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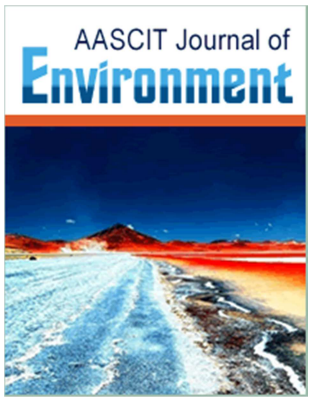

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Improvement on Jiangxi Seismic Environment and Digital Seismological Network

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Abstract
The fundamental cause of tectonic earthquakes is underground water erosion or magma explosion instead of inter-continental plate collision. According to this new discovery, it's easy to explain many past great earthquakes around the world, and also easy to predict some future possible earthquake foci by observing landforms. These research results are important to economically protecting against earthquakes and reducing disasters. Especially, according to this new discovery, many seismic environments or digital seismograph networks in the world can be improved. Through on-the-spot investigation or observing topographic maps, one can find that many areas in Jiangxi Province of China lack underground water, and the possibility of devastating earthquakes occurring in these areas is very low. Hence the observation on these areas can be lessened. But some areas such as Jiujiang, Poyang, and Huichang are seismic risk areas, their seismic environments can be improved and the observation on these areas should be enhanced and optimized. In addition, since most earthquakes occurred in raining or flooding seasons, the observations in these seasons should be enhanced, while the observations in dry seasons could be lessened.

1. Introduction

Since earthquakes are highly destructive and may cause great damage to property and loss of life, it is quite necessary that the seismologist be able to predict when and where there is going to be an earthquake. However, before most earthquakes really occurred, earthquake monitoring institutions could not predict their occurrences [1]. In fact, due to the complexity of earthquake prediction, seismologists haven't been able to accurately predict the occurrences of earthquakes, and they haven't even given thorough explanation for the cause of earthquakes [2]. As for some great earthquakes around the world, although some experts have given tentative explanations for their causes, their opinions vary greatly [3,4]. Since the existing explanations for the cause of earthquakes are not thorough enough to convince other people or to be used to predict earthquake foci, the authors of this paper, based on existing research results, made a scientific analysis on the geographical environments and regional geological tectonic features of some notable earthquakes over the world, revealed the root cause of tectonic earthquakes, and discovered the law of tectonic earthquake occurrence—that is, a tectonic earthquake is generally caused by underground water erosion or magma explosion, which finally leads to inter-continental plate collision. According to this new law, it's easy to explain many past great earthquakes around the world, and also easy to predict some future possible earthquake foci by observing landforms, that is, great earthquakes occur easily in coastal areas, or areas retaining large amounts of water, but not in areas lacking water.

So these research results are important to economically protecting against earthquakes

and reducing disasters. Especially, according to this new explanation, many seismic environments and digital seismograph networks in the world can be improved. China Digital Seismological Observation System and one of its subnets—Jiangxi digital seismological network can also be improved.

In order to understand how to improve a seismic environment and optimize a digital seismograph network, we should first study the root cause of earthquakes, and then use the law of earthquake occurrence to guide the improvement on seismic environment and digital seismograph networks.

2. Fundamental Cause of Earthquakes

2.1. The Existing Explanation of the Cause of Earthquake and Its Drawback

Earthquakes are classified as naturally occurring earthquakes and artificial earthquakes [2]. Naturally occurring earthquakes can be further divided into three categories: (i) tectonic earthquakes; (ii) volcanic earthquakes; (iii) impacting earthquake (the impact of large meteorites on the ground). Most of the world's earthquakes are tectonic earthquakes, accounting for 90 percent of the total number of earthquakes, and most of these are shallow earthquakes, which affect a wide area, cause great destruction to ground and buildings, and usually cause a great loss of life and property. Hence, the cause of tectonic earthquakes and the earthquake focus mechanisms have been studied more deeply. In fact, in the last century, scientists had already recognized that general earthquakes are closely related with the construction processes causing widespread deformation of earth surface. Geologists inferred that massive fault dislocation or abrupt rock collision is the cause of violent earthquakes. Their inference immediately became a credible assumption [1]. However, what is the real force that makes the rocks beneath the earth's surface break, dislocate or subside abruptly? Geologists haven't clearly given the answer. In fact, a colorless, odorless, tasteless, transparent, permeable, changeable, and erosive agent—water— is the real force that makes the earth's surface soften, break, subside, dislocate, or collide. Under the constant erosion of water, some parts of the Earth's lithosphere become more and more thin, and some places of these parts were even worn out by stagnant water, making water enter the mantle to cause massive explosion which leads to massive fault dislocation or abrupt rock collision, finally causing earthquakes.

2.2. The Cause of Some Typical Earthquakes in the World

According to the above law, we can see that a big river, lake, or ocean with constant flowing water or stagnant water must make a wide area of earth's surface soften or break. Especially under the high pressure of big and high mountains or ocean ridges, it is easy for the earth's surface to subside, dislocate, or collide. This is the reason why earthquakes occur easily in costal areas or inland basin. In addition, big and high mountains that can catch rain-clouds help generate heavy rainfall, which results in mountains' softening, limestone caves, landslides, mountain-rocks' rupture or collapse to cause earthquakes. This is the reason why earthquakes also occur at the foot of big and high inland mountains, where inland basin retains large amounts of water constantly. According to this explanation, it is easy to explain many world earthquakes such as the 1906 & 1989 San Francisco earthquakes [5] in the U.S., and the 1976 Tangshan earthquake [6], 2008 Wenchuan earthquake [3,7], and 2005 Jiujiang earthquake [8] in China.

On November 26, 2005, a moderate earthquake known as the Jiujiang earthquake (Supplementary Fig.1) that measured at 5.7 M [8] occurred between Jiujiang and Ruichang in China's Jiangxi province, killing dozens of people and damaging many houses. According to a survey from Earthquake Administration of China [9], the chief cause of this earthquake was the difference between the Jiuling uplift and the Poyanghu depression. It is thus clear that they haven't given the root cause of the earthquake.

Fig. 1. *Deep pools in field produced by Jiujiang-Ruichang Earthquake.*

In order to find out the root cause of the earthquake, one should analyze the geographic environment and tectonic settings of this earthquake. In fact, the epicenter was between Jiujiang and Ruichang, which is the lowest-lying place in Jiangxi Province. It is located near the Yangtze River, and is covered by many other rivers or lakes such as Poyang Lake, which is the biggest freshwater lake in China. Hence, the area is rich in surface water and groundwater. These waters erode and soften the earth's surface in this area severely, even penetrate the rock layer to cause magma explosion, especially under the great pressure produced by the nearby high mountains such as the Jiuling Mountains, making the earth's surface break or cave in easily, and finally causing the earthquake. But since the mountains near Jiujiang and Ruichang are lower than Wenchuan's mountains, and the water surrounding Jiujiang and Ruichang is less than in seas, the Jiujiang earthquake was only a medium earthquake.

2.3. The Real Cause of Earthquakes

According to the above research on some typical

earthquakes, we can conclude that a tectonic earthquake is generally not caused by any collision between two continental plates, but usually results from a local movement of the earth's crust. Usually due to mountain bodies, ocean ridges, or the earth's surface suffering from long-lasting underground erosion by water or violent impact of magma explosion, the earth's crust will finally break, subside or slip to cause earthquakes. Since coastal areas are rich in water, the earth's crust in these areas is eroded more severely by water, so earthquakes occur more frequently in these areas. Inland areas join tightly with continental-plate, and are eroded less severely by underground water than coastal areas, so earthquakes occur less frequently or severely in these areas. In an area with many high mountains catching much vapor and rain, the waters flowing down from the high mountains may form big rivers, and if the river valleys at the foot of mountains retain large amounts of water for a long time, the river valleys may form a strong earthquake belt. The places far from big rivers or short of water have fewer or no earthquakes. Hence, we can predict some future possible earthquake foci from the general configuration of the earth's surface, we can also reduce the seismic risk by reducing the accumulated water in these areas. If we focus our attention on these places to monitor seismic activity, we can effectively predict earthquakes and reduce the damage of earthquake disasters.

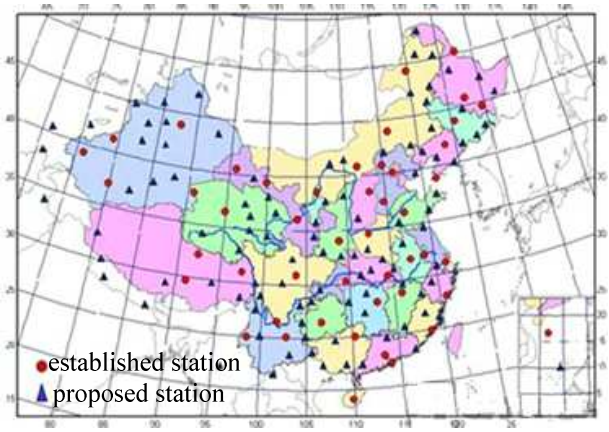

Fig. 2. *Distribution of CDSN.*

3. Improvement on Jiangxi Seismic Environment

Through on-the-spot investigation or observing topographic maps, we can find that many areas in Jiangxi province lack underground water, and the possibility of devastating earthquakes occurring in these areas is very low, while some areas such as Jiujiang, Poyang, and Huichang have some basins retaining large amounts of water constantly, these places are seismic risk areas. In order to reduce the seismic risk of these areas, we should reduce the accumulated water in these areas, making these areas drier. For example, some areas near Jiujiang and Poyang, due to the perfusion of the Yangzhe River and Poyang Lake, have had deep water and become a wetland suffering water erosion seriously. Although with the enhancement of Yangtze River's emptying effect, the water level of Poyang Lake sometimes dropped rapidly, there is still large flood flowing into Poyang Lake during the flood season of the Yangtze river, making the lake become a deep pool storing flood water in the areas near Jiujiang and Poyang, we should enhance the emptying effect of Yangtze Ruiver, such as widening a segment of Yangtze River downstream starting from Hukou (the mouth of the lake) in Jiangxi Province.

4. The Present Condition of Jiangxi Digital Seismological Network and Its Improvement

Supported by the central and local governments, China Earthquake Administration began to establish "China Digital Seismological Observation System" [10] in 1996. According to the principle of uniform distribution of seismic stations and at the same time ensuring intensive observation in some key administrative areas, the observation system was designed to consist of national and regional monitoring, as well as mobile seismograph networks. The system began operation at the end of 2000, and was basically completed at the end of 2007. The National Digital Seismograph Network (CDSN) is equipped with 152 seismic stations (Supplementary Fig.2). All of the seismic stations perform 24-bit data acquisition and the waveform data are synchronously transmitted to the Center of National Digital Seismograph Network via a satellite network. There are altogether 31 regional digital seismograph networks in China, which have 685 digital seismic stations performing 16-bit data acquisition. The waveform data are synchronously transmitted to the centers of local seismograph networks. The Mobile Digital Seismograph Network has 800 portable digital seismographs, which are of exactly the same type as those in the regional digital seismograph networks. Between 1999 and 2001, the Capital-Circle Digital Seismograph Network (covering Beijing Municipality, Tianjin Municipality and Hebei Province) for real-time data transmission was established, which has 107 seismic stations performing 24-bit data acquisition. The national, regional and Capital-circle digital seismograph networks have gone into full operation since 2002 and have yielded a great deal of observational data. The seismological observation system in China has experienced rapid development since 2003: CEA has accomplished analog-to-digital conversion of all seismological networks, thus, full digitization of seismological observation in China has been realized.

An important part of the China Digital Seismological Observation System is 31 regional digital seismograph networks, which are mainly used to monitor the areas of frequent seismicity, key economic regions of high background seismicity, or population accumulation areas of high background seismicity. These regional digital seismograph networks were also designed according to the principle of uniform distribution of seismic stations. For example, Jiangxi digital seismological network completed in 2007 consists of

24 substations and 1 network center. These substations are respectively located at Jiujiang city, Duchang County, Yongxiu County, Xiushui county, Jingdezhen city, Shangrao city, Yugan county, Jinxian county, Yichun city, Gaoan city, Fengcheng city, Nancheng County, Le'an County, Ji'an city, Wan'an County, Jinggangshan city, Ganzhou city, Huichang county, Shicheng county, Dayu county, Anyuan county, Xunwu county, and Longnan County. The network center is located at Nanchang city. The aperture of the network is 500 km long from east to west, and 600 km wide from south to north. The distribution and data transmission of the network is shown in Fig.3. All substations are equipped with EDAS-24IP type seismic data acquisition device, except Huichang substation and Shangrao substation equipped with EDAS-24L6 type seismic data acquisition device. In additional, Huichang national substation is equipped with a JCZ-1 type super-broadband seismograph, the other three national substations located at Nanchang, Jiujiang, and Shangrao are equipped with CTS-1 type broadband seismographs, four other substations are equipped with BBVS-60 type broadband seismographs, and 16 substations are equipped with KS2000 M type broadband seismographs. All seismic data acquisition devices' sampling frequency was set to 100 Hz, and they all use SDH firber-optic link to convey information to the network centre of the provincial seismic telemetry station. The network centre uses JOPENS, a data processing system for seismic station network centre, to collect, store, transfer, and process the seismic observation data. Since the data processing system receives multiple links' data simultaneously, the efficiency of this system is usually low. Hence, it is urgent to improve this system.

In fact, according to the principle of tectonic earthquake occurrence, we can optimize Jiangxi digital seismological network to improve its processing efficiency of seismic observation data. First, from the viewpoint of space, through on-the-spot investigation or observing topographic maps, we can find that the terrain of Jiangxi Province slopes from south to north, forming a big basin called Poyang Lake in the northern part of Jiangxi. Therefore the rain or water received by this land can flow down into the basin, and then enter Yangtze River. So most areas of Jiangxi Province don't retain large amounts of water, except some basins in Huichang, Jiujiang or Shangrao, even Poyang Lake would dry in winter. Therefore many areas, such as Longnan, Xunwu, Anyuan, Dayu, Shicheng, Jinggangshan, Ji'an, Le'an, Fengcheng, Yichun, Gaoan,Jingdezhen, and Xiushui, lack underground water, and the possibility of devastating earthquakes occurring in these areas is vey low. Hence the observation on these areas can be lessened, for example, reducing the acquisition，storage and processing of seismic data from these areas. But some areas such as Jiujiang, Poyang, and Huichang retaining large amounts of water constantly are seismic risk area, the observation on these areas should be enhanced.

Next, from the viewpoint of time, Jiangxi seismic observation isn't sensitive enough to time. Since most earthquakes occurred in raining or flooding seasons, the observations in these seasons should be enhanced, while the observations in dry seasons could be lessened.

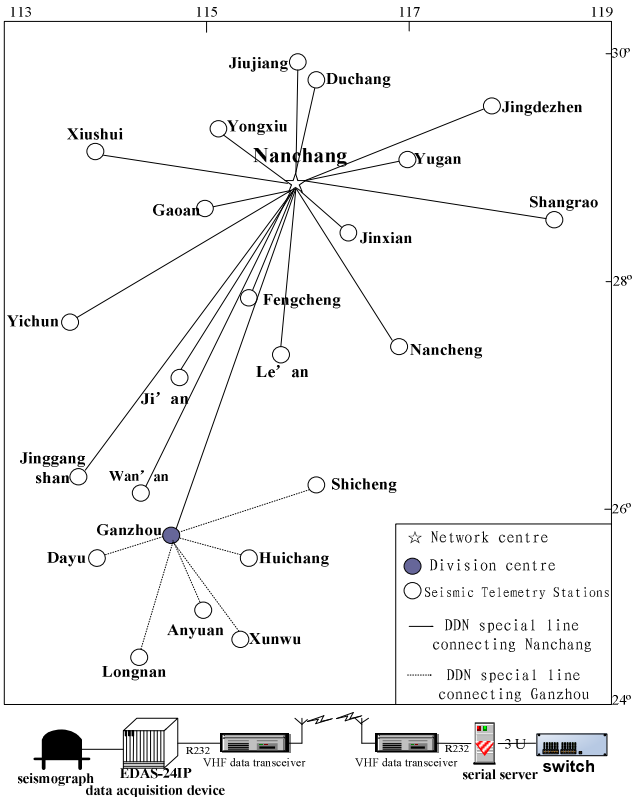

Fig. 3. *Distribution of Jiangxi Seismological Network.*

5. Conclusions

A scientific analysis on the geographical environments and regional geological tectonic features of some notable earthquakes over the world revealed the root cause of tectonic earthquakes—that is, a tectonic earthquake is generally caused by long-term erosion of underground water or magma explosion, which finally causes inter-continental plate collision. According to this law, it's easy to explain many past great earthquakes around the world, and also easy to predict some future possible earthquake foci by observing landforms or topographic maps. The place covered with larger bodies of water such as large rivers, lakes, or seas has a possibility of earthquake occurrence, and the place retaining no much water is seismic safe area. Through on-the-spot investigation or observing topographic maps, we can find that many areas in Jiangxi province lack underground water, and the possibility of devastating earthquakes occurring in these areas is vey low. Hence the observation on these areas can be lessened. But some areas such as Jiujiang, Poyang, and Huichang have some basins retaining large amounts of water constantly, these places are seismic risk areas, the observation on these areas should be enhanced.

Generally, a national or international digital seismograph network designed according to the principle of uniform distribution of seismic stations can be improved similarly. This research can be developed into a new theory called

macro-seismology.

References

[1] Bolt, B.A. Earthquakes and Geological Discovery, Scientific American Library, W.H. Freeman, New York, 1993.

[2] Geller R J, Kagan Y Y. Earthquake cannot be predicted [J]. Science,275:1616-1617(1997).

[3] Wang Yunsheng, et al. The Genetic Mechanism of Wenchuan Earthquake [J]. Journal of Mountain Science 8, 336-344(2011).

[4] Robert N. Parker, et al. Mass wasting triggered by the 2008 Wenchuan earthquake is greater than orogenic growth [J]. Nature Geoscience Volume: 4, 449–452, 2011.

[5] Wald, D.J., Kanamori, Hiroo, Helmberger, D.V., and Heaton, T.H., Source study of the 1906 San Francisco Earthquake [J]. Bulletin of the Seismological Society of America 83(4), 981–1019, 1993.

[6] Liu Qiyuan, et al. Seismogenic tectonic environment of 1976 great Tangshan earthquake: results given by dense seismic array observations. Earth science Frontiers 14(6), 205-213, 2007.

[7] Song Yang, et al. A review of the research on complex erosion by wind and water[J]. Journal of Geographical Sciences 16(2), 231-241, 2006.

[8] Li CY; Zeng XF; Zhang JX. The tectonic settings and seismogenic tectonics of the M5.7 Jiujiang earthquake in 2005, Jiangxi Province, China. Science in China (Series D:Earth Sciences) 5 ,640-653(2008)

[9] Wang Dun,et al. On seismogenic and its background tectonics of Jiujiang-Ruichang seismic sequence. Journal of Geodesy and Geodynamics 27(6), 2007.

[10] Liu Ruifeng, et al. Construction and development of China Digital Seismological Observation network. Acta Seismological Sinica 21(5), 535-541, 2008.