The Institute for Planetary Materials seeks to apply methods of materials science to natural materials from Earth and other bodies in order to understand the formation and evolution of planets and life.

Investigating Martian rocks: Clues to surface and interior processes

Ryugu

Asteroid science: Records of solar system processes from meteorites and sample returns

Case study: Comprehensive analysis of the Chelyabinsk meteorite

Martian meteorite NWA 8171: polymict breccia containing igneous, impact melt, and sedimentary clasts
Hydrogen-helium phase separation: Helium "rain* on Jupiter explains lack of neon in atmosphere. *At extreme P-T, all phases are fluids.

Unsolved questions on early Earth: Rare gas sequestration
- Rare gases were acquired from solar nebula and then lost again.
- Mechanisms are still unclear.
- At least one deep mantle (or core) reservoir exists rich in He.
- Trapped early as Earth formed. Where/how?
- Xe isotope proportions indicate a massive loss of atmosphere occurred with mantle degassing, >97% gas loss occurred 100 Ma after Earth formation.
- Question: How could early Earth store 10^7 greater gas content than now?

Model of Neon Depletion: Ne preferentially dissolves into He in a de-mixing region

Structural Diversity in Molecular Systems “van der Waals” compounds: Xe-H2, Kr(H2)4

Green: Kr octahedra. Grey spheres represent rotationally disordered H2 molecules.