

中华人 民共 和 国
土壤 环境 背景 值 图 集

THE ATLAS OF SOIL ENVIRONMENTAL
BACKGROUND VALUE IN THE
PEOPLE'S REPUBLIC OF CHINA

中国环境科学出版社



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前　　言

(一)

土壤环境背景值是指土壤在发育形成过程中,未受或很少受到人为活动的影响,特别是未受或很少受到污染、破坏的情况下,土壤本身固有的化学组成和含量。它基本反映土壤环境原有的物质组成、性质和结构特征。

编制土壤环境背景值图是土壤环境背景值研究的深化,它将土壤环境背景值的研究成果,以专题地图的形式表现出来,使之成为直观、形象的图面资料,能定性、定量、定位地反映土壤中不同元素背景含量在空间的分布特征,反映区域分异规律及与制约因素之间的内在联系,并准确地揭示出土壤环境背景值异常区的位置,为进一步研

究异常区的成因奠定了良好基础。

《中华人民共和国土壤环境背景值图集》的编辑与出版,将为我国环境保护事业的发展和环境科学的基础研究提供科学依据;为防治地方环境疾病和掌握土壤微量元素含量、分布提供可靠依据;对地质科学研究和地球化学找矿有极大的参考价值;为高等院校和科研单位开展有关教学与科研工作提供重要基础资料;也为我国地图科学和环境制图的发展积累更丰富的经验。它标志着我国在土壤环境背景值的研究领域中已跨入了世界先进行列。

(二)

《中华人民共和国土壤环境背景值图集》的编制,是“七五”国家科技重点攻关项目《全国土壤环境背景值研究》的子专题,是攻关项目规定必须达到的目标之一。项目的主持部门是国家环境保护局,参与主持部门是国家教育委员会和中国科学院。承担专题的组长单位是中国环境监测总站,副组长单位是北京大学和中国科学院沈阳应用生态研究所。本图集由中国环境监测总站主编,副主编单位有东北师范大学、中国科学院成都山地灾害与环境研究所和成都市环境保护科学研究所。北京大学参加了部分基础图件的编绘工作。各省、市、自治区及大连、温州、厦门、深圳等城市的环境保护监测站、环保科学

研究所等单位,中国科学院的有关研究所,国家教育委员会的有关大专院校等国内数十个单位,参加了全国土壤环境背景值的研究工作,为本图集的编制提供了大量的基础数据和图件资料。我国制图学、土壤学、环境学界的老专家陈述彭、张力果、陈静生、廖克、陈昱、魏复盛、吴燕玉等先生应邀作为图集编制的顾问,自始至终为图集的编辑出版给予了亲切的指导。该图集的编辑出版是集体智慧的结晶,是我国自“六五”开展土壤环境背景值研究以来的10年期间,100余个单位协作攻关,1000余名同行、专家共同努力、艰苦奋斗的劳动成果。

(三)

图集由4个图组构成,共187幅图,分为序图组(6幅)、单元素环境背景值图组(133幅)、多元素环境背景值图组(28幅)和实验图组(20幅)。序图组主要反映土壤环境背景值的主要影响因素,如土壤类型、土壤母质母岩、土壤pH值、土壤有机质含量、土壤质地等因素的分布状况。便于读者在深入探讨土壤微量元素的地域分异规律时参考。同时将采样点分布图列入序图组中,并加注了各省、市、自治区的统一编号,和《中国土壤元素背景值》相一致,便于大家在使用时核对各点位的元素含量。单元素环境背景值图组中共收集了三种类型的图件。第一种类型是重点研究的13个元素的分区分级统计图,有铜(Cu)、铅(Pb)、锌(Zn)、镉(Cd)、镍(Ni)、铬(Cr)、汞(Hg)、砷(As)、氟(F)、锰(Mn)、钴(Co)、钒(V)、硒(Se),此种类型的图以手工编图为主,编绘时首先由计算机按元素分别进行了影响因素分析,然后根据影响因素的顺序,按着含量等级综合,绘制等级界线成图,以充分发挥专家智能的作用。第二种类型是计算机绘制的分级点位符号图,全面反映61个化学元素在土壤A层的含量分布状况,用定位分级符号表现出来。第三种类型是插值格网图,在分级点位图的基础上,以克里格(Kriging)法进行插值,由计算机来完成,筛选出59个化学元素的格网图,同时列出了每个元素插值的数学模型与效果检验

参数,供大家在使用时参考。多元素环境背景值图组包括15组综合分级点位图和13组综合插值格网图。将61个化学元素在逐级进行相关显著性聚类分析的基础上,经筛选把环境地球化学性质相近,数据相关性较好的元素划分为一组,对组内数据进行标准化处理后将系数加和,按顺序统计量分级由计算机绘制而成。其目的在于对土壤中各元素的环境地球化学区划作初步探索,以求为土壤环境背景值的后续研究指出方向。实验图组主要包括彩色分级立体透视图、彩色分级立体透视剖面图和等值线图,以探索计算机绘图的多种表现形式,使读者对部分元素背景含量在全国的分布特征有更直观、醒目的感性认识。由于该图组属实验性质,只选择了部分元素和影响因素成图。

本图集采用了以机助制图为主,机助制图与常规制图相结合的原则,并用多种表现方法和绘图方法,便于读者相互比较,取长补短,各取所需,相得益彰。制图所用的全部数据资料均经过严格的质量审查。从布点设计、采样、样品处理、化验分析、数据处理,直至图件编绘,都是在全程序的质量保证和质量控制下进行的,因而是可信的,编图数据均采用按顺序统计量统一分级,与《中国土壤元素背景值》数据册相对应,两套资料可对照使用。

(四)

《中华人民共和国土壤环境背景值图集》在我国属首次编辑出版,在世界也属罕见。由于第一次编制61个元素的大型全国土壤环境背景值图集,既具有创新性和开拓性,也具有探索性和冒险性。我们认为,在我们这个贫穷而落后的东方古国,在开展“四化”建设的伟大事业中,没有一点开拓进取和敢于冒险的精神,是任何事情也不可能成功的。正是在这种精神的鼓舞下,激励我们不辞辛劳,不惜流汗,在有限的财力物力条件下,日夜兼程,以最快的速度,完成了规模浩大的图集攻关任务。今天,我们将这本图集奉献给我们伟大的祖国和可爱的人民,表达了我国环保工作者的赤诚之心,愿为我国环境保护事业的发展贡献绵绵之力,如果它能为祖国“四化”大业和环保事业的发展起到一点作用,那将是我们极大的欣慰。

由于是探索性的工作,加之我们的业务水平有限,图集中不当和不足之处在所难免,恳请国内、外同行、专家不吝赐教,我们愿意认真

听取大家的意见,以便再版时进一步修改、补充,使之更加完善。

在图集的编制、研究过程中,曾得到了美国地质调查局H.T.Sacklette博士、R.R.Tidball博士、L.L.Jackson博士、邱成财博士、赵峻田博士、J.A.Erdman博士、乔治亚大学萨瓦拉河生态系统研究所D.C.Adriado博士、美国国家环保局吴捷博士等多方支持。重庆大学信息制图研究所、成都地图出版社印刷厂等单位对图集的绘制印刷工作给予了大力支持和协助。在此,编委会向一切给予本图集研究、编辑、出版、印刷工作以热情关怀,大力支持的人士,表示衷心的感谢!

FOREWORD

I

Soil environmental background value(abbr. SEBV) means the intrinsic chemical composition and contents of the soil itself which has not been or very little affected by the human activities,especially under the circumstances of being not polluted or not ruined in the process of the development and formation of the soil,It reflects fundamentally the characteristic of the intrinsic material composition properties and structure of the soil.

To compile the atlas of SEBV is to deepen the research work of SEBV. It shows the achievements in scientific research as a form of the thematic map,so as to become an aduio-visual and imaged drawing material which can reflect qualitatively ,and quantitatively ,and also in orientation, the spacial distribution characteristic of the different element background content in soil. In addition,it reflects Law of Regional Differentiation and the internal relations between the differentiation factors, and it also reveals exactly the position of abnormal from SEBV, and thus to establish a good foundation for further investigating the cause of the forma-

tion of abnormal regions.

The compilation and publication of the Atlas of Soil Environmental Background Value in the P. R. China(abbr. ASEBV) will show profound significace as follows: (1)It will provide scientific foundation for both the development of the great task of environmental protection of our country and the rigorous work of basic research or environmental science; (2)It will provide reliable basic for both prevention and treatment of local environmental disease and grasp of soil trace element content and distribution which possess important reference value for geological prospecting and geochemistry information of mineral resources; and(3)It would provide by itself as an important material for institutions of higher learning, and also for scientific research units to carry out the concerned teaching and scientific research work ,and,at the same time.it would promote the development and enrich further experience by itself for the map science and environmental mapmaking work in our country .Thus, the present atlas marks that our country in the research field of SEBV has stepped into the advanced rank of the world.

II

The work of compiling SEBV is a subtitle of the emphasized research projects of tackling key problem, the Study of National SEBV,during the Seventh Five-Year plan in our country, and it is assigned one of the targets which should be achieved. The responsible department of the project is National Environmental Protection Agency of the People's Republic of China , and participating responsible department is China National Education Committee and Chinese Academy of Sciences. The leader unit is China National Environmental Monitoring Centre(abbr. CNEMC); the associate leader units are Beijing University and Shenyang Applied Ecology Research Institute of Chinese Academy of Sciences. The chief editor unit of the present atlas is CNEMC; the associate chief editor units are Northeast Normal University, Chengdu Institute of Mountain Disasters & Environment, Chinese Academy of Sciences , and Chengdu Municipal Environmental Protection Research Institute. Beijing University took part in co compiling and drawing some of the fundamental graphs. There were about several ten units,such as environmental protection monitoring stations, and scientific institutes of each province, city, autonomous region; and cities

of Dalian, Wenzhou, Xiamen, and Shenzhen, etc. ; the concerned institute of Chinese Academy of Sciences and the concerned University or College of National Education Committee to take part in the work of SEBV throughout China; so that a large amount of fundamental data and graph material were provided for composition of the present atlas. Elder specialists of our country in the field of map-makimg, soil science, and environmental science. such as Mr. Chen Shupeng, Mr. Zhang Liguo, Mr. Chen Jingsheng, Mr. Liao Ke, Mr. Chen Yu, Mr. Wei Fusheng, and Ms Wu Yanyu, et al. have been invited as compiling advisers. They directed the composition and publication of the present atlas cordially from the beginning to the end. Therefore, the present atlas could be regarded as a crystallization of collective wisdom. It is really the fruit of labour by tremendous efforts of over a hundred coordinate units for tackle key problem, and over a thousand colleagues and experts to pay great attention to the study of SEBV during nearly ten years, since the start of Sixth Five-Year plan.

III

The atlas 187 maps in all, is composed of four map-groups. It is the preliminary map-group (6 maps), the mono-element background value map-group(133 maps), the multi-element background value map-group (28 maps), and the experimental map-group(20 maps). The preliminary map-group reflects mainly the distribution characteristics of influencing factors of SEBV, such as soil type, soil mother material and mother rock, soil pH value, soil organic matter content, and soil texture,etc.. It is convenient for the readers to make reference while they go further into the law of Regional Differentiation about the soil trace elements, and at the same time, the map of sampling sites is also put into the preliminary map-group, and in addition, there are attached notes of unified serial numbers of each province, city, and autonomous region, which are in agreement with the data manual,"China SEBV", so that it is convenient for the readers to check each site of the element content. The mono-element back-

ground value map-group collects 3 types of maps. The first type is regionalized-and graded-statistic map of 13 elements,i. e. Cu,Pb,Zn,Cd,Ni, Cr,Hg,As,F,Mn,Co,V and Se, which are emphasized in the investigation. This type of map is compiled and drawn mainly by hand. In doing so, the first thing is to use computer to analyse the influencing factors of the elements respectively. Then based upon the sequence of major influencing factors of each element,we worked out the synthesis with the graded content, and drew graphs of the grades boundary,so as to give full play to specialists, knowledge and skill. The second type is a graded point sites map, which was formed mainly by computer. It reflects all-sidedly content distribution in layer A of the soil of the 61 chemical elements shown by the graded symbols of locations. The third type is an interpolating grid map. It was based upon graded point sites map to carry out interpolation by means of Kriging by computer. Thus graphs of 59 chemical elements

were screened. Meanwhile, the mathematical model of interpolation and effectiveness-examination parameters of each element are listed to provide reference for the reader's utilization. The multi-element background value map-group includes 15 synthetical graded point sites maps and 13 synthetical interpolating grid maps. Based upon the cluster analysis of correlation significance of 61 elements grade by grade. It can be grouped by screening that the elements possess similar environmental geochemical properties and the better correlation, and then standardized the data within each group, and then summed up the coefficients grade statistically in sequence at last drew. The maps by computer respectively purpose of such cartography lies in the preliminary exploration for environmental geochemical regionalization of each element in soil, and thereby to point out the direction of successive study on SEBV. Experimental group includes mainly perspective map, perspective profile map and isopleth map of which the purpose is to explore the various forms of display of computer mapping, so that the readers can obtain more audio-visual and more attractive perceptual knowledge of the distribution characteristic of SEBV from a part of elements distributed throughout China. The map group is

limited to the selection of only some elements and influencing factors, owing to the fact that this graph is still at the experimental stage.

The present Atlas applied a principle of taking the computer drawing as a major means and combining the computer drawing with the conventional drawing and at the same time various methods of display and drawing were used, so that the readers can judge from the comparison between one method and another, take advantage of one drawing to offset others' weakness, take what he needs or the methods themselves may be able to supplement each other. All the data and informations used in compiling and drawing have passed strict quality review. The design of distribution of point sites, sample treatment, examination and analysis, data processing, until compiling and drawing the map, are all conducted, under the quality control and quality assurance through the whole process. Therefore, the present Atlas is reliable. The data applied in the map compiling were all graded according to the sequential statistic value and corresponded to those of the data manual of "China SEBV". Thus, the both Books can be referred to each other.

IV

It is for the first time to compile and publish "ASEBV" in China, and it is also seldom to see such a work in the world. Owing to the first time to compile such a large atlas, including 61 chemical elements, it has not only the properties of blazing new trails and exploitation, but also the properties of exploration and adventures. However, we believed that without any enterprising and adventurous spirit, there would be no possibilities of success on anything while we were carrying out the great task of Four Modernization for such an oriental ancient nation in which poor and less developed were not resolved as yet. Since under encouragement of the above spirit, we were excited to make nothing of hardships, and spared no pains in a sweat, and under the conditions of limited financial and material resources, we worked night to day with the most rapid speed to accomplish the broad scale job of tackle key problem of the atlas. Now, we offer the present atlas to our motherland and the beloved people to express our ulter devotion, and we are willing to make any sacrifice with our meager strength. If the present atlas is somewhat useful to the great task of the Four Modernization of our country and to the development of the environmental undertaking, it will be very gratified to us.

Since it was an exploratory work, and at the same time we were limited by our professional skill, mistakes and inadequacy in the atlas have been hard to avoid. We whole hearted hope that internal and external persons of the same trade or experts will not stint to give criticism, we are ready to hear the opinions in order to make further revision and supplement in second edition, so as to make the Atlas more perfect.

In the compiling and studing of the atlas, we have the honour of many-sided acquiring support offered by Dr. H. T. Shacklette, Dr. R. R. Tidball, Dr. L. L. Jackson, Dr. Cary T. Chiou, Dr. T. T. Zhao, Dr. J. A. Erdman, USGS, D. C. Adriano, Savannah River Ecology Laboratory, University of Georgia, Mr. Chieh Wu, Environmental Protection Agency of U. S. A. during the printing and publishing, we acquired a great support and assistance from the institutions such as Chongqing University Information Cartography Institute, Chengdu Map Publisher printing Factory, etc.. Here, we express heartfelt thanks to all the units which concerned and supported the compiling and publishing work of the atlas.

The Editorial Department of "ASEBV"

本专题研究的化学元素在化学周期表中的位置

族 周 期	1 A
1	1 氢 H $1s^1$ 原子量(2) 55.87 原 子 序 数 26 Fe 铁 符号(1) 名称 电子结构 $(Ar) 3d^6 4s^2$
2	3 锂 Li $4 Be$ 铍 $1s^2 2s^1$ 原子量(2) 9.01218 原 子 序 数 4 名称
3	11 钠 Na $12 Mg$ 镁 $1s^2 3s^1$ 原子量(2) 22.98977 原 子 序 数 11 名称
4	19 钾 K $20 Ca$ 钙 $21 Sc$ 钪 $22 Ti$ 钛 $23 V$ 钒 $24 Cr$ 铬 $25 Mn$ 锰 $26 Fe$ 铁 $27 Co$ 钴 $29 Cu$ 铜 $30 Ni$ 镍 $31 Zn$ 锌 $32 Ge$ 锗 $33 As$ 砷 $34 Se$ 硒 $35 Br$ 溴 $36 Kr$ 氪 $37 Xe$ 氙 $38 Rb$ 铷 $39 Sr$ 锶 $40 Zr$ 锆 $41 Y$ 钇 $42 Nb$ 铌 $43 Mo$ 钼 $44 Ru$ 钌 $45 Rh$ 铑 $46 Pd$ 钯 $47 Ag$ 银 $48 Cd$ 镉 $49 In$ 铟 $50 Sn$ 锡 $51 Sb$ 锑 $52 Te$ 碲 $53 I$ 碘 $54 At$ 砹 $55 Cs$ 铯 $56 Ba$ 钡 $57 La$ 镧 $58 Ce$ 铈 $59 Pr$ 镨 $60 Nd$ 钕 $61 Pm$ 钷 $62 Sm$ 钐 $63 Eu$ 铕 $64 Gd$ 钆 $65 Tb$ 铽 $66 Dy$ 镝 $67 Ho$ 钬 $68 Er$ 铒 $69 Tm$ 铥 $70 Yb$ 镱 $71 Lu$ 镥 $72 Hf$ 铪 $73 Ta$ 钽 $74 W$ 钨 $75 Re$ 铼 $76 Os$ 锇 $77 Ir$ 铱 $78 Pt$ 铂 $79 Au$ 金 $80 Hg$ 汞 $81 Tl$ 铊 $82 Pb$ 铅 $83 Bi$ 铋 $84 Po$ 钋 $85 At$ 砹 $86 Rn$ 氡 $87 Fr$ 钫 $88 Ra$ 镭 $89 Ac$ 锕 $90 Th$ 钍 $91 Pa$ 镤 $92 U$ 铀 $93 Np$ 镎 $94 Pu$ 钚 $95 Am$ 镅 $96 Cm$ 锔 $97 Bk$ 锫 $98 Cf$ 锔 $99 Es$ 锿 $100 Fm$ 镄 $101 Md$ 镆 $102 No$ 锘 $103 Lr$ 铹 $104 Rf$ 𫓧 $105 Hg$ 汞 $106 Ra$ 镭 $107 Rn$ 氡 $108 Fr$ 钫 $109 Pa$ 镤 $110 Th$ 钍 $111 Np$ 镎 $112 Pu$ 钚 $113 Am$ 镅 $114 Cm$ 锔 $115 Bk$ 锫 $116 Cf$ 锔 $117 Es$ 锿 $118 Fm$ 镄 $119 Md$ 镆 $120 No$ 锘 $121 Lr$ 铹 $122 Rf$ 𫓧 $123 Fr$ 钫 $124 Pa$ 镤 $125 Th$ 钍 $126 Np$ 镎 $127 Pu$ 钚 $128 Am$ 镅 $129 Cm$ 锔 $130 Bk$ 锫 $131 Cf$ 锔 $132 Es$ 锿 $133 Fm$ 镄 $134 Md$ 镆 $135 No$ 锘 $136 Lr$ 铹 $137 Rf$ 𫓧 $138 Fr$ 钫 $139 Pa$ 镤 $140 Th$ 钍 $141 Np$ 镎 $142 Pu$ 钚 $143 Am$ 镅 $144 Cf$ 锔 $145 Es$ 锿 $146 Md$ 镆 $147 No$ 锘 $148 Lr$ 铹 $149 Rf$ 𫓧 $150 Fr$ 钫 $151 Pa$ 镤 $152 Th$ 钍 $153 Np$ 镎 $154 Pu$ 钚 $155 Am$ 镅 $156 Cf$ 锔 $157 Es$ 锿 $158 Md$ 镆 $159 No$ 锘 $160 Lr$ 铹 $161 Rf$ 𫓧 $162 Fr$ 钫 $163 Pa$ 镤 $164 Th$ 钍 $165 Np$ 镎 $166 Pu$ 钚 $167 Am$ 镅 $168 Cf$ 锔 $169 Es$ 锿 $170 Md$ 镆 $171 No$ 锘 $172 Lr$ 铹 $173 Rf$ 𫓧 $174 Fr$ 钫 $175 Pa$ 镤 $176 Th$ 钍 $177 Np$ 镎 $178 Pu$ 钚 $179 Am$ 镅 $180 Cf$ 锔 $181 Es$ 锿 $182 Md$ 镆 $183 No$ 锘 $184 Lr$ 铹 $185 Rf$ 𫓧 $186 Fr$ 钫 $187 Pa$ 镤 $188 Th$ 钍 $189 Np$ 镎 $190 Pu$ 钚 $191 Am$ 镅 $192 Cf$ 锔 $193 Es$ 锿 $194 Md$ 镆 $195 No$ 锘 $196 Lr$ 铹 $197 Rf$ 𫓧 $198 Fr$ 钫 $199 Pa$ 镤 $200 Th$ 钍 $201 Np$ 镎 $202 Pu$ 钚 $203 Am$ 镅 $204 Cf$ 锔 $205 Es$ 锿 $206 Md$ 镆 $207 No$ 锘 $208 Lr$ 铹 $209 Rf$ 𫓧 $210 Fr$ 钫 $211 Pa$ 镤 $212 Th$ 钍 $213 Np$ 镎 $214 Pu$ 钚 $215 Am$ 镅 $216 Cf$ 锔 $217 Es$ 锿 $218 Md$ 镆 $219 No$ 锘 $220 Lr$ 铹 $221 Rf$ 𫓧 $222 Fr$ 钫 $223 Pa$ 镤 $224 Th$ 钍 $225 Np$ 镎 $226 Pu$ 钚 $227 Am$ 镅 $228 Cf$ 锔 $229 Es$ 锿 $230 Md$ 镆 $231 No$ 锘 $232 Lr$ 铹 $233 Rf$ 𫓧 $234 Fr$ 钫 $235 Pa$ 镤 $236 Th$ 钍 $237 Np$ 镎 $238 Pu$ 钚 $239 Am$ 镅 $240 Cf$ 锔 $241 Es$ 锿 $242 Md$ 镆 $243 No$ 锘 $244 Lr$ 铹 $245 Rf$ 𫓧 $246 Fr$ 钫 $247 Pa$ 镤 $248 Th$ 钍 $249 Np$ 镎 $250 Pu$ 钚 $251 Am$ 镅 $252 Cf$ 锔 $253 Es$ 锿 $254 Md$ 镆 $255 No$ 锘 $256 Lr$ 铹 $257 Rf$ 𫓧 $258 Fr$ 钫 $259 Pa$ 镤 $260 Th$ 钍 $261 Np$ 镎 $262 Pu$ 钚 $263 Am$ 镅 $264 Cf$ 锔 $265 Es$ 锿 $266 Md$ 镆 $267 No$ 锘 $268 Lr$ 铹 $269 Rf$ 𫓧 $270 Fr$ 钫 $271 Pa$ 镤 $272 Th$ 钍 $273 Np$ 镎 $274 Pu$ 钚 $275 Am$ 镅 $276 Cf$ 锔 $277 Es$ 锿 $278 Md$ 镆 $279 No$ 锘 $280 Lr$ 铹 $281 Rf$ 𫓧 $282 Fr$ 钫 $283 Pa$ 镤 $284 Th$ 钍 $285 Np$ 镎 $286 Pu$ 钚 $287 Am$ 镅 $288 Cf$ 锔 $289 Es$ 锿 $290 Md$ 镆 $291 No$ 锘 $292 Lr$ 铹 $293 Rf$ 𫓧 $294 Fr$ 钫 $295 Pa$ 镤 $296 Th$ 钍 $297 Np$ 镎 $298 Pu$ 钚 $299 Am$ 镅 $300 Cf$ 锔 $301 Es$ 锿 $302 Md$ 镆 $303 No$ 锘 $304 Lr$ 铹 $305 Rf$ 𫓧 $306 Fr$ 钫 $307 Pa$ 镤 $308 Th$ 钍 $309 Np$ 镎 $310 Pu$ 钚 $311 Am$ 镅 $312 Cf$ 锔 $313 Es$ 锿 $314 Md$ 镆 $315 No$ 锘 $316 Lr$ 铹 $317 Rf$ 𫓧 $318 Fr$ 钫 $319 Pa$ 镤 $320 Th$ 钍 $321 Np$ 镎 $322 Pu$ 钚 $323 Am$ 镅 $324 Cf$ 锔 $325 Es$ 锿 $326 Md$ 镆 $327 No$ 锘 $328 Lr$ 铹 $329 Rf$ 𫓧 $330 Fr$ 钫 $331 Pa$ 镤 $332 Th$ 钍 $333 Np$ 镎 $334 Pu$ 钚 $335 Am$ 镅 $336 Cf$ 锔 $337 Es$ 锿 $338 Md$ 镆 $339 No$ 锘 $340 Lr$ 铹 $341 Rf$ 𫓧 $342 Fr$ 钫 $343 Pa$ 镤 $344 Th$ 钍 $345 Np$ 镎 $346 Pu$ 钚 $347 Am$ 镅 $348 Cf$ 锔 $349 Es$ 锿 $350 Md$ 镆 $351 No$ 锘 $352 Lr$ 铹 $353 Rf$ 𫓧 $354 Fr$ 钫 $355 Pa$ 镤 $356 Th$ 钍 $357 Np$ 镎 $358 Pu$ 钚 $359 Am$ 镅 $360 Cf$ 锔 $361 Es$ 锿 $362 Md$ 镆 $363 No$ 锘 $364 Lr$ 铹 $365 Rf$ 𫓧 $366 Fr$ 钫 $367 Pa$ 镤 $368 Th$ 钍 $369 Np$ 镎 $370 Pu$ 钚 $371 Am$ 镅 $372 Cf$ 锔 $373 Es$ 锿 $374 Md$ 镆 $375 No$ 锘 $376 Lr$ 铹 $377 Rf$ 𫓧 $378 Fr$ 钫 $379 Pa$ 镤 $380 Th$ 钍 $381 Np$ 镎 $382 Pu$ 钚 $383 Am$ 镅 $384 Cf$ 锔 $385 Es$ 锿 $386 Md$ 镆 $387 No$ 锘 $388 Lr$ 铹 $389 Rf$ 𫓧 $390 Fr$ 钫 $391 Pa$ 镤 $392 Th$ 钍 $393 Np$ 镎 $394 Pu$ 钚 $395 Am$ 镅 $396 Cf$ 锔 $397 Es$ 锿 $398 Md$ 镆 $399 No$ 锘 $400 Lr$ 铹 $401 Rf$ 𫓧 $402 Fr$ 钫 $403 Pa$ 镤 $404 Th$ 钍 $405 Np$ 镎 $406 Pu$ 钚 $407 Am$ 镅 $408 Cf$ 锔 $409 Es$ 锿 $410 Md$ 镆 $411 No$ 锘 $412 Lr$ 铹 $413 Rf$ 𫓧 $414 Fr$ 钫 $415 Pa$ 镤 $416 Th$ 钍 $417 Np$ 镎 $418 Pu$ 钚 $419 Am$ 镅 $420 Cf$ 锔 $421 Es$ 锿 $422 Md$ 镆 $423 No$ 锘 $424 Lr$ 铹 $425 Rf$ 𫓧 $426 Fr$ 钫 $427 Pa$ 镤 $428 Th$ 钍 $429 Np$ 镎 $430 Pu$ 钚 $431 Am$ 镅 $432 Cf$ 锔 $433 Es$ 锿 $434 Md$ 镆 $435 No$ 锘 $436 Lr$ 铹 $437 Rf$ 𫓧 $438 Fr$ 钫 $439 Pa$ 镤 $440 Th$ 钍 $441 Np$ 镎 $442 Pu$ 钚 $443 Am$ 镅 $444 Cf$ 锔 $445 Es$ 锿 $446 Md$ 镆 $447 No$ 锘 $448 Lr$ 铹 $449 Rf$ 𫓧 $450 Fr$ 钫 $451 Pa$ 镤 $452 Th$ 钍 $453 Np$ 镎 $454 Pu$ 钚 $455 Am$ 镅 $456 Cf$ 锔 $457 Es$ 锿 $458 Md$ 镆 $459 No$ 锘 $460 Lr$ 铹 $461 Rf$ 𫓧 $462 Fr$ 钫 $463 Pa$ 镤 $464 Th$ 钍 $465 Np$ 镎 $466 Pu$ 钚 $467 Am$ 镅 $468 Cf$ 锔 $469 Es$ 锿 $470 Md$ 镆 $471 No$ 锘 $472 Lr$ 铹 $473 Rf$ 𫓧 $474 Fr$ 钫 $475 Pa$ 镤 $476 Th$ 钍 $477 Np$ 镎 $478 Pu$ 钚 $479 Am$ 镅 $480 Cf$ 锔 $481 Es$ 锿 $482 Md$ 镆 $483 No$ 锘 $484 Lr$ 铹 $485 Rf$ 𫓧 $486 Fr$ 钫 $487 Pa$ 镤 $488 Th$ 钍 $489 Np$ 镎 $490 Pu$ 钚 $491 Am$ 镅 $492 Cf$ 锔 $493 Es$ 锿 $494 Md$ 镆 $495 No$ 锘 $496 Lr$ 铹 $497 Rf$ 𫓧 $498 Fr$ 钫 $499 Pa$ 镤 $500 Th$ 钍 $501 Np$ 镎 $502 Pu$ 钚 $503 Am$ 镅 $504 Cf$ 锔 $505 Es$ 锿 $506 Md$ 镆 $507 No$ 锘 $508 Lr$ 铹 $509 Rf$ 𫓧 $510 Fr$ 钫 $511 Pa$ 镤 $512 Th$ 钍 $513 Np$ 镎 $514 Pu$ 钚 $515 Am$ 镅 $516 Cf$ 锔 $517 Es$ 锿 $518 Md$ 镆 $519 No$ 锘 $520 Lr$ 铹 $521 Rf$ 𫓧 $522 Fr$ 钫 $523 Pa$ 镤 $524 Th$ 钍 $525 Np$ 镎 $526 Pu$ 钚 $527 Am$ 镅 $528 Cf$ 锔 $529 Es$ 锿 $530 Md$ 镆 $531 No$ 锘 $532 Lr$ 铹 $533 Rf$ 𫓧 $534 Fr$ 钫 $535 Pa$ 镤 $536 Th$ 钍 $537 Np$ 镎 $538 Pu$ 钚 $539 Am$ 镅 $540 Cf$ 锔 $541 Es$ 锿 $542 Md$ 镆 $543 No$ 锘 $544 Lr$ 铹 $545 Rf$ 𫓧 $546 Fr$ 钫 $547 Pa$ 镤 $548 Th$ 钍 $549 Np$ 镎 $550 Pu$ 钚 $551 Am$ 镅 $552 Cf$ 锔 $553 Es$ 锿 $554 Md$ 镆 $555 No$ 锘 $556 Lr$ 铹 $557 Rf$ 𫓧 $558 Fr$ 钫 $559 Pa$ 镤 $560 Th$ 钍 $561 Np$ 镎 $562 Pu$ 钚 $563 Am$ 镅 $564 Cf$ 锔 $565 Es$ 锿 $566 Md$ 镆 $567 No$ 锘 $568 Lr$ 铹 $569 Rf$ 𫓧 $570 Fr$ 钫 $571 Pa$ 镤 $572 Th$ 钍 $573 Np$ 镎 $574 Pu$ 钚 $575 Am$ 镅 $576 Cf$ 锔 $577 Es$ 锿 $578 Md$ 镆 $579 No$ 锘 $580 Lr$ 铹 $581 Rf$ 𫓧 $582 Fr$ 钫 $583 Pa$ 镤 $584 Th$ 钍 $585 Np$ 镎 $586 Pu$ 钚 $587 Am$ 镅 $588 Cf$ 锔 $589 Es$ 锿 $590 Md$ 镆 $591 No$ 锘 $592 Lr$ 铹 $593 Rf$ 𫓧 $594 Fr$ 钫 $595 Pa$ 镤 $596 Th$ 钍 5

目 录

序图

2—3	中国土壤环境背景值采样点分布图	1:12000000
6—7	中国土壤图	1:12000000
10—11	中国土壤母质母岩图	1:12000000
14—15	中国土壤 pH 值点位图	1:12000000
18—19	中国土壤有机质含量点位图	1:12000000
22—23	中国土壤质地分级点位图	1:12000000

单元素背景值图

26—27	中国土壤环境铜(Cu)元素背景值图	1:12000000
30—31	中国土壤环境铅(Pb)元素背景值图	1:12000000
34—35	中国土壤环境锌(Zn)元素背景值图	1:12000000
38—39	中国土壤环境镉(Cd)元素背景值图	1:12000000
42—43	中国土壤环境镍(Ni)元素背景值图	1:12000000
46—47	中国土壤环境铬(Cr)元素背景值图	1:12000000
50—51	中国土壤环境汞(Hg)元素背景值图	1:12000000
54—55	中国土壤环境砷(As)元素背景值图	1:12000000
58—59	中国土壤环境氟(F)元素背景值图	1:12000000
62—63	中国土壤环境锰(Mn)元素背景值图	1:12000000
66—67	中国土壤环境钴(Co)元素背景值图	1:12000000
70—71	中国土壤环境钒(V)元素背景值图	1:12000000
74—75	中国土壤环境硒(Se)元素背景值图	1:12000000
78—79	铜(Cu)	1:12000000
80	锂(Li) 钠(Na)	1:25000000
81	钾(K) 铷(Rb)	1:25000000
82—83	铅(Pb)	1:12000000
84	铯(Cs) 铍(Be)	1:25000000
85	镁(Mg) 钙(Ca)	1:25000000
86—87	锌(Zn)	1:12000000
88	锶(Sr) 钡(Ba)	1:25000000
89	钛(Ti) 锆(Zr)	1:25000000
90—91	镉(Cd)	1:12000000
92	铪(Hf) 钼(Mo)	1:25000000
93	钨(W) 铁(Fe)	1:25000000
94—95	镍(Ni)	1:12000000
96	银(Ag) 硼(B)	1:25000000
97	铝(Al) 镊(Ga)	1:25000000
98—99	铬(Cr)	1:12000000
100	铟(In) 铟(Tl)	1:25000000
101	锗(Ge) 锡(Sn)	1:25000000
102—103	汞(Hg)	1:12000000
104	锑(Sb) 铋(Bi)	1:25000000
105	钽(Ta) 碲(Te)	1:25000000
106—107	砷(As)	1:12000000
108	溴(Br) 碘(I)	1:25000000
109	钍(Th) 铀(U)	1:25000000

110—111	氟(F)		1:12000000
112	钪(Sc)	钇(Y)	1:25000000
113	镧(La)	铈(Ce)	1:25000000
114—115	锰(Mn)		1:12000000
116	镨(Pr)	钕(Nd)	1:25000000
117	钐(Sm)	铕(Eu)	1:25000000
118—119	钴(Co)		1:12000000
120	钆(Gd)	铽(Tb)	1:25000000
121	镝(Dy)	钬(Ho)	1:25000000
122—123	钒(V)		1:12000000
124	铒(Er)	铥(Tm)	1:25000000
125	镱(Yb)	镥(Lu)	1:25000000
126—127	硒(Se)		1:12000000
129	铜(Cu)	铅(Pb)	1:25000000
130	锌(Zn)	镉(Cd)	1:25000000
131	镍(Ni)	铬(Cr)	1:25000000
132	汞(Hg)	砷(As)	1:25000000
133	氟(F)	锰(Mn)	1:25000000
134	钴(Co)	钒(V)	1:25000000
135	硒(Se)	锂(Li)	1:25000000
136	钠(Na)	钾(K)	1:25000000
137	铷(Rb)	铯(Cs)	1:25000000
138	铍(Be)	镁(Mg)	1:25000000
139	钙(Ca)	锶(Sr)	1:25000000
140	钛(Ti)	锆(Zr)	1:25000000
141	铪(Hf)	钼(Mo)	1:25000000
142	钨(W)	铁(Fe)	1:25000000
143	银(Ag)	硼(B)	1:25000000
144	铝(Al)	镓(Ga)	1:25000000
145	铟(In)	铊(Tl)	1:25000000
146	锗(Ge)	锑(Sb)	1:25000000
147	铋(Bi)	钽(Ta)	1:25000000
148	碲(Te)	溴(Br)	1:25000000
149	碘(I)	钍(Th)	1:25000000
150	铀(U)	钪(Sc)	1:25000000
151	钇(Y)	镧(La)	1:25000000
152	铈(Ce)	镨(Pr)	1:25000000
153	钕(Nd)	钐(Sm)	1:25000000
154	铕(Eu)	钆(Gd)	1:25000000
155	铽(Tb)	镝(Dy)	1:25000000
156	钬(Ho)	铒(Er)	1:25000000
157	铥(Tm)	镱(Yb)	1:25000000
158	镥(Lu)		1:25000000

多元素背景值图

162—163	锌、镉(Zn、Cd)分级点位图	1:12000000
164—165	钠、钾、铷(Na、K、Rb)分级点位图	1:25000000
	锂、铯(Li、Cs)分级点位图	1:25000000
	镁、钙、锶、钡(Mg、Ca、Sr、Ba)分级点位图	1:25000000
	溴、碘(Br、I)分级点位图	1:25000000

166—167	镍、钴(Ni、Co)分级点位图	1:12000000
168—169	镍、钴、铁(Ni、Co、Fe)分级点位图	1:25000000
	锆、铪(Zr、Hf)分级点位图	1:25000000
	铝、钛(Al、Ti)分级点位图	1:25000000
	钍、铀(Th、U)分级点位图	1:25000000
170—171	钒、铬(V、Cr)分级点位图	1:12000000
172—173	总稀土(La—Lu、Y)分级点位图	1:25000000
	铈组稀土(La—Eu)分级点位图	1:25000000
	钇组稀土(Y、Gd—Lu)分级点位图	1:25000000
	锌、镉(Zn、Cd)格网图	1:25000000
174—175	氟、砷(F、As)分级点位图	1:12000000
176—177	镍、钴、铁(Ni、Co、Fe)格网图	1:25000000
	钒、铬(V、Cr)格网图	1:25000000
	钠、钾、铷(Na、K、Rb)格网图	1:25000000
	锂、铯(Li、Cs)格网图	1:25000000
178—179	钙、镁(Ca、Mg)格网图	1:25000000
	溴、碘(Br、I)格网图	1:25000000
	锆、铪(Zr、Hf)格网图	1:25000000
	铝、钛(Al、Ti)格网图	1:25000000
180—181	钍、铀(Th、U)格网图	1:25000000
	总稀土(La—Lu、Y)格网图	1:25000000
	铈组稀土(La—Eu)格网图	1:25000000
	钇组稀土(Y、Gd—Lu)格网图	1:25000000

实验图

185	钠(Na)透视图	
	钠(Na)透视剖面图	
186—187	镁、钙(Mg、Ca)透视图	
	镁、钙(Mg、Ca)透视剖面图	
	铷(Rb)透视图	
	铷(Rb)透视剖面图	
188—189	锶(Sr)透视图	
	锶(Sr)透视剖面图	
	溴、碘(Br、I)透视图	
	溴、碘(Br、I)透视剖面图	
190—191	钍(Th)透视图	
	钍(Th)透视剖面图	
	镨(Pr)透视图	
	镨(Pr)透视剖面图	
192—193	铕(Eu)透视图	
	铕(Eu)透视剖面图	
	中国土壤 pH 值等值线图	1:25000000
	中国土壤有机质含量等值线图	1:25000000
194	镁(Mg)等值线图	1:25000000
	钙(Ca)等值线图	1:25000000

CONTENT

Preface Map

2 — 3	The Map of Sampling Sites Distribution of China SEBV	1 : 12000000
6 — 7	The Map of China's Soil	1 : 12000000
10 — 11	The Map of Mother Material and Mother Rock of China's Soil	1 : 12000000
14 — 15	The Graded Site Map for Soil pH in China	1 : 12000000
18 — 19	The Graded Site Map for Organic Matter Content in China's Soil	1 : 12000000
22 — 23	The Graded Site Map for Soil Texture in China's Soil	1 : 12000000

Mono—Element Background Value Map

26 — 27	The Map of China SEBV of Element Copper (Cu)	1 : 12000000	
30 — 31	The Map of China SEBV of Element Lead (Pb)	1 : 12000000	
34 — 35	The Map of China SEBV of Element Zinc (Zn)	1 : 12000000	
38 — 39	The Map of China SEBV of Element Cadmium (Cd)	1 : 12000000	
42 — 43	The Map of China SEBV of Element Nickel (Ni)	1 : 12000000	
46 — 47	The Map of China SEBV of Element Chromium (Cr)	1 : 12000000	
50 — 51	The Map of China SEBV of Element Mercury (Hg)	1 : 12000000	
54 — 55	The Map of China SEBV of Element Arsenic (As)	1 : 12000000	
58 — 59	The Map of China SEBV of Element Flourine (F)	1 : 12000000	
62 — 63	The Map of China SEBV of Element Manganese (Mn)	1 : 12000000	
66 — 67	The Map of China SEBV of Element Cobalt (Co)	1 : 12000000	
70 — 71	The Map of China SEBV of Element Vanadium (V)	1 : 12000000	
74 — 75	The Map of China SEBV of Element Selenium (Se)	1 : 12000000	
78 — 79	Copper (Cu)	1 : 12000000	
80	Lithium (Li)	Sodium (Na)	1 : 25000000
81	Potassium (K)	Rubidium (Rb)	1 : 25000000
82 — 83	Lead (Pb)		1 : 12000000
84	Cesium (Cs)	Beryllium (Be)	1 : 25000000
85	Magnesium (Mg)	Calcium (Ca)	1 : 25000000
86 — 87	Zinc (Zn)		1 : 12000000
88	Strontium (Sr)	Barium (Ba)	1 : 25000000
89	Titanium (Ti)	Zirconium (Zr)	1 : 25000000
90 — 91	Cadmium (Cd)		1 : 12000000
92	Hafnium (Hf)	Molybdenum (Mo)	1 : 25000000
93	Tungsten (W)	Iron (Fe)	1 : 25000000
94 — 95	Nickel (Ni)		1 : 12000000
96	Silver (Ag)	Boron (B)	1 : 25000000
97	Aluminium (Al)	Gallium (Ga)	1 : 25000000
98 — 99	Chromium (Cr)		1 : 12000000
100	Indium (In)	Thallium (Tl)	1 : 25000000
101	Germanium (Ge)	Tin (Sn)	1 : 25000000
102 — 103	Mercury (Hg)		1 : 12000000
104	Antimony (Sb)	Bismuth (Bi)	1 : 25000000
105	Tantalum (Ta)	Tellurium (Te)	1 : 25000000
106 — 107	Arsenic (As)		1 : 12000000
108	Bromine (Br)	Iodine (I)	1 : 25000000
109	Thorium (Th)	Uranium (U)	1 : 25000000

110 — 111	Flourine (F)		1 : 12000000
112	Scandium (Sc)	Yttrium (Y)	1 : 25000000
113	Lanthanum (La)	Cerium (Ce)	1 : 25000000
114 — 115	Manganese (Mn)		1 : 12000000
116	Praseodymium (Pr)	Neodymium (Nd)	1 : 25000000
117	Samarium (Sm)	Europium (Eu)	1 : 25000000
118 — 119	Cobalt (Co)		1 : 12000000
120	Gadolinium (Gd)	Terbium (Tb)	1 : 25000000
121	Dysprosium (Dy)	Holmium (Ho)	1 : 25000000
122 — 123	Vanadium (V)		1 : 12000000
124	Erbium (Er)	Thulium (Tm)	1 : 25000000
125	Ytterbium (Yb)	Lutetium (Lu)	1 : 25000000
126 — 127	Selenium (Se)		1 : 12000000
129	Copper (Cu)	Lead (Pb)	1 : 25000000
130	Zinc (Zn)	Cadmium (Cd)	1 : 25000000
131	Nickel (Ni)	Chromium (Cr)	1 : 25000000
132	Mercury (Hg)	Arsenic (As)	1 : 25000000
133	Flourine (F)	Manganese (Mn)	1 : 25000000
134	Cobalt (Co)	Vanadium (V)	1 : 25000000
135	Selenium (Se)	Lithium (Li)	1 : 25000000
136	Sodium (Na)	Potassium (K)	1 : 25000000
137	Rubidium (Rb)	Cesium (Cs)	1 : 25000000
138	Beryllium (Be)	Magnesium (Mg)	1 : 25000000
139	Calcium (Ca)	Strontium (Sr)	1 : 25000000
140	Titanium (Ti)	Zirconium (Zr)	1 : 25000000
141	Hafnium (Hf)	Molybdenum (Mo)	1 : 25000000
142	Tungsten (W)	Iron (Fe)	1 : 25000000
143	Silver (Ag)	Boron (B)	1 : 25000000
144	Aluminium (Al)	Gallium (Ga)	1 : 25000000
145	Indium (In)	Thallium (Tl)	1 : 25000000
146	Germanium (Ge)	Antimony (Sb)	1 : 25000000
147	Bismuth (Bi)	Tantalum (Ta)	1 : 25000000
148	Tellurium (Te)	Bromine (Br)	1 : 25000000
149	Iodine (I)	Thorium (Th)	1 : 25000000
150	Uranium (U)	Scandium (Sc)	1 : 25000000
151	Yttrium (Y)	Lanthanum (La)	1 : 25000000
152	Cerium (Ce)	Praseodymium (Pr)	1 : 25000000
153	Neodymium (Nd)	Samarium (Sm)	1 : 25000000
154	Europium (Eu)	Gadolinium (Gd)	1 : 25000000
155	Terbium (Tb)	Dysprosium (Dy)	1 : 25000000
156	Holmium (Ho)	Erbium (Er)	1 : 25000000
157	Thulium (Tm)	Ytterbium (Yb)	1 : 25000000
158	Lutetium (Lu)		1 : 25000000

Multi—Element Background Value Map

162 — 163	The Graded point Sites Map of Zinc and Cadmium (Zn , Cd)	1 : 12000000
164 — 165	The Graded point Sites Map of Sodium, Potassium and Rubidium (Na , K , Rb)	1 : 25000000
	The Graded point Sites Map of Lithium and Cesium (Li , Cs)	1 : 25000000
	The Graded point Sites Map of Magnesium, Calcium, Strontium and Barium (Mg,Ca,Sr,Ba)	1 : 25000000
	The Graded point Sites Map of Bromine and Iodine (Br , I)	1 : 25000000