EARTH, VENUS, AND MARS: A TRINITY RE-UNITED. N. Hoffman, WNS GeoScience, 22 Marlow Place, Eltham VIC 3095, Australia (nhoffman@vic.bigpond.net.au).

Introduction: A review of the temperature history of the atmospheres of the Terrestrial Planets demonstrates that a single simple model of coexisting CO_2 and H_2O on cold-surfaced planets can explain the present state and evolution of all the Terrestrial planets with a minimum of additional constraints.

Paradoxes: If these sister planets originally had similar volatile inventories, how has their evolution been so different? Why is Venus a fiery dry CO_2 greenhouse, yet Earth is a temperate wet planet with only a trace of CO_2 vapour? Why is Mars so dry and cold now, yet has clear traces of fluid flow on its surface? How have the planets responded over geologic time to the gradual warming up of the Sun by some 20%-30% since its early days? How can we reconcile the Terrestrial planets with a single, all-embracing model? Here, I revisit these questions from a novel perspective and offer new answers.

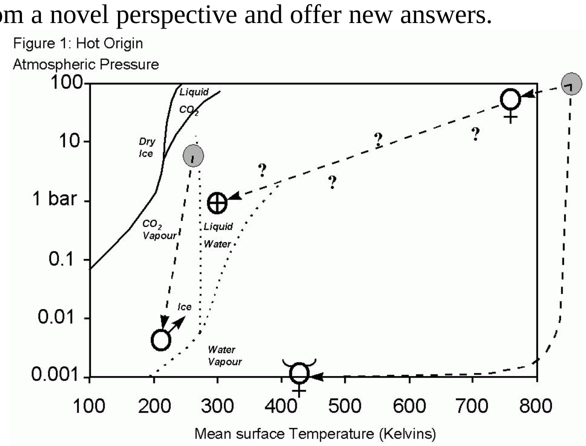

Figure 1: In the conventional hot-origin paradigm for the terrestrial planets, Earth begins in a greenhouse and has to escape by removal of CO2. Meanwhile, Mars is warm and wet but becomes colder and drier with age.

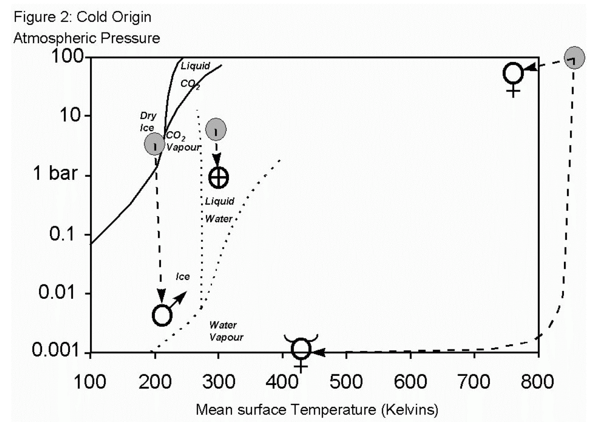

Figure 2: In the cold surface model for the planets, Venus and Mercury still evolve as hot worlds, but Earth begins cooler and higher pressure than it is now and evolves gently. Mars has a parallel track to Earth, but evolves to a more extreme state.

Mars is now explained by the White Mars paradigm as a cold ice-and-rock world that has probably never seen liquid water at its surface, yet has a complex fluid history involving CO_2. Earth starts a little warmer than Mars, skirts the very edge of greenhouse runaway, but evades it by a slender margin due to limited early outgassing balanced by CO_2 sequestration within liquid water bodies. An interesting observation for Earth is that the atmosphere and its influence for the development of multicellular life may not so much be linked to the availability of Oxygen, as to the removal of CO_2

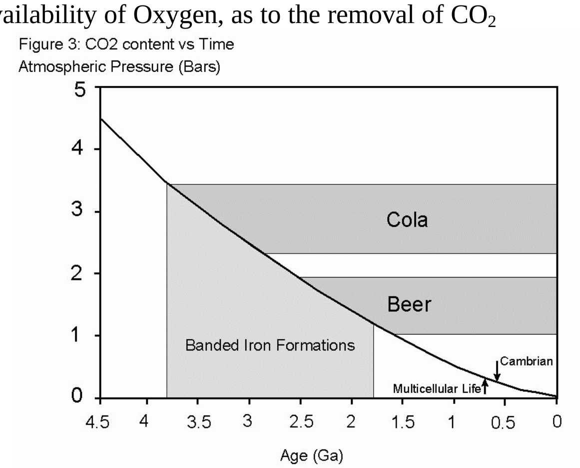

Figure 3: The CO_2 concentration of the atmosphere required to maintain the Earth at its present mean temperature despite a cooler early Sun.

Note that large CO_2 concentrations are required until relatively recent geological time and that the

Cambrian explosion of life corresponds to the oceans ceasing to resemble a carbonated beverages. Early life must have evolved in the presence of considerable amounts of CO_2 and it is interesting that some primitive extremophiles such as *Cyanidium Caldarium* are highly CO_2 tolerant, remaining viable at pH Zero.