

Lecture 10 – Sulfur Cycles

READINGS FOR NEXT LECTURE:

- Krebs Chapter 28 pages 590-607

READINGS FOR NEXT THURSDAY'S LECTURE:

- Global climate change articles (handed out separately)

Outline for today:

- I. Quizzes
- II. Global climate change discussion next Thursday
- III. Sulfur
 - A. Reservoirs and residence times
 - B. Biology of sulfur
 - C. Global S cycle
 - D. Human Impacts
 - E. Isotope analyses

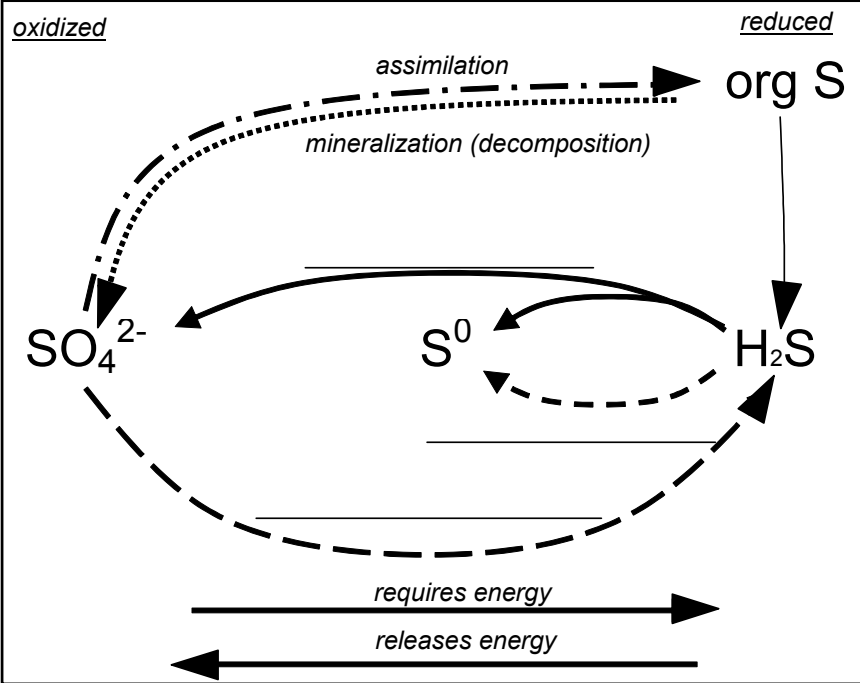
III. Sulfur

A. Reservoirs and residence times

<u>Reservoir</u>	<u>Size (10^{12} g)</u>	<u>Flux (10^{12} g/yr)</u>	<u>MRT (yr)</u>
Atmosphere	2	270	_____
Seawater	1.3×10^9	310	_____
Sedimentary Rocks	7.4×10^9	220	_____
Land Plants	8500	24	_____
Soil Organic Matter	16000	72	_____

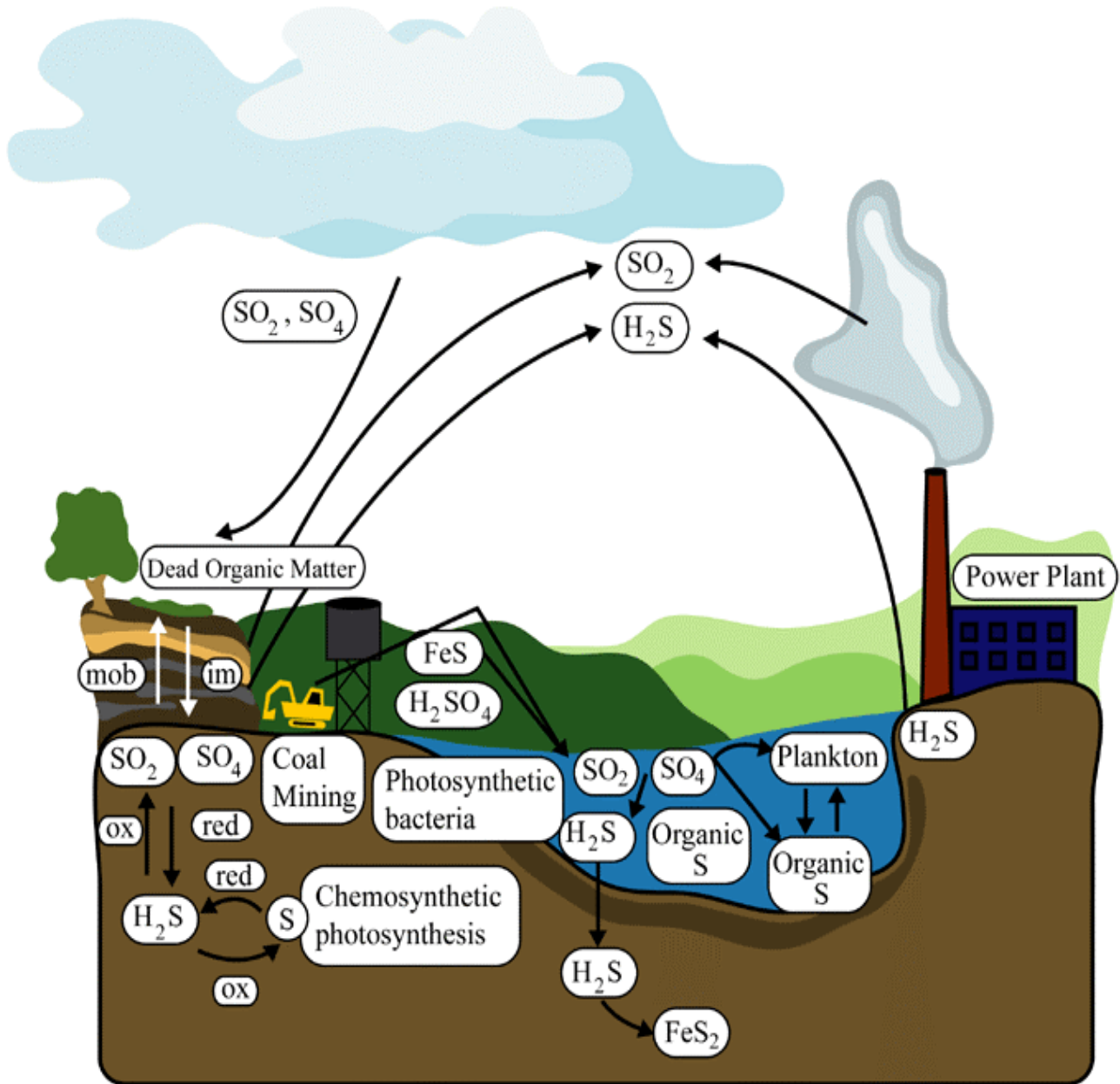
Will S be well-mixed in the atmosphere?

B. Biology of sulfur



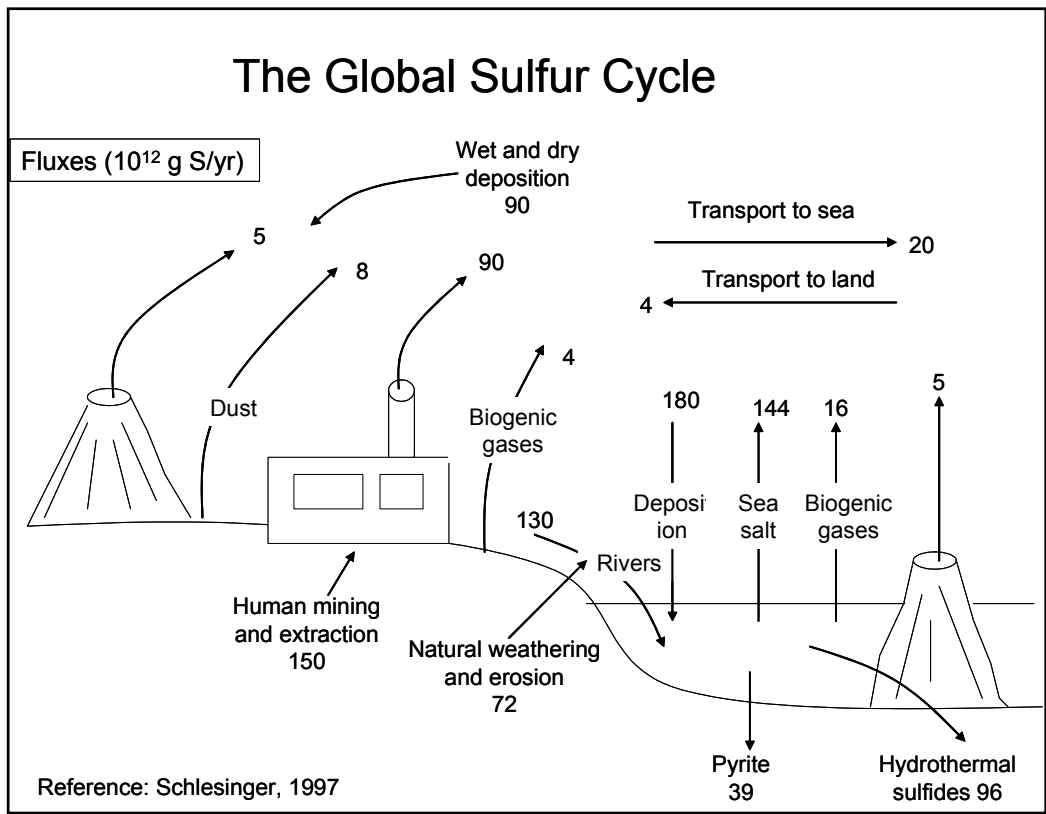
C. Global cycle
 Adapted from Smith,200. Elements of Ecology.

The Global Sulfur Cycle



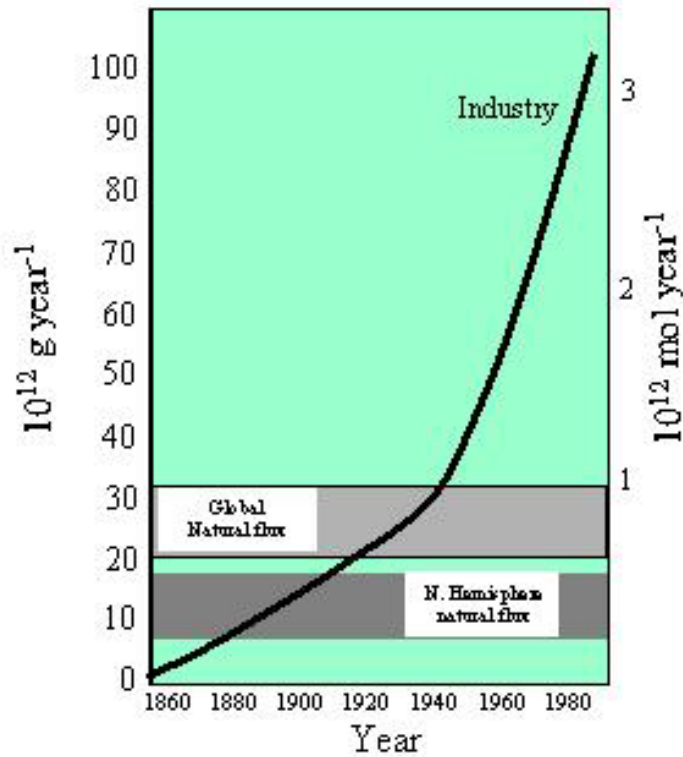
red: reduction
 ox: oxidation
 im: immobilization
 mob: mobilization

The global sulfur cycle, with two components: gaseous and sedimentary. Human activities which contribute to the cycle include: acid drainage from coal mining and fossil fuel burning.



D. Human impacts

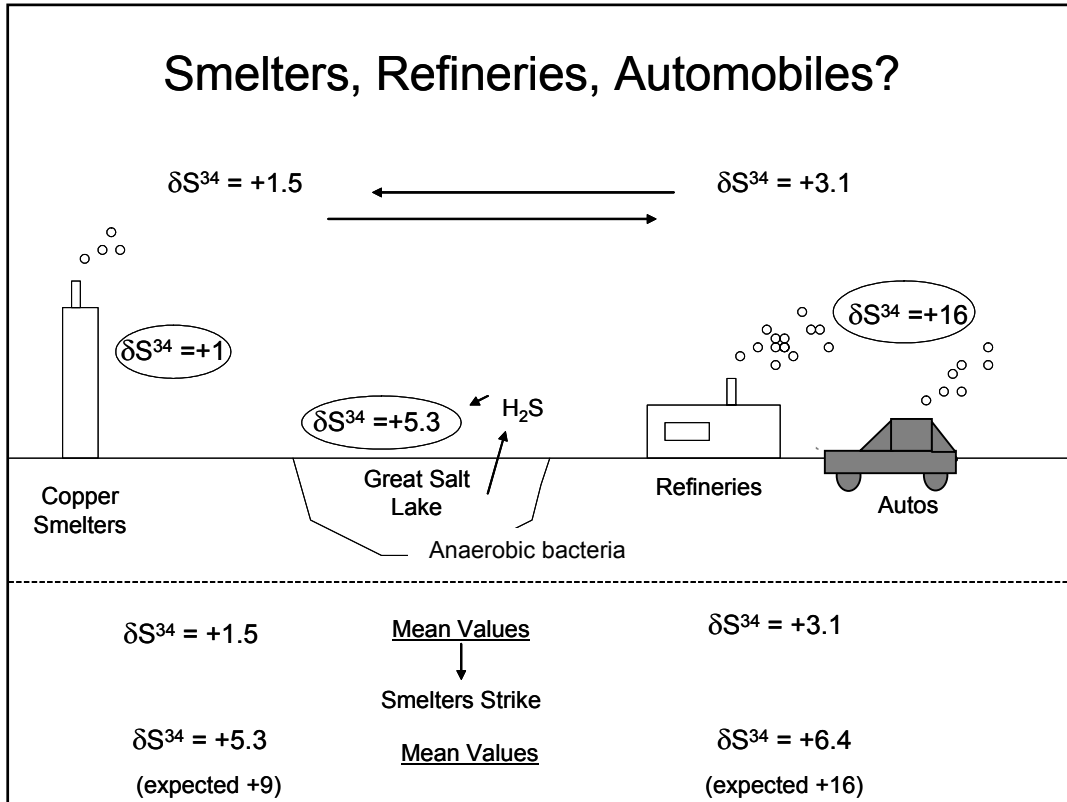
Global SO₂ Emissions



Adapted from Charlson et al. 1992 Science **255**:423

E. Isotope analyses

$$\delta^{34}\text{S} = 1000 * [(\text{}^{34}\text{S}/\text{}^{32}\text{S})_{\text{sample}} - (\text{}^{34}\text{S}/\text{}^{32}\text{S})_{\text{standard}}] / (\text{}^{34}\text{S}/\text{}^{32}\text{S})_{\text{standard}} \quad \text{in } \text{‰}$$



Study questions:

- Name the major ways in which the sulfur cycle resembles and does not resemble the nitrogen and phosphorus cycles.
- What are major anthropogenic and non-anthropogenic sources of S emissions into the atmosphere?
- How does acid rain form? How does acid mine drainage form?
- Explain how sulfate reducing bacteria indirectly create SO_2 emissions.
- Explain how isotope ratios can be used to determine the relative contributions of different sources.