

**Venus, Earth and Mars  
.... Game, Set and Match!**

Greenhouse Effects on the Rocky Planets.

[As the innermost planet Mercury has no atmosphere and therefore no greenhouse, only the other three rocky planets Venus, Earth and Mars are appropriate here.]

**AGW:** Proposes that the only greenhouse gases are the special GG - those that can capture IR directly, such as carbon dioxide and methane.

A planet's observed surface temperature, **OBS** is greater than its calculated Stefan-Boltzmann temperature, **SB** – ie heat from the Sun - because greenhouse gases trap some of the planet's radiated heat increasing the observed temperature by  $\Delta$

$$\mathbf{OBS = SB + \Delta} \quad (1)$$

**AGW** assumes that  $\Delta$  is the greenhouse effect, **G**, and that it increases with  $\text{CO}_2$

ie  $\mathbf{G = f(P_{CO_2})}$

but just what particular function that might be depends on which AGW expert is using the data! There are many shown in the IPCC reports; Al Gore seems to favour linear,

$$\mathbf{G \propto P_{CO_2}}$$

Although Mars has only a small atmosphere, it is 95%  $\text{CO}_2$  - similar to Venus' 96%. The product (Pressure\* % $\text{CO}_2$ ) is 14x greater than Earth's. According to AGW, Mars should have a larger greenhouse than Earth; instead it's much less!

**No special greenhouse gases:** (Chapter 1B):

A planet's greenhouse effect, **G** is proportional to its *pressure*, and (Chapter 2) a planet's surface also receives extra heat from its Interior, (which in turn is the sum of the tidal heat, Interior radioactive decay heat and heat left over from the planet's formation) producing the larger observed temperature, **OBS**.

$$\mathbf{OBS = (SB + IntT) + G} \quad (2)$$

where **OBS**  $\equiv$  observed temperature of the planet's surface,

**SB**  $\equiv$  calculated Stefan-Boltzmann temperature

**IntT**  $\equiv$  Interior Temperature, the contribution of Temperature coming from the planet's Interior heat, (in turn, IntT = tidal + radio-active + residual).

From Chapter 1B, the greenhouse trapped heat is proportional to

- the atmosphere's density (ie P) - or more accurately than needed here, to the product C\*P where C is atmosphere's specific heat, and
  - to each planet's surface temperature so that,
- $$\mathbf{G = k*P*(SB + IntT)} \quad (\mathbf{k} \text{ is the same for all the rocky planets}).$$

Then,  $\mathbf{OBS = (SB + IntT)*(1+k*P)}$  (3)

**Testing AGW vs non-AGW:**

These two propositions can be tested with the rocky planet data (Table 1).

**AGW** proposes that  $\Delta = \text{OBS} - \text{SB}$  (Row 6) is the greenhouse effect, **G** and therefore  $\Delta/P_{\text{CO}_2}$  is constant. **(Row 7): Clearly, AGW is a long way wrong.**

		Mercury	Venus	Earth	Mars
Row	<b>DATA</b>				
1	Pressure, bar	0	95	1	0.006
2	% CO2	0	96	0.04	95
3	CO2 density, bar	0	91.2	0.0004	0.0057
4	SB, K	437	232	255	209
5	OBS, K	ca 440	735	288	215
6	$\Delta$ =OBS-SB, K	ca 3	503	33	6

### CALCULATIONS

#### a: CO2 comparison

7	$\Delta$ /CO2 dens=constant <b>No!</b>		5.52	82500	1053
8	G/CO2 <b>No!</b>		5.21	13619	4.36

#### b: Pressure comparison

9	IntT		27.6	27.6	6
10	$\Delta$ /Press		5.29	33	1000
11	G/Press = constant <b>Yes!</b>		5.00	5.45	4.15

**Table 1<sup>1</sup>: Greenhouse on the Rocky Planets.**

#### No special greenhouse gases :

**Row 10** is better, even though it is *only* the greenhouse effect,  $\Delta \propto P_{\text{total}}$  being considered. It is assumed in this row that  $\text{IntT} = 0$ , demonstrating the values depart when IntT becomes relatively more significant, eg Mars where  $G \approx 0$ .

*However, we can do much better than that!*

**Row 11** is eq 3 where the planet's interior heat (IntT) supplements the greenhouse effect, ie  $\Delta = G + \text{IntT}$ . The greenhouse proportionality is the same for each planet, validating this proposal.

.....  
The calculations involved.

For each planet, equation (3) applies, ie

$$\begin{aligned} \text{OBS}^V &= (\text{SB}^V + \text{IntT}^V) * (1+k*P), \\ \text{OBS}^E &= (\text{SB}^E + \text{IntT}^E) * (1+k*P), \\ \text{OBS}^M &= (\text{SB}^M + \text{IntT}^M) * (1+k*P). \end{aligned}$$

Therefore, for the 3 rocky planets considered here, there are 3 equations with 4 unknowns – the 3 IntT, one for each planet, and k. No solution! Extra information or approximations are required.

To this end, first consider Venus and Earth together.

Set  $\text{IntT}^V = \text{IntT}^E$  then one can calculate that IntT & k

Justification:

- They are similar sized planets with similarly active interiors.
- As they were formed at much the same time, 4-6 billion years ago, their residual heats and radio-active decays are similar.
- The effect of tidal heating is similar. Earth has a Moon, the Moon's tidal effect being approximately twice that of the Sun's, which somewhat balances Venus' closeness to the Sun. (Anyway, tidal heating is small. Mercury has the largest tidal heating of the rocky planets but  $\Delta$ =OBS-SB including tidal, residual heats and radio-active heat, still only totals about 3K.)

Now we have 2 equations with only 2 unknowns, IntT & k.

This returns  $\text{IntT}^V = \text{IntT}^E = 27.6$  - falling well within the limits from Fig 1 of  $33\text{K} > \text{IntT}^E > 12\text{K}$  - and  $k=0.01928$ :  $k$  can then be used for Mars to give  $\text{IntT}^M = 6.0$  returning a value for  $G \approx 0$ , matching expectations for a planet with such low pressure.

**The greenhouse effects,  $G$ , constant for each planet are**

**Venus: 475 K**

**Earth: 5.5 K**

**Mars: 0.02 K**

However, Figure 1 shows  $\text{IntT}^E$  is variable – when measured over thousands of years.

[AGW does not allow for a significant  $\text{IntT}$  but Row 7 shows this is wildly inaccurate. *Even if one includes  $\text{IntT}$*  (Row 9) producing (Row 8), the end result is still wrong. Even if the proposed functional relationship between  $G$  &  $P_{\text{CO}_2}$  is non-linear, Mars cannot have  $G$  intermediate between Venus and Earth as expected by AGW.]

### **CONCLUSIONS:**

- 1. The greenhouse effect,  $G$  is proportional to an atmosphere's total pressure.**
- 2.  $G$  for each planet is therefore constant.**
- 3. Vostok shows a planet's geologically released internal heat,  $\text{IntT}$  varies with time.**
- 4.  $G$  is unrelated to an atmosphere's carbon dioxide density. AGW is wrong.**

Chapter 1B is validated by #1 & #2 and Chapter 2 by #3.

---

<sup>i</sup>American Chemical Society:

<https://www.acs.org/content/acs/en/climatescience/energybalance/planetarytemperatures.html>

[Lyatt Jaeglé](http://www.atmos.washington.edu/2002Q4/211/notes_greenhouse.html): Similar data are provided in website

[http://www.atmos.washington.edu/2002Q4/211/notes\\_greenhouse.html](http://www.atmos.washington.edu/2002Q4/211/notes_greenhouse.html)