IISER-Kolkata
ES 1201
Mid-Semester Examination, 2019
Time: 1 Hour, Full Marks: 20

Question 1

(i) For the isochron method of geochronology, one needs at least three minerals that have

(a) crystallized from the same magma with the same parent/daughter isotope ratio
(b) crystallized from different magmas with different parent/daughter isotope ratio
(c) crystallized from the same magma with different parent/daughter isotope ratio

(ii) Zircon analysis of a rock that follows below Concordia in Pb-isotope diagram indicates

(a) The minerals crystallized from a magma at the same time and did not change isotope composition
(b) The minerals crystallized from a magma at the same time but experienced a later disturbance in isotopic ratios
(c) The minerals crystallized from different magmas at different times and did not change isotopic composition

(iii) Among the following, where would you expect ^{26}Mg ?

(a) Very old crustal rocks
(b) Martian rocks / meteorites coming from Mars
(c) In the earth's core

(iv) Very early formation of the Earth's core would result in

(a) An increase in $^{187}Os/^{188}Os$ in the solid inner core
(b) An increase in the liquid outer core
(c) An increase in the mantle over chondrite

(v) If segregation of the earth's core took place very early in the history (first 20-30 million years), then,

(a) The mantle will have less ^{182}W than chondrite
(b) The mantle will have more ^{182}W than chondrite
(c) The mantle will have same ^{182}W as chondrite

(vi) An one-billion year old magma generated in the Mantle will have

(a) Lower $^{87}Sr/^{86}Sr$ ratio than the then bulk earth
(b) Higher $^{87}Sr/^{86}Sr$ ratio than the then bulk earth
(c) Same $^{87}Sr/^{86}Sr$ ratio as in bulk earth

(vii) If there is progressive cooling of the earth's mantle, older mantle-derived magmas should have come from

(a) Greater depths
(b) Shallower depths
(c) Any depth

(viii) **With increase in Nusselt Number, the thickness of the Thermal Boundary Layer**

(a) Increases

(b) Decreases

(c) Does not change

(ix) **The lower limit of the Thermal Boundary Layer in the Earth coincides with**

(a) Moho

(b) Upper crust-lower crust boundary

(c) Base of the lithosphere

(x) **One possible model of the Mantle (not considering a layered structure) is**

(a) Lava lump model

(b) Plum cake model

(c) Water filter model

10x0.5=5 Marks

Question 2: Fill up the blanks

(xi) Concentration of heat producing elements in the upper continental crust is --- than that in the lower crust

(xii) The main site of continental crustal growth today is in ------ environment

(xiii) Peeling-off tectonics in early earth does not take the ----- continental crust down in the mantle

(xiv) Most of the arc magma is generated by melting of the ------ ------ lying above the subducted oceanic slab

4x0.5=2 Marks

Question 3: Answer the following questions with major points only. Answer with bullet points is acceptable. Lengthy unnecessary narration is to be avoided.

1. What are the isotopic evidences suggesting origin of Hawaiian lavas from great depths, perhaps from the D'' layer ? (1)
2. What is the isotopic evidence from oceanic reservoirs that some upper continental crust must have been subducted? (1)
3. How does oxygen isotope ratios throw light on previous occurrences of snowball earth? (2)
4. What are the properties of the mantle that attempt to retard convection? (2)
5. What are the effects of internal heat production on the convective cycle in the mantle ? (2)
6. What are the major influx from the crust to the mantle? (2)
7. What is subduction factory? (2)
8. What is the major change in composition of garnet found in the Transition Zone? (1)

13 Marks (1+1+2+2+2+2+2+1)