Workshop Without Walls: Upstairs Downstairs

Breakout Group 1 Note-taking

Debate #4:

What observations do you want?

Just about everything centers on some compositional information. (Time)

What are the key parameters we want?
    Mg/Si?

Observations of K/Na in exoplanet atmospheres could prove useful. Could provide a link from atmospheric to geospheric measurements.
We might learn something about the planet, but not (carbon-based) life.

Disintegrating planets may give a test case.
    Is it too much to wish for one with another planet in the habitable zone?

Having a better understanding of the diversity of compositions of different planets in a similar system? Even C/O would be useful.

Useful scientific knowledge unrelated to the planet being alive. (comparative planetology)

What about Jupiter core planets, with their atmospheres stripped off? What would the end state be for the interior? And the resulting surface composition?

Bigger planets may not be things we should just throw out. They could be habitable? And could they have different biosignatures?

Can we get the age of the system? Can we improve this better than <> 100 Mya.

Can we get surface vs. radiating temperature? (We're working on it.)

What do you think this community can contribute to this over the next 5-10 years?

We need to reassess experiemntal needs for super-Earths. Specifically, high-pressure phases for super Earths.
    Is this a hopeless pressure? Too high for experimental setups?
    Need to rely on extrapolation - expensive, difficult to do, and scientifically not ideal.

And this is for the *best* case, lowest mass “super-Earths.”

There are people doing first-principle calculations at the relevant pressures.

Warning signs recently - discovery of new phases associated with elemental redox states not incorporated into the first-principle calculations.

How would these deep pressure phases affect the upper mantle, and in turn, the outgassed atmospheres.

Are there planets where the high pressures “don’t matter?” Could you end up with a planet that “doesn’t care” about the deep, high-pressure things associated with these different pressure regimes. It could be that the effect here is the convection/dynamo issues.

Another, potentially more accessible thing is different compositions instead of higher pressures.

How are these things related? Could larger planets have more oxidized interiors? Could it turn a planet from a sink to a source of oxygen?

We need better scaling laws for this.

Maybe it doesn’t matter what happens lower because it’s reversible. What happened early in the planet’s history to allow oxidation of the upper mantle?

Core formation may also matter, in terms of how it could affect oxidation. (Again, history dependent.)

How does the Urey ratio - the contribution of heat from radioactive decay - change as a function of planet mass?

Need a “whole Earth model” that we can run over these different size/mass/pressure scales.

Even the people that build these models know they are indequate.

What we need is PDFs of the input properties and Monte Carlo simulations. (The surface/atmospheric folks are doing this too.)

We can try big simulations for this, with systematic studies and scaling laws.

Will the observers be satisfied with statistical info?

Even in this case, how will you predict phase equilibria? Need experimental help.

Weathering reactions and sinks for atmospheric species. How are these affected by these dramatically different atmospheric compositions? Venus may give an example? What would we need for that? What about Titan?

BE PREPARED FOR SURPRISE.