Andesitic magma formed

The average composition of the continental crust is andesitic, a composition that falls between that of basalt and riolite. Laboratory experiments show that partial melting of the moist oceanic crust produces an Andesitic magma. Remember that the oceanic crust is dry, but after it forms it interacts with seawater, which fills the cracks several miles deep (kilometers). The sediments above the oceanic crust are also filled with water, but these are mostly non-subducible. Andesite is formed above the places where water is released from the underducted slabs and migrates into the wedge of the mantle above the subduing slab, forming water-rich magmas. These magmas then intruded on the continental crust above, some forming volcanic andesites, others crystallizing as deep-diorite plutoniums. Was this article helpful? Igneous rocks are formed by crystallization by a liquid, or magma. They include two types: volcanic or extrusive igneous rocks in which magma cools and crystallizes on the earth's surface Intrusive or plutonic igneous rocks in which magma crystallizes deep into the Earth. Magma is a mixture of liquid rock, crystals and gas. Characterized by a wide range of chemical compositions, at high temperature, and properties of a liquid. Magmas are less dense than the surrounding rocks and therefore will move upwards. If the magma rises to the surface it erupts and then crystallizes to form an extrusive or volcanic rock. If it crystallizes before reaching the surface it will form a deep igneous rock called plutonic rock or igneous intrusive. Since magma cooling occurs at a different rate, the crystals that form and their interrelation (texture) show different properties. Rapid cooling on the surface results in many small crystals or hardening in a glass. It gives rise to an aphanitic consistency (crystals cannot be distinguished with the naked eye) or obsidian (volcanic glass). Slow cooling at depths in the earth results in fewer much larger crystals, gives rise to a pharaanitic consistency. The porhpiritic texture develops when slow cooling is followed by rapid cooling. Phenocrys = larger crystals, matrix or earth mass = smaller crystals. Other rocky structural terms The chemical composition of magma is controlled by the abundance of elements in the earth. Yes, Al, Fe, Ca, Mg, K, Na, H and O are 99.9%. Because oxygen is so abundant, chemical analyses are usually provided in terms of oxides. SiO_2 is the most abundant oxide. Basaltic or Gabbroic - SiO_2 45-55 wt%, high in Fe, Mg, Ca, bass in K, Na Andesitic or Dioritic -- SiO_2 55-65 wt%, intermediate. in Fe, Mg, Ca, Na, K Rhyolitic or Granitic -- SiO_2 65-75%, low in Fe, Mg, Ca, high in K, Na. Gas - Deep in the Earth almost all magmas Gas. The gas gives the magmas their explosive character, because the gas expands as the pressure decreases. Higher SiO_2 content magmas have a higher viscosity than lower SiO_2 content magmas Lower temperature magmas have a higher viscosity than higher temperature Mostly H_2O with some smaller amounts of SULFUR CO_2, Cl and F rhyolitic or granite magmas usually have a higher gas content than basaltic or gabbroic magmas. Temperature of Magmas Basaltic or gabbroic - 1000-1200oC Andesitic or dioritic - 800-1000oC Rhyolitic or granitic - 650-800oC. Viscosity of Magmas - Viscosity is the resistance to flow (as opposed to fluidity) It depends on the composition, temperature, gas content. Higher SiO_2 magmas have a higher viscosity than low-temperature SiO_2 magmas that have a higher viscosity than higher temperature magmas. Magma Summary Table Type Solidified Volcanic Rock Solidified Plutonic Rock Chemical Composition Temperature Viscosity Basalt Gas Content Basalt Gabbro 45-55 SiO_2 %, High in Fe, Mg, Ca, bass in K, Na 1000 - 1200 oC Bass Andesitic Andesite Diorite 55-65 SiO_2 %, intermediate in Fe, Mg, Ca, Na, K 800 - 1000 oC Intermediate Intermediate Rhyolite Granite 65-75 SiO_2 %, low in Fe, Mg , Ca, high in K, Na 650 - 800 oC High High When magmas reach the earth's surface they erupt from a mouth. They can erupt explosively or non-explosively. Non-explosive eruptions are favored by low gas content and low viscosity magmas (basaltic andesitic magmas). Usually they start with fire fountains due to the release of dissolved gases Produce lava flows on the surface Produce lava pillows if erupted under water Explosive eruptions are favored by a high gas content and a high viscosity (from andesitic to riolitic magmas). The expansion of gas bubbles is counteracted by the high viscosity of magma - it results in pressure construction High pressure in gas bubbles causes bubbles to burst when low pressure is reached on the Earth's surface. Burst of bubbles fragments the magma into pyroclasts and tefra (ash). Cloud of gas and tefra rises above the volcano to produce a column of eruption that can rise up to 45 km into the atmosphere. If the eruption column collapses, a pyroclastic flow may occur, in which gas and tefra rush along the sides of the volcano at high speed. This is the most dangerous type of volcanic eruption. The deposits produced are called undead. Sideways explosions and avalanches of debris occur when the gas is suddenly released from a large landslide or avalanche of debris that extinguished part of the volcano For magmas to form, a part of the earth must become warm enough to melt the rocks present. Under normal conditions, the geothermal gradient is not high enough to melt rocks, and therefore with the exception of the outer core, most of the Earth is solid. Therefore, magmas are formed only in special circumstances. To understand this we must first look at how rocks and minerals melt. As the pressure on the the melting temperature also changes. For pure minerals, there are two general cases. For a pure dry mineral (without H_2O or CO_2 present), the molten temperate increases as the pressure increases. For a mineral with H_2O or CO_2 present, the melting temperature decreases first as the pressure increases Since the rocks rocks of minerals, behave slightly differently. Unlike minerals, rocks do not melt at a single temperature, but melt over a wide range of temperatures. Then it is possible to have partial fuses, from which the liquid portion could be extracted to form magma. The two general cases are: the melting of dry rocks is similar to melting dry minerals, melting temperatures increase as pressure increases, except that there is a temperature range on which there is partial melting. The degree of partial melting can vary from 0 to 100% The melting of rocks containing water or carbon dioxide is similar to the melting of wet minerals, melting temperatures initially decrease as the pressure increases, except that there is a temperature range on which there is a partial fusion. Much evidence suggests that basaltic magmas result from dry partial melting of the mantle. Basalts contain most of the oceanic crust and only the crust of subli of the mantle. Basalts contain minerals such as olivine, pyrosthene and plagioclase, none of which contain water. Basalts erupt non-explosively, indicating a low gas content and therefore a low water content. The mantle is made of garnet peridotite (a rock composed of olivine, pyros and garnet) - the evidence comes from pieces bred from erupting volcanoes. In the laboratory we can determine the melting behavior of grenade peridotite. Under normal conditions, the temperature in the Earth, shown by the geothermal gradient, is lower than the beginning of the melting of the mantle. So, for the mantle to melt, there must be a mechanism to increase the geothermal gradient. Once such a mechanism is convection, in which the material of the warm mantle rises to lower pressure or depth, bringing with it its heat. If the raised geothermal gradient becomes higher than the initial melting temperature at any pressure, a partial fusion will form. The liquid from this partial fusion can be separated from the remaining crystals because, in general, liquids have a lower density than solids. Basaltic or gabbroic magmas seem to originate in this way. Most granite or rhyolithic magma appears to derive from the wet melting of the continental crust. Proof of this is: most granites and riolites are found in areas of continental crust. When granite magma erupts from volcanoes it does so in a very explosive way, indicating a high gas content. Solidified granite or rhyme contains quartz, feldspar, hornblende, biotite and muscovite. The latter minerals contain water, indicating a high water content Still, the temperature in the continental crust is usually not high enough to cause melting, and therefore another source of heat is needed. In most cases it seems this heat source is basaltic magma. Basaltic magma is generated in the mantle, then rises into the continental crust. But, since basaltic magma has a high density, it can stop in the crust and crystallize, releasing heat into the surrounding crust. This increases the geothermal gradient and can cause partial wet melting of the crust — (DE) Mr President, commissioner, i.e. the The average composition of the continental crust is andesitic, but if andesite magma is produced by melting the continental crust, then it requires complete melting of the crust. Crust temperatures are unlikely to fuel enough. Andesitic magmas erupt in areas above subduction zones - suggests the relationship between andesite production and subduction. One theory predicts the partial wet fusion of the subduct oceanic crust. But newer theories suggest partial wet melting of the mantle. When magma solidifies to form a rock it does so over a temperature range. Each mineral begins to crystallize at a different temperature, and if these minerals are somehow removed from the liquid, the liquid composition will change. Depending on how many minerals you lose in this way, you can create a wide range of compositions. Processes are called magmatic differentiation by crystalline fractionation. Crystals can be removed from a variety of processes. If the crystals are denser than the liquid, they can sink. If they are less dense than the liquid they will float. If the liquid is squeezed by pressure, the crystals will be left behind. The removal of crystals can then change the composition of the liquid portion of the magma. Let me illustrate this in a very simple case. Imagine a liquid containing 5 MgO molecules and 5 SiO_2 molecules. Initially the composition of this magma is expressed as 50% SiO_2 and 50% MgO. now let's imagine removing 1 mgo molecule by putting it in a crystal and removing the crystal from the magma. Now, what are the percentages of each molecule in the liquid? If we continue the process once again by removing another molecule mgo So, the composition of the liquid can be changed. Bowen has discovered by experiment that the order in which minerals crystallize from a basaltic magma depends on temperature. Olivina and Ca-rich plagioclase are cooled as basaltic magma first. After further cooling, Olivina reacts with the liquid to produce ca-rich pyrosan and plagioclase react with liquid to produce plagioclase less rich than Ca. But, if ca-rich olivine and plagioclase are removed from the liquid by crystalline fractionation, then the remaining liquid will be richer in SiO_2. If the process continues, an original basaltic magma can change first to andesite magma, so a riolite magma with falling temperature Basalts, Andesites, Dacites, and Rioliths are all distinct volcanic rock types based on their mineral assemblage. Depending on the conditions present during the eruption and cooling, each of these types of rock can form one of the following types of volcanic rocks. Obsidian - dark-colored volcanic glass showing a concoidal fracture. Usually riolitic or Pumice - light and light colored rock consisting mainly of holes (vesicles) that were once occupied by gases, usually riolitic, dacitic or andesitic. Vesicular rock - rock filled with holes (Swiss cheese) or vesicles that were once occupied by gas. Usually basaltic basalt andesitic. Amygdaloidal basalt. If vesicles in a vesicular basalt are subsequently filled by precipitation of calcite or quartz, the fillings are called amygdules and basalt is called amygdaloidal basalt. Pyroclasts and Pyroclast Tefra = hot and broken fragments. Result of the explosive tearing of the magma. Loose assemblies of pyroclasts called tefra. Depending on the size, the tefra can be classified as bombs. lapilli, or ashes. Rock formed by accumulation and cementation of tefra called pyroclastic rock or tuff. Welding, compaction and deposition of other grains cause the tefra (loose material) to be converted into pyroclastic rock. Volcanoes Shield Volcano - volcanoes that erupt low viscosity (usually basaltic) magma that flows long distances from the vent. Pyroclastic cone or ash cone - a volcano built mainly with deposits of fall tefra located immediately around the vent. Stratovolcano (composite volcano) - a volcano built with woven lavic castings and pyroclastic material. Crater - a depression caused by explosive ejection of magma or gas. Caldera - a depression caused by the collapse of a volcano in the cavity once occupied by the magma Lava Dome - a steep volcanic structure resulting from the eruption of high viscosity, low-gas magma Hot Springs and Geyser - hot water resulting from magma warming deep on Earth. Springs flow, geysers erupt. Crack eruptions - An eruption that occurs along a narrow crack or crack in the Earth's surface. Pillow Lava - Lava formed by the eruption beneath the surface of the ocean or a lake. Deep-cooled igneous rocks. The name comes from the Greek god of the underworld - Pluto. Dams - a small tabular intrusion that cuts layers of pre-existed rock. Windows windows windows - a tabular intrusion that has meddled parallel to pre-exist layers of rock. Laculitis - similar to a windows windows windows, except that the layers above are bent upwards by intrusion. Volcanic Hills - a former volcanic conduit that has been exposed by volcano erosion. Batoliths - a large intrusion usually of granite or dioritic composition. Stocks - a somewhat smaller intrusion usually intruded from a larger batolite. Methods of melting intrusions - arrest crystallization - Xenoliths Injection Question - Why do we see intrusive igneous rocks on the earth's surface? Response - They are exposed by erosion that has removed all material above intrusion intrusion