Establishing Geochemical Standards and Methods for CHNS Abundances and CNS Isotopes

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ABSTRACT

Purpose: Determination of carbon, nitrogen, hydrogen and sulfa abundances and stable isotopes, initially by combustion method.

Method: Rut samples with different geological ages and thermal maturities, including reference materials, were analyzed using an elemental analyzer with three subsystems.

Results: Carbon, nitrogen, hydrogen and sulfa abundances of rut samples were determined to validate the accuracy, precision and reliability of the elemental analyzer.

INTRODUCTION

Abundances and stable isotope ratios of carbon, nitrogen, hydrogen and sulfa have become important tools for understanding the properties of organic matter and the history of geologic processes, improving our understanding of the chemical composition of Earth materials and the origin of petroleum and natural gas. The elemental and isotopic compositions of geologic materials are critical to understanding the formation and evolution of the Earth's crust and mantle.

MATERIALS AND METHODS

For CHNS abundance determination, the Thermo Scientific™ FLASH™ Elemental Analyzer operates with the dynamic flash combustion technique. Samples are weighed to the nearest 0.01 mg and introduced to the combustion reactor by means of an IsoLink™ autosampler. The reactor is heated by a Helius™ Induction heating system, and combustion gas is passed through a Thermo Scientific™ MAS Plus Autosampler. The resulting gases are then mixed with a pulse of oxygen and directed to the Thermo Scientific™ IsoLink™ combustion unit. The combustion gases are then mixed with a pulse of oxygen and directed to the Thermo Scientific™ IsoLink™ combustion unit. The combustion gases are then mixed with a pulse of oxygen and directed to the Thermo Scientific™ IsoLink™ combustion unit.

RESULTS

The analysis of rut samples with different geological ages and thermal maturities, including reference materials, was performed on the Thermo Scientific™ FLASH™ Elemental Analyzer, which was optimized for CHNS and CNS isotope analyses. The results were compared with those obtained from other elemental analyzers, such as the Thermo Scientific™ NanoFlash™ Elemental Analyzer.

Table 1. Peak sample information

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Sample Name</th>
<th>Sample Type</th>
<th>CHNS Abundance</th>
<th>CNS Abundance</th>
<th>δ¹⁵N</th>
<th>δ¹³C</th>
<th>δ³⁴S</th>
<th>δ³²S</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Jurassic</td>
<td>3.08</td>
<td>1.04</td>
<td>0.49</td>
<td>2.72</td>
<td>0.96</td>
<td>0.58</td>
<td>0.86</td>
</tr>
<tr>
<td>002</td>
<td>Jurassic</td>
<td>3.08</td>
<td>1.04</td>
<td>0.49</td>
<td>2.72</td>
<td>0.96</td>
<td>0.58</td>
<td>0.86</td>
</tr>
<tr>
<td>003</td>
<td>Jurassic</td>
<td>3.08</td>
<td>1.04</td>
<td>0.49</td>
<td>2.72</td>
<td>0.96</td>
<td>0.58</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Table 2. Peak CHNS and CNS data

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Weight (mg)</th>
<th>CHNS Abundance</th>
<th>CNS Abundance</th>
<th>δ¹⁵N</th>
<th>δ¹³C</th>
<th>δ³⁴S</th>
<th>δ³²S</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>0.02</td>
<td>3.08</td>
<td>1.04</td>
<td>0.49</td>
<td>2.72</td>
<td>0.96</td>
<td>0.58</td>
</tr>
<tr>
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<td>2.72</td>
<td>0.96</td>
<td>0.58</td>
</tr>
</tbody>
</table>

For CNS isotope determination, the combustion oven was programmed to operate at 3 mg/min and using the same factor for the calibration. The results were analyzed 15 times and for all samples, the accuracy of the results was compared with those obtained using other elemental analyzers.

ACKNOWLEDGMENTS

The authors thank the University of St. Andrews for providing the elemental analyzer. We also acknowledge the support of the Thermo Scientific™ NanoFlash™ Elemental Analyzer and the Thermo Scientific™ IsoLink™ combustion unit.

REFERENCES


CONCLUSIONS

The Thermo Scientific™ NanoFlash™ Elemental Analyzer was optimized for CHNS and CNS isotope analyses, and the results were compared with those obtained using other elemental analyzers. The Thermo Scientific™ NanoFlash™ Elemental Analyzer was optimized for CHNS and CNS isotope analyses, and the results were compared with those obtained using other elemental analyzers. The Thermo Scientific™ NanoFlash™ Elemental Analyzer was optimized for CHNS and CNS isotope analyses, and the results were compared with those obtained using other elemental analyzers. The Thermo Scientific™ NanoFlash™ Elemental Analyzer was optimized for CHNS and CNS isotope analyses, and the results were compared with those obtained using other elemental analyzers.

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