IISER PUNE

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH PUNE

MID-Semester Examination, January-2020

Course code: EC-1213 Course name: Evolution of Earth and life

Duration: 2 hrs Date: 22nd February 2020

Instructor name: Dr. Gyana R Tripathy Total points: 35 marks

Instructions:

(i) This question paper consists of 11 questions and 2 printed pages. Please verify that the question paper you have received has all the questions in sequential order.

(ii) Answer **ALL** questions from Group A and any **FIVE** from the Group B.

Group-A (Answer **ALL** questions)

1. A mafic rock crystalized 2.02×10^9 years ago and had an initial $^{87}Sr/^{86}Sr$ of 0.7020. Estimate the Rb/Sr ratio (by weight) of the upper mantle from which the magma was withdrawn, assuming a primordial $^{87}Sr/^{86}Sr$ of 0.69897 and an Earth age of 4.6×10^9 years. Atomic weights of Sr (87.589 amu) and Rb (85.468 amu) are given. The decay constant of ^{87}Rb is 1.42×10^{-11} yr^{-1}. Abundance of ^{87}Rb (27.8%), ^{87}Sr (7.04 %) and ^{86}Sr (9.9%) are also provided. [5 marks]

2. (i) What do you mean by the word "clastic"? Explain, briefly, how sequence of sediment deposition (such as- shale, limestone and sandstone) can help us understand the past sea level changes. (ii) The U and Th concentrations of a marine sedimentary rock are 22 µg/g and 3 µg/g respectively. Compute what fraction of uranium in this rock is detrital in nature. Given that average U/Th ratio of the upper continental crust is 3.0. [4 marks]

3. Fill in the blanks in the following table. Your answer must arrange these rocks in the increasing order of their silica content; the rock with lowest silica should be at the top of your table and highest silica containing rock should be at the bottom. [4 marks]

Name of Intrusive rock	Name of the corresponding Extrusive rock	Name two minerals present in the rock
----	Andesite	----
----	Rhyolite	----
Gabbro	----	----

4. Concentrations of dissolved ions in a river are as follows: [Na] = 120 μM; [K] =50 μM; [Ca] = 300 μM; [Mg] = 200 μM; [Cl] = 20 μM. The Ca/Na and Mg/Na molar ratios of the silicate rocks present in the basin are 0.7 and 0.3 respectively. Calculate the carbonate weathering rate (in mm/yr) for this river basin. Water discharge for the river is 1×10^{12} L/yr; Area = 2×10^{5} km^2. Assume atomic weight of Ca (40 amu), Mg (24.3 amu), K (39.1 amu) and Na (21 amu). The density of carbonate minerals is 2.7 gm/cm^3. [4 marks]

5. Radiometric dating of sediment layers from a paleo-lake (a lake that existed in the past) was investigated. Ages for two depth layers from this lake are provided below. Using this data, (i) estimate the sedimentation rate for this lake? (ii) When did this lake become dead? [3 marks]

Depth (in cm from top layer)	Age (in kilo-years)
60 cm	1.8 kiloyears
560 cm	3.8 kiloyears

Group-B (Answer (***short notes***) on any **FIVE** questions; the **first five** attempted answers will be evaluated)

6. What do you mean by hydrogen burning process? What is the typical temperature required for this process? [3 marks]

7. Discuss the moon formation process. What chemical evidence that supports this hypothesis? [3 marks]

8. What was the atmospheric oxygen level before great oxidation event? How does sulphur isotope help in tracing the evolution of atmospheric oxygen level. [3 marks]

9. What is the major source of water to the planet Earth? Provide a relevant graph in support of your answer. [3 marks]

10. Discuss briefly how we can constrain the timing of core formation in our planet? [3 marks]

11. (i) What type of plate boundary is responsible for uplift of Himalaya? (ii) What is the source of geothermal heat inside the earth? [3 marks]