

The Sm-Nd System

- Both Sm and Nd are LREE
 - Incompatible elements fractionate → melts
 - Nd has lower Z → larger → liquids > does Sm

Ac-Lr Actinide															Halogen	Noble Gas

$^{147}\text{Sm} \rightarrow ^{143}\text{Nd}$ by alpha decay

$$\lambda = 6.54 \times 10^{-13} \text{ a}^{-1} \text{ (half life 106 Ga)}$$

- Decay equation derived by reference to the non-radiogenic ^{144}Nd

$$\begin{aligned} \text{👉 } ^{143}\text{Nd}/^{144}\text{Nd} &= (^{143}\text{Nd}/^{144}\text{Nd})_0 \\ &+ (^{147}\text{Sm}/^{144}\text{Nd})(e^{\lambda t} - 1) \end{aligned}$$

Sm-Nd Evolution curve is opposite to Rb - Sr

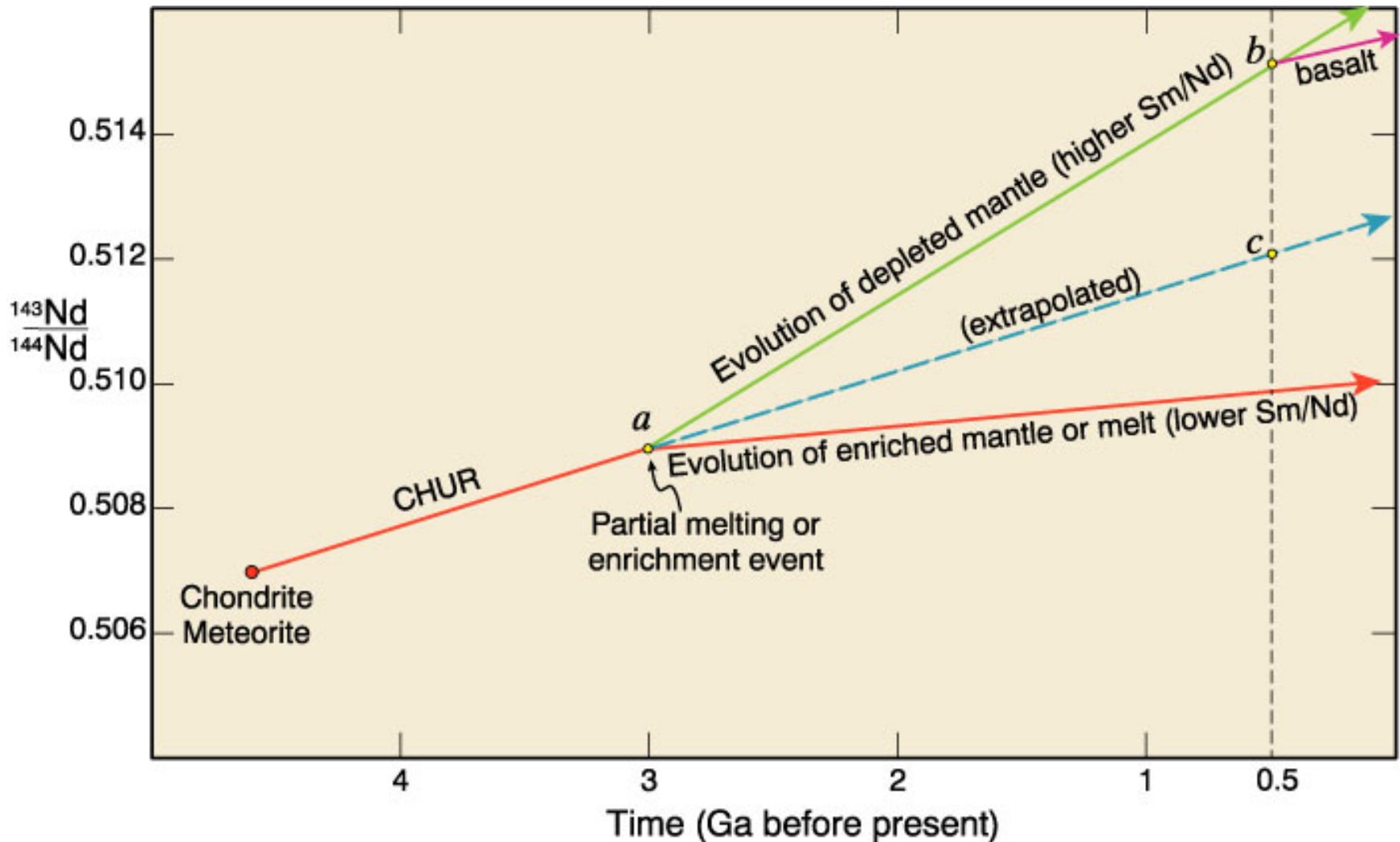


Figure 9.15. Estimated Nd isotopic evolution of the Earth's upper mantle, assuming a large-scale melting or enrichment event at 3.0 Ga b.p. After Wilson (1989). Igneous Petrogenesis. Unwin Hyman/Kluwer.

The U-Pb-Th System

A little more complex system.....

- ☞ 3 radioactive isotopes of U: ^{234}U , ^{235}U , ^{238}U
- ☞ 3 radiogenic isotopes of Pb: ^{206}Pb , ^{207}Pb , and ^{208}Pb
 - ♦ Only ^{204}Pb is strictly non-radiogenic
- U, Th, and Pb are incompatible elements, & concentrate in early melts
- Isotopic composition of Pb in rocks = function of
 - ☞ $^{238}\text{U} \rightarrow ^{234}\text{U} \rightarrow ^{206}\text{Pb}$ ($\lambda = 1.5512 \times 10^{-10} \text{ a}^{-1}$)
 - ☞ $^{235}\text{U} \rightarrow ^{207}\text{Pb}$ ($\lambda = 9.8485 \times 10^{-10} \text{ a}^{-1}$)
 - ☞ $^{232}\text{Th} \rightarrow ^{208}\text{Pb}$ ($\lambda = 4.9475 \times 10^{-11} \text{ a}^{-1}$)

The U-Pb-Th System

Concordia = Simultaneous co-evolution of ^{206}Pb and ^{207}Pb via:

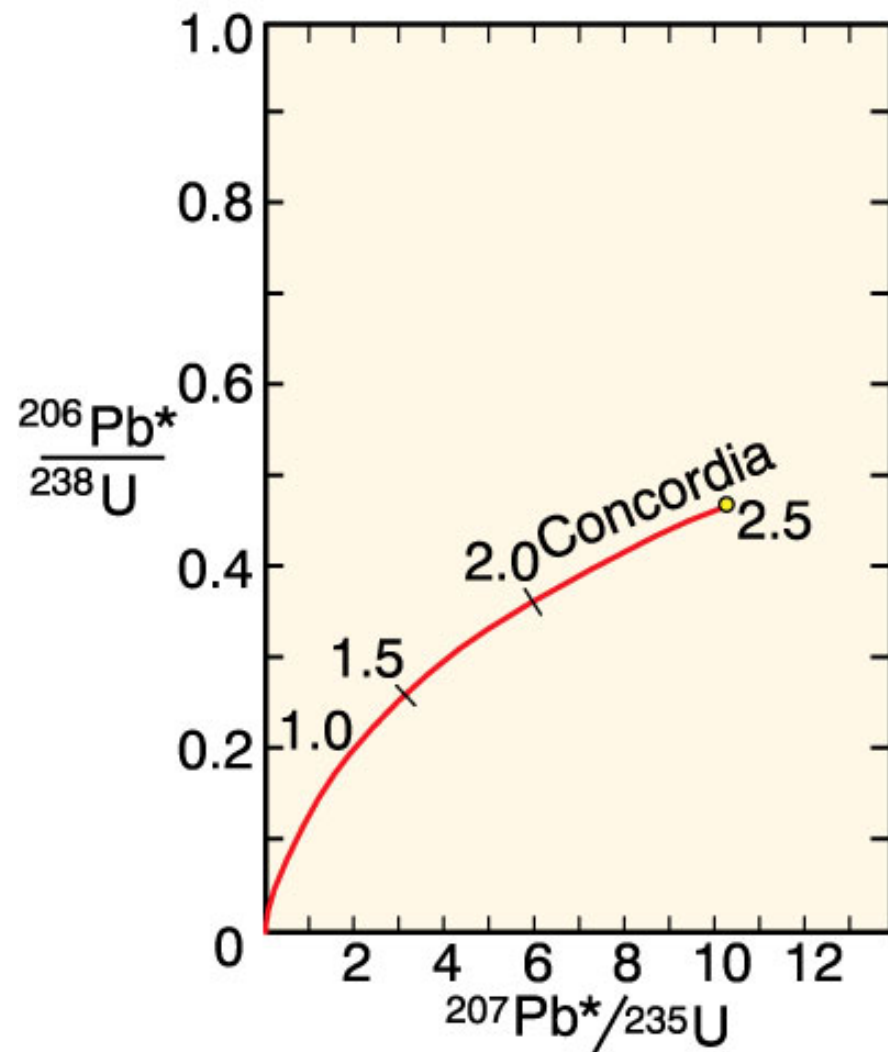
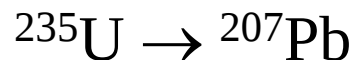


Figure 9.16a. Concordia diagram illustrating the Pb isotopic development of a 3.5 Ga old rock with a single episode of Pb loss. After Faure (1986). Principles of Isotope Geology. 2nd, ed. John Wiley & Sons. New York.

The U-Pb-Th System

Discordia = loss of both ^{206}Pb
and ^{207}Pb

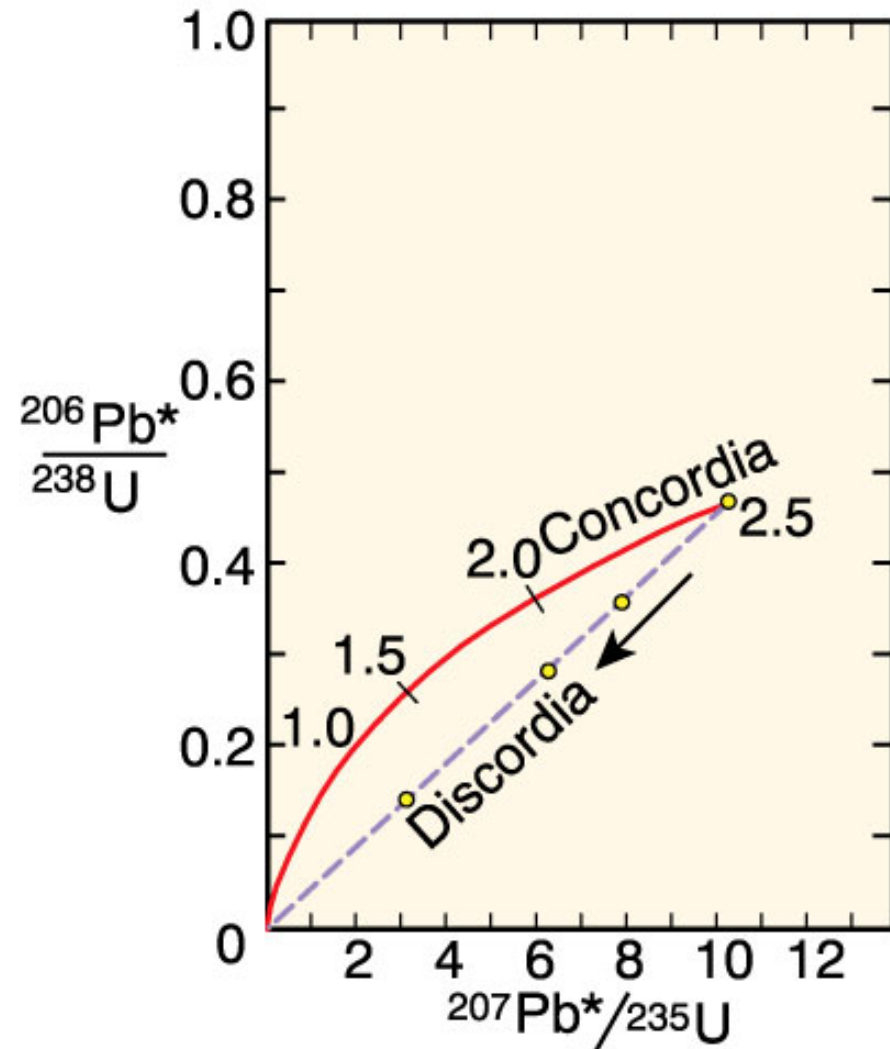


Figure 9.16a. Concordia diagram illustrating the Pb isotopic development of a 3.5 Ga old rock with a single episode of Pb loss. After Faure (1986). Principles of Isotope Geology. 2nd, ed. John Wiley & Sons. New York.

The U-Pb-Th System

Concordia diagram after 3.5 Ga total evolution

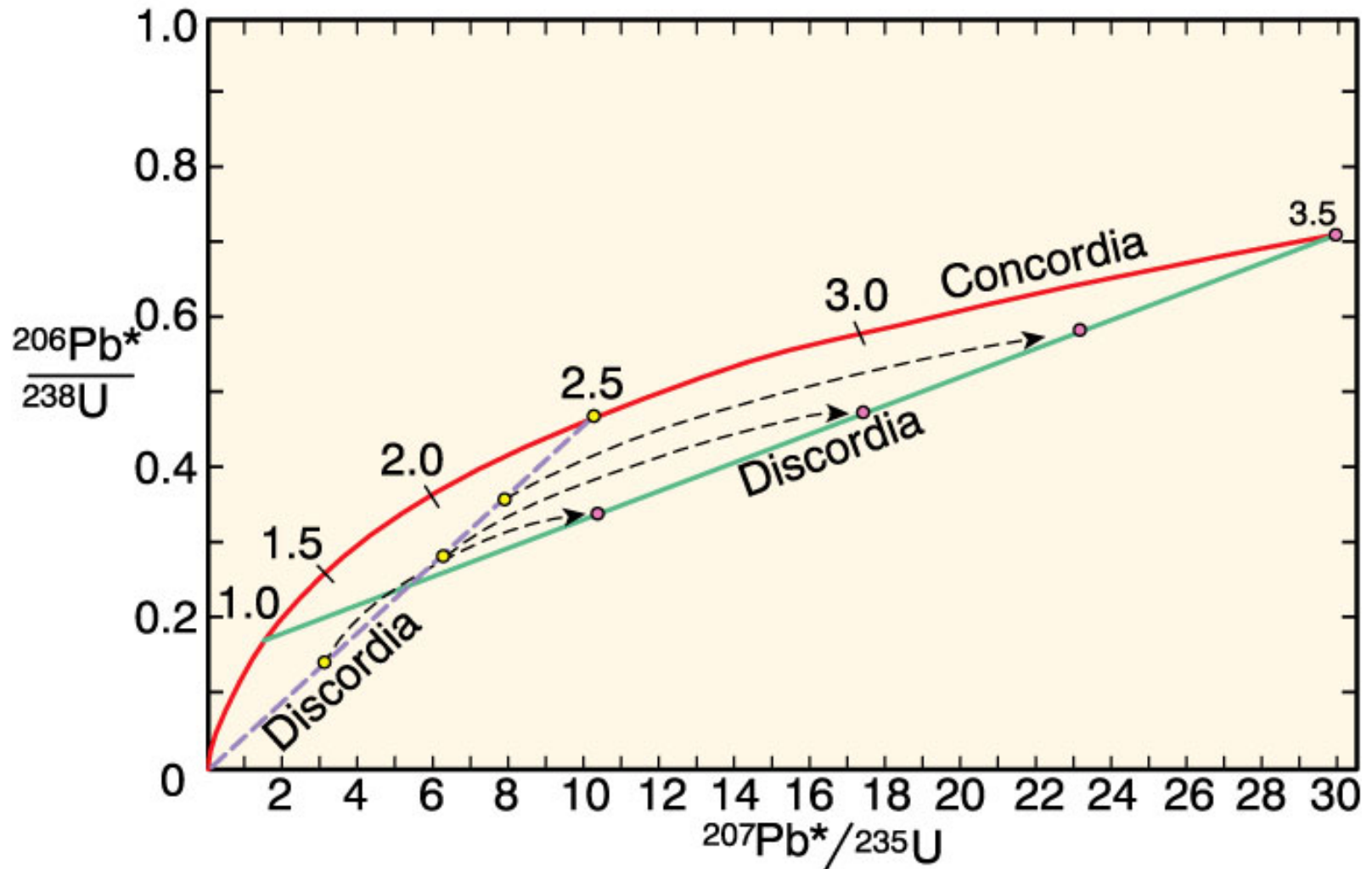


Figure 9.16b. Concordia diagram illustrating the Pb isotopic development of a 3.5 Ga old rock with a single episode of Pb loss. After Faure (1986). Principles of Isotope Geology. 2nd, ed. John Wiley & Sons. New York.

The U-Pb-Th System

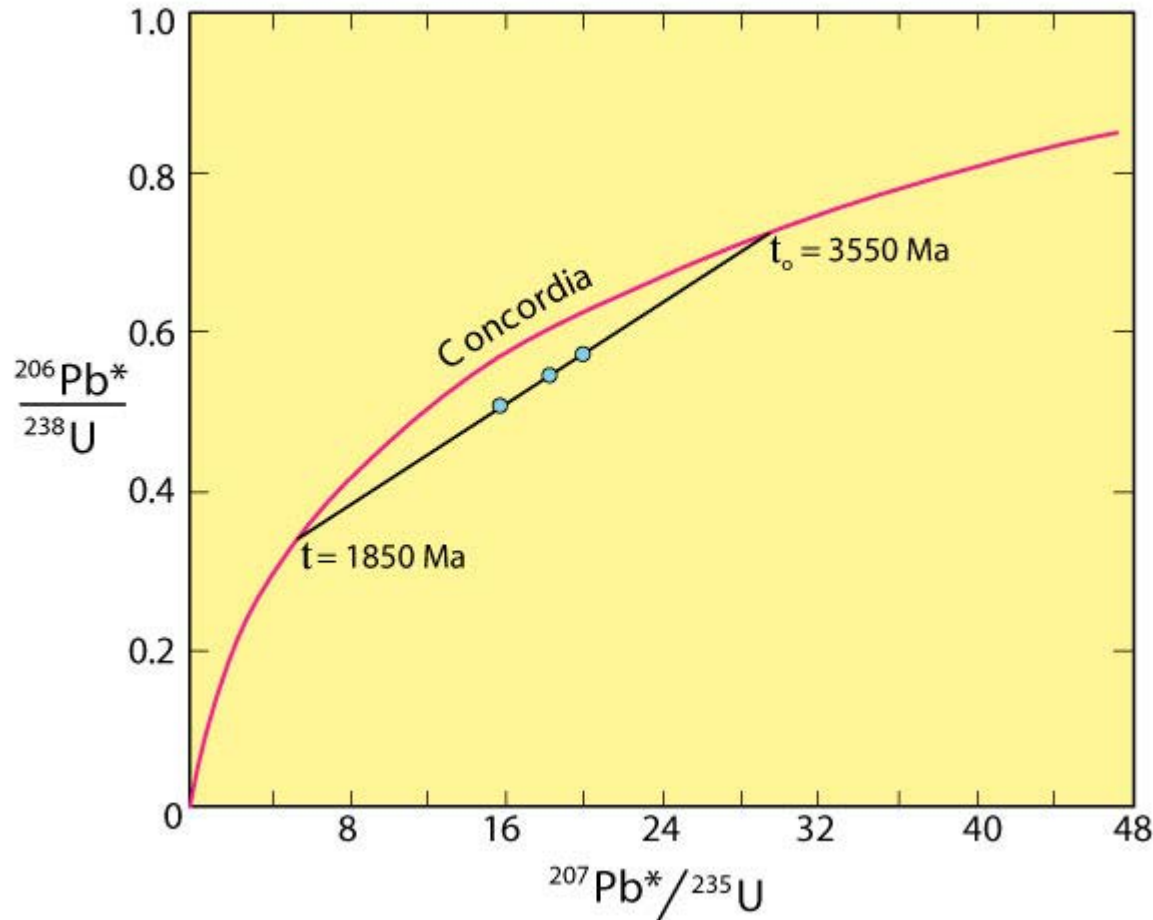


Figure 9.17. Concordia diagram for three discordant zircons separated from an Archean gneiss at Morton and Granite Falls, Minnesota. The discordia intersects the concordia at 3.55 Ga, yielding the U-Pb age of the gneiss, and at 1.85 Ga, yielding the U-Pb age of the depletion event. From Faure (1986). Copyright © reprinted by permission of John Wiley & Sons, Inc.