Origin of Earth's Oceans

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An important debate in the understanding of the early Solar System concerns the origin of the Earth's oceans. The D/H ratio for Earth oceans is enriched by a factor of 6.4 over the protosolar value of 2.5×10^{-5}, and it has been believed that delivery of water by comets, which have a D/H ~ 30×10^{-5} (three measurements) may have contributed to this enrichment. Dynamical models of terrestrial planets formation suggest that Mars-sized planetary embryos might deliver sufficient water to the Earth from the asteroid belt, and that the fractional cometary contribution might be small. However, this is not consistent with Earth noble gas abundances. D/H measurements have been made for comets likely originating in the same part of the solar nebula. It is expected that there might be a different D/H ratio for comets formed at different distances within the solar nebula. In addition, the standard against which the cometary D/H is measured, ocean water, may have changed over time because of various fractionation processes and would not represent Earth's primordial water. We present a proposal to obtain new comet D/H measurements and to better understand the isotopic composition of primordial Earth water through a program to look at the D/H ratios in deep mantle xenoliths recovered from Iceland and Hawaii. Mantle plume bases reach to the core mantle/boundary, at depths that have not had an opportunity to degas. We will use $^{3}He/^{4}He$ as a tracer for primitive material, and look at D/H measurements versus depth in deep boreholes.