

How Do Metamorphic Rocks Formed

Igneous rock three main rock types, the others being sedimentary and metamorphic. Igneous rocks are formed through the cooling and solidification of magma or lava. Igneous rocks are formed through the cooling and solidification of magma or lava. Igneous rock (igneous from Latin igneus 'fiery'), or magmatic rock, is one of the three main rock types, the others being sedimentary and metamorphic 4e6e46bd11

Metamorphic petrology is the study of metamorphism. Metamorphic petrologists rely heavily on statistical mechanics and experimental petrology to understand metamorphic processes. 4e6e46bd11

Metamorphic rock The original rock (protolith) Metamorphic rocks arise from the transformation of existing rock to new types of rock in a process called metamorphism. During this process, the rock remains mostly in the solid state, but gradually recrystallizes to a new texture or mineral composition. Metamorphic rocks arise from the transformation of existing rock to new types of rock in a process called metamorphism. The original rock (protolith) is subjected to temperatures greater than 150 to 200 °C (300 to 400 °F) and, often, elevated pressure of 100 megapascals (1,000 bar) or more, causing profound physical or chemical changes. The protolith may be an igneous, sedimentary, or existing metamorphic rock 4e6e46bd11

Pressure-temperature-time path Metamorphism is a dynamic process which involves the changes in minerals and textures of the pre-existing rocks (protoliths) under different P-T conditions in solid state. rocks (protoliths) under different P-T conditions in solid state. The changes in pressures and temperatures with time experienced by the metamorphic rocks are often investigated by petrological methods, radiometric dating techniques and thermodynamic modeling. The changes in pressures and temperatures with time experienced by the metamorphic rocks The Pressure-Temperature-time path (P-T-t path) is a record of the pressure and temperature (P-T) conditions that a rock experienced in a metamorphic cycle from burial and heating to uplift and exhumation to the surface 4e6e46bd11

Igneous rocks are also geologically important... 4e6e46bd11 Igneous rocks occur in a wide range of geological settings: shields, platforms, orogens, basins, large igneous provinces, extended crust and oceanic crust. 4e6e46bd11 Migmatites commonly display distinctive banding and folded structures, including ptymatic folds, produced by melt migration and ductile deformation. They have long been regarded as linking regional metamorphism, crustal melting, and the origin of granitic rocks, and remain central to research on the evolution of the continental crust. 4e6e46bd11 Migmatites form during prograde metamorphism when rocks reach temperatures and pressures sufficient for partial melting. The newly formed material, known as the neosome, commonly consists of light-coloured leucosome and darker melanosome, while remnants of the original rock form the paleosome; an intermediate mesosome may also be present. 4e6e46bd11 The sedimentary rock cover of the continents of the Earth's crust is extensive (73% of the Earth's current land surface), but sedimentary rock is estimated to be only 8% of the volume of the crust. Sedimentary rocks are only a thin veneer over a crust consisting mainly of igneous and metamorphic rocks. Sedimentary... 4e6e46bd11 Gneisses are common in the ancient crust of continental shields. Some of the oldest rocks on Earth are gneisses, such as the Acasta Gneiss. 4e6e46bd11 Metamorphic rocks make up a large part of the Earth's crust and form 12% of the Earth's land surface. They are classified by their protolith, their chemical and mineral makeup, and their texture. They may be formed simply by being deeply buried beneath the Earth's surface, where they are subject to high temperatures and the great pressure of the rock layers above. They can also form from tectonic processes such as continental collisions, which cause horizontal pressure, friction, and distortion. Metamorphic rock can be formed locally when rock is heated by the intrusion of hot molten rock called magma from the Earth's interior. The study of metamorphic... 4e6e46bd11 == Metamorphic processes == 4e6e46bd11 == Geological significance == 4e6e46bd11 The name facies was first used for specific sedimentary environments in sedimentary rocks by Swiss geologist Amantz Gressly in 1838. Analogous with these sedimentary facies a number of metamorphic facies were proposed in 1920 by Finnish petrologist Pentti Eskola. Eskola's classification was refined by New-Zealand geologist Francis John Turner throughout his career. A classic... 4e6e46bd11 Igneous and metamorphic rocks make up 90–95% of the top 16 kilometres (9.9 mi) of the Earth's crust by volume. Igneous rocks form about 15% of the Earth's current land surface. Most of the Earth's oceanic crust is made of igneous rock. 4e6e46bd11

Metamorphic facies pressure graph) are wide because they are gradational and approximate. A metamorphic facies is a set of mineral assemblages in metamorphic rocks formed under similar pressures and temperatures. Rocks which contain certain minerals can therefore be linked to certain tectonic settings, times and places in the geological history of the area. The boundaries between facies (and corresponding areas on the temperature v. pressure (See diagram in Figure 1). The area on the graph corresponding to rock formation at the lowest values of temperature and pressure is the range of formation of sedimentary rocks, as opposed to metamorphic rocks, in a process called diagenesis. The assemblage is typical of A metamorphic facies is a set of mineral assemblages in metamorphic rocks formed under similar pressures and temperatures. The assemblage is typical of what is formed in conditions corresponding to an area on the two dimensional graph of temperature vs 4e6e46bd11

The magma can be derived from partial melts of existing rocks in a terrestrial planet's mantle or crust. Typically, the melting is caused by one or more of three processes: an increase in temperature, a decrease in pressure, or a change in composition. Solidification into rock occurs either below the surface as intrusive rocks or on the surface as extrusive rocks. Igneous rock may form with crystallization to form granular, crystalline rocks, or without

crystallization to form natural glasses. 4e6e46bd11

Greenschist Other common minerals include quartz, orthoclase, talc, carbonate minerals and amphibole (actinolite). Greenschists commonly have an abundance of green minerals such as chlorite, serpentine, and epidote, and platy minerals such as muscovite and platy serpentine. The platiness gives the rock schistosity (a tendency to split into layers). Greenschists are metamorphic rocks that formed under the lowest temperatures and pressures usually produced by regional metamorphism, typically 300–450 °C Greenschists are metamorphic rocks that formed under the lowest temperatures and pressures usually produced by regional metamorphism, typically 300–450 °C (570–840 °F) and 2–10 kilobars (29,000–145,000 psi) 4e6e46bd11

== Description == 4e6e46bd11

Metamorphism Metamorphism usually takes place at temperatures in excess of 150 °C (300 °F), and often also at elevated pressure or in the presence of chemically active fluids, but the rock remains mostly solid during the transformation. Metamorphism is distinct from weathering or diagenesis, which are changes that take place at or just beneath Earth's surface. grains (porphyroblasts). Atoms in the interior of Metamorphism is the transformation of existing rock (the protolith) to rock with a different mineral composition or texture. Metamorphic rocks are typically more coarsely crystalline than the protolith from which they formed 4e6e46bd11

Sedimentary rock Geological detritus originates from weathering and erosion of existing rocks, or from the solidification of molten lava blobs erupted by volcanoes. e. Sedimentary rocks are only a thin veneer over a crust consisting mainly of igneous and metamorphic rocks. Sedimentary rocks are deposited in layers Sedimentary rocks are types of rock formed by the cementation of sediments—i. particles made of minerals (geological detritus) or organic matter (biological detritus)—that have been accumulated or deposited at Earth's surface. crust. Biological detritus is formed by bodies and parts (mainly shells) of dead aquatic organisms, as well as their fecal mass, suspended in water and slowly piling up on the floor of water bodies (marine snow). Sedimentation may also occur when dissolved minerals precipitate from water solution. The geological detritus is transported to the place of deposition by water, wind, ice or mass movement, which are called agents of denudation. Sedimentation is any process that causes these particles to settle in place 4e6e46bd11

Various forms of metamorphism exist, including regional, contact, hydrothermal, shock, and dynamic metamorphism. These differ in the characteristic temperatures, pressures, and rate at which they take place and in the extent to which reactive fluids are involved. Metamorphism occurring at increasing pressure and temperature conditions is known as prograde metamorphism, while decreasing temperature and pressure characterize retrograde metamorphism. 4e6e46bd11 == The diagenesis - metamorphism sequence == 4e6e46bd11

Migmatite It typically occurs in the deeper parts of the continental crust, commonly within Precambrian cratonic blocks, and represents a transitional stage between metamorphic and igneous rocks. represents a transitional stage between metamorphic and igneous rocks. Migmatites form during prograde metamorphism when rocks reach temperatures and pressures Migmatite is a rock formed under high-grade metamorphism by partial melting (anatexis), producing a mixture of metamorphic and newly formed igneous material 4e6e46bd11

Subduction zone metamorphism The metamorphic conditions the slab passes through in this process generates and alters water bearing (hydrous) mineral phases, releasing water into the mantle. This water lowers the melting point of mantle rock, initiating melting. of rock types formed by the high-pressure, low-temperature conditions a subducting slab encounters during its descent. Arc magmas account for more than 20% of terrestrially produced magmas and are produced by the dehydration of minerals within the subducting slab as it descends into the mantle and are accreted onto the base of the overriding continental plate. Subduction zones host a unique variety of rock types formed by the high-pressure, low-temperature conditions a subducting slab encounters during its descent. Understanding the timing and conditions in which these dehydration reactions occur, is key to interpreting mantle melting, volcanic arc magmatism, and the formation of continental crust. The metamorphic conditions the A subduction zone is a region of the Earth's crust where one tectonic plate moves under another tectonic plate; oceanic crust gets recycled back into the mantle and continental crust gets produced by the formation of arc magmas 4e6e46bd11

== Petrology == 4e6e46bd11

Gneiss common and widely distributed type of metamorphic rock. This rock is formed under pressures ranging from 2 to 15 kbar, sometimes even more, and temperatures over 300 °C (572 °F). It is formed by high-temperature and high-pressure metamorphic processes acting on formations composed of igneous or sedimentary rocks. It is formed by high-temperature and high-pressure metamorphic processes acting on formations composed Gneiss (NYSE) is a common and widely distributed type of metamorphic rock. Gneiss nearly always shows a banded texture characterized by alternating darker and lighter colored bands and without a distinct cleavage 4e6e46bd11

Greenschist is a general field petrologic term for metamorphic or altered mafic volcanic rock. In Europe, the term prasinite is sometimes used. A greenstone is sometimes a greenschist but can also be rock types without any schistosity, especially metabasalt (spilite). However, basalts may remain quite black if primary pyroxene does not revert to chlorite or actinolite. To qualify for the name, a rock must also exhibit schistosity or some foliation or layering. The rock is derived from basalt, gabbro or similar rocks containing sodium-rich plagioclase feldspar, chlorite, epidote and quartz. 4e6e46bd11 Greenschist is defined by the presence of... 4e6e46bd11 Metamorphic minerals are unstable upon changing P-T conditions. The original minerals are commonly destroyed during solid state metamorphism and react to grow into new minerals that are relatively stable. Water is generally involved in

the reaction, either from the surroundings or generated by the reaction itself. Usually, a large amount of fluids (e.g. water vapor, gas etc.) escape under increasing P-T conditions e.g. burial. When the rock is later uplifted, due to the escape of fluids at an earlier stage, there is not enough fluids to permit all the new minerals to react back into the original minerals.... 4e6e46bd11 == Historic definition == 4e6e46bd11 A metamorphic facies is characterized by a stable mineral assemblage specific to a pressure-temperature range and specific starting material. Subduction... 4e6e46bd11

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