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Preface

Introduction to the special issue of "Loess and Climatic Record": Memory of Professor Liu Tungsheng for his scientific contributions and his centenary birthday

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ABSTRACT

This special issue is to memory Professor Liu Tungsheng for his scientific contributions and his centenary birthday. Liu Tungsheng was the former President of the International Association for Quaternary Association (INQUA), and the Honorary President of the Chinese Association for Quaternary Research (CHIQUA). Liu's best known contribution to Quaternary research is his pioneering and systematic study of the extensive loess deposits of China, which has been regarded as the best terrestrial paleoclimatic archive on the Earth. He won many international awards including the Tyler Prize for Environmental Achievement in 2002 and the Alexander von Humboldt Medal in 2007. He was an inspiring leader, one of China's, and indeed one of the world's most outstanding Earth scientists. This introduction aims to explore the personal factors behind his great achievements and reviews the papers included in this special issue from his colleagues, friends, and students.

1. Introduction

Loess and loess-like sediments cover about 10% of the Earth's land surface and make up one of the most widespread surficial Quaternary sediments on the Eurasian continent (Liu, 1985). The thickest (more than a hundred meters) and the most widespread loess deposits occur on the Chinese Loess Plateau. Chinese loess was first systematically investigated in China on the purpose of water conservation works of the Loess Plateau led by Professor Liu Tungsheng in the mid-1950s.

A critical point for the paleoclimatic aspect of Chinese loess occurred in the year of 1961, when he participated the 6th INQUA Congress in Poland, during which a paper was presented by Liu Tungsheng and Zhang Zonghu with a remarkable figure showing multiple palaeosols intercalated in a thick loess section (Fig. 1). This founded the basis for paleoclimatic record of loess deposits, because the loess-paleosol alternations were latter demonstrated to reflect Quaternary glacial-interglacial climatic cycles. Another fundamental progress occurred in the year of 1982, when Liu and his colleague carried on a paleomagnetic polarity study of the Luochuan loess, central Chinese Loess Plateau (Heller and Liu, 1982). They firstly constrained a basal age of 2.4 Ma for the loess deposits, and indicated that the magnetic susceptibility curve clearly exhibits orbital time scale climatic fluctuations. This definitely opens a new field for paleoclimate studies of loess.

On 22nd November 2017, we celebrated the centenary birth of the father of Chinese loess researches, Professor Liu Tungsheng. Under the joint efforts of his colleagues, friends and students, this special issue dedicated in *memoriam* Professor Liu Tungsheng was finally finished. As guest editors we hope that this special issue can help to better understand and recall the outstanding scientific contributions of Professor Liu.

2. Personal endeavors that underpinned Liu's phenomenal achievements

Professor Liu Tungsheng was a famous Quaternary geologist. There were many aspects to what he managed to achieve during his lifetime in the field of geological research. As the first Chinese earth scientist to receive the Highest Science and Technology Prize of China, it is evident that his academic achievements were well recognized by the wider community. Now, when we recall Professor Liu Tungsheng's brilliant academic career, we must not forget the personal endeavors that underpinned his phenomenal achievements.

Above all, we think, his painful adolescent experiences and unique pathway through life gave Professor Liu Tungsheng a profound sense of history, and therefore of a historical mission to change Chinese long poverty and backward situation. Professor Liu grew up in the northeast of China. He personally witnessed the atrocities committed in China by the invading Japanese Army. In the summer of 1937, when he was preparing to go to university after having graduated from Tianjin High School, the Japanese launched a full-scale invasion of China. Liu traveled to Kunming in Yunnan Province via Hong Kong and Vietnam to study at the United Southwest University which had been founded as an amalgamation of Qinghua University, Peking University and Nankai University. When he was in his final year at university, he served in the Battlefield Service Corps, and

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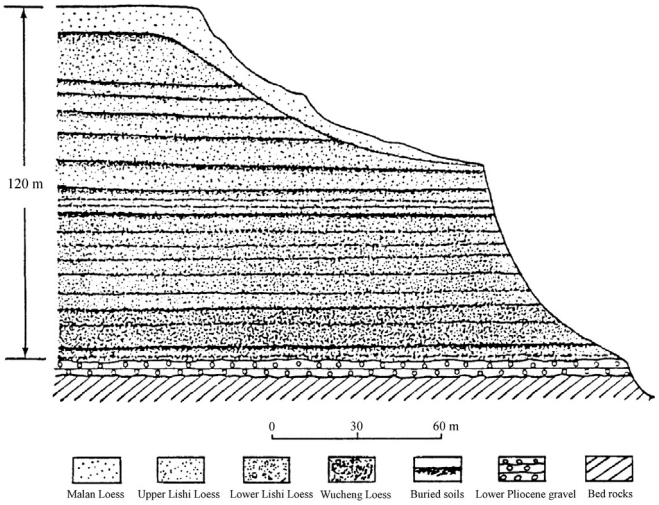

Fig. 1. Loess-paleosol sequences at Wucheng, central Chinese Loess Plateau from the pioneering pedostratigrahic works of Liu and Chang (1964).

became an English language interpreter for the 'Flying Tiger Division' that had been formed from American Air Force volunteers. At this time, he gained a deep and lasting impression of the way in which China was lagging behind scientifically and technologically, of the basic nature of China's weaponry, of the backward economic development of China's people and of the country's ineffectual and poorly organized societal structures. These experiences made him personally passionate about altering China's state of backwardness. As a result, once social order had been re-established, and when there were conditions conducive to scientific researches, he consciously put every fiber of his being into his work.

Second, Liu Tungsheng had an outstanding organizational ability and an all-absorbing passion for his work. It is of vital importance to mention that his 'most famous work' was to prove that loess had been transported by wind and deposited as sediments on the Chinese Loess Plateau. He also organized more than thirty young university graduates from the Institute of Geology of the Chinese Academy of Sciences to investigate ten large-scale trans-sections on the Loess Plateau, in particularly difficult conditions and without the aid of vehicles or any other forms of transport, walking on foot the entire way, and living in local farmers' houses. During this systematic stratigraphic survey of the ten large trans-sections, they collected a vast quantity of loess samples. After a full analysis of these field data, which focused in particular on the particle size distribution curves of Malan Loess, he convincingly put forward his evidence for the wind transportation and subsequent deposition of Chinese loess, thus laying solid foundations for the subsequent extraction of information about climatic and environmental changes from these loess deposits. Actually, this work could not have been conducted without the cooperation of a sizeable research team, this demonstrates his excellent organizational ability and personality charm.

Third, his open mind and modesty were important contributors to his success. For a comparatively long time, Chinese society had essentially closed itself off from the rest of the world, meaning that there had been very few opportunities to exchange information with those who lived beyond China's borders, not to mention opportunities for scientists to cooperate over their research. In spite of this, Professor Liu Tungsheng tried hard in reading literatures in order to realize the new international scientific progress. After Deng Xiaoping advocated 'Reform and Opening Up' policy, Liu became more or less the first Chinese geographer to work cooperatively with Western scientists. His first foray into international cooperation was with the team from the Australian National University led by Professors Donald Walker and Jim Bowler for salt lake research in western China, when Professor Liu was the head of the Chinese team. After this cooperative research, Liu's collaboration with foreign scientists included sending Chinese students abroad to study; this became a vital part of his work, and allowed him to collaborate with foreign scientists who became lifelong friends, like Jim Bowler, Edward Derbyshire, Friedrich Heller, George Kukla, Nat Rutter, Kerry Kelts, Ann Wintle, Ian Smalley, Stephen Porter, Frank Oldfield, Donald Walker, Ray Bradley, André Berger, Subir Banerjee, Devendra Lal, John Dodson and Denis-Didier Rousseau. When Professor Liu collaborated with foreign scientists, he adopted a very gentle and frugal Confucian approach; in other words, he was always softly spoken, and was always a modest and complete gentleman. It is precisely because of this that he gained a large number of international friends and thereby nurtured a fertile environment for the development of research into Chinese loess and the Quaternary geology. For example, when China successfully got the opportunity to organize the 1991 International Quaternary Association Conference, Professor Liu was elected chairman against fierce competition, having been supported and promoted by his international colleagues.

Fourth, in his research experience, Professor Liu Tungsheng possessed a robust work ethic and a highly innovative mind. A milestone in the study of loess came when he proved that Chinese loess was first deposited 2.5 million years ago, and that the history of climate change could be very closely compared with the deep sea record, further proving that the glacial-interglacial fluctuations which have characterized the Quaternary period are exhibit a global consistency. This work began in the early 1980s, when Professor Liu brought loess samples from China to the paleomagnetic laboratory run by the Swiss scientist Dr. Friedrich Heller to constrain loess chronology and thus lay the foundations for future research. Following this, as leader of his own team, he constantly expanded our knowledge of this particular field, and developed many climatic proxies. Based on spatial correlation, he proved the relative continuity of loess deposition, thus ensuring that loess becomes one of the best archives of global climate change. At a very early stage he made a direct correlation between the climatic record exhibited by loess and the tectonic uplift history of the Tibetan Plateau (TP). He proposed the view that the tectonic uplift of the Tibetan Plateau would have intensified the aridification of northern China, a view that was later proven by the late Tertiary eolian record of northern China, as well as by subsequent atmospheric modeling.

Fifth, Liu Tungsheng had an extremely broad range of academic interests. He was not only fascinated by Quaternary geology, but was also intrigued by philosophy, history, literature and archeology. He not only conducted research into geological questions, he also paid especial attentions to the social purpose of such research. In the 1960s, as a leader of his team, he conducted research into local diseases found in northern China, such as 'Keshan disease' (a form of myocardial necrosis), Kashin-Beck disease and fluoride poisoning. He innovatively suggested the concepts of the 'first environment' and the 'second environment', thereby distinguishing between environments free from human pollution and environments contaminated by manmade pollution, and establishing whether endemic local diseases were caused by the local water, soil, living conditions or