Benha university
Faculty of science
Geology Dept.
1 / 1 /2017

Second Level
Special Geology, Geochemistry & Geophysics
Principals of Petrology (232 G)
Time: Two Hours

نموذج اجابة

Examination of the Principals of Petrology (232 G) for the Second level students (Special Geology, Geochemistry & Geophysics), Jan. 2017.

Answer the following questions.

1- For each question below, write the letter indicating the correct answer. (24 Marks)

1. **b. in the center of the flow**
2. **c. quartz**
3. **c. basalt**
4. **b. olivine**
5. **b. mafic rocks crystallize at higher temperatures than felsic rocks**
6. **a. basalt**
7. **c. peridotite**
8. **d. granitic (felsic)**
9. **b. Marble**
10. **a. True**
11. **b. rate of cooling of the magma or lava**
12. **c. Phenocrysts**
13. **c. Intrusion of magma into fractions**
14. **b. Laccolith**
15. **c. plagioclase feldspar**
16. **d. granite**
17. **a. melting temperature**
18. **a. basalt**
19. **c. gabbro porphyry**
20. **a. grain size**
21. **d. all of the above**
22. **a. very rapid cooling**
23. **b. violent, explosive volcanic eruption**
24. **d. two phases of cooling, one fast and one slow**

2- Discuss in detail the following: - (12 Marks)

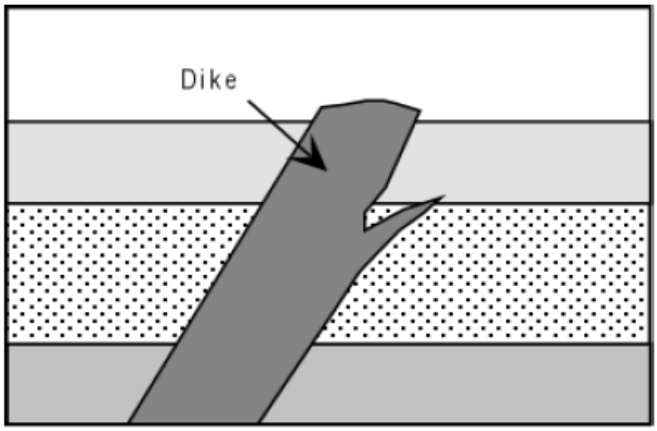
a. The different types of igneous intrusive bodies and their relation to geologic structures?

Plutonic (Intrusive) Igneous Rocks

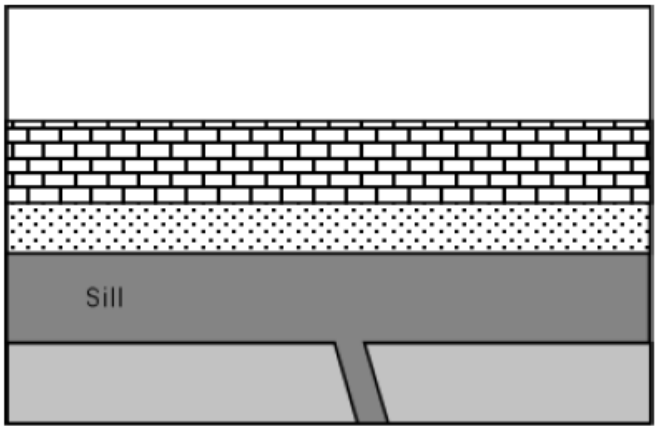
Hypabyssal Intrusions

Intrusions that intrude rocks at shallow levels of the crust are termed hypabyssal intrusions. Shallow generally refers to depths less than about 1 km. Hypabyssal intrusions always show sharp contact relations with the rocks that they intrude. Several types are found:

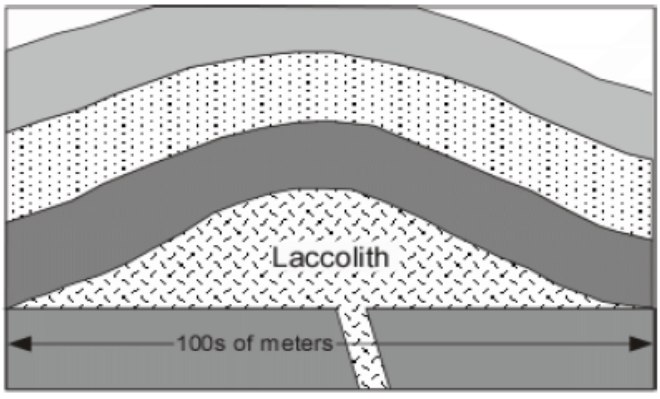
- **Dikes** are small (<20 m wide) shallow intrusions that show a discordant relationship to the rocks in which they intrude. Discordant means that they cut across preexisting structures. They may occur as isolated bodies or may occur as swarms of dikes emanating from a large intrusive body at depth.



- **Sills** are also small (<50 m thick) shallow intrusions that show a concordant relationship with the rocks that they intrude. Sills usually are fed by dikes, but these may not be exposed in the field.



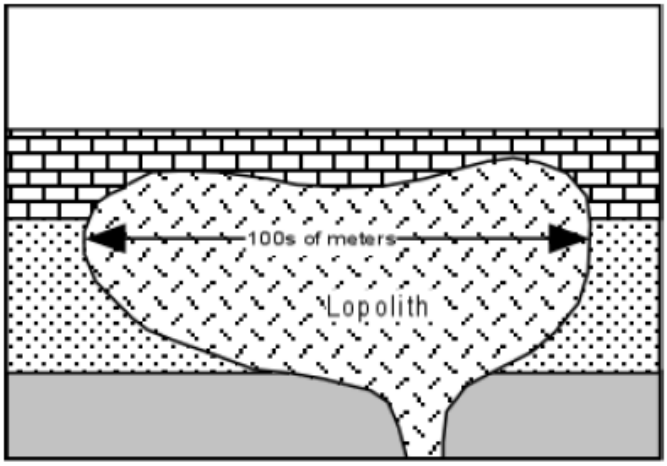
- **Laccoliths** are somewhat large intrusions that result in uplift and folding of the preexisting rocks above the intrusion. They are also concordant types of intrusions.



Plutons

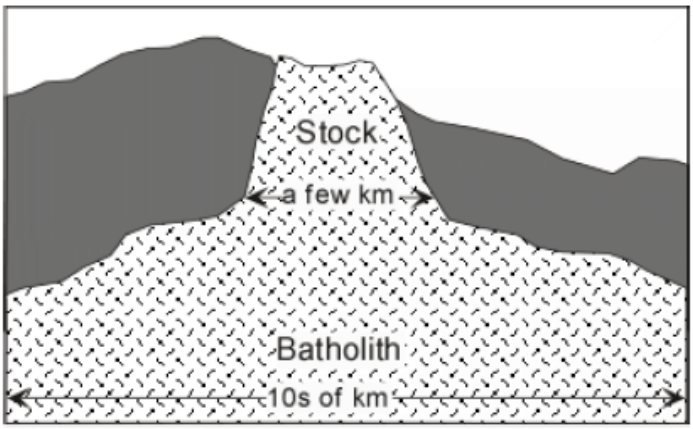
Plutons are generally much larger intrusive bodies that have intruded much deeper in the crust. Although they may show sharp contacts with the surrounding rocks into which they intruded, at deeper levels in the crust the contacts are often gradational.

- **Lopoliths** are relatively small plutons that usually show a concave downward upper surface. This shape may have resulted from the reduction in volume that occurs when magmas crystallize, with the weight of the overlying rocks causing collapse of into the space once occupied by the magma when it had a larger volume as a liquid.



- **Batholiths** are very large intrusive bodies, usually so large that there bottoms are rarely exposed. Sometimes they are composed of several smaller intrusions.

- **Stocks** are smaller bodies that are likely fed from deeper level batholiths. Stocks may have been feeders for volcanic eruptions, but because large amounts of erosion are required to expose a stock or batholith, the associated volcanic rocks are rarely exposed.



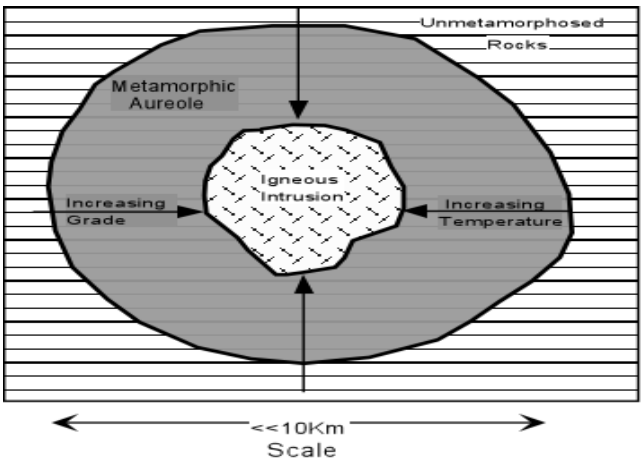
b. Different types of metamorphism

Main types of metamorphism

Contact Metamorphism

Contact metamorphism occurs adjacent to igneous intrusions and results from high temperatures associated with the igneous intrusion**.**

Since only a small area surrounding the intrusion is heated by the magma, metamorphism is restricted to the zone surrounding the intrusion, called a***metamorphic*** or ***contact aureole***. Outside of the contact aureole, the rocks are not affected by the intrusive event. The grade of metamorphism increases in all directions toward the intrusion. Because the temperature contrast between the surrounding rock and the intruded magma is larger at shallow levels in the crust where pressure is low, contact metamorphism is



often referred to as high temperature, low pressure metamorphism. The rock produced is often a fine-grained rock that shows no foliation, called a ***hornfels***.

Regional Metamorphism

Regional metamorphism occurs over large areas and generally does not show any relationship to igneous bodies. Most regional metamorphism is accompanied by deformation under non-hydrostatic or differential stress conditions. Thus, regional metamorphism usually results in forming metamorphic rocks that are strongly foliated, such as slates, schists, and gniesses. The differential stress usually results from tectonic forces that produce compressional stresses in the rocks, such as when two continental masses collide. Thus, regionally metamorphosed rocks occur in the cores of fold/thrust mountain belts or in eroded mountain ranges. Compressive stresses result in folding of rock and thickening of the crust, which tends to push rocks to deeper levels where they are subjected to higher temperatures and pressures.

Cataclastic Metamorphism

Cataclastic metamorphism occurs as a result of mechanical deformation, like when two bodies of rock slide past one another along a fault zone. Heat is generated by the friction of sliding along such a shear zone, and the rocks tend to be mechanically deformed, being crushed and pulverized, due to the shearing. Cataclastic metamorphism is not very common and is restricted to a narrow zone along which the shearing occurred.

Hydrothermal Metamorphism

Rocks that are altered at high temperatures and moderate pressures by hydrothermal fluids are hydrothermally metamorphosed. This is common in basaltic rocks that generally lack hydrous minerals. The hydrothermal metamorphism results in alteration to such Mg-Fe rich hydrous minerals as talc, chlorite, serpentine, actinolite, tremolite, zeolites, and clay minerals. Rich ore deposits are often formed as a result of hydrothermal metamorphism.

Burial Metamorphism

When sedimentary rocks are buried to depths of several hundred meters, temperatures greater than 300^{o}C may develop in the absence of differential stress. New minerals grow, but the rock does not appear to be metamorphosed. The main minerals produced are often the Zeolites. Burial metamorphism overlaps, to some extent, with diagenesis, and grades into regional metamorphism as temperature and pressure increase.

Shock Metamorphism (Impact Metamorphism)

When an extraterrestrial body, such as a meteorite or comet impacts with the Earth or if there is a very large volcanic explosion, ultrahigh pressures can be generated in the impacted rock. These ultrahigh pressures can produce minerals that are only stable at very high pressure, such as the SiO_2 polymorphs coesite and stishovite. In addition they can produce textures known as shock lamellae in mineral grains, and such textures as shatter cones in the impacted rock.

3- Write short notes on the following: (12 Marks)

a. Granularity

The absolute size of crystals in igneous rocks ranges from almost submicroscopic dimensions (e.g. microlites) to crystals measurable in yards, as in some pegmatites.

This range may be more than 1 : 1,000,000; but in the average igneous rock the range of size is probably about 1 : 1000.

b. Metamorphic facies

is a set of metamorphic mineral assemblages, repeatedly associated in time and space and showing a regular relationship between mineral composition and bulk chemical composition, such that different metamorphic facies (sets of mineral assemblages) appear to be related to different metamorphic conditions, in particular temperature and pressure, although other variables, such as PH2O may also be important.

c. Directive textures

Textures which are produced by flow in magmas during their crystallisation are said to be ***directive***. In so far as flow produces bands in which there is a juxtaposition of different textures, the appearances so caused have already been dealt with under the heading of structure. But indications of flow may be present without destroying the uniformity of the rock. Thus crystallites, microlites, and crystals may be swung by flow into parallel lines or bands, which follow the stream-lines of the magma. If the magma was very viscous the stream-lines may be tortuous, and obstacles such as phenocrysts may produce much disturbance.

Feldspathic lavas, such as trachytes, phonolites, andesites, etc., often have their feldspar laths arranged in parallel position by flow. This texture is known as ***trachytic***. A more or less parallel arrangement of feldspars in certain syenites is known as ***trachytoid*** texture.

d. Exsolution texture

Is the intergrowths of orthoclase and albite (perthite and microperthite), and of orthorhombic and monoclinic pyroxenes, are known. In the first-named the albite often appears as irregular, elongated, vein-like patches enclosed in the orthoclase.

-Good Luck-