1. Drake and Righter (2002) use several different arguments to investigate the source of the Earth’s water.

a) The highly siderophile elements (HSE) show concentrations of about $3 \times 10^{-3}$ times chondritic in the Earth’s mantle. If chondrites contain ~10 wt% H$_2$O and the mass of the Earth’s mantle is $4 \times 10^{24}$ kg, what mass of water was delivered by chondrites? How does this compare with the estimated surface water inventory of $10^{21}$ kg?

b) The Earth’s water has a D/H ratio of about $10^{-4}$, while comets have a D/H of about $2 \times 10^{-4}$. What is the maximum fraction of the Earth’s water that could have been delivered by comets?

c) Assuming solar elemental abundances, the ratio of Ar/O in comets should be about $5 \times 10^{-3}$, and most of the argon is $^{36}$Ar. If all the Earth’s water is delivered by comets, how much $^{36}$Ar should there be in the Earth’s atmosphere?

d) The actual mass of atmospheric $^{36}$Ar is about $2 \times 10^{16}$ kg. What fraction of the Earth’s water could have been delivered by comets? How would this estimate change if the Earth’s total water content exceeded $10^{21}$ kg?

e) Say what you can about the source and amount of water on Mars, using the following information: the mass of $^{36}$Ar in the Martian atmosphere is about $10^{11}$ kg, Martian mantle HSE concentrations are about the same as for Earth, the mass of the Martian mantle is about $4 \times 10^{23}$ kg and Martian water has a D/H ratio of about $2 \times 10^{-4}$. How might you reconcile your different estimates of the Martian water abundance?