Evolution of the D/H ratio on Venus

Sources of D and H

Accreted with Primordial
Ocean or very little water
Comets
Outgassing of volatiles
Global Resurfacing Event

D/H ratios of sources?
Earth, chondrites, Halley
Primordial solar nebula, Jupiter, Interstellar medium
Current Venus

Escape Mechanisms

Thermal - Jeans escape, Blowoff

Nonthermal - Supply energy by **E** (to ions) or hv

Energy ends up as kinetic energy

High speed atoms/molecules escape

Possibly high speed ions as well

Fractionation

More light isotopes escape than heavier isotopes

Quantify by fractionation factor f

$$f\frac{dH}{H} = \frac{dD}{D}$$

What are current escape rates?
What are current fractionation factors?

Tackling the problem of 4.5 By worth of evolution

Assume current escape rates or timescales
Assume current fractionation factors
Why?
Is this any use?

My contribution

Gurwell (1995) - reconcile steady state and primordial ocean
Me - reconcile global resurfacing and primordial ocean
Assume a fractionation factor of 0.3, timescale of 300 My
Start 4.5 Bya, global resurface 0.5 Bya
Assume terrestrial D/H for both injections

Solution

$$H = H_o e^{-t/\tau} + H_G e^{-(t-T)/\tau}$$

$$D = D_o e^{-ft/\tau} + D_G e^{-f(t-T)/\tau}$$

Two variables, two constraints. Solve for the sizes of the two injections

200m primordial ocean and 8cm global resurfacing injection
Well within with upper limits

Success?

Model is simple and can reproduce current atmosphere with reasonable primordial ocean and global resurfacing injection.
But.....Assume everything constant

When D ~ H the algebra probably fails

In conclusion

This model is as good as anyone elseπs
This model is as poor as anyone elseπs