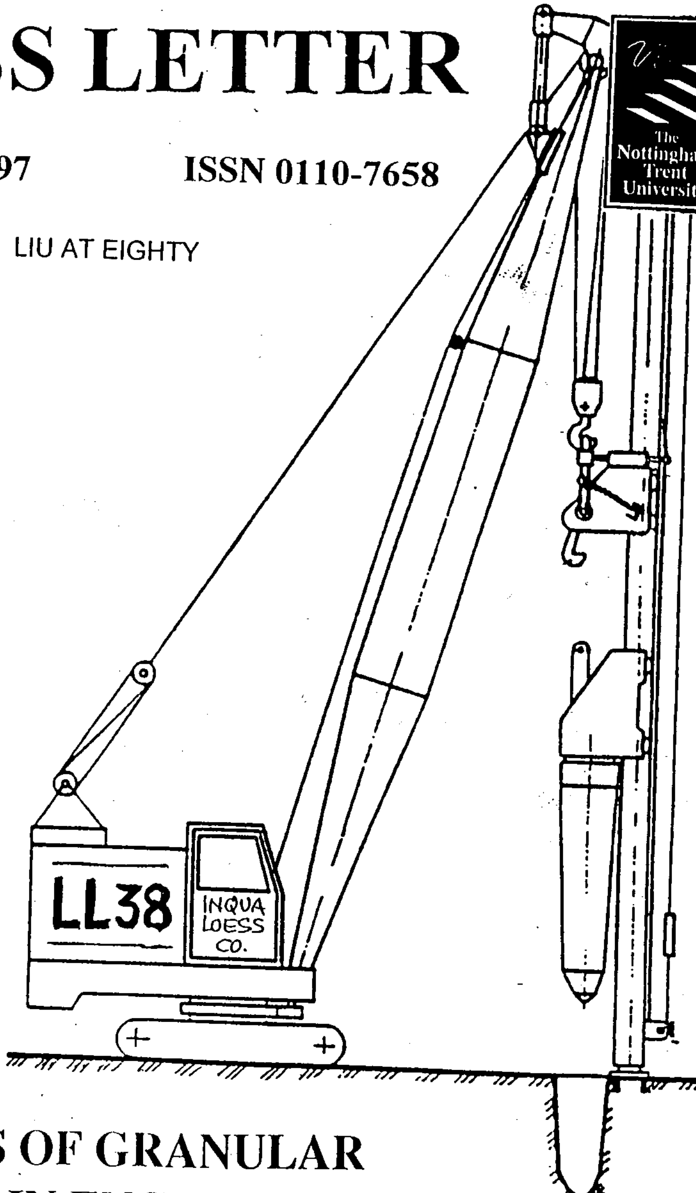
LOESS LETTER

OCTOBER 1997 ISSN 0110-7658

The Nottingham Trent University

LIU AT EIGHTY

38



MECHANICS OF GRANULAR MATERIALS IN ENGINEERING AND EARTH SCIENCES

WEDNESDAY 28 JANUARY and
THURSDAY 29 JANUARY 1998

t The Royal Society, 6 Carlton House Terrace,
ondon SW1

Organized by
Professor G.S. Boulton,
Professor J.M. Rotter and
Professor D. Muir Wood

http://inqua.geoscience.org.za/

WELCOME TO THE XV INQUA CONGRESS HOMEPAGE

INTERNATIONAL UNION FOR QUATERNARY RESEARCH (INQUA)

3rd - 12th August 1999

International Congress Centre (ICC), Durban, South Africa

THEME: **"The environmental background to hominid evolution in Africa"**

You are visitor number : 0052, since the 26th January 1997.

(Feedback)

For More information contact : eaucamp@geoscience.org.za
Last update : January 26, 1997

This page is sponsored by the Council for Geoscience

HTML by : Ian Jackson

02/14/97 10:47:24

Loess Letter 38: October 1997
Less than two years to 15th INQUA in Durban- have you registered your interest? Contact 15th INQUA via their website http://inqua.geoscience.org.za. The Drakensberg loess beckons.

LL38 appears somewhat late to allow us to announce the Bonn-Heidelberg LoessFest, to celebrate 175 years since Karl Caesar von Leonhards inspired idea- the naming and defining of Loess. Celebration meeting planned for early in 1999 in Bonn, with excursion to Heidelberg. Contact Ludwig Zoeller at zoeller@goanna.mpi-hd.mpg.de.

LL38 serves several purposes (1) to wish Liu Tung-sheng a happy 80th birthday: congratulations from the Loess Commission and all at Loess Letter (2) to focus some attention on the Danube loess- note the blue cover(for Blue Danube/An der schonen Blauen Donau Op.314)- we include extracts from papers from Bulgaria and Slovakia (3) to support the Royal Society meeting on the nature and properties of granular materials on January 28/29 1998. Loess is a classic natural granular material, perhaps we will get a chance to say so in London at the end of January.

There is a vast amount of loess material being published. Searching the Science Citation Index via the keyword Loess yielded 571 hits at the end of 1997, and thats only stuff published since 1994. We need to think all the time of ways to improve accessibility and communication; the obvious route is via the Internet and the World Wide Web, but little progress has been made in this direction so far. We hope to have some sort of "LL online"service established by Durban INQUA, but have to report slow progress.

Next Loess Commission meetings. A meeting followed by an excursion on the Loess of the Columbian Plateau is planned for late 1998 and will be organised by Prof.Alan Busacca of Washington State University(busacvca@wsu.edu).

Durban Symposia. Two provisional titles are available for possible Loess Commission symposia at Durban INQUA:
1) Fluctuations of loess tracers to indicate atmospheric circulation variations in global and regional scales.
2) Quaternary collapsing soils
More details in LLs 39 & 40.

Report on the workshop of the INQUA Loess Commission held in Xian on June 8-9 1997 at the National Key Lab.of Loess & Quaternary Geology, by Nick Fedoroff

Atmospheric Aerosol, Loess and Global Change

This workshop was organised by Prof An Zhi-sheng, president of the Loess Commission and director of the National Key Lab.of Loess and Quaternary Geology. Fifteen papers were presented by Chinese and foreign scientists and a meeting of the Loess Commission was held. This meeting followed a symposium of the Xiang Shan Science conferences held in Beijing on June 3-6 1997 which was devoted to Environmental Changes and Scientific Continental Drilling in East Asia. The Xiang Shan symposium was largely concerned with Chinese loess as four of the projected drilling sites will deal totally or partially with loess deposits. New trends appeared during these two conferences, such as the importance of the Plio-Pleistocene climatic sequence, the linkage of dust emission from desert sources to variations in atmospheric circulation as well as applied themes such as dust pollution in cities.
The correlation in China between loess deposition and the winter monsoon on one hand and pedogenesis and the summer monsoon on the other is now almost fully understood and accepted.

The potential contribution of the magnetic signal to the understanding of Quaternary environmental changes was discussed by K.Verosub. However it appears that the origin of this signal is not yet fully understood so results must be interpreted with great caution. Carbon stable isotope studies performed on calcitic nodules of Chinese loess enabled J.Z.Sun to reconstruct palaeotemperatures during accretion of these nodules.

The sequence of loess and red clays of the Loess Plateau of China which is a unique, continuous, terrestrial long term sequence(~7-8 Ma) has been discussed and compared with the Lake Baikal sequence(S.Colman & Y.Inouchi). Both sequences are now correlated with long term deep sea cores. Apparently red clays exhibit some aeolian characteristics. Systematic and detailed grain size analysis enabled j.Vandenbeghe to dentify dust flows in Chinese loess and to correlate these flows with the Dutch stratigraphy of the Upper and Middlee Pleistocene.

An attempt to identify Younger Dryas in Chinese loess and then to correlate it with north-west Africa was presented by W.J.Zhou. Holocene loessial sedimentation was also discussed. In southern Russian steppes(around the Caspian Sea), dust deposition stopped, according to N.Fedoroff, at the Pleistocene-Holocene transition; at around 4000 BP some aeolian gypsum and more soluble salts were added to the soils.

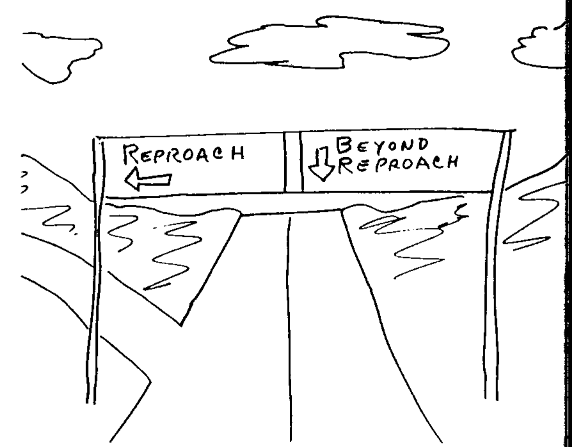
Australia has no significant loess deposits, however large quantities of dust have been and are deflated into the oceans. The similarities between the pellety fabric of lunette deposits and some loess such as that of Israel or those deposits surrounding the Caspian Sea have to be noted.

Q.Z.Yang presented a very interesting project involving investigating aeolian dust trapped in ice of the Tibetan Plateau in order to understand the present day atmospheric circulations and to reconstruct the past ones, and Z.D.Chen discussed the origin of airborne trace elements in the sediments of a lake in Taiwan. X.Y.Zhang offered some new and very interesting results; he has quantified the rate of injection of dust from Chinese deserts into the atmosphere annually (~800 Tg). About 30% is redeposited on to the deserts, 20% is transported over regional scales whereas the remaining 50% is subject to long range transport to the Pacific Ocean and beyond. Zhang has demonstrated that during interglacials the regional scale transport of dust is mainly attributable to non-dust-storm processes and is dominated by northwesterly surface winds. Conversely during glacial stages the impact of dust storms on the accumulation of loess increased. The different glacial vs interglacial patternms for dust transport to the Loess Plateau suggest that variations in both dust flux and coarse particles(larger than 20 microns) can be regarded as the proxies of the intensity of the East Asian winter monsoon under glacial cycles.
This is in contrat to the dust deposition rates, which are strongly influenced by the monsoonal circulation.

Scientists from the Shaanxi Environmental Protection Agency(J.J.Yang, J.Chen & H.B.Wang) reported on the dust pollution in this province, more especially in the city of Xian.

Xian, June 10 1997, N.Fedoroff

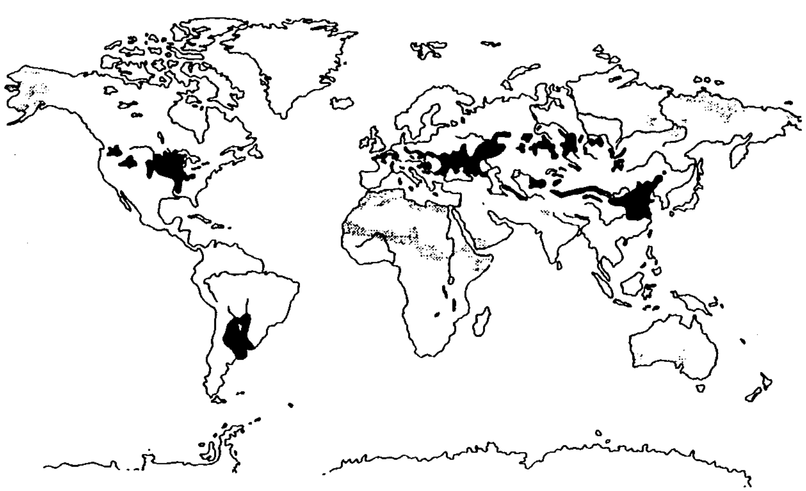
"We have formulated our response to global warming"



International Joint Field Meeting

1928

International Union for Quaternary Research



Loess in Argentina: Temperate and Tropical

Paraná ARGENTINA
15-21 MAY, 1998

INQUA Loess Commission
Climates of the Past (CLIP)
Universidad Nacional de Entre Ríos (UNER)
Palaeoclimates of the Southern Hemisphere (PASH)

sidad Nacional Entre Ríos

ganised by Dr. Martín Iriondo Mailing Address: C.C. 487, 3100 Paraná - ARGENTINA
Fax: 54-42-571226 e-mail: rniriond@arcride.edu.ar

HAZARDS RELATED WITH UNDERGROUND STRUCTURES IN COLLAPSIBLE LOESS

EVSTATIEV, D., KARACHOROV, P. and EVLOGIEV, I.

Geological Institute of Bulgarian Academy of Sciences
Sofia 1113 BULGARIA

ABSTRACT: The underground structures, built in collapsible loess of Bulgaria, create great problems for contemporary construction. Their existence provides no hazard in natural conditions, but their support is damaged after loess moistening, thus causing serious deformations of the buildings and equipment situated at the surface. The exact localization of the structures, their strengthening and the water-protection measures are the main activities for the elimination of the hazard, potentially related with them.

1 INTRODUCTION

A great number of underground structures are built in loess soils all over the world, which is due to the favourable geotechnical properties of loess under natural conditions. It possesses low water content and is easily excavated, the vertical slopes and unsupported vaults being stable. Loess soils have also excellent thermal insulation properties. In ancient times (several centuries B.C.) the Thracians used to build on Bulgarian territory dwellings in loess - the so called troglodyte houses. A great number of similar houses had been used in the Middle Ages till the 30-ies of the XX century (Gounchev, 1934). Churches deeply embedded in the ground, storehouses, drainage galleries and sceptic pits were also built on loess terrains. Galleries as parts of the town fortification systems had also been made in loess massifs. A several hundred meters tunnel was built in the first Bulgarian capital Pliska during the VII-VIII century, starting from the tzar palace and passing under the fortress wall. This unique structure with brick lining is in a very good condition at the present moment too.

The underground fortification construction was more rigorously developed during the last century and in the beginning of the present one, as well as, before and during the Second World War when tens of kilometers of air-raid shelters and other military equipment were built. Many of them are used now by the civil defense autorities.

A great deal of the underground equipments are situated under contemporary urbanized territories. It is well-known that loess is one of the most susceptible to technogenic changes soils and its good geotechnical properties are considerably aggravated after moistening. Loess exhibits unloaded collapsibility or loaded collapsibility under the buildings on top of it, when it is in an saturated state. The deformations due to the collapse are higher when underground structures are present. The cases when the latter are under or in close proximity to existing buildings represent an extreme hazard. The old underground equipment creates also serious problems when deep excavations in loess are performed.

2 BASIC PROPERTIES OF LOESS

The loess soils occupy 12 000 km^2 of the territory of the country and have a specific composition and structure, favourable physical and mechanical properties under natural conditions, i.e. when it has not been subjected to technogenic changes.

Almost the whole Danubian plain is covered by loess, which was formed during the Pleistocene and has an aeolian genesis (Minkov, 1968). Loess composition and properties are regularly changed in horizontal and vertical direction. Several lithofacial varieties are established to the south of the deflation zone - the Danube river: loess-like sand, sandy loess, silty loess, clayey loess and loess-like clay.

Loess is inhomogeneous in vertical direction too. It has a full lithostratigraphic section on the older palaegeomorphological forms - seven loess horizons, divided by six palaeosoils. The number of the loess horizons on river terraces decreases from six on the oldest to one on the youngest terrace. The palaeo soils have predominantly clayey composition, well developed carbonate zones and are important for the underground construction in two ways - as a reinforcing element of the loess massif and as a water barrier because of the higher clay content, the latter function being an unfavourable one.

The loess cover in the northern regions of the loess area near the Danube river has a thickness of 40-60 m and it becomes gradually thinner (about several meters) to the south (Fig.1). The more thick loess cover is developed in the region of sandy and silty loess, possessing the best properties for underground construction

The clay fraction content (d < 0.005 mm) of loess determines its behaviour from geotechnical point of view. The clay in sandy loess is up to 10 %, in silty loess - up to 20 % and in loess-like clay - > 30 % (Minkov, 1968). Hydrous micas and montmorillonite prevail in the clayey fraction of loess. The silty fraction (0.05-0.005) contains mainly quartz and less feldspars and mica.

The most important for underground construction loess varieties - sandy and silty loess, comprise more than 60-70 % quartz grains which determines the low water retaining capacity of loess (W = 10-17 %). The carbonate content of loess exceeds sometimes 20 %. The greater part of carbonates are n dispersed state in the clayey fraction. The high Ca'' content in the adsorption complex of the clayey fraction determines its relatively lower hydrophilicity (Minkov, Evstatiev, 1975).

Loess has a neutral or slightly alkaline reaction, a ow sulphate content and is not corrosive for the netals used in the underground structures.

The sandy and silty loess have low dry density ρ_d, on the average 1.42 g/cm^3 and 1.39 g/cm^3 espectively. Their porosity is higher - n = 47-52 %, nd this is one of the prerequisites for their greater collapsibility under moistening. Collapse settlement of up to 100 cm can be also obtained under overburden pressure. This is a very important fact or the building of underground structures, specially in urbanized territories. The modulus of otal deformation of the surface part of silty loess is $E_o = 130 \times 10^5$ Pa. E_o is increased with depth and mounts to $E_o = 190 \times 10^5$ Pa at 15 m below the urface. The Poisson's ratio is $\mu = 0.3$.

The modulus of total deformation of water aturated loess decreases 3 times, i.e. loess with igher water content falls into the category of the oft water saturated clayey soils. The foundations in iem should be performed after preliminary nprovement of the base.

The natural hydrogeological conditions are vourable for underground construction. The loess assif is cut and drained by river valleys. Water-aturated horizons can be formed in the bottom part f the loess when it is deposited on water npermeable clays, and temporary water domes, rmed on fossil soils.

According to Minkov (1968) precipitation water in penetrate through sandy and silty loess to the epth of 3.5 m. The water content in this zone uctuates during the different seasons depending on ecipitation. Water movement in downwards rection under natural conditions proceeds in an nsaturated medium, i.e. infiltration takes place.

CHARACTERISTICS OF THE NDERGROUND STRUCTURES

epending on their destination, two groups of built-loess underground structures can be stinguished:

i) equipments for military purposes - hiding-places, caches, parts of fortification systems;

ii) equipments for civil purposes - canalization collectors, sceptic pits, storehouses.

The most widely distributed structures of first group are the air-raid shelters, built mainly before and during the Second World War. They are situated in the town areas at a depth of 13-14 m below the surface.

In the cases when the bomb-proof shelters are designed to begin at the surface, they have at least 2 entrances, inclined entrance galleries with steps and passage galleries, connecting the single compartments. The entrance galleries are 80-120 cm wide and 180-220 cm high. The plan view has a broken-line shape. The walls are vertical and the ceilings are arched.

The corridor galleries have the size and form of the entrance ones and are built on one level. The main rooms also have vertical walls and arched ceilings. They are of different size depending on their destination - the width is from 150 to 280-300 cm, the height of the arch lock being from 240-260 to 340 cm and the length - from 2.50 to 8.00-12.00 m.

Some of the hiding-places are built in the lowest part of steep loess slopes. Their entrances and the galleries connecting the main rooms are built on one level.

The galleries and the main rooms are lined with one-stretcher-wide brick masonry with lime mortar or with reinforced concrete with a thickness of the section of 20-30 cm.

The thickness of the lining varies depending on the width and height of the spaces. The masonry is 25 or 29 cm thick (one brick) for sizes up to 150/220 cm and the reinforced concrete - 25 cm. The thickness of both brick masonry and reinforced concrete is 44-55 cm for larger rooms.

The concrete strip foundations are bedded at a depth of 40-60 cm under the floor. Their width is usually equal to the wall width. The floor construction is made of either bricks on a 15 cm sand bed or 10 cm thick concrete layer. The floor has no links with the strip foundations of the walls.

Some of the deep military shelters are used as storehouses at present. The greater part of the shallow galleries built in the XVII-XIX century are also used for civil purposes as storehouses, cold store chambers or water-conducting collectors. The construction is performed by 25-30 cm thick brick masonry or hewn stone with vertical walls and cylindrical vault. The dimensions of the storehouses and cold store chambers are: width - 2.5 m, height - 3.0; the section of the water-conducting collectors is 1.0 x 1.8 m and their length is up to several hundreds of meters.

The sceptic pits are dug to the depth of 5 to 12 m with a diameter in the range of 1.2-3.0 m. They seldom reach the bottom part of the loess complex and are not lined in most of the cases. The pits have been filled with household waste, loess and building materials in consequence.

4 FACTORS CAUSING THE DEFORMATION OF THE UNDERGROUND STRUCTURES

Most of the underground structures are built in silty loess with a depth of the collapsible zone about 13-14 m. Under conditions of natural water content (W=10-18 %) the values of the physical and mechanical parameters of collapsible loess are as follows: bulk density ρ = 1.52-1.78 g/cm^3, pore volume n = 45-51 %, cohesion c = 0.14-0.20x10^5 Pa and angle of internal friction Φ = 22-26°, coefficient of uloaded collapsibility δ_c = 0.02, plate modulus E_o = 120 - 140x10^5 Pa.

The main reason for the deformation of the underground structures is loess collapse under technogenic moistening. The collapse itself is realized under overburden pressure or from the additional load of the structures. The deformations proceed in two ways, depending on the location of the underground equipment.

In the case of deeply situated galleries on the boundary between collapsible and uncollapsible loess sediments and normal water content the system "buildings at the surface - collapsible loess-underground structure" is in a stable equilibrium. The underground structure in this case is in a very good operation condition. However, the strength properties of loess are strongly aggravated under moistening leading to a three-fold reduction of the plate modulus - from 120 to 40x10^5 Pa, two-fold decrease of cohesion and five- to thirty-fold reduction of the angle of internal friction. Thus loess is transformed from a soil of weak structure into a plastic material, flowing even without additional loading. At the moment of collapse the weight of the whole loess massif is applied on the underground structure. When the thickness of the collapsed zone is 13-14 m, the load on the arch of the gallery is 2.2x10^5 Pa. The arch is usually capable to bear this load but deformations of the structure occur due to the uneven settlement of the strip foundations. The mentioned load causes contact stresses under the foundations, reaching 5x10^5 Pa. The settlement of the soil base under this heavy load is irregular with values of up to 20 cm.

Vertical cracks in the wall lining (opened to about 15-21 mm) appear in the zone with abrupt change of the settlement. The cracks fade in the arch reaching the size of 0.1 mm in the arch lock.

Other types of deformation are also generated from vertical overloading. Longitudinal cracks opened up to 0.1-0.2 mm are formed along the arch lock of the gallery. Similar cracks are established between the walls and the arch abutments but they are due to horizontal overloading. Greater cracks in the structures provide conditions for outflow of loess material.

Local swelling of the lining is observed as a result of the hydrostatic pressure of plastic loess without disturbing of its integrity. The swelling is most often formed on the arches between the locks and abutments of the vaults, as well as on the walls of the galleries.

The deformations of the deep underground structures affect the buildings erected on top of them. They are deformed by the settlement of loess in the active zone of the foundations, by the collapse of loess between the foundations of the building and the underground structure and by settlement and caving of the underground structures (Fig.2).

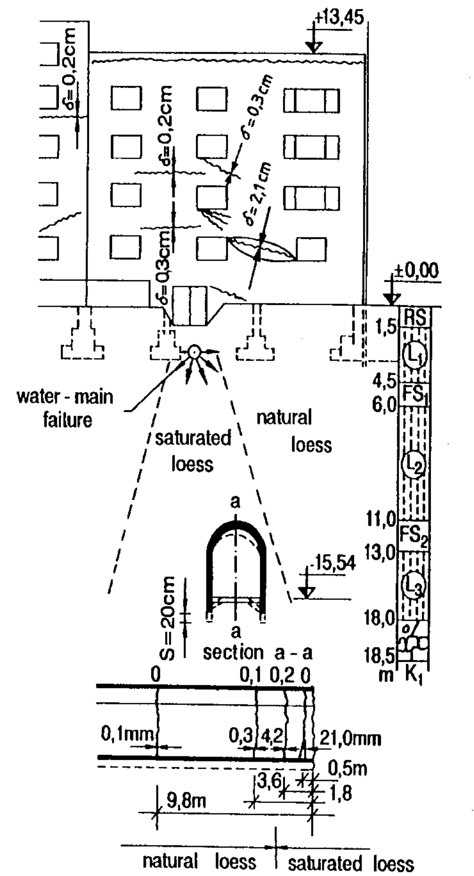
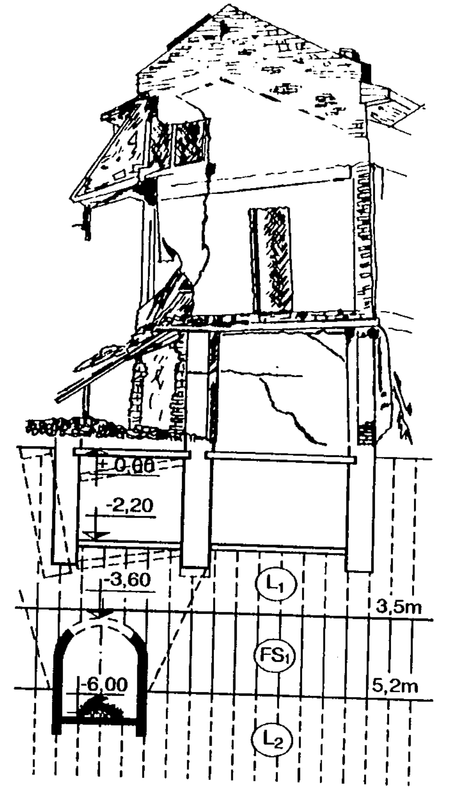


Fig.2. Deformations of deep underground structures and of the buildings on top of them: Rs - contemporary soil; Ln - loess horizon; Fs - fossil soil; K_1 - Low Cretaceous limestone

The underground equipment for civil purposes - semi-passable canalization collectors from the XVII-XIX century, storehouses, cold stores and others, are built in the top part of the collapsible zone. Their deformation under accidental moistening of collapsible loess leads to catastrophic consequences for the overground buildings (Fig.3).



3. Collapse of a building due to deformation of a
ow underground structure: Rs - contemporary soil;
loess horizon; Fs - fossil soil

central urban territories are subjected to crowding and reconstruction in the recent years. e are many shallow or deep old sceptic pits in ı. Deep foundations should be performed more more often in proximity to existing buildings. In cases it is obligatory to strengthen the slope of excavation and the foundations of the existing ing. In-situ cast piles anchored in the loess if are used in similar situation. The building can estroyed because of slope sliding when a part of stabilizing anchors are occasionally fixed in ic pits (Fig.4).

NCLUSION AND RECOMMENDATIONS

results of the performed investigation have n that the underground structures in collapsible represent a serious danger in urbanized ories. The complicated mechanism of the gical hazard caused by them requires a

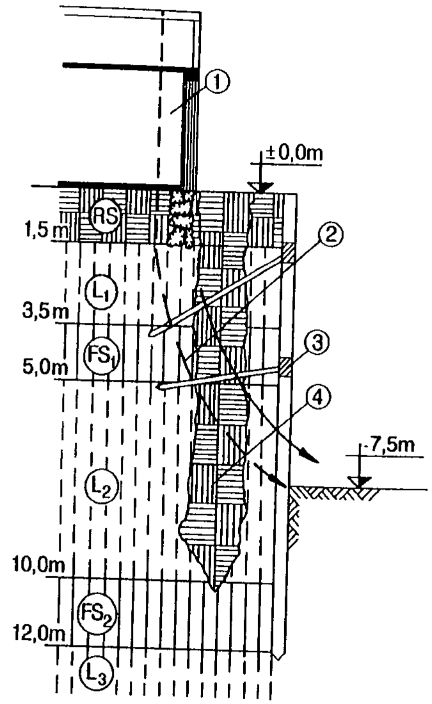


Fig.4. Collapse of a slope and a part of a building caused by unsuccessful anchoring through a sceptic pit:
Rs -contemporary soil; Ln - loess horizon; Fs - fossil soil;
1 - destroyed part of a buiding; 2 - sliding surface; 3 - strengthening structure of the loess slope;
4 - a sceptic pit

complex approach for its prevention and elimination of the negative consequences. This approach includes a group of activities which have to be carried out in the following order:

1. Elimination of the cause for oversaturation of the loess base. Most often it is due to accidents in the water supply and canalization system. The towns built on loess in Bulgaria are old and these systems do not conform to the contemporary requirements. It is indispensable to build new water supply and canalization systems which are suitable for the specific of loess soils condition, especially in the urban zones with existing underground structures.

2. Stabilization of the damaged underground structures. These measures include strengthening of the foundations and removing of the damages of the structure. The casting of short piles by compacting of the concrete mortar with compressed air is a very appropriate method for strengthening of the foundations. The foundations of the galleries are very often situated at the boundary with the uncollapsible zone of the loess massif, which facilitates the transfer of a part of their load to the adjacent underlying strong layers.

3. Stabilization of the damaged overground buildings. These activities include the strengthening of their foundations and structure. The short piles are also very suitable for the cases of loess base collapsing only under the additional load from the buildings. The top parts of the piles are connected by a grid-girder, combining the single foundations. The injection strengthening is a good solution when the loess base is of greater thickness. There is a considerable experience in the East European countries in injecting of silicate grouts, which coagulate under the action of the cations of the absorption complex of the clayey fraction and of the salts, contained in the loess. The effect of the silicatization is stronger when it is combined with carbon dioxide injection.

The next step after the stabilization of the soil base is to repair the damaged structures by: building of strengthening concrete walls, beams and columns, restoring the integrity of cracked brick walls and other methods for repair of damaged buildings.

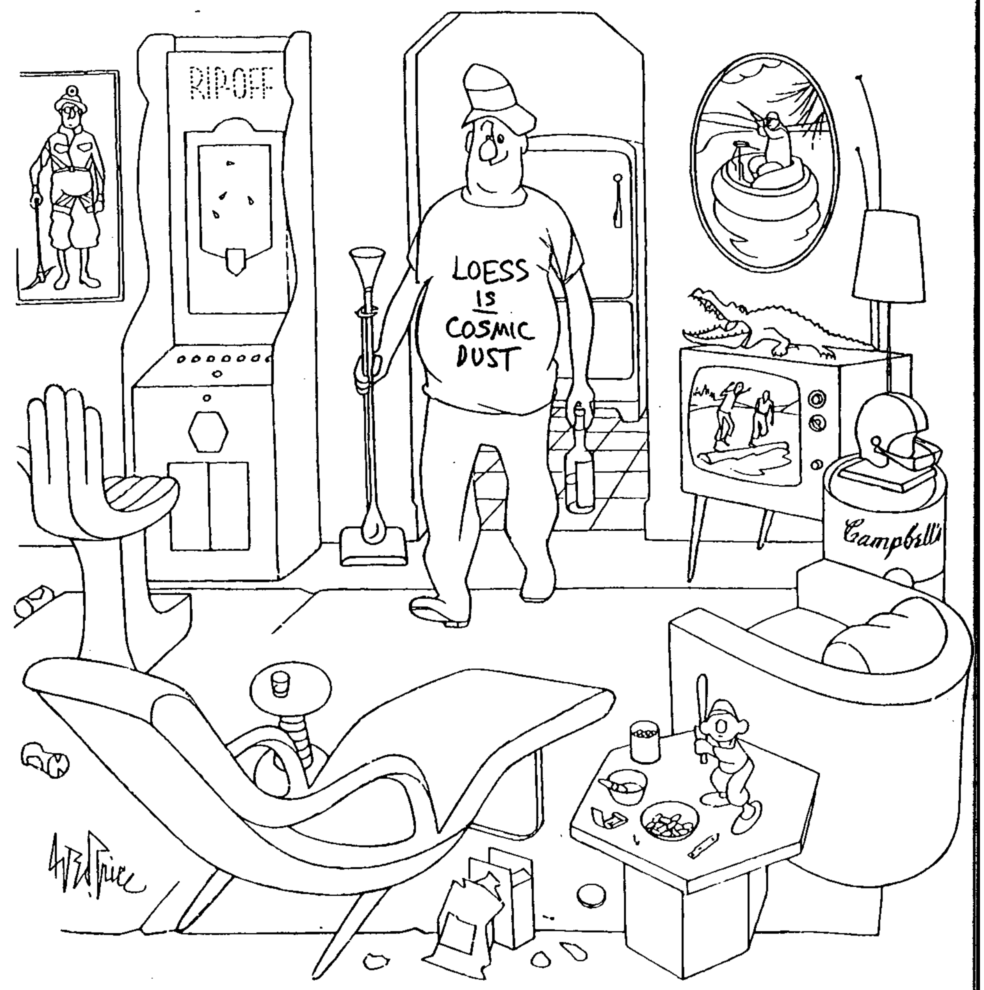
The performance of these three groups of activities is time consuming and requires considerable financial resources, but only in this way the further safe use of overground and underground structures built in collapsible loess soils can be guaranteed.

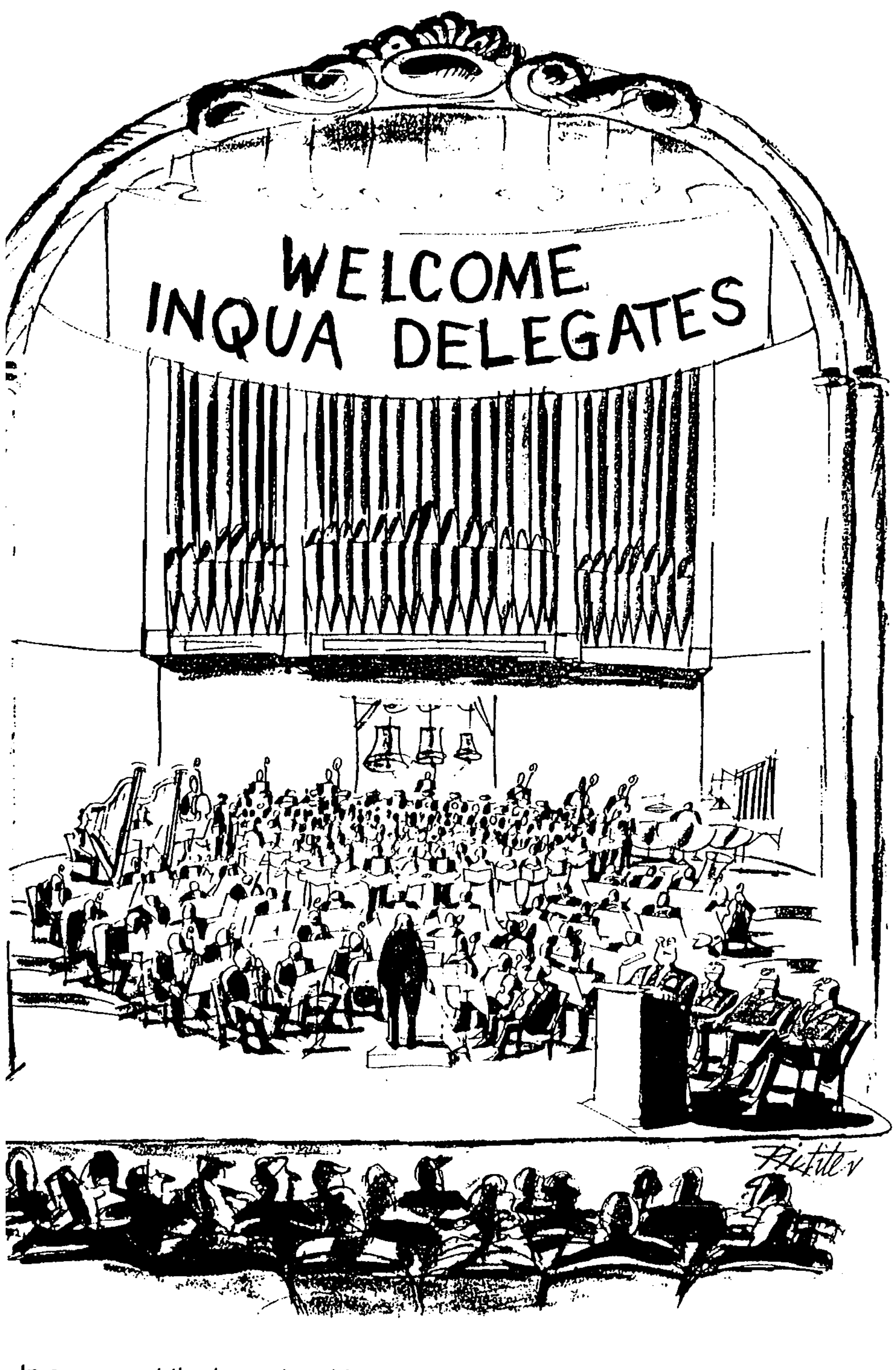
REFERENCES

Gounchev, G. 1934. Near-surface houses in Danubian Bulgaria. *Annual Book of Sofia University*, Hist.-Phil. Dept., book XXX, 14: 1-76 (in Bulgarian)

Minkov, M. 1968. Loess in North Bulgaria. Sofia, BAS, 202 p. (in Bulgarian)

Minkov, M., D. Evstatiev 1975. Foundations, linings and screens of stabilized loess soils. Sofia, Technika, 189 p. (in Bulgarian)





In a moment the keynote address on Amino-Acid Dating, but first Mahlers Eighth Symphony...

Thick loess deposits reveal Quaternary climatic changes

Ian Smalley Endeavour Vol. 21(1) 1997

Anyone who has done any sort of course in physical geography knows three things about loess: it is yellow, it occurs in China (Figure 1), and it is blown by the wind. In fact, loess soils cover about 10 per cent of the whole continental land area, where they were deposited by aeolian action over the two million years of the Quaternary period. Loess is a silty soil, finer than sand and coarser than clay; the soil structure is good for root penetration and, given enough water, it is a first-class agricultural soil. Loess as a soil is a valuable resource; the loess which has formed the topsoil in Iowa, USA, and the Ukraine and the Argentinian pampas is new, young soil material, probably less than 10,000 years old. Its youth means that it still contains plant nutrients and it is no surprise to find that loess soils are the most productive on the planet.

The relative constancy of deposition over the last two million years allows certain Quaternary events to be traced and investigated. The thick loess deposits, in particular those in China and Central Asia, contain many old, buried soils, the palaeosols, and these give a good indication of recent climatic change. This, more than anything, probably accounts for the high level of interest in loess soils and loess deposits. The loess deposits offer a picture of climate and environmental change over the past two million years, and it is the thick loess deposits of China and Central Asia, those derived from the High Asia region (Figure 2), which provide the best records.

Hardcastle at Timaru, 1890

The idea that loess deposits could be used as a 'climate register' appears to originate with John Hardcastle [2,3], in Timaru in 1890. On 2 October 1890 John Hardcastle delivered his paper to the Philosophical Institute of Canterbury; the meeting was held in the Canterbury Museum in Christchurch, New Zealand. The title of the paper was 'On the Timaru loess as a climate register' and it appears to have been the first to link loess with the climatic record. Hardcastle was a schoolmaster at Geraldine, in the South Island, and he was also a particularly observant natural scientist. He stood on the beach at Timaru and observed the coastal loess section, the so-called Dashing Rocks section. He suggested that 'the loess contains marks of several pauses in its deposition; in bands containing (a) drought veins, the product of a dry climate; (b) rust-granules, the product of a wet climate; (c) multitudes of birds crop-stones, which I shall presently suggest have an interesting significance as an index of climate; and (d) at one level certain alteration of texture produced by extreme severity of climate' [2].

The Hardcastle paper was published in the *Transactions and Proceedings of the New Zealand Institute* in 1891. There is probably no way in which this remarkable observation could have made any impact on the world of science at the end of the nineteenth century. It was a brilliant but isolated observation; it did not connect with any contemporary mainstream science. It has been

Figure 1 A nineteenth-century view of loess in China. An illustration from Baron Ferdinand von Richthofen's great five-volume work *China: Ergebnisse eigener Reisen und darauf gegründeter Studien* (1877–85) which provided the first detailed Western look at the Chinese loess. The cohesive loess stands in tall vertical cliffs.

argued that its complete neglect was due to the fact that it was published in an obscure journal that was read only in New Zealand, but it is highly likely that publication in a visible European journal would not have had much effect; Hardcastle was ahead of his time.

Liu in Poland, 1961

The defining moment for loess stratigraphy came in 1961, at the Sixth Congress of the International Union for Quaternary Research (INQUA) in Poland. Julius Fink of the University of Vienna (who was to become the first president of the INQUA Loess Commission) organized a symposium on loess. He invited Liu Tung-sheng, the leading Chinese loess scholar, to attend and to present a paper. The paper, by Liu and co-worker Chang Tsung-hu, was published in Lodz in 1964 as part of Volume 4 of the Congress Report [4]. It contained the illustration shown in Figure 3, possibly the most significant diagram ever published in a loess paper. Figure 3 shows 17 buried soils (palaeosols) in a thick, 120 m loess deposit. This means that during the time of formation of this deposit there were 17 climatic oscillations. This was a remarkable observation to present at a time when most Quaternary investigators believed that there were four climatic oscillations in the whole of the Quaternary period, as suggested by Penck and Bruckner at the beginning of the twentieth century. In fact, the paper by Karl Brunnacker, presented at the same symposium and published in the same volume, was entitled 'The Wurm cold phase in Bavaria in the light of loess research' and the work was firmly based on the concept of four glacial periods, the Gunz, Mindel, Riss and Wurm. At the Symposium on loess the old fourfold Quaternary ended and the new multi-oscillation Quaternary appeared, although not many people at the time appreciated this. As with Hardcastle, this gem

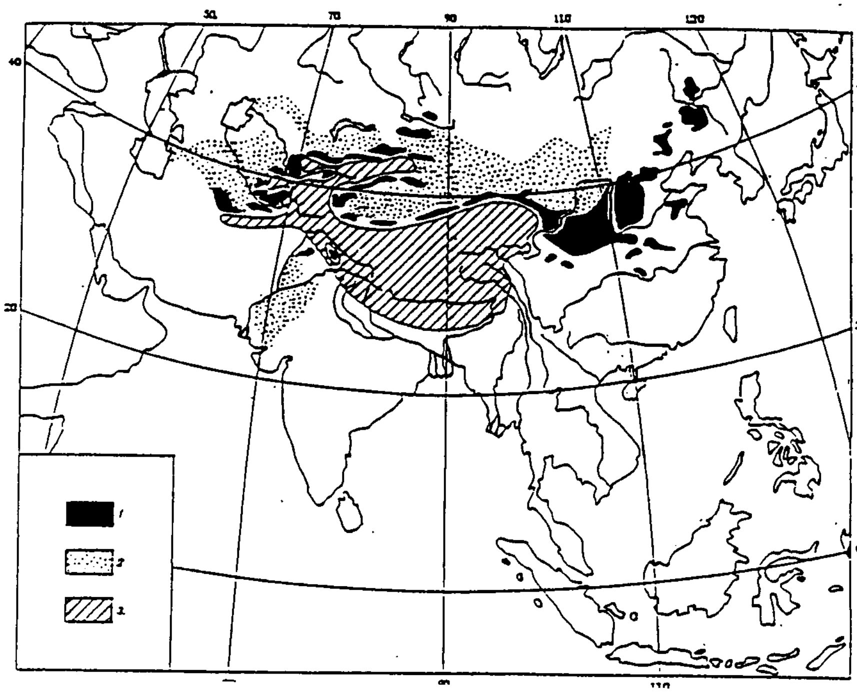


Figure 2 The loess around High Asia: a sketch map by Alekseev and Dodonov [1]. The loess material appears to originate in the high regions and be deposited in the mountain fringe regions. Key: 1: loess; 2: sand; 3: land over 3000 m elevation.

was well buried. The papers for the Sixth INQUA Congress were eventually published in Lodz with the 11 papers of the Loess Symposium at the end of Volume 4. The observation that the Quaternary period contained a large number of climatic oscillations was probably the key discovery of the previous 50 years of Quaternary investigation, but this particular document was not accessible. As the Chinese investigators prepared to disseminate their remarkable finding more widely the Cultural Revolution occurred and scientific publication ceased. The great discovery was lost in the 10-year silence.

The Baoji Section, 1990

Now, China is the scene of much loess investigation. The 1990s have brought much activity [5,6] and many investigators are studying Chinese loess stratigraphy. The 13th INQUA Congress was held in Beijing in 1991, and discussion of loess predominated. Not the 11 papers of 1961: now there were more than 100 papers, mostly by Chinese scientists and engineers, with a large proportion of them building on the pioneering observations of Liu and Chang. Figure 4 gives a reasonably good view of the current situation. This comes from a joint Chinese–Canadian study [7] of a thick loess deposit at Baoji, on the Chinese Loess Plateau. It shows the basic situation that exists today. It has turned out that the Gauss/Matuyama (G/M) magnetic transition corresponds, more or less, with the beginning of loess deposition, and (some workers have suggested) with the end of the Pliocene and the beginning of the Quaternary period. This major magnetic transition is dated at about 2.4 million years ago (BP – before present); it was a transi-

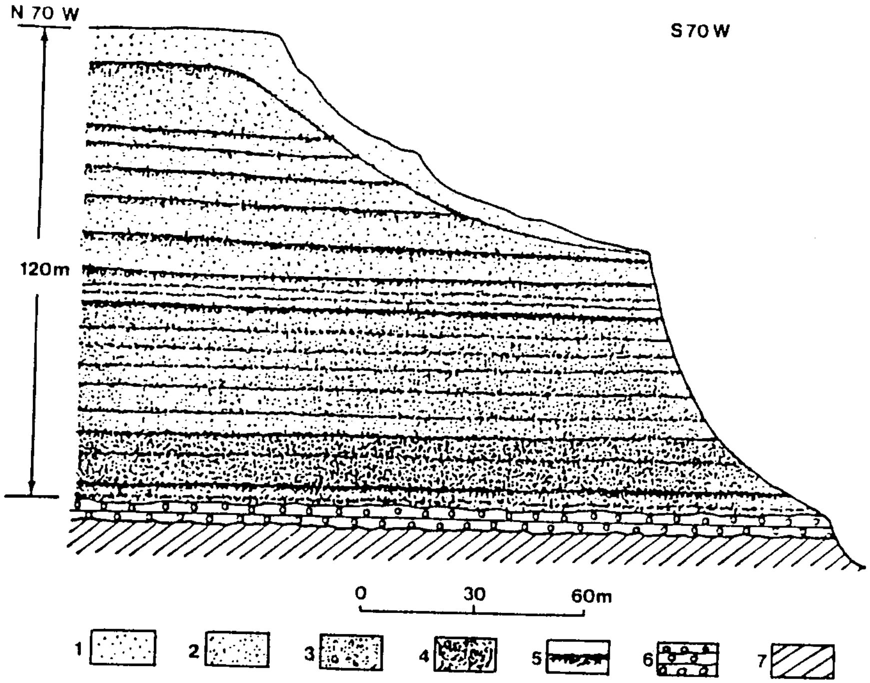


Figure 3 Buried soil layers in the loess at Wucheng, Shaanxi province. This is the picture which Liu Tung-sheng showed at the Warsaw INQUA congress in 1961. It established the multi-event nature of the Quaternary period. Key: 1: Malan loess; 2: Upper Lishih loess; 3: Lower Lishih loess; 4: Wucheng loess; 5: buried soils = palaeosols; 6: Lower Pliocene conglomerate; 7: Palaeozoic sandstones. (From Liu and Chang [4].)

tion from a normal field to a reversed field, and the field reversed again in the Matuyama/Brunhes transition at about 730,000 BP (see Figure 4). These magnetic dates enhance the loess record and allow the soil-forming episodes to be dated. The sequence of 32 soils means that there were 32 warm periods since the G/M transition, and the soils are separated by loess layers which indicate cold periods. If there were 32 oscillations in 2.4 million years it means that, on average, each climatic cycle lasted for 75,000 years, which is not an enormously long time. Each cycle has a warm phase and a cold phase and each phase has a cooling and a warming aspect. We appear today to be in a warm phase which may have begun about 10,000 years ago (the time chosen as the beginning of the Holocene period). If this is the case, we are, say, 8000 years away from the maximum temperature of the cycle. The loess record, very roughly interpreted, suggests that natural warming will continue for another 8000 years.

The Chinese loess is being vigorously investigated and major works are under way on the Central Asian loess to the west and north of High Asia. The Central Asian loess probably contains a climate record to rival the Chinese loess but various factors have combined to delay its investigation and exploitation. But this time is ending and soon there will be striking results from the Central Asian region. Even the modest loess in New Zealand, where the whole story began, is contributing climatic data and providing a picture of the Southern Hemisphere Quaternary.

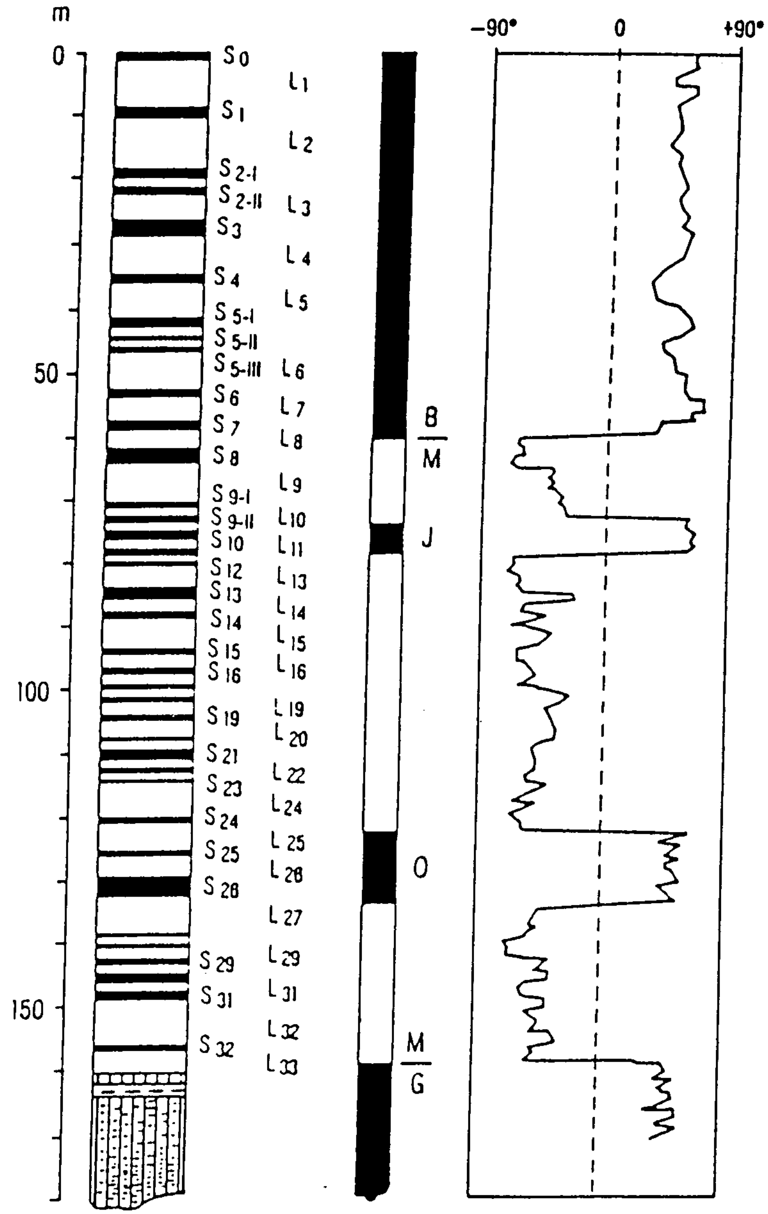


Figure 4 Loess–palaeosol sequence at Baoji on the Chinese Loess plateau. The loess and palaeosol units are numbered from the top, and magnetic field variations are shown. Over 30 climatic oscillations since the Gauss/Matuyama magnetic reversal are indicated. Loess deposition begins as the Pliocene ends, at about the time of the G/M transition. (After Rutter *et al.* [7].)

References

[1] Alekseev, M.N. and Dodonov, A.E. *Izv. Akad. SSSR Ser. Geol.* **11**, 9–19, 1989 (in Russian).

[2] Hardcastle, J. On the Timaru loess as a climate register. *Trans. Proc. N. Z. Inst.* **23**, 324–32, 1891.

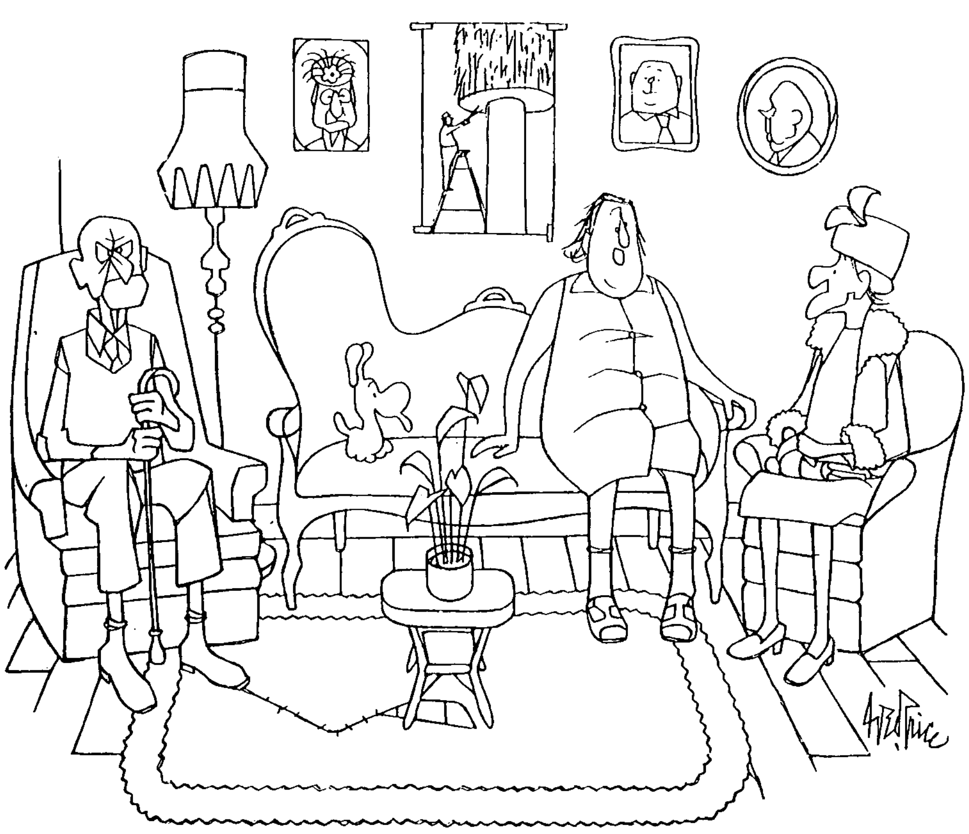
[3] Smalley, I.J. *J. Glaciol.* **29**, 480–84, 1983.

[4] Liu, T.-S. and Chang, T.-H. *Proc. Sixth INQUA Congress, Warsaw, 1961* **4**, 503–24, 1964.

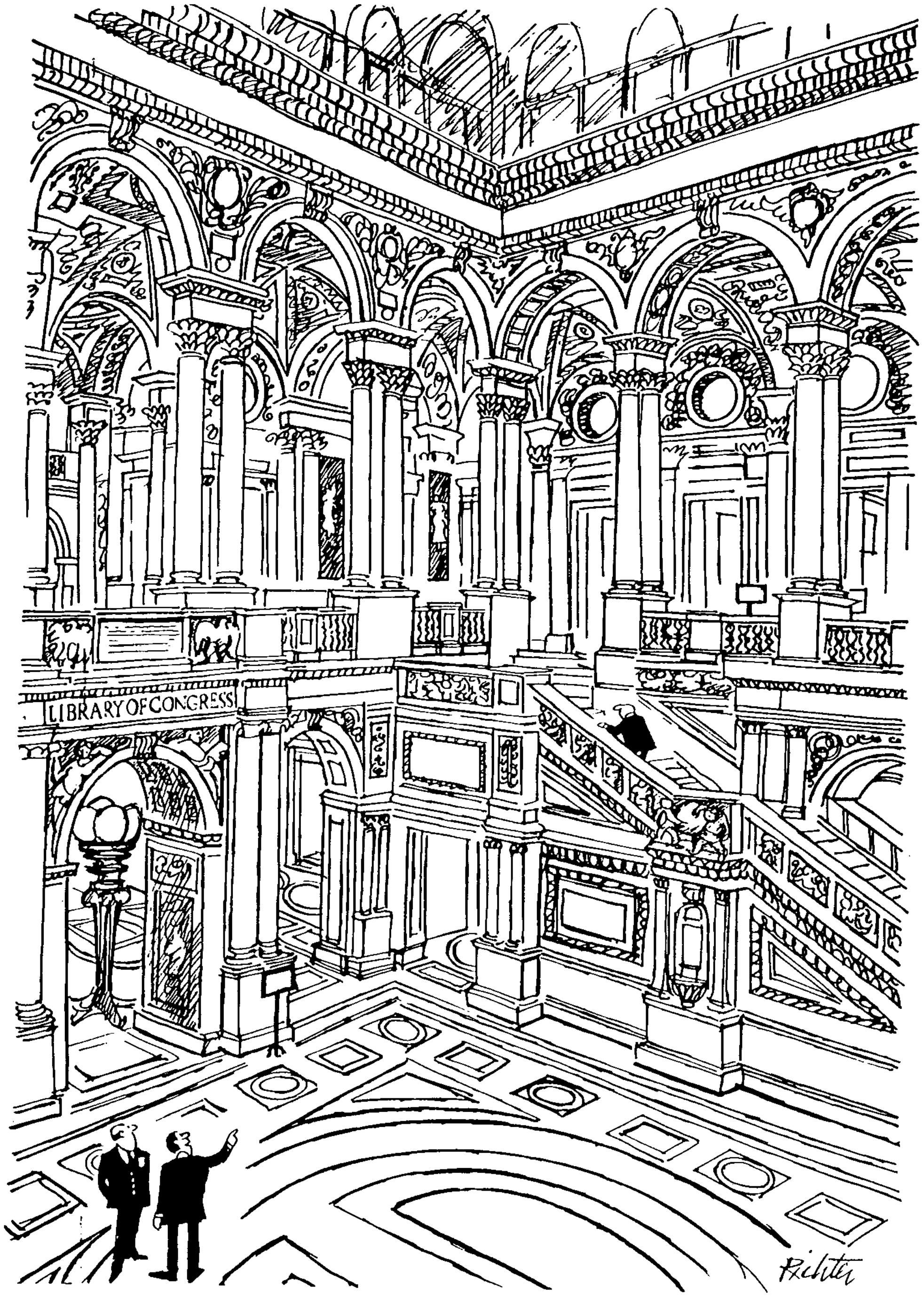
[5] Derbyshire, E. (Ed.) *Quatern. Sci. Rev.* **14** (7–8), 1995.

[6] Derbyshire, E. (Ed.) *Quatern. Proc.* no. 4, 1995.

[7] Rutter, N., Ding, Z., Evans, M.E. and Wang, Y. *Quatern. Int.* **7–8**, 97–102, 1990.



Something he read in Loess Letter annoyed him and hes been sulking ever since



He wants 624- but we use a completely different system

An International Conference on Geotechnical & Geological Engineering

Melbourne, Australia. 19 - 24 November 2000

INVITATION FROM CHAIRMAN

As we approach the third millennium it is instructive to reflect on the advances in the geo-engineering sciences which have occurred over the past 50 or 60 years. The disciplines of soil mechanics, rock mechanics, engineering geology and geotechnical engineering generally have come of age and are recognised by our peers in other professions. Although we have three international societies generally representing these disciplines, together with a number of more specialist international groups, all have a common goal - to foster and facilitate the practice and knowledge relating to our disciplines.

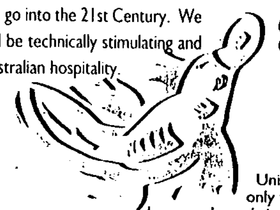
There is much synergy between the interests of the International Society for Soil Mechanics and Foundation Engineering (ISSMFE), the International Society for Rock Mechanics (ISRM) and the International Association of Engineering Geology (IAEG). As a consequence, the three incumbent Presidents of these groups promoted the concept of an international conference to bring together the three disciplines at the end of the second millennium, to reflect on the states of practice and how we might go forward to the next millennium. This idea has been widely embraced, with the conference to be held in association with the International Geosynthetics Society, the International Tunnelling Association and the International Association of Hydrogeologists.

As chairman of the committee charged with organising this conference, it is my very great pleasure to invite you to join us in Melbourne in November, 2000 to celebrate the advancements we have made, to reflect on the states-of-practice and to consider where advances must be made as we go into the 21st Century. We promise you a conference which will be technically stimulating and an assurance of some very warm Australian hospitality.

Max Ervin
Conference Chairman
JUNE 1997

MELBOURNE, VICTORIA - YOUR HOST CITY

Melbourne is a city renowned for its parks and gardens, eating, shopping, sporting and cultural activities. Her charm and character is enhanced by beautiful old buildings with ornate facades and her wide leafy tree-lined streets. People from all parts of the world have played a vital role in the growth of this city from a tiny village of the 1830's to a bustling metropolis of more than 3 million people. If ever a city was to be used as a true example of the meaning of the word multi-cultural, it would be Melbourne.



Unique to Australia, the Platypus is one of only two mammals that lay eggs. Found living along creeks and rivers, they have a broad, flat snout, webbed feet, thick brown fur and a broad flat tail for swimming. Living in burrows in creek banks, the platypus female lays up to three leathery eggs which hatch in around 10 days. The young feed off their mother's milk and stay with her for about four months.

SCIENTIFIC PROGRAMME

The conference will provide a forum for all interested parties to meet and discuss both formally and informally issues relevant to the current states-of-practice as well as future directions. The conference will combine five themes of common interest, with a number of invited lectures from eminent practitioners, researchers and recent achievers on issues that are relevant to our various disciplines. The themes being developed are in the areas of Geotechnical Earthquake Engineering, Underground Works, Stability of Natural and Excavated Slopes, Environmental Geotechnics, Ground Improvement and Ground Support.

For each of the themes, we propose a combination of invited keynote and issues lectures, discussion sessions/workshops and selected paper presentations. Although parallel sessions will be necessary for some of the invited lectures, it is intended to schedule all lectures to provide the maximum opportunity for delegates to attend those of common interest.

This approach is being planned to allow dissemination of current states-of-the-art, to provide ample opportunity for interested groups to openly debate specific issues, and to facilitate the presentation of key papers submitted to the conference. There will also be both general and invited poster sessions, again aimed at stimulating interaction between delegates.

Above all, this conference will bring together the key international contributors to the development of our disciplines and provide a previously not available opportunity for these pioneers, the recent achievers and the practitioners in geo-engineering to meet both formally and informally in a stimulating technical environment.

CRITICAL DATES

Call for Abstracts Distributed	February, 1999
Abstract Deadline	May 1, 1999
Notification of Abstract Submission	July 1, 1999
Paper Deadline	November 1, 1999
Return of Papers	March 1, 2000
Final version of Papers to be received by the Secretariat	July 1, 2000

ACCOMMODATION INFORMATION

Accommodation has been reserved to suit all price ranges, a complete list will be published in the Conference Main Announcement.

GeoFair2000

A wide and varied exhibition of equipment, software, instruments and machinery for geotechnical and geological education, investigation, design, and construction will be co-ordinated by the Conference Organising Committee in conjunction with specialist scientific exhibition planners and experts from our industry.

GeoFair2000 will be held in the Melbourne Convention and Exhibition Centre, in the midst of GeoEng2000 Conference space, and a degree of exposure of Conference delegates to the exhibition will be ensured. The general engineering and scientific community will also be able and encouraged to attend GeoFair2000.

Expressions of interest in participating in GeoFair2000 will be welcomed by the Secretariat at any time, although general solicitation of interest will be distributed in 1998.

SECRETARIAT
GeoEng2000
C/- ICMS Pty Ltd
84 Queensbridge Street
SOUTHBANK VIC 3006 Australia
Phone: + 61 3 9682 0244 Fax: + 61 3 9682 0288
e-mail: geoeng2000@icms.com.au
Website http://civil-www.eng.monash.edu.au/discipln/mgg/geo2000.htm

Sunday November 19	Monday November 20	Tuesday November 21	Wednesday November 22	Thursday November 23	Friday November 24
	Registration Opening Ceremony	Special Lectures	Special Lectures	Special Lectures	Special Lectures
	Concurrent Sessions	Concurrent Sessions	Concurrent Sessions	Concurrent Sessions	Concurrent Sessions
Registration Pre-Conference Tour	Welcome Reception			Conference Dinner	Closing Ceremony

REQUEST FOR REGISTRATION FORM

Please complete the details below and return to the Conference Secretariat to obtain a copy of the Conference Main Announcement & Registration Brochure when it becomes available.

Melbourne Convention Centre, 19 - 24 November, 2000

Name: ....

Company: ....

Address: ....

....

State: .... Post Code: .... Country: ....

Telephone: (   ).................................. Fax: (   ): ....e-mail: ....

[illegible] form to
[illegible] C/-ICMS Pty Ltd, 84 Queensbridge Street, SOUTHBANK VIC 3006, Australia
Telephone: +61 3 9682 0244, Facsimile +61 3 9682 0288, e-mail: geoeng2000@icms.com.au
Website http://civil-www.eng.monash.edu.au/discipln/mgg/geo2000.htm

GeoComputation 98

3rd International Conference on GeoComputation
17-19th September 1998 Bristol UK

The 1998 Annual GeoComputation Conference will take place at the Department of Geography, University of Bristol. The Conference will be based around a series of sessions related to the following themes and Keynote Speakers:

Dynamic Modelling - *Prof. Peter Burrough*
Geographical Analysis and Explanation Machines - *Prof. Stan Openshaw*
Virtual Libraries - *Prof. Mike Goodchild*
Modelling Virtual Environments - *Prof. Mike Batty*
Physical Process Modelling - *Prof. Malcolm Anderson*
Spatial Data Analysis - *Prof. Luc Anselin*
Visualising Alternative Geofutures - *Prof. Keith Clarke*
Diffusion Modelling - *Prof. Andy Cliff / Prof. Peter Haggett*
Remote Sensing of Spatial Distributions - *Prof. Paul Curran*
Concluding Keynote Address - *Prof. Helen Couclelis*

An accompanying **Keynote Book** will be available to all Conference Delegates at the Conference *(included in registration costs)*.
Additional Keynote contributions and sessions under review.

The provisional Programme is as follows:

Thursday 17th September	Arrival and Registration
	Opening Address and Reception
	3-course Dinner, Hawthorns Hotel, Clifton
Friday 18th September	Morning Paper Sessions
	3-course Lunch, Hawthorns Hotel, Clifton
	Afternoon Paper Sessions
	Conference Dinner onboard S.S. Great Britain
Saturday 19th September	Morning Paper Sessions
	3-course Lunch, Hawthorns Hotel, Clifton
	Closing Address and Reception

Accommodation:
will be provided in the Hawthorns Hotel, Woodland Road, Clifton, Bristol which is located 200m from the Geography Department.

Registration Costs for the Conference are as follows:
Before 1st July 1998: Full Residential - £205 / Daily Delegate - £110 per day/
Postgraduate Residential (no evening meals) - £125 (en-suite priority booking: add £40)
After 1st July 1998: Full Residential - £240 / Daily Delegate - £120 per day /
Postgraduate Residential (no evening meals) - £160

Early booking is advised *(prior to 1st July 1998)* to guarantee room availability.

For further information contact the organising committee:

Dr S.Brooks, Professor P. Longley, Dr W.Macmillan, Dr R. McDonnell, Dr R. Abrahart
Telephone: +44 (0) 117 928 9109, Fax: +44 (0) 117 928 7878, E-mail: geocomp-conf@bristol.ac.uk

Further Details and Updates see Web Site ***http://www.ggy.bris.ac.uk/geocomp/geocomp.html***

GeoComputation 98

3rd International Conference on GeoComputation
17-19th September 1998 Bristol UK

Organising Committee:
Dr S. Brooks
Professor P. Longley
Dr W. Macmillan
Dr R. McDonnell
Dr R. Abrahart

Tel: +44 (0) 117 928 9109
Fax: +44 (0) 117 928 7878
E-mail: geocomp-conf@bristol.ac.uk
Web Site http://www.ggy.bris.ac.uk/geocomp/geocomp.html

Correspondence address:
Dr S. Brooks,
Department of Geography,
University of Bristol,
University Road,
Bristol BS8 1SS, UK

GUIDELINES FOR THE SUBMISSION OF ABSTRACTS

All papers accepted for presentation at the Conference will be included in a book of abstracts and on CD-ROM for distribution to all delegates. Details for submission of full papers for the CD-ROM will be posted on the Web site after abstracts have been reviewed. The deadline for abstract submission is 15th January, 1998 This will be strictly adhered to.

For your abstract to be accepted, the following rules must be followed explicitly:
Type name, middle initial *(if desired)*, and the last name followed by a comma, then the Department *(do not abbreviate)* followed by a comma, the City followed by the Country, followed by a full-stop *(use English Language place names if possible e.g. Vienna not Wein, Rome not Roma, etc.)*. You may include an email address in the general format of: name@location.domain.country (e.g. John.White@wu-wein.ac.at). You may not include phone numbers.

TITLE AND TEXT FORMAT: Type the title of the paper in upper and lower case. End the entry with a full stop. Do not put quotation marks around the title. Do not underline anything in the title. The text should follow directly underneath the title. If you are using a word processor, you may use a limited amount of bold within the text. Do not underline within the body of the abstract, but use italics instead. You may also use subscripts and superscripts where appropriate.

REFERENCES: You may use a few references if absolutely essential to your paper, but remember to use italics, not underline. If there is more than one author, the author presenting the paper should be the first named.

LENGTH OF ABSTRACT: The abstract should be no more than 500 words long.

KEY WORDS: After the final paragraph type 'key words' followed by a colon, then type a maximum of five key words separated by commas.

GUIDELINES FOR THE SUBMISSION OF ABSTRACTS - an example:

> Paul Longley, Department of Geography, University of Bristol, University Road, Bristol BS8 1SS, United Kingdom.
>
> The Use of GIS to Analyse Patterns of Local Revenue Raising.
>
> During the last five years .... *(type your abstract of up to 500 words)*.
> Key words: GIS, local taxation, council tax.

3 copies of abstracts should be submitted to **Dr Sue Brooks, Department of Geography, University Road, Bristol BS8 1SS, UK** by **15th January 1998.**

SLOVAK GEOLOGICAL MAGAZINE

Monitoring of collapsible soils in Slovakia

ALENA KLUKANOVÁ[1] – JANA FRANKOVSKÁ[1]

[1]Dionýz Štúr Institute of Geology, Mlynská dolina 1, 817 04 Bratislava

Abstract: Collapse is an important factor in assessing the economy of construction foundation and security. Collapsible soils affect unfavourably the foundation of constructions and the environment, since the process of collapse causes significant volume changes as well as changes in the properties of soils. Collapse monitoring in foundation soil consists of several subsequent stages. In the beginning stages, collapsing sediment occurrences are identified. In the territorial units studied monitoring of unfavourable results of collapse is carried out, consisting of inventory and documentation of damaged objects. Based on a set of obtained data and information, areas with soils susceptible to collapse may be distinguished, determining their engineering geological properties, degree of susceptibility to collapse, as well distinguishing regions and sub-regions with same susceptibility to collapse

Key words: collapse, collapsible soils, susceptibility to collapse, monitoring, damages to objects

Introduction

Monitoring of collapsible soil is one of the subsystems of the "Partial monitoring system of geological factors" (KLUKANOVÁ, 1993), which is a part of "Environmental Monitoring of the Slovak Republic". The aims of geofactor monitoring are to investigate and evaluate the mechanism of origin and evolution of processes in natural environment, to foresee their evolution trends in time and space and to suggest measures to reduce negative effects of these processes

Under the term "collapse", used predominantly in geotechnical literature and referring mainly to aeolian sediments, we understand a sudden reduction of volume due to moisture and load Soil collapse leads in many cases to a failure of foundations and damage to buildings due to uneven or excessive subsidence Therefore, collapsible soils belong to unreliable foundation soils

The large number of failures and break-downs in buildings caused by soil collapse in our country as well as abroad points to the fact that geotechnical problems of collapsible soils have not been paid due attention. On the other hand, in many cases foundations are designed with excessive security, or inadequately, although modern and expensive technologies are being applied. The choice of inadequate design may be affected by various circumstances. Meagre knowledge of physical and mechanical properties of foundation soils is one of the most serious causes. Other factors to mention are: unexpected presence of water, insufficient knowledge of the load of the building, or wrong use of technology.

The problems of collapse are in Slovakia even more aggravating due to the fact that aeolian sediments occur on an area of almost 7000 km^2 (ŠAJGALÍK, 1985), which is approx. 14% of the surface of the Slovak Republic (Fig. 1). From the above it follows that it is important to investigate and evaluate the mechanism of soil collapse, surface collapse manifestations, changes in the geological environment, to foresee their temporal and spatial effects and to take measures which would minimize these effects to an acceptable level

Conditions and mechanism of soil collapse

A number of Slovak as well as foreign authors have studied the conditions and mechanism of soil collapse According to STN (Slovak Technical Standard) 73 1001 "Foundation of structures Subsoil under shallow foundations", collapse may occur if any of the following conditions has been identified

- the soil is of aeolian genesis,
- the content of the silt component is more than 60 % of dry soil weight,
- the content of the clayey component is less than 15 % of dry soil weight,
- the saturation degree is less than 60 % and liquid limit is less than 32 %

Among other conditions of collapse the above standard mentions porosity exceeding 40 % and simultaneous natural moisture below 13 % As collapsible soils are classified those in which the collapse coefficient (I_{mp}) exceeds 1 %

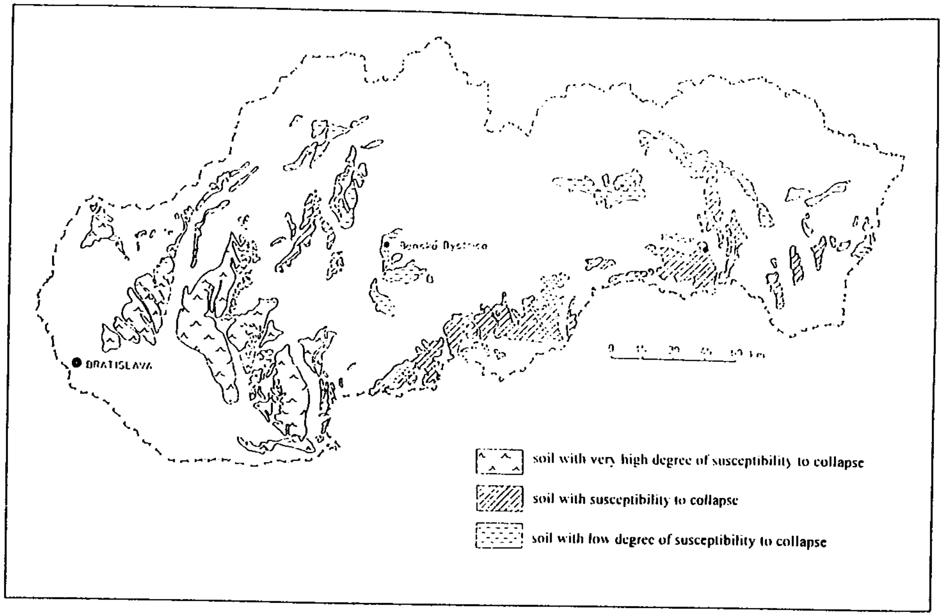


Fig. 1 Extend of collapsible soils in Slovakia. Map was compiled on the basis the work of J. Šajgalík, I. Modlitba and A. Klukanová

The causes of soil collapse are various. They are controlled by the genesis of soil, post-genetic processes, compactness of soil, hydrogeologic conditions, mineral composition etc. On the basis of microstructural analysis (Klukanová, 1988) and the results of the work of Šajgalík and Modlitba (1983), collapse may be divided into three phases, which, however, take place simultaneously.

In the first phase, the original microstructure is destroyed, due to increased moisture under external pressure. The increase of saturation degree in soil causes loss of capillary adhesion force and to a considerable extent it decreases the strength of clay bridges. The destruction leads also to damage of clay films covering sand or silt quartz grains, or other clastic minerals. Aggregates and micro-aggregates disintegrate as well. The intensity of carbonate dissolution and their migration in the soil increase.

In the second phase, the microstructure is disintegrating, which is reflected in the displacement of damaged clay films. Water, which causes also subsurface erosion, along with external stress affect, the transport of particles. Other important effects are: decrease of carbonate content, compressing of other fabric elements, decrease of the total volume of soil.

In the third phase, new micro-structure is formed after collapse. The soil acquires a heterogeneous structure, in contrast to the former homogeneous one, the basic structural units of the soil having disintegrated, i.e. individual grains are not perfectly covered by clay films any more and they are not connected by clay bridges. The per-cent content of individual pore-size fractions changes. The collapsed soils have lower percentage of pores with the size of up to 0.005 mm. The content of pores with a size of 0.005 to 0.01 is significantly higher. From the above facts it follows that the translocation of disintegrated clay films and bridges has a principal role in the soil collapse process (Klukanová, 1988).

Characterisation of collapsible soils

There are several groups of collapsible soils. The two most important are:

- soils with a high degree of susceptibility to collapse. The collapse coefficient is higher than 3%. Among these soils are typical and sandy loess.

- soils susceptible to collapse. Their collapse coefficient ranges from 1 to 3%. Into this group belong aeolian sandy, clayey loess and a part of loess-like sediments described later.

Available results show that collapse depends above all on the fabric. Collapsible soil is composed of silt and sand grains covered by clay films, connected by clay bridges and clay buttresses. We assume that most susceptible to collapse is a soil having an exactly balanced ratio between the quantity of clay minerals and sand or silt grains, so that these grains are covered by clay minerals and connected by clay bridges. Clay minerals are not present in such fabric in any other form. Any variation from the balanced ratio between the two fractions (other form of clay mineral occurrence in the fabric) results in collapse. Any soil having above described fabric is collapsible at increased moisture and/or increased strain in the foundation soil. The degree of collapse is affected also by porosity (especially by pores with a diameter of about 0.01 mm), the contents of carbonates, oxides, hydroxides of metals (above all iron and manganese) and soluble salts. From the above it follows that the collapse process is very complex, depending on many factors, which are to a great extent variable.

From the viewpoint of geotechnical properties, collapsible soils have high strength under conditions of onstant natural moisture. After saturation with water, their strength rapidly decreases. The properties of these soils change significantly after collapse. Collapsible soils put higher requirements on geotechnical investigations than other foundation soils. Their characteristics, determined according to the results tests, are set out by the standard STN 73 1001.

Extensive investigations of the properties of collapsible sediments in previous years (Klukanová et al. 1989, 1992, Klukanová, 1988) allow us to characterize basic physical-mechanical properties of their various types and their variations.

Soils with a high degree of susceptibility to collapse

Among soils with a high degree of susceptibility to collapse are typical loess and sandy loess.

Typical loess is characterized by being non-bedded, primarily calcareous, having capillary porosity. It is generally dry, of yellow to dark-yellow colour with visibly predominant grain-size composition varying in the range of 20 - 63 μm, which corresponds to coarse-grained silt to very fine-grained sand.

The fabric consists exclusively of skeletal microstructure. The soil is very homogeneous and isotropic. Fig. 2 shows a micrograph of the fabric of a typical loess. The silt fraction is predominant. According to grain-size analysis, it is characterized by a high content of the silt fraction (65-72 %) and low content of the clay (7-17 %) and sand fractions (15-20%). The water content depends on the content of clay particles, which, due to their properties and the size of specific surface bind the predominant part of

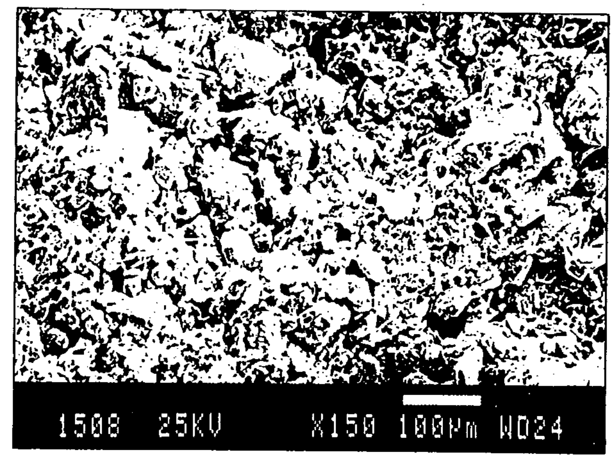


Fig. 2 The micrograph of the fabric of a typical loess. Locality Mnešice brick-plant near Nové Mesto nad Váhom

like sediments) or changed in situ (autochtonous loess-like sediments), or it is non-aeolian material, in which the process of loessification took place. In place of loessification there is often loamification or gleyfication. The most important secondary processes taking place during resedimentation are:
- deluvial, colluvial processes and solifluction, due to which slope, deluvial and solifluction loess is formed,
- fluvial and proluvial processes - fluvial and proluvial loess,
- changes caused by cryoturbation - cryoturbational loess,
- eluvial and pedogenetic processes - give the origin to loess.

Loess-like sediments may have formed either from typical, sandy or clayey loess. Their porosity is lower than in the original material. A great change is observable, concerning the contents of carbonates. Some of these soils are totally without carbonates. They differ also in colour. Loess-like sediments may be characterized on the micro-scale only with difficulty, since they are strongly heterogeneous having anisotropic fabric. Heterogeneity is enhanced also by the occurrence of several basic microstructure types (matrix, skeletal, laminar as well as honeycomb etc.). Prone to collapse are however only those which have skeletal and skeletal-matrix type of microstructure. Fig. 8 shows a micrograph of the fabric of a loess-like soil.

Monitoring of collapsible soils

Among best ways of characterizing regional occurrence of collapsible soils is monitoring of their unfavourable results, i.e. damage to objects. An inventory of damaged objects was started to be taken on the territory of East Slovak Lowlands, Búčske Terraces, lower flow of the river Hron. We shall proceed towards the Southern Slovak Basin, Trnava and Nitra Hills. Failures are recorded in a specially designed inventory form (Fig. 9). The documentation of specific failures is aimed at most damaged construction parts, there are characterized the failures, the age of the object, the depth of foundations, type material used for the construction of the building, factors affecting the extent of damages, or repair work.

The investigation of the extent of damages to buildings is carried out on selected objects, in regular intervals - twice in a year - especially as far as the state, number and width of failures on objects are concerned, determined by indirect measurement of failure openness. The number and size of failures are then evaluated in time and space.

Engineering geological properties of soils are determined on undisturbed soil samples taken from boreholes, pits and outcrops near the object. The samples are tested in the engineering geology laboratory at the Dionýz Štúr Institute of Geology in Bratislava. First of all there are investigated moisture, plasticity, grain-size composition, bulk and specific density, saturation degree, contents of carbonates and organic matter. Besides this, mineral and chemical composition, as well as the fabric of soils, especially its changes caused by collapse, are studied as well, using an scanning electron microscope. The susceptibility to collapse of these soils is monitored as well using collapse test not only in oedometer, but also in a triaxial chamber.

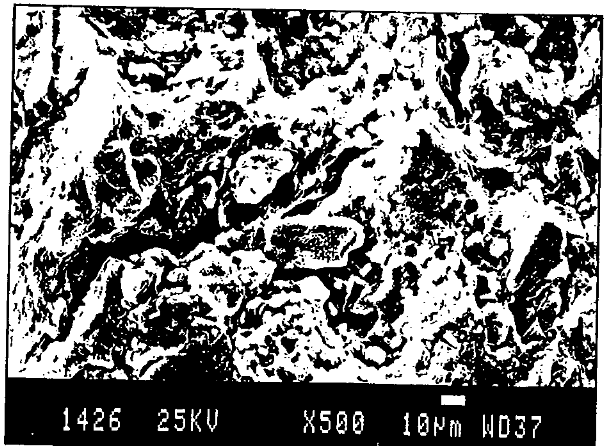


Fig. 8 The micrograph of the fabric of a loess-like sediment

The output is a data bank, containing data on the degree and character of damages to an object, their development in time, about conditions at foundation of the object and causes of the collapse process etc. The inventory is complemented by a map on the scale 1 : 10 000, or 1 : 50 000, showing the extent and intensity of collapse processes on the territory studied, as well as an evaluation of the time course of the monitoring, with an interpretation of the measured data. The data bank with data on the occurrence and intensity of collapse processes will be adjusted for data input into a partial information system.

Causes of damages to objects

Among principal factors causing damages to objects are increased load and moisture, due to water infiltration into foundation soil. The source may be damaged water piping, sewers, drain pipes or excessive precipitation. Moisture increase causes deterioration of geotechnical properties of foundation soil, decrease of its loading capacity, large deformations of constructions due to irregular or excessive subsidence of foundations. The occurrence of failures in buildings, foundations as well as supporting upper parts of building may be caused also by incorrect calculation of foundations of the building itself, or by a change of loading (e.g. by load concentration transferred from the neighbouring object, dynamic effects from a road or railway with high transport intensity).

Map of the susceptibility of soils to collapse

One of the most important outputs is the construction of maps of the susceptibility of soils to collapse. It is compiled by the method of engineering geological zoning. Zones and sub-zones are distinguished having the same susceptibility to collapse. The method applied in the compilation of the map corresponds to the proposed manual for the compilation of engineering geological maps of geofactors of the environment (KLUKANOVÁ et al., 1995). By the traffic-light method we mark homogeneous territorial units - zones and sub-zones with the same susceptibility. Green represents territories not susceptible to collapse, orange are territories susceptible to collapse and red are territories with very high susceptibility to collapse. Criteria for distinguishing the zones have been described in the above manual.

Fig. 10 shows the map of the susceptibility of soils to collapse on the scale 1 : 50 000 from the area of Búčske Terraces.

Conclusion

The aim of monitoring is to investigate changes in the observed characteristics, an analysis of relationships between these changes, a prognosis of the development of these processes, the verification of the reliability of prognoses in practice as well as a generalization of information in relation to territories with the same geological structure and other conditions of natural environment.

The paper refers to two groups of soils with different susceptibility to collapse: soils with a high degree of susceptibility to collapse and soils susceptible to collapse. In the first group there are typical loess and sandy loess. To soils susceptible to collapse belong aeolian sands, clayey loess and loess-like sediments with skeletal and skeletal-matrix microstructure. The character of their fabric affects the engineering geological properties and their changes due to environmental changes.

Monitoring of collapsible soils belongs to the most accurate ways of characterizing the results of collapsible soil occurrences. The aim of monitoring is to follow and evaluate the mechanism of soil collapse, its surface manifestations and negative changes in the geological environment, its destruction, to foresee the effects of these changes in time and space and to bring about measures which would reduce unfavourable effects of collapse to an acceptable level. The result should be input data used for finding solutions to the problems of environmental protection and optimisation of exploitation of the geopotential in the country.

Within the first stage of monitoring, an inventory of damaged objects is taken in the form of an evaluation of the unfavourable results of soil collapse. When documenting specific damages, the most damaged constructional parts are registered, the damages are characterized, as well as the age of the object, depth of foundations, type material used for the construction, factors affecting the extent of damages, or repair work. Further work will lay in permanent observation of changes of damages on selected objects, as well as of changes in soil properties.

A special kind of generalization of the results of the partial monitoring system is the evaluation of susceptibility of the territory to soil collapse, expressed in cartographic form as a map of the susceptibility to soil collapse, in which there are evaluated pre-defined geological regional units. The map is constructed by the method of engineering-geological zoning. Zones and sub-zones are distinguished, having the same susceptibility to collapse, i.e. the zone of territory not susceptible to collapse, the zone susceptible to collapse and zone of territory with very high susceptibility to collapse.

Loess Letter 38: October 1997

Loess Letter (LL) is the newsletter of the INQUA Loess Commission. INQUA is the International Union for Quaternary Research, which encourages and correlates research and investigation on Quaternary topics, within the ICSU framework. ICSU is the International Council of Scientific Unions which looks after World-wide science. The Quaternary is the last 2 million years (more or less), and loess is that remarkable wind-blown silt which provides the basis for the best agricultural soil in the world (the parent material for Chernozems to form in).

Loess stratigraphy provides an excellent terrestrial opportunity to study climate change and the sequence of Quaternary events, and this is probably the most popular research topic within the loess community at the moment.

LL is published twice a year, normally in April and October, by the Collapsing Soils Research Group at Nottingham Trent University. The editors are Ian Jefferson (Ian.Jefferson @.ntu.ac.uk) and Ian Smalley (ijs4@le.ac.uk): send any news items or announcements to:

Loess Letter
Civil & Structural Engineering Department
Nottingham Trent University
Nottingham
NG1 4BU
UK

For information about INQUA contact the secretary:

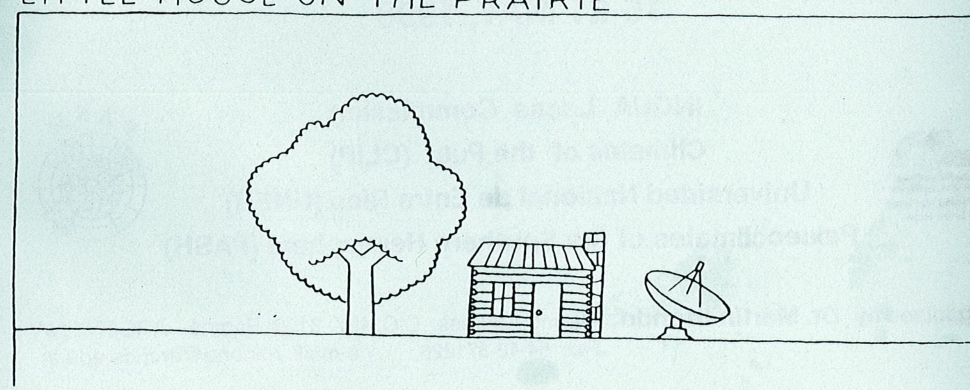
Dr Sylvi Haldorsen
Department of Soil & Water Sciences
Agricultural University of Norway
P O Box 5028
N-1432 Aas
Norway
email: sylvi. Haldorsen @ ijuf.nlh.no

For more information about the Loess Commission contact the president:

Prof Dr An Zhi-Shen
National Laboratory of Loess & Quaternary Geology
P O Box 17
No. 22-2 Xiyling Road
Xian 710054
China
Tel. (29) 552-4744
Fax: (29) 552 - 2566

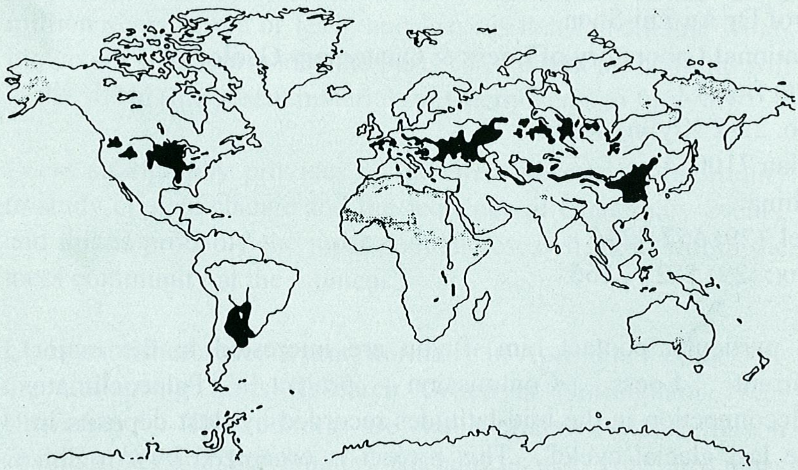
In particular contact him if you are interested in the major current Loess Commission project "Palaeoclimate teleconnection in the mid-latitudes recorded by dust deposits in the last glacial cycle". This project is organized by An Zhi-Sheng, N Fedoroff, Liu Tung-sheng and G J Kukla and participation is invited. The other project for the 1995-1999 inter-congress period is "The structure and hydro-collapse properties of loess soils" organized by the CSRG at Nottingham Trent.

LITTLE HOUSE ON THE PRAIRIE



International Joint Field Meeting

INQUA
1928
International Union for Quaternary Research



Loess in Argentina: Temperate and Tropical

Paraná ARGENTINA
15-21 MAY, 1998

INQUA Loess Commission
Climates of the Past (CLIP)
Universidad Nacional de Entre Ríos (UNER)
Palaeoclimates of the Southern Hemisphere (PASH)

Universidad Nacional de Entre Rios

PASH

Organised by Dr. Martín Iriondo Mailing Address: C.C. 487, 3100 Paraná - ARGENTINA
Fax: 54-42-571226 e-mail: rniriond@arcride.edu.ar