**Benha University 2nd Year (Geology) Students**

**Faculty of Science Principles of petrology (232G)**

**Geology Department Date: 07 – 06 – 2017**

**Time Allowed: 2 hours**

**………………………………………………………………………………………………….............**

***Modal answer***

**1. Define only 6 items from the following: (12 marks)**

1. **Metamorphic facies.**

It is a group of rocks of varying chemical composition characterized by a definite set of minerals which have arrived at approximately equilibrium or formed under the same particular conditions (temperature-pressure conditions). The different famous facies are such as "hornfels facies, sanidinite facies, greenschist facies, blueschist facies, amphibolite facies, eclogite facies, granulite facies.

1. **Anamorphic zone.**

Anamorphic zone is a zone that found beneath the katamorphic zone, in which constructive alterations take place involving the formation of complex minerals from those simpler chemical types.

1. **Microlites.**

They are somewhat larger bodies which can be definitely recognized as minute crystals, whose properties are often determinable so that the mineral can be identified.

1. **Rift and grain” structure.**

These are due to jointing. In granites, three mutually perpendicular, equally spaced joints, which are taken into advantage while producing cubical blocks, are known as 'mural jointing.

But for processing of the blocks down to smaller dimensions, the mutually perpendicular closely spaced joints (one horizontal and the other vertical) are taken into advantages. These joints are known as rift and grains.

1. **Devitrification.**

It is the process by which crystals grow within an amorphous material. It is the transformation of glass to crystalline matter. Devitrification is a very slow process at ordinary temperature and pressure, but heat, pressure, and circulating solutions, probably tend to speed up the process. Glass within igneous rocks devitrifies with time to become a fine-grained rock known as a pitchstone.

1. **Crystallites.**

They are embryocrystals, not yet organized to full crystalline status, and which therefore do not react to polarized light.

1. **Plutonic metamorphism.**

This type of metamorphism is the changes produced in rocks by great heat and uniform pressure. These changes take place in the deepest zone (katazone) of the earth crust in which directed pressure becomes less, while the uniform pressure and heat become so great. This metamorphism is giving rise the metamorphic rocks known as "granulites, eclogites.

1. **Pyrosphere.**

It is a zone of igneous activity and lava formation, situated between the lithosphere and the barysphere

1. **Metamorphism grade.**

It is the stage or degree of metamorphism at which the rocks have arrived, e.g. greenschist facieses a type of low-grade metamorphism while, the eclogite facies is high-grade metamorphism.

Rocks belonging to the same facies may be the same grade of metamorphism

The pressure-temperature range of metamorphic conditions is dividing into four divisions of metamorphic grade;

*very-low-grade,*

*low-grade,*

*medium-grade*

*high-grade of metamorphism*

**2. Answer only two questions from the following: (12 marks)**

1. **What are the differences between phacolith and Laccolith (Draw if possible)**

|  |  |
| --- | --- |
| Phacoliths | Laccolith |
| It is One of the simplest types of the forms in folded regions.  In folding the crests and troughs of the folds become regions of weakness and tension, whereas the middle limbs are compressed; so that igneous material, when present, will tend to find its way into the crests and troughs, and will there exhibit doubly-convex, lens-like forms of small dimensions. | It is a form of intrusion in unfolded regions (concordant)  A magma of considerable viscosity injected into stratified rocks does not spread very far, but tends to heap itself up about the orifice of irruption.  Thus a bun-shaped mass of igneous rock is formed which has a flat base and a domed top; the strata above it are lifted up in the form of an inverted bowl.  The effects of progressive increase of viscosity during the injection of a laccolith, and its stiffening due to cooling at the contacts, may cause a steepening of the lateral margins of the mass almost to verticality; and if the irruptive impulse continues unchecked, this will pass into fracture. |

1. **What are the forms of extrusive igneous rocks**

The forms of extrusive igneous rocks are (1) Lava Flows, and (2) Pyroclastic Deposits:

(1) Lava Flows:

They are emitted either from cones or fissures.

They usually form tabular bodies elongated in flow direction.

The form of lava depends on composition and temperature of eruption.

Thus, basic lavas (basalt) are highly mobile and flow for great distances,

Whereas acid magmas (rhyolite and trachyte) are sluggish and remain heaped up in steep-sided masses.

(2) Pyroclastic Deposits:

The explosive action that takes place in volcanic eruption produces a fragmental type of igneous material.

Pyroclastics have many forms depending on the distance and force of eruption into:

a. Agglomerate: the crust that forms over the lava column may be blow to pieces by a renewal of activity and the fragments may be distributed in and about the crater as a mass of

b. Lapilli: between size of a walnut and a pea, ejected far from agglomerates.

c. Volcanic dust: Finest of all are the dust-like particles which may be deposited near the volcano and may consolidate to form beds of volcanic tuff.

1. **The igneous rocks are classified into several types based on the mode of origin (Genetic classification). (Discuss)**

The genetic classification of igneous rocks is the ideal classification in which the igneous rocks can be grouped into three categories:

1- Tholeiitic igneous rock series:

They are relatively rich in iron and show a varying degree of absolute iron enrichment in the intermediate members.

Typical tholeiitic rocks include tholeiitic basalts, tholeiitic andesites, ferrodacites, ferrorhyodacites and ferrorhyolites, many gabbros, some ultramafic rocks, ferrodiorites, ferrograndiorites and ferrogranites.

2- Calc-alkaline igneous rock series:

They are relatively poor in iron and show little or no absolute iron enrichment in the intermediate members, and are generally richer in alumina than the rocks of tholeiitic series.

Typical Calc-alkaline rocks include Calc-alkaline basalts, andesites, latite-andesites, dacites, rhyodacites and rhyolites, certain gabbros and ultramafic rocks, diorites, monzodiorites, tonalites, grandiorites and granites.

3- alkali igneous rock series:

There are very variable in character but are characterized by a higher content of alkalies for a given silica percentage than tholeiitic or calc-alkaline series.

Typical alkali rocks include alkali basalts, alkali gabbros, etc.

**3. Answer only two questions from the following: (12 marks)**

1. **The forms of intrusions depend on several factors (Discuss)**

The forms that they take depend primarily on the geological structure, and subordinately on their relations to the structural features, such as bedding-planes, of the rocks which they penetrate.

Two main types of geological structure may be distinguished in this connection:

One in which the strata remain more or less horizontal over wide areas, but in which, while mainly unaffected by folding, they are frequently broken by nearly vertical fractures due to tension.

The other comprising mountain belts characterized by intense folding, contortion, and fracturing along gently-inclined planes (thrust-planes).

The other factor by which the forms of intrusive bodies are governed is their attitude to "the main structural planes of the rocks" into which they are injected.

If the molten material has been guided by the bedding planes of the intruded rock, the resulting igneous body is said to be "concordant".

On the other hand, the magma may break across the bedding planes, and then forms a "transgressive" or "discordant mass".

1. **Define the vesicular and amygdaloidal structures and compare between them.**

When lavas heavily charged with gases and other volatiles are erupted on the surface, the gaseous constituent's escapes from the magma as there is a decrease in the pressure. Thus, near the top of flows, empty cavities of variable dimensions are formed.

The individual openings are known as vesicles and the structure as a whole is known as vesicular structure.

If, however, the vesicles thus formed are subsequently filled in with some low-temperature secondary minerals, such as calcite' -zeolite, chalcedony etc., these infillings are called 'amygdales'.

1. **Determine the several types of magma with comparing between them on the basis of composition, temperature, viscosity, and gases.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Basaltic magma | Andesitic magma | Rhyolitic magma |
| composition | SiO2 45-55 wt%, high in Fe, Mg, Ca, low in K, Na | SiO2 55-65 wt%, intermediate. in Fe, Mg, Ca, Na, K | SiO2 65-75%, low in Fe, Mg, Ca, high in K, Na |
| temperature | 1000 to 1200°C | 800 to 1000°C | 650 to 800°C |
| viscosity | Lower | Intermediate | Higher |
| gases | Higher | Intermediate | Lower |
|  |  |  |  |

**4. Discuss in brief how to determine the metamorphic rocks under microscope (petrographically), (Draw if possible). (12 marks)**

The texture of a rock involves the size of the component crystals, their shape, distribution and orientation.

In general, when the proper crystallographic faces are rarely developed in the recrystallized minerals called xenoblastic crystals.

But, when, minerals have proper crystalline faces called idioblastic crystals.

Metamorphic textures divided into the following:

* Granoblastic (Granulose) texture:
* Porphyroblastic (Maculose) texture:
* Decussate or hornfelsic texture:
* Cataclastic (Mylonitic) texture:
* Schistose texture:
* Gneissose texture:

1- Granoblastic (Granulose) texture:

It indicates recrystallization texture in which the principal constituents are granular or equidimensional.

2- Porphyroblastic (Maculose) texture:

It indicates large idioblastic crystals embedded in a fine-grained groundmass.

3- Decussate or hornfelsic texture:

This is noticed in the higher grades of thermal metamorphism of argillaceous sediments, in which the crystals of flaky or elongated minerals arrange themselves in positions nearly at right angles to each other.

4- Cataclastic (Mylonitic) texture:

This is the broken and fragmented rocks developed by shearing stress upon hard brittle materials with little new mineral formations. Eyes or lenses of undestroyed parent rocks persist enclosed in the granulated groundmass, known as "eye or augen textures".

5- Schistose texture:

This indicates regionally metamorphosed rocks, results from the arrangement of flaky, tabular or rod-like minerals in more or less parallel contiuous bands with their elongated direction perpendicular to the direction of directed pressure (stress).

6- Gneissose texture:

It is coarse discontinuously banding with ill-defined or discontinuous foliation.

Or, it is a composite texture as a result of alternation of schistose and granulose bands, whereas the schistose bands arranged in more or less discontinuous bands.

***With my best wishes***

***Dr. Amr Abdelnasser***