南岭贵东岩浆岩与铀成矿作用

李子颖　等著

地质出版社

南岭贵东岩浆岩与铀成矿作用

李子颖　黄志章　李秀珍　何建国　著

地质出版社

·北　京·

内 容 提 要

本书对南岭贵东岩浆岩与铀成矿作用开展了多学科领域的系统研究，阐明了贵东岩浆岩的时空演化和岩性岩相与地球化学特点，揭示了铀矿化特征和成矿机理，提出了热点铀成矿作用，并建立了相应的成矿模式。本书内容包括绪论、地幔柱和热点作用、华南地幔柱构造及铀区域成矿特征、贵东热点作用、贵东岩体构造变形及热动力作用、岩浆活动及岩浆期次划分、贵东岩体岩浆岩岩石学及地球化学、交代蚀变作用、热点活动与铀成矿关系、铀矿成矿地球化学条件及成矿机理研究等部分。

本书是《南岭贵东岩浆岩与铀成矿作用显微图册》的姊妹篇，该书不仅对从事铀矿地质研究和勘查的工作人员，而且对高等院校及从事资源矿产研究和开发的人员均具有参考价值。

Brief Introduction

The book deals with multiple geoscientific and systematic studies on magmatism and uranium metallogeny in Guidong area of eastern Nanling Mountains, South China. It is mainly involved in magmatic time and space evolution, its geochemical signatures, uranium metallogeneic features and mechanism and model as well, and divided into introduction, mantle plume and hotspots, South China mantle plume tectonics and uranium regional metallogeny, Guidong hotspot, deformation and thermal dynamics of Guidong granitic massive, magmatism and phases, petrological and geochemical studies, metasomatism and alteration, uranium metallogeny related to hotspots, uranium metallogenic conditions and mechanism etc..

This book is a sister publication of ***The Microphoto Atlas and Studies On Magmatism and Uranium Metallogeny in Guidong Area of Eastern Nanling Mountains, South China***. It is of important referential values not only for people engaged in uranium and other mineral resource study and exploration, but also for teachers and students in colleges and universities.

图书在版编目(CIP)数据

南岭贵东岩浆岩与铀成矿作用/李子颖等著. —北京：地质出版社，2010. 12

ISBN 978-7-116-07012-7

Ⅰ. ①南… Ⅱ. ①李… Ⅲ. ①南岭—火成岩—成岩作用②南岭—铀矿床—成矿作用 Ⅳ. ①P588. 192②P619. 140. 2

中国版本图书馆 CIP 数据核字(2010)第 242335 号

NANLING GUIDONG YANJIANGYAN YU YOUCHENGKUANG ZUOYONG

组稿编辑：王大军 白 铁
责任编辑：白 铁 汪福炘
责任校对：杜 悦
出版发行：地质出版社
社址邮编：北京海淀区学院路 31 号，100083
电 话：(010)82324508(邮购部)；(010)82324579(编辑部)
网 址：http://www.gph.com.cn
电子邮箱：zbs@gph.com.cn
传 真：(010)82310759
印 刷：北京天成印务有限责任公司
开 本：787mm×1092mm $^{1}/_{16}$
印 张：19.5
字 数：400 千字
版 次：2010 年 12 月第 1 版
印 次：2010 年 12 月第 1 次印刷
定 价：60.00 元
书 号：ISBN 978-7-116-07012-7

(如对本书有建议或意见，敬请致电本社；如本书有印装问题，本社负责调换)

序

《南岭贵东岩浆岩与铀成矿作用》是作者在完成多项课题研究的基础上，集成大量的科学资料和数据，针对南岭贵东岩体岩浆岩和热活动与铀成矿作用系统总结而成，反映了最新的热液型铀矿研究成果，是一部很好并有特色的学术专著。

20 世纪 50 年代在贵东花岗岩岩体内发现铀矿不仅是中国铀成矿找矿历史上的新突破，也是世界铀矿找矿的新突破。它打破了花岗岩体内不能形成铀矿的禁区，记录了中国第一代铀矿找矿工作者所走过的艰辛之路，开创了岩体内带找寻铀矿的新领域，从而成就了当今在中国花岗岩中找到了众多铀矿田的史实，并成为中国主要工业铀矿类型之一。贵东岩体中铀矿找矿的突破本身就是创新，如今它已是中国重要的铀矿产出岩体。贵东岩体作为南岭花岗岩东西向成矿带中的重要一员，在南岭花岗岩与成矿作用的研究历史中也占据重要的一席。因此，总结贵东岩浆岩与铀成矿作用不仅对铀矿地质研究和勘查工作具有重要意义，而且对研究钨、锡、铅、锌、铜等矿产成矿规律和预测也具有重要价值。

对贵东岩体和铀矿的勘查研究始于 1957 年，50 多年来做了大量的勘查和研究工作，在找矿突破上取得重大成就，在成矿规律和理论研究方面取得许多重要成果。然而，至今还没有一本专门的针对贵东岩浆作用和铀成矿作用的论著。因此，从这点上讲，该书的出版具有特别的意义。

该书是一本涉及岩浆作用和铀成矿作用的综合性著作，涉及地质科学中诸多学科，如：区域地质学、地球化学、地球物理、构造地质学、岩石学、矿物学、同位素地质学、矿床学、蚀变交代和流体包裹体研究等。该书充分吸纳了国内外的最新研究成果，深入论述了诸多学科问题，如深部动力学问题、岩浆岩的岩性和成因及时空演化，宏观和微观构造特征及其动力学机制，铀成矿的矿源、矿化物质的迁移、成矿深度、铀矿石沉淀的物理化学条件和铀矿富集的优选空间问题等等，并取得了许多重要成果，在成矿理论上提出了新的热点铀成矿作用，具有重要的科学价值。

本书与《南岭贵东岩浆岩与铀成矿作用显微图册》是姊妹篇，它的出版是铀矿地质研究的一件幸事，也是资源矿产研究的一件幸事，我很高兴地向大家推荐这部专著，同时也向全体著者致以衷心的祝贺。

中国工程院院士

2010 年 10 月于北京

Preface

The book "Magmatism and Uranium Metallogeny in Guidong Area of Eastern Nanling Mountains, South China" is based on the comprehensive and projects studies data and results, involved in multiple geoscientific and systematic studies on magmatism and uranium metallogeny in Guidong area of eastern Nanling Mountains, South China, marking the recent research progresses on the hydrothermal uranium deposits, being an outstanding academic monograph.

The Uranium deposit in eastern Guidong Massif of Nanling Mountains was discovered in the nineteen fifties and marks not only the breakthrough in the granite-related uranium exploration in China, but also the first one within the granite-related uranium deposits in the world. The discovery of uranium mineralization within the Guidong granite massive indicated a new road to explore uranium resource, and in fact up to now, a number of uranium deposits have been founded within and outside granitic massives through hard working and studies of generations of uranium exploration geologists. The granite-related uranium deposit has become one of very important industrial types of uranium deposits in China. The uranium deposits in the Guidong massive are the typical representative of hydrothermal uranium deposit occurring in granites and record a creative exploration history. It should also be pointed out that the Guidong granitic massive is one of important Nanling East-West extending mineralized granitic massive. Hence, the book is not only of very important significances to uranium deposit studies and exploration themselves, but also very valuable for the study on metallogenic regularity and prognosis of the mineral resources such as tungsten, tin, lead, zinc and copper etc.

The studies on Guidong granitic massive and related uranium exploration began in 1957, and since that time a lot of works have been done and achievements gotten in uranium resource, metallogenic regularity and theory etc. However, up to now, there is no monograph dealing with magmatism and uranium metallogeny in the Guidong massive published, so from this point of view, the publication of this book is of special significances.

This is a comprehensive uranium geoscientific book, dealing with many subjects, such as regional geology, geochemistry, geophysics, tectonics, petrology, mineralogy, isotopes, deposits, metasomatism and alteration, fluid inclusions, uranium mineralization etc. Based on the references of the newest progresses in similar research fields at home and broad, it puts emphases on the scientific problems, such as deep geodynamics, magma origin and its time and space evolution, macro- and micro structure and texture and their stress dynamics, uranium sources

此为试读,需要完整PDF请访问: www.ertongbook.com

and migration and precipitation, physical and chemical conditions of uranium formation etc. showing abundant data and results, especially hotspots-related uranium metallogeny. The basic achievements are of important scientific values.

This book is a sister publication of ***The Microphoto Atlas and Studies On Magmatism and Uranium Metallogeny in Guidong Area of Eastern Nanling Mountains, South China***. It is a fortunate event for uranium geology research and exploration. So, I am very happy to recommend you the significant and characteristic monograph, and at the same time, extend my faithful congratulations to the authors for the book publication.

Chen Yuchuan

Academician of Chinese Engineering Academy

Oct. 2010 in Beijing, China

前　言

岩浆作用是地壳中热的主要来源。岩浆作用的整个演化发展过程，不仅是一个地区热液活动历史的见证，而且是岩浆作用地区地球化学史的反映。因此，众多学者潜心于岩浆作用的研究，来探索岩浆作用与成矿的关系。

贵东岩体在中国铀成矿找矿历史上具有不可磨灭的足迹。它记录了中国第一代找铀矿工作者所走过的艰辛之路；记录了中国铀成矿找矿工作突破苏联地质专家禁止岩体内带找矿的禁区；开拓了岩体内带找寻铀矿的新领域，给花岗岩内带找矿带来了新生，从而成就了当今在华南花岗岩中找到了多个铀矿田的史实。

贵东岩体是中国重要的铀矿产出岩体，铀矿床既可以赋存于不同花岗岩的构造带中，又可以赋存于切穿辉绿岩的构造带中，还可以产于外带沉积变质岩的构造带中。由于特殊的构造地质历史，贵东岩体与铀成矿结下了不解之缘。贵东岩体的研究是从1957年进入下庄地区找矿工作开始的，在半个多世纪的时间里，众多生产一线的地质人员、大专院校及地质研究院(所)专业人士，对该地区开展了多学科的研究工作。核工业北京地质研究院从1961年至今，开展了构造、岩浆岩、地球化学、岩浆岩的热交代作用、交代蚀变、矿床物质成分、成矿时代及流体包裹体等领域的研究，取得重要的研究成果和认识。作者在上述研究成果的基础上，通过完成“华南主要铀矿田成矿标志识别”和“大型花岗岩型铀矿床成矿地球化学研究”等课题，对贵东岩体岩浆岩及铀矿床成矿作用开展了多学科领域的系统研究，获得了大量的科学资料和数据，取得了一系列重要成果。为推动铀矿地质研究工作的发展，决定将上述研究成果以热点成矿作用为主线做一系统总结，编书出版，以飨读者。

本书共9个部分，包括绪论、地幔柱和热点作用、华南地幔柱构造及铀区域成矿特征、贵东热点作用、贵东岩体构造变形及热动力作用、岩浆活动及岩浆期次划分、贵东岩体岩浆岩岩石学及地球化学、热点活动与铀成矿关系、铀矿成矿地球化学条件及成矿机理研究。以上各个章节分别由李子颖、黄志章、李秀珍、何建国撰写，照相由李秀珍完成，衣龙升翻译了英文摘要，张玉燕等完成了全书的文字录入和部分图件清绘工作，全书由李子颖审定。

《南岭贵东岩浆岩与铀成矿作用》一书的撰写与研究工作是在核工业北京地质研究院、地矿所两级领导和科技处的大力支持下完成的；得到原国防科工委(国家国防科工局)和中核集团有关部门及中国核工业地质局的大力支持，特别是朱鑫璋博士、严叔衡研究员、冯运昌研究员、张金带研究员、齐占顺研究员和赵凤民研究员给予许多支持和

指导，核工业290研究所、741矿山等单位也给予了大力支持和协助，报告中分析测试项目得到了核工业北京地质研究院分析测试研究所、国土资源部物化探测试中心、中国科学院地质所、中国地质科学院同位素分析室、扫描电镜分析室、中国地质大学X光室、北京大学红外光谱分析室、中国石油规划院K-Ar分析室、X光分析室等单位的帮助，在此一并致以衷心感谢。本书在编辑出版过程中得到地质出版社白铁、王大军的帮助，同样致以衷心感谢。

作　者：李子颖

2010年10月于北京

Foreword

Magma activities are the products of thermo-dynamics, its evolution reflects not only thermal activity history, but also physical and chemical processes, which are related to uranium mineralization. Hence, magmatism is studied in order to find out the relationship between magma activities and metallogeny.

The exploration history for uranium resources in the Guidong massive shows very important roles in Chinese uranium exploration history, and records a hard and creative road to find a new type of uranium deposit within granites, which was considered to be impossible to find one before. The discovery of uranium deposits within Guidong granites led to have found many new granite-related uranium deposits in South China which has become a major uranium province in China.

The Guidong massive is one of important uranium-productive granitic bodies in China, uranium deposits founded are located both within and outside granites, such as contact zones between granite and meta-sediments, also in the tectonic belts cutting diabase dykes. There is an original relationship between magmatism and uranium mineralization. The studies on Guidong granitic massive and related uranium exploration began in 1957, and a lot of studies and exploration work have been done since that time by the people from institutes, universities and geological terms. However, major research works have been carried out by Beijing Research Institute of Uranium Geology, mainly dealing with many subjects, such as tectonics, geochemistry, geophysics, petrology, mineralogy, isotopes, deposits, metasomatism and alteration, fluid inclusions, uranium mineralization etc., and a number of data and achievements gotten, and based on the hotspots-related uranium metallogeny, the data and achievements have been summarized and compiled as this book to promote uranium exploration.

The book is composed of nine parts like introduction, mantle plume and hotspots, South China mantle plume tectonics and uranium regional metallogeny, Guidong hotspot, deformation and thermal dynamics of Guidong granitic massive, magmatism and phases, petrological and geochemical studies, metasomatism and alteration, uranium metallogeny related to hotspots, uranium metallogenic conditions and mechanism etc., which is written by Prof. Dr. Li Ziying, Prof. Huang Zhizhang, Mrs. Li Xiuzhen and Prof. He Jianguo. The photos are taken by Mrs. Li Xiuzhen. The text and photos have been finalized by Prof. Dr. Li Ziying. English translation of the abstract and major conclusions has been made by Mr. Yi Longsheng, and finalized by Prof. Dr. Li Ziying.

The book publication and related studies are completed with the vigorous supports of the Scientific and Technological Management Department, Geological and Mineral Resources Division and Heads of Beijing Research Institute of Uranium Geology (BRIUG), and greatly supported by the China Atomic Energy Authority, Bureau of Geology, China National Nuclear Coporation (CNNC) and so on. Special thanks are given to the help and support from Dr. Zhu Xinzhang, Dr. Qi Zhanxun, Prof. Zhang Jindai, Prof. Yan Shuheng, Prof. Feng Yunchang, Prof. Zhao Fengmin and so on.

Also thanks are given to the institutions such as the Research Institute No. 290 of CNNC, the Uranium Mine No. 741 of CNNC, Geological Party No. 293 for their assistance and help during the field work, labs of BRIUG, Geophysical and geochemical institute of Ministry of Land and Resources, Geological Institute of Chinese Academy of Sciences, labs of Chinese Academy of Geosciences, China University of Geosciences, Beijing University and Research Institute of Petro China etc. for their analyses of the samples...

This book is a sister publication of **The Microphoto Atlas and Studies on Magmatism and Uranium Metallogeny in Guidong Area of Eastern Nanling Mountains, South China**. It is sincerely hoped that the book may be of important referential values not only for people engaged in uranium and other mineral resource study and exploration, but also for teachers and students in colleges and universities.

Finally, thanks are extended to Mr. Bai Tie in the Geological Press for his hard editorial work of the book.

The authors

Feb. 2010 in Beijing, China

目　　录

序

前　言

第一章　地幔柱和热点作用 …… (1)

第一节　基本概念和理论 …… (1)

第二节　热点活动与成矿作用 …… (3)

第二章　华南地幔柱构造和铀成矿区域特征 …… (5)

第一节　华南中、新生代地幔柱构造作用与区域地质构造演化 …… (5)

第二节　华南主要铀成矿区域特征 …… (9)

一、区域上铀矿形成于隆起区或其边缘 …… (9)

二、区域性深大断裂控制铀矿化 …… (10)

三、成矿年龄的相近性和含矿主岩的相异性 …… (11)

四、“红色化”现象与铀矿化 …… (12)

五、基性岩浆活动 …… (13)

六、区域地球化学和地球物理成矿标志 …… (14)

第三章　贵东岩体热点作用 …… (19)

第四章　贵东岩体构造变形和热动力作用 …… (25)

第一节　贵东岩体内显微构造现象 …… (25)

第二节　应力变形岩石分类 …… (28)

一、保留原结构裂损变形岩 …… (29)

二、残留原结构碎裂变形岩 …… (29)

三、强碎裂新生结构变形岩 …… (30)

四、其他类型构造岩——角砾岩、变余糜棱岩和叠加构造岩 …… (31)

第三节　贵东岩体的构造 …… (32)

一、近东西向构造 …… (33)

二、北东东向构造 …… (37)

三、北北东向构造 …… (43)

第五章　岩浆活动及岩浆岩期次划分 …… (55)

第一节　岩浆活动特点 …… (55)

一、贵东岩体产出区域地质背景 …… (55)

二、贵东岩体周边岩浆活动特点 …… (55)

此为试读，需要完整PDF请访问：www.ertongbook.com

第二节　贵东岩体岩浆岩的侵入期次划分 …… (56)
一、岩浆岩侵入期次划分方案 …… (56)
二、贵东岩体岩浆岩年代学研究 …… (57)
三、贵东岩体岩浆岩期次划分 …… (63)
第六章　贵东岩体岩浆岩岩石学和地球化学 …… (68)
第一节　粗粒斑状黑云母花岗岩岩石学和地球化学 …… (68)
一、粗粒斑状黑云母花岗岩岩石学特征 …… (68)
二、粗粒斑状黑云母花岗岩的副矿物特征 …… (73)
三、粗粒斑状黑云母花岗岩类主量元素特征 …… (74)
四、粗粒斑状黑云母花岗岩类的稀土元素特征 …… (77)
五、粗粒斑状黑云母花岗岩类的微量元素特征 …… (78)
第二节　中粒斑状黑云母花岗岩岩石学和地球化学 …… (80)
一、中粒斑状黑云母花岗岩岩石学特征 …… (80)
二、中粒斑状黑云母花岗岩的副矿物特征 …… (84)
三、中粒斑状黑云母花岗岩的主量元素特征 …… (85)
四、中粒斑状黑云母花岗岩的稀土元素特征 …… (86)
五、中粒斑状黑云母花岗岩的微量元素特征 …… (86)
第三节　细粒白云母花岗岩岩石学和地球化学 …… (88)
一、细粒白云母花岗岩岩石学特征 …… (88)
二、细粒白云母花岗岩的副矿物特征 …… (91)
三、细粒白云母花岗岩的主量元素特征 …… (92)
四、细粒白云母花岗岩的稀土元素特征 …… (92)
五、细粒白云母花岗岩的微量元素特征 …… (93)
第四节　斑状角闪黑云母二长花岗岩岩石学和地球化学 …… (94)
一、斑状角闪黑云母二长花岗岩岩石学特征 …… (94)
二、斑状角闪黑云母二长花岗岩的副矿物特征 …… (101)
三、斑状角闪黑云母二长花岗岩的主量元素特征 …… (102)
四、斑状角闪黑云母二长花岗岩的稀土元素特征 …… (103)
五、斑状角闪黑云母二长花岗岩的微量元素特征 …… (104)
第五节　中-细粒黑云母花岗岩岩石学和地球化学 …… (105)
一、中-细粒黑云母花岗岩岩石学 …… (105)
二、中-细粒黑云母花岗岩的副矿物特征 …… (108)
三、中-细粒黑云母花岗岩的主量元素特征 …… (109)
四、中-细粒斑状黑云母花岗岩的稀土元素特征 …… (109)
五、中-细粒黑云母花岗岩的微量元素特征 …… (110)
第六节　细粒黑云母花岗岩岩石学和地球化学 …… (111)
一、细粒黑云母花岗岩岩石学特征 …… (111)
二、细粒黑云母花岗岩的副矿物特征 …… (114)
三、细粒黑云母花岗岩的主量元素特征 …… (115)

四、细粒黑云母花岗岩的稀土元素特征 …… (116)
五、细粒黑云母花岗岩的微量元素特征 …… (116)
第七节　细粒石榴子石白云母花岗岩岩石学和地球化学特征 …… (118)
一、细粒石榴子石白云母花岗岩岩石学特征 …… (118)
二、细粒石榴子石白云母花岗岩的副矿物特征 …… (119)
三、细粒石榴子石白云母花岗岩的主量元素特征 …… (119)
四、细粒石榴子石白云母花岗岩的稀土元素特征 …… (119)
五、细粒石榴子石白云母花岗岩的微量元素特征 …… (120)
第八节　脉岩岩石学和地球化学特征 …… (121)
一、中酸性脉岩岩石学特征及地球化学特征 …… (121)
二、铁镁质脉岩岩石学及地球化学特征 …… (129)
第九节　贵东岩体岩浆岩简要结论 …… (137)
第七章　岩浆岩的热交代作用 …… (144)
第一节　铝硅酸盐矿物中的几种交代类型 …… (144)
第二节　岩浆岩的热交代作用 …… (146)
第三节　岩浆热交代作用过程及空间分布 …… (151)
第八章　热点活动与铀成矿关系 …… (155)
第一节　铀矿床地质特征 …… (155)
一、铀矿床产出的围岩 …… (155)
二、矿床构造及其循环流通构造系统 …… (156)
三、铀矿床空间分布 …… (172)
四、矿体形态及其在空间上分布 …… (173)
五、铀矿形成深度 …… (174)
第二节　铀成矿作用研究 …… (176)
一、确定矿化期及矿化阶段的因素分析 …… (176)
二、多阶段成矿与主要成矿期的讨论 …… (177)
第三节　下庄铀矿田的物质成分研究 …… (182)
一、下庄矿田铀矿石的矿物组成 …… (183)
二、矿石的矿物组合 …… (207)
第四节　铀矿床近矿(脉)旁蚀变作用 …… (208)
一、近矿(脉)旁蚀变研究趋势 …… (208)
二、蚀变带的空间结构 …… (210)
第九章　铀矿成矿地球化学条件及成矿机理研究 …… (228)
第一节　铀成矿物理化学条件的地质现象 …… (228)
一、矿石沉淀过程与矿物生成顺序的地球化学实质 …… (228)
二、蚀变带岩石中主量元素氧化物变化的地球化学规律 …… (232)
三、铀矿床蚀变带岩石中微量元素变化的地球化学规律 …… (237)
四、矿床的矿物包裹体研究及地球化学条件分析 …… (239)
五、矿床的同位素地球化学 …… (246)

第二节　铀成矿机理讨论 …… (256)
一、成矿流体性质 …… (256)
二、矿化物质来源 …… (257)
三、铀沉淀富集物理化学条件 …… (257)
第三节　铀成矿模式 …… (258)
结论 …… (261)
参考文献 …… (264)
英文摘要 …… (273)
图版说明及图版 …… (277)
附图:贵东岩基地质图

Contents

Preface

Foreword

1 Mantle plume and hotspots …… (1)

1. 1 Basic concepts and theories …… (1)

1. 2 hotspots activities and metallogenesis …… (3)

2 Mantle plume tectonics and regional uranium metallogenic features in South China …… (5)

2. 1 The Mesozoic and Cenozoic mantle plume action and regional geologic and tectonic evolution in South China …… (5)

2. 2 Characteristics of major uranium metallogenetic regions in South China …… (9)

2. 2. 1 Regionally located in uplifting area or at the margin …… (9)

2. 2. 2 Regional deep and large faults controlling uranium metallogenesis …… (10)

2. 2. 3 Similar ore-forming age and different ore-hosting rocks …… (11)

2. 2. 4 "Red phenomenon" and uranium metallogenesis …… (12)

2. 2. 5 Basic magmatic activities …… (13)

2. 2. 6 Prospecting indications of regional geochemistry and geophysics …… (14)

3 Guidong hotspot …… (19)

4 The tectonic deformation and thermal dynamics of the Guidong massive …… (25)

4. 1 The micro-structure inside the Guidong massive …… (25)

4. 2 Classification of rocks deformed by stress …… (28)

4. 2. 1 Deformed crack texture of keeping primary texture rock …… (29)

4. 2. 2 Deformed rocks with original texture remained …… (29)

4. 2. 3 Strongly deformed rocks with new textures …… (30)

4. 2. 4 Other types of structural rocks-breccia, blastomylonite and superimposed tectonic rock …… (31)

4. 3 Tectonics of the Guidong massive …… (32)

4. 3. 1 Near EW-striking tectonics …… (33)

4. 3. 2 NEE-striking tectonics …… (37)

4. 3. 3 NNE-striking tectonics …… (43)

5 Magmatic activities and the stages …… (55)

5. 1 Characteristics of magmatic activities …… (55)

5. 1. 1 Regional geologic setting of the Guidong massive …… (55)

5.1.2 Characteristics of magmatic activities around the Guidong massive ····· (55)
5.2 Stages of the Guidong magmatic rocks ····· (56)
5.2.1 Division bases of magmatic stages ····· (56)
5.2.2 Geochronological Studies on the Guidong magmatic rocks ····· (57)
5.2.3 Stages of the Guidong magmatic rocks ····· (63)
6 Petrology and geochemistry of the Guidong magmatic rocks ····· (68)
6.1 Petrology and geochemistry of coarse-grained porphyritic biotite granite ····· (68)
6.1.1 Petrologic characteristics ····· (68)
6.1.2 Characteristics of accessory minerals ····· (73)
6.1.3 Characteristics of major elements ····· (74)
6.1.4 Characteristics of rare earth elements ····· (77)
6.1.5 Characteristics of trace elements ····· (78)
6.2 Petrology and geochemistry of medium-grained porphyritic biotite granite ····· (80)
6.2.1 Petrologic characteristics ····· (80)
6.2.2 Characteristics of accessory minerals ····· (84)
6.2.3 Characteristics of major elements ····· (85)
6.2.4 Characteristics of rare earth elements ····· (86)
6.2.5 Characteristics of trace elements ····· (86)
6.3 Petrology and geochemistry of fine-grained muscovite granite ····· (88)
6.3.1 Petrologic characteristics ····· (88)
6.3.2 Characteristics of accessory minerals ····· (91)
6.3.3 Characteristics of major elements ····· (92)
6.3.4 Characteristics of rare earth elements ····· (92)
6.3.5 Characteristics of trace elements ····· (93)
6.4 Petrology and geochemistry of porphyritic hornblende biotite monzogranite ····· (94)
6.4.1 Petrologic characteristics ····· (94)
6.4.2 Characteristics of accessory minerals ····· (101)
6.4.3 Characteristics of major elements ····· (102)
6.4.4 Characteristics of rare earth elements ····· (103)
6.4.5 Characteristics of trace elements ····· (104)
6.5 Petrology and geochemistry of medium-fine grained biotite granite ····· (105)
6.5.1 Petrologic characteristics ····· (105)
6.5.2 Characteristics of accessory minerals ····· (108)
6.5.3 Characteristics of major elements ····· (109)
6.5.4 Characteristics of rare earth elements ····· (109)
6.5.5 Characteristics of trace elements ····· (110)
6.6 Petrology and geochemistry of fine-grained biotite granite ····· (111)
6.6.1 Petrologic characteristics ····· (111)
6.6.2 Characteristics of accessory minerals ····· (114)
6.6.3 Characteristics of major elements ····· (115)
6.6.4 Characteristics of rare earth elements ····· (116)

6.6.5 Characteristics of trace elements …… (116)
6.7 Petrology and geochemistry of fine-grained garnet muscovite granite …… (118)
6.7.1 Petrologic characteristics …… (118)
6.7.2 Characteristics of accessory minerals …… (119)
6.7.3 Characteristics of major elements …… (119)
6.7.4 Characteristics of rare earth elements …… (119)
6.7.5 Characteristics of trace elements …… (120)
6.8 Petrology and geochemistry of vein and dike rocks …… (121)
6.8.1 Petrology and geochemistry of medium-acidic vein rocks …… (121)
6.8.2 Petrology and geochemistry of ferromagnesian dike rocks …… (129)
6.9 Brief conclusion of the Guidong magmatic rocks …… (137)
7 Hydrothermal metasomatism of magmatic rocks …… (144)
7.1 Types of metasomatism in aluminosilicate minerals …… (144)
7.2 Metasomatism of magmatic rocks …… (146)
7.3 Metasomatic process and spatial distribution …… (151)
8 Relationship between hotspot activities and uranium mineralization …… (155)
8.1 Geologic characteristics of uranium deposits …… (155)
8.1.1 Wall rock of uranium deposits …… (155)
8.1.2 Tectonics and the circulating structural system of deposits …… (156)
8.1.3 Spatial distribution of uranium deposits …… (172)
8.1.4 Shapes and the spatial distribution of ore bodies …… (173)
8.2 Study on uranium metallogenesis …… (174)
8.2.1 Discussion about the mainstage and multi stages of metallogenesis …… (176)
8.2.2 Uranium ore-forming depth …… (176)
8.2.3 Factors controlling the ore-forming stages …… (177)
8.3 Compositional study on the deposits …… (182)
8.3.1 Uranium ore mineral composition of Xiazhuang orefield …… (183)
8.3.2 Uranium ore mineral assemblage of Xiazhuang orefield …… (207)
8.4 Alterations near the uranium ore (veins) …… (208)
8.4.1 Trending of study on alterations near the uranium ore (veins) …… (208)
8.4.2 Spatial frame of alteration zone …… (210)
9 Conditions and mechanism of uranium metallogenesis …… (228)
9.1 Geological phenomena of physical and chemical conditions for uranium metallogenesis …… (228)
9.1.1 Geochemical substance of ore depositing and crystallizing processes …… (228)
9.1.2 Major elements geochemistry inside alteration zones of rocks …… (232)
9.1.3 Trace elements geochemistry inside alteration zones of rocks …… (237)
9.1.4 Study on fluid inclusions …… (239)
9.1.5 Isotopic geochemistry of uranium deposits …… (246)
9.2 Discussion on uranium metallogenetic mechanism …… (256)
9.2.1 Properties of ore-forming fluids …… (256)

此为试读,需要完整PDF请访问: www.ertongbook.com