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Forrest G. Hall and Andrea Papagno, Editors

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BOREAS TE-8 Aspen Bark Chemistry Data

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Summary

The BOREAS TE-8 team collected pigment density data from aspen bark and leaves from four sites within the BOREAS SSA from 24-May-1994 to 16-Jun-1994 (IFC-1), 19-Jul-1994 to 08-Aug-1994 (IFC-2), and 30-Aug-1994 to 19-Sep-1994 (IFC-3). One to nine trees from each site were sampled during the three IFCs. Each tree was sampled in five different locations for bark pigment properties: basal stem section, which was any bark sample taken below one-half the tree height; upper stem section, which was any bark sample taken from the main stem above one-half the tree height; bark taken from branches up to 3 years old; a 2-year-old branch segment; and a 1-year-old branch segment. Additionally, a limited number of leaves were collected. Bark samples were removed from the stem of the tree, placed in ziplock bags, and transported to UNH, where they were processed and analyzed by a spectrophotometer.

In each data file, samples are identified by Site, Date, Tree#, and Sample Location (see 1st paragraph above. Pigment density values are normalized to mg/m². Density values for the following pigments are provided: Chl a, Chl b, Total Chl (Chl a+b), Carotenoids, Chl a to b ratio, and the Total Chl to carotenoids ratio. The data are stored in ASCII files.

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1. Data Set Overview

1.1 Data Set Identification
BOREAS TE-08 Aspen Bark Chemistry Data

1.2 Data Set Introduction
These data are pigment densities for aspen bark samples and aspen leaf samples collected from four sites within the BOREal Ecosystem-Atmosphere Study (BOREAS) Southern Study Area (SSA) during the three Intensive Field Campaigns (IFCs) of 1994. Each tree was divided into five different bark sampling locations: basal stem, upper stem, branch, 2-year-old branches, and 1-year-old branches. Additionally, several leaves were also measured for pigment density for comparison to bark data.

1.3 Objective/Purpose
The purpose of this work was to understand the potential influence of aspen bark photosynthesis on bark spectra and on the carbon budget of boreal aspen stands.

1.4 Summary of Parameters
Each data set contains the sample location, the chlorophyll (chl) A density, chl B density, total chl density, carotenoid density, ratio of chl A/chl B, and the ratio of total chl/carotenoid.

1.5 Discussion
The bark of aspen (Populus tremuloides) is green and photosynthetic. The phenomenon of bark photosynthesis in aspen has been studied extensively; it has been shown that bark photosynthesis can account for between 5-40% of whole tree photosynthesis. BOREAS used remote sensing systems as a primary means for data collection to better understand the ecosystem-atmosphere interactions. Aspen is a dominant forest cover type, especially in the SSA. Therefore, bark spectral properties could significantly affect data collected and analyzed by remote sensing instruments in BOREAS. The photosynthetic pigment content of the bark affects the spectral properties, and the pigments densities were quantified.

This study was undertaken to quantify the pigment and spectral properties of aspen bark samples (spectral data are presented in separate files with a separate documentation file). The results of this study provide an initial understanding of the potential influence of aspen bark photosynthesis on remotely collected data and carbon budget for aspen stands. A more intensive study should be conducted to scale lab-based spectral measurements to airborne and spaceborne platforms. Additionally, direct measurements of bark photosynthesis would be required to determine the significance to the boreal carbon budget.

The quality of the pigment data is believed to be good. Comparisons with data reported by other researchers who have studied aspen bark photosynthesis show similar results. Additionally, leaf pigment samples correspond to measurements taken by other BOREAS researchers, showing that the bark samples should be of good quality.

1.6 Related Data Sets
BOREAS TE-08 Aspen Bark Spectral Reflectance Data
BOREAS TE-09 NSA Leaf Chlorophyll Density
BOREAS TE-10 Leaf Chemistry Data
2. Investigator(s)

2.1 Investigator(s) Name and Title
Dr. Slava Kharouk, Scientist
Dr. Barret N. Rock, Associate Professor

2.2 Title of Investigation
Aspen Bark Input in Tree-Atmosphere Interactions

2.3 Contact Information

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barry.rock@unh.edu

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(301) 286-2039 (fax)
Andrea.Papagno@gsfc.nasa.gov

3. Theory of Measurements

Bark pigment characteristics, primarily chlorophylls a and b, are important molecule complexes in the process of photosynthesis and carbon assimilation. Therefore, in order to better understand the phenomenon of bark photosynthesis and how it relates to the bark spectral properties, pigment extractions were made of bark and leaf samples. These samples were taken at the same time and place as spectral samples (see BOREAS TE-08 Aspen Bark Spectral Reflectance Data).
4. Equipment

4.1 Sensor/Instrument Description
A Beckman DU-7 spectrophotometer was used to make absorbance measurements. Calibrated 1-cm quartz vials were used for measurements within the spectrophotometer.

4.1.1 Collection Environment
Bark and leaf samples were collected from the field. Measurements took place in laboratory conditions.

4.1.2 Source/Platform
None given.

4.1.3 Source/Platform Mission Objectives
None given.

4.1.4 Key Variables
Chl a, chl b, carotenoid densities.

4.1.5 Principles of Operation
Absorption due to light extinction (see Lichtenthaler, 1987; Gregory, 1989).

4.1.6 Sensor/Instrument Measurement Geometry
None given.

4.1.7 Manufacturer of Sensor/Instrument
Beckman Spectrophotometer, Model DU-7
Beckman Coulter, Inc.
4300 N. Harbor Boulevard
P.O. Box 3100
Fullerton, CA 92834-3100
(800) 742-2345
(800) 634-4366 (fax)

4.2 Calibration

4.2.1 Specifications
Absorption is calibrated based on use of a 100% dimethyl sulfoxide (DMSO) blank in a standard 1-cm quartz cuvette.

4.2.1.1 Tolerance
None given.

4.2.2 Frequency of Calibration
A 100% DMSO blank was used for calibration once every 10 measurements.

4.2.3 Other Calibration Information
None.
5. Data Acquisition Methods

Bark samples from different locations within the tree were collected and analyzed to determine chl a, chl b, total chl (chl a+b), and carotenoid concentrations. At the Paddockwood field site, within a day following collection, bark and leaf samples were removed from the tree using a cork borer of known diameter. Bark sections were peeled off the stem or branch wood, placed in ziplock bags with wet napkins, and kept cool until samples could be processed. These samples were then cut into pieces and added to 4 ml DMSO in capped glass vials, a standard procedure described by Lichtenthaler (1987) and Hixcox and Israelstam (1979) for chlorophyll extraction. Samples were allowed to extract in darkened conditions for 48 hours and were then kept frozen until processing could take place at the University of New Hampshire (UNH). Vials were kept frozen during transport to UNH and were measured within 1 week of arrival (except for IFC-1 samples; see Section 6.1).

At UNH, the extracted solutions were refrigerated for 30 minutes prior to measurement. The spectrophotometer was calibrated using 100% DMSO in a quartz cuvette. Four ml of extract were placed in a 1-cm quartz cuvette, and absorption was measured at four different wavelength positions. The sample was returned to the glass vial. The quartz cuvette was rinsed between samples with 80% acetone and the spectrophotometer was recalibrated every 10 samples. Extract solution absorbance was measured with a Beckman DU-7 spectrophotometer at 470.0 nm, 646.8 nm, 663.2 nm, and 750.0 nm (Lichtenthaler, 1987; Spencer, 1996). The results were printed and then entered into a spreadsheet. Absorbance values were used to calculate pigment concentrations using standard extinction equations reported by Lichtenthaler (1987) (see also Spencer, 1996). Absorption at 750.0 nm (value at 750 should be made equal to zero and the difference is applied to the other wavelengths) was used to calibrate other absorbance values (Middleton, personal communication; Spencer, 1996). Pigment concentration values were then normalized to mg/dm² using the known amount of extraction used and the original surface area of the sample extracted.

6. Observations

6.1 Data Notes

Samples from IFC-1 were measured shortly after returning from Canada. However, data were erroneous because of a malfunctioning siphon that was initially used to fill and rinse the cuvette with the sample solution. This problem was noted and corrected. IFC-1 samples had been stored at 4 °C and were remeasured in early August 1994 following correction of the problem.

The authors conducted some preliminary research on bark area leaf area ratios that is not reported here. This information can be found in Spencer, 1996.

6.2 Field Notes

Samples were collected at field sites, placed in ziplock bags, and kept cool until processing. Extractions were conducted at the field lab and were then frozen (about 4 °C) until they were measured with the spectrophotometer at UNH.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

Four sites were sampled during the three 1994 IFCs. Not all sites were sampled during each IFC because of destructive sampling logistics. Two BOREAS tower sites were used: Old Aspen (SSA-9OA) and Young Aspen (YA). Additionally, the originally identified BOREAS YA site was sampled during all three IFCs and is identified in these data sets as the Young Aspen-Auxiliary 04 site (YA-AUX04), and a non-BOREAS mixed aspen and white spruce site is identified as YA-AUX07. One to five trees were destructively harvested during each IFC.
The following is sample collection information at the four SSA locations:

- **SSA-9OA**: One tree was harvested during IFC-2. Branch samples only were collected during IFC-1, and no samples were collected from the SSA-9OA during IFC-3 because of the logistics of destructive sampling.
- **YA-AUX04**: Three trees were destructively harvested during each of the three IFCs.
- **YA**: Five trees were harvested during IFC-2 and -3.
- **YA-AUX07**: This is a non-BOREAS site that exists within the BOREAS SSA and was established in order to harvest a second mature (>60 yr. old tree) aspen stand for TE-08 research. This site was a mixed site of mature aspen overstory and white spruce understory. It was located on the property of Snow Castle Lodge approximately 3 km N of the SSA-YA site (see Spencer, 1996, for more details). One tree was harvested from this site during IFC-3.

The SSA measurement sites and their associated North American Datum of 1983 (NAD83) coordinates are:

- **YA**, site id D0H4T, Lat/Long: 53.65601 N, 105.32314 W, UTM Zone 13, N: 5,945,298.9 E: 478,644.1.
- **YA-AUX07**, Located 3 km N of SSA-YA on the property of Snow Castle Lodge, UTM Zone 13. This was a mixed site of mature aspen overstory (>60 yrs) and white spruce understory.

7.1.2 **Spatial Coverage Map**

7.1.3 **Spatial Resolution**
These data are point measurements at the given location.

7.1.4 **Projection**
None given.

7.1.5 **Grid Description**
None given.

7.2 **Temporal Characteristics**

7.2.1 **Temporal Coverage**
These data were collected from 24-May-1994 to 16-Jun-1994 (IFC-1), 19-Jul-1994 to 08-Aug-1994 (IFC-2), and 30-Aug-1994 to 19-Sep-1994 (IFC-3).

7.2.2 **Temporal Coverage Map**
None given.

7.2.3 **Temporal Resolution**
Each site was visited once.

7.3 **Data Characteristics**
7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

<table>
<thead>
<tr>
<th>Column Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
</tr>
<tr>
<td>SUB_SITE</td>
</tr>
<tr>
<td>START_COLLECTION_DATE</td>
</tr>
<tr>
<td>END_COLLECTION_DATE</td>
</tr>
<tr>
<td>DATE_OBS</td>
</tr>
<tr>
<td>TREE_ID</td>
</tr>
<tr>
<td>SAMPLE_LOCN</td>
</tr>
<tr>
<td>CHLOROPHYLL_A_DENSITY</td>
</tr>
<tr>
<td>CHLOROPHYLL_B_DENSITY</td>
</tr>
<tr>
<td>TOTAL_CHLOROPHYLL_DENSITY</td>
</tr>
<tr>
<td>CAROTENOID_DENSITY</td>
</tr>
<tr>
<td>CHLOROPHYLL_A_TO_B_RATIO</td>
</tr>
<tr>
<td>TOTAL_CHL_TO_CAROTENOID_RATIO</td>
</tr>
<tr>
<td>SPECIES</td>
</tr>
<tr>
<td>CRTFCN_CODE</td>
</tr>
<tr>
<td>REVISION_DATE</td>
</tr>
</tbody>
</table>

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.</td>
</tr>
<tr>
<td>START_COLLECTION_DATE</td>
<td>The start date of the period when the samples were acquired, in the form DD-MON-YY:HH:MI, where time is in GMT.</td>
</tr>
<tr>
<td>END_COLLECTION_DATE</td>
<td>The end date of the period when the samples were acquired, in the form DD-MON-YY:HH:MI, where time is in GMT.</td>
</tr>
<tr>
<td>DATE_OBS</td>
<td>The date on which the data were collected.</td>
</tr>
<tr>
<td>TREE_ID</td>
<td>Identifier of the mapped tree or plant stem.</td>
</tr>
<tr>
<td>SAMPLE_LOCN</td>
<td>Specific location where the sample was measured.</td>
</tr>
<tr>
<td>CHLOROPHYLL_A_DENSITY</td>
<td>Chlorophyll A per unit hemi-surface area.</td>
</tr>
<tr>
<td>CHLOROPHYLL_B_DENSITY</td>
<td>Chlorophyll B per unit hemi-surface area.</td>
</tr>
<tr>
<td>TOTAL_CHLOROPHYLL_DENSITY</td>
<td>Total chlorophyll (chlorophyll A + chlorophyll B) per unit hemi-surface area.</td>
</tr>
<tr>
<td>CAROTENOID_DENSITY</td>
<td>Carotenoid per unit hemi-surface area.</td>
</tr>
<tr>
<td>CHLOROPHYLL_A_TO_B_RATIO</td>
<td>The ratio of chlorophyll-A to chlorophyll-B.</td>
</tr>
</tbody>
</table>
TOTAL_CHL_TO_CAROTENOID_RATIO

The ratio of total chlorophyll (chlorophyll-A + chlorophyll-B) to carotenoid density.

SPECIES

Botanical (Latin) name of the species (Genus species).

CRTFCN_CODE

The BOREAS certification level of the data.
Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-?? (CPI but questionable).

REVISION_DATE

The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

<table>
<thead>
<tr>
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<th>Units</th>
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</thead>
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<tr>
<td>START_COLLECTION_DATE</td>
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<td>END_COLLECTION_DATE</td>
<td>[none]</td>
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<tr>
<td>DATE_OBS</td>
<td>[DD-MON-YY]</td>
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<tr>
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<tr>
<td>CHLOROPHYLL_A_DENSITY</td>
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</tr>
<tr>
<td>CHLOROPHYLL_B_DENSITY</td>
<td>[milligrams][meter^-2]</td>
</tr>
<tr>
<td>TOTAL_CHLOROPHYLL_DENSITY</td>
<td>[milligrams][meter^-2]</td>
</tr>
<tr>
<td>CAROTENOID_DENSITY</td>
<td>[milligrams][meter^-2]</td>
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<tr>
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7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

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<td>TREE_ID</td>
<td>[Human Observer]</td>
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<td>SAMPLE_LOCN</td>
<td>[Human Observer]</td>
</tr>
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<td>CHLOROPHYLL_A_DENSITY</td>
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<tr>
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<tr>
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<td>[Laboratory Equipment]</td>
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<tr>
<td>CAROTENOID_DENSITY</td>
<td>[Laboratory Equipment]</td>
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<tr>
<td>CHLOROPHYLL_A_TO_B_RATIO</td>
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<td>[Human Observer]</td>
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<td>[BORIS Designation]</td>
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<td>[BORIS Designation]</td>
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### 7.3.5 Data Range

The following table gives information about the parameter values found in the data files on the CD-ROM.

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<th>Maximum Value</th>
<th>Missng Value</th>
<th>Unrel Value</th>
<th>Below Detect Limit Value</th>
<th>Data Not Cllctd</th>
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<td>CHLOROPHYLL_A_TO_B_RATIO</td>
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<tr>
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<td>N/A</td>
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<td>None</td>
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<td>CRTFCN_CODE</td>
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<td>24-DEC-98</td>
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<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Minimum Data Value -- The minimum value found in the column.

Maximum Data Value -- The maximum value found in the column.

Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.

Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the parameter value, but the value was deemed to be unreliable by the analysis personnel.

Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation.

Data Not Cllctd -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.

N/A -- Indicates that the value is not applicable to the respective column.
7.4 Sample Data Record

The following are wrapped versions of data record from a sample data file on the CD-ROM.

```
SITE_NAME, SUB_SITE, DATE_OBS, START_COLLECTION_DATE, END_COLLECTION_DATE, TREE_ID, SAMPLE_LOCN, CHLOROPHYLL_A_DENSITY, CHLOROPHYLL_B_DENSITY, TOTAL_CHLOROPHYLL_DENSITY, CAROTENOID_DENSITY, CHLOROPHYLL_A_TO_B_RATIO, TOTAL_CHL_To_CAROTENOID_RATIO, SPECIES, CRTFCN_CODE, REVISION_DATE
'SSA-9OA-FLXTR', '9TE08-BKC01', 03-AUG-94, 24-MAY-94, 02-JUN-94, 1, 'LEAVES', 142.0, 37.0, 179.0, 66.0, 3.88, 2.7, 'Populus tremuloides', 'CPI', 18-NOV-98
'SSA-9OA-FLXTR', '9TE08-BKC01', 03-AUG-94, 24-MAY-94, 02-JUN-94, 1, 'LEAVES', 117.0, 33.0, 150.0, 54.0, 3.57, 2.77, 'Populus tremuloides', 'CPI', 18-NOV-98
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data tracked by the BOREAS Information System (BORIS) was the data collected at a given site on a given date.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

Absorption data were calibrated with absorption data from the 750-nm band and were then input into the extinction equations listed in Section 9.1. These values were then normalized for the amount of solution used and the surface area of the sample to arrive at a figure in mg/dm². See Section 9.2.1 for further details.

Extinction coefficients are from Lichtenthaler (1987):

\[
[\text{chl a}] = 12.25A(663.2) - 2.79A(646.8) \quad (1)
\]
\[
[\text{chl b}] = 21.50A(646.8) - 5.10A(663.2) \quad (2)
\]
\[
[\text{chl a} + \text{chl b}] = [\text{chl a}] + [\text{chl b}] \quad (3)
\]
\[
[\text{carotenoids}] = (1000A(470) - 1.82[\text{chl a}] - 85.02[\text{chl b}]) / 198 \quad (4)
\]

where \(A(\text{wavelength})\) is the absorption at the specified wavelength.

9.1.1 Derivation Techniques and Algorithms

Not applicable.
9.2 Data Processing Sequence

9.2.1 Processing Steps

- Absorption results were entered into a spreadsheet.
- Absorption at 750.0 nm (value at 750 was made equal to zero and the difference was applied to the other wavelengths) was used to calibrate other absorbance values (Middleton, personal communication; Spencer, 1996).
- Pigment concentration values were then normalized to mg/dm² using the known amount of extraction used and the original surface area of the sample extracted.
- Absorbance values were used to calculate pigment concentrations using standard extinction equations reported by Lichtenthaler (1987) (see also Spencer, 1996).
- As part of its data integration efforts, BORIS staff converted the pigment concentration values to mg/m² to be compatible with other similar measurements.

9.2.2 Processing Changes

None given.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

Data were corrected with the measurement at 750 nm because of the purity of the DMSO and the possibility for debris in the extract solution. The value at 750 nm should be equal to zero for chlorophyll and pigment absorption. If the absorption value at 750 nm was greater than 0.01, the sample was rerun or discarded.

9.3.2 Calculated Variables

See Sections 9.1 and 9.3.1.

9.4 Graphs and Plots

None given.

10. Errors

10.1 Sources of Error

Error could have been created by the calibration discussed in Section 9.3.1. The extraction solution should have been filtered to avoid this problem. However, discussions with other BOREAS teams measuring chlorophyll concentration showed TE-08's calibration method discussed in Section 9.3.1 to be an acceptable practice.

10.2 Quality Assessment

Several tests were conducted to be sure that consistent, reliable data were collected by the instrument. The tests included comparisons of light absorption to a standard of 100% DMSO and comparisons of results with those of TE-10. Our data appear to be consistent with TE-10's results.

10.2.1 Data Validation by Source

None given.

10.2.2 Confidence Level/Accuracy Judgment

The data appear to be good. Leaf chlorophyll data were checked against those of TE-10 and found to be not significantly different.

10.2.3 Measurement Error for Parameters

None given.
10.2.4 Additional Quality Assessments
   All data were checked for potential problems and discarded if problems were evident.

10.2.5 Data Verification by Data Center
   Data were examined for general consistency and clarity.

11. Notes

11.1 Limitations of the Data
   These data are calculated on an area basis rather than a weight basis because of the bark tissue heterogeneity.

11.2 Known Problems with the Data
   None given.

11.3 Usage Guidance
   None given.

11.4 Other Relevant Information
   None given.

12. Application of the Data Set

   These data provide information on the chlorophyll density of aspen bark. This information can be scaled up to the whole tree level to determine the amount of whole tree chlorophyll found in the bark tissue. This gives a preliminary indication as to the importance of bark photosynthesis on a whole tree/stand level. More work should be done in this area to determine bark photosynthesis significance to aspen carbon dynamics. Gas exchange measurements should be conducted on aspen bark during different times of the year. See Spencer, 1996, for more discussion.

13. Future Modifications and Plans

   These data have been presented in more detail in Spencer, 1996.

14. Software

14.1 Software Description
   Quattro Pro 4.0 was used for most analyses and then Excel 5.0 was used for the final and summative analyses. For a statistical package TE-08 used Stata Pro 4.0.

14.2 Software Access
   None given.
15. Data Access

The aspen bark chemistry data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information
   For BOREAS data and documentation please contact:

   ORNL DAAC User Services
   Oak Ridge National Laboratory
   P.O. Box 2008 MS-6407
   Oak Ridge, TN 37831-6407
   Phone: (423) 241-3952
   Fax: (423) 574-4665
   E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification
   Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics

15.3 Procedures for Obtaining Data
   Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans
   The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products
   None.

16.2 Film Products
   None.

16.3 Other Products
   These data are available on the BOREAS CD-ROM series.
17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation
Beckman Spectrophotometer Manual, Beckman Spectrophotometer, Model DU-7, Beckman Coulter, Inc., Fullerton, CA 92834-3100.

17.2 Journal Articles and Study Reports


17.3 Archive/DBMS Usage Documentation
None.

18. Glossary of Terms
None.

19. List of Acronyms

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<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>ASCII</td>
<td>American Standard Code for Information Interchange</td>
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<tr>
<td>BOREAS</td>
<td>BOReal Ecosystem-Atmosphere Study</td>
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20. Document Information

20.1 Document Revision Date(s)
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20.2 Document Review Date(s)
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20.4 Citation
When using these data, please include the following acknowledgment as well as citations of relevant papers in Section 17.2:

Shannon L. Spencer and Barret N. Rock, both of the Complex Systems Research Center at UNH.

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20.5 Document Curator

20.6 Document URL
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BOREAS TE-8 Aspen Bark Chemistry Data

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The BOREAS TE-8 team collected pigment density data from aspen bark and leaves from four sites within the BOREAS SSA from 24-May-1994 to 16-Jun-1994 (IFC-1), 19-Jul-1994 to 08-Aug-1994 (IFC-2), and 30-Aug-1994 to 19-Sep-1994 (IFC-3). One to nine trees from each site were sampled during the three IFCs. Each tree was sampled in five different locations for bark pigment properties: basal stem section, which was any bark sample taken below one-half the tree height; upper stem section, which was any bark sample taken from the main stem above one-half the tree height; bark taken from branches up to 3 years old; a 2-year-old branch segment; and a 1-year-old branch segment. Additionally, a limited number of leaves were collected. Bark samples were removed from the stem of the tree, placed in ziplock bags, and transported to UNH, where they were processed and analyzed by a spectrophotometer. In each data file, samples are identified by Site, Date, Tree#, and Sample Location (see 1st paragraph above). Pigment density values are normalized to mg/m². Density values for the following pigments are provided: Chl a, Chl b, Total Chl (Chl a+b), Carotenoids, Chl a to b ratio, and the Total Chl to carotenoids ratio. The data are stored in ASCII files.

BOREAS, terrestrial ecology, aspen bark.