Aspects of Loess Studies

by Ian Smalley

Loess deposits are providing important keys to paleo-environments over the past two million years, especially where the deposits are interbedded with fossil soils. Loess also provides one of the best soils for food production. There are many problems, however, in loess regions caused by rapid erosion by wind and water. This article comments briefly on these aspects and on some current trends such as thermoluminescence dating and the use of loess for brick-making. (Ed.)

Loess Stratigraphy

During the past 20 years, studies on loess have flourished, and interesting scientific results are being obtained in many parts of the world. It is now widely recognized that the long loess sections encountered in several parts of the world (Fig. 1) provide the best terrestrial record of Quaternary events. They offer a remarkable "window" to environmental changes that have taken place in the past two million years. The succession of paleosols in the Chinese and Central Asian loesses shows clearly the alternation of many warm and cold periods during the time of loess deposition (e.g. Liu et al., 1985a). Correlating the loess record with the data from oceanic cores is a current major task for Quaternary stratigraphers, and loess investigators from many parts of the world are contributing to this endeavour (e.g. Pecsli, 1985 and see Catt, this issue - Ed.).

Figure 1: Loess deposits of the world (after S.R. Taylor et al., *Geochimica et Cosmochimica Acta*, v. 47, 1983).

Loess and Agriculture

Food production and distribution remain a problem, and it is necessary to identify and cherish the world's best agricultural soils. These are commonly loess soils, and there is a remarkable correspondence between the distribution of loess and the occurrence of good agricultural land. Even in Britain, a country not well endowed with loess deposits, modest loess admixtures in the soils of southern England have brought great agricultural benefits. In the South Island of New Zealand, loess soil removed to allow opencast coal mining will be replaced and returned to agriculture, for it is recognized as a valuable national resource. And in China,

water is to be diverted from the Yangtze basin to the arid loess lands of the north in order to increase their agricultural potential.

Loess in China

Many of the factors that make loess soils so ideal for agricultural purposes also render them vulnerable to erosion. The presence of the North China plain (Fig. 2) is a monument to the many years of erosion of the inland loess by the Yellow River, and great efforts are underway to prevent further soil loss here. The other great region of loess erosion was central North America where the droughts of the 1930s allowed vast quantities of top-soil to blow away. If short-term economics permit, this type of soil erosion can be efficiently controlled. Sensible windbreaks and ploughing practices can solve the practical problems, but there is still a need for more research on the actual mechanisms of wind erosion, particularly at the level of particle interaction and energy transfer in the erosion zone.

Figure 2: Source and depositional areas of loess in China (after Liu Tungsheng et al., 1985b).

The recent establishment of the Xian Laboratory of Loess and Quaternary Geology demonstrates the seriousness with which loess studies are taken in China. Another major event was the publication of "Loess and the Environment" (Liu et al., 1985b). The appearance of this book marks a major step forward in the study of Chinese loess and demonstrates clearly the critical role that it plays in the life and economy of China. The authors state that "The study of all the processes leading to loess deposition will probably answer many unsolved problems related to loess, for example, the source of kaolinite in loess, the reason for the high CaCO_3 content in loess, and the formation mechanism of the silt-size, sharp angular quartz particles. All these problems are of major importance in protecting the current environment.

TL Dating and Other Current Trends

One modern technique now being used in loess studies is thermoluminescence (TL) dating (Dreimanis et al., 1985). The TL dating method appears to be particularly suited to eolian sediments such as loess, and it now offers the chance of obtaining absolute dates on the more recent deposits.

The basis of the method is the ability of minerals, such as quartz and feldspar, to trap electrons produced by radioactive decay processes in the natural environment. These electrons are removed from their traps when the grains are exposed to light, as in eolian transport. Thus the number of electrons in the minerals today represents the amount of time that has passed since the grains were last exposed to light, i.e. deposition. Heating the grains in the laboratory also releases the electrons, which then recombine within the crystals and produce light. This is the natural TL signal, which is compared to the TL produced by laboratory irradiation. This comparison yields the "equivalent dose" used in the age equation for dating loess deposits.

In the coming years, it is expected that there will be continuing activity in the field of loess stratigraphy (e.g. Pecs, 1984), but there may also be a growing emphasis on the applied and environmental aspects of loess research. Activities being considered now by the INQUA Loess Commission (see Episodes, vol. 9, p. 170-172, 1986) include the awarding of a Loess Medal at each INQUA Congress, a new project on loess for brick-making, the completion of the Loess Map of Europe, the continued publication of the Loess Letter, and the organization of various meetings. The Loess Commission would also like to promote the development of loess studies in South America, where little has been published about the large deposits there. In particular, the Commission stresses the need for care and preservation of the world's loess, a major natural resource that must be protected and used sensibly.

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