F. End-Permian mass extinction (pp. 375-378)

1. <u>Biggest</u> extinction in history (two pulses of mass extinction)

2. Victims: 52% of families, ~95% of marine speces, 75% of land animals (big adaptive radiation after)

3. <u>Gone</u>: trilobites, blastoids, rugose corals, tabulate corals

4. <u>Hit hard</u>: brachiopods, bryozoans, crinoids, therapsids, ammonoids, clams, snails, some foraminifera

5. Heavily calcified & motile forms were more likely to have survived in oceans (this was a selective extinction)

6. Hypothesized causes (complex story)

a. Related to Pangaea forming? (less shoreline & plate tectonics disruption - subduction and seafloor spreading stopped (?) for a while)

b. Unstable outer core - launched superplumes - Siberian Traps + Emeishan Volcanics + Choiyoi Group + 4 other volcanic provinces

c. Siberian Traps magmas intruded through limestones & coals & rock salts - released ~100,000 gigatons of CO_2 + lots of methyl chloride

d. Choiyoi released ~63 million gigatons of CO_2

e. Ozone collapse & solar wind radiation

f. Weakened geomagnetic field - increased galactic cosmic radiation bombardment

g. Volcanic ash & clouds from radiation-created aerosols blocked sunlight - severe cooling

h. <u>High</u> volcanic CO_2 levels in atmosphere led to greenhouse climate; oceans got acidic & affected calcified organisms

i. Warming released CH_4 from methane clathrate ice <u>in</u> continental shelf sediments; high CH_4 levels led to <u>intense</u> greenhouse climate

j. Radiation & climate changes resulted in global land plant die-off (wood debris & fungal spike & paleosol debris at Pm-Tr bdy.)

k. Atmospheric hypoxia & oceanic superanoxia

l. <u>Impacts</u>

i. Bedout Impact Crater

ii. Wilkes Land Impact Crater

iii. Extraterrestrial carbon at Permian-Triassic boundary