中国地理学会　中国土木工程学会

第二届全国冻土学术会议论文选集

PROCEEDINGS OF SECOND NATIONAL CONFERENCE ON PERMAFROST

(SELECTION)

甘肃人民出版社

中 国 地 理 学 会

中 国 土 木 工 程 学 会

第二届全国冻土学术会议论文选集

中国科学院兰州冰川冻土研究所编辑

甘 肃 人 民 出 版 社

中国地理学会　中国土木工程学会
第二届全国冻土学术会议论文选集
中国科学院兰州冰川冻土研究所编辑
甘肃人民出版社出版
（兰州第一新村51号）
甘肃省新华书店发行　　天水新华印刷厂印刷
开本787×1092毫米1/16　　印张32　插页10　字数712,000
1983年5月第1版　　1983年5月第1次印刷
印数：1—3,600
书号：13096·85　　定价：5.50元

前　言

自1978年中国地理学会召开第一届全国冰川冻土学术会议[1]以来，我国冻土学研究蓬勃发展。为了交流研究成果，总结寒冷地区工程建设的经验，中国地理学会和中国土木工程学会于1981年10月12日至18日在兰州联合召开了第二届全国冻土学术会议。会议由中国地理学会常务理事、本届全国冻土学术会议组织委员会主任施雅风教授主持。参加会议的182位代表来自全国68个科研单位、生产部门和高等院校。应邀出席的，还有日本雪冰学家黑岩大助教授，美国陆军寒区研究与工程实验室严银照博士和J.布朗博士。中国地质学会工程地质委员会和第四届国际冻土学术会议组织委员会主席T.L.佩威教授给会议发来了贺信。会议收到182篇论文，它们广泛涉及冻土学领域的各个分支学科。

普通冻土研究方面，涌现了一批概括区域冻土特征、探讨区域因素对冻土分布的影响、高山冻土地带性划分以及冻土历史、发展方面的论文；冷生现象和地下冰的研究更为深入；季节冻结和融化深度的计算，在统计和数值方法上均有所发展；多种物探方法在冻土研究中的应用已取得成效；利用地球资源卫星像片判译冻土也有了良好开端；测定未冻水含量的新方法正着手尝试，第一次测定了大含水量冻融土的热物理参数。

冻土物理力学研究方面，关于冻结过程中的水分迁移理论和冻胀作用，特别是法向冻胀力的研究，提出了许多实测数据和计算方法；比较系统地开展了冻土声学，介电性质及其与含水量的关系等方面的实验研究；冻土的水热交换问题，在相关统计和理论分析上均有进展；对冻土蠕变特性也进行了较系统的研究；还开展了现场大型冻融交界面直剪试验；冻土残余强度与三轴强度的研究，在国内是属首次。

工程冻土研究方面，无论是多年冻土区，还是季节冻土区，关于道路、桥涵、隧道、给排水、房建以及水利等方面的地基基础稳定性的计算原理和方法，工程设计和施工，以及冻害防治等等，都开展了多种形式的试验研究和理论探索，取得了可喜的成果。

这本论文集选载的72篇论文，比较全面地反映了近三年来我国冻土学研究的水平与成就。因篇幅所限，若干论文我们已推荐给《冰川冻土》杂志发表。

本论文选集由周幼吾主持，中国科学院兰州冰川冻土研究所编辑部袁远荣编辑。文集插图由李玉芳、祝国存、王银学清绘。由于时间短促，编辑水平有限，错误在所难免，尚祈读者和作者谅解，并惠予指正。

这次会议的召开和论文集的编辑、出版，得到中国科学院兰州冰川冻土研究所、铁道部科学研究院西北研究所、黑龙江省水利科学研究所等单位的大力支持，在此表示谢意。

第二届全国冻土学术会议组织委员会

一九八二年五月

1）第一届全国冰川冻土学术会议于1978年11月27日至12月3日在兰州举行，由科学出版社（北京）出版了二届会议文集——《中国地理学会冰川冻土学术会议论文选集》（冰川学）和《中国地理学会冰川冻土学术会议论文选集》（冻土学）。

PREFACE

Permafrost study in China continues florishing and has had a great progress since the First National Conference on Glaciology and Cryopedology, 1978.*

In order to exchange the research results and to summarize the experiences on engineering construction in cold regions, the Geographyical Society of China and the China Civil Engineering Society jointly convened the Second National Conference on Permafrost in Lanzhou, Oct.12—Oct.18, 1981. Prof. Shi Yafeng, a standing member of the Geographical Society of China, director of Lanzhou Institute of Glaciology and Cryopedology, Academia Sinica and Chairman of the Organization Committee of this Conference, presided over this conference.182 delegates from 68 scientific institutions, production units and universities participated. Among those invited to attend this meeting were: Prof. Daisuke Kuroiwa, and expert on Snow and Ice in Japan; Dr. Yin-Chao Yen and Dr. Jerry Brown of the U.S.Army Cold Regions Research and Engineering Laboratory. The Organization Committee also received messages of congratulations from Commission on Engineering-geology of the Geological Society of China and from Prof. Troy L.Péwé, chairman of the Organization Committee of the Fourth International Conference on permafrost.

182 articles concerning all the fields of cryopedology were received. A brief introduction is as follows.

1.*General Cryopedology*

Articles were presented to epitomize the regional characteristics of permafrost, to discuss the influence of environmental factors on permafrost distribution, and to deal with the classification of alpine permafrost, the history and development of frozen ground, showing progress on statistical and numeral methods for calculating the seasonal thaw-freeze depth, successful experiences of geophysical prospecting methods, landsat image interpretion

*The First National Conference on Glaciology and Cryopedology was held in Lanzhou, Nov.27—Dec.3, 1978. The memiors have been published by the Science Press(Beijing): Proceedings of the Symposium on Glaciology and Cryopedology Held By Geographical Society of China (Glaciology) and Proceedings of the Symposium on Glaciology and Cryopedology Held By Geographical Society of China (Cryopedology).

for locating permafrost and cryogenetic phenomena in good beginning, a good start in developing a new approach for measuring the unfrozen water and the successful attainment of thermal-physical parameters of freezing thawing soils with large water content

2. *Physics and Mechanics on Frozen Soils*

In the theory on moisture migration in freezing soil and with the frost heaving action, especially the frost heave force in normal direction, some observed data and calculation methods were given; the research on sonical and dielectrical properties of freezing/frozen soils and their relation to water content were started to develop systematically; a progress on relative statistical and theoretical analysis of water-heat exchange problem was obtained; results on systematic research of creep characteristics on frozen soil were introduced; studies on strength, both relic and triaxial, of frozen soil were presented for the first time in China; and the direct-shearing experiment at thaw-freeze interface was carried out in site.

3. *Engineering Cryopedology*

Articles showed satisfactory results of experimental and theoretical study on the principles and methods for evaluating the foundation stability, design and construction, as well as the frost damage prevention etc. for highway and railroad, bridge and culvert, tunnel, water supply and drainage, room building and hydraulic engineering in cold regions.

72 of the 182 articles are published in this anthology to reflect the level and achievements of permafrost study in China during the past three years. Some articles were recommended for publication in the "Journal of Glaciology and Cryopedology".

This collection is compiled by chief editor Zhou Youwu, Associate Professor and vice director of Lanzhou Institute of Glaciology and Cryopedology, Academia Sinica, and by responsible editor Yuan Yuanrong. Plates are painted by Li Yufang, Zhu Guocun and Wang Yinxue. There would be some mistakes in compilation, comments and suggestions are invited and encouraged.

The Organization Committee would like to acknowledge their appreciation for the contributions of the following institutions to the compilation and publication of this collection: Lanzhou Institute of Glaciology and Cryopedology, Academia Sinica, Northwestern Institute, China Academy of Railway Science, and the Research Institute of Water Conservancy Science of Heilungjiang Province.

Organization Committee of the Second National Conference on Permafrost

May, 1982

目 录

工　程　冻　土

GEOGRAPHICAL SOCIETY OF CHINA
CHINA CIVIL ENGINEERING SOCIETY

PROCEEDINGS OF SECOND NATIONAL CONFERENCE ON PERMAFROST

(SELECTION)

CONTENTS

Physico-Mechanical Properties of Frozen Soil

Engineering Geocryology

普 通 冻 土

中国冻土分布及其地带性规律的初步探讨

徐敦祖　王家澄

（中国科学院兰州冰川冻土研究所）

根据《1：400万中国冻土分布图的编制》一文[1]所提出的编图原则和方法，我们编制了1：400万中国冻土分布图（从略）。现就该图反映出来的冻土分布规律及其与环境因素的关系作如下论述。目的在于勾画我国冻土分布的基本轮廓，为各省区的远景规划及有关工程的规划设计提供一份参考资料。

一、冻土分布范围及总体格局

我国位于欧亚大陆的东南部，就大陆本部（包括海南岛，不包括其它岛屿）而言，从北往南大致穿越了35个纬度（北纬53°—18°），东西相隔61个经度（东经135°—74°）。我国的地势西部高、东部低。在大兴安岭、太行山和贵州高原东缘山地以西是大高原、山原、极高山、高山和大盆地，除盆地外，海拔都超过1000米。在这一线以东，有一条东北-西南走向的平原带，平原带以东又有相当宽广的中山、低山和丘陵。辽阔的疆域和复杂的地形，使我国冻土独具特色：类型多、分布面积广。

我国冻土可分为三大类：多年冻土（其中包括大片连续的——忽略了坡向、雪盖和局部热源影响后，各种地表条件都能形成或保存多年冻土的地区和不连续的——部分地表条件能形成或保存多年冻土的地区）、季节冻土和瞬时冻土。各类冻土的区划前提、区划指标、保存时间及冻融特征见表1。

表1 冻土类型区划依据*

冻土类型	区划前提	区划指标（年平均气温℃）	冻土保存时间	冻融特征
多年冻土	年平均地面温度≤0℃	大片连续的为-2.4—-5.0，不连续的为-0.8—-2.0	≥2年	季节融化
季节冻土	最低月平均地面温度≤0℃	8—14	≥1月	季节冻结不连续冻结
瞬时冻土	极端最低地面温度≤0℃	18.5—22	<1月	不连续冻结夜间冻结

*表中季节冻结（或季节融化）的含义是指土持续冻结（或融化）时间大于或等于一个月；不连续冻结指土持续冻结时间不足一个月。