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Earth's planetary evolution and the extinction of the dinosaurs

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Summary

There is evidence of a separate distribution of non-metal elements and compounds in Earth's geologic record. This interpretation is based upon the recognition of patterns of non-metal isotopes of carbon, oxygen, nitrogen, and sulphur throughout geologic time. An electric/magnetic based fractionation process is believed to be responsible for this, early in the history of the solar system. A theory of planetary evolution is developed to explain this non-metal geologic overprint. At the end of the Protoplanetary stage about 3800 Ma ago, the Earth is envisioned with 30 to 40 moons. One moon accreted for each world-wide geologic unconformity or period during the Phanerozoic. A geologically reasonable solution to the problem of the history of the Lunar orbit enables an estimate of how many moons Earth may have had. A simple gravitational stratification of non-metal elements and compounds overprinted onto the distribution of moons can explain all major mass extinctions. For the non-avian dinosaurs (hereafter referred to simply as dinosaurs), the Paleogene Moon accretion input large amounts of carbon monoxide and nitrogen gas into the Earth's atmosphere. A significant drop in the oxygen content occurred. Cretaceous dinosaurs became infertile in the lower oxygen content of the Paleogene atmosphere. A moon accretion process is interpreted. A database of Large Igneous Provinces is rearranged to identify 30 moons. A method for supercontinent formation and breakup results from simple moon accretion. Plate tectonics became Earth's dominant structural force about 84 Ma ago when Earth evolved from the Accretionary stage into the Mature stage.

Theory / Method / Workflow

A separate distribution of non-metal elements and compounds is interpreted in Earth's geologic record (Figure 1). The non-metal elements consist of carbon, nitrogen, oxygen, fluorine, phosphorus, sulfur, chlorine, bromine, and iodine plus only compounds among themselves. The chemically inert noble gases (helium, neon, argon, krypton, and xenon) are also part of the non-metal group. The direct relation between accretion time and mass of each compound means the non-metals are gravitationally stratified.

A theory of planetary evolution is formulated to explain how this happened.

There are three stages in planetary evolution: Protoplanetary, Accretionary, and Mature.
The Protoplanetary stage is the first stage. For the Earth-Lunar Moon system, this is defined as from the origin of the solar system until after the impact of the Orientale crater on the Lunar Moon about 3800 Ma ago (Wilhelms, 1987). Planetary formation must be driven by magnetic and electric fields which fractionated the early nebular disk into a metallic and non-metal distribution of matter. The much smaller distribution of non-metals was unaffected by these magnetic fields and remained in a gravitationally stratified circum-planetary disk around each forming planet.

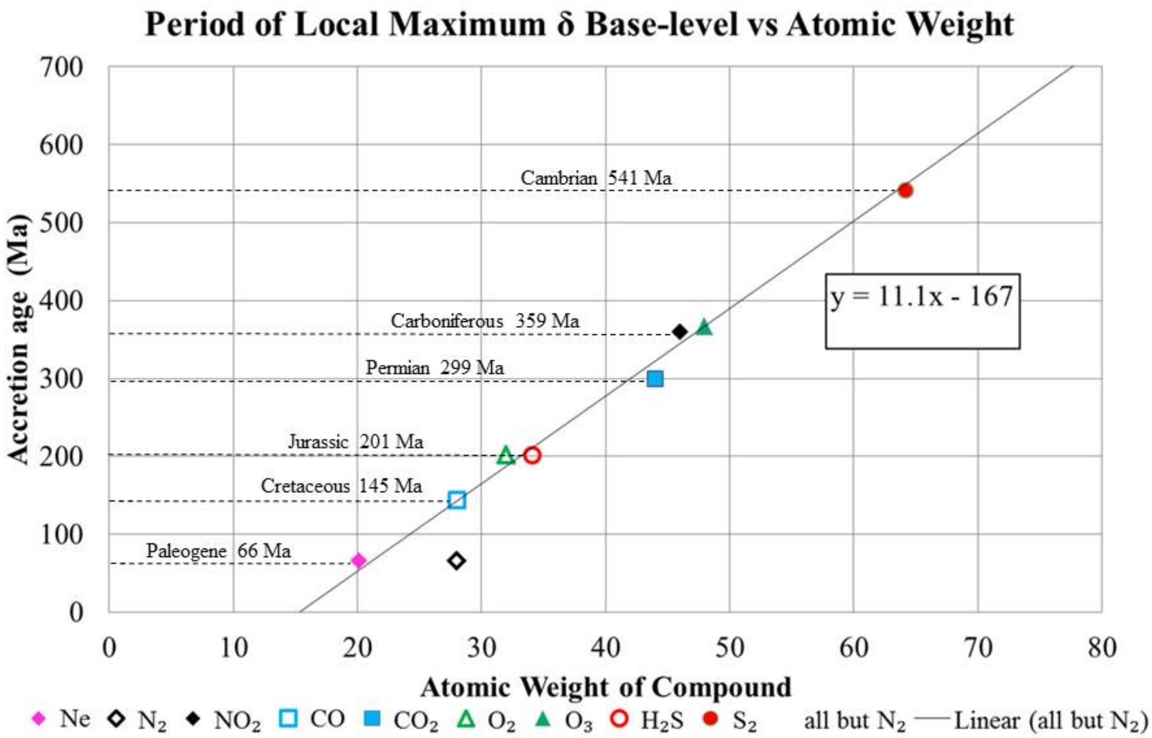

Figure 1: The period with local maximum δ base-level is plotted against the compound's atomic weight (this can also be the accretion time of the moon in the middle of each layer). This proves the gravitational stratification of non-metal elements/compounds on the basis of $\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$, and $\delta^{34}S$ isotope curves throughout geologic time. The straight-line is not fit to the N_2 point due to solar photochemical effects from ammonia in Zone 1. There are more compounds in the Proterozoic but δ data becomes sparse.

The 'metallic' distribution contained all the rest of the elements and their compounds. Also contained in this distribution are compounds between these elements and non-metals (e.g. iron sulfide, iron oxide). Hydrogen is believed to be acting as a metal so all compounds with hydrogen are part of this metallic distribution (e.g. H_2O). This is a much larger distribution of matter and it continued into the formation of planets surrounded by many moonlets. Moonlets are similar to planets in that they differentiate a mantle and an iron moonlet core (IMC). In general, moons are different in that they form later and are conglomerates of moonlets. By the end of the Protoplanetary stage this had created the Archean Earth and possibly thirty moons in orbit. The circum-planetary disk of non-metal elements and compounds was accreted onto them. Thus the numerous moons show an overprint of the gravitational stratification of the non-metal elements and compounds (Figure 2).

The Accretionary stage is defined by regular moon accretions which slowly reduce the number moons. Jupiter, Saturn, Uranus and Neptune have well-developed ring structures due to accreting moons. On Earth, a Phanerozoic moon created a world-wide geologic unconformity upon accretion. The last dozen moons to accrete had significant influences on the atmosphere due to the different ratios of these non-metals in the moons and Earth's evolving atmosphere. Accreting moons broke apart near the planet (Roche limit) into many fragments. A Main Ring of breccia and non-metal dust formed. Large fragments of the accreting moons' crust and mantle

created impact craters (e.g. Chicxulub). The much denser iron moon and moonlet cores (IMCs) did not fragment but caused the Earth's liquid outer core and molten mantle to gravitationally plume and stretch out in a fusion process. A Large Igneous Province (LIP) was created upon accretion. The dense IMC sank into the upper mantle and became a hotspot. Geologically, a world-wide unconformity was recorded for each accretion of a moon core and Main Ring during the Phanerozoic. Moons are the named for the geologic period that the moon core's accretion event began. Thus, at the end of the Precambrian (start of the Phanerozoic) about 541 million years ago when the Cambrian Moon core accreted, the Earth had ten moons; Ordovician Moon, Silurian Moon, Devonian Moon, Carboniferous Moon, Permian Moon, Triassic Moon, Jurassic Moon, Cretaceous Moon, Paleogene Moon, and Lunar Moon.
The Mature stage is a planet that no longer has regular moon accretions, e.g. Venus and Mercury.

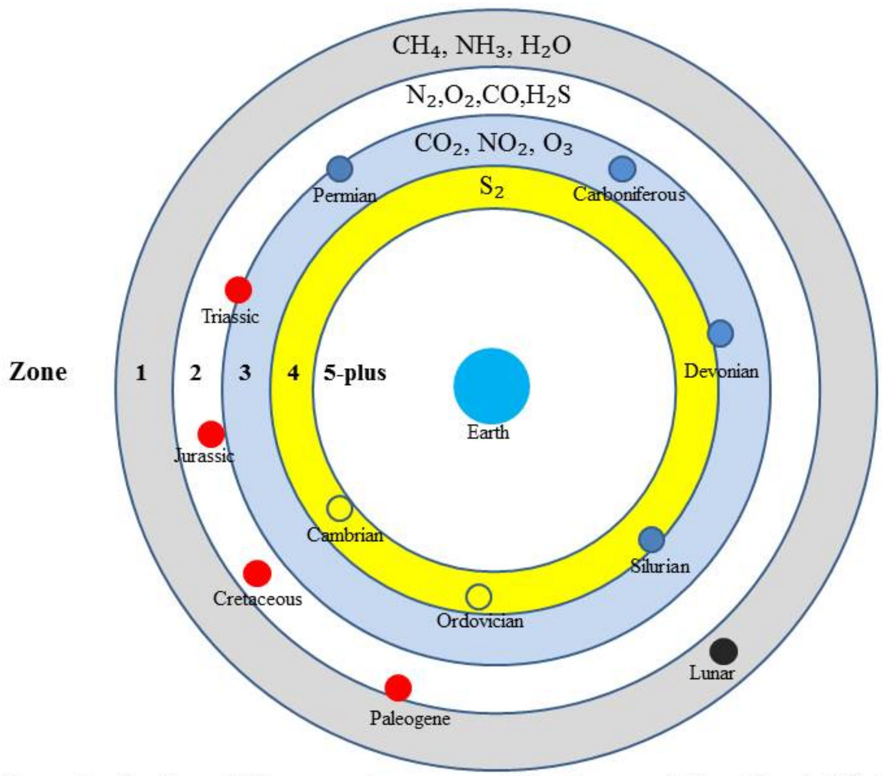

Figure 2: Conceptualization of Phanerozoic moons within the gravitationally stratified layers of carbon, nitrogen, oxygen, and sulfur compounds. One moon for each geologic period. There are more moons and layers in the Proterozoic. By 3800 Ma, the moons had swept up the layers. Zone is defined by the number of atoms in the compound for carbon, nitrogen, and oxygen. Sulfur atoms count as two because they sit below them on the Periodic Table. Only detected compounds are shown.

Results, Observations, Conclusions

Moon	Compound	CH_4	NH_3	H_2O	HF	N_2	CO	O_2	PH_3	H_2S	HCl	F_2	CO_2	NO_2	O_3	P_2	S_2	Cl_2	Extinction Intensity	Comment
(Period start)*	age (Ma)	11	22	33	55	144	144	188	210	211	238	255	322	344	366	521	545	620		equation 1 age
Lunar		**CH_4**	**NH_3**	**H_2O**																
Paleogene (66)	74			H_2O	**HF**	**N_2**	CO												0.47	hypoxia
Cretaceous (145)	154					N_2	**CO**	O_2	?	H_2S			CO_2						0.20	marine acidification
Jurassic (201)	210							**O_2**	**PH_3**	**H_2S**	HCl		CO_2	NO_2					0.47	marine acidification
Triassic (252)	260								PH_3	H_2S	**HCl**	**F_2**	CO_2	NO_2	O_3				0.69	marine acidification
Permian (299)	307												**CO_2**	NO_2	O_3		S_2		0.15	marine acidification
Carboniferous (359)	372												CO_2	**NO_2**	**O_3**		S_2		0.31	marine acidification
Devonian (419)	427												CO_2	NO_2	O_3		S_2		0.39	marine acidification
Silurian (444)	453												CO_2	NO_2	O_3	?	S_2		0.57	marine acidification
Ordovician (485)	497														O_3	**P_2**	S_2	?	0.59	marine acidification
Cambrian (541)	550?															**P_2**	**S_2**	Cl_2	-	marine acidification
Ediacaran (635)	644?															?	S_2	**Cl_2**	-	marine acidification
Zone		1	1	1	1	2	2	2	2	2	2	2	3	3	3	4	4	4		
Continuous Exposure Guidance Level 90 days					0.1		20			1	1		5000	0.5	0.02					

* extinctions usually occur just before the start of a period so for the End Permian extinction, it is listed as the start of the Triassic at 252.2 Ma

Extinction intensity from Bambach et al. (2004), big five extinctions are coloured

equation 1: accretion age = 11.1*(atomic_weight) - 167

Figure 14: Matrix of accretions for the past 660 Ma. All interpreted compounds are on top row. Extinction intensity is from Bambach et al. (2004). The 'big five' extinctions are colored. CEGL-90 are U.S.A. current Continuous Exposure Guidance Levels -90 days in air (National Research Council, 2007, 2008, 2009), lower the ppm the more lethal. Middle of the layer is colored. Accretion boundaries begin with the first arriving fragment of each moon (section 4.6). The noble gases estimated accretion ages are: helium(-), neon (57 Ma), argon (276 Ma), krypton (763 Ma), and xenon (1290 Ma).

Novel/Additive Information

A link is shown between world-wide geologic unconformities, mass extinctions, Large Igneous Provinces (LIPs), mantle hotspots, geomagnetic polarity reversals, supercontinent formation, and accretions of Earth's moons. The accretion process can be multiplied with the Matrix of Accretions to explain the causes of Earth's numerous mass extinctions (including the dinosaurs). Moons are conglomerates of moonlets. The Lunar Moon formed when the Procellarum Moonlet fused with the SPA Moonlet. Lunar mascons were created by IMCs of accreting moonlets during moon formation. Speculation on events during the Protoplanetary phase suggests the Late Heavy Bombardment or Terminal Lunar Cataclysm on the Lunar Moon was the period of the formation of all of Earth's moons.