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TRACE ELEMENTS IN NEW ZEALAND OILS
THEIR SIGNIFICANCE FOR ANALYTICAL CHEMISTRY,
GEOCHEMISTRY AND OIL CLASSIFICATION

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the requirements for the degree of Doctor of
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Anita Frankenberger
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ABSTRACT

This work is a study of trace elements in New Zealand and some overseas oils. Trace elements have been successfully used in previous studies to distinguish marine oils of different origins, to identify groups of related oils in individual regional areas and to establish migration patterns.

This is the first study of trace element concentrations and variations in New Zealand crude oils. A wide range of oil samples of different origins and geographical regions was analysed and the obtained trace element concentrations enabled a comprehensive comparison of trace element contents in terrestrial, lacustrine and marine oils. Over 120 oil samples of various marine and terrestrial origins were analysed for 42 elements and the resulting trace element concentrations were subjected to correlation and principal components analysis.

The trace element concentrations in New Zealand oils are very similar to those in other terrestrial-derived crude oils. Elements, associated with clay minerals had a high mutual correlation and were present in concentrations, comparable with, or exceeding those in marine oils. The origin of these elements and their implications to the classification of Taranaki Basin oils are discussed.

Trace elements in the asphaltene fractions of some New Zealand and overseas oils, in extracts of coal from the Pakawau Group and in ashed coal samples were determined to obtain additional information about the origin of Taranaki Basin oils.

In this study, 42 trace elements were determined by instrumental neutron activation analysis, graphite furnace atomic absorption and inductively coupled plasma emission spectrometry. Instrumental NAA was used to quantify a wide range of elements in undiluted and untreated crude oils. Graphite furnace AAS is a more sensitive method for some elements and was used to determine trace elements that were not detectable by INAA.

The analysis of organic oil solutions was difficult due to the complex organic oil
matrix. Various ashing, low temperature ashing, acid oxidation and extraction techniques were investigated and were considered to be unsuitable for the quantification of low amounts of elements in crude oils. A mixed-solvent system, using toluene and isopropanol, enabled the use of ready available aqueous standards and allowed the quantification of trace elements other than those present in the standard oil solutions. The close matching of standard and sample solutions was essential for the accuracy of the trace element results. Various analytical techniques, their use and suitability for the analysis of crude oils are discussed in detail.
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TABLE OF CONTENTS

I. INTRODUCTION 14

1.1 PREVIOUS WORK 14

1.2 AIM OF THE STUDY 18

II. PETROLEUM GEOLOGY AND GEOCHEMISTRY 21

2.1 OIL FORMATION AND ACCUMULATION 21

2.1.1 DIAGENESIS, CATAGENESIS, METAGENESIS 21

A. Diagenesis 21
B. Catagenesis 23
C. Metagenesis 24

2.1.2 KEROGEN 24

2.1.3 TRACE ELEMENTS IN CRUDE OILS 27

2.1.4 ORIGIN OF TRACE ELEMENTS IN OILS 29

2.2 NEW ZEALAND OILS 30

2.2.1 GEOLOGY OF Taranaki Basin 30

2.2.2 ORGANIC GEOCHEMISTRY 32

2.2.3 SAMPLES 35

A. Taranaki Basin 36
   * McKee Field 42
   * Kapuni Field 43
   * Maui Field 43
   * Kaimiro Field 43
   * Moki Discovery 44
   * Tariki and Ahuroa Discovery 44
   * Kupe South Discovery 44
   * Stratford Discovery 45
   * Moturoa Field 45
   * Kora Discovery 45
   * Other samples 46
2.3 OVERSEAS OIL SAMPLES

2.3.1 CHINA

* Jiuji Basin
* Minhe Basin
* Turpan Basin

2.3.2 AUSTRALIA

* Cooper/Eromanga Basin
* Timor Sea

2.3.3 U.S.A.

* San Juan Basin
* Los Angeles Basin
* Williston Basin
* Uinta Basin
* Gulf of Mexico
* Alaska

2.3.4 NORTH SEA

* Norwegian oils

2.3.5 CANADA

* Alberta Basin

2.3.6 MIDDLE EAST

2.3.7 NIGERIA

2.4 POTENTIAL SOURCE ROCKS

2.4.1 NEW ZEALAND

2.4.2 OVERSEAS SAMPLES

2.5 FORMATION WATER SAMPLES
3.3.2 THEORY

3.3.3 ADVANTAGES, ERRORS AND PRECISION

3.3.4 INSTRUMENTATION

3.3.5 SAMPLES AND ANALYTICAL METHOD

3.4 GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY

3.4.1 PREVIOUS WORK

3.4.2 THEORY

3.4.3 ADVANTAGES, ERRORS AND PRECISION

3.4.4 INSTRUMENTATION

3.4.5 STANDARDS

A. Organic standards
B. Aqueous standards

3.4.6 SAMPLES AND ANALYTICAL METHODS

A. Oil samples
B. Heating programs and wavelengths
C. Vanadium determination

IV. RESULTS AND DISCUSSION

4.1 TRACE ELEMENTS AND INTER-ELEMENTAL CORRELATIONS IN NEW ZEALAND OILS

4.1.1 NICKEL AND VANADIUM

4.1.2 BROMINE AND CHLORINE

4.1.3 ALUMINIUM

4.1.4 CHALCOPHILE ELEMENTS

4.1.5 SIDEROPHILE ELEMENTS
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nickel and V content in oils from various origins</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Formation of petroleum from sedimentary matter</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Structural subdivision and structural cross-section for Taranaki Basin, New Zealand</td>
<td>31</td>
</tr>
<tr>
<td>4</td>
<td>Hydrocarbon accumulations under production or development</td>
<td>33</td>
</tr>
<tr>
<td>5</td>
<td>Main hydrocarbon-producing fields and wells in Taranaki Basin</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>Stratigraphic map of Taranaki Basin</td>
<td>41</td>
</tr>
<tr>
<td>7</td>
<td>East Coast hydrocarbon accumulations and stratigraphic map</td>
<td>47</td>
</tr>
<tr>
<td>8</td>
<td>Hydrocarbon occurrences in the Canterbury Basin</td>
<td>48</td>
</tr>
<tr>
<td>9</td>
<td>Hydrocarbon occurrences in the Westland area</td>
<td>49</td>
</tr>
<tr>
<td>9a</td>
<td>Stratigraphic column for the central Westland Basin</td>
<td>50</td>
</tr>
<tr>
<td>9b</td>
<td>Stratigraphic column for the Murchison Basin</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>Hydrocarbon occurrences in the Jiuxi Basin, China</td>
<td>52</td>
</tr>
<tr>
<td>11</td>
<td>Hydrocarbon occurrences in the Cooper/Eromanga Basin, Australia</td>
<td>54</td>
</tr>
<tr>
<td>11a</td>
<td>Stratigraphic column for the Cooper/Eromanga Basin, Australia</td>
<td>55</td>
</tr>
<tr>
<td>12</td>
<td>Nickel standard curves obtained with NBS oil and Maui-1 oil solutions</td>
<td>80</td>
</tr>
<tr>
<td>13</td>
<td>Peak shapes of of V in oil and aqueous solutions</td>
<td>83</td>
</tr>
<tr>
<td>14</td>
<td>Trace element concentrations in coals after ashing at different temperatures</td>
<td>92</td>
</tr>
</tbody>
</table>
Trace element concentrations in bitumen extracted from shale with toluene, chloroform, toluene/methanol and toluene/dichloromethane

Trace element concentrations in bitumen extracted from New Zealand coal with different solvents

Nickel and Fe concentrations in bitumen obtained after 6, 12, 24, 48 and 72 hours extraction of coal with chloroform/methanol

Diagram of a plasma torch

GBC system 1000 with AAS 902 and graphite furnace head

Nickel and Fe standard curves obtained with fuel oil and aqueous standard solutions

Nickel peaks in new and worn graphite furnace tube

Nickel absorption peak with recorded background absorption

Absorption peak heights for Ni in oil solutions at different ashing temperatures

Vanadium standard curve (GBC system 2000/3000)

Tailing of V absorption peaks at high concentration compared to a absorption peak at low concentration

Range of trace element concentrations in New Zealand oils (log values and standard deviations)

Nickel (µg/g) versus V (ng/g) for New Zealand oils

Nickel/V for oils from the McKee Field

API gravity versus Ni+V concentration (µg/g)

Sulphur (wt %) versus V (ng/g) for New Zealand oils

Correlation matrix for New Zealand oils
31 Aluminium (µg/g) versus V (ng/g) for New Zealand oils
31a Aluminium/V for oils from the McKee Field
32 Cobalt (ng/g) versus Mn (ng/g) for New Zealand oils
32a Co/Mn for oils from the McKee Field
33 Co/Mn (normal concentration scale), New Zealand oils
34 Iron (µg/g) versus Sc (ng/g), New Zealand oils
34a Iron (µg/g) versus Sc (ng/g) for oils from the McKee Field
35 Cobalt (ng/g) versus As (ng/g) for New Zealand oils
36 Nickel (µg/g) versus As (ng/g) for New Zealand oils
37 Nickel (µg/g) versus Zn (µg/g) for New Zealand oils
38 Arsenic (ng/g) versus Br (ng/g) for New Zealand oils
39 Range of trace element concentrations in New Zealand and overseas oils (log values and standard deviation)
40 Nickel (µg/g) versus V (ng/g) for New Zealand and other terrestrial-derived oils
41 Nickel (µg/g) versus V (ng/g) for oils from the Cooper/Eromanga Basin, Australia
42 Nickel (µg/g) versus V (µg/g), New Zealand and overseas oils
42a Nickel/V, New Zealand and overseas oils (log values)
43 Correlation matrix for terrestrial-derived oils
Correlation matrix for lacustrine-derived oils 161
Correlation matrix for marine oils 161
Aluminium (µg/g) versus V (µg/g) for New Zealand and overseas oils 162
Cobalt (ng/g) versus Mn (ng/g) for New Zealand and overseas oils 163
Correlation matrix for New Zealand bitumen 167
Arsenic (ng/g) versus Br (ng/g) for New Zealand bitumen 168
Cobalt (ng/g) versus Ni (µg/g) for New Zealand bitumen 169
Nickel (µg/g) versus V (ng/g) for New Zealand and overseas bitumen 170
Principal component 2/pc1 for New Zealand oils 173
PC3/PC1 for New Zealand oils 174
PC3/PC2 for New Zealand oils 175
Three dimensional graph of principal components for New Zealand oils 177
Three dimensional graph of principal components for New Zealand oils (individual groups) 178
PC2/PC1 for New Zealand and overseas oils 180
PC3/PC1 for New Zealand and overseas oils 181
PC3/PC2 for New Zealand and overseas oils 182
PC2/PC1 for all oil samples (6 trace elements) 183
PC3/PC1 for all oil samples (6 trace elements) 184
PC3/PC2 for all oil samples (6 trace elements) 185
62 Three dimensional graph of principal components for New Zealand and overseas oils

62a Three dimensional graph of principal components for New Zealand and overseas oils (individual groups)

63 Three dimensional graph of principal components (6 trace elements) for all oil samples

63a Three dimensional graph of principal components (6 trace elements) for all oil samples (individual groups)

64 PC2/PC1 for New Zealand oils and bitumen

65 PC3/PC2 for New Zealand oils and bitumen

66 Cobalt (ng/g) versus Ni (µg/g) for New Zealand asphaltene samples

67 Manganese (ng/g) versus Fe (µg/g) for New Zealand asphaltene samples

68 Cobalt (ng/g) in maltenes and asphaltenes for New Zealand oils

69 Nickel (µg/g) in maltenes and asphaltenes for New Zealand oils

70 Cobalt (ng/g) versus Ni (µg/g) for New Zealand and some overseas asphaltene samples
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Evolution of sedimentary matter</td>
</tr>
<tr>
<td>2.2</td>
<td>Complete sample list</td>
</tr>
<tr>
<td>2.3</td>
<td>Well cutting and coal samples</td>
</tr>
<tr>
<td>3.1</td>
<td>Trace element concentrations in filtered and unfiltered ToeToe-2B oil solutions</td>
</tr>
<tr>
<td>3.2</td>
<td>Trace element concentrations in untreated, ashed and acid-oxidised Tuhua-2 oil</td>
</tr>
<tr>
<td>3.3</td>
<td>Trace element concentrations in aqueous standard BECl, before and after acid-oxidation</td>
</tr>
<tr>
<td>3.4</td>
<td>Nickel values in standard oil and some New Zealand oils, determined in a mixed-solvent system</td>
</tr>
<tr>
<td>3.5</td>
<td>Zinc concentrations (µg/g) in some New Zealand oils, determined by INAA and GFAAS</td>
</tr>
<tr>
<td>3.6</td>
<td>Nickel concentrations (µg/g) in some New Zealand oils, determined by INAA and GFAAS</td>
</tr>
<tr>
<td>3.7</td>
<td>Asphaltene content of oil samples</td>
</tr>
<tr>
<td>3.8</td>
<td>Asphaltene content in New Zealand oils, compared with results from other studies</td>
</tr>
<tr>
<td>3.9</td>
<td>Comparison of Ni, Co and Fe concentrations in asphaltenes, determined by INAA and GFAAS</td>
</tr>
<tr>
<td>3.10</td>
<td>List of coal samples and ash content</td>
</tr>
<tr>
<td>3.11</td>
<td>Bitumen content (wt %) of rock and coal samples</td>
</tr>
<tr>
<td>3.12</td>
<td>Irradiation, decay and counting times for INAA</td>
</tr>
<tr>
<td>3.13</td>
<td>Trace element content of NBS standard oils</td>
</tr>
<tr>
<td>3.14</td>
<td>Instrumental NAA analysis of a Venezuelan standard oil</td>
</tr>
<tr>
<td>3.15</td>
<td>Wavelengths used for the determination of trace elements by GFAAS</td>
</tr>
</tbody>
</table>
3.16  Drying, ashing and atomizing temperatures used in the determination of trace elements by GFAAS  121

4.1  Variations in trace element concentrations in Waitangi Seep oil sample  125

4.2  Trace element concentrations of oils stored in glass and metal containers  126

4.3  Vanadium/Ni and Ni/V ratios for oils from the McKee Field  130
APPENDICES

A Trace elements concentrations in New Zealand oils 230
B Trace elements concentrations (17) in overseas oils 231
C Trace elements concentrations (6) in overseas oils 232
D Nickel/V and V/Ni ratios for New Zealand oils 233
E Cadmium, Cu and Pb concentrations determined in a mixed-solvent system 234
F Trace element concentrations in bitumen 235
G Trace element concentrations in coal, determined by ICP-ES and GFAAS 236
H Trace element concentrations in asphaltenes 237
I Trace element concentrations in kerogen 238
J Trace elements in formation water 239
K Original correlation matrix for New Zealand oils 240
L Original correlation matrix for overseas oils 241
M Original correlation matrix for overseas oils (6 elements) 242
N Original correlation matrix for New Zealand oils and bitumen 243
O Principal components analysis, New Zealand oils 244
P Principal components analysis, New Zealand and overseas oils 245
Q Principal components analysis, New Zealand and overseas oils (6 elements) 246
R Principal components analysis, New Zealand oils and bitumen 247