The r-process of nucleosynthesis: the influence of nuclear data on the abundance pattern

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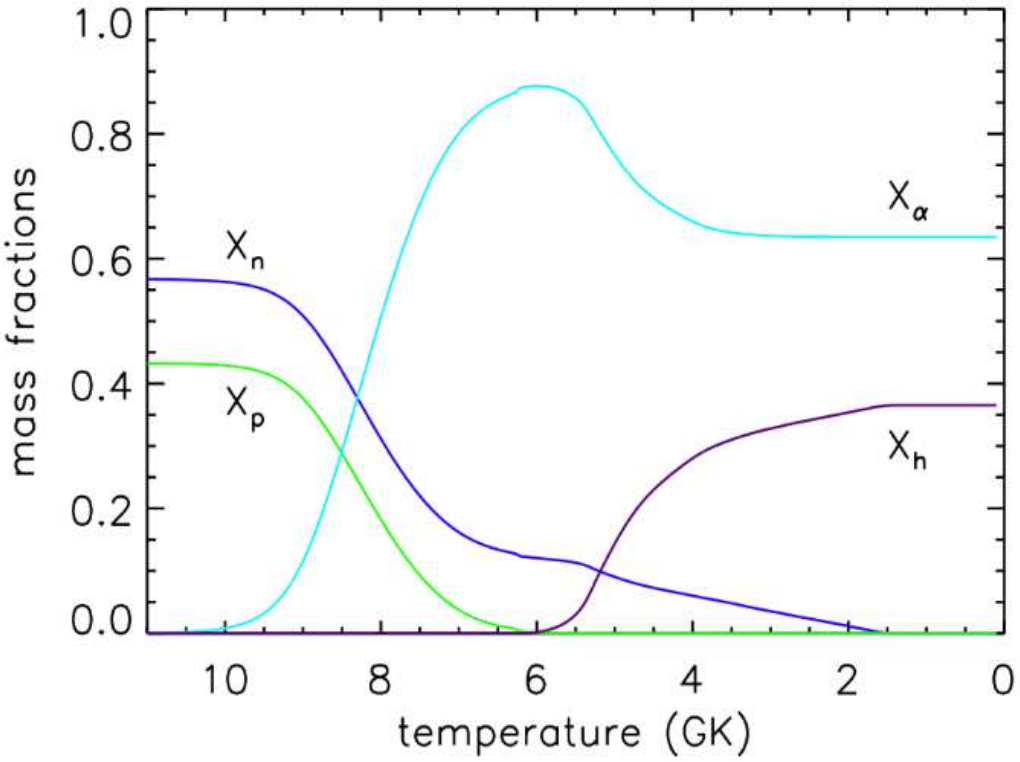
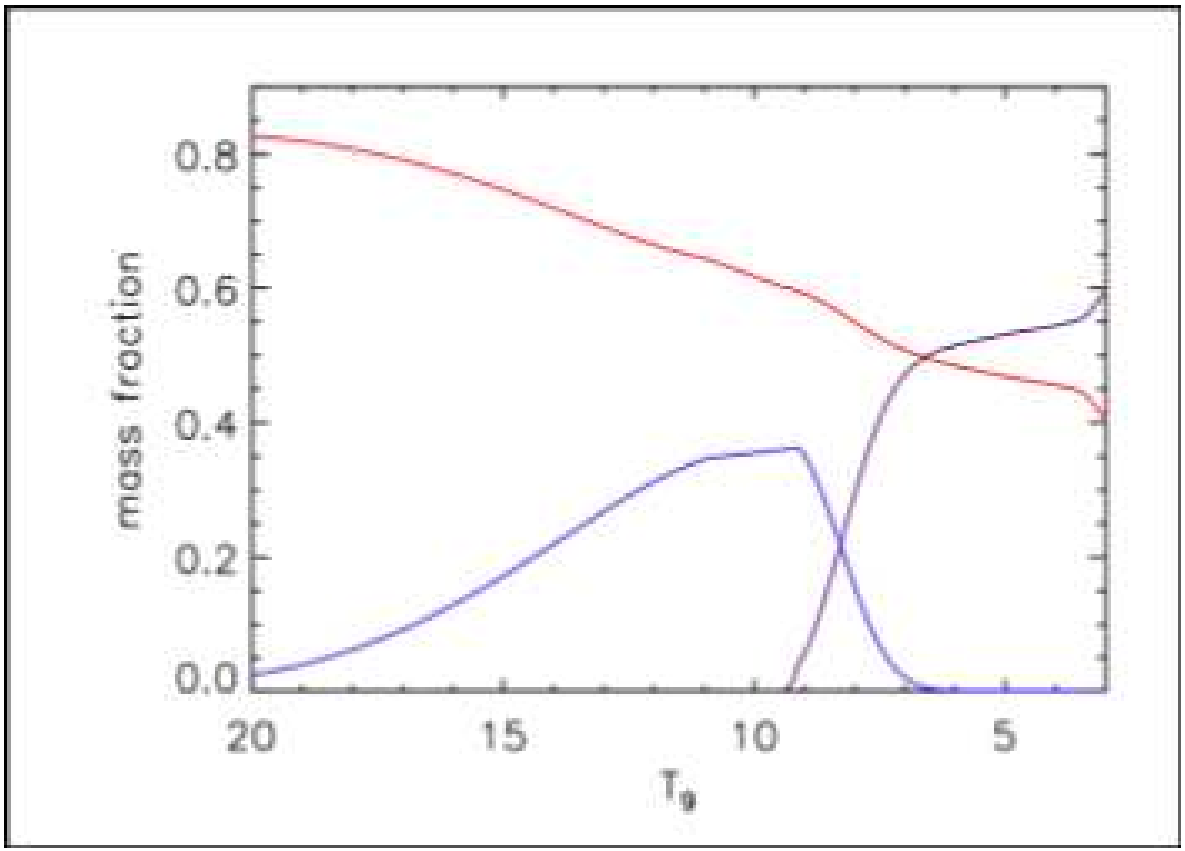
Recall from yesterday: whats happening here?



Recall from yesteday: what is happening here?



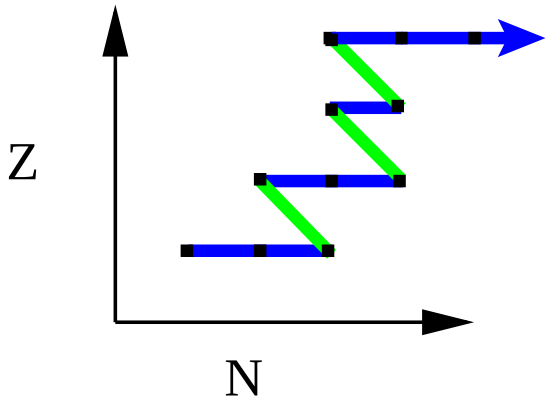
red: neutrons, blue: protons, purple: alphas

r-process

e. g. Uranium-238 Z=92, N=146 $\rightarrow$ need lots of neutrons

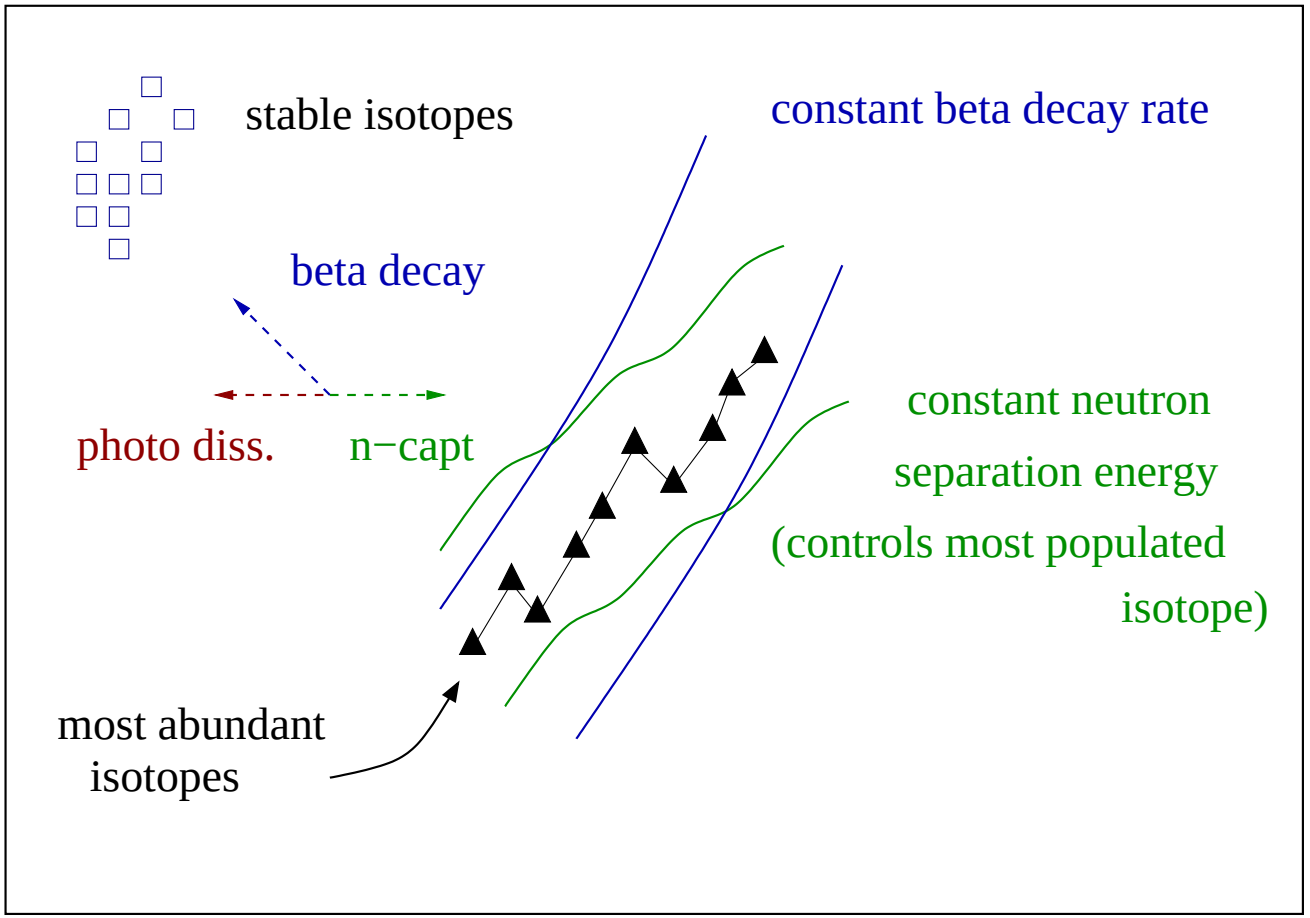
$$A(Z,N) + n \leftrightarrow A+1(Z,N+1) + \gamma$$

$$A(Z,N) \rightarrow A(Z+1,N-1) + e^- + \bar{\nu}_e$$

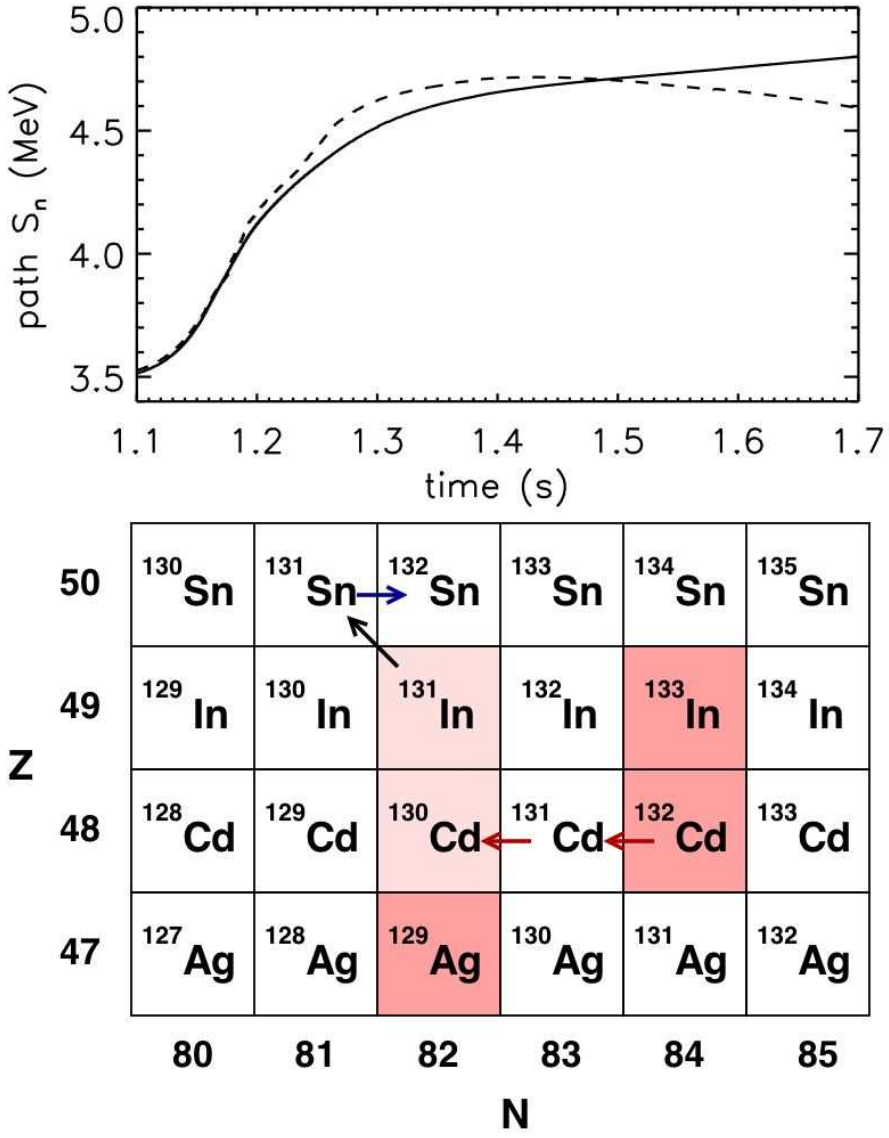


rapid neutron capture as compared with beta decay

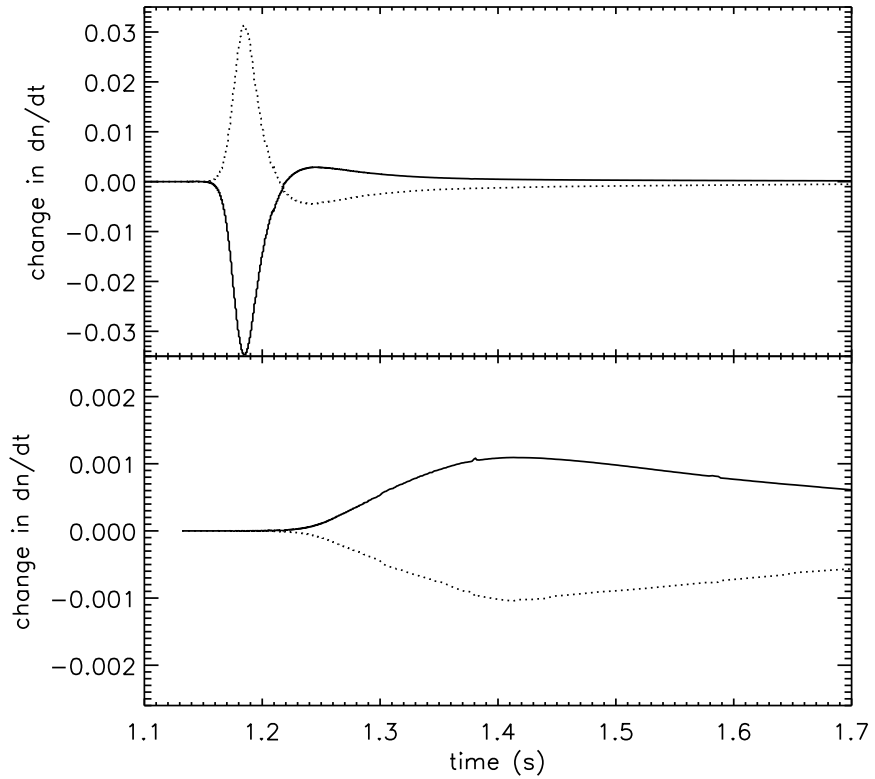
How to read r-process flow plots



Equilibrium and Actual Separation Energies



Effect of changing separation energies, capture rates

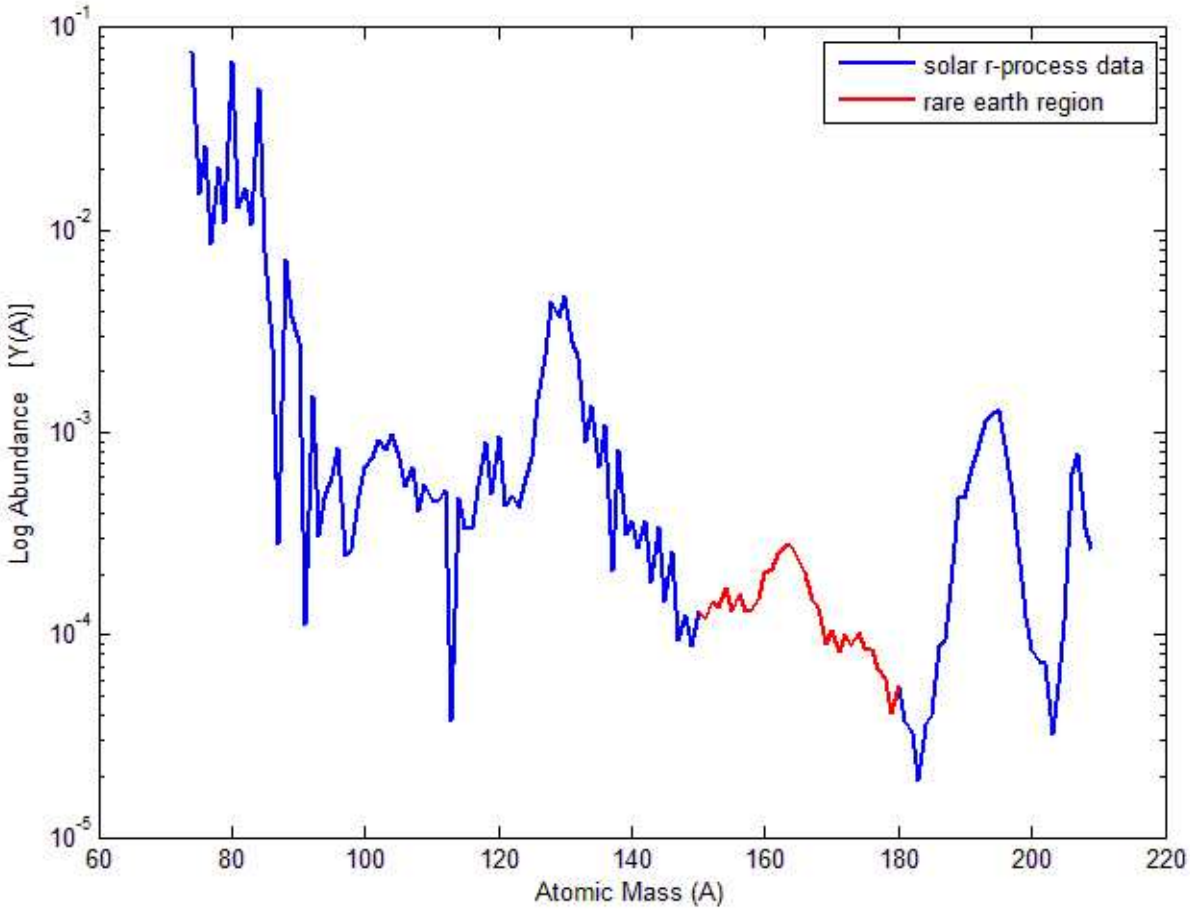


Suppose we increase photo-dissociation/capture rates

Solid - change in the 130 peak rate of "eating" neutrons

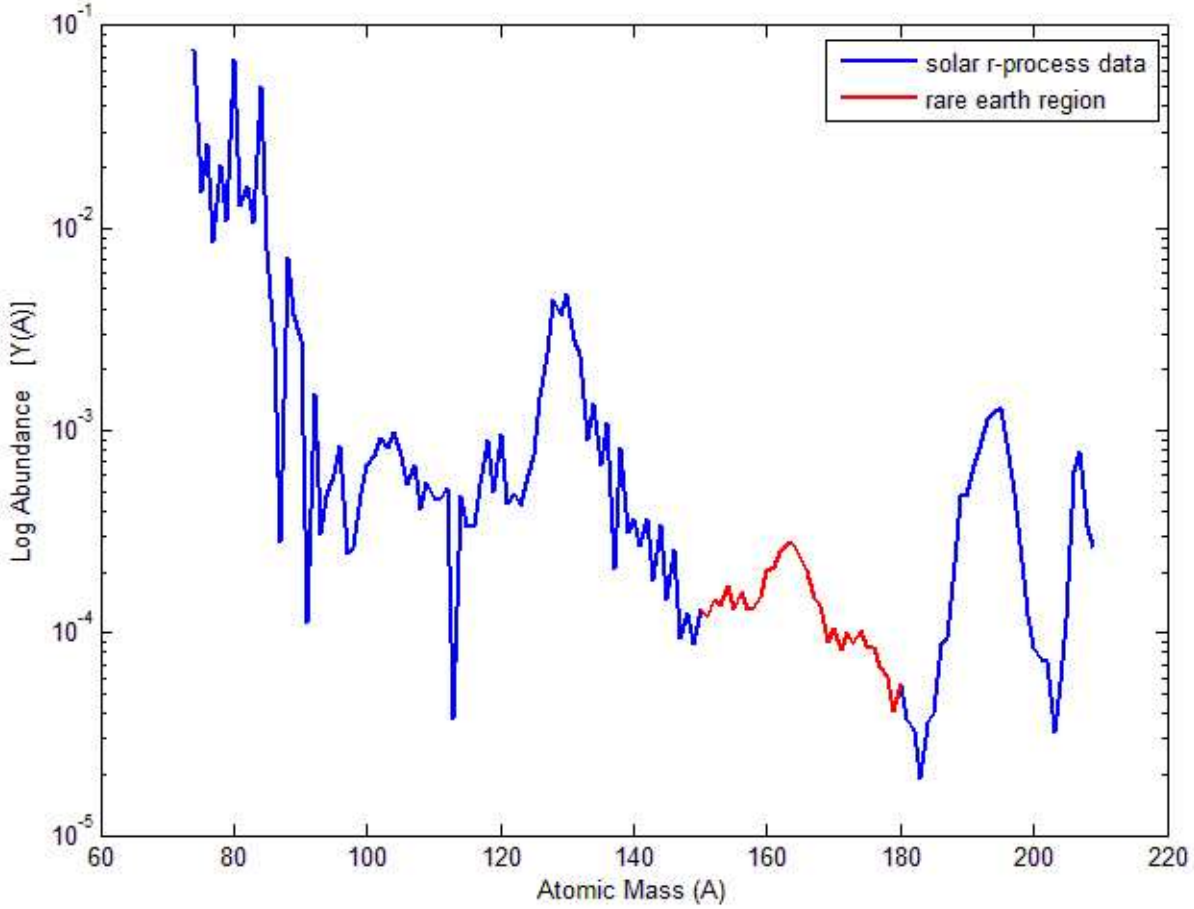
Dotted - change in the rest of the abundance patterns rate of "eating" neutrons

How does the rare earth peak form?



Solar abundance data with the rare earth peak in red

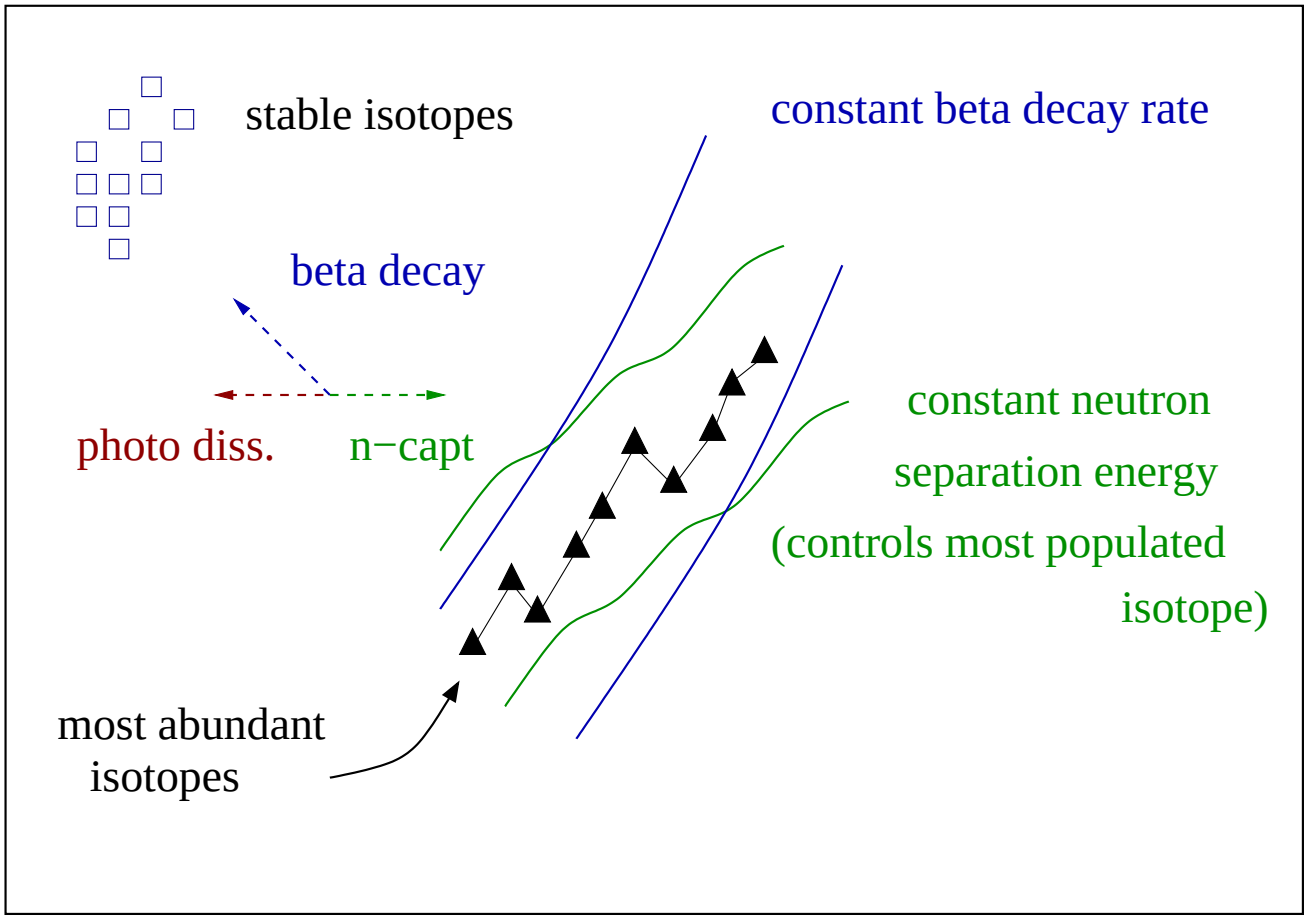
The rare earth peak: how did it form?



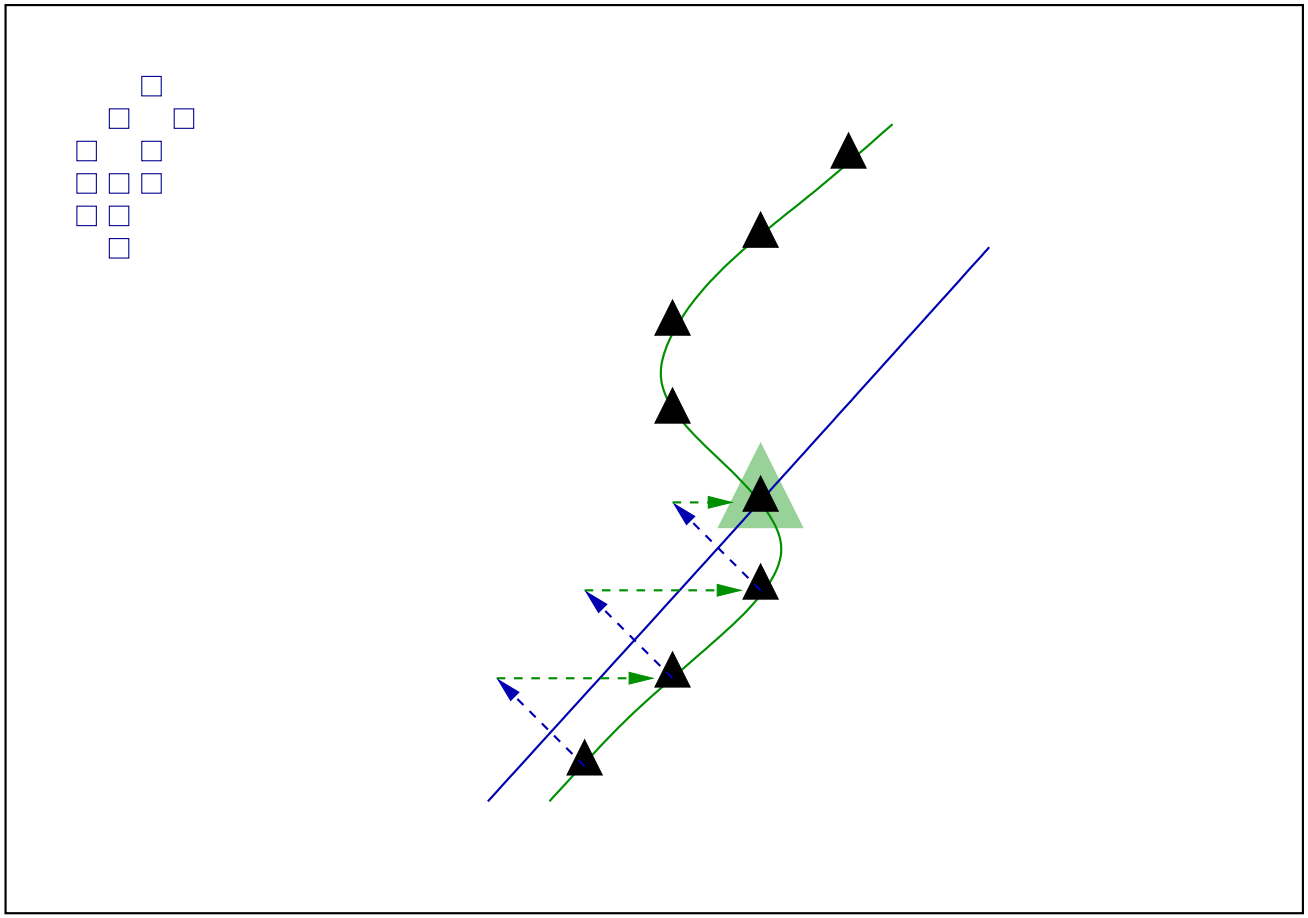
Fission cycling or neutron capture?

In most models it forms by a "pile-up" of nuclei in the slow drift back to stability, i.e. through neutron capture.

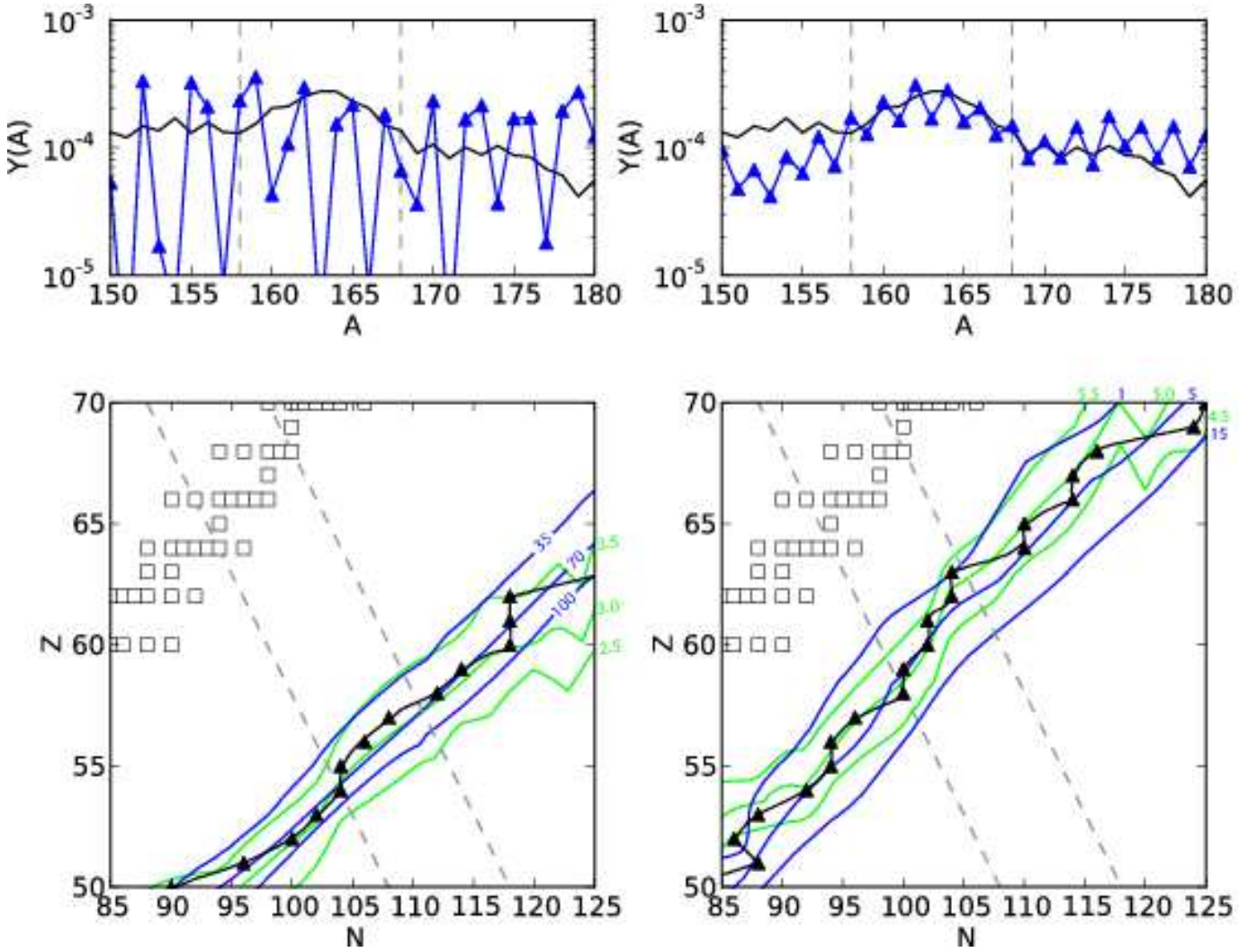
How to read r-process flow plots



How to form structures

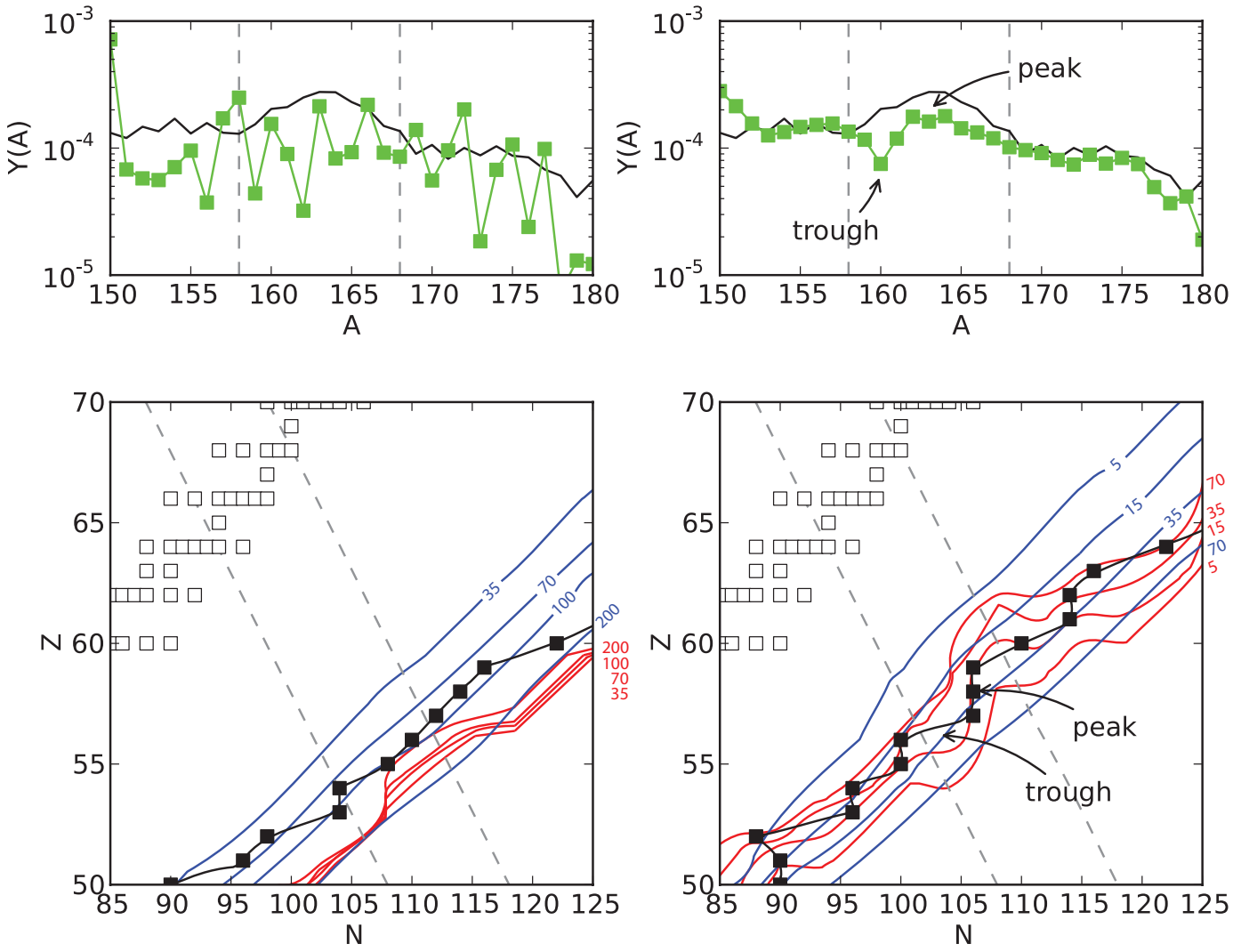


Hot Peak Formation - FRDM Mumpower et al 2012

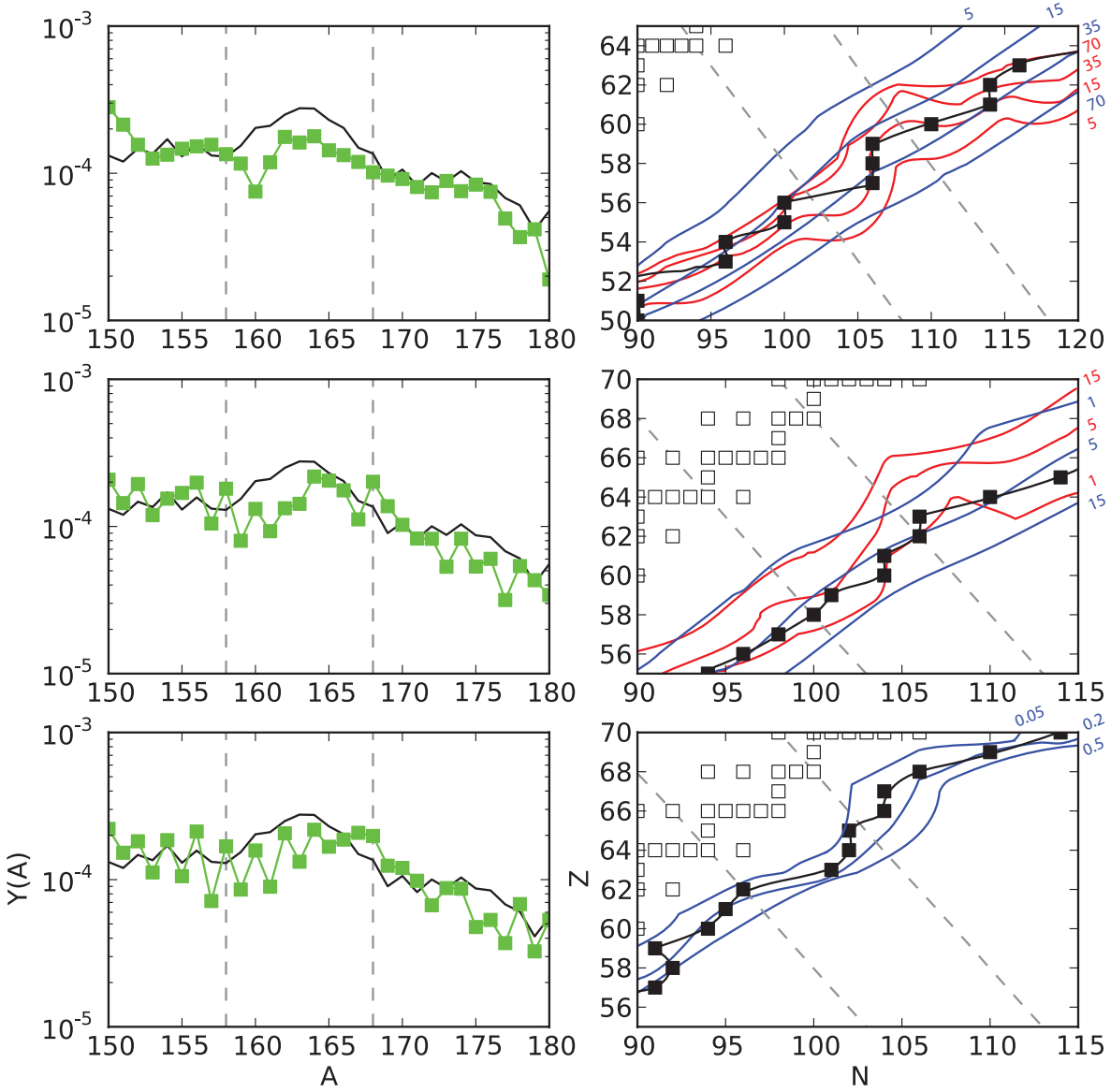


Cold Peak Formation - ETFSI

Mumpower et al 2012

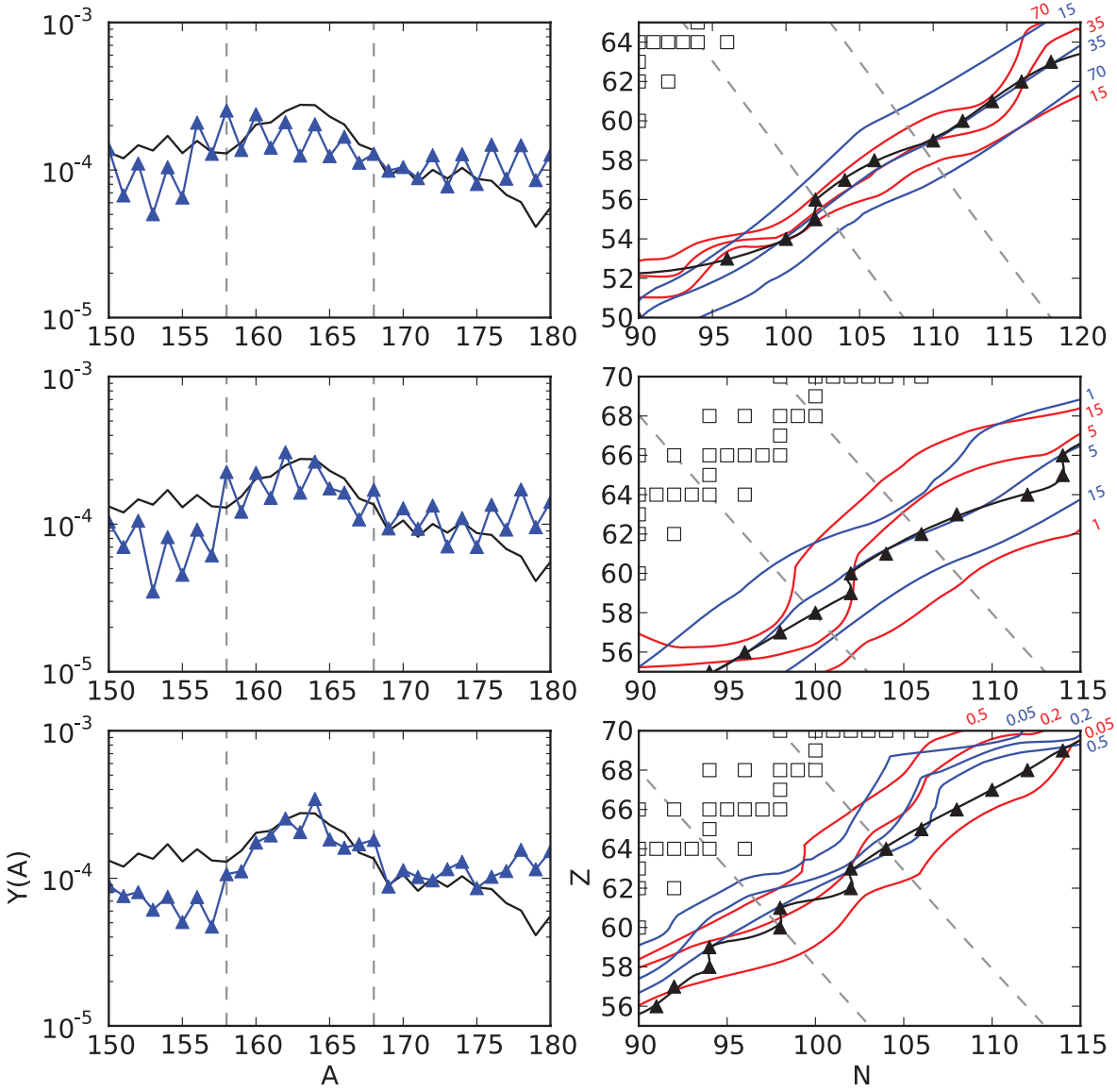


ETFSI decay to stability



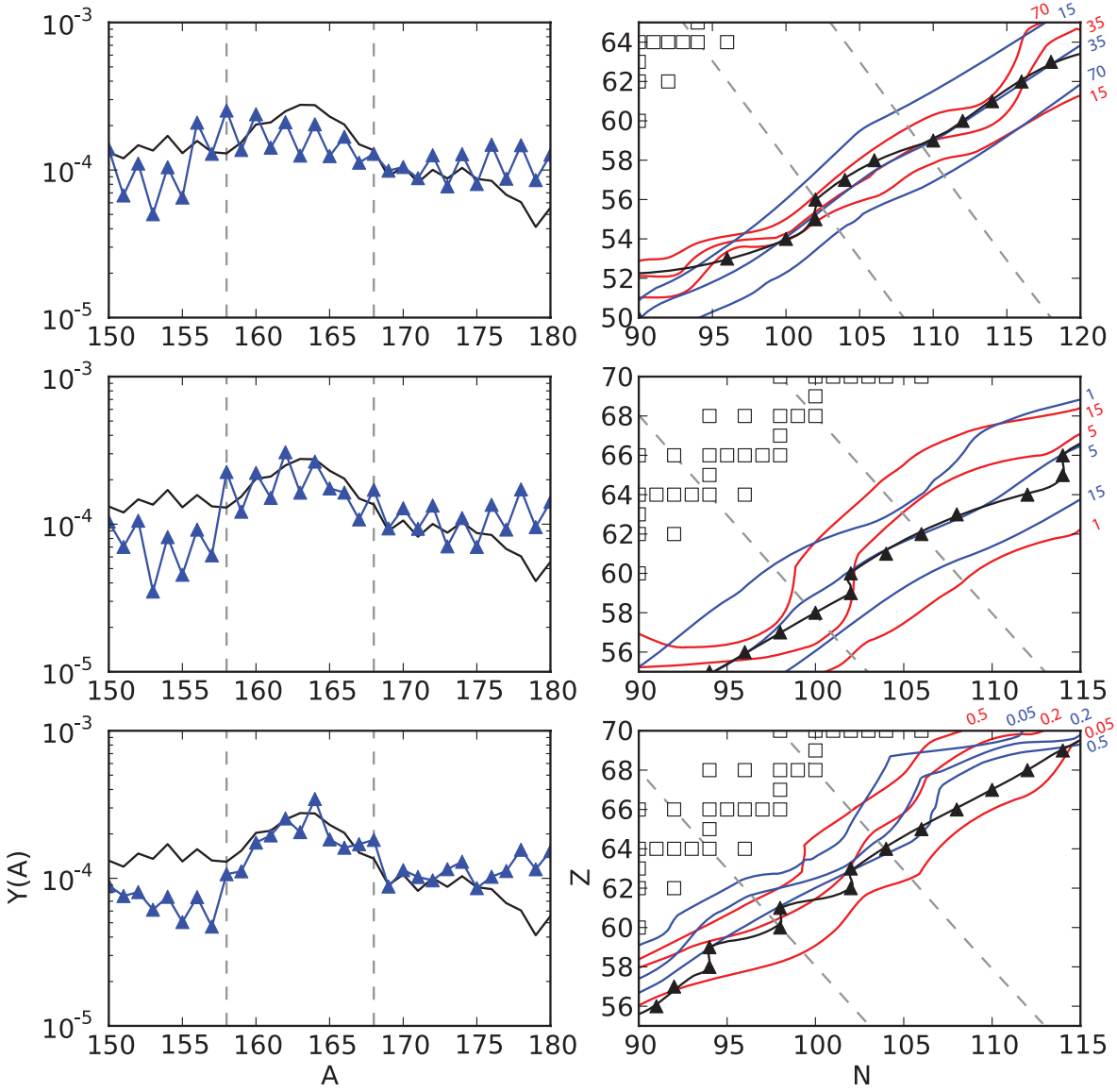
Calculation with the ETFSI model

FRDM decay to stability



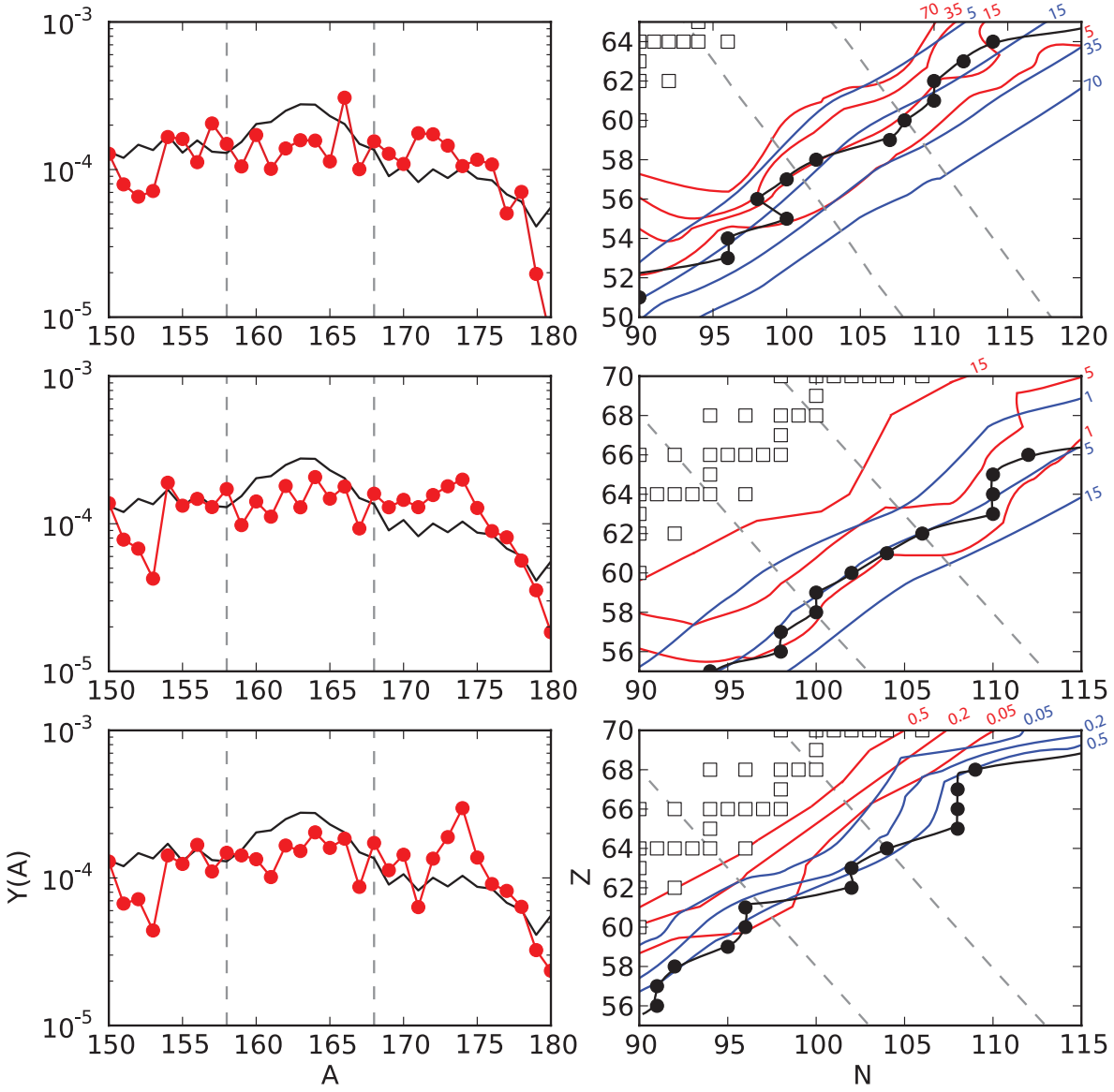
Calculation with the FRDM model

FRDM decay to stability



Calculation with the FRDM model

HFB-17 decay to stability



Calculation with the FRDM model