rock consisting mainly of pyroxene and garnet.
188. *effusive rocks* Rocks formed by rapid movement of the magma to the earth's surface with quick solidification to fine-grained rocks.
189. *elasticity* The capability of a material to regain its original shape or condition after the removal of an applied load.
190. *elastic limit* The point on the stress/strain-curve defining the transition from elastic to non-elastic behaviour.
191. *elongate* Shape term for a rock particle in which the longest diameter is much greater than the intermediate or shortest diameter. Expressed quantitatively as "flatness ratio" > 0.66 and "elongation ratio" < 0.66 .
192. *elongation ratio* Ratio of the intermediate to longest diameters of a particle.
193. *eluviation* Downward movement of soluble or suspended material in a soil or superficial deposit by groundwater percolation.
194. *en echelon jointing* Joints in relatively narrow zones, where one joint is replaced by another joint which is slightly off-set. At their ends, joints are sometimes bifurcated and sometimes linked to the adjacent joint in the zone.
195. *endogenetic* A term applied to geological processes originating within the earth and to rocks that owe their origin to such processes.

196. *enstatite* Mineral. A variety of rhombic pyroxene.
197. *epidote* Mineral. Common in metamorphic rocks.
198. *epicenter* The point on the surface vertically above the of the earthquake focus, i.e. the area of energy release.
199. *eolian* Deposited by wind.
200. *erosion* The wearing and removal of soil or rock fragments caused by glaciers, running water and wind.
201. *epidote* A silicate mineral, commonly found in crystalline, metamorphic rocks. It occurs often as joint coating.
202. *epigene* A general term for geological processes originating at or near the surface of the earth.
203. *epigenetic* A term now generally applied to ore deposits of later origin than the rocks among which they occur.
204. *equidimensional* Shape term for a rock particle in which the three diameters are of approximately equal length. Expressed quantitatively as 'flatness ratio' > 0.66 and 'elongation ratio' > 0.66.
205. *equidimensional blocks* Small differences in dimensions, caused by three dominant sets of joints, approximately orthogonal, with occasional irregular joints.
206. *equigranular* Textural term for a rock characterised by crystals or grains of the same size or approximately the same size.
207. *essexite* Plutonic rock, typically with 10 - 65 % plagioclase, 0 - 30 % alkali feldspar, 5 - 45 % feldspathoids, 30 - 60 % mica, hornblende, augite.
208. *eutaxitic* Structural term for some pyroclastic rocks characterised by a streaked or banded appearance, due to pumice clasts or other material being stretched out whilst still in a hot viscous state, and subsequently preserved by welding.
209. *evaporite* Sedimentary rock consisting of minerals resulting from the evaporation of saline water.
210. *exfoliation* Process by which thin, curvilinear scales or shells or rock are successively spalled or stripped away from the bare surface of a rock mass or boulder under the action of mechanical and/or chemical weathering and release of confining pressure by erosion. Often results in a rounded rock mass. Commonly seen in granite corestones.
211. *exogenetic* A term applied to geological processes originating at or near the surface of the earth and to rocks that owe their origin to such processes.
212. *expansion bolt* Rock bolt fixed by expansion shell.
213. *exposure* A visible rock outcrop.
214. *extension* A strain involving an increase in length.
215. *extrusive* Term for an igneous rock that has been erupted onto the earth's surface (e.g. rocks formed from lava flows). Also applies to all pyroclastic rocks. (Contrast with "intrusive").
216. *failure* The result of instability. Both failure and instability are used rather inconsistently in the literature as they often overlap.
217. *failure criterion* Theoretical or empirical stress or strain relationship defining the failure condition of a material.
218. *false bedding/schistosity* See current bedding.
219. *fan* Gently-sloping mass of detrital material deposited at locations of abrupt decrease in slope gradient. Forms a part-cone shape in cross-section and is fan-shaped in plan. Of alluvial or colluvial origin.
220. *fault* Major rupture zone ranging in width from decimetre to more than hundred meters, occasionally thousand meter. The walls are often striated and polished (slickensided) resulting from the shear displacement. Frequently rock on both sides of a fault is shattered and altered or weathered, resulting in fillings such as breccia and gouge.
221. *fault gouge* Filling material in faults.
222. *feldspar* Group of abundant aluminosilicate rock-forming minerals of general composition $M,Al(Al,Si)_3O_8$ where M is commonly potassium, sodium or calcium. Crystals are usually white or nearly white (but frequently coloured by impurities), translucent, and possess good cleavage in two directions intersecting at or near 90°. They occur commonly in many rock types and decompose readily to clay.

223. *feldsparphyric* Textural term for a rock containing large megacrysts or feldspar, e.g. feldsparphyric rhyolite.
224. *feldspathic* General term for any rock or other mineral aggregate containing feldspar.
225. *feldspathoid* Group of minerals mainly occurring in ultrabasic rocks (most common: nepheline and leucite).
226. *felsic* General term for light-coloured minerals (e.g. quartz, feldspars, muscovite), or an igneous rock composed chiefly of these minerals. (Contrast with "mafic").
227. *felsitic texture* Texture with mineral grains in a fine grained matrix, making distinction between the individual grains difficult.
228. *femic* Term for rocks having a high content of iron and magnesium. Normally dark, basic rocks.
229. *ferralites* Prominently iron-rich residual soils.
230. *ferromagnesian* Term for any rock-forming minerals containing iron or magnesium.
231. *ferruginous* An adjective applied to rocks with a prominent iron content.
232. *fibrecrete* Fibre reinforced sprayed concrete (shotcrete).
233. *fissile* Capable of being readily split along closely spaced planes
234. *fissility* Property possessed by some rocks, such as shale, of splitting easily into thin layers along closely-spaced, approximately planar, parallel surfaces. Its presence distinguishes shale from mudstone.
235. *fissure* Open crack or fracture in a rock or soil mass. Also used to describe a volcanic vent in the form of a crack.
236. *flagstone* Sandstone variety with closely spaced bedding planes.
237. *flakiness* The ratio between width and thickness of particles as determined in laboratory.
238. *flat* Shape term for a rock particle in which the shortest diameter is much smaller than the intermediate or longest diameter.
239. *flatness ratio* Ratio of the shortest to intermediate diameters of a particle.
240. *flint* Dark grey or black variety of chert.
241. *fluorite* The mineral calcium fluoride.
242. *flow-banded* Structural term for a rock formed by alternating layers of different colour, composition and/or texture as a result of the flow of molten rock. Most common in igneous rocks, but sometimes visible in pyroclastic flow deposits.
243. *flysch* The widespread deposits of sandstones, marls, shales and clays (originally used for deposits located in the southern borders of the Alps, later used as a general term). The total thickness of such a sequence is commonly many thousands of metres, but the individual beds are thin, only a few centimetres to a few metres thick.
244. *foidite* Common term for plutonic rocks rich in feldspathoids.
245. *fold axis* The line along the ridge of an anticline or the bottom of a syncline.
246. *folding* Curving of layers in the bedrock.
247. *foliated* Structural term for the layered, planar arrangement of the constituent grains of a rock formed by flattening of minerals due to metamorphism.
248. *foliation partings* Small discontinuities developed along the foliation planes in metamorphic rocks.
249. *foliation joints* Joints developed along the foliation planes in metamorphic rocks.
250. *foot wall* The wall beneath an inclined discontinuity or ore body.
251. *formation* A term applied stratigraphically to set of strata possessing a common suite of lithological characteristics.
252. *fracture* A general term used in geology for all kinds of discontinuities caused by mechanical stresses in the bedrock. Fractures include joints and cracks and faults. It is suggested not to use this term in rock engineering and engineering geology.
253. *fracture cleavage* A capacity to part along closely spaced, parallel surfaces of fracture or near-fracture, commonly in a single set, but occasionally in intersecting sets. It is closely related to joint structure, but the joints are so closely spaced as to give the rock a distinctive structure not ordinarily to be described in terms of joints.
254. *fracture index* Ratio of seismic velocity for intact rock samples to seismic velocity of rock mass in situ.

255. *fracture intercept* The mean distance between successive fractures as measured along an intersecting straight line at exposed surfaces or in core samples. All fractures are counted, whether or not they belong to the same set.
256. *fragment* A rock or mineral particle larger than a grain.
257. *free swelling* Laboratory index describing the ability of clay materials to swell.
258. *fresh rock* No visible sign of weathering/alteration of the rock material.
259. *friable* Term for a soil that crumbles very easily in the hand.
260. *friction bolt* Rock bolt with the support capacity represented by the friction between the drill hole wall and the rock bolt along its entire length. Examples of such rock bolt are the Swellex-bolt and the Split-set bolt.
261. *gabbro* Dark-coloured, fine- to coarse-grained, basic intrusive igneous rock. with typical composition: 30 - 70 % plagioclase, 30 - 70 % pyroxene, 0 - 30 % olivine, biotite, and hornblende, negligible content of quartz.
262. *garnet* A group of hard minerals. Most common varieties: grossular, almandine pyrope and spessartine.
263. *gentle fold* Fold with an inter-limb angle between 120° and 180°.
264. *geode* Sub-spherical hole in a lava, often later filled with crystals.
265. *geognosy* The science which treats the solid body of the earth as a whole and of the different occurrences of minerals and rocks of which it is composed and of the origin of these and their relations to one another.
266. *geosyncline* A mobile downwarping of the Earth's crust, perhaps 100 km or more across, in which sediments (and often volcanic rocks) are deposited simultaneously with the downwarping.
267. *GIN* Stands for *Grout Intensity Number* and is the product of pressure (in bar) and grout take (in litres per drill hole metre).
268. *glacial striation/striae* Striation of bedrock caused by the movement of glacier containing rocks and cobbles.
269. *glacio* A combining form frequently used with other words to denote formation by or relationships to glaciers.
270. *glaciofluvial* Pertaining to streams flowing from glaciers or to deposits made by such streams.
271. *glassy* Shape term for a rock particle with a surface texture that looks and feels like glass or quartz. Surface is typically shiny, straight or smoothly curved and lacks distinct crystal shapes.
272. *global stability* Overall (or total) stability; the potential of a collapse or breakdown of the tunnel and thus affecting the operation of the project as a whole.
273. *gneiss* Coarse-grained foliated rock formed by regional metamorphism, in which bands of granular minerals alternate with bands of flattened, elongated minerals showing preferred orientation parallel to the banding.
274. *gneissic granite* Granite with slight parallel-orientation of mineral grains due to deformation and metamorphism.
275. *gouge* Fine-grained (silt- and clay-size) material in a fault. Also known as "rock flour".
276. *graben* A trough-shaped parallel-sided valley usually bounded by faults.
277. *graded bedding* Structure evident in a bedded sedimentary deposit in which each layer shows a gradual and progressive change in particle size, usually from relatively coarse at the base of the bed to relatively fine at the top (e.g. fine sand grading to clay, cobbles grading to coarse sand).
278. *grading* Particle size distribution, defined as the percentages of the various grain sizes present in a soil as determined by sieving and sedimentation.
279. *granite* Light coloured, fine- to coarse-grained, acid igneous rock. Typical composition 15 - 55 % quartz, 15 - 75 % alkali feldspar, 0 - 50 % plagioclase and 5 - 20 % mica (mainly biotite). Commonly forms both major intrusive bodies and minor intrusions such as dykes.
280. *granitic gneiss* gneiss of granitic composition.
281. *granodiorite* Medium-coloured, fine- to coarse-grained, acid igneous rock. Typical composition 15 - 75 % plagioclase feldspar, 15 - 55 % quartz, 0 - 25 % alkali feldspar, 5-40 % biotite, hornblende or pyroxene. Typically contains more mafic minerals than granite.
282. *granular* 1) Engineering term for a cohesionless soil, i.e. one which cannot form a coherent mass. (Contrast with "cohesive").

- 2) Geological term for the texture of a rock that consists of mineral grains of approximately equal size.
283. *granulite* Gneiss with no or little mica. Main minerals: quartz, feldspar, pyroxene and garnet.
284. *graphite* Grey to black, opaque, shiny, six-sided mineral. A naturally-occurring crystalline form of carbon. Common as crystals or thin flakes in veins and in many metamorphic rocks.
285. *graphite schist* Mica schist with >15 % graphite.
286. *gravel* Soil particles 2 to 60mm in size.
287. *greenschist* Metamorphic, schistose rock with mineral composition approximately as in greenstone.
288. *greenstone* Metamorphic, homogeneous rock with 50 - 90 % amphibole, 0 - 50 % plagioclase, chlorite, epidote.
289. *greywacke* Arenaceous sedimentary rock containing more than 15% silt and clay. A "dirty" sandstone. (Contrast with "arenite").
290. *grit* Sand, especially coarse sand.
291. *ground* 1) Soil, rock or fill in place prior to the execution of the construction works.
2) For rock excavation works it means: the in situ rock mass subjected to stresses, ground water, and other external factors.
292. *ground response curve* Diagram curve expressing the rock mass behaviour with out and with rock support behaviour. Such curve is limited to continuous materials, i.e. massive rock or highly jointed and crushed (particulate) rock masses.
293. *ground water* The freely moving water that occurs below the ground water table.
294. *ground water table* The level below which the geologic formation is fully saturated, also called "phreatic surface".
295. *groundmass* Relatively fine-grained glassy or crystalline material between the megacrysts in a megacrystic igneous rock. Also known as the "rock matrix".
296. *grouted bolt* Rock bolt completely surrounded by grout, and hence well protected against corrosion.
297. *grouting* Injection of fine-grained cement mixture or chemical agent into the rock mass.
2) Coarse-grained sandstone.
298. *grout* A fluid used for injection (grouting) of rock masses or soils with the purpose of sealing off water. The fluid may be a cement slurry, a mix of cement and sand and other additives, or a mixture of special chemicals.
299. *gunite* A patent name for a cement and sand mixture used as shotcrete.
300. *gypsum* White or colourless soft mineral composed of hydrous calcium sulphate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$). The most common sulphate mineral. Often forms extensive beds of evaporite interstratified with limestone, shale and clay.
301. *haematite* A red iron oxide mineral (Fe_2O_3).
302. *hade* To deviate from vertical; said of a vein or fault.
303. *halite* Evaporite mineral composed of sodium chloride (NaCl). Also known as "rock salt" or "common salt".
304. *halloysite* Clay mineral made up of very small hollow tubes, as shown by the electron microscope.
305. *hanging wall* The wall rock above an inclined discontinuity or orebody.
306. *hardness* Resistance of a material to indentation or scratching
307. *hazard* A source of danger. (A hazard is a situation that poses a level of threat to life, health, property or environment. Hazard and possibility interact together to create risk)
308. *healed joint* The joint has been "welded" together by filling material such as quartz, calcite, epidote, etc.
309. *hedenbergite* Mineral. A variety of monoclinic pyroxene.
310. *hidden layer* A layer of ground with low seismic velocity which cannot be detected by seismic refraction (syn.: blind zone)
311. *Holocene* Most recent part of geological time, from the end of the Pleistocene (approximately 8 000 to 10 000 years ago) to the present.

312. *hornblende* Black, dark green or greenish black, ferromagnesian silicate mineral. Crystals may be granular, fibrous or columnar. Primary constituent of many acid and intermediate igneous rocks, and a common metamorphic mineral in gneiss and schist.
313. *hornblende schist* Metamorphic, schistose rock with a high content of hornblende (equivalent with amphibolite).
314. *hornfels* Glassy, generally very fine-grained, rock produced by contact metamorphism. Shows no cleavage, schistosity or alignment of minerals.
315. *horst* A topographically high area bounded by faults.
316. *hue* Basic colour or a mixture of basic colours.
317. *humus* Strongly altered, organic material.
318. *hydration* Chemical reaction that results in the transfer of water from the fluid phase into the structure of a mineral.
319. *hydraulic fracturing* Method to measure the principal stress situation by fracturing of the rock surrounding a section of a drill hole. The fracture is obtained using increasing water pressure.
320. *hydraulic gradient* The ratio of the pressure difference between two points and the distance between them.
321. *hydrolysis* Chemical process where a mineral reacts with water.
322. *hydrothermal activity* Circulation of hot fluids and gases, usually associated with movement of magma. Fluids often contain various minerals in solution, which precipitate in rock joints and fissures.
323. *hygroscopic* Tending to absorb water.
324. *hypabyssal* A general term applied to minor intrusions, such as sills and dykes, and to the rocks of which they are made, to distinguish them from volcanic rocks and formations, on one hand, and plutonic rocks and major intrusions such as batholiths, on the other.
325. *hyperite* Fine grained variety of gabbro with more or less ophitic texture. Contains rhombic as well as monoclinic pyroxene.
326. *hypersthene* Mineral. A variety of rhombic pyroxene.
327. *hypogene* A general term intended to include both plutonic and metamorphic classes of rocks, i.e., a term used for rocks formed within the earth.
328. *hysteresis* The stress/strain curves are different for loading and unloading.
329. *igneous rocks* Rocks, which have solidified from liquid melts, or magmas.
330. *ignimbrite* Rock composed of compacted volcanic ejecta (see "tuff").
331. *illite* A clay mineral.
332. *incipient joints* Joints that may develop parallel to bedding or parallel to foliation or cleavage.
333. *incompetent rock* Rock which is weaker than adjacent rock and relatively more liable to deformation.
334. *incompetent ground* Overstressed rock masses.
335. *inclined fold* Fold whose axial plane is inclined from the vertical. One fold limb is commonly steeper than the other, but the steeper limb is not overfolded.
336. *inclusion* A general term for foreign bodies (gas, liquid, glass, or mineral) enclosed by minerals; also extended in its English usage to cover enclosures of rocks and minerals within igneous rocks.
337. *induration* The hardening of rock by the action of heat, pressure or cementation.
338. *inequigranular* Textural term for a rock characterised by a mixture of crystals or grains of significantly different sizes.
339. *initial support* Rock support installed to secure safe working conditions for the tunnelling crew.
340. *inlier* An area or group of rocks surrounded by rocks of younger age.
341. *in situ* Latin words (in situ) meaning "in place" or "in its original position". Distinguishes rocks and soils found in their original position of formation, as opposed to transported materials.
342. *instability* The lack of stability
343. *interbedded* Structural term for beds in a sedimentary deposit with mean spacing >20 mm lying between, or alternating with, other beds of different character (e.g. sand with interbedded clay).

344. *intercalation* Lens or thin layer of other material occurring in sediment or sedimentary rock which is otherwise uniform.
345. *interlaminated* Structural term similar to "interbedded", except applied to very thin beds with mean spacing <20 mm.
346. *interlocking* Being joined or connected so that neither part can be operated independently.
347. *intermediate* Chemical term for an igneous rock containing 54 to 62% silica and usually less than 50% dark minerals. (Contrast with "acid" and "basic").
348. *interstratified* General structural term for sedimentary deposits consisting of alternating layers of different character. Covers both "interbedded" and "interlaminated".
349. *intrusive* Term for an igneous rock that has been forced into pre-existing rocks and solidified from magma underground. (Contrast with "extrusive").
350. *inverted bedding* Older layers are on top of younger.
351. *irregular blocks* Wide variations of block sizes and shapes. See also polyhedral block.
352. *irregular jointing* Wide variations of block size and shape.
353. *isoclinal fold* Fold whose limbs are parallel (i.e. the inter-limb angle is 0°).
354. *isostasy* State of level compensation between masses of rocks in adjacent sectors of the crust.
355. *isotropic* Term for rock and soil with the same physical properties in all directions.
356. *joint* Geological definition: A discontinuity of natural origin along where it has been no visible displacement. In rock engineering and engineering geology joint is used as a scale term and therefore also includes minor shear ruptures.
357. *joint characteristics* See "character of the joint surface".
358. *joint coating* A thin (< 0.1 mm) mineral layer on discontinuity surfaces.
359. *joint condition factor (jC)* A numerical factor including: size, continuity, alteration, smoothness and waviness of the joint applied in the RMi classification system.
360. *joint pattern* The occurrence of joint sets in an area.
361. *joint rosette* Graphical method to present the joint pattern in an area.
362. *joint roughness factor* A numerical value representing the smoothness and waviness of the joint.
363. *joint set* A group of more or less parallel joints
364. *joint spacing* The perpendicular distance between two joints within a joint set.
365. *joint system* Similar to "joint pattern".
366. *joint wall* The joint plane surface.
367. *joint waviness* The planarity of a joint wall.
368. *jointing* The occurrence of joint sets forming the system or pattern of joints as well as the amount or intensity of joints.
369. *juvenile water* Groundwater believed to have come directly from magmatic sources.
370. *kaolin* Group of clay minerals derived mainly by alteration of alkali feldspars and micas. Appearance is that of a soft, white or nearly white non-plastic clay. Commonly occurs as a thin coating or filling in joints in igneous rocks, but extreme alteration may convert whole rock mass to kaolin.
371. *kaolinized* Alteration term for a rock containing minerals, especially feldspars and micas, replaced by, or altered to, kaolin as a result of hydrothermal activity.
372. *karst topography* Topography characterised by sinkholes, caves, solution features and large underground drainage systems. Common in limestones, rare in other rocks.
373. *keelformed overbreak* Characteristic shape of overbreak caused by high, anisotropic rock stress.
374. *Keyper marl* A fine-grained red siltstone forming the higher part of the Triassic in north-west Europe, typically in Germany. (The term 'marl' is here incorrectly used.)
375. *Kirsch's equations* Equations, which may be used for evaluating the tangential stresses around tunnels and other underground openings.
376. *k-value* The ratio between horizontal and vertical stresses within the rock mass.

377. *K-value* Applied as boundary load in numerical models.
378. *laccolith* A dome-shaped intrusion with both floor and roof concordant with the bedding planes of the invaded formation; the roof is arched upward as a result of the intrusion.
379. *lacustrine sediments* Sediments deposited or formed in a lake.
380. *lahar* Mudflow in volcanic material. Caused by water saturation (e.g. by intense rainfall) of un lithified lava or pyroclastic deposits on the flanks of a volcano.
381. *laminated* Structural term for a sedimentary rock or superficial deposit formed, arranged or deposited in very thin layers <20mm thick.
382. *lamprophyre* Dark coloured, very fine- to coarse-grained, basic rock characterised by high percentages of mafic minerals which often form megacrysts in a finer matrix of similar minerals plus altered feldspars.
383. *landslide* Rapid downhill movement of rock and/or soil by gravity.
384. *lapilli* Pyroclastic rock material of gravel size (i.e. 2 to 60mm). Descriptive term for tuff composed wholly or predominantly of this grain size.
385. *laterite* Residual soil, usually reddish in colour, rich in secondary oxides of iron and/or aluminium. A product of intensive in situ rock weathering through leaching of more soluble elements. Common in tropical areas with strong seasonal rainfall.
386. *latite* Volcanic rock with low quartz content (< 15 %; i.e. monzonitic).
387. *lava* General term for molten, extrusive magma erupting non-explosively from a volcanic vent or fissure. Also, the term for the rock solidified from this magma.
388. *leaching* Separation and removal of the soluble constituents in a rock by the natural action of percolating groundwater.
389. *lenticular* shaped approximately like a double convex lens. When a mass of rock thins out from the centre to a thin edge all around, it is said to be lenticular in form
390. *lenticular bedding* Beds in a sedimentary rock or superficial deposit formed by discontinuous lens-shaped bodies of one material surrounded by another type of material, e.g. sand lenses in a clay deposit. Lenses are usually double convex in cross-section.
391. *leucite* Mineral. A variety of feldspathoid.
392. *leucocratic* Light-coloured as applied to igneous rocks. Most fine- to coarse-grained acid rocks are leucocratic. (Contrast with "mesocratic" and "melanocratic").
393. *lignite* (Brown coal) A brownish-black coal, intermediate between peat and black coal.
394. *limb* One flank or side of a fold. A simple fold has two limbs.
395. *limestone* Sedimentary rock composed wholly or predominantly (50 - 100 %) of calcium carbonate, mainly in the form of the mineral calcite. Other minerals: quartz, feldspar, mica.
396. *limonite* Usually dark brown or yellowish brown (may be yellow, red or nearly black), amorphous hydrated iron oxide material (ferric oxide). A very common weathering (oxidation) product of all iron-bearing minerals.
397. *line* To cover the inner surface of. A *lined tunnel* is a tunnel where the surface is covered (by concrete). Most often used for tunnel which are lined with concrete lining. Covers also tunnels with penstock imbedded in concrete. The expression was launched before shotcrete had been introduced as support in tunnels.
398. *lineament* Distinct, linear topographic features, often reflecting weakness zones. Easily recognisable on aerial photos
399. *lineation* General term for any rock structure arranged in lines. Also, the term for the appearance of stretched-out, flattened minerals in metamorphic rocks.
400. *liquid limit* Moisture content at which a soil passes from the plastic to the liquid state, as determined by the liquid limit test.
401. *listric fault* A curved, generally concave-upward, downward flattening fault. Listric faults may be characterized by normal or reversed separation.
402. *lithic* Relating to or made of existing rock fragments. Term for a tuff composed predominantly of fragments of previously-formed rocks.

403. *lithified* Term for a rock which has been converted into a coherent solid mass from a newly-deposited loose sediment by such processes as cementation, compaction and crystallisation. Lithification may occur concurrent with, soon after or long after deposition.
404. *lithology* The character of rocks as based on the megascopic observation of hand specimens. In its French usage, the term is synonymous with petrography.
405. *lithosphere* That part of the Earth consisting of the crust and the upper mantle to a depth of about 100 km, forming the crustal plates.
406. *loam* Soil with a wide range of particle sizes.
407. *lobate* Term for a long, rounded, tongue-like shape. Often applicable to the shape of colluvial deposits.
408. *local stability* Some local rock fall may occur in the tunnel but not to an extent which affects the overall stability or the operation of the project, or poses any health and safety threat to people and equipment during construction of the project.
409. *loess* Silt-size dust-like deposit washed out of the atmosphere by rain and accumulating only in grass plain regions.
410. *loose deposits* General term used for all kinds of soil.
411. *Lugeon* The unit for water loss measurement. 1 *Lugeon* (1 L) is the water loss in litre per minute and per metre bore hole at an over-pressure of 1MPa (= 10 bars).
412. *Lugeon test* See Water loss test.
413. *Macrostructure* Structural features of a soil mass which can be identified by the naked eye. (Contrast with "microstructure").
414. *mafic* General term for dark-coloured, ferromagnesian minerals, or an igneous rock composed chiefly of these minerals. (Contrast with "felsic").
415. *magma* Molten rock material formed within the earth. Solidifies at or near the earth's crust to produce extrusive and intrusive igneous rocks Extrusive magma becomes "lava".
416. *magnesite* Carbonate mineral ($MgCO_3$).
417. *magnetite* Black iron oxide mineral with strong magnetic properties (Fe_3O_4).
418. *major joint* Large joints, but smaller than the master joints.
419. *mantle* Part of the Earth at depths between 10 km under ocean surface (more under land) and 2900 km, with a relative density between 3.3 and 5.7 as interpreted from records of seismic waves.
420. *marble* Metamorphosed limestone. Generally light coloured (often stained by impurities), fine- to coarse-grained crystalline metamorphic rock consisting mainly of recrystallized calcite and/or dolomite.
421. *marginal basin* A semi-isolated basin lying behind the volcanic chain of an island arc system.
422. *marine limit* The highest level of the ocean. (In Norway: by the end of the last glaciation).
423. *marl* Unconsolidated sediment of argillaceous and calcareous materials.
424. *massive* Structural term for an igneous or metamorphic rock with homogeneous texture over large areas, i.e. with no layering, foliation or other planar structures. May also be applied to sedimentary rocks with no evidence of stratification (i. e. no bedding or lamination).
425. *massive rock* Few joints or very wide joint spacing.
426. *master joints* Joints that cut through a number of rock units and can be followed several tens or hundreds of metres.
427. *matrix* Finer-grained material enclosing, or filling the spaces between, the larger grains or particles in a mixed sedimentary rock or superficial deposit. Synonymous with groundmass in an igneous rock.
428. *megacryst* Any crystal or grain in an igneous or metamorphic rock that is significantly larger than the surrounding groundmass of matrix. A general, non-genetic term.
429. *megascopic* A general term, more appropriate than macroscopic, applied to observations made on minerals and rocks by means of the naked eye or pocket lens but not with a microscope.
430. *melanocratic* Dark-coloured, as applied to igneous rocks. All basic rocks are melanocratic. (Contrast with "leucocratic" and "mesocratic").

431. *mesocratic* Medium-coloured (i.e. composed of roughly equal amounts of light and dark constituents), as applied to igneous rocks. Most intermediate rocks are mesocratic. (Contrast with "leucocratic" and "melanocratic").
432. *meta-* Prefix used with an igneous, pyroclastic or sedimentary rock name to indicate that the rock has been partially metamorphosed, e.g. meta-tuff.
433. *metamorphism* Alteration of mineralogy, texture and structure of the rock due to high pressure and/or temperature.
434. *metasomatism* A process of replacement of minerals in a rock by additional constituents to form fresh minerals.
435. *mica* A group of rock-forming silicate minerals, all with good cleavage in one plane only.
436. *mica gneiss* Gneiss with > 40 % mica.
437. *mica quartzite* Quartzite with > 10 % mica.
438. *mica schist* Metamorphic, schistose rock, typically with 25 - 75 % mica (biotite and muscovite), < 70 % quartz, 0 - 25 % feldspar and minor amounts of chlorite, epidote and garnet.
439. *microcline* A variety of alkaline feldspar.
440. *microcrystalline* Textural term for a crystalline rock with crystals that are too small to be seen by the naked eye, but which can be distinguished separately under an ordinary microscope.
441. *micro-fissure* Minute defects from cm length downward in size into truly microscopic range. (Not included in the term joint)
442. *micro-fractures* General term for all small-scale discontinuities in the rock fabric. Includes cracks, fissures and planes of separation through or between individual grains.
443. *microstructure* Structural feature of a soil mass which cannot be identified completely by the naked eye; the use of a microscope is required for full assessment. (Contrast with "macrostructure").
444. *migmatite* A composite rock which includes igneous and metamorphic constituents.
445. *mineral box work* Weathering feature resulting from hard mineral deposits formed in rock joints standing out prominently on a weathered surface.
446. *mineralised* Transformation term for new minerals formed either by conversion of existing minerals, or by filling of discontinuities with new substances.
447. *minor joints* Smaller, relative unimportant joints.
448. *Mohs' scale of hardness* A scale divided into 10 classes defined by certain index minerals; from talc (hardness 1, softest) to diamond (hardness 10, hardest).
449. *Mohr's envelope* The envelope of Mohr's circles, representing failure at various stress levels.
450. *molasse* A provincial Swiss name for a soft green sandstone associated with marl and conglomerates, belonging to the Miocene Tertiary period, extensively developed in the lower country of Switzerland, and composed of Alpine detritus. The sediments include thick association of continental and marine, clastic sedimentary rocks that consists mainly of sandstones and shales formed as shore deposits. The depositional environments involved include beaches, lagoons, river channels, and backwater swamps.
451. *montmorillonite* A swelling clay mineral belonging to the smectite group.
452. *monzonite* Plutonic rock with 0 - 15 % quartz, 15 - 55 % alkali feldspar, 10 - 55 % plagioclase, 0 - 10 % feldspathoids, 15 - 45 % mica, hornblende, pyroxene.
453. *moraine* Materials deposited chiefly by direct glacial action. See drift.
454. *mottled* Term for non-uniform colour distribution of a rock or soil where the secondary colour constituent forms blotches or marks of approximately equal size.
455. *mudstone* Sedimentary rock composed predominantly of silt- and/or clay-size particles. A more general term than "siltstone" or "claystone".
456. *muscovite* Colourless, yellow or light brown mineral of the mica group. Forms distinctive shiny thin prisms or flakes. Very common in gneisses and schists, and some acid igneous rocks.
457. *mylonite* Very fine-grained crystalline metamorphic rock with streaked or banded texture produced by shearing and fracturing of original grains during intense dynamic metamorphism.
458. *NATM* New Austrian Tunnelling Method; a system for tunnel design and construction developed especially for squeezing rock.

459. *neo-* New or recent. Used in the geological time, Neogene
460. *nepheline* Mineral. A variety of feldspathoid.
461. *nepheline syenite* Plutonic rock with 5 - 55 % nepheline, 10 - 80 % alkali feldspar, 0 - 40 % plagioclase, 10 - 45 % hornblende, pyroxene, mica.
462. *neutral fold* Fold with its axial plane more or less horizontal. Neither an anticline nor a syncline.
463. *nodule* A small, irregular, rounded lump of a mineral or rock, usually contrasting in composition with the material in which it is embedded e.g. nodular chert in limestone.
464. *Nonel* Non-electric ignition system for blasting.
465. *non-systematic joints* Random, often irregular or curved joints. Non-systematic joints do not have any definite pattern and frequently terminate at joints belonging to a set.
466. *norite* Plutonic rock with composition as gabbro, except for rhombic instead of monoclinic pyroxene.
467. *normal fault* Dipping fault, in which the overlying face or wall appears to have moved downward relative to the underlying face. The angle of the fault is usually 45° to 90°.
468. *oblique* Not parallel: intersecting at an acute angle.
469. *olistostrome* Large (unsorted) fragments of volcanic and sedimentary rocks in a clayey/sandy matrix
470. *olistostromal rocks* Characterised by a chaotic mixture of sharp to partly rounded grains/particles made of volcanic rocks, turbiditic sandstones and limestones set in a sandy and limy matrix.
471. *olivine* A green aluminium silicate mineral found in basic and ultrabasic igneous rocks.
472. *olivinite* Plutonic, ultrabasic rock consisting mainly of olivine.
473. *oolite* Limestone composed chiefly of ooliths, which are small (0.25 to 2 mm diameter) spherical particles.
474. *opal* Amorphous silica mineral. Softer, less dense, less transparent and lacks crystalline structure compared with quartz. Opal occurs in nearly all colours. Transparent coloured varieties are used as gemstones.
475. *open fold* Fold with an inter-limb angle between 70° and 120°.
476. *ophiolite* An assemblage of mafic (dark) and ultramafic rocks ranging from spilite and basalt to gabbro and peridotite, including rocks rich in serpentine, chlorite, epidote and albite derived from them by later metamorphism, whose origin is associated with an early phase of the development of a geosyncline.
477. *ophitic* A term applied to microscopic rock texture to designate a mass of longish, interlacing crystals, the spaces between which are filled with minerals of later crystallisation.
478. *ore* Rock containing ore minerals, and economically mineable.
479. *ore minerals* Minerals with density higher than $5 \cdot 10^3 \text{ kg/m}^3$.
480. *orogeny* The process of mountain formation by major folding.
481. *orthoclase* Mineral. A variety of alkali feldspar.
482. *orthogneiss* Gneiss of igneous origin.
483. *orthotropic* Of a material which has different mechanical properties in one direction compared with the other two.
484. *outcrop* Area with bedrock, ore body or weakness zone at the surface.
485. *outlier* Outcrop of younger strata surrounded by older strata.
486. *overall stability* See 'global stability'
487. *overbreak* Rock excavated beyond specified cross-section of a tunnel.
488. *overburden* Overlying rock, or soil.
489. *overcoring* A technique for isolating as far as possible a cylinder of rock carrying instrumentation from the surrounding rock; carried out with core drilling equipment.
490. *overfolded* Term for a fold, or the limb of a fold, that has tilted beyond the perpendicular.
491. *oxidation* Chemical weathering process involving the reaction between rocks and atmospheric oxygen, the oxygen usually being dissolved in water. The main products are oxides and

- hydroxides. Iron is the mineral most obviously affected; iron oxidation products are characteristically brown, red and yellow in colour. (Contrast with "reduction").
492. *paleo-* Involving or dealing with ancient forms or conditions. It is used for geological times, e.g. Paleozoic, Paleocene.
493. *paragneiss* A gneiss of sedimentary origin.
494. *parasitic fold* Small fold on the limb of a larger fold.
495. *parent material (of a soil)* The pre-existing sediment or rock from which a soil is formed by weathering.
496. *particulate materials* Rock mass composed of small blocks (< 1 dm³ volume), i.e. heavy jointed rocks.
497. *parting* 1) Small discontinuities in rock, such as foliation or bedding partings.
2) A small joint in coal or rock.
498. *peat* A deposit largely formed of dead vegetation which may be in course of consolidation.
499. *pebble* A rock fragment between 4 and 64 mm in diameter, which has been rounded or otherwise abraded by the action of water, wind or glacier ice.
500. *pegmatite* Light coloured, very coarse-grained igneous rock, generally of granitic composition. Commonly occurs as irregular dykes or veins, especially around the edges of large intrusions.
501. *pelagic deposits* Ocean sediments without land-derived material.
502. *penplain* Plain (or almost a plain) which is the culmination of a cycle of erosion.
503. *percolation* The movement of groundwater in the zone of saturation under hydrodynamic forces, generally with a dominant lateral component.
504. *peridotite* Ultrabasic, igneous rock, formed essentially of the mineral olivine.
505. *perimeter blasting* Rock blasting according to a predefined contour.
506. *permanent support* Rock support installed to meet the requirements for a satisfactory function of the project during its life.
507. *permeability* The specific permeability, K (in m²) is often referred to simply as *permeability*. It depends on the nature of the rock mass only, and not on the nature of the fluid. The relationship between specific permeability and hydraulic conductivity is defined by $K = k \times \mu / (\rho \times g) = k \times \nu / g$ where μ = dynamic viscosity of the fluid; ν = cinematic viscosity of the fluid; ρ = density of the fluid; g = gravitational acceleration (9.81m/s²)
508. *persistence* Joint length or continuity normally measured as trace length. May give a rude measure of the area extent or penetration length of a discontinuity. Termination in solid rock or against other discontinuities reduces the persistence.
509. *persistent joint* Used to describe a dominating (master) joint.
510. *pervasive* To pass through, used for prevalent (major) joints crossing other joints.
511. *phanerocrystalline* A term applied to igneous rocks in which all the crystals of the essential minerals can be distinguished individually by the naked eye; contrasted with aphanitic.
512. *phenocryst* A term applied to isolated larger crystals visible to the unaided eye and lying in a finer mass of a rock of igneous origin.
513. *phonolite* Volcanic rock containing more than 60 % feldspathoids.
514. *phreatic* Relating to groundwater in the saturated zone.
515. *phyllite* Fine-grained metamorphic rock with well-developed slightly undulating cleavage. Commonly green, grey or reddish brown in colour. Chlorite and sericite crystals often form a distinctive shiny, smooth surface on cleavage faces.
516. *physiography* The shape of landforms, a synonym for geomorphology.
517. *piezometer* Instrument for measuring pore pressure in soil and rock masses.
518. *piping* An underground flow of water with a sufficient pressure gradient to cause scour along a preferred path.
519. *pitted* Shape term for a rock particle with an uneven surface texture characterised by numerous small depressions. Commonly caused by preferential weathering and erosion of different minerals.
520. *plagioclase feldspar* Group of sodium-calcium feldspars of general composition (Na,Ca)Al(Si,AL)Si₂O₈. (See "feldspar").

521. *planar* A flat, level, even surface (the curvature is zero or minimal).
522. *planarity* Character of the joint surface as related to an ideal plane. Deviations from planar surfaces can be on several scales from small scale (smoothness) to large scale (waviness).
523. *plane strain* State of two-dimensional strain with zero strain perpendicular to the actual strain plane.
524. *plane stress* Two-dimensional stress condition with zero stress perpendicularly to the actual stress plane.
525. *plastic limit* Moisture content at which a soil becomes too dry to be in a plastic condition, as determined by the plastic limit test.
526. *plasticity* Property which enables a soil or other material to be deformed continuously and permanently without rupture.
527. *plate tectonics* A tectonic theory of lateral movement of lithosphere plates, to account for recorded movements of crustal sectors in geological time.
528. *platy block* See tabular block.
529. *Pleistocene* Geological time period between approximately 2 million and 8,000 to 10,000 years ago, i.e. immediately prior to the Holocene.
530. *plunge* The inclination of a line.
531. *plunging* Used to describe an anticline or syncline with an inclined axis.
532. *pluton* A large mass of igneous rock inferred to have been formed by slow cooling in a pressure confined situation deep in the crust, i.e. a batholith.
533. *plutonic* Pertaining to, or the general term for, any rock formed at considerable depth below the earth's surface by crystallisation of magma and/or by chemical alteration.
534. *point load strength* The strength of a piece of rock loaded between two hardened steel points.
535. *polygenic olistostromal rocks* Rocks characterised by a chaotic mixture of sharp to partly rounded grains/particles composed of volcanic rocks, turbiditic sandstones and limestones set in a sandy and limy matrix.
536. *polyhedral* Shape term for a rock mass with no consistent joint sets, such that individual rock blocks usually vary widely in shape and size.
537. *popping* Violent detachment of rock slabs with considerable force and speed.
538. *porosity* The ratio of the volume of voids in a rock or soil to its total volume.
539. *porphyritic* Textural term for an igneous rock containing large crystals (phenocrysts) that are compatible in composition and mode of formation with the groundmass or matrix in which they occur. (Contrast with "xenocrystic").
540. *porphyry* A general term used rather loosely for igneous rocks which contain relatively large isolated crystals set in a finer-grained mass.
541. *pre-grouting* Grouting of the rock masses ahead of the tunnel working face.
542. *primary joints* A set of joints being both larger and/or more frequent than joints of other sets in the same locality.
543. *principal stresses* Normal rock stresses on planes with no shear stress.
544. *psammite* 1) Fine-grained, fissile, clayey sandstone (see arenite).
2) Any rock composed of sandy particles; sandstone.
545. *pseudomorph* Mineral which occurs in the crystal form of another mineral as a result of alteration, or solution and replacement, within the same crystal shape.
546. *pumice* Light-coloured glassy rock formed from acid lava. Contains abundant voids or cavities, which means it is often sufficiently buoyant to float on water.
547. *pyrite* Light brown or dark yellow iron sulphide mineral (FeS₂). Often forms cube-shaped, striated crystals with a bright metallic surface. Common in veins and fault-zone rocks.
548. *pyroclast* Individual rock fragment or particle ejected explosively from a volcanic vent. Classified by size into fine ash, coarse ash, lapilli, blocks and bombs.
549. *pyroclastic* General term for any rock composed of material ejected explosively from a volcanic vent, including agglomerate, tuff, and ash.
550. *pyroxene* Groups of mafic silicate minerals. Commonly appear as dark green or black prismatic crystals displaying cleavage in two directions parallel to the crystal faces and intersecting at approximately 90°.

551. *pyrrhotite* Mineral, sulphide of iron (magnetic pyrite); a common minor constituent in igneous rocks.
552. *quartz* Colourless (often coloured by impurities), glassy, hard mineral composed of crystalline silica (SiO₂). Commonly appears either as six-sided transparent crystals or as a dense crystalline mass lacking distinctive shape. Very common in all types of rocks and mineral veins.
553. *quartzite* A non-foliated metamorphic rock consisting mainly of quartz (> 75 %). Formed by recrystallization of sandstone due to contact or regional metamorphism.
554. *quartz latite* Medium-coloured, very fine-grained, intermediate igneous rock. The very fine-grained equivalent of quartz monzonite.
555. *quartz monzonite* Medium-coloured, fine- to coarse-grained, intermediate igneous rock containing roughly equal amounts of plagioclase and alkali feldspar.
556. *quartzphyric* Textural term for a rock containing large megacrysts of quartz, e.g. quartzphyric rhyolite.
557. *quartz syenite* Medium-coloured, fine- to coarse-grained, intermediate igneous rock. Feldspar component is predominantly alkali feldspar.
558. *quartz trachyte* Medium-coloured, very fine-grained, intermediate igneous rock. The very fine-grained equivalent of quartz syenite.
559. *Quaternary* Geological time period from approximately two million years ago up to the present. Split into two parts : the Pleistocene and the Holocene.
560. *random joint* Individual joint not belonging to any joint set.
561. *ravelling ground* A ground, which gradually breaks up into individual pieces, flakes, or fragments. The process is time-dependent and materials may be classified by the rate of disintegration as slowly or rapidly ravelling. For a material to be ravelling it must be moderately coherent and friable or discontinuous. Examples are jointed rocks, fine moist sands, sand-gravel with some binder and stiff fissured clays.
562. *recrystallization* Formation of new crystalline mineral grains in a rock due to metamorphism or processes involving percolating groundwater. New crystals may have the same or a different composition from the original crystals.
563. *recumbent fold* Overturned fold whose axial plane is horizontal or nearly horizontal.
564. *reduction* Chemical process whereby oxygen is removed in rocks and the leached parts of soils. Related to the continuous presence of water, which makes oxygen scarce, e.g. by reducing ferric iron (Fe₂O₃) to ferrous iron (FeO). Characteristic colours of reduced soils are greens and greys. Often associated with strong bacterial activity in the soil. (Contrast with "oxidation").
565. *regional metamorphism* Large scale metamorphism connected to mountain range formation.
566. *regression* A seaward retreat of a shoreline, generally expressed as a seaward migration of shallow-marine facies.
567. *regular bedding* Alternating layers of materials of different grain size in a bedded sedimentary deposit. Grain size within each layer is essentially uniform.
568. *regular jointing* Three joints sets orthogonally arranged as in igneous and metamorphic rocks.
569. *remnant stresses* See "residual stresses".
570. *remote sensing* Measurements of the Earth's surface made from aircraft or satellite.
571. *residual soils* Soils remaining in their place of formation. (Contrast with "saprolite"; residual represents a more advanced stage of weathering than saprolite).
572. *residual stresses* Stresses, which have been locked into the rock material during earlier stages of its geological history. Stresses caused by contraction during the cooling of a rock melt (magma) is a relevant example of this category.
573. *resistance* Capacity of a component, or cross section of a component of a structure to withstand actions without mechanical failure, e.g. resistance of the ground, bending resistance, buckling resistance, tensile resistance
574. *retrograde metamorphism* Metamorphism creating rocks with new minerals which are stable at lower temperature and pressure than the original.
575. *reversed fault* Fault, resulting from the action of compressional forces, in which the downthrown side lies underneath the fault plane. Fault plane usually dips at a low angle.
576. *rhombic porphyry* Volcanic rock with rhombic crystals of feldspar in a fine-grained matrix.

577. *rhombohedral blocks* Six-sided prisms each face of which is a rhombus.
578. *rhomboidal blocks* See rhombohedral blocks.
579. *rhyodacite* Medium-coloured, very fine-grained, acid igneous rock. Intermediate in composition between rhyolite and dacite. Contains less alkali feldspar than rhyolite and less plagioclase feldspar than dacite. Often contains megacrysts or quartz and feldspar.
580. *rhyolite* Medium-coloured, fine-grained, acid igneous rock. The very fine-grained equivalent of granite. Often contains megacrysts of quartz and feldspar.
581. *rind* Discoloured, relatively thin, often loose and flaky outer layer on the surface of a boulder or rock block caused by weathering.
582. *rip rap* Stones of irregular shape with specified limits of size, tipped or placed to protect an embankment from scour.
583. *RMi* Rock Mass index.
584. *RMR* Rock Mass Rating.
585. *rock flour* A general term for finely comminuted rock material corresponding in grade to mud, but formed by the grinding action of glaciers and ice sheets, and therefore composed largely of unweathered mineral particles.
586. *rock burst* Sudden, violent detachment of thin rock slabs from sides or roof caused by overstressing of hard, brittle rock. See also "popping".
587. *rock mass* Rocks penetrated by discontinuities, i.e. the structural material which is being excavated and in which the tunnel or underground opening is located.
588. *rock quality designation (RQD)* An expression of the degree of jointing (or density of joints) defined as intact core lengths greater than a threshold value of 0.1 m along any bore hole or scan line.
589. *rock slabbing* The loosening of thin rock slabs caused by overstressing of brittle, rocks. See "popping" and "rock burst".
590. *rock slide* Slide in a rock slope involving volume > 10,000 m³
591. *rough* Shape term for a rock particle with a surface texture that feels uneven, corrugated or lumpy, i.e. that lacks smoothness.
592. *rounded* Shape term for a rock particle with markedly rounded edges and corners.
593. *RQD* See "rock quality designation".
594. *rudaceous* Term for any sedimentary rock composed wholly or predominantly of gravel and larger-sized grains.
595. *running ground* A particulate 'dry' material invades the tunnel until a stable slope is formed at the face. Stand-up time is zero or nearly zero. Examples are clean medium to coarse sands and gravels above ground water level.
596. *rupture* A fracture/break, here limited to have been developed by excavation activities.
597. *salic* Common term for igneous rocks with high content of silicon and aluminium; i.e. light coloured, acid rocks.
598. *sand* Soil particles 0.06 to 2 mm in size.
599. *sandstone* Sedimentary rock composed predominantly of sand-size particles.
600. *saprolite* Soil derived from in situ rock weathering which retains evidence of the original rock texture, fabric and structure. (Contrast with "residual soil").
601. *saussurite* Alteration of feldspar into epidote and zoisite.
602. *scaling* Remove loose blocks or thin layers (or scales) from the rock surface.
603. *schist* Medium- to coarse-grained, foliated, crystalline metamorphic rock. Splits readily into flakes or slabs due to parallel arrangement of most of the constituent minerals. Coarser and more undulating foliation compared with "phyllite"; finer and often not banded compared with "gneiss".
604. *schistosity* Foliation in schist or other coarse-grained crystalline metamorphic rock due to the parallel, planar arrangement of platy and prismatic mineral grains (e.g. mica).
605. *Schmidt hammer* Non-destructive test of the quality of rocks and concrete. It measures the 'rebound hardness' of the tested material.
606. *Schmidt net* Equal area stereonet.

607. *scree* Large scale accumulation of talus near to the angle of repose.
608. *seam* 1) A minor, often clay-filled zone with a thickness of some cm. When occurring as weak clay zone in a sedimentary sequence, a seam can be considerably thicker. Otherwise, seams may represent very minor faults or altered zones along joints, dikes, beds or foliation.
2) A plane in a coal bed at which the different layers of coal are easily separated.
609. *seamy* A tunnel man's term and may be described as irregular schistose layers in crystalline rock; shale or clay layers commonly interbedded in sandstone or limestone; and also any rock with numerous clay-filled joints and fractures.
610. *secant modulus* Young's modulus determined by the inclination of the line between origo and a given point on the stress/strain curve.
611. *seismicity* Pertaining to earth vibrations or disturbances produced by earthquakes.
612. *sericite* White, fine-grained mineral of the mica group. Similar composition to muscovite. Common in fault gouge and other rocks associated with dynamic metamorphism.
613. *serpentine* A group of minerals, most commonly occurring in metamorphic rocks.
614. *serpentinite* Metamorphic rock consisting mainly of serpentine.
615. *shale* A laminated mustone or a rock fissile on the bedding planes.
616. *shear* A discontinuity formed by shear movement, often occurring as a "seam" or "shear zone".
617. *shear fault* A fault formed mainly by horizontal movement along the strike of the fault.
618. *shear plane* Surface along which differential movement has taken place parallel to the surface.
619. *shear zone* Belt of rock of significant thickness that has been crushed and contorted by shear movement.
620. *shrinkage joints* Joints caused by tensional forces set up in a rock body as a result of cooling (in an igneous rock) or desiccation (of a sedimentary rock).
621. *sheeting joint* Joint developed more or less parallel to the surface of the ground. They probably arise as a result of pressure release due to removal of overlying rock by weathering and erosion. Also called an "unloading joint".
622. *shoring* Form of prop or support, usually temporary, that is used in excavations. Shores are also used to support the forms for cast-in-place concrete slabs, beams, and girders in reinforced concrete frames.
623. *shotcrete* Sprayed concrete (in USA. included gunite).
624. *silica* Silicon dioxide (SiO₂). Occurs naturally as crystals (e.g. quartz), in cryptocrystalline form (e.g. chalcedony) and in amorphous form (e.g. opal). Combined in silicates as an essential constituent of many minerals.
625. *silicate* Compound material consisting of one silicon and four oxygen atoms arranged in triangular pyramids, either isolated or joined through one or more of the oxygen atoms to form chains, sheets or three-dimensional structures with metallic elements such as aluminium. Silicate minerals are the most common rock-forming compounds and make up approximately 95% of the earth's crust
626. *siliceous* Term of a rock containing abundant silica.
627. *sill* Table-like body of intrusive igneous rock that conforms to the bedding or other planar structures of the country rock in which it is intruded.
628. *sillimanite* Brown, grey, light green or white silicate mineral. Forms long needle-like crystals. Often found in high temperature, contact-metamorphosed sedimentary rocks.
629. *silt* Soil particles 0.002 to 0.6 mm in size.
630. *siltstone* Sedimentary rock composed predominantly of silt-size particles. (See also "mudstone").
631. *singularity* Small weakness zone or seam.
632. *sinistral* Pertaining to the left (e.g. sinistral slip is left slip).
633. *skarn* Thermally metamorphosed impure limestone characterised by presence of silicate minerals containing calcium.
634. *slaking* Breaking-up, crumble or disintegration of a rock or soil when exposed to moist air, saturated or immersed in water.

635. *slate* Fine-grained, metamorphic rock with a very well-developed parallel cleavage. Splits into very thin plates or flakes. Most slates are metamorphosed shales.
636. *slickenside* Smooth striated surface caused by friction during relative movement of rock along the surface (e.g. along a fault plane). Striations are normally low linear grooves and ridges parallel to the direction of movement. Surface often appears shiny or polished.
637. *slip* The relative displacement of formerly adjacent points on opposite sides of a fault measured along the fault surface.
638. *slump bedding* Beds in a sedimentary deposit which have been disturbed or deformed by slumping of the newly-deposited sediment under water, usually on a sloping surface.
639. *smectite* A group of clay minerals with swelling properties.
640. *smooth* An even or level surface; having no roughness or projections that can be seen or felt.
641. *smoothness of joint* The condition of asperities being the small scale joint surface roughness.
642. *soapstone* Metamorphic, ultrabasic rock consisting mainly of talc, magnesite and chlorite.
643. *solution* Chemical weathering process in which minerals are dissolved by percolating or static groundwater, e.g. removal of calcium carbonate in limestone or chalk by carbonic acid (weakly acid rainwater).
644. *sorted* Term for a loose sediment or sedimentary rock composed of particles of essentially uniform size. "Well-sorted" refers to very uniform sorting. (Contrast with "poorly-sorted"). Note "sorted" in geological use is the opposite of "graded" in engineering use.
645. *spalling* Similar to "rock slabbing".
646. *sparagmite* Arkosic sandstone of late Precambrian age.
647. *spheroidal weathering* Mainly chemical weathering along fractures producing boulders of less weathered rock
648. *spiling* Fan-shaped rock bolting ahead of the working face.
649. *spilitic basalt* Basalt containing albitic feldspar, usually accompanied by chlorite, calcite, epidote, actinolite or other low grade greenstone minerals.
650. *split* Separation lengthways, as along the direction of grain or layers. The term is used similar to parting.
651. *splitting* 1) The property or tendency of a stratified (sedimentary) rock of separating along a plane or surface of parting.
2) A plane in a coal bed at which the different layers of coal are easily separated
652. *spotted* Term for non-uniform colour distribution of rock or soil where the secondary colour constituent forms small rounded spots.
653. *springline* The line defining the transition between wall and roof in a tunnel.
654. *squeezing ground* Slow inward movement into the tunnel of the surrounding rock, caused by overstressing of deformable (plastic or ductile) rock.
655. *stability* the strength to stand or endure.
656. *stand-up time* The period of time a tunnel or cavern is stable without rock support.
657. *stepped joint* The course of the joint is resembling a stair step.
658. *stiffness* The ratio between stress and deformation.
659. *strain* Relative elongation or shortening of a material as result of loading.
660. *stratum* A layer that is separable along bedding planes from layers above and below; the separation arises from a break in deposition or a change in the character of the material deposited.
661. *stratified* General structural term for a sedimentary rock or superficial deposit formed, arranged or deposited in layers or beds of any thickness. (See also "bedded" and "laminated")
662. *streaked* Term for non-uniform colour distribution of a rock or soil where the secondary colour constituent forms elongated, discontinuous, sometimes branching, lines
663. *striated* Shape term for a rock particle with a surface texture characterised by a series of fine, parallel grooved lines, caused, for example, by slickensiding in a fault zone.
664. *strike of a plane* The trace of the intersection of the plane and a horizontal surface.
665. *strike slip* The component of slip measured parallel to the strike of a fault
666. *strike-slip fault* Similar to "shear fault".

667. *striped* Term for non-uniform colour distribution of a rock or soil where the secondary colour constituent forms elongated, continuous, non-branching lines.
668. *structure* Manner of building. The arrangement or interrelation of all the parts of a whole. In geology a term reserved for the larger features of rocks.
669. *structural domain* Portion of a rock mass characterised by a relatively uniform arrangement of discontinuities.
670. *structural joints* Joints related to the structure or texture of the rock materials. They are mainly connected to the ability of the rock to split along schistosity, bedding or other weak layers or bands for example of mica, chlorite or other soft or anisotropy minerals.
671. *structure* One of the larger features of a rock mass, like bedding, foliation, jointing, cleavage or brecciation; also the total sum of such features as contrast with texture. Also, in a broader sense, it refers to the structural features of an area such as anticlines or synclines. Not to be confused with "texture".
672. *sub* Prefix, which means: under, below, from, below, up, or near.
673. *subangular* Shape term for a rock particle with slightly sharp (slightly angular) edges and corners.
674. *subrounded* Shape term for a rock particle with slightly rounded edges and corners
675. *subsidence* The sinking or caving in of the ground, or the settling of a structure to a lower level, essentially as a result of removal of support in an underground opening below.
676. *supracrustal rock* Rock created at the surface (i.e. sedimentary and volcanic rocks).
677. *swelling* The increase in volume exhibited by certain soils or rocks on absorption of water
678. *syenite* Plutonic rock containing 0 - 20 % quartz, 40 - 80 % alkali feldspar, 0- 20 % plagioclase, 0-10 % feldspathoids, 10 - 35 % hornblende, pyroxene, biotite.
679. *syncline* Fold in the shape of a basin whose core contains the stratigraphically younger rocks
680. *synform* Fold with the concave side upwards.
681. *syngenetic* A term now applied to mineral or ore deposits formed contemporaneously with the enclosing rocks, a contrasted with epigenetic deposits, which are of later origin than the enclosing rocks.
682. *talc* Mineral. Soft and very slippery. Most commonly occurring in basic and ultrabasic rocks, for instance, soapstone.
683. *talc schist* Metamorphic, highly schistose rock with a high content of talc, and also chlorite, hornblende and muscovite.
684. *talus* Loose and incoherent deposits, usually at the foot of a slope or cliff.
685. *tangent modulus* Young's modulus determined by the inclination of the tangent to the stress/strain curve.
686. *tangential stresses* Stresses around a tunnel or underground opening tangential to the surface.
687. *tectonic joint* Joint formed by tectonic activity. The orientation of tectonic joints is usually controlled by the directions of the principal regional stresses.
688. *texture* Shape, fabric and size of the minerals in a rock.
689. *throw* Amount of vertical displacement on a fault.
690. *thrust* Low-angle reverse fault with a dip of less than 45°.
691. *thrust fault* A fault with a small dip angle, in which one set of rocks has been pushed over another set; an extreme type of reversed fault.
692. *tight fold* Fold with an inter-limb angle between 0° and 30°
693. *till* The unstratified or little-stratified deposits of glaciers.
694. *tillite* A term applied to consolidated till formed during glacial epochs anterior to that of the Pleistocene
695. *tonalite* Diorite with quartz constituting 5 - 20 % of the light coloured minerals (quartz diorite).
696. *total stability* See 'global stability'.
697. *trachyte* Volcanic rock consisting mainly of alkaline feldspar.
698. *trachyandesite* Usually dark-coloured, fine-grained, intermediate igneous rock. Commonly contains megacrysts of alkali feldspar.

699. *travertine* Calcium carbonate, CaCO_3 , of light colour and usually concretionary and compact, deposited from solution in ground and surface waters. (Travertine forms the stalactites and stalagmites of limestone caves.)
700. *tremolite* Mineral. A variety of monoclinic amphibole.
701. *tufa* Precipitated limestone deposit found around springs issuing from a limestone formation.
702. *tuff* General rock name for all lithified pyroclastic rocks composed of rock fragments of gravel or finer size (< 60 mm). Subdivided according to dominant grain sizes into lapilli, coarse-ash and fine-ash types
703. *tuffaceous* Term for a sedimentary rock containing up to 50% tuff material
704. *tuffite* Mixed sedimentary/pyroclastic rock containing roughly equal amounts of sedimentary material and tuff material.
705. *turbidite* A sedimentary deposit from a turbidity current, consisting of fragments from various rocks in a clayey/sandy matrix of volcanic/sedimentary composition.
706. *UDEC* Numerical modelling program ((Universal Distinct Element Code).
707. *ultrabasic rocks* Igneous rocks having SiO_2 content < 44% (dunite, peridotite, pyroxenite).
708. *unconformity* A surface of erosion which separates rocks of two substantially different ages.
709. *undulation* A wavy, curving form or outline
710. *uneven* Not uniform in height, breadth, etc. (an uneven floor)
711. *unevenness* Small scale roughness that tends to be damaged during shear displacement unless the discontinuity walls are of high strength and/or the stress levels are low, so that dilation can occur on these small features.
712. *unlined* A tunnel without (concrete) lining. It is uncertain whether 'lining' includes shotcrete-supported tunnels where shotcrete has been applied on the roof as well as the walls.
713. *unloading joint* (See "sheeting joint").
714. *upright fold* Fold whose axial plane is vertical or near-vertical
715. *vadose* A term applied to seepage waters occurring below the surface and above the water table; contrasted with phreatic.
716. *varves* Thinly, laminated, fine-grain glacial lake sediments, reflecting seasonal changes in deposition.
717. *vein* Mineral filling a fault, joint or other fracture in a rock; the vein is formed later than the host rock. Commonly has a table- or sheet-like form. Often associated with alteration of the host rock. Most veins are of igneous origin
718. *vent* Opening at the earth's surface through which volcanic materials are extruded.
719. *vesicle* Cavity of variable shape in a lava, formed by the entrapment of a gas bubble during the solidification of the lava.
720. *vermicullite* Clay mineral usually formed from alteration of mica; it expands greatly when heated.
721. *vesicular lavas* Lavas containing gas bubbles which have been trapped during solidification, i.e. pumice. The bubbles may later be filled with minerals.
722. *virgin rock stress* The stress situation prior to excavation.
723. *viscoelasticity* The property of a material of partly elastic, partly viscous behaviour when applied to loading.
724. *vitric* Term for a pyroclastic rock composed predominantly of volcanic glass fragments.
725. *voids ratio* Ratio of volume of voids to volume of solids (of porosity).
726. *volcanic* General term for any extrusive igneous or pyroclastic rock
727. *volcanic ash* Deposits of sand grade and finer fragmental material derived from a volcano in eruption.
728. *volumetric joint count (Jv)* Measure for the number of joints intersecting a rock mass volume of 1 m³.
729. *wacke* (See "greywacke").
730. *water content* The ratio of weight of pore water to weight of solid material, expressed as percentage.
731. *water loss test* Pressurized water is pumped into a section of a bore hole, and the loss of water is measured (also called Lugeon test).

732. *water-table* Level up to which all rock pore-space is filled with underground water.
733. *waviness* Large scale undulations/roughness which, if interlocked and in contact, cause dilation during shear displacement since they are too large to be sheared off.
734. *wavy bedding* Beds in a sedimentary deposit with markedly undulating bedding surfaces, i.e. the bed surfaces are not straight as in regular or graded bedding.
735. *weakness zone* A part or zone in the ground in which the mechanical properties are significantly lower than those of the surrounding rock mass. Weakness zones can be faults, shears / shear zones, thrust zones, weak mineral layers, etc.
736. *weathering* Refers to the various processes of physical disintegration and chemical decomposition that occur when rocks at the Earth's surface are subjected to physical, chemical, and biological processes induced or modified by wind, water, and climate.
737. *weathering pit* Small shallow depression or basin in an otherwise flat or evenly sloping rock surface, caused by preferential weathering of specific rock fragments or crystals in rocks composed of mixtures of different fragments or crystals.
738. *weathering rind* (See "rind")
739. *weathering zone* Portion of a rock mass delineated on the basis of its degree of weathering in terms of, for example, relative content of rock and soil.
740. *wedge failure* Two intersecting discontinuities release a wedge-shaped rock mass.
741. *weighted joint density (wJd)* The volumetric joint count found from the amount of joints intersecting a line or a drill core by adjusting for their intersecting angle.
742. *welded tuff* Vitric tuff (i.e. with a high proportion of glass fragments) that has been compacted by the squeezing together of its glass fragments under the combined action of heat retained by its particles, weight of overlying material and hot gases within the rock.
743. *wireline equipment* Core-boring equipment which provides for the recovery of core tubes and cores by wire suspension through the drill rods.
744. *wrench fault* (See "strike-slip fault")
745. *Wulff net* Equal angle stereographical diagram to present geological structures in the form of like planes and lines.
746. *xenocrystic* Textural term for an igneous rock containing large crystals (xenocrysts) that are foreign in origin compared with the groundmass or matrix in which they occur. (Contrast with "porphyritic").
747. *zeolite* Group of aluminium-silica minerals. Characterised by the ability of losing crystalline water when heated, and regaining water when cooled