

学校编码: 10384

密级_____

学号: 33320131151721

廈門大學

硕士学位论文

南沙海域沉积物铀、碘、磷的研究

The Research of Uranium, Iodine and Phosphorus in the
Sediments from Nansha Sea area

胡盼盼

指导教师姓名: 刘广山 教授

专业名称: 环境科学

论文提交日期: 2016年5月

论文答辩时间: 2016年5月

2016年5月

厦门大学学位论文原创性声明

本人呈交的学位论文是本人在导师指导下，独立完成的研究成果。本人在论文写作中参考其他个人或集体已经发表的研究成果，均在文中以适当方式明确标明，并符合法律规范和《厦门大学研究生学术活动规范（试行）》。

另外，该学位论文为（）课题（组）的研究成果，获得（）课题（组）经费或实验室的资助，在（）实验室完成。（请在以上括号内填写课题或课题组负责人或实验室名称，未有此项声明内容的，可以不作特别声明。）

声明人（签名）：

年 月 日

厦门大学学位论文著作权使用声明

本人同意厦门大学根据《中华人民共和国学位条例暂行实施办法》等规定保留和使用此学位论文，并向主管部门或其指定机构送交学位论文（包括纸质版和电子版），允许学位论文进入厦门大学图书馆及其数据库被查阅、借阅。本人同意厦门大学将学位论文加入全国博士、硕士学位论文共建单位数据库进行检索，将学位论文的标题和摘要汇编出版，采用影印、缩印或者其它方式合理复制学位论文。

本学位论文属于：

（ ） 1.经厦门大学保密委员会审查核定的保密学位论文，于 年 月 日解密，解密后适用上述授权。

（ ） 2.不保密，适用上述授权。

（请在以上相应括号内打“√”或填上相应内容。保密学位论文应是已经厦门大学保密委员会审定过的学位论文，未经厦门大学保密委员会审定的学位论文均为公开学位论文。此声明栏不填写的，默认为公开学位论文，均适用上述授权。）

声明人（签名）：

年 月 日

目录

目录.....	I
Contents.....	V
图目录.....	IX
Figure contents.....	X
表目录.....	XI
Table contents.....	XII
摘要.....	XIV
Abstract.....	XVI
第一章 绪论.....	- 1 -
1 研究海区基本地理特征及研究进展.....	- 1 -
2 铀的地球化学.....	- 2 -
2.1 铀的基本性质.....	- 2 -
2.2 铀在自然界中的分布.....	- 2 -
2.3 铀的循环.....	- 3 -
2.4 沉积物中铀的研究现状及进展.....	- 3 -
2.5 沉积物中铀的研究意义.....	- 3 -
3 碘的地球化学.....	- 4 -
3.1 碘的基本性质.....	- 4 -
3.2 碘在自然界中的分布.....	- 4 -
3.3 碘的循环.....	- 5 -
3.4 碘与有机碳的关系.....	- 5 -
3.5 沉积物中碘的研究现状及进展.....	- 5 -
3.6 沉积物中碘的研究意义.....	- 5 -
4 磷的地球化学.....	- 6 -
4.1 磷的基本性质.....	- 6 -

4.2	自然界中的磷.....	- 6 -
4.3	磷的循环.....	- 6 -
4.4	沉积物中磷的研究现状及进展.....	- 7 -
4.5	沉积物中磷的研究意义.....	- 7 -
5	研究目的、研究内容与技术路线.....	- 7 -
5.1	研究目的.....	- 7 -
5.2	研究内容.....	- 7 -
5.3	技术路线.....	- 8 -
第二章 样品与测定方法.....		- 9 -
1	样品.....	- 9 -
1.1	采样站位信息及样品描述.....	- 9 -
1.2	研究海区沉积类型.....	- 10 -
2	沉积物含水率、有机碳含量的测定.....	- 12 -
3	沉积物铀的测定.....	- 12 -
3.1	本研究测定原理.....	- 13 -
3.2	仪器与试剂.....	- 13 -
3.2.1	实验仪器.....	- 13 -
3.2.2	试剂及其配制.....	- 14 -
3.3	样品预处理.....	- 14 -
3.4	样品铀含量测定步骤.....	- 15 -
3.5	结果计算.....	- 15 -
3.6	条件实验.....	- 16 -
3.6.1	底数和灵敏度.....	- 16 -
3.6.2	温度.....	- 17 -
3.6.3	荧光强度与被测溶液 pH 值的关系.....	- 17 -
3.6.4	稀释倍数实验.....	- 18 -
3.6.5	碳酸盐浓度实验.....	- 20 -
3.6.6	平行性实验.....	- 21 -
3.6.7	精密度实验.....	- 21 -

3.6.8 回收率实验.....	- 22 -
3.6.9 方法检出限.....	- 22 -
4 沉积物碘的测定.....	- 23 -
4.1 测定方法.....	- 23 -
4.2 条件实验.....	- 24 -
4.2.1 质量控制实验.....	- 24 -
4.2.2 平行性实验.....	- 25 -
4.2.3 精密度实验.....	- 25 -
4.2.4 回收率实验.....	- 26 -
5 沉积物磷的测定.....	- 26 -
5.1 测定方法.....	- 27 -
5.2 条件实验.....	- 28 -
5.2.1 质量控制实验.....	- 28 -
5.2.2 平行性实验.....	- 28 -
5.2.3 精密度实验.....	- 29 -
5.2.4 回收率实验.....	- 30 -
第三章 铀的地球化学研究.....	- 31 -
1 南沙海域沉积物含水率和有机碳含量.....	- 31 -
2 南沙海域沉积物岩心铀的含量及其分布.....	- 35 -
3 不同海域海洋沉积物中铀含量水平比较.....	- 40 -
4 沉积物铀与有机碳的关系.....	- 41 -
第四章 碘的地球化学研究.....	- 43 -
1 南沙海域沉积物岩心碘的含量及其分布.....	- 43 -
2 不同海域海洋沉积物中碘含量水平比较.....	- 47 -
3 沉积物碘与有机碳的关系.....	- 48 -
4 沉积物中碘与有机碳比值 I/C_{ORG}	- 49 -
5 沉积物碘与铀之间的关系.....	- 53 -
第五章 磷的地球化学研究.....	- 54 -

1 南沙海域沉积物岩心磷的含量及其分布.....	- 54 -
2 不同海域海洋沉积物中磷含量水平比较.....	- 58 -
3 沉积物磷与有机碳的关系.....	- 59 -
4 沉积物中有机碳与磷比值 C_{ORG}/P	- 60 -
5 沉积物中磷与铀之间的关系.....	- 63 -
6 沉积物中磷与碘之间的关系.....	- 63 -
第六章 各元素反映的南沙海域海洋环境变化问题.....	- 65 -
1 南海的沉积速率.....	- 65 -
2 年表、年代序列的建立.....	- 71 -
3 元素反映的环境变化.....	- 74 -
3.1 元素含量变化.....	- 74 -
3.2 气候变化特征.....	- 74 -
3.3 磷对环境变化的指示意义.....	- 76 -
3.4 与碳酸盐沉积比较所反映的环境变化.....	- 77 -
第七章 结语.....	- 79 -
1 本研究的成果.....	- 79 -
1.1 元素含量的测定.....	- 79 -
1.2 元素之间相关性的比较.....	- 79 -
1.3 年代序列的建立.....	- 79 -
1.4 环境意义研究.....	- 80 -
2 本研究的特点及存在的不足.....	- 80 -
3 展望.....	- 80 -
参考文献.....	- 82 -
致谢.....	- 93 -

Contents

Chapter 1 Introduction.....	- 1 -
1 The basic geographical characteristics and progress of research area.....	- 1 -
2 The geochemistry of uranium.....	- 2 -
2.1 The basic properties of uranium.....	- 2 -
2.2 The distribution of uranium in nature.....	- 2 -
2.3 The circulation of uranium.....	- 3 -
2.4 The development of research on uranium in sediments.....	- 3 -
2.5 The research significance of uranium in sediments.....	- 3 -
3 The geochemistry of iodine.....	- 4 -
3.1 The basic properties of iodine.....	- 4 -
3.2 The distribution of iodine in nature.....	- 4 -
3.3 The circulation of iodine.....	- 5 -
3.4 The relationship between iodine and organic carbon.....	- 5 -
3.5 The development of research on iodine in sediments.....	- 5 -
3.6 The research significance of iodine in sediments.....	- 5 -
4 The geochemistry of phosphorus.....	- 6 -
4.1 The basic properties of phosphorus.....	- 6 -
4.2 The phosphorus in nature.....	- 6 -
4.3 The circulation of phosphorus.....	- 6 -
4.4 The development of research on phosphorus in sediments.....	- 7 -
4.5 The research significance of phosphorus in sediments.....	- 7 -
5 The aim, contents and technical route for the research.....	- 7 -

5.1	Aim.....	- 7 -
5.2	Contents.....	- 7 -
5.3	Technical route.....	- 8 -
Chapter 2 Samples and measuring method.....		- 9 -
1	Samples.....	- 9 -
1.1	Sampling sites information and the description of samples.....	- 9 -
1.2	The sedimentary type of research area.....	- 10 -
2	The determination of moisture content, organic carbon content in sediments.....	- 12 -
3	The determination of uranium in sediments.....	- 12 -
3.1	The measuring principle of this study.....	- 13 -
3.2	Instruments and reagents.....	- 13 -
3.3	Sample pretreatment.....	- 14 -
3.4	The determination steps of uranium.....	- 15 -
3.5	The results of calculation.....	- 15 -
3.6	Condition experiments.....	- 16 -
4	The determination of iodine in sediments.....	- 23 -
4.1	The determination method.....	- 23 -
4.2	Condition experiment.....	- 24 -
5	The determination of phosphorus in sediments.....	- 26 -
5.1	The determination method.....	- 27 -
5.2	Condition experiment.....	- 28 -
Chapter 3 The geochemistry of uranium.....		- 31 -
1	The moisture content and organic carbon content in Nansha Sea sediments.....	- 31 -
2	The uranium contentin and distribution in the core of Nansha Sea sediments.....	- 34 -

3	The comparison of uranium content in sediments from different marine.....	- 38 -
4	The relationship between the content of uranium and organic carbon.....	- 39 -
Chapter 4 The geochemistry of iodine.....		- 41 -
1	The iodine contentin and distribution in the core of Nansha Sea sediments.....	- 41 -
2	The comparison of iodine content in sediments from different marine.....	- 44 -
3	The relationship between the content of iodine and organic carbon content.....	- 45 -
4	The I/C _{org} in sediments.....	- 46 -
5	The relationship between iodine and uranium in the sediments.....	- 49 -
Chapter 5 The geochemistry of phosphorus.....		- 50 -
1	The phosphorus contentin and distribution in the core of Nansha Sea sediments.....	- 50 -
2	The comparison of phosphorus content in sediments from different marine.....	- 53 -
3	The relationship between the content of phosphorus and organic carbon.....	- 54 -
4	The C _{org} /P in sediments.....	- 55 -
5	The relationship between phosphorus and uranium in the sediments.....	- 57 -
6	The relationship between phosphorus and iodine in the sediments.....	- 57 -
Chapter 6 The marine environment change reflectd by these element.....		- 58 -
1	The deposition rate in south China sea.....	- 58 -
2	The establishment of the chronology sequence.....	- 64 -
3	The environment change reflectd by these element.....	- 66 -
3.1	The change of elements.....	- 66 -
3.2	The climate change characteristics.....	- 66 -
3.3	The denotative meaning of phosphorus to environmental change.....	- 68 -
3.4	The environmental changes refeltced by phosphate and carbonate.....	- 69 -
Chapter 7 Conclusion.....		- 71 -

1	The results.....	- 71 -
1.1	The determination of element content.....	- 71 -
1.2	The comparison of correlation between elements.....	- 71 -
1.3	The establishment of the chronology sequence.....	- 71 -
1.4	The research of environmental significance.....	- 72 -
2	The characteristics and the deficiencies.....	- 72 -
3	The prospect.....	- 72 -
	References.....	- 74 -
	Acknowledgements.....	- 85 -

图目录

图 1-1 技术路线图.....	- 8 -
图 2-1 沉积物采样站位图.....	- 9 -
图 2-2 南沙群岛及其邻近海域沉积成因类型图.....	- 10 -
图 2-3 南沙群岛及其邻近海区沉积物来源-粒度分布图.....	- 11 -
图 2-4 南海沉积物类型分布.....	- 12 -
图 2-5 铀的样品预处理与测定流程.....	- 16 -
图 2-6 微量铀分析仪的底数和灵敏度.....	- 17 -
图 2-7 pH 与荧光强度的关系.....	- 18 -
图 2-8 铀含量、 (F_1-F_0) 、 (F_2-F_1) 与稀释倍数.....	- 20 -
图 2-9 Na_2CO_3 浓度与铀含量、 (F_1-F_0) 、 (F_2-F_1)	- 20 -
图 2-10 碘的样品预处理与测定流程.....	- 24 -
图 2-11 碘的质量控制图.....	- 25 -
图 2-12 磷的样品预处理与测定流程.....	- 27 -
图 2-13 磷的质量控制图.....	- 28 -
图 3-1 南沙海域沉积物含水率和有机碳分布.....	- 34 -
图 3-2 南沙海域沉积物铀的含量分布.....	- 39 -
图 4-1 南沙海域沉积物碘的含量分布.....	- 46 -
图 4-2 I/C_{org} 比值的分布.....	- 52 -
图 5-1 南沙海域沉积物磷的含量分布.....	- 57 -
图 5-2 C_{org}/P 比值的分布.....	- 62 -
图 5-3 NS-7、NS-8 柱样铀与磷的关系.....	- 63 -
图 6-1 南海沉积物的沉积速率频数分布图.....	- 71 -
图 6-2 NS-7 柱样元素含量分布和沉积年龄.....	- 72 -
图 6-3 NS-8 柱样元素含量分布和沉积年龄.....	- 73 -
图 6-4 NS93-5 柱样的底栖有孔虫 (a) 与 NS-7 柱样的碘 (b)	- 75 -
图 6-5 NS93-5 柱样的 $\delta^{18}\text{O}$ (a) 与 NS-7 柱样的铀 (b)	- 76 -
图 6-6 NS-7、NS-8 与 SZ2 柱样磷含量分布.....	- 77 -
图 6-7 S08-57 柱样的 CaCO_3 含量分布与 NS-7、NS-8 柱样铀、碘含量分布.....	- 78 -

Figure contents

Figure 1- 1 The technical route.....	- 8 -
Figure 2- 1 Sampling sites of the sediments.....	- 9 -
Figure 2- 2 The genetic type of sediments in Nansha Islanda and adjacent sea eare.....	- 10 -
Figure 2- 3 The distribution of sediment source and granularity in Nansha Islanda.....	- 11 -
Figure 2- 4 The type distribution of the south China sea sediments.....	- 12 -
Figure 2- 5 the procedure of sample pretreatment and determination of uranium.....	- 16 -
Figure 2- 6 Base and sensitivity of micro-uranium analyzer.....	- 17 -
Figure 2- 7 The relation of pH and fluorecence intensity.....	- 18 -
Figure 2- 8 The uranium content, (F_1-F_0) and (F_2-F_1) with dilution multiple.....	- 20 -
Figure 2- 9 Na_2CO_3 with uranium content, (F_1-F_0) and (F_2-F_1)	- 20 -
Figure 2- 10 the procedure of sample pretreatment and determination of iodine.....	- 24 -
Figure 2- 11 Quality control chart of iodine.....	- 25 -
Figure 2- 12 The procedure of sample pretreatment and determination of phosphorus.....	- 27 -
Figure 2- 13 Quality control chart of phosphorus.....	- 28 -
Figure 3- 1 The distribution of moisture rate and organic carbon.....	- 34 -
Figure 3- 2 The distribution of uranium content in the Nansha Sea sediments.....	- 39 -
Figure 4- 1 The distribution of iodine content in the Nansha Sea sediments.....	- 46 -
Figure 4- 2 The distribution of the rate of I/C_{org}	- 52 -
Figure 5- 1 The distribution of phosphorus content in the Nansha Sea sediments.....	- 57 -
Figure 5- 2 The distribution of the rate of C_{org}/P	- 62 -
Figure 5- 3 The relationship between uranium and phosphorus of NS-7、 NS-8.....	- 63 -
Figure 6- 1 Frequence distribution of deposition rate in the south China sea.....	- 71 -
Figure 6- 2 The distribution of iodine content and the sedimentary age of NS-7.....	- 73 -
Figure 6- 3 The distribution of iodine content and the sedimentary age of NS-8.....	- 73 -
Figure 6- 4 The benthic foraminifera in core NS93-5 and iodine in core NS-7.....	- 75 -
Figure 6- 5 The $\delta^{18}O$ in core NS93-5 and Uranium of NS-7.....	- 76 -
Figure 6- 6 The distribution of phosphorus content of NS-7, NS-8 and SZ2.....	- 77 -
Figure 6- 7 The distribution of $CaCO_3$ of S08-57 and the uranium and iodine of NS-7 and NS-8.....	- 78 -

表目录

表 2-1 采样站位信息及样品描述.....	- 10 -
表 2-2 共存离子对荧光强度的影响.....	- 19 -
表 2-3 平行性实验.....	- 21 -
表 2-4 标准物质分析结果.....	- 22 -
表 2-5 回收率实验.....	- 22 -
表 2-6 方法检出限.....	- 22 -
表 2-7 碘标准工作曲线的斜率和截距.....	- 25 -
表 2-8 碘的平行性实验.....	- 25 -
表 2-9 标准物质的碘分析结果.....	- 26 -
表 2-10 碘回收率实验.....	- 26 -
表 2-11 磷标准工作曲线的斜率和截距.....	- 28 -
表 2-12 磷的平行性实验.....	- 29 -
表 2-13 标准物质的磷分析结果.....	- 29 -
表 2-14 磷回收率实验.....	- 30 -
表 3-1 含水率、有机碳含量.....	- 31 -
表 3-2 沉积物中铀含量.....	- 35 -
表 3-3 文献报道的海洋沉积物铀含量水平.....	- 40 -
表 4-1 沉积物碘含量水平.....	- 43 -
表 4-2 文献报道的海洋沉积物碘含量水平.....	- 47 -
表 4-3 文献报道的海洋沉积物中 I/C_{org} 比值.....	- 53 -
表 5-1 沉积物磷含量.....	- 54 -
表 5-2 文献报道的海洋沉积物磷含量水平.....	- 58 -
表 6-1 南海沉积物的沉积速率.....	- 66 -

Table contents

Table 2- 1 Sampling sites information and the description of samples.....	- 10 -
Table 2- 2 The influence of coexisting ions on the fluorescence intensity.....	- 19 -
Table 2- 3 Parallel experiments.....	- 21 -
Table 2- 4 Analytic results for standard materials.....	- 22 -
Table 2- 5 Experiment of recovery rate.....	- 22 -
Table 2- 6 Detection limit of the method.....	- 22 -
Table 2- 7 The slope and intercept of the standard working curve of iodine.....	- 25 -
Table 2- 8 Parallel experiments of iodine.....	- 25 -
Table 2- 9 Analytic results of iodine for standard materials.....	- 26 -
Table 2- 10 Experiment of recovery rate of iodine.....	- 26 -
Table 2- 11 The slope and intercept of the standard working curve of phosphorus.....	- 28 -
Table 2- 12 Parallel experiments of phosphorus.....	- 29 -
Table 2- 13 Analytic results of phosphorus for reference materials.....	- 29 -
Table 2- 14 Experiment of recovery rate of phosphorus.....	- 30 -
Table 3- 1 The content of moisture rate, organic carbon.....	- 31 -
Table 3- 2 The content of uranium in the sediments.....	- 35 -
Table 3- 3 The Uranium levels of the marine sediments in records.....	- 40 -
Table 4- 1 The content levels of iodine in the sediments.....	- 43 -
Table 4- 2 The Iodine levels of the marine sediments in records.....	- 47 -
Table 4- 3 The literature of the rate of I/C_{org} in the marine sediments.....	- 53 -
Table 5- 1 The content of phosphorus in the sediments.....	- 54 -
Table 5- 2 The phosphorus levels of the marine sediments in records.....	- 58 -
Table 6- 1 The deposition rate of south China sea sediments in records.....	- 66 -

厦门大学博硕士学位论文摘要库

Degree papers are in the “[Xiamen University Electronic Theses and Dissertations Database](#)”.

Fulltexts are available in the following ways:

1. If your library is a CALIS member libraries, please log on <http://etd.calis.edu.cn/> and submit requests online, or consult the interlibrary loan department in your library.
2. For users of non-CALIS member libraries, please mail to etd@xmu.edu.cn for delivery details.