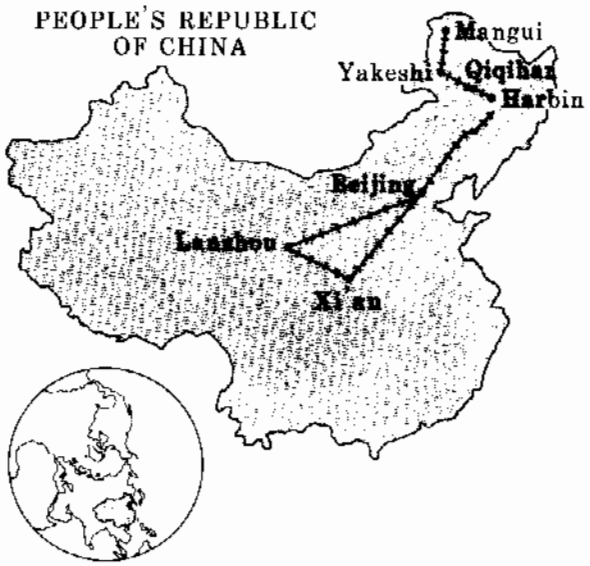


U.S. PERMAFROST DELEGATION TO THE PEOPLE'S REPUBLIC OF CHINA

by Jerry Brown

The U.S. delegation poses with the Chinese railway engineers and crew of the special train.

A U.S. delegation of 15 scientists and engineers representing federal and state agencies, industry, and universities specializing in problems of seasonally and perennially frozen ground visited China during July 15-31, 1984. The objectives of this visit were to (1) view permafrost conditions and construction practices in a region comparable to interior Alaska; (2) meet with organizations responsible for frozen ground research, design, and construction; and (3) exchange detailed technical information with the two major frozen-ground institutes in Lanzhou.

The trip was cohosted by the Ministry of Railways and the Academia Sinica's Institute of Glaciology and Cryopedology in Lanzhou. Upon receipt of the official invitation from the Ministry of Railways in January 1984, the U.S. National Research Council Polar Research Board's Committee on Permafrost organized our participation. The 16-day visit was in return for a U.S.-hosted visit of a Chinese delegation to Alaska and the West Coast in July 1983 as part of the Fourth International Conference on Permafrost.

The visit consisted of two segments: a train trip through the western permafrost region of Northeast China, and technical sessions in Lanzhou. The train trip began at Harbin. The private, four-car train proceeded to Yakeshi, then went to the end of the Yalin Line at Mangui in northern Inner Mongolia and returned by the same route to Qiqihar, covering a total of 2000 km.

Since the 1950s **Dr. Jerry Brown**, *former Chief, Earth Sciences, Cold Regions Research and Engineering Laboratory (CRREL), has been studying soils and permafrost conditions in Alaska. A full account of this trip may be found in CRREL Special Report 85-9; an earlier trip was covered in CRREL Report 82-3. (His current address: National Science Foundation, Washington, DC 20550.)*

The Delegates to China, 1984

Delegate	Institution
Jerry Brown (Leader)	Chairman, Committee on Permafrost and Cold Regions Research and Engineering Laboratory
Troy L. Péwé (Deputy Leader)	Arizona State University
Richard L. Berg	Cold Regions Research and Engineering Laboratory
David C. Esch	Alaska Department of Transportation & Public Facilities
Oscar J. Ferrians, Jr.	U.S. Geological Survey
George Gryc	U.S. Geological Survey
Raymond A. Kreig	R.A. Kreig & Associates
Victor Manikian	ARCO Alaska, Inc.
Michael C. Metz	GeoTec Services, Inc.
Stuart E. Rawlinson	Alaska Division of Geological and Geophysical Surveys
Richard D. Reger	Alaska Division of Geological and Geophysical Surveys
Robert E. Smith	ARCO Oil and Gas Co.
Larry Sweet	Alaska Department of Transportation & Public Facilities
Ted Vinson	Oregon State University
Gunter Weller	Geophysical Institute, University of Alaska

Chinese technician reading temperatures at the south abutment of the bridge at Jinlin. (Larry Sweet photo.)

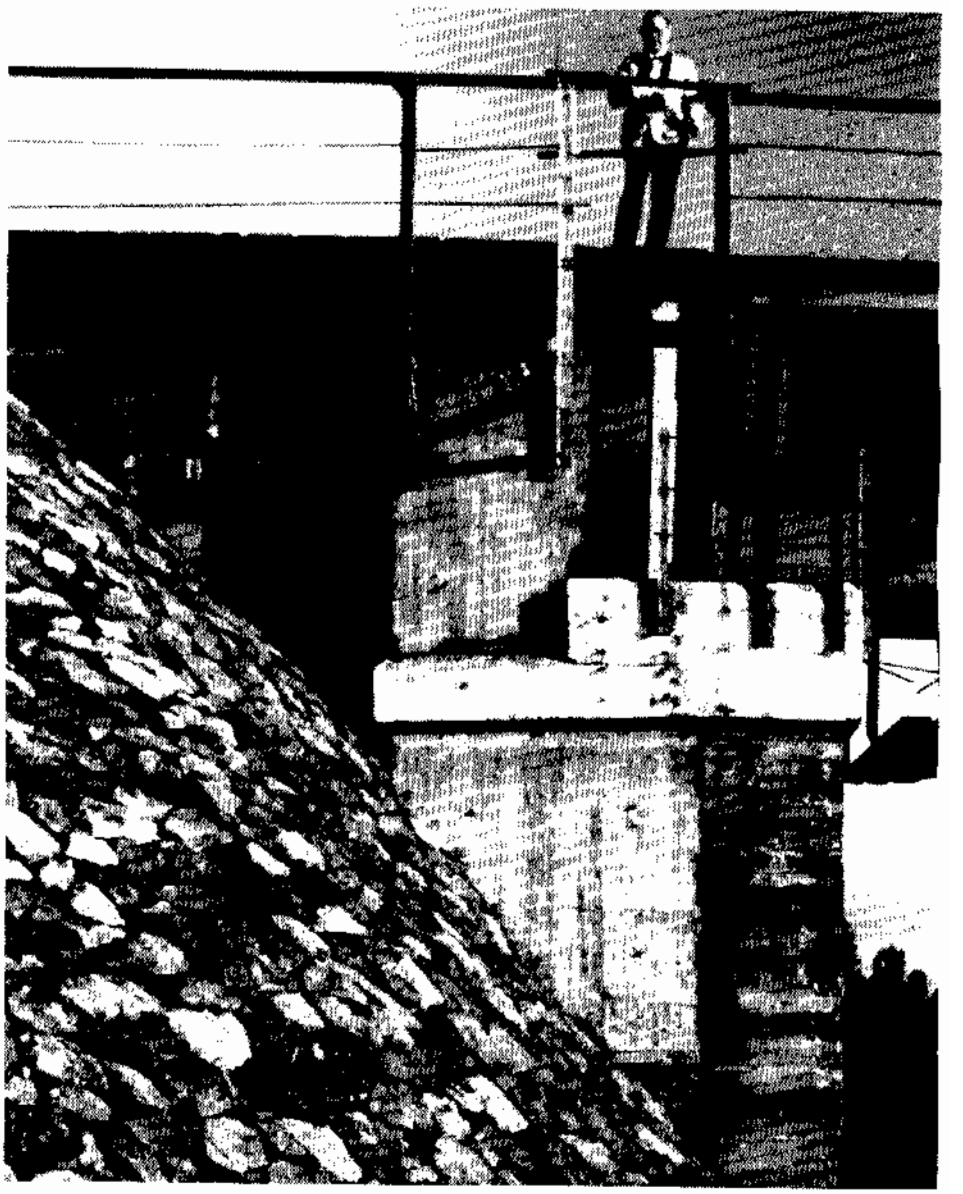
The train stopped en route at six permafrost locations. Several photographs taken at stops along the way are included in this article.

The delegation's visit to the Wanjia Frozen Soil Field Test Station near Harbin illustrated field testing of piles and foundations subjected to deep seasonal frost penetration and heave. While in Harbin, the U.S. delegates presented several summary talks on frost heave, in situ measurements, and pile foundations at the Low Temperature Construction Science Research Institute. A one-day technical exchange took place at Yakeshi with Chinese and U.S. groups each presenting four talks. The Chinese covered permafrost distribution and mapping, and design, construction, and performance of railbeds, culverts, bridges, and building foundations. They also presented results of their field observations and successes and failures of structures affected by frost heave and permafrost degradation. A videotape illustrating permafrost research and frost heave problems in northeast China was shown. (For information about this 30-minute videotape, now with English sound track, contact Vic Manikian, ARCO Alaska, Inc., P.O. Box 100360, Anchorage, AK, 99510.)

Technical exchanges took place with the Qiqihar railway representatives of the Harbin Railway Administration at the Low Temperature Laboratory in Qiqihar. The U.S. delegation summarized ongoing and future frozen ground research in federal and Alaska agencies and industry. They then toured the Low Temperature Laboratory's large cold room and material testing facility and saw a slide show recapping the train trip, including sites not visited due to time restrictions. Each delegate was given a photo album and a comprehensive report on past field investigations and design and construction practices. The report has been translated and is included as an appendix to a CRREL Special Report on the trip.[1]

The trip in Northeast China provided a number of new insights into recent Chinese frozen ground investigations. Clearly the design and construction of railways built on permafrost is well advanced. Problems related to railway winter drainage,

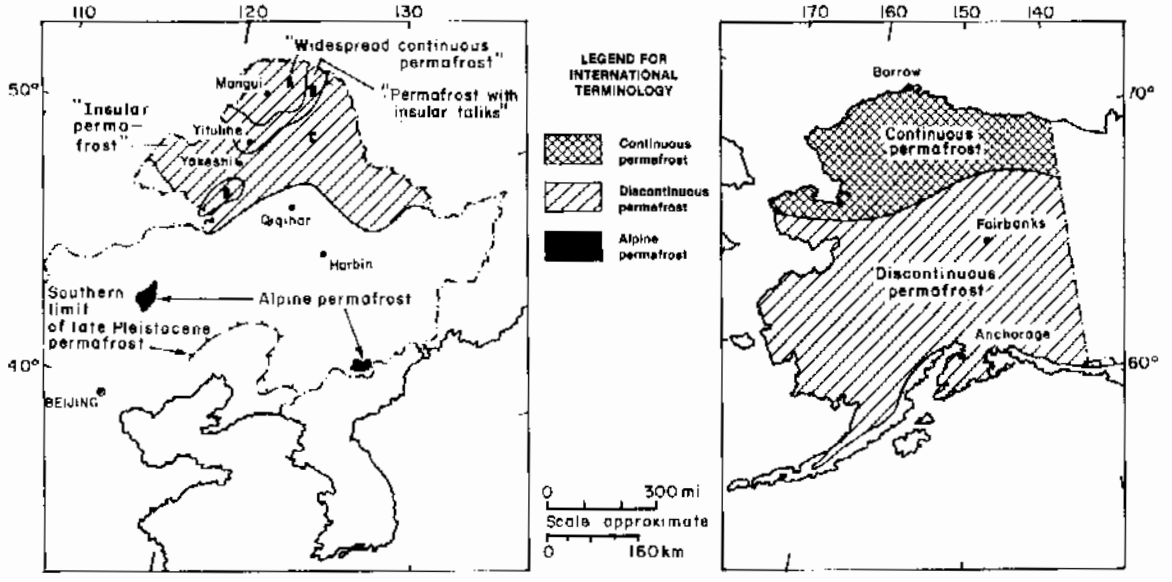
Steel plate girder bridge on the Yalin Line between Yakeshi and Mangui. Permafrost has been degrading under the riverbed, and there are access tubes in the river and the abutment that are used to measure temperatures.



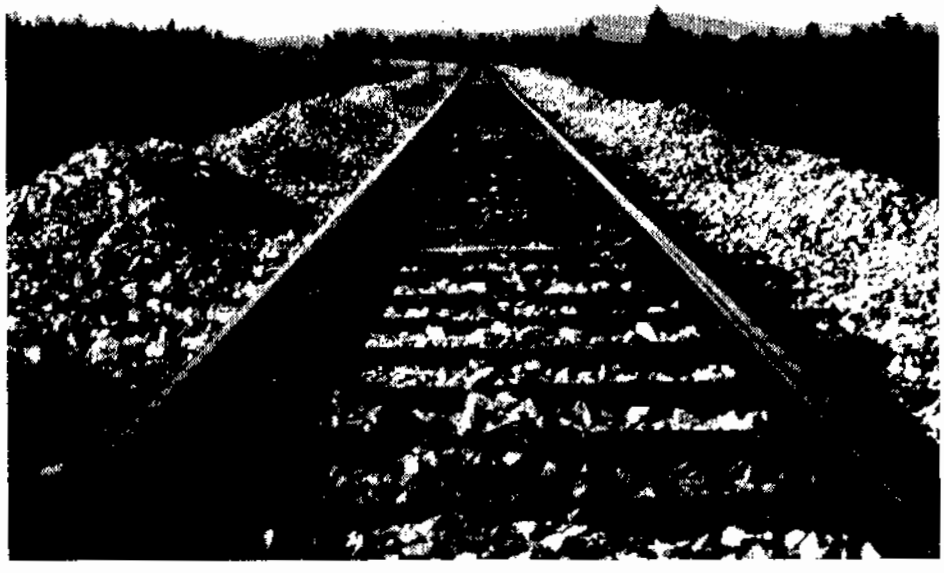
The south abutment of the bridge at Jinlin on the Yalin railroad in Inner Mongolia. The abutment was built on permafrost and has settled. The light-colored concrete near the center of the photo is a cap that has been inserted to level the bridge. (Dave Esch photo.)

thaw settlement, damage to culverts, and frost heave have been experienced and in many cases resolved. Large labor resources allow excellent maintenance of the railbed. Much of northeast China's railway system serves forestry needs, and specialized institutes and field stations have been established to obtain design data. In the past decade, new approaches have been made in foundation design. Ventilated slab and pile foundations are being used for residential dwellings and other structures. However, experience in these areas seems limited.

The distribution of permafrost in China was clarified by the visit. Much of northern Inner Mongolia is underlain by permafrost and is within the southern part of the dis-



A comparison of the distribution of permafrost in northeast China and in Alaska. Note the differences in terminology for the permafrost zones in China and Alaska (the Chinese terms are in quotes); all permafrost areas in China are in the discontinuous zone as defined internationally.



A section of the Yalin railroad south of Mangui, Inner Mongolia, is constructed over permafrost. To prevent continued subsidence of the railroad bed from melting of the permafrost, the embankment has been insulated with 1 to 3 meters of peat for a distance of 10 to 15 meters on each side of the center alignment. Ballast is placed on each side of the tracks to allow for continued leveling of the rails. (Larry Sweet photo.)

Xie Yingi, director of the Wanjia Frozen Soil Field Test Station located east of Harbin, holds a thermometer used to measure ground temperatures at various depths.

continuous permafrost zone. A comparison of permafrost conditions between Alaska and northeast China is shown above. The delegates observed ground temperature monitoring wells and were provided ground temperature maps. Members of the U.S. delegation had with them several enhanced Landsat images for portions of the routes. These proved useful in the discussions and for field observations from the train. The Chinese were most interested in these images.

After flying to Xi'an, the delegation took a train to Lanzhou, where members were hosted by the Academia Sinica's Institute of Glaciology and Cryopedology and the Chinese Academy of Railway Science's Northwest Institute. A half day was spent in each institute in briefings and visits to the facilities. Several of the delegates had previously visited the institutes and were able to note recent changes in research projects and organization. The second and final day was devoted to two concurrent sessions on general geocryology and engineering geocryology. All of the U.S. delegates presented talks and there were five Chinese presentations. Approxi-

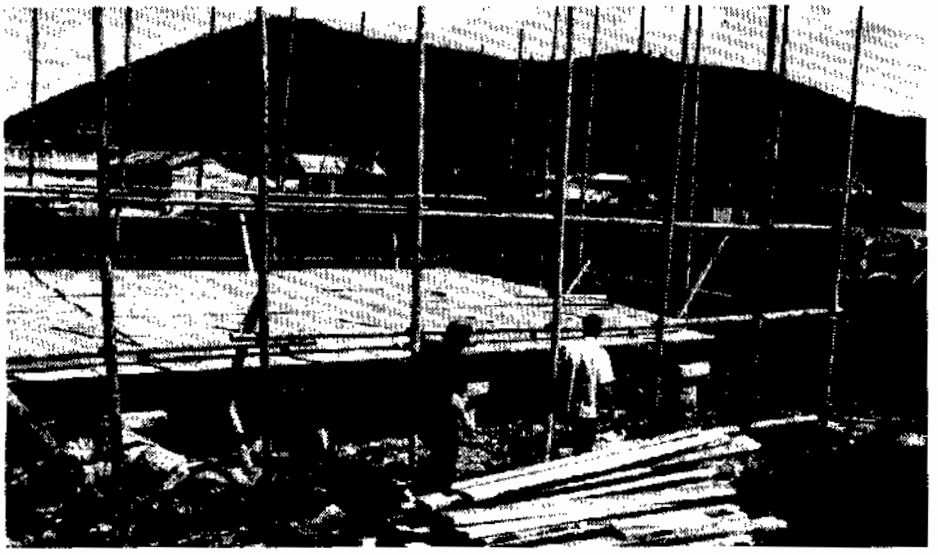
Right, slope stabilization along the Yalin railroad line south of Mangui. Underdrains are used to remove excess water that had previously caused serious icings on the track. Continuing slope movement is shown by the partially closed rock-lined drainage ditch.

Left, edge of the railroad along the Yalin Line between Qiqihar and Yakeshi shows the source of the embankment. Material was hand dug in carefully laid out plots to determine the amount that had been excavated by each crew of workers. (Larry Sweet photo.)

Right, Chinese engineers describe the instrumentation used to measure frost heave forces on vertical walls at a test site at the Wanjia Frozen Soil Field Test Station near Harbin. (Larry Sweet photo.)

mately a hundred Chinese attended. A number of discussions took place on the topics of frost heave, remote sensing, and piles and foundations. These intensive discussions resolved questions regarding Chinese engineering geocryology, particularly on foundation design and frost heave research.

In Beijing, several delegates made a courtesy visit to the Academia Sinica's Foreign Affairs Bureau, and several delegates visited the Institute of Remote Sensing Applications. One delegate lectured at the Geologic Institute of Academia Sinica.



Left, concrete panel floor assembly placed on concrete piles for building foundations in Mangui, the northern end of the Yalin railroad in Inner Mongolia. The permafrost conditions in this area are similar to those in interior Alaska and cause the same sorts of construction problems. (Larry Sweet photo.)

The foundation for a large apartment building to house railroad workers in Mangui. The structure, built on permafrost, was elevated approximately 1 meter above the ground surface. The holes near ground level provide ventilation to the space under the building. (Larry Sweet photo.)

Ray Kreig, Richard Reger, and Troy Péwé explain the details on a satellite photo that shows the surrounding area of Inner Mongolia to Chinese engineers at the Yakeshi Forestry Survey and Design Institute. (Larry Sweet photo.)

Another delegate with particular interest in terrain and route analysis remained for several days to lecture and visit the Ministry of Railways Special Design Institute.

Prior to leaving, U.S. delegates compiled an informal list of topics for future exchanges, including:

General Geocryology

- Establish several U.S. and Chinese ground temperature sites using comparative instrumentation. (A site in the Poker and Caribou creeks watershed in the Fairbanks area is being developed as a U.S. location.)
- Correlate landscape analysis and surveying techniques for permafrost terrain.
- Conduct joint studies on ground ice and seasonal icing formations.
- Conduct joint studies on age, history, and climatic sensitivity of permafrost.
- Evaluate and apply methods of environmental protection for permafrost terrain.
- Conduct joint studies on origin and classification of alpine permafrost.

Engineering Geocryology

- Utilize Chinese frost heave field test facilities and U.S. laboratory and analytical capabilities to improve engineering practices.
- Evaluate U.S. mitigative techniques to reduce permafrost degradation (such as thermopiles, insulation) at Chinese field test facilities for foundations, piles, bridges, and roadbeds.
- Prepare comparative evaluation of U.S. and Chinese cold regions engineering design practices based on available and revised building codes.

REFERENCE

[1]Brown, J. 1985. Permafrost Delegation Visit to People's Republic of China, 15-31 July 1984. Cold Regions Research & Engineering Laboratory, Hanover, NH. Special Report 85-9. 137 pp. ◆