

EXAM "CHEMICAL GEODYNAMICS" 29 January 2014

Answer the questions only on these papers. Use the backside if necessary. Write your name and number on each sheet.

Name and number

1. (a) Explain as precisely as possible the principle behind the term 'electron capture' as one of the mechanisms of nuclear decay.

- (b) Indicate in the picture below how the number of neutrons and/or the number of protons will change during electron-capture decay

number of protons				
		number of neutrons		

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2. The equation on which the isochron diagram for the Rb-Sr system is based is:

$$^{87}\text{Sr}/^{86}\text{Sr} = (^{87}\text{Sr}/^{86}\text{Sr})_i + ^{87}\text{Rb}/^{86}\text{Sr}(e^{\lambda t} - 1)$$

Explain as precisely as possible (a) how such a diagram is constructed, (b) how you can obtain absolute age dates from it, and (c) which factors will determine any errors in the ages obtained.

What are the two most important assumptions that should be met for a reliable geochronological application?

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3. (a) Use an ϵ_{Nd} vs time diagram (or $^{143}\text{Nd}/^{144}\text{Nd}$ vs. time) to explain the concept of 'crustal residence time'. Illustrate also the difference between 'model ages' based on CHUR and based on 'depleted mantle'.

(b) A sample of granite has $^{143}\text{Nd}/^{144}\text{Nd}$ and $^{147}\text{Sm}/^{144}\text{Nd}$ of 0.51215 and 0.1342, respectively. The present chondritic $^{143}\text{Nd}/^{144}\text{Nd}$ and $^{147}\text{Sm}/^{144}\text{Nd}$ are 0.512638 and 0.1967, respectively. The decay constant of ^{147}Sm is $6.54 \times 10^{-12} \text{ Ga}^{-1}$. Calculate the τ_{CHUR} , i.e., crustal residence time relative to a chondritic mantle, for this granite.

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4. Explain as precisely and completely as possible why in an isotope diagram with ϵ_{Nd} (or $^{143}\text{Nd}/^{144}\text{Nd}$) on the y-axis and $^{87}\text{Sr}/^{86}\text{Sr}$ on the x-axis the fields for MORB and continental crust fall on opposite sides of the "Bulk Earth", namely in the upper left and lower right quadrants, respectively.

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5. What makes zircon an 'ideal' mineral for age dating? Explain the concept of the concordia diagram ($^{207}\text{Pb}^*/^{235}\text{U}$ vs. $^{206}\text{Pb}^*/^{238}\text{U}$) and discordia lines in it.

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6. Sketch the patterns of an OIB and a MORB rock in a chondrite-normalized REE diagram, and give a plausible explanation for the difference between the two.

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7. From a detailed comparison of volcanics from different island arcs and associated sediments, it appears that a correlation exists between the amount of trace elements (e.g., Ba or Th) that is supplied to the trench via the sediment flux and the concentration levels of these elements in the volcanics. Explain why for a proper comparison not just the concentrations in the volcanics should be taken, but that ratios such as $Ba_{6.0}/Na_{6.0}$ or $Th_{6.0}/Na_{6.0}$ must be used.

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8. Explain the way(s) in which we can determine the composition of the entire continental crust, and what problems might be involved to obtain a reliable result.