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Geochemical Principle of the Life Evolution

Through the relationship between fossils and rock geochemistry, to study the evolution of life on the earth

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Abstract This paper has integrated the latest achievements of lithostratigraphy, biostratigraphy and geochemical survey in China. Research indicates, the directionality, staged, and irreversibility of biological evolution can all be reflected in the time evolution of rock geochemistry. The outbreak and extinction of biological population correspond to the lithostratigraphic geochemical interfaces .Between the number of biological species, and the rock elemental content, existed a significant correlation. The fractal distribution of rock geochemistry reflects the basic structural features of life on the earth, just like a human body meridian acupuncture point map.

In the long-term formation and evolution process, the biological chain system is always in a dynamic equilibrium with the global ecological environment. The abundance and lack of certain elements in the environment, has important influence on the physiological and biochemical processes of plants and animals, thus restricting the regional ecological structure. At last, the authors propose geochemical view point of the origin and evolution of life: Life is the essential characteristic of the universe, the adaptation and coordinated development of biological systems and their living ecological environment, is the fundamental causes and driving forces of biological evolution. Biological evolution is the inevitable result of the interaction of the Earth's lithosphere, hydrosphere, atmosphere and biosphere.

Key words Origin and evolution of Life, Rock strata, Biological fossils, Geochemistry, System synthesis

According to modern system theory of Earth lithosphere-biosphere interaction, this paper analyzes the latest achievements of lithostratigraphy, biostratigraphy and geochemical survey in China (Bai,1986;Hebei,1989;Hebei, 1996; Ineer Mongolia,1989;Lioaning,1989;Shandong,1989;Shanxi,1989;Sun,2006;Yan,1997;Yuan,2011), put forward the geochemical view of the origin and evolution of life.

1. An Overview of the Origin and Evolution of Life

Scientists found 37.7-43 billion years of microbial fossils on the Canadian coast, indicating that the earliest life entity on Earth are close to the time of Earth's formation (AFP, 2017).

Spencer regards evolution as a process that is solemnly revealed, and the therein program is embedded in the structure of the universe. Darwin proceed from the origin of species, discussed the horizontal evolution or diversity sources. Wallace argues that natural selection is difficult to explain the emergence of human advanced capabilities. Gould and Eldredge proposed theory of punctuated equilibrium (Chen, 1996). Manfred Eigen's the hypercycle theory think, there is a molecular self-organization stage. Kenneth J. Hsu believes that, the catastrophes of nature have contributed to the tremendous changes in biological evolution (Kenneth, 1986). Stephen Meyer wisdom design theory very well explained the necessary information that form the first living cell (Huang,2009,Meyer,2009).From the view point of life elements geochemistry, the history of the origin of life is how the atoms of life elements are combined into complex chemical substances, which in turn form the process of life. (Feng,1980).

2 Relationship between Earth life and rock geochemistry

2.1 Biological fossil assemblage and rock geochemistry

Rock strata as the biological fossil 's carrier, its geochemical time evolution also shows directionality, staged periodicity, and irreversibility. Between rock types geochemical and fossil distribution has the correspondence and correlation.

The correlation analysis shows that between the strata age and the elemental content, there is a significant linear correlation. There was a significant negative correlation between the number of species and the geological age, γ=-0.4818, n=80, $\gamma_{0.05}$=0.2172. In general, the more new the eras, the more the species tend to be richer.

The biological population outbreak and extinction, correspond to the lithostratigraphic geochemical interface. Chemical elements content high and low become the threshold of the emergence or absence of biological fossils. Xu et al. analyzed the profiles of the Sinian and Cambrian boundary sections, found Ni-Ir-$\delta^{13}C$ double anomalies in the black shale layer. (Wang, 1999).

2.2 Biological species and rock element content

Periodicity is ubiquitous in natural phenomena. In North China lithostratigraphic formations, paleontology fossil species varies between 1 to 227, which prosperous periods and silence periods appear alternately, showing about 250 Ma periodic characteristic of , related to the galaxy years. Between the rock elemental content and the number of biological fossil species, there is a significant correlation. This fully illustrates the constraints of the geochemical environment to biological evolution.

Between the two, we can establish as follows polynomial equations:

$y = -0.0026x_1^4 + 0.0165x_1^3 + 0.0165x_1^2 + 0.1588x_1 + 0.0673$ $R^2 = 0.5461$ $\gamma=0.7390$ $\gamma_{0.05}=0.2172$ $n=80$

$y= lgY$ Y=number of fossil species $x_1=lg [(U\times Bi\times N\times S)/(FeO\times Pt)]$

$y = -0.0117x_2^3 + 0.1209x_2^2 - 0.1476x^2 + 0.9954$ $R^2 = 0.2542$ $\gamma=0.5042$

$X_2=lg[(U\times H_2O\times N\times S)/(MgO\times Ni\times FeO\times CO_2)]$

$y = 0.0376x_3^4 + 0.6293x_3^3 + 1.4786x_3^2 + 1.6976x_3 + 33.711$ $R^2 = 0.1938$ $\gamma=0.4402$

$X_3=lg[(U\times H_2O\times Al_2O_3\times Fe_2O_3)/(MgO \times CO_2)]$

This shows, with associated intermediate-acid magma activity, warm and humid enriched oxygen sulfur volcanic fluid geological and geochemical environment, it is conducive to life reproduction.

2.3 Fractal structure of mineral, rock and strata

Fractal distribution is widespread in various fields in nature. Stratigraphic studied has indicated that, construction of metamorphic supracrustal rock in East of Hebei, in the 10^5~10^0m scale range, showing nested self-similar structures of super cycle, main cycle and secondary cycle. (Gong, 2004).

Acidophile elements and hydrothermal elements and basic-phile elements, between the North China region formation and East of Hebei Caozhuang group, content - time evolution trend is basically the same. This is like the traditional Chinese medicine meridian theory, the ear acupoints resemble inverted miniature human models.Geochemical fractal structure exists between the minera, rock and strata in north China. Like palm acupuncture point corresponding to the human body organs. Chaotic fractal self-similarity is a new starting point for deep understanding of the nature of life.

3 Eco - environmental effects of elemental geochemical distribution

In the process of long-term evolution, biological chain systems is always in a dynamic equilibrium with the global environment, which determines the type and structure of the earth's ecosystem. Human body blood and crustal elements abundance distribution has correspondence and coordination.

Certain elements abundance or lack in the environment, on the animal and plant and even human physiological and biochemical process of growth and development, metabolism, genetic variation, has an important impact, thus restricting the regional ecological structure. Research geochemical distribution of elements and their ecological and environmental effects, development and utilization of regional geochemical data in agriculture, environment, medical and other fields, this research has gained fruitful results. Since the 1980s, China's widely practices on relationships of geochemical elements and biological systems, accumulated a certain trend understanding: （1）The soil of lacks certain elements will affect the growth of the plant, even emerging the morbid. Endemic disease related to the elemental disorders of soil and water environment.（2）In the environment of absence of certain elements, apply the appropriate element fertilizer, can make the plant towards the benign direction development. (3) Excessive levels of certain elements also affect biological development or even illness. (4) The effects of some element in soil on biology, depending on its effective content. (5) Beneficial elements on the biological growth and development optimal benefit is restricted to a limited range（ Yuan,2002）. (6)Genuine traditional Chinese medicinal materials are only distributed in specific areas, soil chemical element content has a certain decisive influence to its active ingredient(Gong,2009a). (7) The distribution of pre-Qin cultural sites in China is closely related to the spatial distribution of Cambrian-Ordovician; (8) The world contries ancient capitals continued life span is closely related to its soil element content(Gong,2009b).

4. Geochemical view of life evolution

Chengjiang fossil group shows the sudden and spontaneity of the evolution, it reveals the spontaneously generation and evolution of the biological large scale uniform field. N. Eldredge put forward the interactive mosaic pattern that gradients and mutations in time and space. Chen based on facts to build a big outbreak evolution model of mushroom cloud-style multi-branch base (Chen, 1996). Plants have "feel" and "the primary nervous system (Ma, 1990). Thought is the natural power of life activities linking the past and the future. Plant physiological function relationship of the internet between genes, should play the roles of the human brain and nervous system (Liu, 2016). Emergent Evolution think, in the process of time, the universe continues to emerge new qualities, unusual and profound meaning characteristics. Prigogine think, evolution is the inner property of the universe, it can be understood

as a complex, orderly unfolding of the whole dynamics phenomena (Chen, 1996). Robert presents the paradigm of the origin of life that is life molecule template synthesis in the surface of the rock composition (Robert, 2012).

In summary, the author puts forward the geochemical view of life evolution. The essence of life is the metabolic process of the open system, that according to a specific gene template, copies and assemblages the chemical elements in the environment. Consciousness includes the perception of the system current status, memory of past experience and selection and operation of the direction of future development, it is essentially a senior tracing and command system for life processes. The evolution of life is one aspect of the evolution of the earth's lithosphere. In the long geological history, the Earth system gradually formed and improved a set of biological chain structure that to adapt to the ecosystem. With the gradual diversification and persistent chemical differentiation of the earth's surface rocks, in order to survive, biological systems had to gradually improve their own perception and movement function, thus the textures and structures of the populations is constantly complicated and refined. Biological evolution is uses the bio-chain textures and structures related to the history of the earth, to the intensive synthesis in a limited space within. Thus achieve functional requirements of new ecological environment. At the same time, genetic template of old populations takes place mutations and modifications, new species began to appear. The animal moves through the locomotion organs, plants migration through the seeds and roots with air, water and other natural power, the purpose is to ingest their own physiological essential nutrient elements.

In short, Biological system with its survival ecological environment, mutual adaptation and coordinated development, it is the fundamental causes and motive powers of biological evolution. Biological evolution is the inevitable result of intrinsic that is Earth lithosphere, hydrosphere, atmosphere and biosphere interaction.

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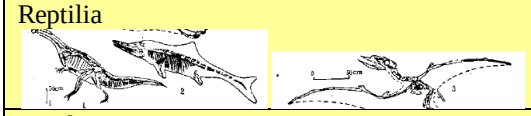
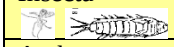
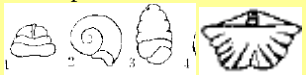
Yuan Baoyin, Xia Zhengkai.2011. Nihewan rift and early man[M]. Beijing: Geological publishing house, p.47-58.

Synopsis of the author

GONG Jin-Zhong (1962—), male, 1983 graduated from the China University of Geosciences (Wuhan) geochemical exploration professional, now as a professor, 40 papers published articles and published 4 books.

Table1 Relation between biological fossils and rock types in North China

Bios fossil	**To be endowed with rocks**
Mammalia 	clay rock sandstone
Reptilia 	sandstone siltstone clay rock
Bivalvia 	sandstone siltstone marl clay rock
Estheria 	marl shale mudstone
Fish 	shale marl sandstone siltstone
Insecta 	sandstone siltstone clay rock
Anthozoa 	shale sandstone
Plants 	shale mudstone siltstone coal clay rock sandstone
Archaeocyatha 	dolomite limestone
Conodonts 	limestone dolo-limestone
Gastropoda 	limestone dolomite marl clay rock shale siltstone
Cephalopoda、  Graptolithina 	dolomite limestone
Gastropoda 	limestone dolomite
Trilobita 	limestone dolomite shale siltstone

Microplants 	shale sandstone
Stromatolite 	dolomite limestone marl

Table2 Biological fossil phylum categories evolution structure in North China

Strata	Age/Ma	Bac	Alg	Bry	Pte	Gym	Ang	Pro	Por-Arc	Cor	Mol-Bra	Art	Ech	Cho
Q	0-2.6		2	1	2	10	49	8			43	28		184
N	5.3-23.3						29				38	3		39
E	26.4-56.5		1		1	4	18				10			
K	96-137		1		24	113	3				93	123	32	
J	151-205				29	99	167				13	43		7
T	216-250				55						44	22		17
P	277-295				412			16	3		16	8		4
C	308-320				123			71	11	19	67	2	11	
D	410-438				2			1		18	9		6	
S	438-448									112	12	7	31	
O	448-490							1			57	21	65	
€	495-543		2						1		20	144		
Z_2j	650-723		111											
Z_1w	723-800		52							6				
Qb	800-1000		202											
Jx	1100-1400		273											
Nk	1500-1600		62											
Ch	1650-1800		228											
Ht	1880-2500		102											
Wt	2560-2680	8?												
Fp	2740-2800	6?												
Zh	2900-3000	4?												
Qx	3100-3200	2?												
Cz	3350-3500	2?												

Bac-bacteria, Alg-algae, Bry–Bryophyta, Pte–Pteridophyta, Gym-Gymnosperm, Ang-Angiosperm, Protozoa–Protozoa, Por-Arc -Porifera-Archaeocyatha, Cor–Corlenterata, Mol-Bra -Mollusk-Brachiopoda, Art- Arthropoda, Ech-Echinodermata, Cho-Chordata

Table 3 Rock types distribution of strata in North China

Str	am	gg	gr	le	mq	mb	sc	ph	sl	qr	qu	br	cg	cs	ss	sl	cl	ms	sh	do	ld	dl	ml	ls	si	fe	β	α	τ	λ	T
Q																															
N																															
E																															
K																															
J																															
T																															
P																															
C																															
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S																															
O																															
€																															
Z_2																															
Z_1																															
Qb																															
Jx																															
Nk																															
Ch																															
Ht																															
Wt																															
Fp																															
Zh																															
Qx																															
Cz																															

Thickness units: m

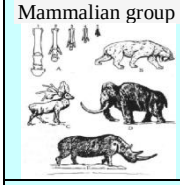
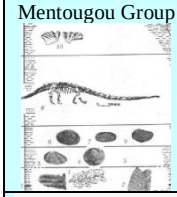
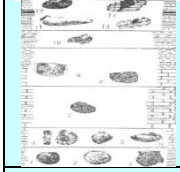
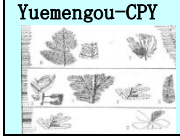
am-amphibolite, gg-granulite, gr-leptynite, le-leptite, mq-magnetite quartzite, mb-marble, sc-schist, ph-phyllite, sl-Slate,qr-quartz sandstone, qu-quartzite, br-reccia, cg-conglomerate, cs-gritstone, ss-sandstone, sl-siltstone, cr-clay rock, ms-mudstone, sh-shale, do-dolomite, ld-lime-dolomite, dl-dolomite-limestone, ml-marl, ls-limestone, si-siliceous rock, fe-ferruginous, β-basalt, α-andesite, τ-trachyte, λ-rhyolite, T-tuff

Table 4 Geochemical distribution of major living elements of strata in North China

Strata	SiO_2	Al_2O_3	CaO	MgO	K_2O	Na_2O	Fe_2O_3	FeO	Fe_2O_3 /FeO	CO_2	H_2O	P	S	N	Cl
Q	37.31	7.14	15.57	8.60	1.55	1.14	2.16	0.69	3.13	5.07	5.16	412	544	1243	273
N	46.51	13.24	7.64	5.65	1.75	2.78	5.96	4.55	2.32	1.15	2.86	2564	163	212	165
E	27.23	4.22	33.22	1.58	0.96	0.16	1.51	0.29	5.21	27.19	3.20	249	412	176	80
K	68.09	13.31	2.09	0.96	4.27	2.96	3.85	0.62	11.59	0.46	1.69	996	154	177	92
J	65.57	11.91	4.26	1.10	4.01	2.18	2.57	0.59	5.92	1.46	2.94	613	81	130	35
T	52.73	11.55	9.01	3.23	2.44	1.21	4.44	0.62	6.26	9.67	2.77	707	74	223	64
P	63.18	15.24	2.43	1.48	1.97	2.20	3.16	1.44	2.31	0.20	3.24	364	177	270	65
C	58.97	19.19	4.43	0.70	2.61	1.01	3.30	0.35	8.44	0.12	4.99	307	260	248	48
D	61.70	12.89	5.57	2.55	1.95	2.47	4.18	0.71	5.89	4.56	2.76	450	110	169	15
S	64.39	11.34	6.60	1.64	1.73	2.44	3.39	0.58	5.84	5.09	2.41	470	110	263	22
O	5.12	1.02	38.15	5.39	0.58	0.09	0.33	0.21	1.39	43.41	0.53	103	75	113	498
€	19.30	4.32	36.68	2.23	1.40	0.17	2.36	0.34	5.80	33.45	1.37	280	60	181	201
Z_2	37.76	6.65	26.82	3.90	1.90	0.20	2.61	0.89	2.93	17.00	0.33	285	200	204	95
Z_1	41.89	5.70	17.88	3.12	2.08	0.26	2.04	0.70	2.91	18.00	0.33	235	180	151	95
Qb	61.03	8.87	8.19	2.11	2.49	0.18	4.26	1.46	3.00	7.91	3.70	472	206	325	58
Jx	25.27	1.26	22.93	14.47	0.61	0.10	0.51	0.17	1.86	33.71	0.83	72	100	159	243
Nk	36.56	3.19	20.00	9.45	2.34	0.10	0.69	0.32	2.14	27.36	1.84	263	64	192	663
Ch	65.77	9.83	3.40	3.11	3.44	0.29	3.04	0.96	3.69	7.51	2.42	357	508	215	169
Ht	38.05	7.26	15.25	9.96	2.20	0.65	2.49	1.48	2.20	22.22	1.29	922	106	181	190
Wt	57.50	13.07	4.73	3.24	2.16	3.14	2.47	3.86	0.70	0.21	1.85	753	576	50	84
Fp	61.67	12.30	3.40	2.27	3.31	3.24	2.04	2.59	0.82	0.09	1.65	633	362	28	130
Zh	56.90	13.16	4.14	3.53	2.11	3.18	4.41	4.02	1.10	0.23	1.81	1419	391	32	83
Qx	60.82	13.56	4.63	3.53	2.07	3.52	3.37	3.13	1.08	0.20	1.10	861	197	25	100
Cz	48.57	11.34	6.67	4.47	0.81	2.38	1.67	12.52	0.15	0.02	2.44	647	15	23	13

Content unit: Oxide%, Eelement μg / g

Table5 Element assemblage and dilution feature of biostratigraphy in North China

Biostratigraphy	Enrichment elements	Depleted elements
Mammalian group Q 	Cl, N	
Jehol Group-JKR 	K, Fe^{3+}, Fe, P, F, Zr, Rb, La, Y, Zn, Nb, Pb, Th, As, Sb, W, Mo, S, Be, Se, Cs, Cd, Hg, Hf, Ta	Ca, Ni
Mentougou Group 	Ba, Sr	Ca, S, Cl, Se, Hg, Pd
Shi feng group PTS 	Hf	Fe^{3+}, Fe, B, Co, Cu, Sb, Mo, Se, Cs, Pt
Yuemengou-CPY 	Al, H, Ti, Sc, Ga, Se, Sn, Hf, Ta	Mg, C, Mn

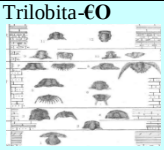
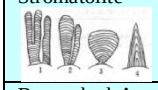
Graptus-anthozoa-SD 	Si Sb	K F Cl Ba Li Ni
Trilobita-€O 	Ca C Mn	Si Al K Na Fe Ti P Sr Zr Rb La Y Sc Ga V Cr Co Zn Th Be Cd As Hf Ta
Stromatolite Pt 	Mg C B	Si H Sr Pb Sn Au
Barren bed-Ar 	Na Fe^{2+} Fe Sc V Cr Co Ni Cu Ag Pd Pt	C H N O Rb B Li U As Sb Bi W Mo Tl

Table 6 Sensitive element contain change in the strata interfaces in North China biological evolution events

Element	evolution event	N	Cl	S	MgO	CO_2	FeO	CaO	H_2O	Mo	
Qpn/N_2s	earliest human	3.4484	3.4359	3.2667	2.8738	2.8111	1.8378	1.6653	1.5462	1.4560	
Element		Pd	Fe_2O_3	P_2O_5	Cs						
Qpn/N_2s		0.3960	0.4778	0.5200	0.5142						
Element		B	N	CO_2	As	Se	Sb	S	Li	W	Tl
N_1j/ENh	mammal	12.44	10.94	8.5775	6.5179	6.3077	4.9000	4.7385	3.7400	3.5000	3.4000
Element		H_2O	Sr	MgO	P_2O_5	CaO	TiO_2	Fe_2O_3	Na_2O	Bi	Rb
N_1j/ENh		0.1520	0.1918	0.2006	0.2323	0.2561	0.2945	0.3333	0.471	2.1000	2.8986
Element		CO_2	CaO	MnO	MgO	S	As	B	FeO		
E_{2-3}x/K_{1-2}n	dinosaur extinction	21.2422	17.12	4.2994	2.6333	2.1684	1.8367	1.8304	1.3810		
Element		Na_2O	Zr	Ga	Ba	Rb	K_2O	Be	La	Fe_2O_3	
E_{2-3}x/K_{1-2}n		0.1060	0.1651	0.1910	0.2313	0.2303	0.2455	0.2706	0.3076	0.5655	
Element		CO_2	Cl	Sr	Ni	Cr	Pd	CaO	Se	P_2O_5	MgO
K_1d/K_1z	Jehol Group flourishing	8.000	6.0755	5.1032	4.8193	4.4591	4.6364	4.3793	3.9000	3.8546	3.5217
Element		FeO	V	Hg	H_2O	Bi	TiO_2	N	Ta	Tl	Ga
K_1d/K_1z		3.333	3.0769	2.2719	2.2178	1.9000	1.856	1.8061	0.0935	0.1271	0.4816
Element		CO_2	Pb	Zn	Ba	K_2O					
T_1l/P_2s	biological extinctio	18.07	3.2800	2.5192	2.2300	1.6460					
Element		FeO	W	V	Bi	Sc	S	N			
T_1l/P_2s		0.2588	0.2639	0.3405	0.4116	0.4164	0.4211	0.5686			
Element		CaO	MgO	Sr	MnO	Na_2O	P_2O_5	F	FeO		
P_2s/P_1sh	vertebrate	12.8305	6.2381	2.2910	2.0231	1.9839	1.985	1.6925	1.2141		
Element		Li	Mo	Cl	As	Fe_2O_3					
P_2s/P_1sh		0.3142	0.3671	0.4568	0.4661	0.6939					
Element		Cl	CO_2	H_2O	CaO	SiO_2	Al_2O_3	Fe_2O_3	TiO_2		
€$_1$c/Z_2jx	trilobita	2.4211	2.3488	2.0606	1.7621	0.0691	0.0586	0.0690	0.0729		
Element		FeO	B	K_2O	MnO	P_2O_5	F	S			
€$_1$c/Z_2jx		0.0899	0.1065	0.1211	0.1557	0.2008	0.2431	0.3000			
Element		W	CO_2	Cl	Cd	Na_2O	FeO	S	Fe_2O_3		
Ht_1s/Wt_3G	stromatolite	8.2917	5.2459	4.8276	3.2747	2.6034	1.6475	1.4607	1.2412		
Element		As	MgO	CaO	Sr	Na_2O	Cr				
Ht_1s/Wt_3G		0.0382	0.0903	0.1007	0.1132	0.1770	0.2018				

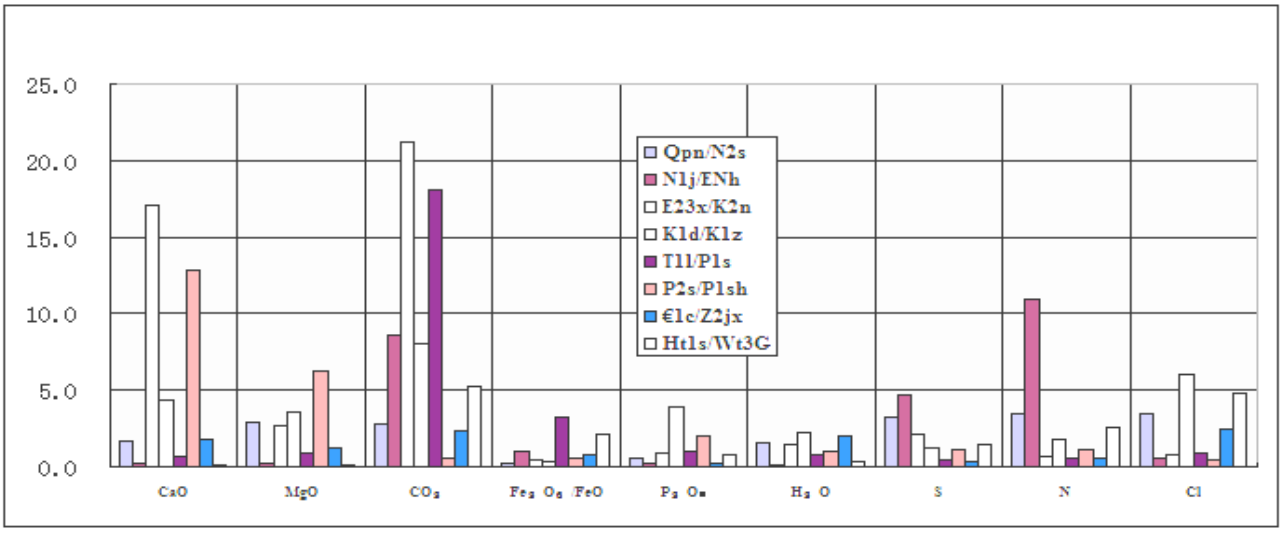


Figure1 Main element content ratios of strata interfaces in North China biological evolution events

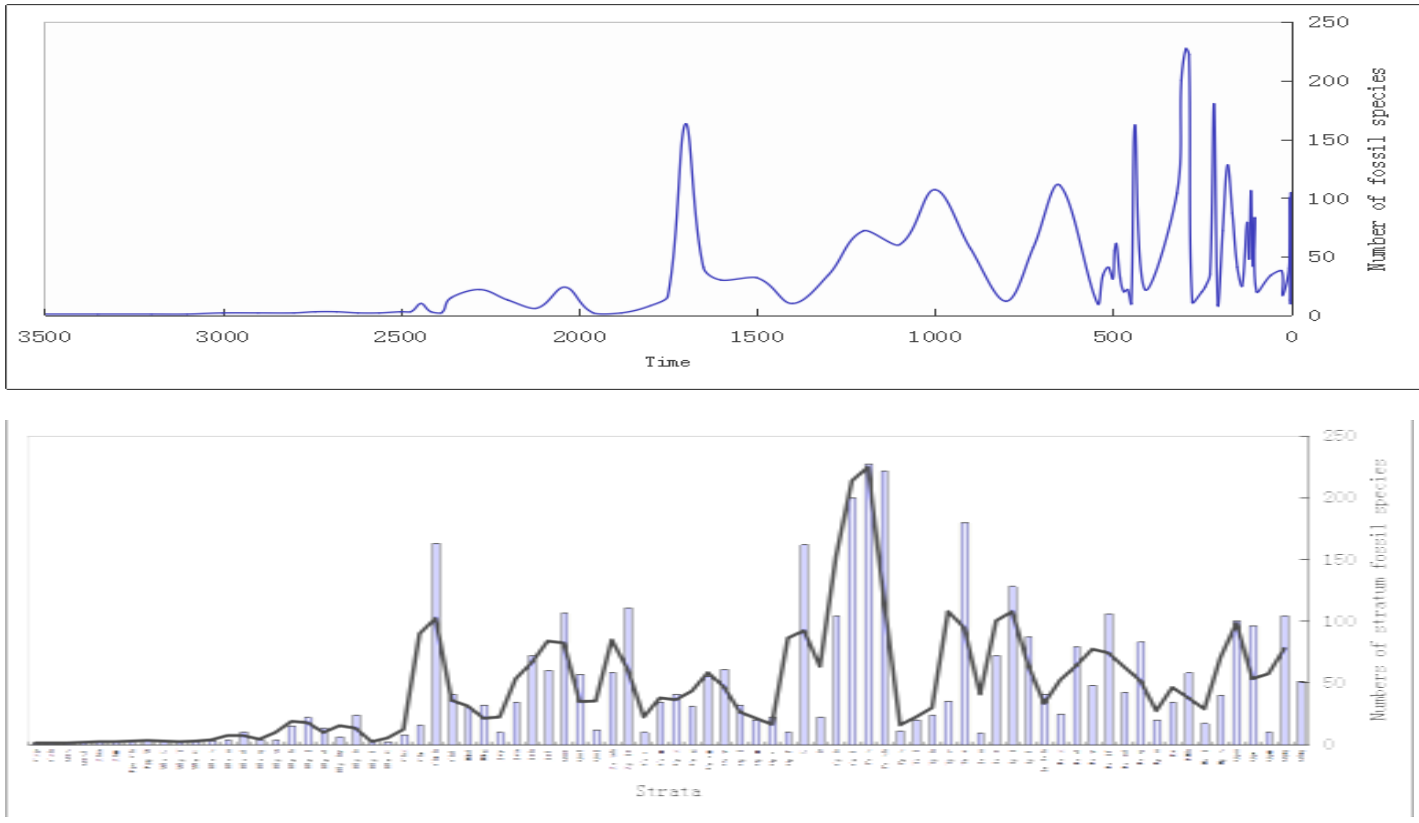


Figure2 Time evolution curve of the number of strata fossil species in North China

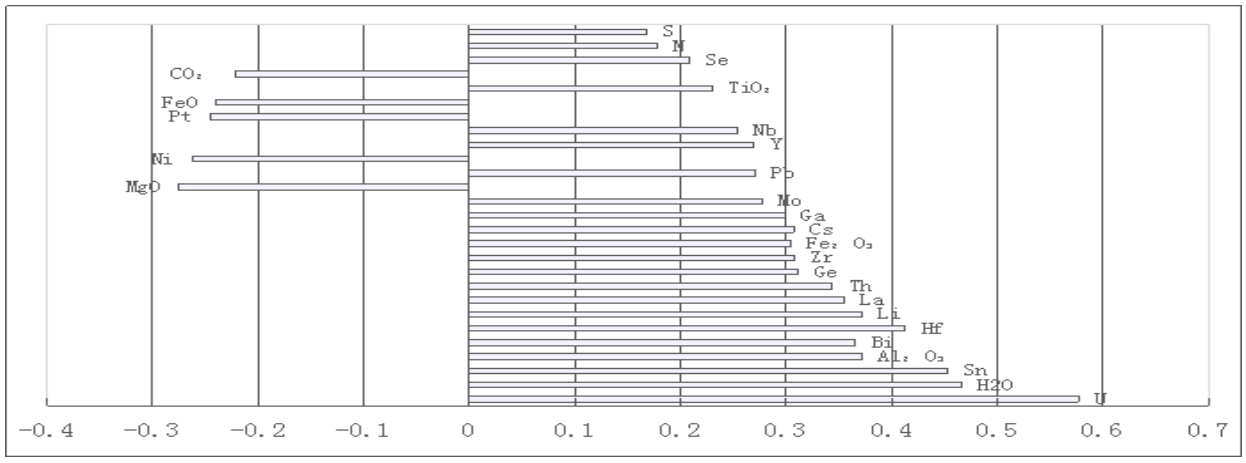
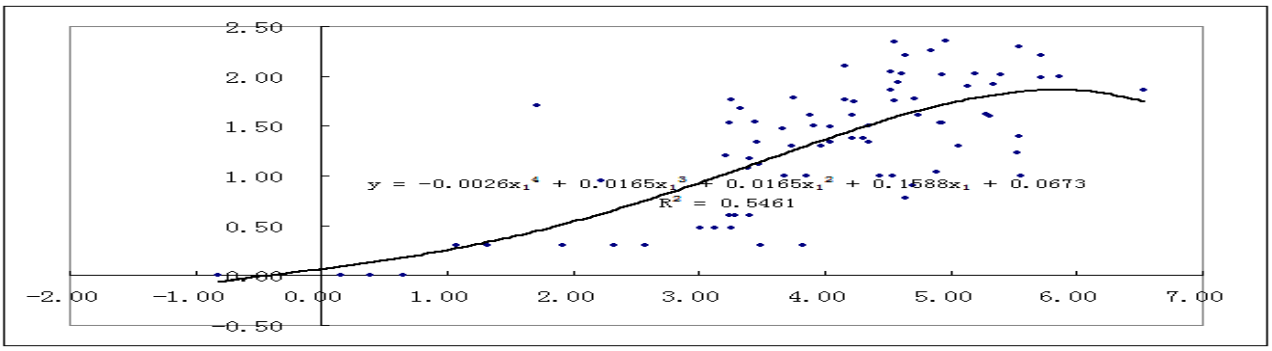
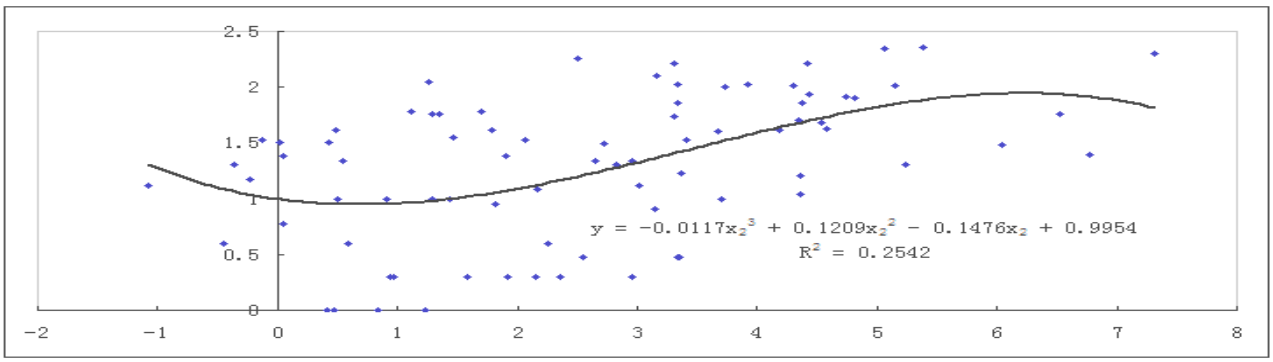


Figure3 Correlation coefficients between the stratum biological species and content of rock elements in North China





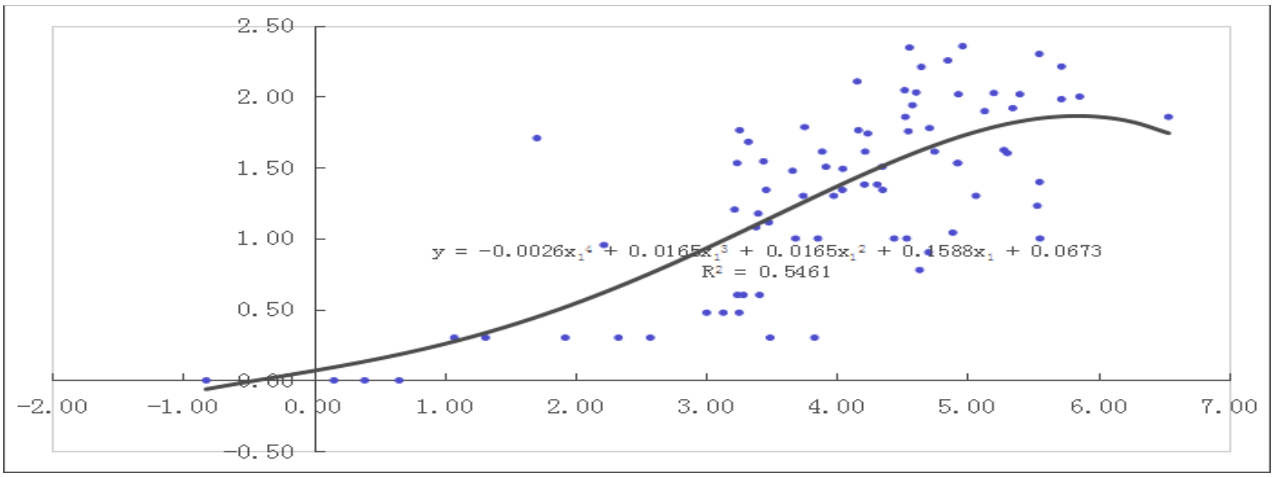


Figure 4 Relation graph of the number of the stratum biological species and content of rock elements in North China

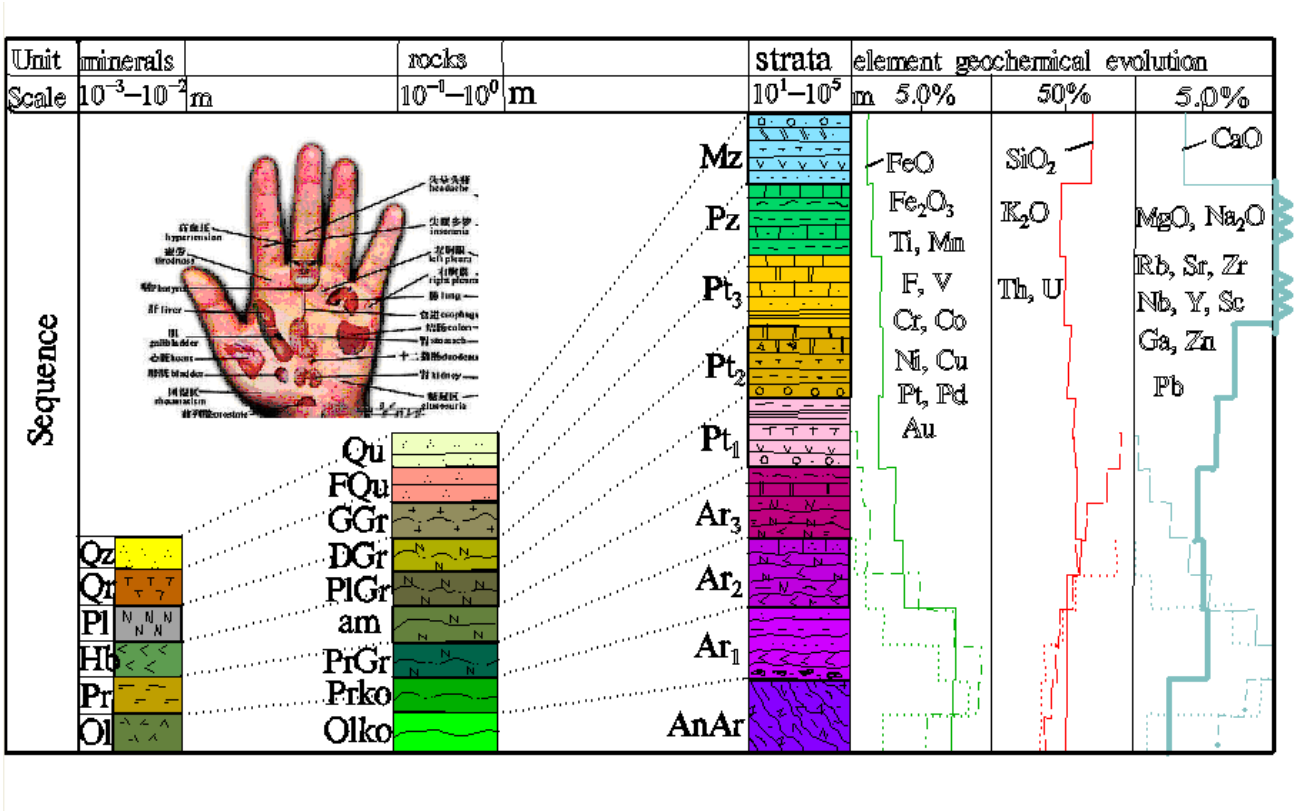
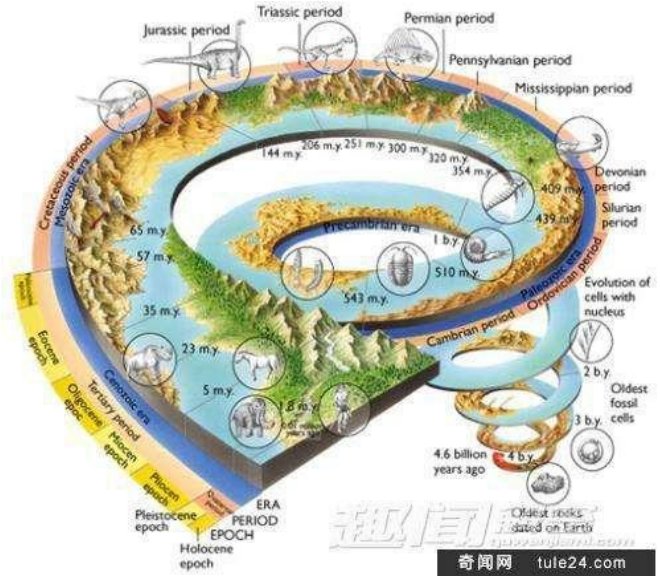
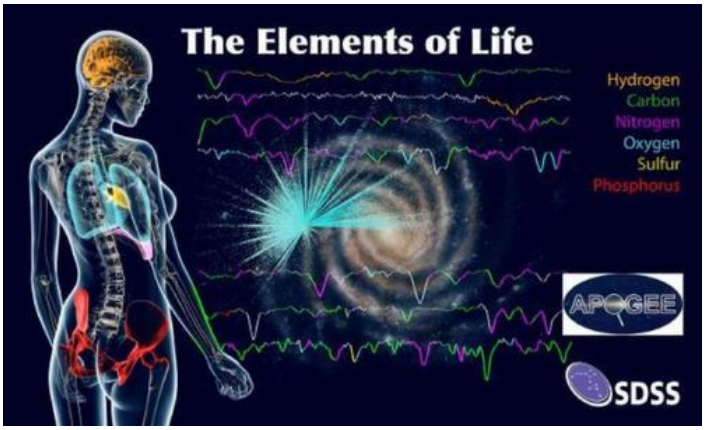


Figure 5 Fractal structure of mineral -rock -strata in North China

Qz-Quartz Qr-Qrthoclase Pl-Plagiocase Hb-Hornblende Py-pyoxene Ol-Olivine Qu-Quartzite Fqu-Feldspar quartzite GGr-Granitic granalite DGr-Dioritic granalite PlGr-Plggioclase granalite am-amphibolite PyGr-pyroxene granalite Pko-Pyroxene komatiite Oko-Olivine komatiite



The Course of Evolution of Life on Earth



The Elements of Life

Life may Spontaneously From its Chemical Elements