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Analysis on Geoscience Popularization of Innovation in China Basing on Functional Classification

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Abstract **— This paper explores the periodical characteristics of geoscience popularization within world geoparks in China, pays specific attention to its academic progress in an international context, and highlights possible implications of the achievements to the geosciences popularization in China. China came into geological field while the *Universal Geography* was printed in Chinese in 1853 during Late Qing Dynasty, when China began to accept the novel earth science. In early 20th century, some education precursors have launched the *China Association of Scientific* Movement, which further initiating wider access of general people to earth science in China. After the founding of the new China geoscience popularization spread rapidly, but has not yet been extended to the vast rural areas. Since the reform and opening up the geoscience popularization rapidly developed in diversity and standardization perspectives. In this paper, we characterized the geosciences popularization in 27 world geoparks in China to framework their geoscience popularization types. As a result, four types of world geoparks were outlined including economy-driven (G_1), economy-oriented (G_2), economy-protection-popularization balanced (G_3), and popularization-protection (G_4). We analyzed how the geoscience popularization of world geoparks integrated many ideas of international geosciences context into the unique Chinese social-economic-academic environment, hereby largely promoting the geosciences development of geoparks in China. Their possible reasons should be attributed to a number of factors: specific history dimension, political orientation, and possible social-economic background. As one of the most eminent feature of Chinese geological field, the geoscience popularization has enlightened and shaped the education and ideas of numerous other geoparks in both national and provincial levels.**

Keywords **— Geosciences Popularization, World Geoparks, Development Process, Functional Classification, Policy and Suggestion.**

I. INTRODUCTION

Science popularization, or science & technology (S&T) popularization, usually refers to present scientific knowledge, S&T methods, and science thoughts to wider public in more easy way and simple language (Stewart and Nield 2012). For those involved in natural resource conservation, that often entails communicating the nature of our science to communities, groups and individuals who have little or no science background (Azman et al. 2010; Stewart and Nield 2012). A geopark is a well-defined area that has been most commonly linked to three primary functions concerning geoheritage protection, regional sustainable development and geoscience popularization (Eder 2004; Dowling 2008; Leman et al 2008; UNESCO 2008; Yang et al. 2011).

Geoparks in China develop promptly (Yang et al. 2011), having formally designated 219 conservation localities or districts, including 27 global geoparks members or world geoparks (Yang et al. 2013). However, despite their scientific importance and significant achievements within geoparks in China, very little has been published about the geoscience popularization of geoparks and their correlations with the Chinese political, economic, and academic settings (Wu and Fu 2009; Yang et al. 2013). In particular, the long-term guardianship needs a broader and deeper public consciousness in geodiversity and geoconservation (Prosser et al. 2011; Stewart and Nield 2012). China geopark development and construction might be considered to have created an "economic driving effect", by utilizing unique geological relic resources to attract large numbers of tourists, promote local tourism development, and bring significant economic benefits (Farsani et al., 2011; Yang et al. 2013). Although still a long way from achieving the conservation and participation levels enjoyed by geoheritage conservation, the importance of geoconservation is increasingly being recognised and acted upon. Therefore, an integrated analysis of the domestic and international effects of geoparks' influence is warranted.

In this study, we analyze the periodical progress of geoscience popularization (GP) during different stages of geopark career in order to evaluate their influence on other geoparks in national and provincial levels and to characterize the underlying possible reasons for this development. To achieve this objective, comprehensive surveys and analysis of 27 world geoparks were undertaken (Fig. 1), with emphasis placed upon the implications of their functional classification and academic implication on other geoparks.

Fig. 1. Locations of world geoparks in China

II. PERIODICAL CHARACTERISTICS OF GEOSCIENCE POPULARIZATION OF WORLD GEOPARKS IN CHINA

China so far has 27 global geopark network members, accounting for nearly 30% of those all over the world.

These geoparks in China annually have attracted hundreds of millions of tourists per year, and also accumulated lots of experience in geopark construction and development. In particular, it is essential to successful geoconservation and geoscience popularization since different geoparks possess distinct characteristics and advantages in geoscience perspective.

A. Enlightenment of Geoscience Popularization During Late Qing Dynasty

Geoscience popularization during Late Qing Dynasty experienced modern science revolution as well as classical science construction, belonging to the small science in terms of material collection and reorganization with numerous disciplines establishing over this time (Chen, 2002; Wu and Fu, 2009; Li and Yang, 2013; Yang et al., 2013). This time interval was characterized by the occurrence of limited relevant journals, publications, and several primary museums, including Capital Tongwen Museum, Jiangnan Business Translation Department, Guangzhou Canton Dialect Museum, Nantong Museum, and Yunnan National Museum in 19th century (Yang et al., 2013). However, science popularization of this period usually limited to people in upper levels or intellectuals. They began to propagate earth science knowledge, while the ordinary people in lower levels still knew nothing about the geoscience popularization due to the lower social-economic development level.

B. Starting of Geoscience Popularization from Early 20th Century to 1949

In the ear 20th century, the national government of China paid more attention to public education, resulting in the institutionalization and standardization of education, science and technology, as well as cultural fields (Yang et al., 2013). The year of 1932 witnessed the establishment of "Science Society of China', with popular science extending to most areas of China. This phase of geoscience popularization was featured by the publishing of a large number of science books, publications, and construction of lots of science museums. In such a setting, the geoscientists bear common roles of researching, teaching and social service, with scientific research and popular science highly integrating. With a higher start, geoscience popularization career was promoted by outstanding scientists and social celebrities, and prompt extended to ordinary people. It subsequently aided and cemented the good scientific foundations of Chinese geological science.

C. Accumulation of China Geosciences Popularization from 1950 to 1978

This period experienced the flourishing of geological books, journals, academic articles, vigorous development of numerous Geological Library and Geological Museums, as well as the rapid rising of broadcast, television careers. It subsequently began to display the geoscience to public with vivid pictures. Over this stage, the geoscience popularization began to combine with practical work in a wide range of fields, producing certain achievements in the infrastructure construction and propaganda patterns of geoscience popularization (Yang et al., 2013). However, the geoscience popularization still could not penetrate vast rural areas due to the overall lower economic development level and affecting of political factors at that time. For this reason, geoscience popularization is primarily political-oriented and focused on patriotic education, dependent of other departments.

D. Fully Flourishing of China Geoscience Popularization Since 1978

Due to reform and opening-up since 1978, most geological journals and museums promptly flourishing, largely promoting the performance of geological activities in terms of Earth Day, Science Popularization Day, and Science Popularization Movies (Chen, 2002; Li and Yang, 2012; Yang et al., 2013). A large numbers of science popularization materials emerged in most comprehensive libraries; movies, TV, and internet gradually played significant roles in science popularization. In particular, the establishment of geoparks provided a good opportunity for geoscience popularization since late 1980s. In recent couples of decades, a series of relevant policy-makings equipped geoscience popularization with special characters. This period, however, can be divided into three stages including the early protection of geoheritages (1978-1999), middle prompt development of geoparks with geoscience popularization as one of functions within geoparks (2000-2009), and current patterns in diversity and regularization.

III. Functional Classification of World Geoparks in China

In general, geoscience popularization within world geoparks, including numerous national geoparks of China was largely lag behind that from those from Western developed countries in terms of museum construction, interpretation system, and geoscience popularization internet (Chen, 2002, 2003; Wu and Fu, 2009; Huang and Yang, 2011; Li and Yang, 2013; Yang et al., 2013). In such a setting, world geoparks was characterized by the lacking of strong geological dimension, and deficiency of geoscience popularization within geological museums. This can also be reflected by the software construction including the ignorance of geoscience popularization, imperfection of interpretation system and popularization language, monotony of popularization products and activities, deficiency of popularization information in internet.

In view of this reason, an attempt at developing an understanding of the geoscience popularization classification through an exploration of their perspectives. Reference reorganization, field investigations, expert interview, and questionnaire survey were incorporated into our present studies to characterize the world geoparks in China. Our results indicated that four types of functional types can be outlined in terms of economy-driven (G_1), economy-oriented (G_2), economy-protection-popularization balanced (G_3), and popularization-protection (G_4) (Figure 2; Table 1).

Economic-driven type (G_1): geoparks of this type were characterized by merely developing economy and largely ignoring science popularization and resource protection

(Figure 3g, 3h). The typical geoparks are Tianzhushan World Geopark, Leye-Fengshan World Geoaprks, and so on. The second type is **economic-oriented geoparks** (G_2), with economic developing being dominated but showing a little attention to resource protection and geoscience popularization (Figure 2). Typical examples are Yuntaishan, Lushan, Longhushan, and Zhangjiajie Geoparks (Figure 3f, 3f). Presently, most geoparks are within these two types (as shown in Figure 2, Table 1). Most world geoparks in east China are **Economic-Protection-Popularization balanced** (G_3), with three functions equally developing (Figure 3c, 3d).

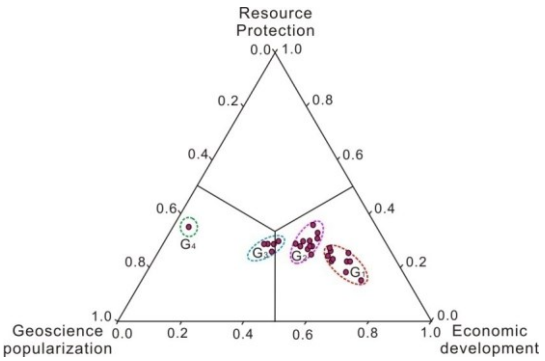

Fig. 2. Functional classification of world geoparks in China

Fig. 3. Examples of geoscience popularization diversity in different types of geoparks. Where a and b show interpretation along the trail and website regarding geoscience popularization in Hongkong Geopark; c and d indicate the geological museum and website related to geoscience popularization of Fangshan Geoaprk; e and f are sign of geological museum and interpretation bullet from Zhangjiajie Geopark; g and h are the simple logos with in Jingbohu Geopark showing the locality and distribution of tourist sites.

The last type is **Popularization-protection** (G_4), with Hong Kong World Geopark being predominating (Figures 2, 3a, 3b). Geopark of this type largely enhanced geoscience popularization by adopting multiple geoscience popularization patterns and increased internet construction. The resource protection was also considered, becoming successful example in geopark construction in China.

IV. Possible Reasons for Geoscience Popularization in World Geoparks in China

The comparatively incomplete geoscience popularization system within the geoparks is considered to be the result of both exogenic and endogenic constrains (e.g. Zhao and Wang， 2002； Chen et al., 2003; Yang et al., 2013; as shown in Fig. 4). In this study, the popularization awareness of geopark managers and intensive study within geoparks concerning popularization are investigated. We also explored its possible relation with simultaneous economic-social settings, hereby constituting the basic developmental configuration of geoscience popularization within geoparks in China.

A. Absence of Popularization Consciousness from Geopark Managers

One of the key success factors for sustainable geoscience popularization within geoparks is the level of awareness and appreciation on the heritage value of the geoheritages by stakeholders, particularly the local geopark managers (Azman et al., 2010; Yang et al., 2013). If the stakeholders can't possess strong awareness of geoscience popularization, they can't have a clear understanding of geoscience popularization within geoparks and present suitable scientific knowledge, or S&T methods to public. Accordingly, they will pay more attention to the economic potential of geoparks rather than the geoscience popularization.

Over the past decade, lots of empirical studies have been conducted to evaluate local community's and geopark managers' understanding, acceptance, level of knowledge as well as awareness of issues related to geoconservation and sustainable development as it becomes more distinct that public acceptance and education are critical to the success of conservation and sustainable development objectives. However, the weak management system and associated uncompleted law construction have largely prevented the development of geoscience popularization in China (Chen, 2002, 2003; Qian and Zhao, 2004; Qian and Ling, 2005; Wu and Fu, 2009; Huang and Yang, 2011; Yang et al., 2013). The authentic ideas of geopark system at different leader levels have not been established and associated law system is still not sufficient. The service quality of popularization within geopark managers is low and their professional knowledge is very limited, resulting in numerous problems between the tourism development and geoheritage protection, increased tourism requirements and inferior cultural connotation of tourism products. These definitely, have greatly prevented the development of sustainable tourism popularization within geopark in China.

B. Lacking of in-depth Academic Research within Geoparks

Give the current condition within geoparks, the role of geoscience popularization should largely depend on the

excavation of scientific connotation and storage of scientific knowledge. This is, however, not the case in most world geoparks in China (Chen, 2003; Huang and Yang, 2011; Yang et al., 2013), where many scientific issues need to be significantly strengthened. In the scientific funds permitted, geoparks should consider to allocate certain parts of funds to implement a lots of academic research projects. In such a case, the world geoparks should establish long-term collaboration relationships with relevant researchers in universities or research institutions, sometimes with foreign universities. By doing this, the in-depth study of scientific connotation within geoparks can be thoroughly investigated, thus providing good basis for the geoscience popularization within world geoparks in China.

C. Geoscience Popularization in Relation to Economic Period

In evaluating the contributions of economic perspective, it must recognize that the development of geoscience popularization as an inevitable phenomenon just resulted from historical background and specific economic period. Its initiation and starting in geoparks were partially made possible by its catering to the small science development at that time (Hou, 2005; Yang et al., 2013; Fig. 4). In particular, the traditional economic largely limited the extending of geoscience popularization to lower level people. Instead, the upper levels or intellectuals stepped up to answer the demands of the country and placed high regard on practical research, promoting frequent idea-exchanging between scientists and social celebrities. After the establishment of the new China, vivid patterns and medias were introduced into geoscience popularization in geoparks in China. Considering domestic environments in terms of planned economy, geoscience popularization therefore can make a significant step forward and followed up from the effects of economy exerted on it during those days (Fig. 4). As one of the representative events of China after the reform and opening-up, the occurrence of geoparks and some associated geoscience popularization modified their propaganda ways and contents to suit the local conditions. This led to many significant and important contributions to geoscience development in China (Fig. 4).

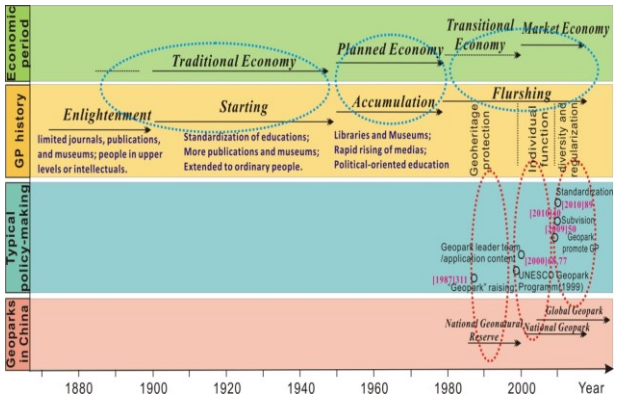

Fig. 4. Geoscience popularization of world geoparks in relation with histrocial-economic-political perspectives

D. Geoscience Popularization in Response to Policy-orientation

Historically, the formulation of geoscience popularization within world geoparks, even in national geoparks, should closely associated with policy-making, as evidently reflected in the relevant documents issued by the Ministry of Land and Resources in China (Li and Yang, 2013; Yang et al., 2013; Fig. 4). In the year of 1985, China established the first national-level geological natural reserve, and in July of 1987 the Ministry of Geology and Mineral (currently Ministry of Land and Resources) issued the document entitling *Establishing of Geological Natural Reserve* (document number [1987]311; Yang et al., 2013), raising the geoparks as natural reserve to protect the valuable geoheritages. This led to 86 Geological Natural Reserve (including 12 national level ones), rather than Geopark before 1999 (Fig. 4). Therefore the geoscience popularization over this period is only focused on the resource protection. Until 2009, science popularization, as the independent function deviated from economic potential and resource protection, was explicitly elaborated in the document of [2009]50 issued by Ministry of Land and Resources. This, however, significantly promoted the development of research and popularization of scientific knowledge within geoparks (Chen, 2002; Yang et al., 2013; Fig. 4). While document of [2010]40 further defined the geopark admittance criteria, refined the interpretation and identification system, and even the details of popularization activities during academic research. These, welded with the following document of [2010]89, explicitly clarified the contents and patterns of geoscience popularization. Therefore, the development of geoscience popularization should be largely associated with the formulation of national policies, particularly in the past decades.

V. Implication and Conclusion

China so far has 27 global geopark members, accounting for nearly 30% all over the world. These geoparks annually have attracted hundreds of millions of tourists per year, and also accumulated lots of experience in geopark construction and development. In particular, it is essential to successful geoconservation and geoscience popularization since different geoparks possess distinct characteristics and advantages.

Our study indicated that geoscience in China has a good history accumulation, ranging from the scientific enlightenment during Late Qing Dynasty to present development of standardized, diversified geoscience popularization, providing a good basis for the geopark construction. According to three major functions of geoparks, four different types of world geoparks can be outlined China, including economy-driven (G1), economy-oriented (G2), economy-protection-popularization balanced (G3), and popularization-protection (G4).

Here, some possible reasons can be related to the absence of popularization consciousness from geopark managers, lacking of in-depth academic research within geoparks, and particularly policy-orientation as well as

economic-development. Some proper measurements, therefore, can be put forward to strengthen the geoscience popularization dimension. For instance, suitable measurements can be shaped to share different facilities and scientific resources, to build a comprehensive science station (room), public geoscience gallery (billboard), to set up a popular service sites. Besides, popular geoscience education system, demand feedback, and resource sharing mechanism should be largely promoted. Through outreach, interpretation, and partnership we need to involve people in geodiversity, engage government and policy makers and work with those involved in managing the natural and built environment. We should also strengthen the construction of geoscience popularization infrastructure resources and digital resources to improve the geoscience exhibition ability.

The public popularization should be designed for carious stakeholders and can be combined with some nonprofit careers. In addition, as those from European and American countries, full-time and part-time staffs involved in geoscience popularization should be trained and cultivated people who are familiar with modern management and museum geoscience knowledge should be encouraged. Simultaneously, the geoparks should be welded with academic universities and research institutions to carry out in-depth scientific researches and to shape a large number of innovative, high-quality, and skilled talents by the aid of short-term training or distance education.

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