(7mks)

ANSWERS TO ENTRANCE 2002

(i) Faces, A =110 ,B = 110, C = 20T, D = 010, E = 001.

Common forms; C = Negative hemi orthodome, D = Clino pinacoid, A = Prism

(ii)Monoclinic system, orthoclase

(iii) The cyclosilicates; they contain rings of SiO_4 tetrahedral, having a silicon to oxygen ratio of 1:3. They may be 3, 4 or 6 tetrahedral groups which are linked to form a single tetrahedral structure giving it the perfect cleavage that occurs among members of the group (tourmaline).

The double chain inosilicates; these are silicates in which tetrahedral are linked into chains by sharing 2 or 3 oxygen atoms with their atoms. In the double chain half of the are 3 oxygen atoms while the other half share 2 oxygen atoms with the neighboring tetrahedral giving an oxygen ratio of 4: 11. Because of their structure they have 2 perfect cleavages that meet at meet at 124° and 56° respectively.

Tectosilicates; these are three dimensional frame work silicate network of SiO_4. All the 4 oxygen atoms of the SiO_4 are shared with the neighboring tetrahedral giving silicon to oxygen ratio of 1:2. In the feldspar group, cleavage is along the cations such as K^{1+}, Ca^{2+} and

Na^+ . In the silica group, there is no cleavage because silicon is strongly bonded by oxygen, producing a very rigid structure. The alkaline feldspars group shows 2 good cleavages that meet at 90°.

(iv) A solid solution series is a mineral series where there is the substitution of one atom for another within the members of the series. In the plagioclase feldspars, there is a solid solution series formed between anorthite (calcium rich end member) and Albite (Sodium rich end member). There is substitution of Calcium for Sodium as you move Anorthite to Albite. This is because these minerals have approximately the same ionic size and ionic charge.

(2i) Differences between Articulate and Inarticulate brachiopods

ARTICULATE BRACHIOPODS	INARTICULATE BRACHIOPODS
-The valves open slightly along the anterior margin by means of a hinge line. - The intestines end blindly. - It is made up of a calcareous shell.	- The valves open and close by means of a muscle system. - The intestines end in the anus. - It is made up of an alternate chitinous and calcium phosphate shell.
- It is made up a semi- circular shell which tapers slightly at the posterior end. - The pedicle opening is known as the delthyrium.	- It is made up of an oval or circular shell in outline with gently convex valves. -The pedicle opening is usually a gape or groove or slit in the pedicle valve.
- Has a simple muscle system made up of a pair of adductor muscles and two pairs of deductor muscles.	- Has additional muscles which control lateral movement of the valve relative to another
- Contains teeths and socket.	- No teeths, no sockets.
- Pedicle is fixed to the pedicle valve by an adjustor muscle.	- Pedicle is fixed to the pedicle valve by a stalk like muscle.
- Larger and ornamented with growth spines and growth lines.	- Smaller, less or none ornamented.

(ii) Trilobites experienced a whole lot of changes in the course of their evolution as follows:

Changes in the position of the facial suture, In the early trilobite the facial suture cut the posterior margin (Opisthoparian) for example paradoxide. In the later species, the facial suture cut the lateral margin (Proparian) for example Dalmanite. In the very young species, the facial suture cuts the genal angle (Gonatoparian) for example Calymene

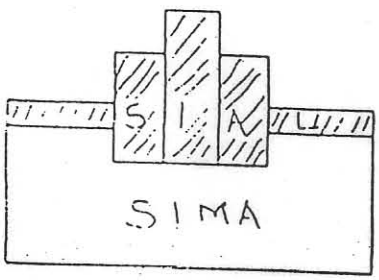
Changes in the size of the pygidium; in some species the pygidium was smaller than the cephalon (micropygous) for example in Trinucleus. In some forms the pygidium is of the same size as the cephalon (isopygous) for example in Illaenus, Dalmanite.

Changes in the number of segments: Trilobites Geologically, in the early forms, the pygidium contains very few segments and as evolution continued the number of segments gradually increased. Most of the early forms had eyes for example in paradoxide with elongated or crisentric eyes. The later forms lacked eyes and were described as blind, for example in Trinucleus.

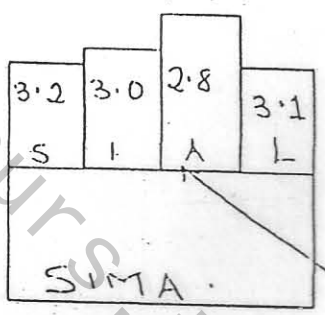
(3a) Isostasy is the tendency of the earths crust to maintain a state of near equilibrium between its layers. The gravitational attraction exerted by neighboring land masses for Example Mountains. The fact that the SiAl is floating on the state of equilibrium on the sima show s that there is a relationship between the heights of continents and the masses of the columns of rocks underlying them. Two scientists (Sir George Aircy and Arch Deacon Pratt) threw more light into this concept.

A ccording to Sir George Aircy the continent resembles ice burg floating on water or different blocks of wood with the same cross section floating on a tank of water. Each ice burg or block of wood rises above the water level at an amount proportional to its height. Such blocks are referred to as being in a condition of isostatic balance. If a small portion of the wood is cut off, that block will adjust itself and part of it that was submerged will be lifted above the water and will not sink as it did originally.

According to Arch Deacon Pratts theory of compensation, vertical columns of blocks in the crust have differe... densities according to their heights and they extend downwards to a depth called "the level of compensation" where their weights are balanced by the upward pressure of the supporting substratum. According to him mountains are high because they are made up of low density rocks while oceans are low because they are made up of high density rocks. These two theories are illustrated on the diagrams below.



Aircy's Hypothesis



Pratt's Hypothesis.

Isostasy is caused by the following:

- Deposition of thick ice sheets on land.
- Massive mass wasting.
- Erosion and deposition of materials.

- Volcanic activities.
- The elasticity of the Sima.
- The existence of mountain ranges.

(3b) Palaeomgnetism is defined as the study of ancient magnetic fields. The earth has a normal magnetic field. This field has been periodically reversed in the past. Such a change in the polarity of the magnetic field of the earth is a magnetic reversal. During normal polarity, they leave near the geographic South Pole and re enters near the geographic North Pole. This orientation is called "normal polarity" because it is the same as the present polarity. During a time of reversed polarity the magnetic lines of the magnetic field runs the other way, leaving earth near the north and entering near the South Pole.

During a magnetic reversal, the North magnetic pole and the South magnetic pole exchange positions. Many rocks contain a record of the strength and direction of the magnetic field at the time the rocks form. During the cooling and crystallization, the iron (magnetite) atoms within the crystal respond to the earth's magnetic field and form magnetic alignments that points towards the North magnetic pole. As the lava cools slowly, below the Curie point (580°C) for magnetite, this magnetic record is permanently trapped in the rocks. Unless the rock is heated again above the Curie temperature this magnetic record is retained and when studied reveals the direction of the earth's magnetic field at the time the lava cooled. Paleomagnetic studies of a series of stacked lava flows have shown that some of the lava flows have a magnetic orientation directly opposite to the earth's present orientation. That is, at the time these lava flows cooled the magnetic poles had exchanged positions. Since lava flows can be dated isotopically, the time of these reversals in the earths past can be determined.

(4i) 1 = Outer zone of spotted slate

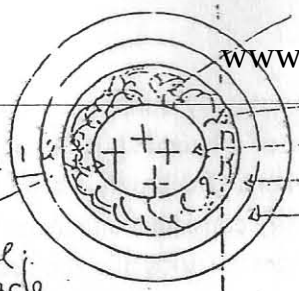
2 = Andalusite zone

3 = Sillimanite zone (zone of hornfels)

(ii) At the zone of spotted clays, the bulk of the rock retains the minerals and textures formed during the earlier phase of regional metamorphism. Chlorite prophyroblast characterize the outer most part of the zone. Chlorites, clay minerals and quartz appear here.

At the Andalusite zone, they is incomplete recrystalization of hornfelses and schists The rocks contain prophyroblast of andalusite and alusites of up to six inches in length set in a ground mass of biotite, muscovite, quartz, feldspars, garnet and staurolite.

At the sillimanite zone you have coarse granoblastic texture of hornfelses containing tufts of small sillimanite needles which appear to grow by the replacement of biotite. Andalusite is not present. At the boarder of the Andalusite and sillimanite zone, sillimanite fibres can be seen



wing on the Andalusite prophyroblast. At the granite contact itself, cordierite appears in ociation with sillimanite in some part of the aureole.

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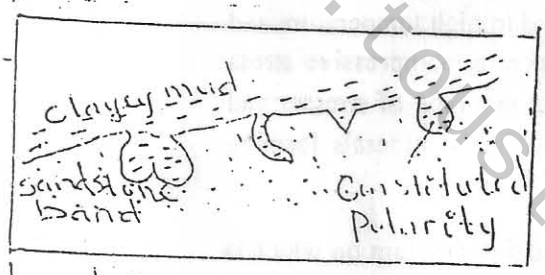
.) Micro folding and banding are common at high grade than low grade regionally etamorphosed rocks because during this period the rocks are subjected to high temperature and essure and at such great depths, there are subjected to greater pressure, compressive stress ading to micro folding (ductile behaviour) of the rocks. More so the operation of stresses and gh temperature results in recrystalization leading to the alignment of new minerals forming anding Unlike at low grade were recrystalization cannot take place.

ii) Load cast is a non directional structure which forms in a sandy marine medium on which is eposited argillaceous mud. Under the effect of gravity, clayey mud turns to sink into the sand ading to the appearance of small bulges. The clay continues to sink and take a spherical form nd at times it detaches. All these are transform into a rock and we have a band of sandstone on hich we find clay. Here the criterion of polarity is indicated by the formation of a small etached bulb (of clay in the sandstone). Flute marks (flute casts) are figures of current or arks of undercutting (weathering due to lateral erosion). They have double significance. They re also indicators of paleo currents and are characteristic of the slow down (drop in speed) of urrent.

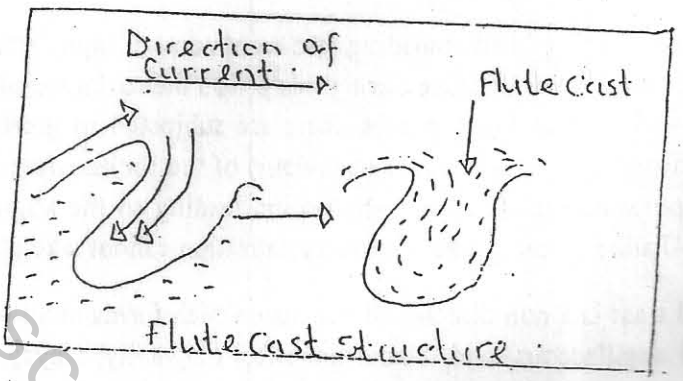
ii) Breccia is a coarse grain sedimentary rock formed by the sedimentation of coarse angular agments of rubble because grains are rounded so rapidly during transport; it is unlikely that the ngular fragments accumulated at the base of a steep slope of rock that is being mechanically eathered. Conglomerate is a coarse grained sedimentary rock formed by the cementation of ounded gravel. It can be distinguished from breccia by the definite roundness of its particles. Their coarse grain nature is an indicator that they have not travelled far but have been transported for a short distance, reason why they are not rounded. There are two types of conglomerate (polymict and oligomict conglomerate)

(iii) Diachronism describes rock unit which appear to be laterally continuous but represent facies produced at different places at different time. Because of a lateral shift in environmental conditions. Such units usually cut across the absolute time plane. Diachronous beds are usually seen occurring between marker beds. These markers are laterally consistent and usually very thin or highly fossiliferous. A facies can be defined as the total characteristics of a rock such as litho logy, the mineralogy, texture structure and fossil content that characterizes a rock as haven't been deposited in a given environment.

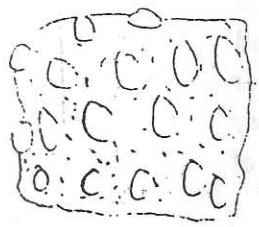
Facies variation refers to the lateral changes due to different environmental conditions in space and time. Sedimentary environments are seen to shift in time. In some cases, a kind of rock produced in a given ancient environment are being deposited at different times in different places and ceased deposition at different times and different places as shown below. In the diagram, there is facie variation between the shales, sandstones and limestone. The shale in the right direction act as Diachronous beds as they occur between the limestone and sandstone marker beds.

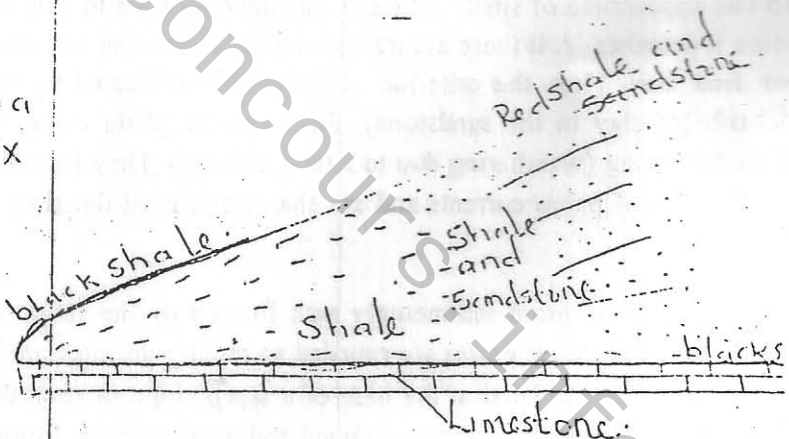


Load Cast structure

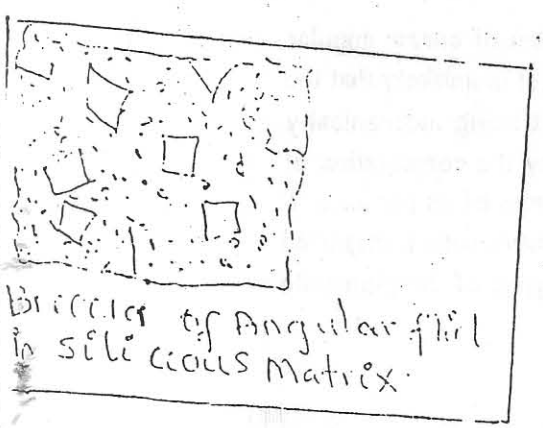


Flute Cast structure


Conglomeratesin a siliceous matrix



Dichronous bed layers


Breccia of Angular fill in siliceous Matrix