This meeting, modified from an original proposal for a FLAG biennial by Jef Vandenberghe, was a combined venture also involving the British Geologists’ Association and Quaternary Research Association, the latter providing resources for the publication of the field guide. It combined Jef’s collaborative work with Wang Xianyan and David Bridgland’s more recently initiated activities with the Lanzhou team of Pan Boatian and Hu Zhenbo. FLAG participants from Canada, Germany, Portugal and Russia joined with a group of Geologists’ Association members and a number of Chinese scientists for a one-day conference and then a six day field excursion, some staying on for an optional additional visit to the glaciated highlands of Tibet.

The one-day conference

This was convened at Lanzhou University. It began with a fulsome introductory session:

- Welcome Speech (Vice President of Lanzhou University)
- Welcome Speech (Nanjing University)
- Introduction to the environments around the Northeastern Tibetan Plateau Ministry of Education
- Introduction to Key Laboratory of Western China’s Environmental Systems (President of Key Laboratory and College of Earth Environmental Sciences)

The discussion meeting followed the typical FLAG format of 15 minutes 5 for questions. Presenters covered a wide range of topics, as follows:

- Late Cenozoic fluvial history worldwide: a context for the Yellow River record David Bridgland
- Coupling of river basins, delta and sea level under glacial-interglacial cycles Zhongping Lai
- Loess Chronologies along a transect between the Huang He and Lái Yin He Manfred Frechen
The Yellow River Field Excursion

The Yellow River field excursion was led by Professors Hu Zhenbo (Lanzhou University), Wang Xianyan (Nanjing University), David Bridgland (Durham University), and Jef Vandenberghe (Vrije Universiteit Amsterdam). They were assisted by a wonderful group of Chinese colleagues and students who made the seven-day excursion thoroughly enjoyable. Crammed into two buses and resplendent in red baseball caps, the group visited outcrops along roads, ravines, and dams, experiencing spectacular geology, historic and modern China, and (not least) delectable food; they were accommodated along the way in mainly new and very well-appointed high-rise hotels. Engagingly, Lanzhou was once the Waterwheel Metropolis, so named for the many enormous bucket systems for gravity irrigation, perfected in the 1500s.

The buses took us several hundred kilometres from Lanzhou, traversing the rugged northeast margin of Tibetan Plateau, where stress from the Cenozoic collision of India with Asia continues to cause active faulting. Our leaders took us through a bewildering landscape of Miocene to Quaternary basin creation and filling and river incision through the intervening mountain ranges of this ‘basin-and-range’ topography, forming spectacular gorges. Thus the group peered over the precipitous edge of Longyang Gorge, 600 m deep and incised in perhaps as little as 250,000 years, based on interpretations discussed on the trip. As the river cut down, a staircase of terraces formed, each mantled by gravel and perched on the hillsides high above the modern river. Terrace specialist David Bridgland never tired of pointing out the beautifully rounded boulders, imbricated to show the former direction of river flow. On one terrace surface, GA member Peter del Strother picked up ventifacts, their facets sculpted when winds swept across an abandoned terrace.
Participants tucking into a splendid meal at Lanzhou. Waterwheel by the Yellow River at Lanzhou. The QRA field guide produced to accompany the excursion.

Where the rivers had eroded more widely through softer material, generations of villagers worked the landscape into an intricate array of agricultural levels where we saw a range of dry-season crops. These anthropogenic terraces have to be distinguished from the natural river terraces, made more difficult by the wind-blown overburden, often much thicker than any fluvial sediments marking the terrace level. A feature of the uppermost landscape is planation surfaces that cut across the bedrock high above the modern river valleys. The surfaces represent periods in the Miocene and Pliocene when the rivers eroded laterally during times of greater tectonic stability, reducing the landscape to a peneplain. Later, renewed uplift promoted river incision through the planation surfaces. Rhythms of planation and incision invite links to early landscape models proposed for the Colorado Plateau by W.M. Davis, whose ideas were brought to China in the early 1900s by American geologist Bailey Willis.

A feature of the landscape around the Yellow River unfamiliar to most is the huge thicknesses of buff-coloured loess (up to 400 m thick)—the largest accumulation of windblown dust on Earth, its formation having commenced about 8 million years ago (in the Miocene). With abundant sediment accessible from the uplifting Tibetan Plateau, westerly winds transported enormous volumes of dust from the deserts and river plains of Central Asia, which became increasingly arid as global cooling set in. The loess accumulated in basins across the area and far out into the Pacific. So much dust was brought down that it began to accumulate on the terrace gravels as soon as the river abandoned them, eventually burying the entire landscape. Our introduction to loess was at a building site
where, among partly constructed skyscrapers, terrace gravels and a cap of loess was visible through green wrappings designed to control the dust.

Also unexpected by most (on a river excursion) was a series of lake basins, formerly isolated by tectonic activity, that were encountered. Hundreds of metres of sediment built up in these during the Miocene and Pliocene, some perhaps of loess origin, settling into the lake or washed in by rivers. As river gorges were cut, the lakes became connected to through-going drainage and emptied into the ocean via the Yellow River. One huge lake that remains internally draining, Qinghai Lake, was visited – 3000 m above sea level and too large for the other side to be visible. It is thought that this might once have been connected to the Yellow River but was separated again, probably by tectonic activity. In the basin-fill areas of the old lakes impressive badland scenery has been formed by erosion and dissection of the lake sediments, the roads sometimes winding through an intricate fretwork of ravines, gullies and pinnacles.

Within the past two million years the Yellow River has thus connected up a series of disconnected river and lake-basin segments finally draining these to the Pacific. Therefore one of the world’s largest rivers can been seen to be very young geologically, at least in its present form.
Participants engaged in an active debate about whether the highest area visited on the NE Tibetan Plateau had ever been glaciated. Roadside sections in rubbly gravel and mud, high in the mountains, did not convince as till, seeming more likely to be debris-flow, or slope deposits. Most agreed on a non-glacial interpretation. But at another site, Jef Vandenberghe pointed out contorted sediments below the land surface -- cryogenic features indicative of a former cold climate.

A word from the British GA members: for those of us who took British geology degrees decades ago, the later Cenozoic was relegated to a single lecture -- in contrast to weeks on the Devonian, Jurassic and Cretaceous. It was widely considered that (a) there was no late Cenozoic of any interest in Britain, (b) the glaciers had destroyed anything that might have been of interest, and (c) it was all geography anyway. Mercifully, those days are long gone! Many thanks to the excursion leaders for showing us some truly magnificent recent geology and providing the participants with an unforgettable experience.