SIX MODELS FOR THE FORMATION OF THE EARTH'S ATMOSPHERE.

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Introduction: The chemical composition of planetary atmospheres can be defined by the mass mixing ratios, **R**(A), of their constituent species, A, relatively to $\mathbf{N_2}$. Moreover, in the case of a pure meteoroid atmosphere released by meteoroids upon atmospheric entry, these ratios would scale as the corresponding concentration ratios measured in Antarctic micrometeorites [1]. Previously, we only considered Ne, N, C (trapped in carbonates) and H_2O. We recently added S locked in the upper mantle to this list, because the predicted meteoroid burdens of S, Ir, Os and Ru strikingly well fit the corresponding values observed in the upper mantle [2], i.e., within a factor 1.05x (Ru) to 1.25x (S). Like in classical basalt magma volcanism, C and S were first likely oxidized into CO_2 and SO_2, by a high temperature in–situ oxidation that would be related to the oxygen fugacity of their assemblage of minerals.

Comparison of 6 models of atmosphere: Table I lists the mixing ratios of Ne, H_2O, CO_2 and SO_2. The successive lines from top to bottom refer to**: #Earth,** *observed* composition**; Model #1,** volcanic atmosphere defined by Rubey [2]**; Model** #**2,** atmosphere released by geysers and fumaroles that are heavily contaminated by surface water [4]**; Model** #**3,** outgassing of Hawaiian volcanoes, which would both sample the most pristine gases from the degassed upper mantle [4], and give a model for the Tharsis bulge volcanism on Mars**; Model** #**4,** atmosphere expected from a cometary impact [5]**; Model** #**5,** "steam" atmosphere from a CI–type asteroid impact [6]**; Model** #**6,** *"pure"* meteoroid atmosphere (up–dated ratios from Table 3.1, in Ref. 1)**.**

Table I: Mass mixing ratios (relatively to $\mathbf{N_2}$)

Type	**R**(Ne)	**R**(H_2O)	**R**(CO_2)	**R**(SO_2)
#EARTH	***1.6*** x $\mathbf{10^{-5}}$	***350***	***83***	***75–150***
#1 (Rubey)	**?**	380	21	1.1
#2 (Fumaroles)	**?**	2000	6.6	1.2
#3 (Hawaii)	**?**	10	4	4.4
#4 (Comet)	**?**	17	2.6	0.06
#5 ("Steam")	10^{-8}	55	54	0.3
#6 (Meteoroid)	**3** x $\mathbf{10^{-5}}$	140	130	**140**

Verdict: From the 6 models of atmosphere considered, yet, only the meteoroid atmosphere (#**6**) reasonably fits the measured composition of the Earth's atmosphere (2nd line). The very low Ne mixing ratio that invalidates model **#5** right away, was derived in Ref. 1 (section 3.3.2)**.**

References: [1] Maurette M. 2006. In *Comets and the Origin and Evolution of Life*, edited by Thomas P.J. et al., pp. 69–111. [2] Maurette M. Forthcoming. Hydrous-carbonaceous meteoroids in the Hadean Aeon. *ASP Conf. Series***.** [3] Rubey W.W. 1955. In *Crust of the Earth*. New-York: Geol. Soc. America, pp. 630–650**.** [4] Hartmann W.K. 1999. *Moon and Planets*. Belmont: Wadsworth. 428p**.** [5] Delsemme A. 2006. In *Comets and the Origin and Evolution of Life*, edited by Thomas P.J. et al., pp. 29–68**.** [6] Fegley B. and Schaefer L. 2008. *Meteoritics & Planetary Science* 43**:** A42**.**