

## **Have a correct understanding of the attribute of geologic environment — give full play to the role of geoscience in environmental protection**

Ha Chengyou

Institute of Environmental Geology, Ministry of Geology and Mineral Resources, Beijing 100081, China

**Abstract**—The earth is an integral dynamic system, geologic environment and human engineering - technical and economic activities constitute another complicated dynamic system; geologic mineral resources are limited, and there is a limit to the geologic environment capacity too; the human engineering - technical and economic activities have exerted an unprecedented influence on earth. The laws of geologic environment deepen and raise man's ability to prevent and control the geologic disasters and improve the environment should be understood.

**Keywords:** geologic environment; attribute; geologic resources; geologic capacity; geologic disaster.

The environment and environmental protection are one vital subject which the international society of today shows much concern over. Following "The declaration of the United Nations on U. N. Human Environment Conference" held in Stockholm of Sweden on 16th June, 1972, "The Rio de Janeiro Declaration of Environment and Development" passed the Brazil Environmental Development Conference held on 3rd -14th June, 1992. It was declared in the conference that each country has its sovereignty and right to develop its own natural resources in light of its own environmental development policies, and each country also has the responsibilities to guarantee that the activities within its jurisdiction or under its control will do no harm to the environment of other countries or the environment of the areas beyond the jurisdiction of various countries. Some principles were also defined in the conference and one of them says that the work of environmental protection is an integral part of the whole process of development and it can not be considered as being divorced from this process so that the continuous development can be realized. All these principles are undoubtedly the fundamental ones guiding the continuous development of society in a fairly long period of time in the future.

The government of our country has always put emphasis on environmental protection, regarded environmental protection as a basic policy of our country. The work of environmental protection has always centered on the general goal of the drive for modernization and been used to promote the economic development and to improve the living standard of the people. Remarkable results have been achieved. Although the people give their voice for saving the earth and protecting the environment uninterruptedly, yet they rarely know what are the geologic environment and its attribute and how they can protect the geologic environment. This thesis dwells on these

problems in order to let people have a correct understanding of the nature and to coordinate the development of human engineering - technical and economic activities with the geologic environment. In short, the geologic environment refers to a geologic entity of the earth which was formed by the geological processes of internal force and external force in the long period of the geological history. When the earth is regarded as a whole, there exist mutual connection, influence and restriction between the core, mantle, and crust of the earth, especially the surface of the crust and the atmosphere, hydrosphere, and biosphere in the long period of the geological history. The geologic environment actually refers to the surface of the crust formed after the latest orogenic movement and the last glaciation of the Quaternary.

Zhang Zonghu hold that the part of the lithosphere surface that has the directest interaction with the atmosphere, biosphere and hydrosphere and the closest relations to humans activities is called the geologic environment. What attributes or laws (laws are called here for the moment) does the geologic environment possess?

### **1 Certain natural conditions of geology and geography have specific geologic environment and specific problems of environmental geology will appear with the increase of human engineering - technical and economic activities**

China has a vast territory, a changeable climate with many mountains here and there, and different geologic conditions, starting from the Pamirs in the west to the confluence of the Heilongjiang River and the Wusuli River in the east, and from Mohe of Heilongjiang Province in the north to the Zengmu shoal in the south. The country stretches for 62 degrees of longitude from east to west, for 50 degrees of latitude from north to south, and covers a land area of 9.6 million km<sup>2</sup>, according for 1/15 of the worlds' total.

The relief of the mainland of China is higher in the west and lower in the east, consisting of three terraces from west to east. The Qinghai - Tibet Plateau, ever known as the roof of the world, has an average height of more than 4000 meters above sea level, with the highest mount of the world Mount Qomolangma within it, which is 8848 meters high. Across the Qinghai - Tibet Plateau eastward and northwards, the elevation is reduced with plateaus and basins with elevations of 1000—2000 meters above sea level as the main terrain. Still eastwards the elevation is 1000 to less than 100 meters above sea level, i. e. the terrain is represented by plains and hills, and mountains in the east part of China, where the economy is the best developed in China. In general, plateaus, mountains and hilly lands amount to 79% of the land area of China while plains and basins approximately occupy 21% of the area.

China is a country with a monsoon climate. Most of its areas are influenced by southeast and southwest monsoons in summer, therefore the precipitation is concentrated. Southeastern China is rainy and wet, but northwestern China is short of rain and arid with marked variation of seasons. When the northwest wind prevails in winter, the dry land of northwestern China becomes even more arid. And the temperatures are quite different in different months of the year. This is the so - called continental climate. China can be divided into four climatic zones, i. e. the area

south of the Qinling Mountains and the Huaihe River is a humid zone, accounting for 32% of the total area of the country; most parts of Northeast China and North China belong to a semi-humid zone, making up approximately 15% of the country, the semi-arid zone occupies 22%; the arid zone in Inner Mongolia and Northwest China accounts for about 31% of the total area.

It is not different to find out that Northwest China possesses certain natural conditions of geology and geography and specific geologic environment, and abounds with mineral resources, oil and natural gas, yet meanwhile it is relatively confined and influenced by the inland conditions with an arid climate and extremely inhomogeneous regional distribution of water resources, i. e. the inconsistency of water resources - forming zones with their distribution. Under the natural conditions, surface run-off takes shape in the mountain areas because of the thawing of snow and ice. As the course of run-off extends forward, the surface run-off is as good as lost completely owing to seepage and evapotranspiration, thus the content of salt increases. After it enters a basin, there appears a saline lake or salt lake. The uplift of the huge mountain bodies in western China resulted in the formation of grand titled piedmont plains such as those along the south and north piedmonts of the Tianshan Mountains and Kunlun Mountains, and the Hexi Corridor sandwiched in between the Qilian Mountains and the Nanshan Mountains. These areas are rich in groundwater resources which have long been used as the main sources of domestic and irrigation water supply in western China. Owing to acceleration of human engineering technical and economic activities, slackness in adopting some effective water conservancy measures, unreasonable irrigation systems and expansion of secondary salinization, a large amount of arable land has turned into barren land, and desertized and sandy areas have expanded continuously in the past few decades. On the other hand, the groundwater level goes down rapidly because of overdevelopment of ground water resources and as a result water resources in some areas have been exhausted. The east part of China is comparatively poor in mineral resources but is rich in port facilities, and streams, rivers, lakes, and seas link up with each other. Therefore, the advantages in the areal position remedy the shortage in resources. Meanwhile the east part of China is influenced by monsoons and is rainy and humid. Being situated in the lower reaches of rivers, the terrain is low and flat with a crisscross network of rivers, therefore, the soil is fertile abounding with various kinds of products. But the farmland is seriously salinized. Influenced by repeated marine transgression and regression since the Quaternary, the groundwater at depth 150m is usually saline or brackish water, while the fresh groundwater resources generally occur at depth below 150m. Unreasonable exploitation of fresh groundwater resources has resulted in land subsidence of many cities in coastal areas and on their peripheries, which has serious influence on normal living environment of the people. It is quite evident that certain natural conditions of geology and geography have specific geologic environments and that specific problems of environmental geology will appear with human engineering - technical and economic activities.

**2 Geologic resources are limited, most of them are not easily renewable, and there is a limit to the geologic environment capacity too**

The natural resources of our country such as land and mineral and water resources are among the front ranks of the world, but as for the occupancy quantity per capita, ours are mostly below the world level. Take the mineral resources for example, our country has many kinds of useful mineral and explored reserves, yet the occupancy quantity per capita is very low, reserves of some useful minerals are shortage, and furthermore many minerals occur as lean ores and few as rich ores. Mineral resources have their specific distribution patterns in time and space, and that is why mineral resources are finite and most of them are nonrenewable. The examples are solid mineral resources such as metals and nonmetals, energy resources such as oil, natural gas and coal and even deep groundwater (including natural brine resources). A small number of resources such as shallow ground water resources and saline minerals in salt lakes are renewable. Even in the case of renewable resources, their renewable process is very slow. As mineral resources are finite, we should develop, utilize and protect them reasonable and any excessive exploitation and excavation are foolish actions. But this view point has not been accepted by the public yet.

Nature has limited capacity to endure the lash of human engineering - technical and economic activities too. The so - called capacity of geologic environment refers to the maximum potentiality for specific geologic space to endure the human engineering - technical and economic activities. All the materials produced and consumed by the people are directly or indirectly obtained from the geologic environment, and all the discarded waste materials coming from the process of production and living by mankind are directly or indirectly relegated or discharged into the geologic environment. In reality, the geologic environment has only limited capacity to supply the people with geologic resources and to accommodate the harmful discarded waste materials thrown and discharged by the mankind.

In short, geologic resources are not inexhaustible and the self - purification capacity of the geologic environment for the pollutants from the outside is not boundless too. With a sharp increase in population, the engineering - technical and economic activities will develop and exceed the permissible limit of the geologic environment, which will surely lead to the deterioration of the environment.

### **3 The earth is a dynamic system and the human technical and economics activities and the geologic environment constitute another complicated dynamic system**

The earth is an integral dynamic system. As a results of the long - continued natural geological processes, it has experienced a reciprocal process of unbalance - balance - unbalance. Even if the earth is in a balance state, it is a relatively dynamic balance. Therefore the change of the geologic environment (whether by nature or by human beings), in a sense, can be regarded as an irreversible process. In most cases, the change of the geologic environment is very slow as if nobody had cared for them. Who would have imagined that the coastal cities such as Shanghai, Hangzhou, Chongming, Nantong and Haimen were once a vast expanse of water ten thousand years ago or even several hundred years ago? The people would never have thought that the big

rivers of world - class such as the Yangtze River and the Yellow River have experienced a long geologic process, i. e. the process of adjusting the balance of the earth dynamic system continuously (erosion, transportation, deposition), from its formation and development up to now.

In the long history of mankind, volcanism has brought the people tremendous disasters. The English word volcano came from the "Roman God of Fire" in the Roman myth. The eruption of Binatubun volcano in the Philippines is the most famous one to this day. On 15th Jan., 1991, Binatubun Volcano which was 5770 feet high let the whole world feel its despotic power just as a huge "gun" did. The mudflow crossed the fields and villages at a speed of eighty miles an hour. The human beings and animals died and grasses and trees withered at the first encounter. 423 houses and 103 acres of farmland were ruined, and 900 persons lost their lives. The economic losses amounted to several billion U. S. dollars. The SO<sub>2</sub> produced by the volcanic eruption entered the stratosphere at an altitude of 25 miles above the earth's surface, and it was combined with moisture to form a thin layer of clouds and mist which shrouded the whole earth and did not vanish in 21 days. It was estimated that this screen weakened the sunlight shining over the earth by 2% and that the average temperature of the whole volcanic fell. In 1815, Tanborak Volcano in Indonesia eruption and deprived 923 persons of their lives. The clouds and mist caused by the volcanic eruption made the temperature of the earth fell abruptly and even brought disasters to places as remote as the U. S. where it snowed in June, July and August of the next year and that is why "no summer that year" was recorded in the history.

We acknowledge that the earth is an integral dynamic system, but that does not mean the people should stick to the inherent balance of nature. We should also acknowledge that the interaction between the human scientific and economic activities and the geologic environment is another complicated nature - technology system (Shalgaiyav). Their interaction depends on the characteristics of the geological environment and the types of the engineering - technical activities. The geological environment develops in accordance with the natural law while the human engineering - technical activities are underway in light of the technical and economic laws. On one hand we should take the characteristics of both sides and the results of their interaction into full consideration; on the other hand we should realize both the limited space of the natural technology system and the possible scope of influence by the interaction between the human engineering activities and the geologic environment, so that we can try our best to coordinate the relationships between them.

#### **4 Have an understanding of nature from the role of feedback, and then an even deeper understanding of it**

Human beings are the most active and positive component part in nature while the geologic environment is an object which is independent of any acts on the consciousness of man. The people usually have an understanding of nature from the role of feedback, and then gain an even deeper understanding of it. Any engineering construction which runs counter to the natural laws will surely yield a result which goes against the will of the sponsor.

As early as 2000 years ago, Li Bing and his son summed up the experience and lessons in bringing the inundation of the Minjiang River under control. They dug a trunk canal by means of "Scooping up mud deep in the beach and constructing low weirs" in the axial zone of the Minjiang River alluvial fan, example i. e. in the place where the current velocity was the highest and they also dug a crisscross network of channels in the lower reaches of the Minjiang River so that the roaring flood was brought under control and discharged tamely along the trunk canal and tributary channels for the irrigation of a vast expanse of fertile farmland in the Chengdu Plain. Thus the disasters by flood were wiped out and the benefits by water were brought forth. This is the best example of how the laboring people of our country have an understanding of nature, conform to nature and bring benefit to mankind.

The examples of turning disasters into benefits by means of science and technology in more than 40 years since the founding of the PRC are too numerous to enumerate. For example, the technology of energy storage in aquifers developed by groundwater recharge in Shanghai has yielded many good results in increasing the supply of underground fresh water, alleviating ground subsidence, raising groundwater level, supplying factories with water resources and heat source, improving ground water quality and promoting desalination of saline water.

D. R. Cotes held that the feedback plays its role with different ways, on different scales and in different times. It may take several years for the response to the changes from human activities to happen, yet as for other changes their effect may happen more rapidly. Take for example the large-scale hydropower project of our country the Yellow River Sanmenxia Reservoir. It was because the characteristics of "much sand and little water" in the Yellow River had not been fully considered that the natural regime of erosion, transportation and deposition in the middle and lower reaches of the Yellow River was changed after the construction of the reservoir, thus there appear a series of environmental geology problems. Each cubic meter of water of the Yellow River contains 37.6kg of silt on an average and the silt through Sanmenxia is approximately 1200 million tons each year. Since the construction of the dam and storage of water, the tempo of silting in the reservoir has been quickened and most of the silt is deposited, thus influencing the life and effectiveness of the reservoir seriously. The loess extending from the edges of the reservoir has swallowed up a large amount of farmland. After the confluent zone of the Weihe River into the reservoir was highly silted, the groundwater level of the Guangzhou Plain has been raised and a vast area of farmland has been flooded, which result in collapsing of loess and influencing irrigation and water supply. Once the human engineering and economic activities destroy the natural balance, the same cost as that for upsetting the natural balance or even more cost will be probably paid if you attempt to set up a new balance. In reality, the mankind get to know and understand nature mainly through the feedback, that is so called "getting new insight through restudying oil material". Up to now, it is still boundless for mankind to understand nature.

**5 The geological environment varies in accordance with the law of nature, even if mankind have understood the laws of the geological environment, they can only slow down the deteriorative trend of the geological environment but they can not changes the variation laws of the ge-**

### **ologic environment**

Earthquakes and volcanic eruption result from the process of continuous adjustment and balance of the internal stresses of the earth. With the progress of science and technology, people gradually understand that most of the earthquakes occur in the vast region between 60 degrees south latitude and 60 degrees north latitude, in which the circum-Pacific seismically active belt is a belt where the seismic activity has been the most intense on the earth. About 80% shallow-focus earthquakes, 90% intermediate-focus earthquakes and nearly all the deep-focus earthquakes in the world are concentrated on this belt. The energy released by the earthquakes in this belt accounts for 80% of the total energy released by the earthquakes on the earth. The periodic occurrence of earthquakes conforms to particular laws. Now people get to know the occurrence and development of earthquakes and attempt to forecast earthquakes, but the level of earthquake prediction in our country is still very low. Although people can not prevent the occurrence of earthquake disasters, yet they can still try to reduce the economy losses and the casualties of personnel caused by earthquake disasters through seismological research.

With the development of economic construction, more and more human engineering and economic activities destroy nature and lead to frequent occurrence of geologic disasters. When people mine mineral resources, the side slopes may become unstable and thus collapse and landslide may happen. Excavation of the side slopes in road construction, storage of water in reservoirs or water leakage and improper slag disposal and earth-filling may result in collapse landslide and debris flow. Of course, the storm is usually the main factor which causes geologic disasters. If we disrupt the critical state of natural geology, it will be unavoidable to provoke rapid and violent changes. In the early stage of the changes, there exist some premonitory phenomena. If we study them carefully and adopt effective measures, the losses in the human engineering and technical and economic activities will be surely reduced. Once the critical state is disrupted, it is very difficult to restore. On 3th June 1980, in the Yanchihe Phosphorus Mine of Hebei Province that a huge rock avalanche is an illustration. The phosphorus ore beds occurred in the lower part of the collapsed mountain body. Unreasonable mining and in particular adoption of the methods of large-scale blasting and cappillar caving made the mountain body above the worked-out area fractured, and in addition it stormed three days in a row, thus leading to the disaster. The change of the geological environment is an irreversible process independent of the role of natural geology, they can reduce or alleviate the losses which the irreversible process of the geologic disasters cause to them. It is self-evident that geology plays an important role in environmental protection.

### **6 The population is exponential by proportional to the deterioration of the geological environment**

It is not accidental for people to connect the population with resources and environment when they discuss the environment. In 1750, the population of the world was about 7 hundred million and it reached 1.6 billion in 1900. Up to 1965, the total population doubled and increased

to more than 3.3 billion. In 1980, the population of the world topped 5 billion. If we say the population increased linearly before 1900, it increased exponentially after 1900. The trend of environment deterioration early conforms to that of the population growth.

The economic development of the modern society of China is a process of gradual transformation from stagnation, poverty and backwardness to richness, flourishing and prosperity and it is also a process of gradual transformation of an agricultural country with the agricultural population as its majority and with the manual labour as its foundation to a modern industrial country with the nonagricultural population as its majority.

From 1949 up to now, a great change has taken place in China's social and economic system. The total population doubled in 40 years and set a record of the quickest increase in the population growth history of China.

The civilization history of population growth of China also shows that the population increased linearly before 1900 and growth exponentially from 1900 up to now. According to the statistics of the population growth in 1900 and the environmental changes influenced by human activities, D. R. Cotes discovered that the relationship between them has transform from linear one to exponential.

Although the population growth tempo of the whole country has been somewhat reduced in recent years, yet the population base is still very large. More than 20 million babies are given birth every year and the population of net increase is 13 to 15 million. Such high population growth is still a heavy burden to a developing country like our country. It is confronted to control the population growth, raising cultural life level and material life level of the people, to improve the environment and solve a series of problems with which the social development.

## **7 Cites are areas with the most complicated and most intensified geologic environment variations**

The development of the world of today is strikingly characterized by the acceleration of urbanization. It is estimated that the cities with a population of more than a hundred thousand persons in 1800 A. D. were less than 50, but the cities like this scale today are far more than 1000 in the whole world. And there are more than 100 cities with a population of more than 1 million. The contradictions of human engineering - technical activities are sharply concentrated on cites and the cities are the areas in which human activities exert the greatest influence on the crust surface (i. e. geologic environment). The urban construction involves a series of problems such as rational use of land, fundamental conditions of foundation, reasonable development of water resources, rational distribution of industrial areas, residential districts, waste disposal sites and various kinds of pipelines and roads. The urban construction should avoid the unfavorable geologic environment whenever possible. With the concentration of population in the cities, development of industry, and gradual upgrading of material civilization, the contradiction between the human engineering - technical and economic activities and the geologic environment become sharper and sharper. The environmental and geologic problems which follow increase and become complicated

day by day. Some of them even lead to geologic disasters which make the urban people suffer heavy losses in lives and properties.

All the delta areas near the outlets of big rivers into the seas in modern or ancient times, in China or elsewhere, are especially full of vitality. Most of the big cities in the world are usually set up along the coastal delta zones, for there are three superiorities here; the first is the superiority of water and soil resources, i. e. there are comparatively sufficient water resources which can be easily opened up; the second is the superiority of oil and gas resources, i. e. the specific depositional environment and characteristics here make the delta areas and their continental shelves main or promising oil and gas producing areas; the third is the regional and positional superiority, i. e. they are situated in the areas of river mouths where land and sea meet and enjoy convenient water transport. The coastal open cities and special economic districts of our country have a population of one hundred million while their area is only 2% of our territory. The gross national product of these areas amounts to 350 billions in 1992, occupying 18.1% of the GNP of the whole country. Of course these coastal and delta cities are confronted with a series of problems in environmental geology, such as shortage of metal, nonmetal and even building materials, thick soft soil, unstable foundation and silting at the river mouths, which exert unfavorable influences on the utilization of coastline, development of shipping and port construction.

The problems in urban environmental geology are many and varied. It means that they are restricted by the conditions of natural geology and geography on the one hand and vary with the development scale of urban construction on the other hand, therefore, it is urged that the research on urban environmental geology must be in close cooperation with departments of urban construction, environmental protection and municipal administration. Starting from promotion of benefits and prevention from disadvantages, the research, should be advantageous to the development of production and to the construction of modern cities with sanitary, fine and safe environment. Any research which neglects the urban geologic environment will pay its price for the results.

## **8 Environmental problems are not restricted by the borders and boundaries of countries**

Mankind are confronted with a series of arduous, urgent, and complicated problems concerning global environmental variations such as environmental pollution, climatic fluctuation, damage of vegetation, water loss and soil erosion, sand migration, desertification and sea level fluctuation. So many environmental variations have posed a serious threat against the survival and development of mankind and the solution of these difficult problems can not be accomplished by only one country. The U. N. Rio Janeiro Declaration of Environment and Development in 1992 pointed out that "In light of the spirit of global partnership, each country should be in cooperation with other countries for preserving, protecting, restoring a healthy and integral ecosystem".

The central target of the International Geosphere - Biosphere Project (IGBP) is to understand and master the physical, chemical and biological processes of the interaction between crucial sub-systems in the earth system, to understand and master the influences by the human activities and

the great changes produced by the earth system, and to predict the trend of the global environment variation in several decades and even several hundred years hereafter. Our country has set up a relevant committee which has achieved fruitful results in its preliminary work.

In short, only through research on global environmental variation from the entirety by means of systmatology and through exploration of the interaction and coupling between various components of a system, can we deepen the understanding of the geological environment and raise man's ability to prevent and control the disasters and to improve the environment.

## 9 Conclusions

The geological environment is a dynamic balance system, and the geologic environment and the human engineering - technical and economic activities are also a kind of complicated dynamic system. To get a clear understanding of the interconnection and interaction between the systems and subsystems is the key for mankind to correctly handle the contradiction between economic development and environment.

The earth has limited geologic mineral resources and limited environmental capacities. It is very important to arouse the public of the whole society and especially the policy makers to pay great attention to this problem. We should exploit and utilize geologic resources reasonably and raise it to the position of a basic policy of the nation for consideration. We should work out a strategic plan for development of the geologic environment and exploitation of geologic resources in the whole country, to strengthen the supervision and administration of mineral resources so that the deterioration of the environment can be reduced and its deteriorative trend can be slowed down.

With the sharp increase of population, exploitation of resources and development and progress of sciences and technology, the human engineering - technical and economic activities have exerted unprecedented and tremendous influence on the geology, and have participated in the variation of the geologic environment more and more extensively and deeply.

Environmental geology is a new applied branch of disipline which especially stresses the interpenetration and hybridization between different branches. Only through the combination of population, resources, development and environment, can we achieve satisfactory results. Environmental geology should be combined with engineering construction, and the understanding of the world should be combined with reasonable utilization of geologic environment and geologic resources so that this branch of knowledge will be even more perfect. Environmental sciences goes beyond boundaries of countries and shows global variability, therefore it calls for scientific cooperation between nations. Every country should cooperate with others and make contributions to the cause of protecting the environment, saving the earth, giving full play to the important role of geoscience in environmental protection, and improving the right to exist for the people of various countries.

## References

ence Press. 1992

Institute of Geomechanics. Geologic glossary(Part 4), Environment geology. Geological Publishing House. 1986

Zhang Zonghu. The research of environmental geology, Seismic Publishing House. 1991

Editorial Committee of Mineral Deposits of China. Mineral Deposits of China. Geological Publishing House. 1989

Li Lierong, Duan Yonghou, Ha Chengyou. For a more beautiful China. China Scientific and Technical Publishing House. 1991

Ma Zongjin. Natural disasters and disaster relief. Seismic Publishing House. 1990

Cotes DR. Environmental geology. Geological Publishing House. 1991

Geography Department of Nanjing University. The development of delta lands. Nanjing; Nanjing University Press. 1986

Huang Dingcheng, Chen Banqin. The research of environmental geology. Beijing; Geologic Publishing House. 1991;1

(Received May 17, 1994)

(Cont'd from P. 512)

#### No. 4

- Adsorption of herbicide triclopyr on homoionic clays  
by Liu Weiping, Alba Pusino, Fang Zhuo and Carlo Gessa ..... (385)
- Measurement of respiration amount of white birch (*Betula platyphylla*) population in the mountainous region of Beijing  
by Fang Jingyun and Wang Xiaoke ..... (391)
- Effect of organic acid on Cd toxicity in tomato and bean growth  
by Xue Dongsen, Robert B. Harrison and Charles L. Henry ..... (399)
- ELISA of polyclonal antibody to fish MT and study on heavy metal tolerance in fish  
by Wang Yingyan ..... (407)
- Investigations on simultaneous determination of silver and mercury in catalytic - ligand substitution reaction with  
stopped - flow technique calibrated by synergistic effect  
by Wang Jianhua and He Ronghuan ..... (414)
- Background contents of heavy metals in sediments of the Yangtze River system and their calculation methods  
by Zhang Chaoshen, Zhang Shen, Zhang Licheng and Wang Lijun ..... (422)
- Study on urban water environmental support capacity  
by Guo Huaicheng and Ye Wenhui ..... (430)
- Biological effects of indoor sunlight in rural dwelling houses  
by Chen Guifu and Qiu Shicong ..... (435)
- Chlorination of water containing bromide and formation of the bromine - substituted trihalomethanes  
by Li Junwen, Yu Zuobin, Chao Fuhuan and Cai Xinpei ..... (443)
- Seasonal changes of endogenous ABA and cytokinins in environmental adaptation of different ecotypes of reed plants  
by Wang Hongliang and Zhang Chenglie ..... (449)
- Effects of lead, cadmium, mercury chlorides and aquatic environmental samples on the growth of *Escherichia coli*  
by Xu Chao, Yuan Jing and Xu Heping ..... (455)
- Environmental impact of electromagnetic radiation from the 10 kW medium wave transmitter of Weihai Broadcasting Station  
by Wen Congjiang, Lu Deming, Wang Shuquan, Wang Baosheng and Hu Baoge ..... (461)
- Recovery of molybdenum, phosphorus and arsenic from leaching solution of molybdenum residues by solven extraction with primary amine and tributylphosphate  
by Zhao Youcai, Chen Shaowei, Xu Dimin and Lin Ming ..... (468)
- Estimate of ammonia transfer from Lake Dianchi water to the air  
by Dai Shugui, Zhuang Yuanyi, Jin Zhaohui and Zhang Mingshun ..... (478)
- Study on gaseous CS<sub>2</sub> using laser - induced fluorescence  
by Pan Zhe, Zhang Yue, Deng Guohong and Li Changlin ..... (484)
- Have a correct understanding of the attribute of geologic environment - give full play to the role of geoscience in environmental protection  
by Ha Chengyou ..... (491)
- Application of the thermal lens effect for determination of iodine  
by Gu Xiaomei, Wang Shunrong, Qin Kexuan and Li Jiechun ..... (502)
- On the indicator of weak sustainability  
by Zhao Jingzhu, Onno Kuik, Huib Jansen, Harmen Verbruggen and Johannes Baptist Opschoor ..... (506)