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QUANTIFICATION OF GALLIUM, INDIUM AND THALLIUM IN METEORITES AND OTHER GEOLOGICAL MATERIALS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY

A Thesis Presented in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy at Massey University

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ABSTRACT

Methods of solvent extraction have been developed for the determination of gallium, indium, and thallium in meteorites and other geological materials. The extraction of gallium is based on forming a chloro complex in HCl solution and extraction into MIBK. Indium was extracted into the same solvent as an iodo complex in an HBr + KI medium to which KOH had been added. Thallium was also extracted as an iodo complex from a H2SO4 + KI medium with addition of K2HPO4 as a salting out agent. Serious interference from iron(III) was eliminated by adding KI to reduce this element to its divalent state that was not extractable into the organic phase.

Graphite furnace atomic absorption spectrometric techniques were employed to determine these three elements in the MIBK phase after extraction from the aqueous phase. Very low limits of detection (l.o.d.) were obtained with these methods. It was possible to lower the l.o.d for these elements either by increasing the aqueous/organic phase ratio before extraction, or by multiple loading injections.

Using the developed methodology, gallium, indium, and thallium were quantified in iron and chondritic meteorites as well as in Cretaceous/Tertiary boundary clays, and some volcanic emissions.

The data for thallium abundances in 49 iron meteorites were the first ever recorded for this type of meteorite and allowed for taxonomic separation of the various groups of irons.

Indium abundances were only recorded in six chondrites because of the very low concentrations in iron meteorites.

My data for thallium and other elements were used to classify the previously non-studied Manitouwabing iron meteorite.

All three Group IIIA elements were determined in Cretaceous/Tertiary boundary clays and it was shown that these and other chalcophile elements have an abundance greater than that which would have been expected from either a volcanic or impact-derived source. Possible sources of this enrichment are discussed.
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LIST OF TABLES

Table I-1  Melting and Boiling Points of Ga, In and Tl .................. 10
Table I-2  Distribution Coefficients of Group IIIB Elements
           in Mineral Acid Media on Strongly Acidic Cation
           Exchangers .................................................. 16
Table II-1 Periodic Table Positions of Hydride Forming Elements that
           Can be Quantified by HGAAS ............................... 28
Table II-2  The Melting and Boiling Points of Hydrides of
           Gallium, Indium and Thallium ............................ 30
Table II-3  Operating Conditions for Hollow Cathode Lamps ............. 32
Table II-4  HCl Acid Molarities for Generating Hydrides of Gallium,
           Indium and thallium ........................................ 36
Table II-5  Precision and Accuracy for Indium Determinations as
           Established by Analysis of a Standard Reference Rock .... 40
Table III-1 Comparison of Gallium Absorbances in the MIBK phase
           after Manual and Mechanical Shaking ........................ 61
Table III-2  Extraction of Chloro Complexes of Gallium .................. 61
Table III-3  Absorbances of Gallium Standard Solutions .................. 63
Table III-4  Precision and Accuracy of GFAAS Gallium
           Determinations as Obtained by Analysis of
           Standard Reference Materials ................................ 65
Table III-5  Maximum Amounts of Elements that Do Not Interfere with the
           Determination of Gallium by GFAAS ........................ 66
Table III-6  Instrumental Parameters for GFAAS Determination
           of Gallium in MIBK Extracts ................................. 67
Table III-7  Precision and Accuracy for the Indium Method as
           Determined by Analysis of Standard Reference
           Rock (MP-1a) .................................................... 75
Table III-8  Instrumental Parameters for GFAAS Determination
           of Indium in MIBK Extracts .................................. 76
Table III-9  The Physical Properties of Thallium Halides.................. 79
Table III-10 Comparison of Standard Addition and Conventional Calibration
             Methods for Quantification of Thallium in the Toluca Iron
             Meteorite ...................................................... 84
Table III-11 Precision and Accuracy of Method for Quantification
             of Thallium in Geological Samples as Determined
             from Analysis of Standard Rocks .......................... 85
Table IV-1  Meteorite Classes and Numbers .................................. 88
Table IV-2  Chondrite Classes and Mean Properties .......................... 90
Table IV-3  Structural Classification of Iron Meteorites ....................... 92
Table IV-4  Comparison Between the Structural and Chemical
Classifications of Iron Meteorites ........................................... 93
Table IV-5  Chemical Classification of Iron Meteorites ............................ 93
Table IV-6  Comparison of Different Treatment Methods for Quantification
of Gallium in the Cañon Diablo Iron Meteorite ......................... 96
Table IV-7  Gallium Abundances (µg/g) in Iron Meteorites as
Determined by GFAAS and Other Methods ................................. 100
Table IV-8  Indium Abundances in Some Iron Meteorites .......................... 102
Table IV-9  Indium Abundances in Chondritic Meteorites ...................... 102
Table IV-10  Thallium and Nickel Abundances in Iron Meteorites .............. 107
Table IV-11  Thallium Abundances in Chondritic Meteorites ................... 108
Table IV-12  Elemental Concentrations in the Manitouwabing and Madoc Irons 110
Table V-1  Elemental Abundances (ng/g)[ppb] for In and Ir and µg/g[ppm]
for Ga and Tl) in K/T Boundary and Other Geological Samples . 123
Table V-2  Mass Balance for Chalcophiles in the Flaxbourne River
and Woodside Creek K/T Boundaries, New Zealand ................... 124
LIST OF FIGURES

Fig. I-1  Plot Showing the Distribution of the Three Isotopes of O in Meteorites ......................................................... 25
Fig. I-2  Logarithmic Plot of Ni vs. Ge in Iron Meteorite Groups ........ 25
Fig. II-1  Reaction Apparatus for Generation of Hydride .................. 31
Fig. II-2  Design of Silica Tube for Atomisation of Hydrides .............. 34
Fig. II-3  Flow Rates of Flame Gases for Quantification of Indium ........ 34
Fig. II-4  Effect of Carrier Gas Flow Rate for Hydride Generation
Quantification of Indium ..................................................... 35
Fig. II-5  Effect of Acidity for Hydride Generation of Gallium,
Indium and Thallium .......................................................... 37
Fig. II-6  Effect of Volume of Sample Solution, Acid, and Sodium Borohydride on Absorbance of Indium Solution ............... 37
Fig. II-7  Effect of Concentrations of Sodium Borohydride on
Generation of Indium Hydride ................................................ 37
Fig. II-8  Effect of Volume of Sodium Borohydride on Formation
of Indium Hydrides ............................................................. 38
Fig. II-9  Effect of Temperature on Hydride Generation of Indium ........ 38
Fig. II-10 Design of Connecting Tube between the Burner and
Generator for Hydride Generation ............................................. 39
Fig. II-11 Typical Absorbance Signals for Hydrides of Gallium,
Indium and Thallium .......................................................... 39
Fig. III-1 GF 1000 Workhead .................................................. 48
Fig. III-2 Sample Injection Probe Geometries ................................ 48
Fig. III-3 A Typical Furnace Cycle ............................................. 53
Fig. III-4 Typical GFAAS Absorbance Signals for Gallium, Indium
and Thallium ................................................................. 53
Fig. III-5 GFAAS Absorbance of Ga Extracted into MIBK from
5M HCl in the Presence of Various Concentrations
of Iron(III) ................................................................. 56
Fig. III-6 Effect of the Ascorbic Acid Concentration on
the GFAAS Absorbance Signal for Gallium with and
without the Presence of Iron .................................................. 57
Fig. III-7 Effect of Sodium Borohydride on the GFAAS Absorption
Signal for 1 µg/mL Gallium in the Presence of Iron ................. 57
Fig. III-8 Effect of the KI Concentration on the Extraction of
Iron and Gallium from 5M HCl into MIBK ............................... 58
Fig. III-9 Effect of Molarity of Several Acids on the Extraction
of Gallium into MIBK .......................................................... 59
Fig. III-10 Stability of the Gallium Chloro Complex in
the Organic Phase after Separation from the
Aqueous Phase ....................................................... 60
Fig. III-11 Effect of Shaking Time on the Extraction of Gallium
from 5M HCl into MIBK ........................................... 60
Fig. III-12 Effect of Acidity on the Extraction of Indium
into MIBK ............................................................... 70
Fig. III-13 Effect of KI Concentration on the Extraction of
Indium in the Presence of Iron ................................. 71
Fig. III-14 Effect on Addition of Salts and Electrolytes on
Extraction of Indium into MIBK ................................. 72
Fig. III-15 Effect of the Concentration of KOH on Extraction
of Indium into MIBK ................................................... 72
Fig. III-16 Effect of Shaking Time on Extraction of Indium
into MIBK ............................................................... 73
Fig. III-17 Stability of the Indium Iodo Complex in the Organic
Phase after Separation from the Aqueous Phase .......... 73
Fig. III-18 Analytical Curves for Indium .......................... 74
Fig. III-19 Effect of Varying Iodide Concentration on the
Extraction into MIBK of Thallium ............................... 79
Fig. III-20 Effect of the H₂SO₄ Concentration on Extraction
of Thallium into MIBK .................................................. 80
Fig. III-21 Effects of Various Agents on Extraction of Thallium ..... 80
Fig. III-22 Effect of Varying K₂HPO₄ Concentrations on the
Extraction of Thallium into MIBK ................................. 80
Fig. III-23 Effect of Shaking Time on the Extraction of Thallium
into MIBK ............................................................... 81
Fig. III-24 Stability of Thallium Iodo Complex in the Organic
Phase after Separation from the Aqueous Phase .......... 81
Fig. III-25 Calibration Curve for GFAAS Absorbance of Thallium .... 82
Fig. IV-1 Effect of Different Acid Mixtures and Sample Digestions
on the Dissolution of Gallium from the Allende Chondritic
Meteorite ............................................................... 97
Fig. IV-2 Comparative Absorbance Data for Gallium in Iron
Meteorites as Determined by NAA and GFAAS ............ 99
Fig. IV-3 Group Separations of Iron Meteorites from a Thallium
vs. Nickel Abundance Plot ....................................... 105
Fig. V-1 Location Map Showing the Flaxbourne River and Woodside
Creek K/T Boundary Sites in Relation to Other Similar
Sites in New Zealand .................................................. 116
Fig. V-2 Elemental Ratios in K/T Boundary Clays Compared with
those in Volcanic Emissions ........................................ 122
CONTENTS

PART ONE
GENERAL INTRODUCTION

I-1 INTRODUCTION 8
I-1-1 Discovery of Group IIIB Elements ................. 8
I-1-2 Chemistry of Group IIIB Elements .................. 9
I-1-3 Geochemistry of Group IIIB Elements .............. 12

I-2 REVIEW OF ANALYTICAL METHODS 14
I-2-1 Separation and Enrichment ........................ 14
   i. Coprecipitation .................................... 15
   ii. Ion Exchange .................................... 15
       a. Separation by Cation Exchange .................. 15
       b. Separation by Anion Exchange .................. 17
   iii. Other Chromatographic Methods ................... 17
   iv. Extraction .................................... 18
I-2-2 Gravimetric Methods ................................ 18
I-2-3 Titrimetric Methods ................................ 19
I-2-4 Spectrophotometric Methods ......................... 20
I-2-5 Electrochemical Methods .......................... 20
I-2-6 Spectrofluorimetric Methods ....................... 21
I-2-7 Atomic Spectrometric Methods ..................... 22
I-2-8 Neutron Activation Analysis ....................... 23
I-2-9 Mass Spectrometric Methods ....................... 23
I-2-10 X-ray Fluorescence Spectrometric Methods ........ 24
I-2-11 Conclusions .................................. 24

I-3 AIMS OF THIS WORK 25
I-3-1 Classification of Meteorites ....................... 25
I-3-2 The Use of Group IIIB Elemental Abundances to
    Evaluate the Impact Theory of Mass Extinctions
    at the Terminal Cretaceous .......................... 26
I-3-3 Development of an Analytical Procedure to
    Determine Group IIIB Elements ...................... 27
PART TWO
DETERMINATION OF GROUP IIIIB ELEMENTS BY HYDRIDE GENERATION ATOMIC ABSORPTION SPECTROMETRY

II-1 INTRODUCTION 28

II-2 EQUIPMENT AND REAGENTS 31
   II-2-1 Hydride Generator .............................. 31
   II-2-2 Instrumentation .................................. 32
   II-2-3 Atomisation ....................................... 33
      i. Direct Flame Atomisation .......................... 33
      ii. Heated Silica Tube Atomisation .................. 33
   II-2-4 Collecting Unit ................................. 34
   II-2-5 Flame Flow Rates ............................... 34
   II-2-6 Carrier Gas Flow Rates ........................... 35
   II-2-7 Reagents ......................................... 35

II-3 EXPERIMENTAL 35
   II-3-1 Effect of Acids on Hydride Generation ........ 36
   II-3-2 Effect of the Total Reaction Volume ........... 37
   II-3-3 The Optimum Amount of Sodium Borohydride ...... 37
   II-3-4 The Optimum Reaction Temperature ................ 38
   II-3-5 Design of the Connecting Tube .................. 38
   II-3-6 Final Analytical Procedures ..................... 39
   II-3-7 The Form and Magnitude of Analyte Signals ...... 39
   II-3-8 Precision and Accuracy ........................... 39

II-4 DISCUSSION AND CONCLUSIONS 40
PART THREE
DEVELOPMENT OF SOLVENT EXTRACTION PROCEDURES FOR
ATOMIC ABSORPTION SPECTROMETRIC QUANTIFICATION OF
GROUP IIIB ELEMENTS

III-1 INTRODUCTION
III-1-1 Principles of Solvent Extraction .............. 43
III-1-2 Classification of Extraction Systems .......... 44
III-1-3 Choice of Solvent ................................ 45
III-1-4 Solvent Extraction in Trace Analysis .......... 46

III-2 INSTRUMENTATION
III-2-1 Equipment ........................................ 48
III-2-2 Glassware ......................................... 48
III-2-3 Reagents ........................................... 48
III-2-4 Hollow Cathode Lamps ............................ 49
III-2-5 Graphite Furnace ................................ 50
III-2-6 Sample Injection Tip Alignment ................. 51
III-2-7 The Sample Vial .................................. 51
III-2-8 Multiple Loadings ................................ 52
III-2-9 Furnace Heating Programmes .................... 52
III-2-10 Absorption Signals and Background Noise ..... 53

SECTION III-1 GALLIUM

III-3 DEVELOPMENT OF A PROCEDURE FOR QUANTIFICATION OF
GALLIUM

III-3-1 Experimental ....................................... 55
i. Sample Purification and Reduction of Interferences ............. 55
a. Use of Ascorbic Acid .................................. 56
b. Use of Sodium Borohydride ............................ 57
c. Use of Other Reductants ............................... 57
d. Reduction of Iron(III) with Potassium Iodide .......... 58
ii. Acid Type and Concentration .......................... 59
SECTION III-2 INDIUM

III-4 DEVELOPMENT OF A PROCEDURE FOR THE QUANTIFICATION OF
OF INDIUM

III-4-1 Experimental ......................................... 70
i. Acids and Their Concentrations ...................... 70
ii. Effect of Iodide on Extraction of Indium
    from Hydrobromic Acid Solution .................. 71
iii. Effect of Addition of Potassium Hydroxide
    and the Acidity of the Solution .................. 72
iv. Shaking Time ............................................ 73
v. The Distribution Ratio ................................. 73
vi. Stability of the Indium Complex in the
    Organic Phase ........................................ 73
vii. Limit of Detection .................................. 74

III-4-2 Choice of Analytical Method for
    Determining Indium ................................ 74

III-4-3 Precision and Accuracy ............................ 74

III-4-4 Final Analytical Procedure ...................... 75

III-4-5 Conclusions ...................................... 76
SECTIO N III-3 THALLIUM

III-5 DEVELOPMENT OF A PROCEDURE FOR QUANTIFICATION OF THALLIUM

III-5-1 Experimental ................................................. 78
  i. Solvent Extraction Systems ............................... 78
  ii. Effect of the Amount of Iodide Added ............... 79
  iii. Effect of Acids and Their Concentrations ....... 80
  iv. Effect of Salting Out ................................. 80
  v. Extraction Shaking Time .............................. 81
  vi. Stability of the Iodo Thallium(I) Complex .... 81
  vii. The Distribution Ratio for Extraction of Thallium ........................................ 81
  viii. Effect of Other Elements ............................ 81

III-5-2 Limit of Detection ........................................... 82
III-5-3 Choice of Analytical Calibration Method .......... 83
III-5-4 Precision and Accuracy ............................... 84
III-5-5 Discussion ................................................ 85

III-6 CONCLUSIONS AND DISCUSSION .......................... 86

PART FOUR
GROUP IIIB ELEMENTS IN METEORITES

IV-1 INTRODUCTION .................................................. 87
  IV-1-1 Chondrites ............................................... 89
  IV-1-2 Iron Meteorites ........................................ 91

IV-2 QUANTIFICATION OF GROUP IIIB ELEMENTS IN METEORITES 94
  IV-2-1 Treatment of Sample .................................... 94
    i. Iron Meteorites ........................................ 94
    ii. Chondrites .......................................... 96
  IV-2-2 Quantification of Group IIIB Elements in Meteorites ...................................... 97
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV-3</td>
<td>DISTRIBUTION OF GROUP IIIB ELEMENTS IN METEORITES</td>
<td>98</td>
</tr>
<tr>
<td>IV-3-1</td>
<td>Introduction</td>
<td>98</td>
</tr>
<tr>
<td>IV-3-2</td>
<td>Gallium in Meteorites</td>
<td>99</td>
</tr>
<tr>
<td>IV-3-3</td>
<td>Indium in Meteorites</td>
<td>101</td>
</tr>
<tr>
<td>IV-3-4</td>
<td>Thallium in Meteorites</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td>i. Correlation Analysis</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>ii. Thallium as a Taxonomic Determinant of Iron Meteorites</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>iii. Conclusions and Discussion</td>
<td>106</td>
</tr>
<tr>
<td>IV-4</td>
<td>THE MANITOUWABING IRON METEORITE</td>
<td>108</td>
</tr>
<tr>
<td>IV-4-1</td>
<td>Analytical Methods</td>
<td>109</td>
</tr>
<tr>
<td>IV-4-2</td>
<td>Results and Discussion</td>
<td>109</td>
</tr>
<tr>
<td>IV-5</td>
<td>GENERAL CONCLUSIONS</td>
<td>110</td>
</tr>
<tr>
<td>V-1</td>
<td>INTRODUCTION</td>
<td>111</td>
</tr>
<tr>
<td>V-1-1</td>
<td>The Cretaceous-Tertiary Boundary</td>
<td>111</td>
</tr>
<tr>
<td>V-1-2</td>
<td>Quantification of Elements in K/T Boundary Clays</td>
<td>115</td>
</tr>
<tr>
<td>V-2</td>
<td>SITE LOCATIONS, GEOLOGY, GEOCHEMISTRY AND BIOSTRATIGRAPHY</td>
<td></td>
</tr>
<tr>
<td>V-2-1</td>
<td>Woodside Creek</td>
<td>116</td>
</tr>
<tr>
<td>V-2-2</td>
<td>Flaxbourne River</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>i. Lithology</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>ii. Biostratigraphy</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>iii. Previous Geochemistry</td>
<td>120</td>
</tr>
<tr>
<td>V-3</td>
<td>MATERIALS AND METHODS</td>
<td>120</td>
</tr>
<tr>
<td>V-3-1</td>
<td>Sample Collection</td>
<td>120</td>
</tr>
<tr>
<td>V-3-2</td>
<td>Sample Dissolution</td>
<td>121</td>
</tr>
<tr>
<td>V-3-3</td>
<td>Analytical Procedures</td>
<td>121</td>
</tr>
<tr>
<td>V-4</td>
<td>RESULTS AND DISCUSSION</td>
<td>121</td>
</tr>
</tbody>
</table>

PART FIVE
GROUP IIIB ELEMENTS IN CRETACEOUS-TERTIARY BOUNDARY CLAYS
PART SIX
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR
FURTHER WORK

VI-1 ANALYTICAL PROCEDURES 125a
VI-2 ANALYSIS OF METEORITES 127
VI-3 ANALYSIS OF CRETACEOUS/TERTIARY BOUNDARY CLAYS 128
VI-4 CLASSIFICATION OF THE MANITOUWABING IRON METEORITE 128
VI-5 RECOMMENDATIONS FOR FURTHER WORK 128

REFERENCES 129