

Title: Heterogeneous accretion of volatiles to Earth's mantle reservoirs

Abstract:

Earth's interior retains volatiles (e.g., nitrogen, carbon, hydrogen and the noble gases) acquired during accretion. Solar, chondritic and cometary noble gases may all have contributed to terrestrial volatile reservoirs. This study shows that helium (He), neon (Ne) and xenon (Xe) isotopes of the upper mantle and the plume mantle source can only be explained if the latter reservoir had a low initial Xe abundance. A record of limited accretion of volatile-rich chondrites into the deep mantle compared to the upper mantle thus survives in the He-Ne-Xe signatures of mantle rocks today. Energetic impacts during accretion did not homogenize the growing planet, and early-formed ^{129}Xe and ^{182}W mantle heterogeneities may have survived through ~ 4.5 Gyr of mantle mixing due to a viscosity contrast originating from differential accreted water contents in the plume and upper mantle reservoirs.