EXPEDITION TO TIEN SHAN, CHINA

1988

LANCASHIRE
POLYTECHNIC

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Report by Jim Birchall

CHINA/TIEN SHAN/88

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CHINA/TIEN SHAN/88

We found no obvious evidence of Karst Caves in the Tien Shan, however, we have made arrangements with the Academia Sinica to mount a joint Sino-British Karst Expendition to the East Kun Lun Mountains in Xinjiang, China.

The Tien Shan China is about as big as Britain, we only got to explore a small section of it at the eastern end. We went as high as 15,000ft to Glacier Observation Post No. 1, and as low as -500ft in the Turfan depression. We camped in alpine forests, we stayed with Kazakh families in their Yurt tents, and we spent days on public transport.

Two cave areas previously identified to us proved to be superficial.

We had discussions with the Xinjiang Bureau of Geology, The Chinese Academy of Sciences (Academia Sinica), the Xinjiang Institute of Geology, the Xinjiang Institute of Geography, the Xinjian West Sci-Tech Exploration Company, all of which were very informative and helpful. We also met the China Xinjiang Mountaineering Association (CMA) who were very nice but completely unhelpful and suspicious.

We have negotiated an (unsigned) protocol agreement with the Academia Sinica to mount a joint expedition to the Altun Shan area of the eastern Kun Lun Mountains, the Altun National Park described as Alpine Guilin. This is a very restricted area and special permits are needed from the Environmental Protection Bureau.

This will be a very expensive expedition and we are now assessing the situation. A paper has been written for Caves and Caving. A copy of the Karst Map of China has been deposited with the BCRA Library.

There were no medical problems only mental frustration problems in dealing and negotiating with the Chinese.

Dr. Jim Birchall

In 1989 Mel Penn will re-visit Xinjiang, China, to re-negotiate the Protocol Agreement.

Jim Birchall, Keith and Diana Wright and Kieran Phelan will be in the Tien Shan Russia.

INTRODUCTION

Essentially this was a 'Blue skys caving trip'.

There was no direct evidence of caves in the Tien Shan. The associated evidence showed that to the south the great mountains of the Himalayan ranges have huge areas of limestone but poor cave development, but to the east the Russian Tien Shan mountain region was rapdily becoming a major caving region in its own right.

Lancashire Polytechnic has been developing links with China for some time now. In 1988 Professor He, President of the Beijing College of Business, came to Preston to sign a protocol agreement with Lancashire Polytechnic. As part of this protocol Professor He invited us to China and Beijing. Our colleagues looked after us in Beijing and made the eventual arrangement to fly us to Urumqi. But at that spot their help and influence stopped.

There was a letter of assistance between Mrs. Xu, Director of Foreign Affairs Office at the College an the Karst Institute at Guiling, this letter was produced and whisked away for translation but I never saw it again.

Surprisingly, all this started on a glacier in Norway. I had just come back from leading an Anglo/Belgium Berger Expedition that had been hit by massive flood conditions and had involved a 36 hour rescue of our Belgium caving colleagues who had been hit by a flood pulse when negotiating Aldos Shaft and sated with caving I was wondering what to do next. Eventually I came across a paragraph in a trekking magazine about the Crane cousins 'Journey to the Centre of the Earth' in China. This sounded really exciting for a caving trip, real Jules Vern stuff, but instead of Inceland it was in China, somewhere hot (glaciers really suck the heat out of you) and somewhere dry (no more flood

pulses) and along with the push from the Polytechnic to do something in China the omens appeared just too good.

On returning to England, I telephoned Richard Crane who told me he was coming to Lancaster to give his first lecture on their 'Journey to the Centre of the Earth'. I met Richard at this lecture and we had a discussion. The centre of the earth - the point on the earth's land mass that is furthest from the sea in any direction, was about 200 miles north of Urumqi in China in the middle of a flat gravelly desert, with no indication of caves whatsoever. So we started to look for the nearest possible caving area to Urumqi. This turned out to be the Tien Shan Mountain Range. Here the mystery deepened. It is remarkable how little is known about the Tien Shan Mountain Range. We talked to Tony Waltham, we corresponded with John Middleton, we consulted the Current Titles in Speleology Index, the Alpine Club Library, the British Geological Survey, the Expedition Advisory Centre, the Library and Map Room of the Royal Geographical Society, and a protracted search through the indexes at the Polytechnic Library. The more we searched the less we found. It was Andy Eavis who pointed out to me that not finding existing information on a target area was exciting in itself, and that most expeditions knew that there were caves where they were going, and that they would be concerned with cave exploring, or cave re-exploring, and that we would be concerned with cave hunting. He also thought that any caves in the Tien Shan would be hard won.

In early 1988 Jack Sheldon married Lauri May (the pin-up on the back of Caves and Caving for issues 39-42). A wealth of expedition caving expertise turned up at the wedding reception in the Bridge Hotel in Ingleton, and a sequence of caving expeditions

was planned, starting in 1988 when there would be a Red Rose Caving reconnaissance expedition to the Tien Shan in North West China, followed by a sequence of expeditions including a reconnaissance expedition to the Russian Tien Shan.

It all sounded very straightforward in the noisy glow of the wedding reception. But the sequence of events have not quite followed through. We have completed our reconnaissance of the Tien Shan in China and this is our report.

We have been invited to mount a joint Sino British Karst expedition to the Kun Lun Mountain Range in Xinjiang in 1989. However, we are unable to mount this expedition in 1989 but Mel Penn will be on a further reconnaissance expedition to the western end of the China Tien Shan and the Kun Lun Shan in 1989.

In early 1989 two caving colleagues visited the Academia Sinica in Urumqi and as part of their discussions, the Chinese have further identified some areas in the Tien Shan that are limestone, arid and not well developed because the water off the glaciers sinks into the limestone.

In 1989 we will be on a reconnaissance expedition to the Tien Shan in Russia. This came as a complete surprise as we had not intended, or expected, to visit Russia in 1989. The chain of events that started this off initiated with Bill Ruthven, secretary to the Mount Everest Foundation, who is really a lapsed potholer from Morecambe.

In presenting this report, we have quoted extensively from our sources of information in order to present a complete case to any future explorers of the area.

GENERAL NARRATIVE OF THE RECONNAISSANCE

The aim of this reconnaisance expedition was to see if there were any caves in the Tien Shan Mountain Range in north west China, and to make arrangements for a complete expedition in 1989.

We found no obvious evidence of karst caves in the Tien Shan, however, we made arrangements with the Academia Sinica to mount a joint Sino British Karst expedition to the East Kun Lun Aktag Mountains in Xinjiang.

In north west China to the north of Tibet lies the huge Xinjiang Uygur Autonomous Region. This is the fabled land of Eastern Turkestan, the Silk Road, and minority Chinese Uighur, Kazakh, and Mongols. To the north lies the Soviet Union, to the east lies Mongolia, to the south lies Tibet, and along the west lies Afghanistan, Parkistan and Kashmir, and in the middle lies Lop Nor the Chinese atomic weapons testing site. Overall, this makes for a large empty but sensitive area. The region is dominated by two huge deserts and two east to west mountain ranges, the Dzungarian desert and the Taklimakan desert, the Tien Shan mountain range and the Kun Lun mountain range.

For an area the size of mainland Europe it has one capital city, Urumqi, and one main single track railway line across the desert.

Part of the area was explored by a Sino Swedish Expedition in 1937. Chris Bonington passed through in 1980/81 during the Kongur Expedition. Nick and Richard Crane rode their bikes across it on their 'Journey to the Centre of the Earth' in 1985. Now tourists and trekkers have started to make their way along the northern branch of the Silk Road.

The Tien Shan is one of the largest mountain ranges in Asia

at 3,00 km long and up to 500 km wide. Half the Tien shan lies in Soviet Asia and half in China. It consists of several mountain ranges. In China it is highest in the west with Mount Tomur at 7,435 m and lowest in the east where it disappears under the Gobi desert.

We know very little about the Tien Shan China, the Underground Atlas says "caves and potholes are also recorded in the Tien Shan mountains of Xinjiang." However, we know a lot more about the western end of the Tien Shan in Russia.

This is one of the major caving regions of the Soviet Union. Here we have Guardakskaya (11,010m) Kap-Kutan-2 and Promezhutoch-Naya now connected into a single system 35 km long. On the Gissarsky range on a plateau at 3,500 m numerous 100 m shafts have been found. On the Zeravshansky range there is the 950 m deep Kievskaya. Near the town of Isfara is the 5 km long Kon-i-Gut cavern with great chambers up to 50 m high. The potential for the area is enourmous, but the terrain is very inhospitable, physical access is difficult, and political access for cavers is non-existant.

With all this in mind we headed for China, Beijing, Urumqi and the Tien Shan.

In Beijing we were the guests of Beijing Institute of Business who have a protocol agreement with Lancashire Polytechnic. In Beijing we scoured the Cartographic Publishing House, the Geological Publishing House, and the Geological Bookshop for books and maps. Here we obtained a Tectonic Map of China, a Karst Map of China, some Lansat photoprints of Xinjiang, and a copy of the new glossy book Karst in China.

Eventually we managed to negotiate our way onto an internal flight from Beijing to Urumqi (all our internal flights had been pre-booked by CAAC in their London Office but CAAC Beijing did not understand this).

In Urumqi we had several discussions with the Xinjiang Bureau of Geology, the Chinese Academy of Sciences (Academia Sinica), the Xinjiang Institute of Geography, the Xinjiang West Sci-Tech Exploration Company, a geographical expedition from the University of Nevada, and a geological expedition from Stanford University, all of which were very informative and helpful.

We also met the China Xinjiang Mountaineering Association (CMA) who were very nice but completely unhelpful and suspicious. They had a huge collection of detailed maps which we couldn't look at unless we had a permit from the CMA Beijing.

Negotiating public and private transport in Xinjiang is a head banging activity. The Tien Shan mountain range is about as big as Britain and we only managed to visit a small section at the eastern end.

We went as high as 4486 m to Glacier Observation Post No. 1 and as low as - 154 m to the Turfan depression. We camped in alpine forests, we stayed with Kazakh families in their Yurt tents, and we spent days on public transport.

Two cave areas near Urumqi had been identified for us by Professor Ziang. The first of these however proved to be loess mine workings and the second appeared as a splended 8 m by 8 m square entrance at the base of a cliff in a river gorge. Unfortunately, when we got down to it it was only 8 m deep and formed by the intersection of two vertical faults in the cliff face and washed out by the river during flood.

On our way down from the glacier we spotted a classic dry river side valley full of wierd erroded standstone rock with solution pockets but no caves.

Outside Urumqi we came across lorries dumping bog standard limestone chippings. We tried to find out where the limestone came from but didn't get anywhere - "it comes from the road" was all that they would tell us.

We made arrangements with one of our liaison guides for private transport from Urumqi to Yining, to Kuqa, to Korla and back to Urumqi. This would have taken us on a triangular circuit across several sections of the Tien Shan, stopping where we wanted to to have a look around. "No problem", he said "I will go and arrange it." (He was already arranging tour groups through the Tien Shan to Kashgar) but he disappeared and we never saw him again. We have now become resigned to the fact that our Chinese liaison guides seem to disappear when they cannot deliver the goods.

It was the Department of Remote Sensing at the Acadima Simica that drew our attention to the Altun Shan area of the Kun Lun mountains and made the suggestion that we form a Sino-British joint expedition to the area.

The area lies in the south east corner of Xinjiang on the edge of the Tibetan plateau. It takes 5 days in a jeep convoy from Urumqi across the Taklimakan desert skirting Lop Nor and leading into the mountains.

According to the Chinese the Altun National Park covers 45,000 square kilometers and encompasses six 6,000 metre peaks. The southern half of this area is described as alpine Guilin and features a karst landscape with karst caves and queer rock formations.

After several meetings at the Acadima Simica a protocol agreement to mount a Sino British Joint Expedition in East Kun Lun Aktag Mountain Xinjiang was drawn up. The protocol has not yet been signed as we need more time to appraise the expedition and raise the necessary funding. Also we need to research out more information on the area. As usual the Chinese are incredibly cagey about maps of the area although we briefly saw some. An American geological expedition recently went through the area on their way to the Ulugh Muztag and we need to discuss what they found with them.

We have since found a two page spread on the area at Karst in China with photographs and a geological section diagram.

In our dealings with the Chinese we got mixed up with the Aletai Shan (in the northern tip of Xinjiang) and the Altun Shan and Aktag Shan (both on the southern edge of Xinjiang).

In our last meeting with Dr. Gao from the Xinjiang Bureau of Geology he draw a large circle on one of our maps of an area the size of Wales just north of Kuqa - Aksu and said that this was a big devonian carboniferious karst area but he didn't know much about it.

In fact this was an area that we had already identified as being interesting from our karst maps and the Sino-Swedish expedition reports. It was part of our itinerary that just disappeared along with our liaison guide.

As we prepared to leave Urumqi one of our escorts Cao Yuajia showed us some photographs of big stalls in limestone caves from near his home town in the Qin Ling Mountains near Xian and drew us a map of the area.

Towards the end we made an attempt to get into the Kashgar area at the western end of the Tian Shan, but this area had started to close down. Long distance buses were being turned back and non Chinese visitors were being collected at the airport and flown out.

When the main group had left Urumqi for home Randy Allsop decided to take off and have a look at Tibet but he was turned away at the border so he headed off to have a look at the Yangtzi River gorges where they cut through high limestone plateaux. He said it was just like the area around the Berger.

Jim Birchall and Tony Cottom decided to return to Beijing and venture south to have a look at the Tai-Hang Shan which is described as a limestone plateau cut by deep gorges with many caves and springs. Unfortunately, after four days on a train across China things started to go wrong in Beijing and we didn't get to reconnoitre the Tai-Hang Shan.

In Beijing we found out that Tony had misplaced his return air ticket and his customs declaration form and his money exchange certificates. We tried for five days to get him out. CAAC Beijing wanted to charge him £1,100 to get him out. We tried everything, even our Chinese hosts were aghast at the treatment that he was getting from CAAC. Two hours before his flight left Beijing we ended up in the posh office of a senior CAAC official above the airport in Beijing - she just laughed herself silly over our flight difficulties. So we had to leave Tony behind in Beijing. We returned to England and sorted the situation out and sent Tony a ticket by international courier (postal strike remember) and Tony eventually got to Preston a week later.

Overall we found the Chinese were very nice and trying to be helpful, but we never got used to the city Chinese gobbing all over the place and blowing their noses on the restaurant curtains.

On reflection it was an incredible experience and another group of cavers now have some experience of dealing with the Chinese and intend going back to China.

We still have an intriguing interest in Tien Shan Russia but that could be very long term. We have the Kun Lun Karst Expedition to organise. There is that very large karst area north of Aksu to investigate. We now have an interest in the area south of Xian, and we never did get a look at the Tai-Hang Shan.

A copy of the Karst Map of China has been deposited with the BCRA library along with our official report.

The team consisted of Jim Birchall and Randy Allsopp for 8 weeks, Tony Cottom for 7 weeks, Peter Muckalt, Keith and Diana Wright, Kieran Phelan and Melvin Penn for 4 weeks.

The expedition was suported by the Sports Council/NCA and the Ghar Parau Foundation, and approved by the Mount Everest Foundation and the British Mountaineering Council.

GEOLOGY OF THE TIEN SHAN

The geology of the Tien-Shan, the Tarim Basin, the Kun-Lun Range, the High Tibetan Plateau, and the Pamirs are described by Gansser as:-

Tien-Shan

North and east of the Pamirs, we find one of the largest mountain ranges of Asia in the Tien-Shan, 3000 km long and up to 600 km wide. In the east a system of parallel, low, and relic ranges disappears in the Gobi Desert. But west of Urumchi the Tien-Shan has its full height with deep contrasting despressions; a contrast such as that between the 6500 m high Bogdo Ola Range and the 700 km long Tien-Shan graben with more than 200 m below sea level (Turfan). The old Tarim mass causes the northwards bulge of the Tien-Shan and the narrowing of the middle part of the range. Here we have the highest elevation, the 7200 m high Khan Tengri. North of the Pamir nucleus, the southwestern Tien-Shan continues in the Alai Range and further west the ranges, so far parallel, spred out. Here we note the striking contrast of the structural alignments east and west of the Pamir centre, i.e. the eastern parallel ranges and the western pronounced virgations. As a westernmost continuation of the Alai, the Karatau trends towards the southern-most Ural chain. Southwards from the Alai-Karatau, successive ranges branch off and turn through west into a southwards trend. This fact is particularly well expressed in the Fergana depression, a classic area for sheaf ranges.

The structural backbone of the Tien-Shan is old, and to a large extent probably Precambrian. Above the Precambrian metamorphics, tillites orginating from late Precambrian or early Cambrian glaciation of the Tarim Basin are widespread in the

southeastern Tien-Shan. The marine transgression begins with the Upper Cambrian and Silurian. Marine Devonian and Carboniferous reflect epeirogenic movements with local overlaps but show no sign of real orogenic phases. With the Upper Carboniferous and Permian a general regression sets in, leading to the widespread continental Angara deposits with their world-famous development of reptiles in the Permo-Triassic. Continental deposits with evaporitic intercalations reach into the Upper Cretaceous, and in some areas include the Tertiaries. In the eastern Tien-Shan important late Jurassic orogenies are followed by transgressive Cretaceous. Marine Cretaceous transgressions begin also in the western Tien-Shan in the Fergana Valley and continue eastwards, along the southern Tien-Shan border, where they gradually become younger. Thrusts of alpine age are reported, but otherwise the Alpine phase affected the Tien-Shan mostly as morphogenetic disturbances of great magnitude, and led to the present elevations and consequent glaciation. How far the Alpine orogenies of the southern Tien-Shan have actually affected the main range is difficult to decide. The Tien-Shan graven, not unlike the Rocky Mountain trench, divides the southern, intensely folded and more netamorphic Tien-Shan with granite intrusions, from the more monotonous northern Tien-Shan with its thick deposits of Middle Palaeozoic rocks.

Precambrian orogenies are responsible to a great extent for the structures of the present Tien-Shan and subsequent disturbances, mostly epeirogenic, are aligned on the old structural trends.

Tarim Basin

East of the Pamirs, the Tien-Shan borders against the Tarim Basin with a sharp thrust contact. This depressed basin is an old stable mass which has been little altered during the geological history of Central Asia, but has played an important role in the alignment of the surrounding mountain ranges. Just as in the southern Tien-Shan, a Precambrian crystalline basement is transgressed by little-disturbed and surpringly little-metamorphosed late Precambrian sediments, partly of glacial origin with thick varval deposits. They have been unconformably overlain by marine Upper Cambrian. From the Carboniferous to the present day the Tarim Basin has been subsiding, and was filled with the out-wash of the Angara continent, and then by Hanhai and Quaternary deposits. Under recent gravels and sands are extensive lagunal clays, suggesting large Quaternary lakes.

Kun-Lun Range

South of the Tarim Basin, and forming the north border of the Tibetan high pleateu, follows the Kun-Lun Range. It is connected to the Pamirs by the Mustagh-Ata Range, striking NNW. It merges into the Alai ranges north of the Pamirs and closes the Tarim Basin towards the west. This northerly strike direction seems still a reflection of the western Himalayan syntaxis which causes the northwards bulge of the Pamir ranges. Eastwards the Kun-Lun divides into a northern branch, the Astin-Dagh, which continues into the Nan-Shan and ends before reaching the Kuku-Nor, and the southern Kun-Lun on the opposite side of the Tsaidam Basim.

Up to the Angara regression, with Jurassic coals and plant remains, the geological history of the Kun-Lun is not unlike that of the Tien-Shan, although the presence of ultrabasic rocks may

indicate a more deep-seated orogeny. The fact that the Kun-Lun forms an important divide between the Angara sedimentation in the north and a corresponding marine influence in the south (Tibet) may also indicate a more orogenic belt. During the Precambrian there must have been several important orogenies; some disturbances followed in pre-Devonian times and a marked orogeny at the end of the Angara sedimentation took place prior to the Cretaceous transgression.

The northeastern branch of the Kun-Lun, the Astin-Dagh and Nan-Shan, has more a block mountain range character, and differs from the main structural style of the Kun-Lun. Young Tertiary sediments, mostly fine clastics up to 4000 m thick, are intercalated between the block-like remnants of the older range. The Tsaidam Basin to the south is geologically very similar to the Tarim Basin. The division between the Astin-Dagh and Nan-Shan is young and the uplift of the impressive horsts and blocks of these ranges occurred in the Mio-Pliocene. At the same time the subsiding Tsaidam Basin was filled with young sediments and only in the Plio-Pleistocene was the basin uplifted to its average height of 3000 m.

The Pamirs

From north to south we can distinguish a northern sedimentary belt, a central crystalline belt, a southern sedimentary zone, and the southern crystalline belt in the Karakorum. Alpine orogenies become increasingly manifest in the Pamirs from the north to the south, the structural alignment remaining roughly constant throughout. The subdivisions into the above mentioned belts, however, oversimplify the geological aspects of the Pamirs. Being actually a Scharung of various large mountain ranges, the structures are generally much more complex.

No sharp boundary can be traced between the Alai Range, which is the western continuation of the Tien-Shan, and the northern Pamirs. The thrust zone of Kashgar (south of the western Tien-Shan) continues westwards but the sedimentary zone marine sediments replace most of the Angara beds and a continental influence is seen only in the Lower Cretaceous. The predominantly Jurassic Pamir limestones are widely distributed. Upper Cretaceous deposits are again marine and transgressive, similar to the main transgression in the Fergana depression. The intermediate crystalline (the central crystalline belt) is steeply folded and is thrust northwards over the sedimentary zone. Thrusting is Alpine, but the folding of the crystalline is reported to be Hercynian, though it may, in accordance with other regional observations, belong to a much older phase. The widespread assumption of Hercynian activity must be carefully analysed. Along the southern border the thrusts are south directed and dip steeply to the north. In the central part of the middle crystalline belt some north-south-directed fault zones occur, and may be related to the general culmination. The Fedtshenco Glacier follows one of these fault zones, its 77 km length making it the world's largest extrapolar ice-stream.

Westwards the Pamir Scharung opens out into a broad virgation. As already mentioned this is in strong contrast to the eastern ranges with their parallel structures. We have already noted how the western extension of the Tien-Shan-Alai virgates in the Fergana region by forming westward and southward diverging branches from the Karatau. In the western extension of the northern Pamir-Alai ranges the Fergana-type structure is repeated in a surprisingly similar way, the vigation extending into

northern Afghanistan. The predominantly sedimentary zones cross the Oxus River (Amu Darya) between its northern bulge at Badakshan in the east and Termez in the west in separate, well-outlined ranges, while the crystalline zones enter northernmost Badakshan. These ranges strike and abut with a steep angle, against the Hindu-Kush, the western continuation of the Karakorum.

KARST IN THE TIEN SHAN

We found no detailed information of Karst in the Chinese Tien Shan.

Karst in China devotes four pages to Karst in Xinjiang including the Tien Shan. The U.S.S.R. Tien Shan is described by Herak and Stringfield as:-

The Orogenic Belt of the Eastern Part of Central Asia, with a Folded Palaeozoic Basement.

Here we find the Tarbagatay Range and the Dzhungarsk Alatau Mountain system, with Hercynian folds: the Tyan'-Shan', with Caledonian and Hercynian folding in the northern part and the Hercynian structural stage in the southern and the northern part of the Pamir-Alaya-Gissaro-Alaysk Mountain system, with Hercynian structures.

Karst phenomena are known to have formed in Palaeozoic limestones in the Tarbagatay Range. The presence of karst is assumed, though seeminly in rather restricted degree, in the Dzhungarsk Alatau system, which has been distinguished as a special region in regionalization of the karst of central Asia. Karst in the Tyan'-Shan' and in the northern chains of the Pamirs and Alaya is much more widespread and better studied. Here the karst regions of the Karatau, of the western Tyan'-Shan', of the inner and central Tyan'-Shan', of the Hercynian chains of the Pamirs and Alaya, and elsehwere have been distinguished.

A distinctive central Asiatic variant of denuded limestone karst is characteristic of the low-mountain desert regions of the Tyan'-Shan' and of the northern chains of the Pamirs and Alaya. It has formed in Palaeozoic rocks, with karren which have been destroyed by physical weathering, caverns, and numerous niches in

canyon walls, but with slight development of sinkholes and other closed surficial karst forms. But in regions of mountains of intermediate height which receive greater precipitation, sinkholes appear in the limestones; while in the high parts of these mountains the pitted karst topography sometimes takes on an unusually typical expression, as, for example, in the Kyrktau Plateau at the western tip of the Zeravshansk Range. In some regions karst wells and shafts occur in Palaeozoic limestones.

Karst phenomena are strongly developed in Upper Devonian and Lower Carboniferous limestones and dolomites in the Karatau Range. There are caverns, the larger of which were formed owing to sulphuric acid, or the so-called "ore" karst and abundant sinkholes, niches, and karren. The edges and overhangs of the karren are often separated from the main limestone and dolomite slabs as a result of intense physical weathering under the sharply continental climate. Just such crumbling karren fields are characteristic of the central Asiatic variant of denuded karst. There are siphon springs of karst origin in the Karatau.

The role of calcareous rocks in the ranges of the western Tyan'-Shan' region in important. For example, flat divides of part of the Ugamsk Range, with abundant sinkholes and "blind" valleys (closed at the lower end) are formed in Palaeozoic limestones. Limestones form the foremost, moderately high range of the Kazy-Kyrt (in the southern Chimkentsk region), in which karst features are also widespread. The narrow and deep gorge of the lower course of the Ugam River, through which the Ugam flows into the Chirchik River, is in limestones. The carbonate karst of the Chirchik Valley receives special notice because the Charvaksk dam and hydro-electric station were built here, near Khodzhikent.

Various solutional features in the limestones (cave passanges, niches, etc.) can also be seen at Khodzhikent.

However, karst in the western Tien Shan in Russia.

The karst of the north slope or the Tersk-Alatau Range belongs to the northern Tyan'-Shan' region. At the natural boundary of the Uch-Kashk, between the upper reaches of the Kyr-Kyr and Tyup rivers, sinkholes and karst wells formed by collapse have been described which are at an altitude of 3,000 - 3,200 m. There is a small karst cavern in the Palaeozoic limestones of the gorge of the Chon-Kyzylsu River.

Surficial features due to solution - niches in limestone cliffs, and other karst phenomena - are rather widespread in the interior and central Tyan'-Shan'. In pre-revolutionary time the reports of the mining engineer K.I. Argentov described periodic karst lakes with communicating subsurface channels - swallow holes - in Kyl'su Canyon (in the Kokkiy River Basin); the karst springs at Kiryuk-Bulak, in limestones of the north slope of the Atbashi Range and Bogoshta Pass; canyons in Lower Carboniferous limestones with caverns, grottoes, niches, and various weathering features in the vicinity of Sonkel' Lake and the Narynsk Range and the Aksaya Basin (Tekelik River canyon). Observed niches and carvern openings in Paleozoic limestones of the interior Tyan'-Shan' in the Naryn River Valley above the city of Naryn; in the canyon along the route from Kochkorka to Naryn, south of Dolon Pass; and in the central Tyan'-Shan', in the Sary-Chat River Valley. A.P. Gorbunov explored a cavern in the Sarydzhaz River Valley above the mouth of the Ottuk River, on the south slope of the Tersk-Alatau Range. Numerous sinkholes along the Naryn river below the mouth of the Alabug, in the interior of the Tyan'-Shan',

and farther south south in the southwest part of the inner Tyan'-Shan', have been formed by solution of lenses of rock salt in Tertiary deposits.

D.L. Armand examined a cavern with large calcite crystals, opened in Devonian limestones in the northern part of the Fergansk Range, in the Baubashat Massif.

Caverns with large calcite crystals are known also in the Pamir-Alaya Mountain system, as, for example, in Upper Silurian limestones in the headwater region of the Magian River, a left tributary of the Zeravshan River. These are not ordinary karst caverns, but were opened up by hydrothermal solutions circulating through tectonic fractures.

In Palaeozoic limestones in the foremost chains and massifs of the Alaya Range (in southeast Fergana), as in the Zeravshan Basin and in the Fergansk Range, there are caverns and cavities of the vertical-channel type whose walls are coated with crusts of large crystals of calcite and of barite. The Bol'shoy Baritovoy Cavern, near the Aravan River, is indeed a wonderful natural phenomenon. The Chil'-Ustunsk Cavern, which is of considerable dimensions and has stalagtitic columns, stalactites, and stalagmites, is of particular interest among the numerous caverns situated near the Oshskikh Mountains. These caverns contain varite, as well as the stalactitic crusts of calcite.

In general the caverns of southern Fergana are of considerable interest mineralogically. Celestite (strontium sulphate) and other minerals are found in them, as well as calcite and barite. The strontium caverns of Lyakan (between Sokh and Isfara) walls are covered with crusts of celestite.

Karst in the Aravan River region has developed in several stages. The dissected topography of pre-Pliocene time was covered almost completely by the sequence of continental deposits, $N_2 + Q_1$ ($Neogene_2$ + $Quaternary_1$, or Pliocene and Lower Quaternary). Formation of the present day topography began with uplift of the region. Burial of ancient limestone ridges beneath the $N_2 + Q_1$ deposits was governed by the degree of prior incision and widening of the valleys. Some karst cavities (caverns, natural shafts) were already being formed before burial of the ancient topography by the $N_2 + Q_1$ deposits, this is shown by traces of their fillings. Some of the cavities were formed during early stages of development of the modern topography (that is, at the beginning of uplift and dissection of the initial surface). The Dikobraz Carvern, west of the Tange gorge not far from the Bol'shoy Baritovoy Cavern, is an example. Youthful karzst forms of the present stage and of the preceiding stage are related to the present topography, which had already formed, and to the rims of youthful epigenetic gorges. The large number of small niche-caves in the edges of gorges and canyons is very typical fo the karst in this region. The original conducits of earlier channels of the Aravan, situated not far below the channel at various levels, are also youthful karst forms.

The Akburinsk karst region, east of the Aravan karst region, has a history of similar topographic development. Karst features are also widespread to the west, in the advance ranges and massifs of the Alaya and Turkestan ranges. Caverns, to say nothing of shallow niches, occur almost everywhere - in Abshirsa, in Shakhimardan, in the Khaydarkan and Sokh regions, down to the boundary of Shadymir, west of Isfara, where the Kan-i-Gut Cavern

is situated. In all parts of the southern mountain framework of the Fergana Valley, from Akbura and Aravan and farther west, solution has played a large role in development of limestone canyons along tectonic fractures. There are vauclusian springs (karst springs, of large flow, whose discharge does not cease during low-water periods) in Abshir-Bulak, in the Abshirsa Canyon, and elsewhere. Surface forms which may be related to the sinkholes are very exceptional. The surfaces of the limestone ranges are bare and rocky. They are distinctive karren areas with corroded blocks and fragments separaged from the main massif by weathering.

Bare corroded limestone crags are also characteristic of the locality where the celebrated Kan-i-Gut Cavern ("the mine of disappearance", or "the mine of death") occurs. This cavern, which is related to the so-called "ore karst" is distinguished for the grandiose nature of its rooms, which reach heights of 40-50 m.

The Kyrktau Plateau, in the Chakyl-Kalyan Mountains in the western part of the Zeravshansk Range, is distinguished by very strongly developed karst which is forming in Devonian and Silurian limestones. The Kyrktau Plateau, with numerous surface forms - sinkholmes, basins, half-disintegrated and disintegrated karren, with chains of sinks in hollows near the ride on the north slope - is a continental analogue of the yaila (a monoclinal and folding limestone) in the mountainous part of the Crimea. To the west, nearer the pass of Takhtakarach, in the headwaters region of the Bul'bul'zarsa and Maydansa, there are also large sinkholes, while on the plateau-like ridge there are destroyed karren fields. One sinkhole passes with depth into a natural shaft with a total depth of 81 m (in the Aravan region there is an even deeper shaft, which

is more than 140 m deep). The grotto of Amankutan, nearby in this same region, is famous as a Palaeolithic camping place. The well-known Kattaopa and Yettykyz caverns are in the southern spurs of the western part of the Zeravshansk Range.

West of Takhtakarach Pass, in the Karatyube Massif, is the original Amir-Temir Cavern which was formed through solution of limestone beds that lie between granites. The cave is an opening in the granite, and only remnants of the limestone strata show its karst origin.

There are also relict features of tropical karst in the northern ranges of the Pamirs and the Alaya. Rocky limestone remnants near the city of Osh, and also limestone summits at Taldyk Pass in the Alaysk Range at an altitude greater than 4,500 m, are such relicts, On the Iskanderdar'ye River, near Lake Iskanderkul', there are groups of limestone outliers.

Karst features in the folded Palaeozoic rocks of the Tyan'-Shan' and the northern ranges of the Pamirs and the Alaya are limited to Mesozoic and Cenozoic rocks deformed during Alpine tectonic movements of the Palaeozoic fold basement. Such, for example, are karst forms in synclinal plateaus in the western foothills of the southern tip of the Fergana Range (where it joins the Alaysk Range), in the Tarana Basin on the divide between the Laysu and Buyg rivers.

Movements along faults in the Paleozoic folded basement explain the origin of folds in the Mesozoic-Cenozoic cover of the southwestern tip of the Gissarsk Range which are related to the epi-Hercynian platform. In the Shurobsaya Basin region, in the southwestern spurs of the Gissarsk Range, the karst has formed principally in Upper Jurassic rocks; limestones are weaky

karstified, and gypsum strongly so. There are caverns, sinkhols (some grouped in chains), karst wells, basins, disappearing streams, and streams in caverns. A large cavern, opened in Upper Jurassic limestones in the Baysuntau Mountains near the village of Machaya, is of interest for its fossils. Karst in the region of the Kugitangtau Range is restricted to Jurassic and Cretaceous sequences containing limestones, gypsum, and rock salt. The Karlyuksk Cavern is about 3 km in total length. The karst of all these regions, in terms of the lithologic, tectonic, and even climatic conditions of its development, closely resembles the eastern part of the Alpine folded zone of the U.S.S.R.

USSR - TIEN SHAN

The Underground Atlas describes the USSR - Tien Shan as:-

The major district of all Soviet Asia is that found within the great Tien Shan mountain range.

The Tien Shan is a mountain region of several major ranges each several hundred kilometres in length. To the south lie those of the Gissarsky, Zeravshansky, Turkestansky, Alajsky and Fergansky; to the north are the Chatkalsky, Kuramisky, Ugamsky and others. Many of the major peaks reach 5,000 m or more, most of the others exceed 3,5000 m. There are vast areas of both limestone and gypsum karst, but the generally inhospitable nature of the terrain, and its distance from habitation, has precluded speleological investigations until very recent times. The resulting achievements prove that the region has the potential to become one of the world's greatest caving areas.

At the south-western end of the southern Tien Shan is the Kugitangtau range. Within this is some fine karst, where many beautifully decorated systems have been explored, including Guardakskaya (11,010 m), Kap-Kutan-2 and Promezhutochnaya, now connected into a single system 35 km long. To the east, on the Bajsuntau mountains of the Gissarsky range, exploration on a plateau at an altitude of 3,500 m has revealed the 565 m-deep Uraliskaya, numberous shafts exceeding 100 m and a resurgence some 1,800 m lower down. At the western end of the Zeravshansky range lies the renowned Kirktau plateau, noted for its great fields of lapies, its many shafts and the 964 m-deep system of Kievskaya. All the other ranges of the south contain great karst massifs, with featues ranging from vauclausian springs, canyons and caves to sinkholes, lapies and deep shafts. On the Alajsky range, by

the town of Isfara, is the 5 km-long Kon-i-Gut cavern with its many great chambers up to 50 m in height. Nearby are the mineralogically spectacular caves of Lyakan with their extensive encrustations of barite and celestite. In the south a series of small but interesting crags, close to the city of Osh, are limestone bastions which are considered the last remnants of a once extensive tropical karst.

While still extensive, karst does not seem to have formed to the same degree in the northern ranges of the Tien Shan, and no really major cave systems have yet been found. The Karzhantau massif has the 260 m-deep Uluchurskaya, and just to the north, on the Boroldatjau plateau, many shafts over

To the south of the Tien Shan are the Pamirs. Volcanic and metamorphic rocks predominate but there are areas of both gypsum and limestone in which karst features have been noted. Few cave investigations have been made to date, but in one gypsum cave a height of +126 m from the entrance has been reached.

ON MAPS

In general we used a 1:9,000,000 Tourist Map of China, and in detail we used 1:1,000,000 Operational Navigation Charts.

In trying to understand the 1:1,000,000 ONC maps of the Tien Shan we had to compare them with the 1:1,000,000 ONC map of the British Isles (and part of Europe).

There is so little detail in the Tien Shan that the scale is very deceiving - eventually we blocked in the three peaks area in the Yorkshire Dales on a scale of 1:1,,000,000 as this was an area we knew in detail and then we could make graphic comparisons.

We also looked at the 1986 RGS/MEF - The Mountains of Central Asia at a scale of 1:3,000,000, on this map the Tien Shan is at the very top of the sheet. Also the Urumqi Korla railway line is missing from this map (its there because we travelled on it for 18 hours through the Tien Shan Mountains, tunnels and viaducts).

Geologically we used the Karst Map of China and the Tectonic Map of China on a 1:4,000,000 scale, but they had to be read in conjunction with the 1:4,000,000 general map of China.

CONCLUSIONS

No direct evidence of karst caves in the Tien Shan was found.

Several areas in the Tien Shan which have karst, cave, and sinking river phenomena have been identified.

Long drawn out arrangements with the Xingjiang Academia Sinica to explore these areas are being negotiated.

A protocol agreement with the Academia Sinica to mount a joint expedition to the Kun Lun Mountains (karst area) is being negotiated in great detail.

In 1989 Mel Penn will return to Urumqi to negotiate further details and make a further reconnaisance of the Tien Shan.

In 1989 we have been invited to the edge of the Russian Tien Shan.

APPENDICES

Expedition Members

Acknowledgements

Additional Notes

References

Maps and Map Details

EXPEDITION MEMBERS

Dr. Jim Birchall

Randy Allsopp

Tony Cottom

Peter Muckalt

Melvin Penn

Kieran Phelan

Diana Wright

Keith Wright

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Mrs. P.E. Johnson, Librarian, Alpine Club Library.

W.H. Ruthven, Hon. Secretary, Mount Everest Foundation.

John Middleton.

Tony Waltham.

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China National Tourist Office, London.

Pan Lin, Lecturer, Beijing Institute of Commerce, Faculty of Accounting, Beijing, China, on secondment to Lancashire Polytechnic.

Joan Chibnall, Map Curator, Geography Library, Sheffield University.

Mrs. J. Parker, Fell and Rock Club Librarian.

Dave Gill.

China/Beijing

Beijing Institute of Business
11 Fu-Cheng Road
Beijing

Prof. He Minglun, President,

Xu Xue Lu, Dean of Faculty of Economic Law

Pan Zhong Gui, Director of the Department of Marxism and Lennist Studiest.

Xu Rui Hong, Vice Director, Office of Foreign Affairs.

Li Chun (Lecturer/Interpreter)

Zhang Xiang (Youth Organiser)

Jai Sheng Uyan (Escort/Interpreter - known as Rosemary)

Li Xin (Driver)

Ron Crisp on secondment from Lancashire Polytechnic.

John Coates on secondment from Lancashire Polytechnic.

Joyce Sanderson, British Scholar, from Lancashire Polytechnic.

China/Urumqi

Academia Sinica
Beijing Road,
Urumqi

The Academia Sinica is divided into two main institutes, the Institute of Geography, and the Institute of Biology, Pedology and Desert.

Institute of Geography of Academia Sinia
Urumqi, Xinjiang

Wang Shuji - Director Xinjiang Institute of Geography.

Prof. Hang De-ling - Head of Department - speaks no English.

Dr. Lian Kuang Ui - Department of Remote Sensing

Dr. Cheng Yaning, Field worker.

Zhang Jiebing, Postgraduate student, interpretor liaison guide.

Abbas-Borhan
President of Xinjiang Association for Science and Technology.

Adiljan-Ahmet
Director, Foreign Affairs Office of Urumqi Municipal Government
Xinjiang Uygur Autonomous Region

Wes and Chris Friberg
Foreign Languages Department
Xinjiang University
Urumqi

Cao Yuanjia - (interpretor/guide)
The middle school of the Fifth Construction Company, Urumqi.

Harry Cao Aiquo
Xinjiang Engineering Institute

Wang Wenting
Vice-General Secretary & Vice Manager
China Xinjiang Mountaineering Association,
China Xinjiang Sports Travel Service
Nan Mon Gymnasium Urumqi

Zhang Jianing
Tourist Group Guide, Kun Lun Hotel

San Stiver, University of Nevada
Debra K. Stiver, University of Nevada.

Alan Carrol, Stanford University
Stephen Graham, Stanford University

Dr. Gao Zhenjia
Xinjiang Bureau of Geology and Mineral Resources

Louise Middleton, Xinjiang University
Eric Dillingham, Xinjiang University

David Harpham - New Zealand caver

Dean Crowell

China/General

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Lo Chung Hing, Deputy General Manager, Bank of China, Hong Kong Branch.

Koji Asada, Osaka, Japan

Ying Chi-Rui, Vice President Shenzhen University

ADDITIONAL NOTES

1. In dealing with the Chinese it should be remembered that there is a Chinese way of doing things and nothing should be counted upon, nothing should be relied upon, their understanding is vastly different than ours. They do not mean to be offensive but you must get used to "Mao" meaning no or not permitted - without an explanation of why, or of things not happening - without an explanation of why. A 50% success rate was regarded as winning, i.e. if you went to try and get four railway tickets and ended up only getting two railway tickets, then you were winning. Eventually we called this the Chinese slow step - one step forward followed by two steps backwards.

2. Beware of the Chinese giving you a bill at the very last minute for anything that you thought you were getting in friendship.

3. Searching for information on the Tien Shan was akin to a Sherlock Holmes investigation. We looked under T for Tien Shan, and C for China, or P for Peoples' Republic of China, followed by R for Russia, S for Soviet Union, and U for U.S.S.R., when most of the information came under A for Asia.

4. During our search for information for the Tien Shan we came across several variations of the spelling as Tian Shan, Tien Shan, Tianshan, Tyan 'Shan, T'ien Shan, Tien Scian. The area itself is also recorded under Turkestan or Turkistan, or even Eastern Turkestan.

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MAPS AND MAP DETAILS

Map of Soluble Rock Types in China, Cartographic Publishing House, Beijing, 1985, Scale 1:4,000,000.

Operational Navigation Chart ONC E-1 (British Isles), Scale 1:1,000,000.

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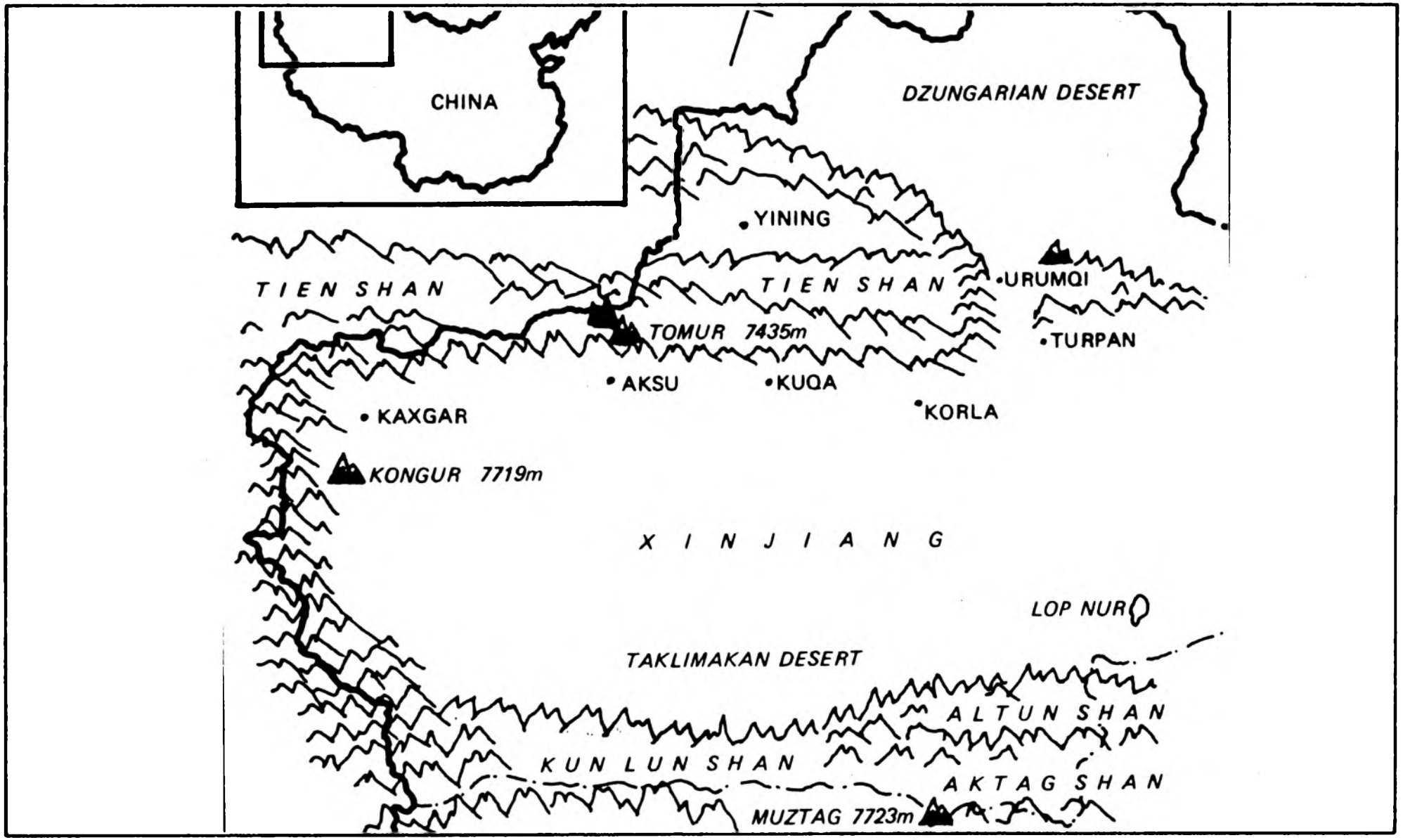
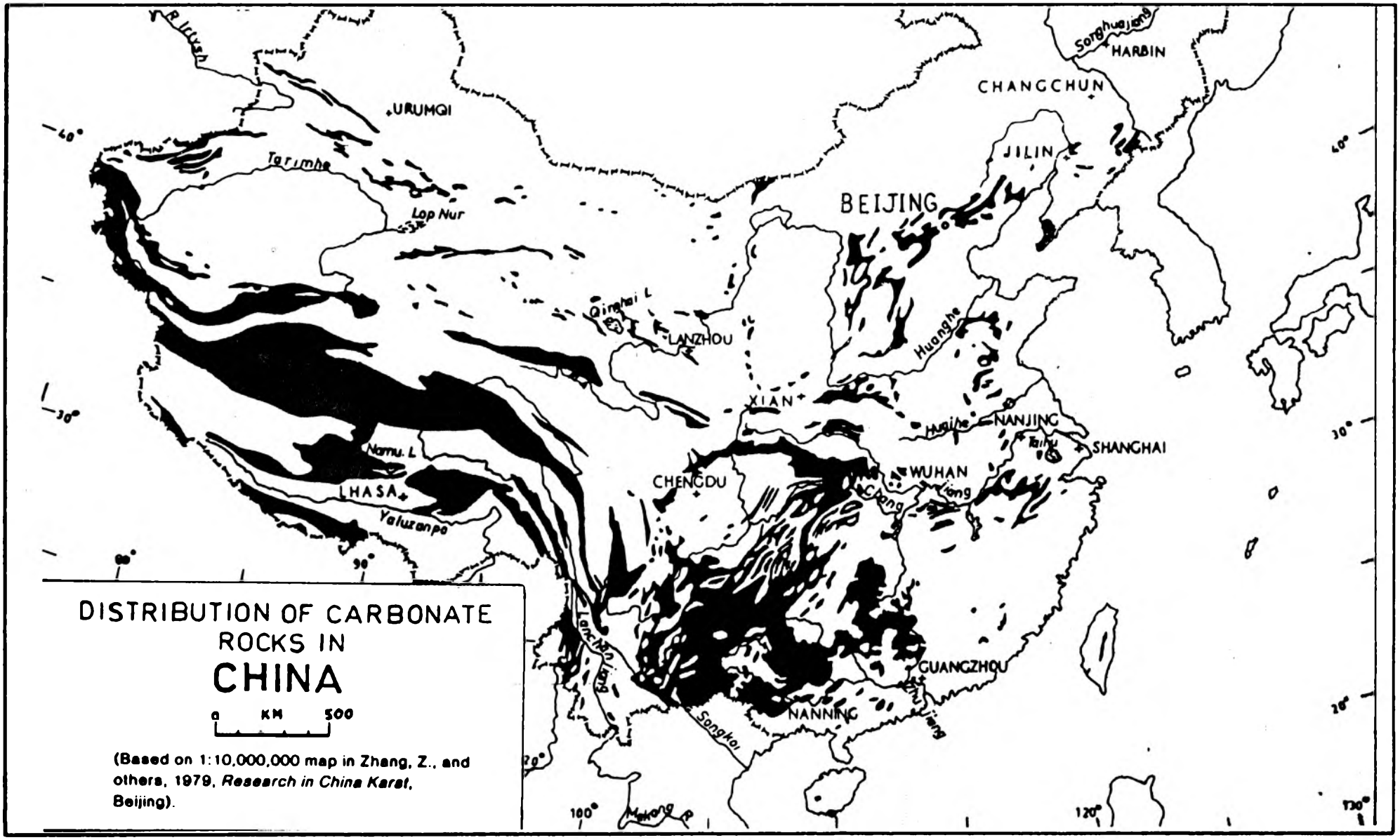
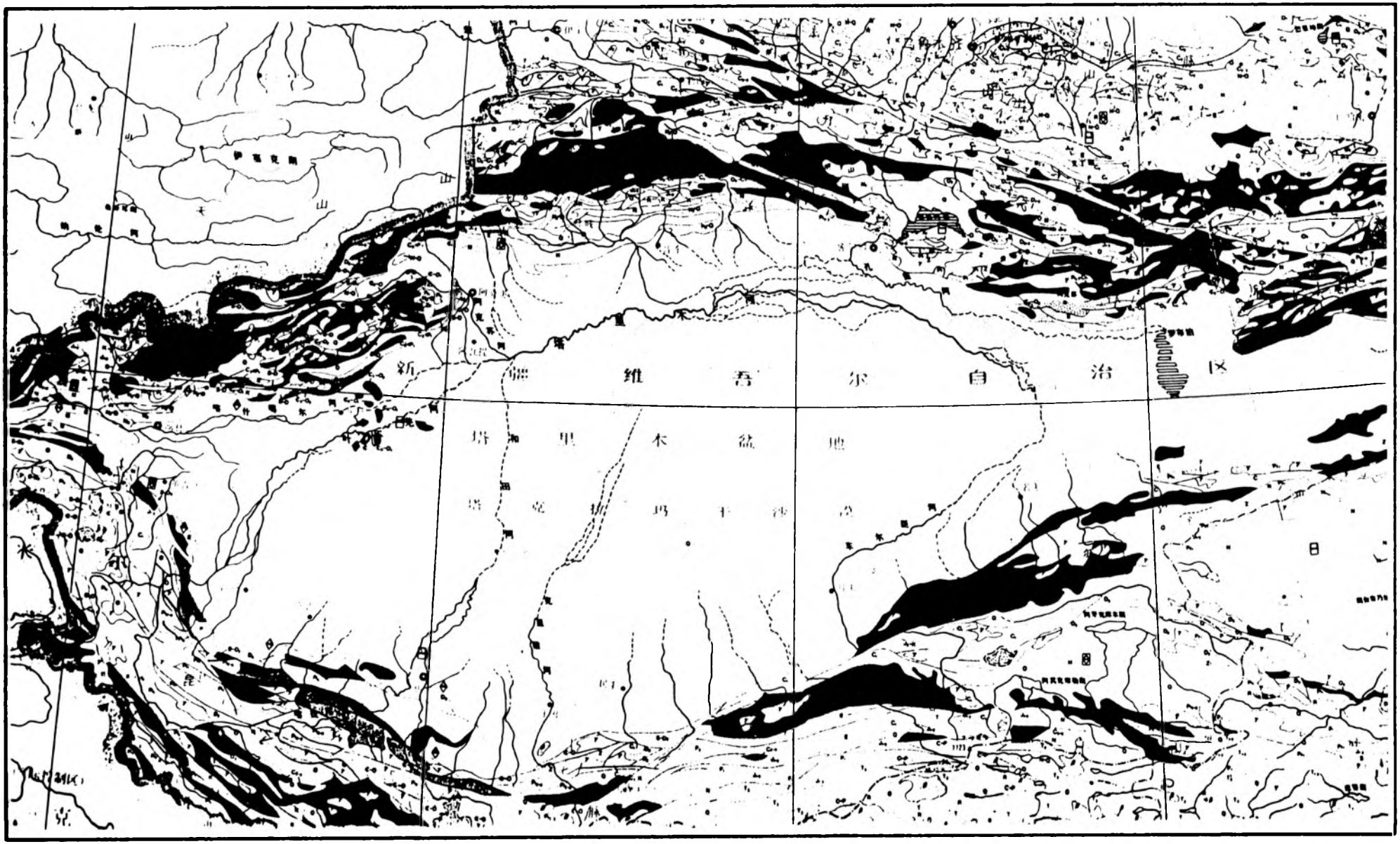
General location map of Xinjiang.



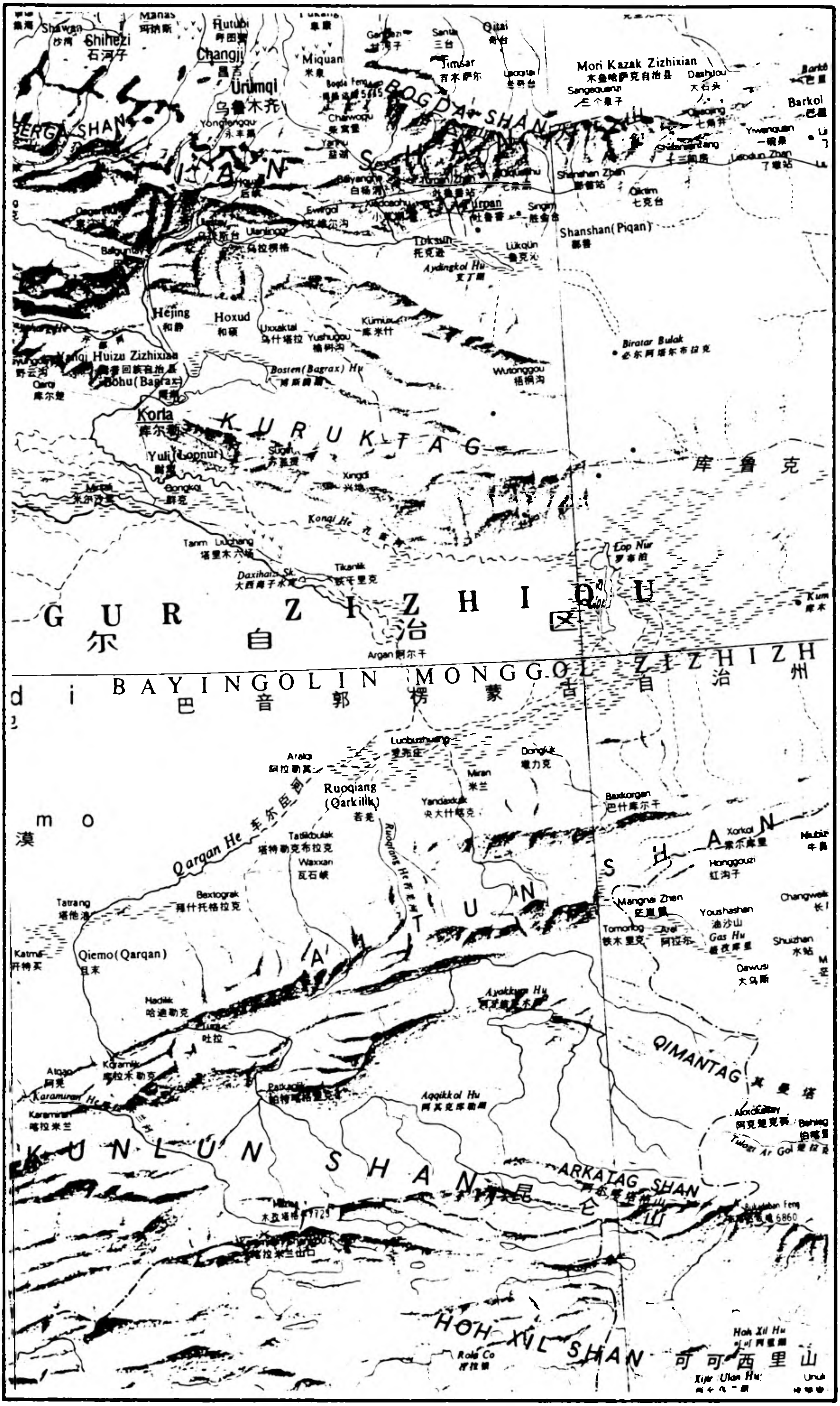
Distribution of Carbonate Rocks in China from Jennings.



Details of karst areas in the eastern Kun Lun from the Map of Soluble Rock Types in China.

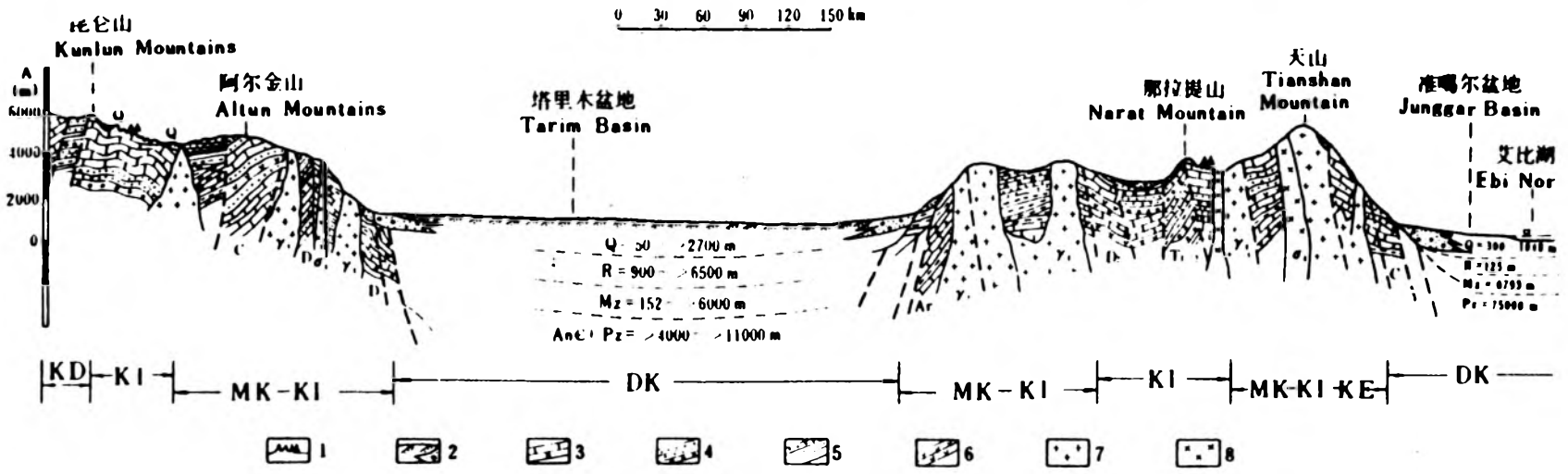


Detail map of Xinjiang Uygur Zizhiqu.



Geological section of the Kunlun-Altun-Narat-Tienshan-Junggar from Karst in China.

390、新疆喀喇昆仑山及昆仑山一带，也有碳酸盐岩分布，发育有多种岩溶类型；此外，还有现代冰川热岩溶现象分布



新疆昆仑山至天山岩溶类型示意剖面图

1—残余峰林、石林等；2—大盆地中沙土及冲积层；3—碳酸盐岩层；4—砂页岩及砾岩等；5—石英岩、片岩和千枚岩等变质岩；6—凝灰碎屑岩；7—酸性火成岩；8—基性超基性岩；γ_2—元古代火成岩；γ_4—华力西期火成岩；σ_4—华力西期超基性岩

Cave areas identified by Professor Ziang.

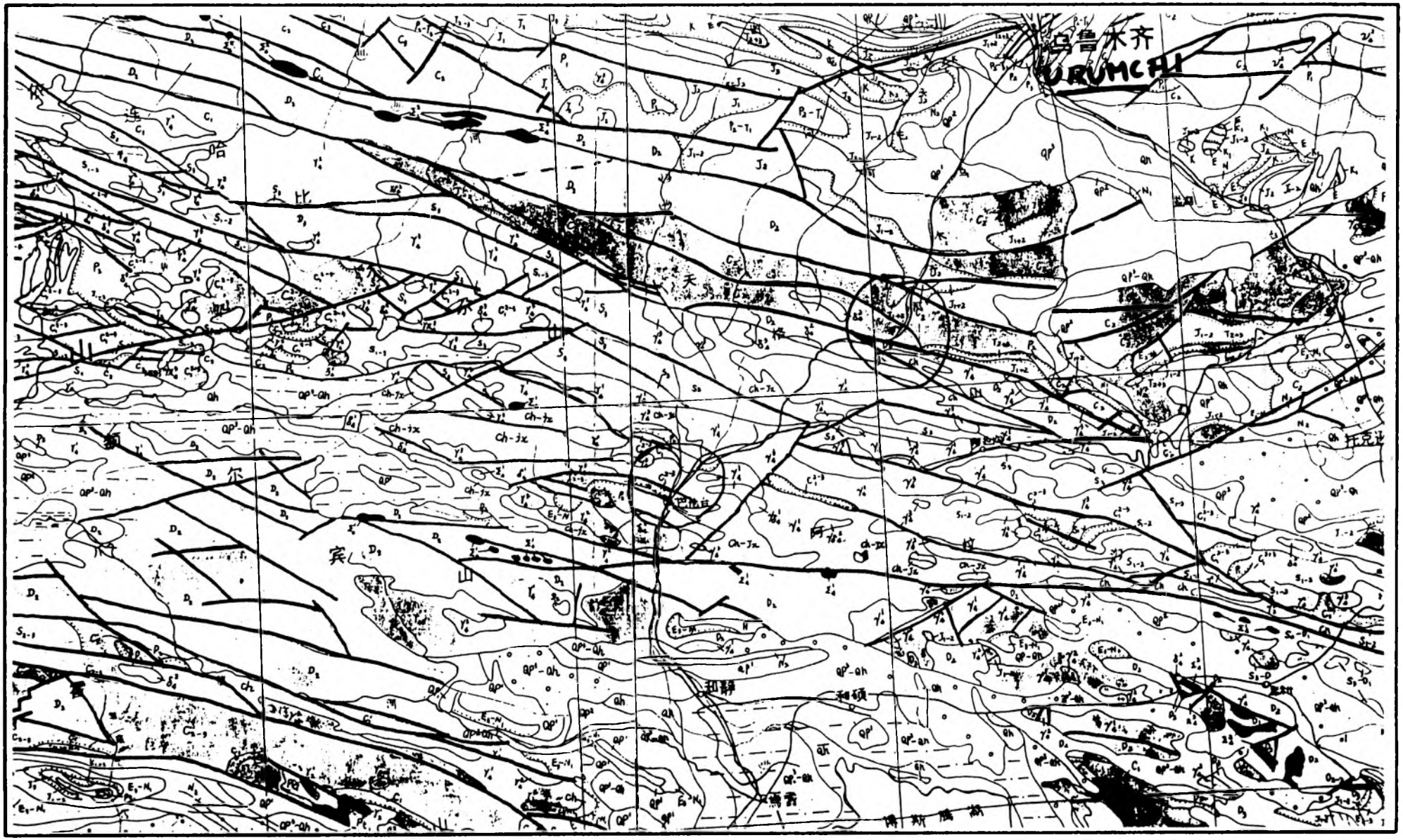
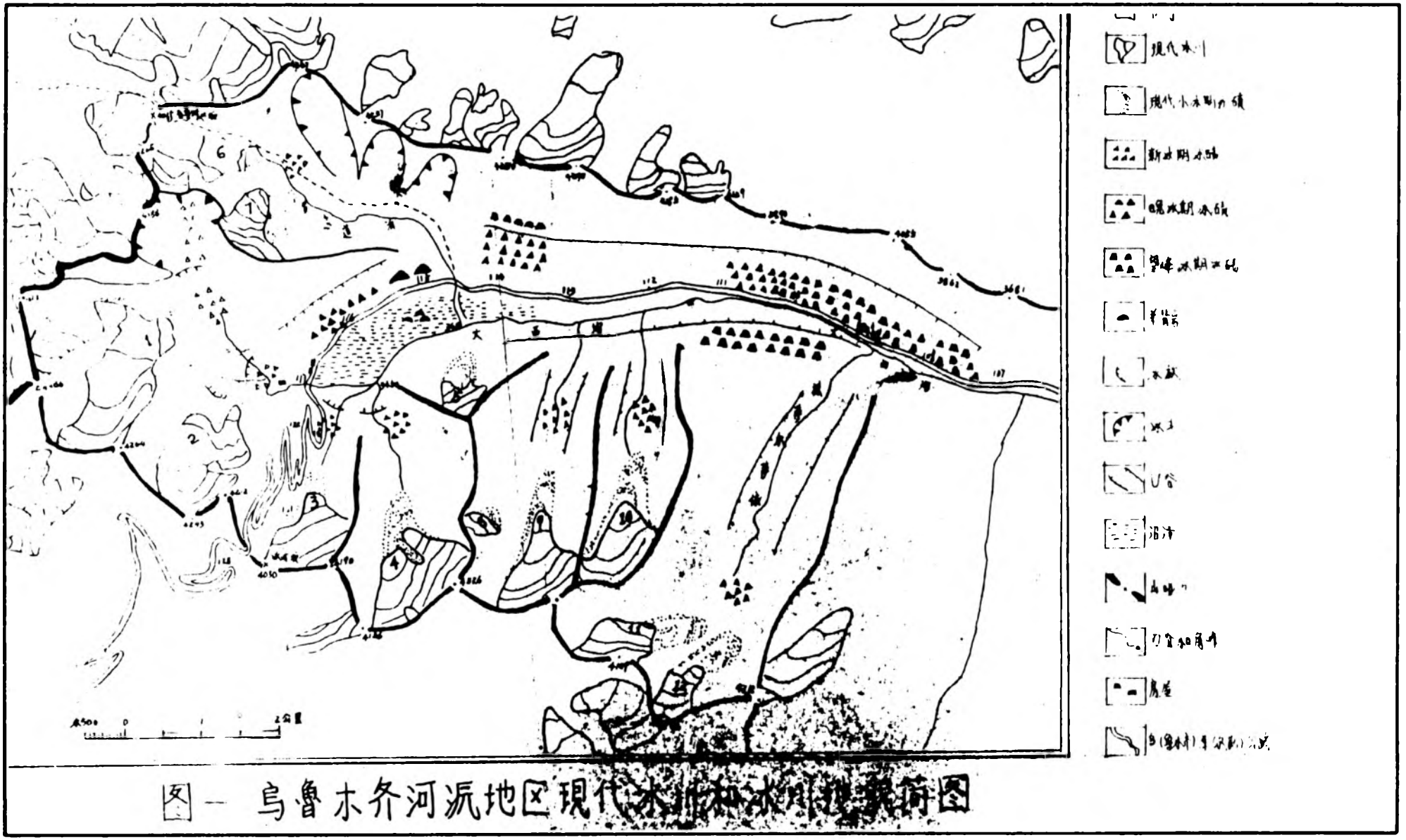
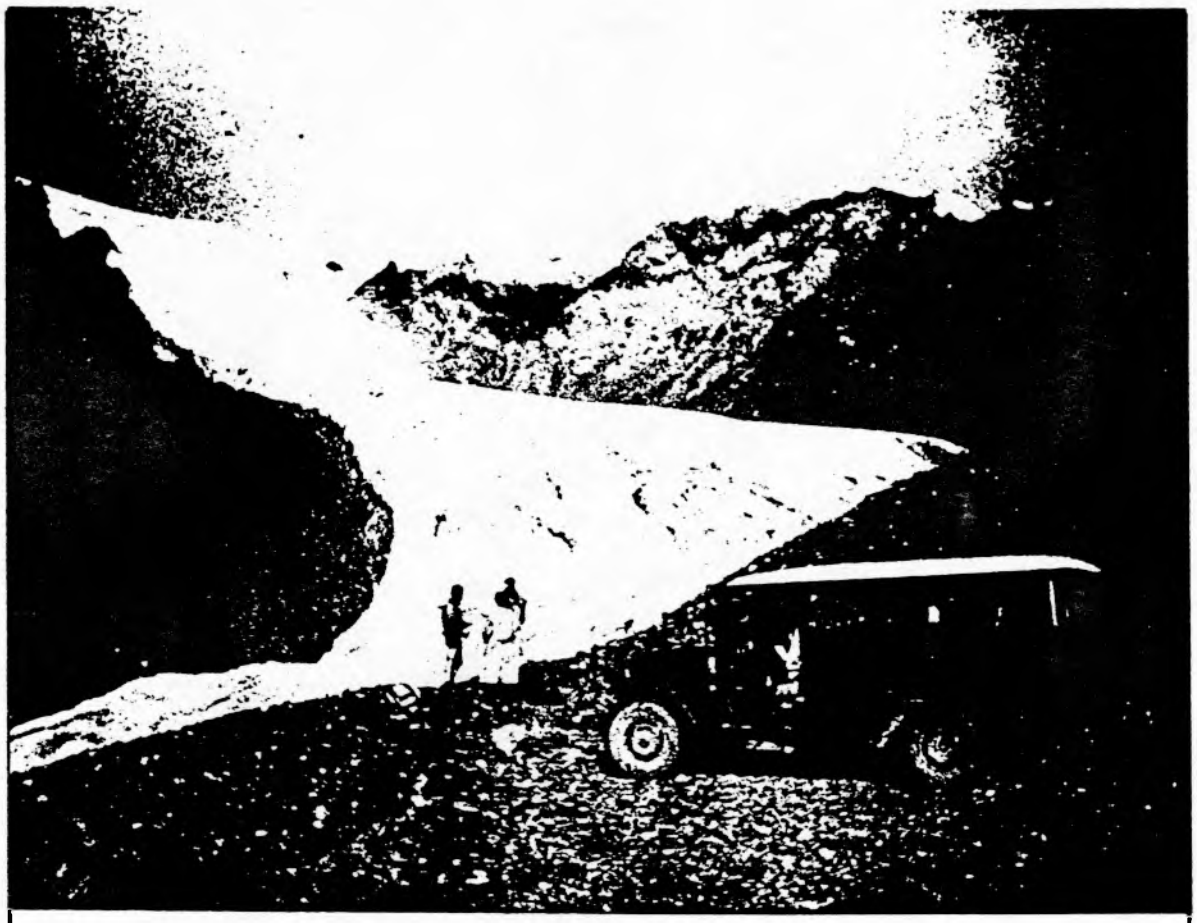


Diagram of the glacier at Glacier Observation Post No.1.



图一 乌鲁木齐河流地区现代冰川和冰川搜索简图



Keith Wright at Glacier Observation Post No.1.

Ziang's Cave.

Protocol for the Sino-British Joint Expedition in East Kun Lun Aktag Mountains,Xingiang.

حۇكگو پەنلەر ئاكادېمىيسى شىنجاڭ جوغراپىيە تەتقىقات ئورنى

中国科学院新疆地理研究所

英国地质调查局负责人：

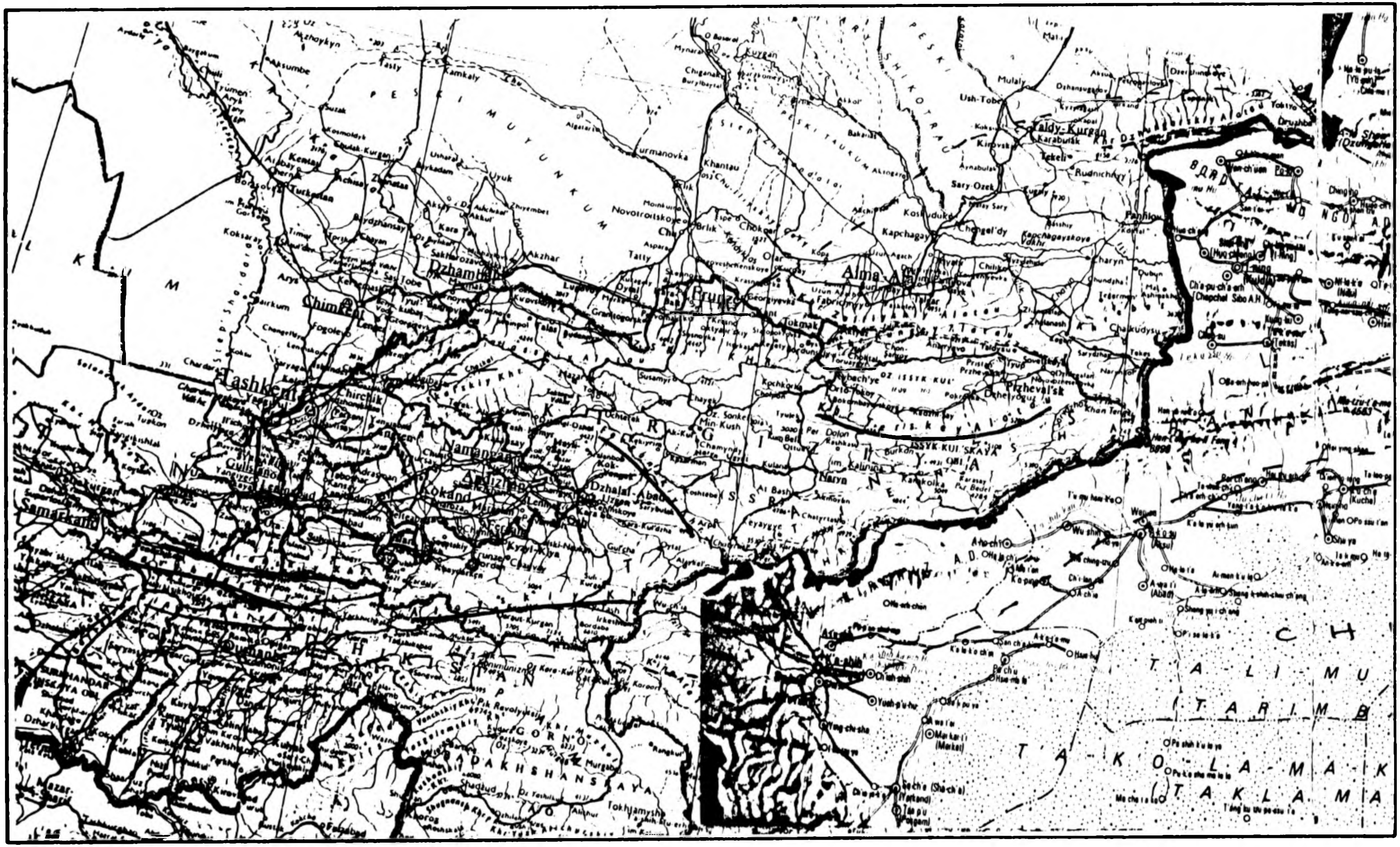
今天，就双方开展联合考察事宜，我们与贵国兰开斯特科技大学 Dr.Tim BeDONALL 和 .MELVIN PENN 进行了initial有意义的洽谈。我们十分欢迎并同意与贵国地质调查局当初学会合作，对阿尔金山阿克塔克地区联合进行有关地质地貌科学考察。我们的意见，该合作科考项目，名为"新疆东昆仑阿克塔克中英联合考察"安排在每年7～8月份为适宜。现由我们初拟的这份考察经费，其标准在国内是最优惠的。希望您们能给一个明确的答复，并共同详拟出可行的考察计划，以便真正付诸实施。由于考察区正处在我国阿尔金山一级自然保护区范围，需办certain批手续，并需交纳环境保护费。整个合作项目也需报请中国科学院审批。为了进一步落实详细的考察计划，建议你局能派一位成员来到讨具体研究，门票的计划，费用。并请你们提出来乌鲁木齐的合适时间，我们等待着你们的回音。

我们很希望促成这个考察研究项目，使我们的初次合作有个良好的开端。

中国科学院新疆地理研究所

1985年8月8日

Map of the main karst/caving areas in the USSR Tien Shan.



Two surveys of caves in the USSR Tien Shan.