The NMS (New Mars Synthesis), Recent Data from Gale Crater and NWA 7034: Evidence for a Persistent Biologically Stabilized Greenhouse on Mars

J.E. Brandenburg Morningstar Applied Physics Vienna Va

Introduction: The NMS [1,2] ,is a concept of Mars Geochemical history drawn from the wide body of data from Mars orbiters, lander-rovers, the Mars Meteorites and a better understanding of Mars analogous environments on Earth. It basic concepts are 1. :Mars has a 4x Lunar cratering rate 2. Mars had a greenhouse giving Earth-like temperatures and atmospheric pressures. 3. Mars had a liquid water northern ocean and hydro-cycle. 4. Mars life began early and shaped the Mars environment, forming a Martian Gaia with an oxygen rich atmosphere to stabilize its planetary greenhouse. 5. Mars climate changed abruptly in recent geologic time, probably due to the formation of the Lyot Impact Basin in the Early Amazonian. Thus, Mars and Earth began similarly and evolved similarly until recent geologic time, approximately 0.5 Billion years ago under the assumption of a 4x Lunar chronology. The NMS assumes Mars held biology from the Early Noachian, and has been geologically active throughout its history. This biology, through the creation of a oxygen rich atmosphere by photosynthesis, stabilized the Mars greenhouse by creating an oxidizing environment , promoting Fe+3 ferric iron and acid formation [2]. These concepts can be tested by new Mars data, particularly the recovery of a new group of Mars meteors of great radiometric age such as NWA 7034 [3,4,5] and recent data gathered from the Curiosity rover in Gale Crater [6] Basically, the new evidence says that exposed sediments a Gale Crater (Fig. 1) are a only billion years old or less, and they tell a story of liquid water and oxidizing conditions for much of Mars history – implying a stable greenhouse-biosphere. In the remainder of this abstract, the basic new evidences supporting the NMS from the newly found meteorites and the Curiosity investigation of Gale crater will be discussed.

New Meteoritic Evidence Evidence for 4x Lunar Absolute Mars chronology comes from the recent discovery of a group of related Mars meteorites: NWA 7034 and its sisters,[5] which are 4.4 Billion years old. Together with ALH84001 at 4.5 Billion year age this completes a picture proposed by the author [3] of a bimodal distribution of terrain ages on Mars , with the southern half of the mars dichotomy being approximately 4.5 Gyr on and the northern portion of much younger age. 1.3-0.2 Gyr. The average surface age for the north of Mars, inferred from this collection of young meteorite ages is approximately 0.5 Gyr, while the average age of the ancient highland terrains is 4.5Gyr. Thus the mars dichotomy is now fully reflected in the radiometric ages in the Mars meteorite collection. Since the radiometric ages of the meteorites are measured, rather than theorized, we can use them to constrain the absolute chronologies of Mars. It has been found by several workers that the chronologies and radiometric ages of Mars meteorites can be reconciled easily if the Mars cratering rate for the chronologies is chosen as 4xLunar rather than some lesser value, such as 2xLunar or 1x Lunar as is presently used. (see Fig. 2) The choice of 4xLunar has the effect of making the northern portion of the Mars dichotomy much younger and thus creating at average age of approximately 0.5 Gyr, in agreement with the average age of the young Mars meteorites. Since many of the exposed strata at Gale crater appear to be of Heperian age or later, and appear to be aqueously formed sediments , this suggests tha liquid water may have been on Mars surface for several Billions of years.

New Evidence Form Gale Crater Mars and Earth are believed to have begun with similar surface conditions, that were warm, wet and rich in organics. Since life is thought to have begun on Earth very early , based on fossil evidence, in rocks of 4.0 Gyr age, it is reasonable , under the Principle of Mediocrity, to assume that it also began on Mars. This is supported by the findings of microfossils in the ancient Mars meteorite ALH84001 in rock 4.0 Gyrs old. The discovery of deeply bedded water-deposited sediments in Gale crater , dating to approximately the Early Amazonian era (Fig.1.) without evidence of carbonates, and with ferric iron in abundance, shows that this sediment was laid down not only in terrestrial conditions of temperature and atmospheric pressure but that the atmosphere was oxygen rich, which prevents the formation of iron carbonates. To have liquid water on Mars requires a dense CO_2 atmosphere, but this is geochemically unstable to form carbonic acid : $H_2O + CO_2 = H_2CO_3$ and thus from carbonates with iron and other metals in basaltic rocks. However a CO_2 greenhouse is stabilized by free oxygen, creating acids such as sulfuric [7] and raising the iron to the ferric (+3) state , which will not form carbonates [2]. Therefore, the existence of Middle Hesperian , water deposited, highly oxidized, sulfate rich- carbonate poor, sediments in a geologic formation on Mars constitutes evidence for a persistent biologically stabilized greenhouse on Mars, extending over billions of years.

References:[1]J.E. Brandenburg and Vincent DiPietro, (1998American Geophys. Union Spring Meeting 1998 [2] J.E. Brandenburg (2003) 6th Int. Conf. on Mars. [3] J.E. Brandenburg,(1995) Earth, Moon and Planets 67, 35-45 [4] L.E. Nyquist, L.E. Borg , and C.Y. Shih.(1998) JGR (planets) 103, E13, p431-445.[4]J.E Brandenburg (2002) Meteoritics Society meeting Los Angeles.[5] Milliken, R. E., et al (2010), Geophys. Res. Lett., 37, L04201, [6] Humayun M. et al (2013) Nature , 503, 513 516. [7] A. G. Fairén , et al, *Nature* **431**, 423-426 (23 September 2004)

Fig/ 1. Exposed Strata at Gale Crater

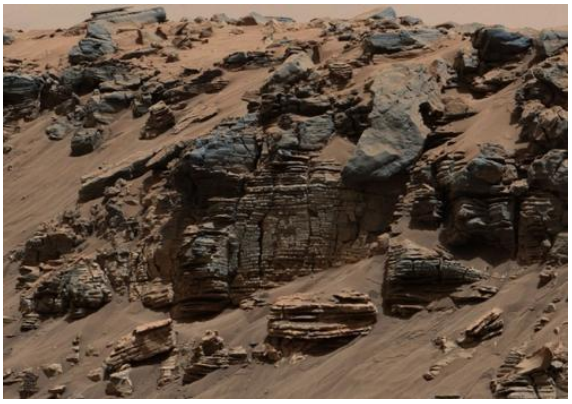

Fig.2 A 4xLunar Chron.w.overlaid meteorite ages [3]