UNIVERSITY OF JOHANNESBURG

FACULTY	: Science
DEPARTMENT	: Geology
CAMPUS	: APK
MODULE	: GLG22A2 SEDIMENTOLOGY AND STRATIGRAPHY
SEMESTER	: First/ Second
EXAM	: **Special Exam Jul 2021**

DATE	: Jul 2021	**SESSION**	:
ASSESSOR(S)	: DR C VORSTER		
	PROF M De KOCK		
MODERATOR	: PROF Z JINNAH (WITS)		
DURATION	: 3 HOURS	**MARKS**	: 120

NUMBER OF PAGES: 3 PAGES

INSTRUCTIONS:

1. Answer ALL THE QUESTIONS.
2. Number your answers clearly
3. Answer section A and section B in separate books

SECTION A: (60 MARKS)

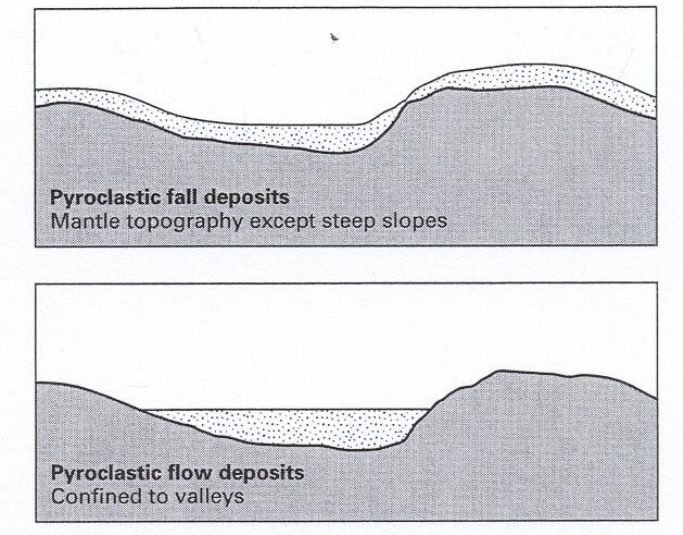
QUESTION 1 (15 MARKS)

1.1) Polymict paraconglomerate
1.2) Lithic fragments
1.3) Chemical maturity
1.4) Mudrock
1.5) Ash (fine ash)
1.6) Stromatolites
1.7) Zoophycos
1.8) Ooids
1.9) Nodular/secondary chert.
1.10) Phosphorites
1.11) Macerals
1.12) Turbulent flow
1.13) Wave base.
1.14) Dune
1.15) Tool mark

QUESTION 2 (10 MARKS)

- Grain size – clay – silt – sand – gravel
- Grain surface features - roundness
- Grain/clast shape – angular to sphericity
- If relevant, ratio of matrix to grains.
- Presence or absence of cement.
- Mineralogy – for sandstones for example feldspar, clay, quartz, rock fragments.
- Mineralogy – for mudrocks – clay composition
- Sorting of the component grains – VW to VP sorted

QUESTION 3 (8 MARKS)



Pyroclastic fall deposits:

- When an explosive volcanic eruption sends a cloud of debris into the air the pyroclastic fragments may return to the ground under gravity
- Volcanic blocks and bombs travel only a matter of hundreds of metres to kilometres from the vent, depending on the force with which they were ejected.
- Finer lapilli and ash may be sent kilometres into the atmosphere and be distributed by wind, and large eruptions can result in ash distributed thousands of kilometres from the volcano.
- A distinctive feature of air-fall deposits is that they mantle (cover) the topography forming an even layer over all but the steepest ground surface.
- The deposits become thinner and are composed of finer grained material with increasing distance from the volcanic vent

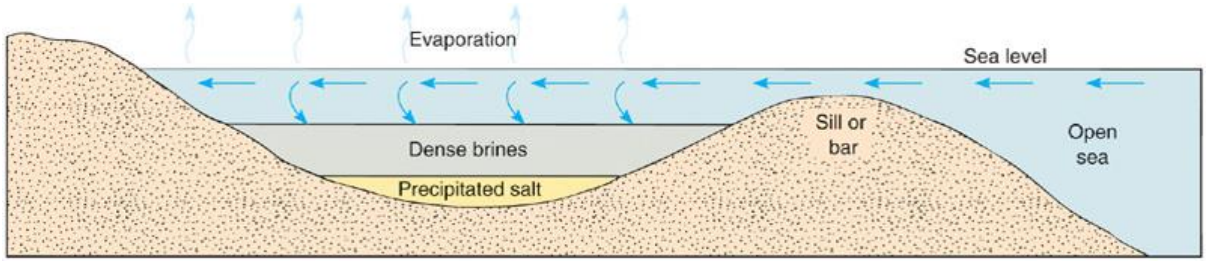
Pyroclastic fall deposits:

- Mixtures of volcanic particles and gases can form masses of material that move in the same way as other sediment–fluid mixtures (mass flow or gravity flow deposit).
- If the sediment-fluid mixture contains a large proportion of pyroclastic particles it called a pyroclastic flow.
- They are essentially high speed mixture of gas, rock fragments and ash.
- These dense, gravity-driven currents /flows travel along the ground, close to surface
- Can travel up to 100's km per hour at 1,000°C
- Deposits are mostly confined to valleys
- Types of deposits that can form are block-and ash flow deposits, scoria flow deposits and ignimbrites.

QUESTION 4 (9 MARKS):

A physical barrier positioned at a basin mouth can function as a screen/filter, turning

the basin into an evaporation “pan”.
At times of high tide or during storm surges, seawater of normal salinity washes over the barrier and replenishes the seawater stock in the “barred” basin or pan.
During episodes of low tide, especially those than occur during the middle of the day when temperatures are at their highest, rapid evaporation of water from the barred basin can occur.
This raises the salinity of the water in the pan and crystallization of minerals can occur.



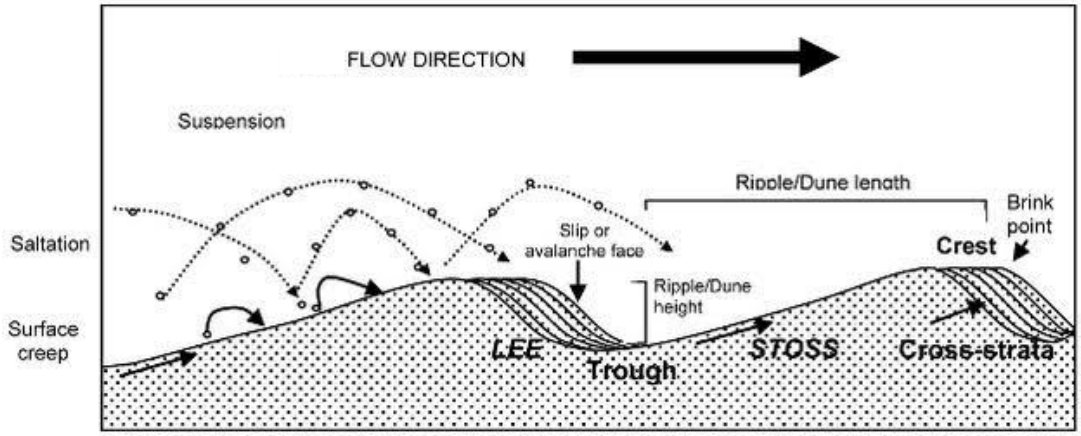
QUESTION 5 (10 MARKS):

Consists of centimeter thick interlayered alternating bands of chert (jasper) and iron-rich minerals.
Iron was transported in solution (must have been Fe^{2+}) and concentrated by precipitation.
Implies that the ocean waters where not oxygenated otherwise Fe would not be soluble.

Source of the iron: Hydrothermal vents (most well accepted theory) or weathering.
In Proterozoic times, the oceans were most likely stratified into deeper masses of anoxic (no –oxygen) bottom waters containing large amounts of iron in solution (Fe^{2+}).
Surface waters were less dense and oxic. With the appearance of photosynthetic organisms (likely during the Archean), O_2 began to enter the atmosphere
Photosynthetic organisms take up CO_2 from the atmosphere and release O_2
BUT almost all of this O_2 reacted with minerals and became trapped in mineral structures so that the amount of free oxygen in the atmosphere was minimal.
At about 2.4 Ga, photosynthetic organisms have evolved and developed to the extend that more O_2 entered the atmosphere than could be absorbed by minerals.
O_2 began to collect in the atmosphere → known as the GREAT OXYGENATION (OR OXIDATION) EVENT (GOE).
Soon the surface waters of the ocean would also become oxygenates.

Periodic overturning of the ocean water (when the waters at the bottom rises to interact with water closer to the surface) and upwelling of water onto subjacent shelf areas, resulted in the precipitation of iron-rich mud rock and alternating episodes of chert precipitation.
When the Fe^{2+} from the deeper water rises up and comes in contact with oxygenated surface water, it becomes oxidized (to Fe^{3+}) and precipitates out of solution.

QUESTION 6 (8 MARKS):



END OF SECTION A

SECTION B: (60 MARKS)

QUESTION 9 (13 MARKS)

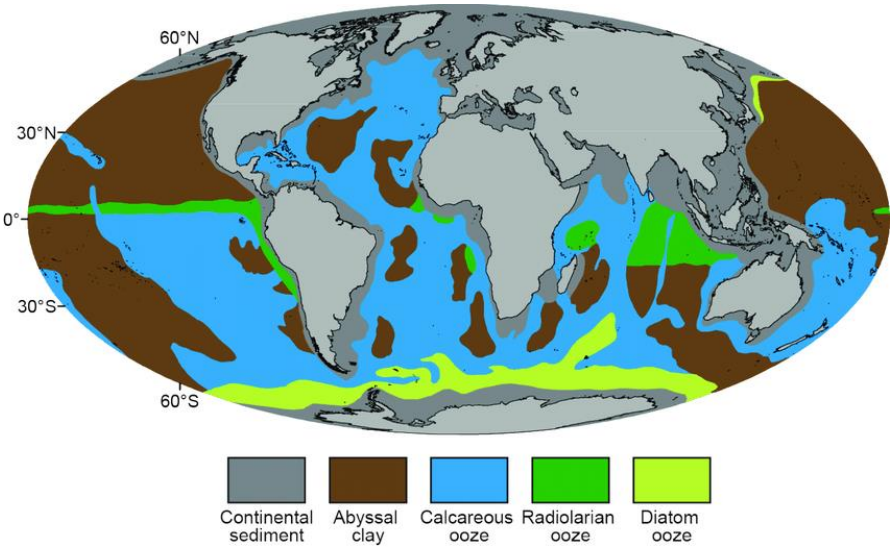
9.1. **Hemipelagic:** a type of marine sediment that consists of clay and silt-sized grains that are terrigenous and some biogenic material derived from the landmass nearest the deposits or from organisms living in the water.

> 25% of fraction > 5 μm of terrigenous, neritic or volcanic origin

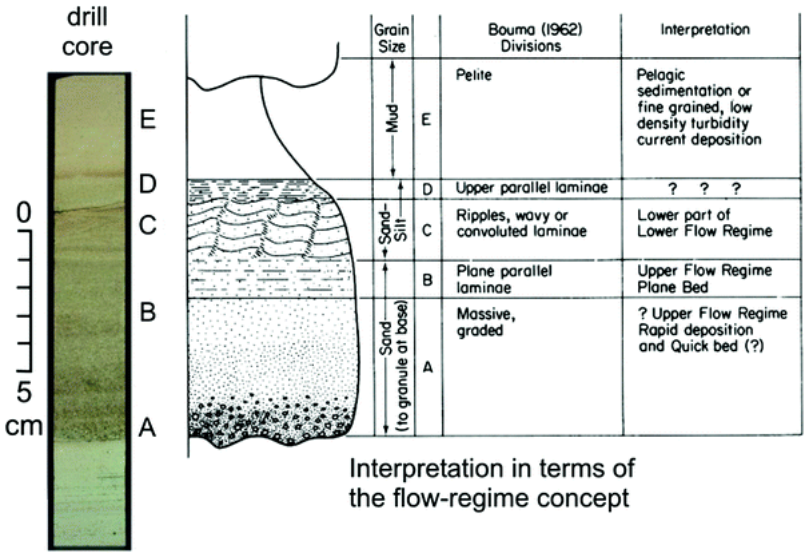
Pelagic: fine-grained sediment that accumulates as the result of the settling of particles to the floor of the open ocean, far from land. These particles consist primarily of either the microscopic, calcareous or siliceous shells of phytoplankton or zooplankton; clay-size siliciclastic sediment; or some mixture of these. Variable amounts of volcanic ash also occur within pelagic sediments. Based upon the composition of the ooze, there are three main types of pelagic sediments: siliceous oozes (>30% biocalsts), calcareous oozes (>30% bioclasts), and red clays (<30% bioclasts).

< 25% of fraction > 5 μm of terrigenous, neritic or volcanic origin

9.2.



QUESTION 10 (10 MARKS)



QUESTION 11 (12 MARKS)

11.1. Skolithos is a common trace fossil ichnogenus that is, or was originally, an approximately vertical cylindrical burrow. It is produced by a variety of organisms in shallow marine environments globally and appear as lineated features in sedimentary rocks.

11.2. An estuary is a semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage.

11.3. Dropstones are isolated fragments of rock found within finer-grained water-deposited sedimentary rocks or pyroclastic beds. They range in size from small pebbles to boulders. Typically form the melting from floating sea ice or ice bergs.

11.4. The foreshore is the area of a coastline that is situated between maximum high water mark and the maximum low water mark.

11.5. Walther's Law states that any vertical progression of facies is the result of a succession of depositional environments that are laterally juxtaposed to each other.

The answer should include a sketch.

QUESTION 12 (20 MARKS)

Students are expected to discuss allogenic and autogenic controls on alluvial fan systems.

Physical processes

Slope

Distance from source

Source composition

Tectonics

Climate

Accommodation space

Biological evolution through time

QUESTION 13 (5 MARKS)

Continental glaciers are associated with glacio-tectonized bedrock (striations and grooves).

Facies associations include loess and fluvio-glacial sediments.

Dominated by poorly sorted matrix supported tillite.

Can be associated with glacial features like kamme, eskers, or drumlins.

SECTION B: (60 MARKS)

END OF SECTION B