Stellar lifetime and abundance ratios in chemical evolution

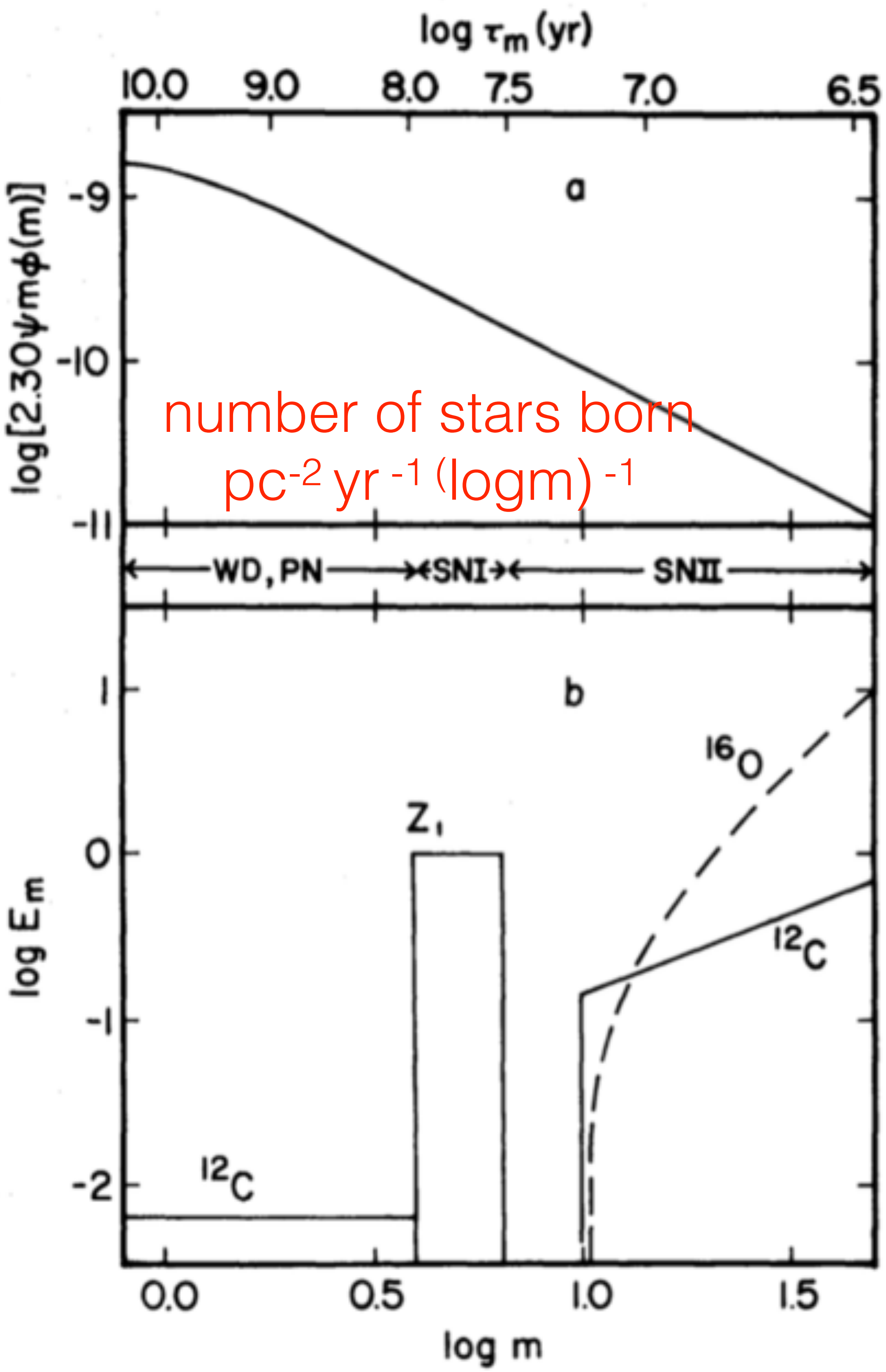
Beatrice 1979

present by Siyao Jia

Outline:

1. Models and assumptions.
2. relative abundances of common primary elements (C, O, Fe)
3. secondary and primary abundances ratios.(Ba, N)

Models and assumptions



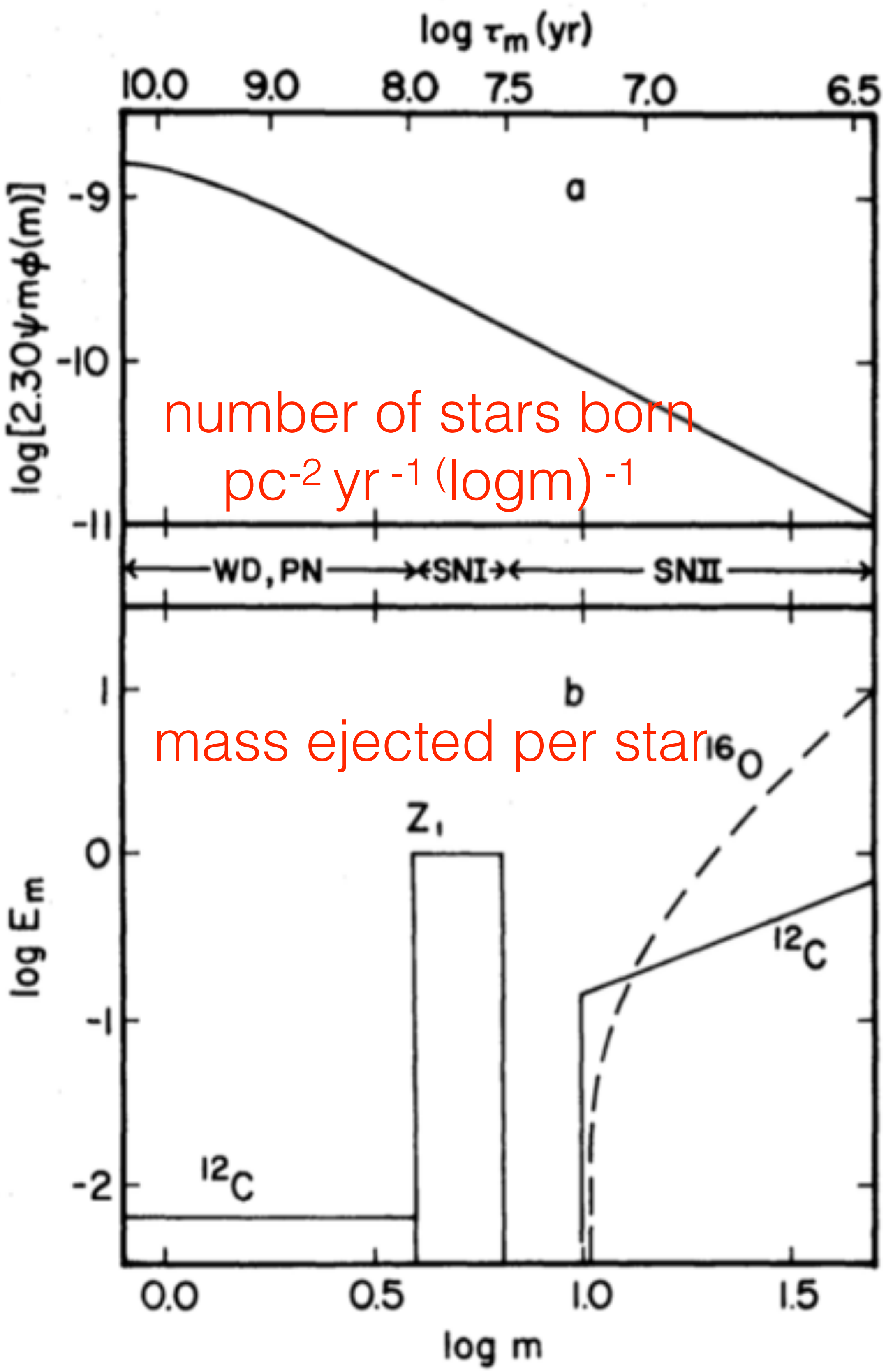
IMF:

$$\phi(m) = 0.156\,\mathrm{m}^{-2.3}, \quad 2 < m \le 50$$
$$= 0.127\,\mathrm{m}^{-2.0}, \quad 1 < m \le 2$$
$$= 0.127\,\mathrm{m}^{-1.25}, \quad 0.8 < m \le 1$$

How stars die:

1. white dwarf:
   Initial mass < 4 solar mass
2. SN I: (Ia?)
   4 solar <Initial mass < 6.5 solar
3. SN II:
   Initial mass > 6.5 solar

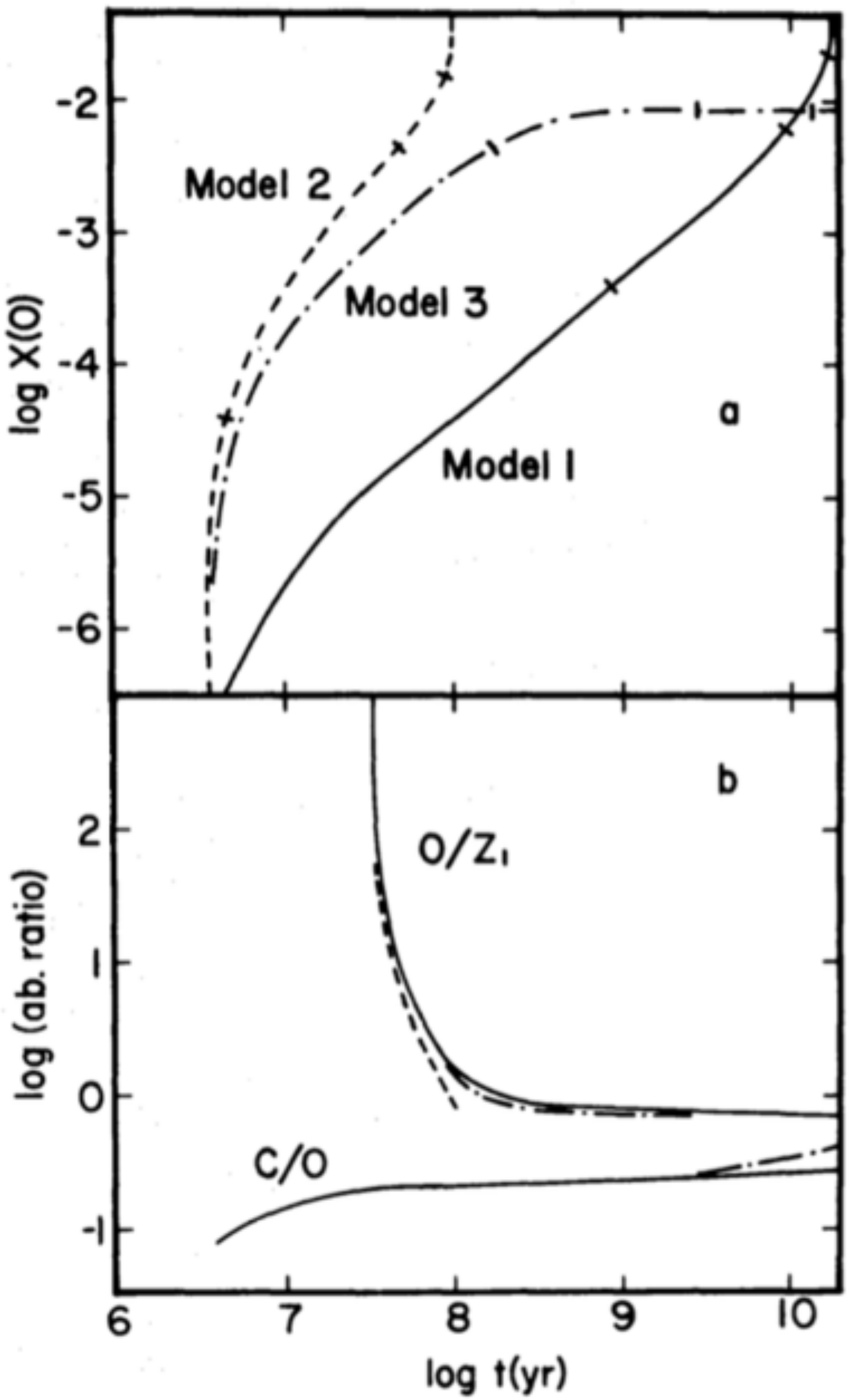
Models and assumptions



Nucleosynthesis:

1. Oxygen:
   made by stars above 10 solar mass
2. Carbon:
   planetary-nebula precursors below 4 solar mass AND
   massive stars above 10 solar mass
3. Iron (Z):
   From SN I with initial mass between 4-6.5 solar mass

Models and assumptions

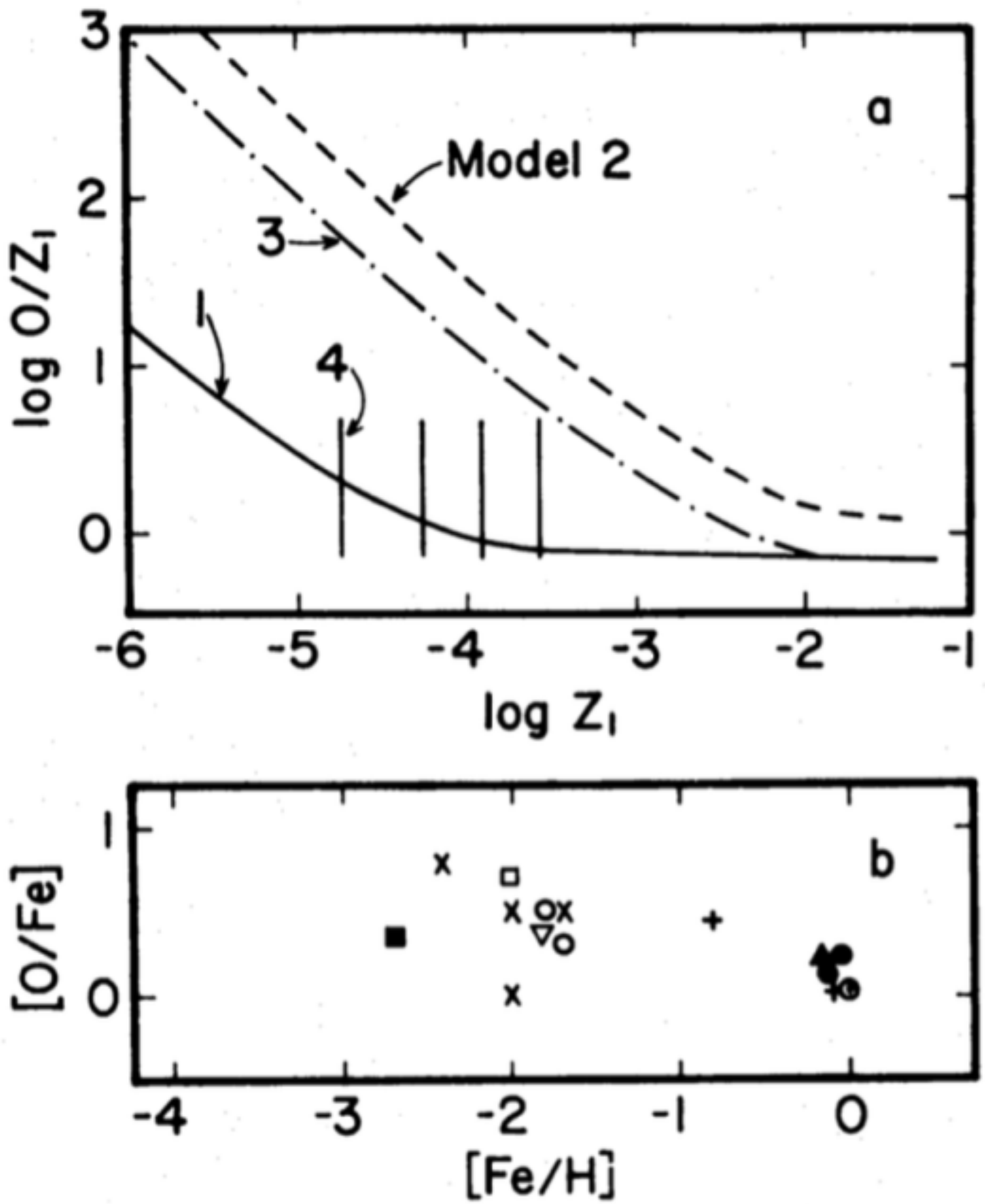


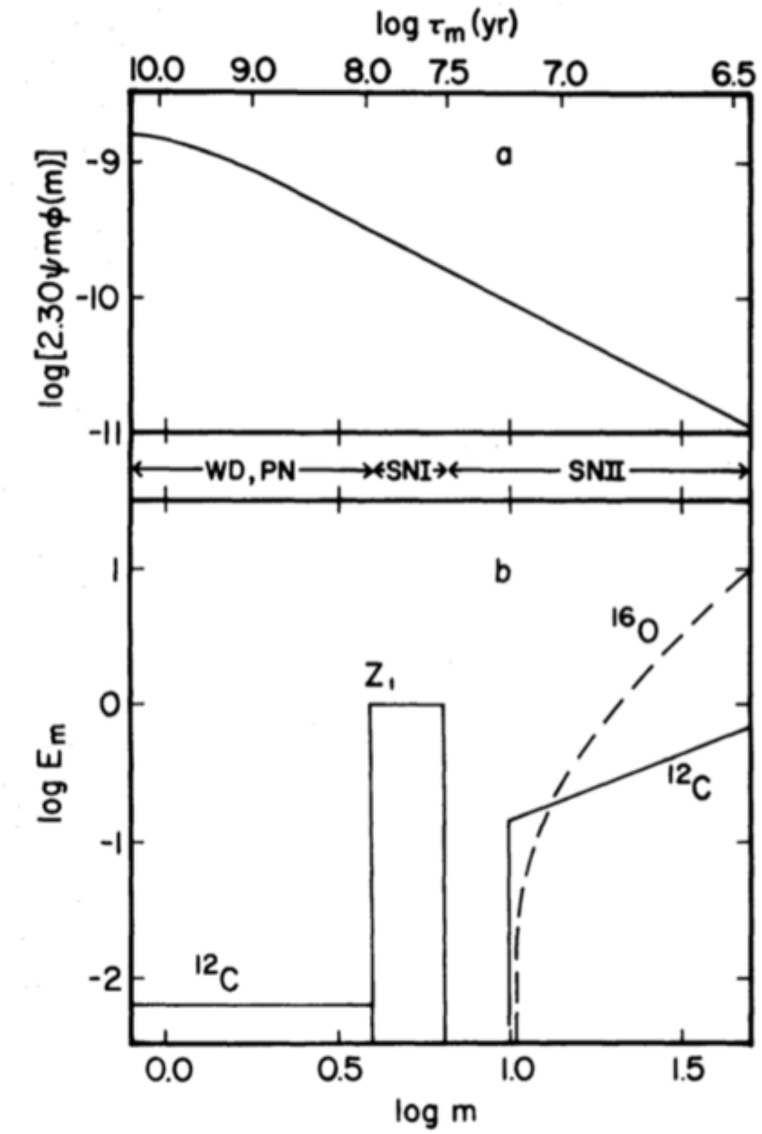
time scales for star formation:

Model 1:
Closed system, 100% enriched gas, completely consumed in $2*10^{10}$ years.
Model 2:
Closed system, 100% enriched gas, completely consumed in 10^8 years.
Model 3:
“Infall type”: gas mass remains constant while the total mass grows.

absolute abundance strong depend on time scales and gas flows, but not the relative abundance!

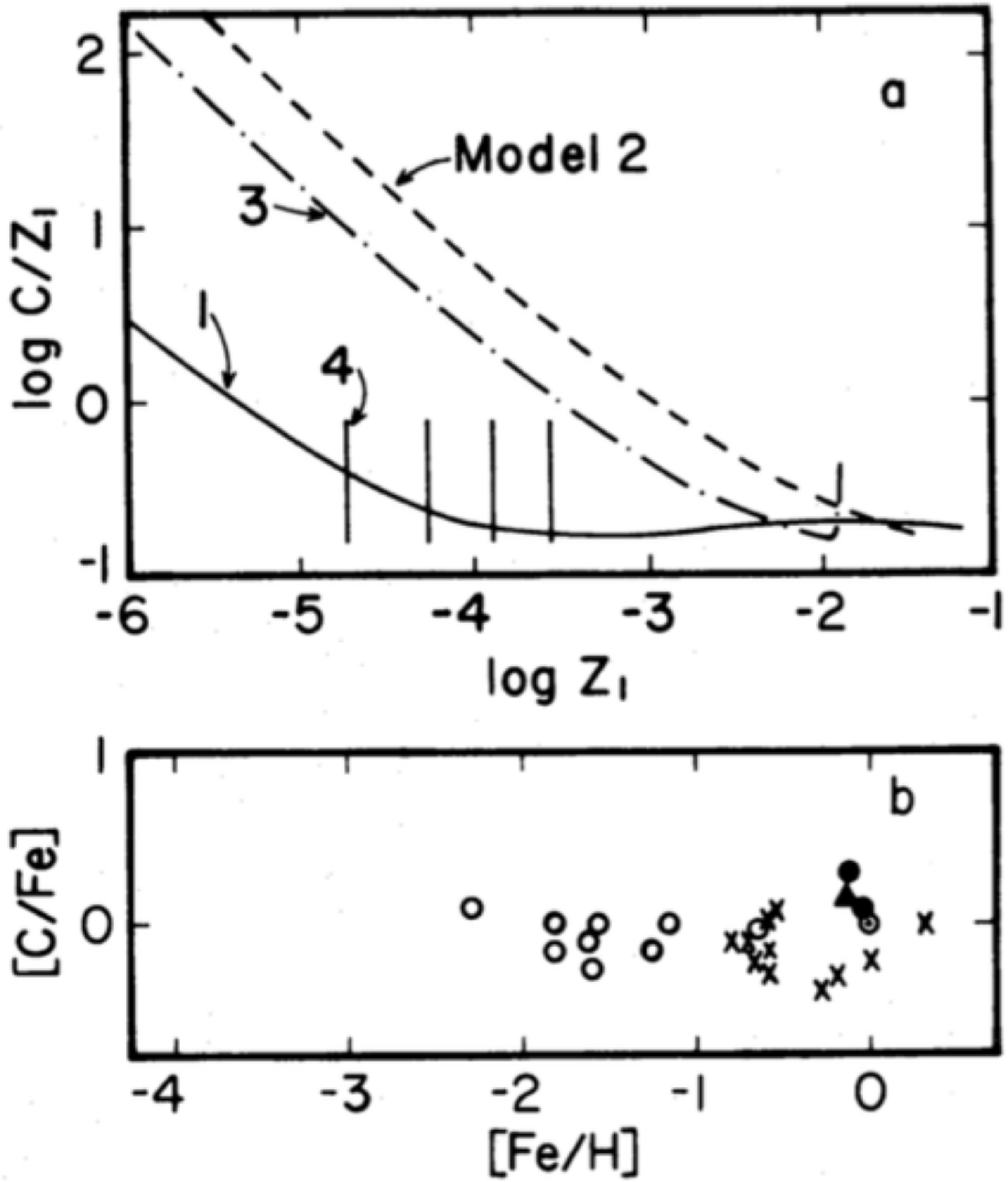
Relative abundance: O/Fe

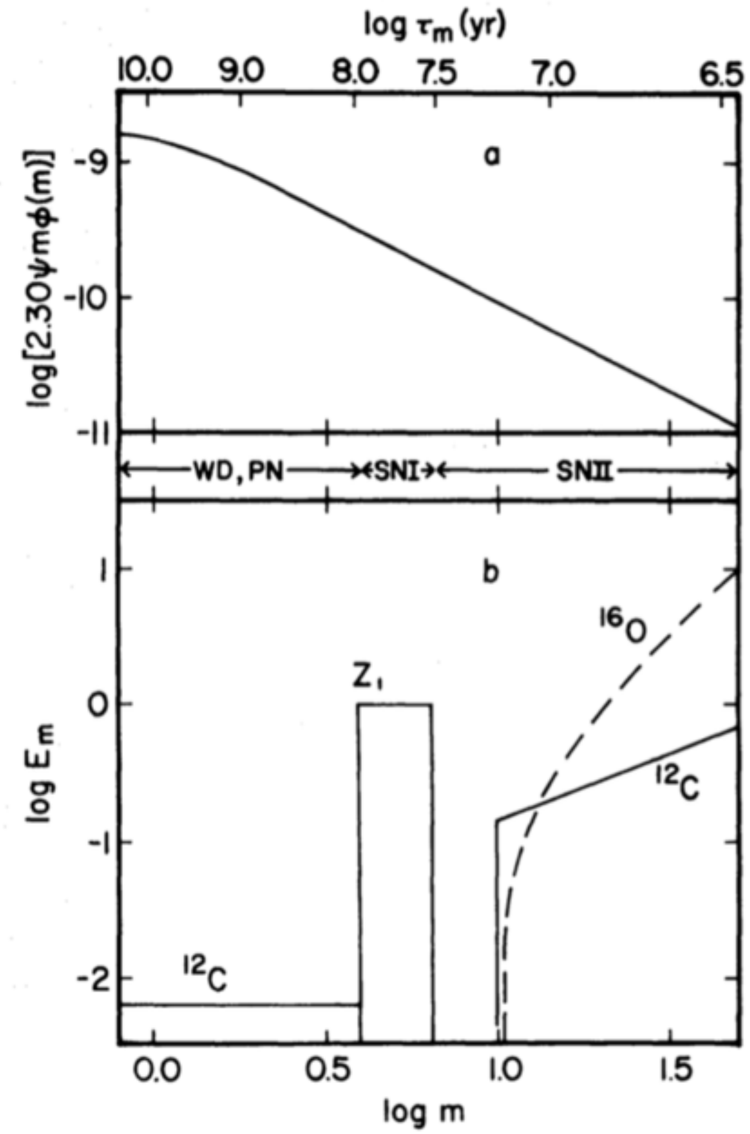




[O/Fe] excess can be explained if iron comes from SNI which has longer lifetimes than those that make oxygen

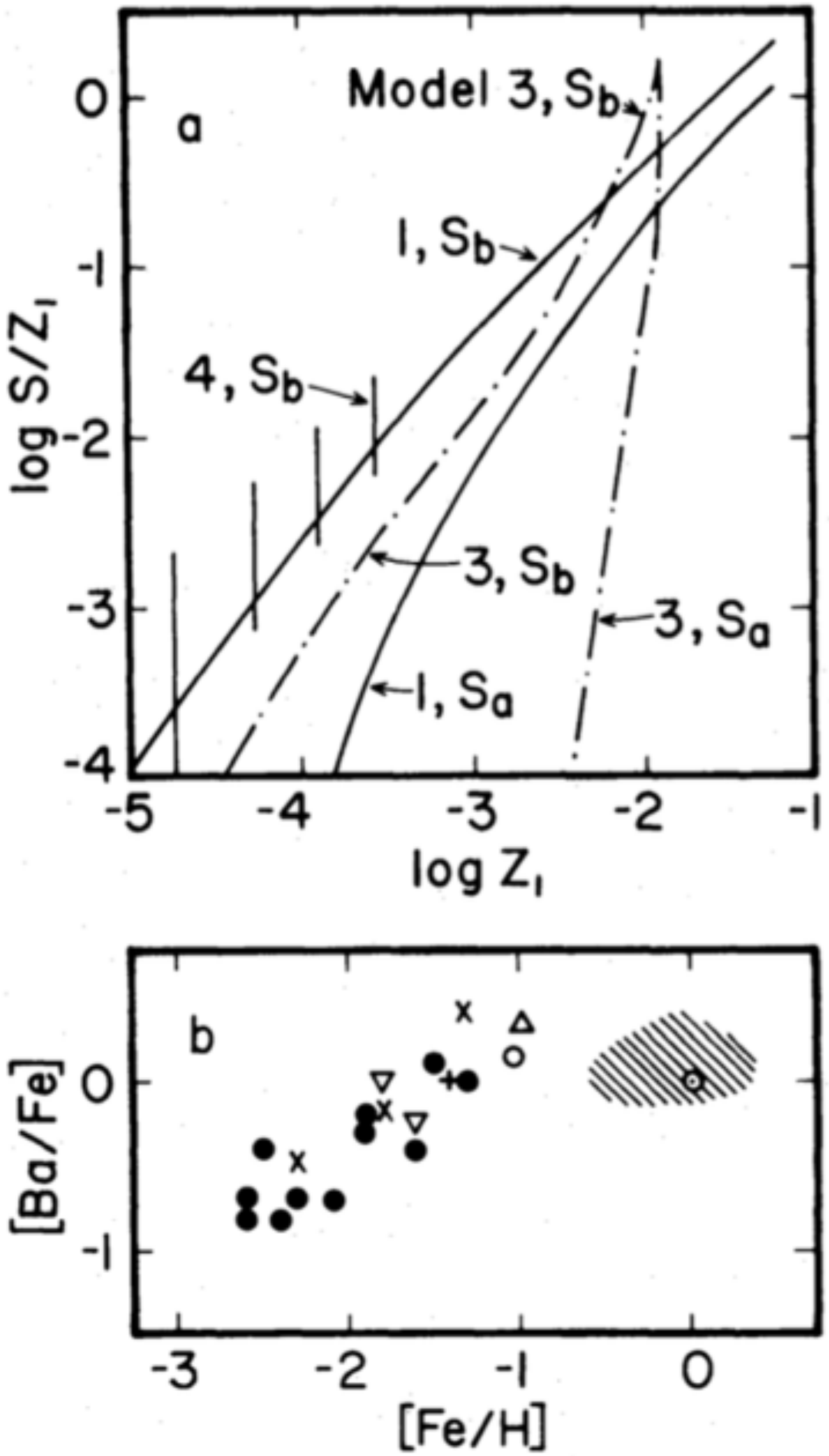
Relative abundance: C/Fe





If large data samples confirm [C/Fe] excess is not as great, it could be stars of 3-8 solar mass produce much of the carbon than stars above 10 solar mass.

Secondary/primary abundance: s-process elements



Sa is from stars below 4 solar mass
Sb is from stars above 4 solar mass.

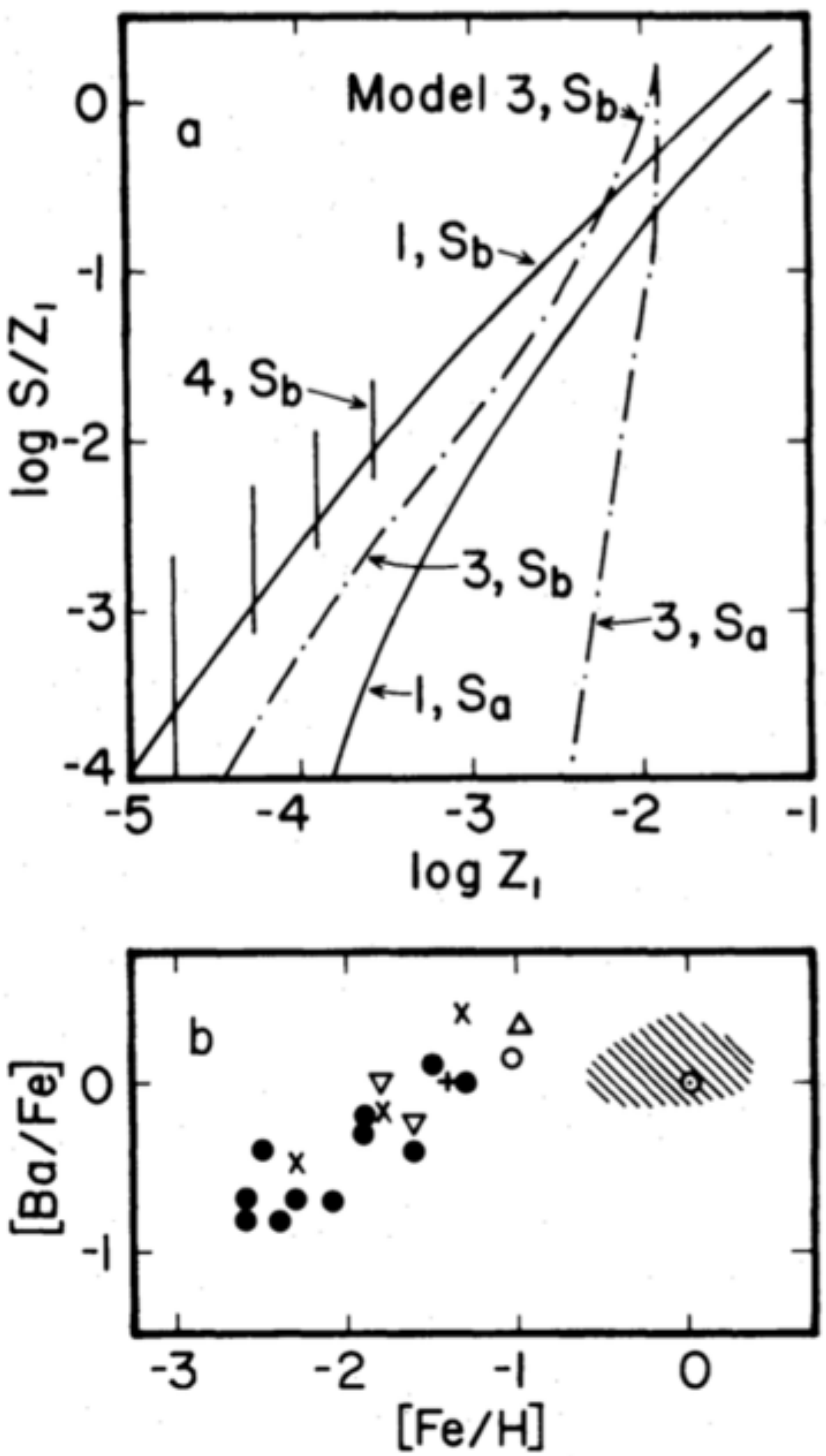
conventional assumption:

stars priced s-process elements proportion to their initial iron abundance.

$S \propto Z^2$

But:
S may lag Z^2 because its production is significantly delayed.

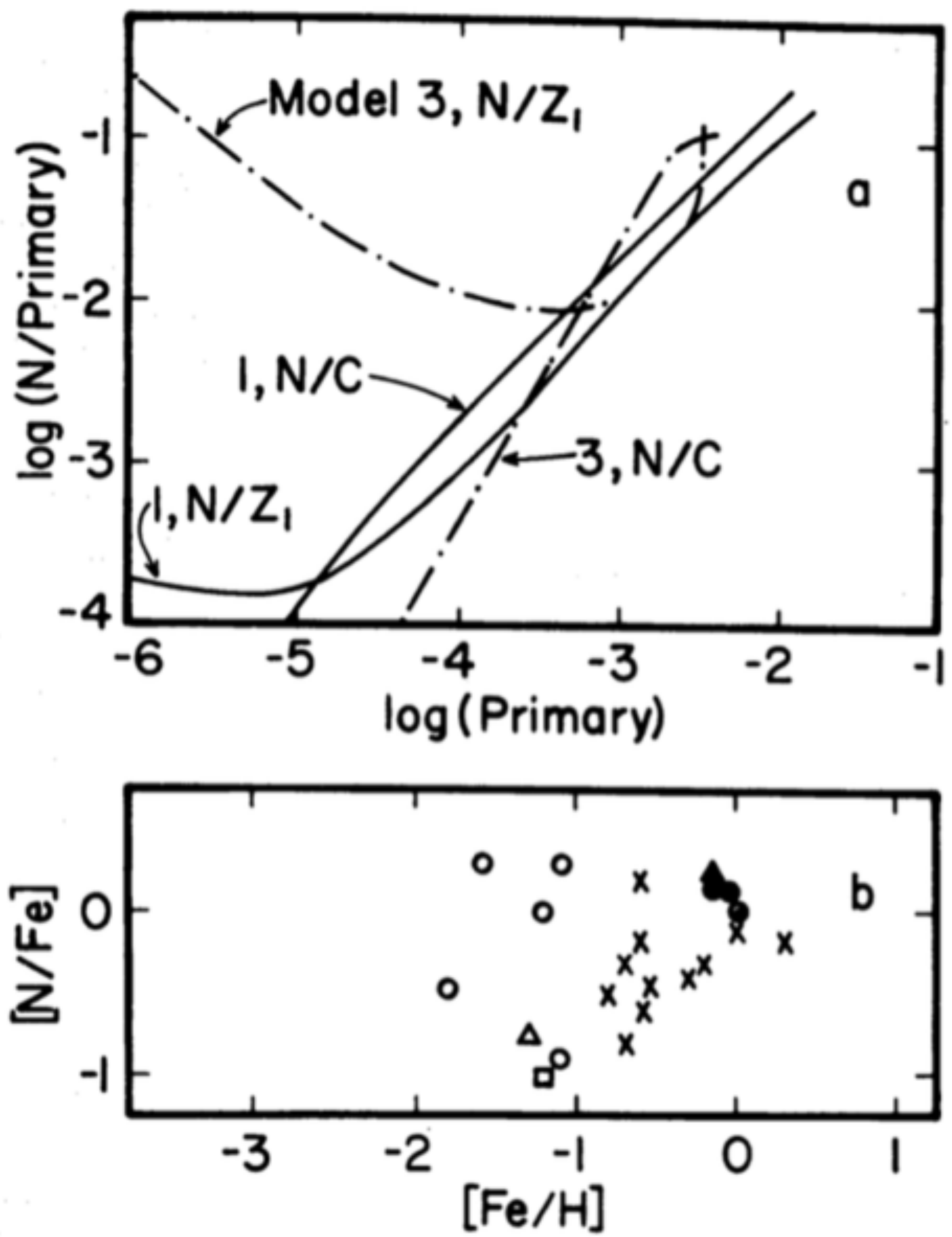
Secondary/primary abundance: s-process elements



[Ba/Fe] rise less deeply than [Fe/H],

which could suggest that Ba production does not scale directly with iron abundance.

Secondary/primary abundance: nitrogen



Similarly, [N/C] show much scatter above a trend of [N/C]=[C/H].

It is suggested that some of the excess nitrogen may be due to efficient mixing into the interstellar medium of N-enriched stellar envelops, while the dens ejected cores of massive stars are less mixed.