Some Personal Discoveries in Teaching Magmatic Rock

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Abstract: There is a lot of knowledge about magmatic rock. When students study the magmatic rock knowledge, they feel difficult to master it. I have explored for many years and found that teaching magmatic rock knowledge in a hierarchical way is effective. First the magmatic rock definition is taught. Second the occurrence of magmatic rock is taught. Third the structure and construction of magmatic rock are taught. Fourth the chemical and mineral composition of magmatic rock is taught. Finally several typical magmatic rocks are taught, such as granite, diorite, gabbro, rhyolite, basalt, diabase and so on. This kind of propulsive teaching method is interlinked with each other, and the students have a good grasp of magmatic rocks knowledge.

1. Introduction

The magmatic rock is an important part of engineering geology course and the foundation of subsequent knowledge of geological disaster and geological structure. The knowledge of magmatic rocks focuses on concepts, so it is difficult for students to master it. I have explored for many years and found that teaching magmatic rocks knowledge in a hierarchical way is effective. First the magmatic rock definition is taught. Second the occurrence of magmatic rock is taught. Third the structure and construction of magmatic rock are taught. Fourth the chemical and mineral composition of magmatic rock is taught. Finally several typical magmatic rocks are taught, such as granite, diorite, gabbro, rhyolite, basalt, diabase and so on. This kind of propulsive teaching method is interlinked with each other, and the students have a good grasp of magmatic rocks knowledge. My teaching experience can be your reference.

2. The definition of magmatic rock

Magmatic rocks are condensed and consolidated by magma. Magma is composed mainly of silicates, which are rich in volatile materials, and formed as a high-temperature and high-pressure molten mass deep in the mantle and crust. Magma is divided into two categories: one is the basic magma, small viscosity and large fluidity; the other is acidic magma, large viscosity and small fluidity.

Magma can travel deep in the mantle and crust, or eject to the surface. As magma rises along weak areas of the earth's crust, it condenses. This process is called intrusive. The rocks formed by the intrusion are called intrusive rocks. The intrusive rocks can be divided into plutonic rocks and shallow diagenetic rocks according to the depth of diagenetic parts. Those with a depth of more than 3km are plutonic rocks and shallow diagenetic rocks on the contrary. When magma rises along the tectonic fissures, it spills over the surface or erupts through the volcano, which is called magmatic expulsion, and the rock formed by magma erupting is called extrusive rock. There are two kinds of extrusive rocks: one is called lava formed by condensation of magma spilling from the surface; the other is called pyroclastic rock formed when magma or its detrital material is ejected into the air and falls from the air to the ground [1].

3. The occurrence of magmatic rock

The occurrence of magmatic rock refers to the shape size of magmatic rock and its relationship

with surrounding rock. The occurrence of magmatic rocks is closely related to the composition, physical and chemical conditions of magma, and also affected by the environment of condensing zone, so its occurrence is varied.

3.1 The intrusive rock occurrence

The first is batholith. The batholith is one of the largest rock masses formed by magma intrusion into the crust and condensation, with a distribution area of more than 60 square kilometers. The common batholith is mostly granitoids formed by acid magma condensation. The batholith has deep burial, large range, slow magma condensation rate, coarse grain and even lithology, making it a good building foundation. For example, the dam site area of the Three Gorges of the Yangtze River is selected on granite-diorite batholith.

The second is stock. The stock is an intrusive rock with small distribution area and irregular shape, and the contact surface with the rock is steep. Some stocks are the protruding part of the batholith, which is usually the foundation with uniform lithology and good stability.

The third is laccolite. The laccolite is an intrusion with a large middle thickness, which is umbrella-shaped or lenticular. It is mostly formed by acidic or neutral magma invading along the layered rock layer and not flowing far due to its great viscosity.

The fourth is sill. The basic magma with less viscosity and greater fluidity intrudes along the sedimentary rock layer and fills in the middle of the rock layer, often forming the rock mass with small thickness and wide range of sections, which is called the sill. So the sill is mostly basal and shallow rock.

The fifth is dike and dyke. The dyke and dike are long and narrow magmatic rock intruded along the fallow or fault zone of the surrounding rock. The narrow ones are called dykes, and the wider and nearly vertical ones are dikes. The dyke and dike are mostly in the zone where the surrounding rock structure fissure develops and the contact area with the surrounding rock is large. The magma condenses quickly and many shrinkage cracks are formed in the rock mass with the development of dyke and dike. Therefore, the rock mass has poor stability and the groundwater is more active [2].

3.2 The extrusive rock occurrence

The occurrence of extrusive rocks is affected by the composition of the magma, viscosity, channel characteristics, surrounding rock structure and surface morphology. The common eruptive rock occurrence is lava flow, volcano cone and lava platform [3].

The first is lava flow. If the magma is a basic magma with small viscosity and easy flow, and erupts to the surface along certain directions of fissures, the lava flow with small thickness and wide area will be formed, such as the Permian basalt flow in the southwest of China. Due to the intermittency of volcanic eruptions, the lava flows often have layered structures of different periods in the vertical direction.

The second is volcanic cone and lava terrace. The viscous magma with less fluidity erupts to the surface along the crater, and bond with the pyroclastic together, the formation of the cone or bell mountain as the center of the crater, called volcanic cone or bell, such as the Changbai Mountain Tianchi. When the magma with the small viscosity slowly spills over the surface, the table-shaped uplands is formed, called lava platforms, such as the Wudalianchi Pool in Heilongjiang Province.

4. The structure and construction of magmatic rock

4.1 The structure of magmatic rock

The structure of magmatic rock mainly refers to the size and degree of crystallization of the mineral grains that make up the magmatic rock. The structure of common magmatic rocks is as follows.

The first is phanerocrystalline structure, which means that all minerals in the rock are crystal particles that can be resolved by naked eye or magnifying glass. This structure is formed under the condition of high temperature and pressure and slow decrease of magma temperature, which is

mainly the structure of plutonic intrusive rocks. It is divided into coarse grain (grain diameter >5mm), medium grain (5-2mm) and fine grain (2-0.2) according to the mineral grain size.

The second is porphyritic structure which referring to a structure in which larger crystals (porphyrites) are scattered among finer materials (substrates). The porphyritic crystals are formed deep underground under high temperature and pressure conditions, and rise to the surface with the magma. The substrate portion cools rapidly to form fine crystals or uncrystallized vitreous matter that can not be resolved by the naked eye or magnifying glass. The porphyritic structure is the structure of shallow diagenetic or extrusive rocks [4].

The third is cryptocrystalline structure whose mineral particles can only be resolved under a microscope. With the naked eye and magnifying glass to observe the cryptic structure of the rock section, it is very rough. Due to the rapid cooling of magma, mineral crystals are very small and are often characterized by extrusive rocks and shallow diagenesis.

The fourth is vitreous structure. The magmatic rock with vitreous structure is composed of vitreous minerals, and the rock section is smooth and glassy. The vitreous structure is the structure of extruded rock.

4.2 The construction of magmatic rock

The construction of a magmatic rock refers to the overall character of its appearance. The common construction of magmatic rocks is as follows.

The first is massive construction, which means that the minerals that make up the rock are uniformly distributed in the rock.

The second is vesicular construction. The rocks are dotted with circular or elliptical cavities of varying sizes. It's a hole left by gas escaping from the magma.

The third is amygdaloidal structure, which means that the rock with a vesicular structure is later filled with siliceous and calcium in the shape of an almond.

The fourth is fluidal construction. In the process of magma flowing on the surface, as minerals of different colors, vitreous materials and pores are elongated, the fluidal construction with different colors streamlines, alternate with each other, are formed along the direction of lava flow.

5. The chemical and mineral composition of magmatic rock

5.1 The chemical composition of magmatic rock

The content of silicon dioxide is the most important chemical component in magmatic rocks, and its content directly affects the change of mineral composition and the properties of magmatic rocks. According to the content of silica, the magmatic rocks are divided into the following four categories. The first is acid magmatic rock, in which the silica is greater than 65%. The second is neutral magmatite, in which the silica is between 52% and 65%. The third is basic magmatic rocks, in which the silica is between 45% and 52%. The fourth is ultrabasic magmatite, in which the silica is less than 65%.

5.2 The mineral composition of magmatic rock

In the common magmatic rocks, only six or seven minerals are the most widely distributed. They are olivine, pyroxene, hornblende, biotite, plagioclase, potash feldspar, and quartz. The most widely distributed mineral is feldspar, accounting for 63% of the total mass of igneous rocks, followed by quartz, pyroxene, amphibole, and mica.

6. Typical magmatic rocks

The first is granite, as shown in figure 1. The granite is the most widely distributed crystalline granular plutonic rock on earth. It is composed of quartz, feldspar and mica. Granite has a density of 2.7, compact and hard, small porosity and high strength. The granite with uniform fine grains that can bear any engineering load is a favorite building material.

Figure 1. Granite

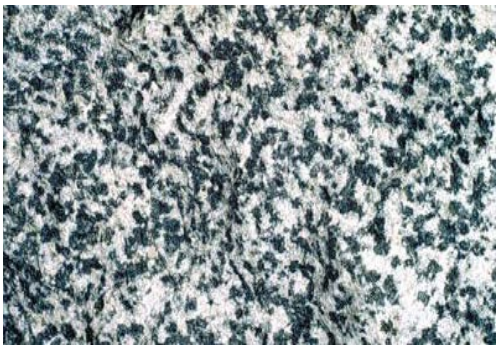

Figure 2. Diorite

The second is diorite, as shown in figure 2. Diorite is a kind of neutral plutonic intrusive rock, and mainly composed of plagioclase, common amphibole, and a small amount of biotite. Because it contains more dark minerals, the diorite is dark gray and green. Diorite is mostly associated with granite and gabbro in nature. It has a density from 2.6 to 3.1 and a high mechanical strength, making it a good foundation and building material.

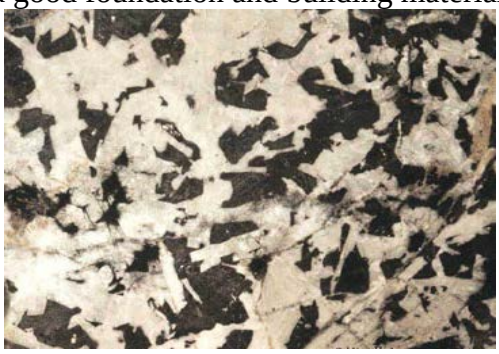

Figure 3. Gabbro

Figure 4. Rhyolite

The third is gabbro, as shown in figure 3. Gabbro is a basic plutonic intrusive rock. The mineral composition is mainly common pyroxene and plagioclase, sometimes containing a small amount of olivine. The occurrence of gabbro is common in plant, basin and cap. Gabbro has high mechanical strength, and is a good foundation and building material.

The fourth is rhyolite, as shown in figure 4. Rhyolite is acid volcanic extrusive rock. Its color is gray-red, sometimes gray-black and purple. The mineral composition is quartz, orthoclase and plagioclase. It is usually a porphyritic structure, often developed with a flow construction [5].

7. Conclusion

This kind of propulsive teaching method is interlinked with each other. The Students fully recognize that the teacher's description of magmatic rocks knowledge is simple, focused and enlightening. Therefore, the students have a high attendance rate and have a good grasp of magmatic rocks knowledge. I hope that my teaching experience can be your reference.

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