COAL BALL PEEL TECHNIQUE

Coal balls are spherical to ellipsoidal masses of calcium carbonate (or calcium magnesium carbonate) in which plant tissues are tree dimensionally preserved, embedded within the carbonate matrix. The carbonate essentially impregnates the residues of the plant cell walls and fills the cell cavities. Concentration of the carbonate occurred by localized precipitation from solution at a time when the plant tissues were at the peat stage and the solid matrix of the coal ball thus formed prevented compression of the entrapped tissues into coal. Coal balls occur sporadically in Carboniferous coal seams of Kansas, Iowa, Indiana, and Illinois.

After coal balls are collected they are cut on saws specially equipped with diamond-edged blades. The cut surfaces are then ready to be lapped (rough ground) with No. 400 carborundum powder. A final polishing is accomplished using No. 600 carborundum powder on plate glass.

The polished surfaces are then ready to be etched a 5% HCl Required etching time may vary but 20..30 seconds in the above solution often is adequate. As the etching process progresses the carbonate matrix is slowly dissolved away leaving a layer of plant cells standing in relief. Great care must be taken so that the surface is not touched and is kept free of loose materials. Gently flowing tap water can be used to wash away excess acid.

The etched surface is then allowed to dry upright. Many investigators pour a few drops of acetone on the etched surface to speed up the water evaporation rate and consequently increase the number of peels which may be made in one period.

The dry coal ball segment is placed on an acetone proof surface with the top surface of the segment at a slant. Enough acetone is applied to moisten the entire etched surface with any excess acetone collecting at the lower elevation. A sheet of 3ml acetate is then gently laid on the etched surface in a manner that permits the acetone to distribute itself evenly between the surface of the ball and the acetate.

One or two milliliters of acetone is sufficient for making an average coal ball peel. Excessive acetone between the acetate and the coal ball may cause bubbling and wrinkling in the peel. The acetone partially dissolves the acetate and consequently allows it to flow in and around the cell wells which stand in relief upon the surface.

As the acetone evaporates the raised parts of the etched surface becomes firmly embedded in the lower surface of the cellulose acetate and will break away from the coal ball when the peel is removed.

Drying time is dependent upon temperature, air circulation, and quantity of acetone involved but 15 to 30 minutes is the range. Insufficient drying time results in a faint print; excessively dry peels may be difficult to remove. The peel is removed by pulling up on the acetate that overhangs the edge of the coal ball. Care should be taken to get the peel off in one piece.

The peel is now ready to be identified.

Adapted from "The Coal Ball Peel Technique" by Thomas N. Taylor, Fast Journal, 1962,
## TECHNICAL BULLETIN

### Parts List – MSC 53700

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60271 Calcified plant specimen, with identified peel and map</td>
</tr>
<tr>
<td>1</td>
<td>60276 6” x 6” glass plate</td>
</tr>
<tr>
<td></td>
<td>60277 300 sheets cellulose acetate 2” x 3”</td>
</tr>
<tr>
<td>1</td>
<td>60279 Coal Ball, unidentified</td>
</tr>
<tr>
<td>1</td>
<td>60280 #600 emery in 1-oz. bottle with dispensing cap</td>
</tr>
</tbody>
</table>

### MSC 53701 Kit

Comparable to 53700 but lacks #60271, Calcified plant specimen with identified peel and map.

### Technique

Coal balls are spherical to ellipsoidal masses of calcium carbonate (or calcium magnesium carbonate) in which plant tissues are three dimensionally preserved, embedded within the carbonate matrix. The carbonate essentially impregnates the residues of the plant cell walls and fills the cell cavities. Concentration of the carbonate occurred by localized precipitation from solution at a time when the plant tissues were at the peat stage and the solid matrix of the coal ball thus formed prevented compression of the entrapped tissues into coal. Coal balls occur sporadically in Carboniferous coal seams of Kansas, Iowa, Indiana, and Illinois.

After coal balls are collected they are cut on saws specially equipped with diamond-edged blades. The cut surfaces are then ready to be lapped (rough ground) with No. 400 Carborundum powder on a piece of heavy iron plate. A final polishing is accomplished using No. 600 Carborundum powder on a piece of plate glass.

The polished surfaces are then ready to be etched in a solution made by adding 2 ml of concentrated hydrochloric acid to 98 ml of water. Required etching time may vary but 2 minutes in the above solution is adequate. As the etching process progresses the carbonate matrix is slowly dissolved away leaving a layer of plant cells standing in relief. Great care must be taken so that the surface is not touched and is kept free of loose materials. Gently flowing tap water can be used to wash away excess acid.

The etched surface is then allowed to dry upright. Many investigators pour a few drops of acetone on the etched surface to speed up the water evaporation rate and consequently increase the number of peels which may be made in one period. **CAUTION:** Acetone is a highly inflammable substance and calls for suitable safety precautions.

The dry coal ball segment is placed on an acetone proof surface with the top surface of the segment at a slight (5 – 10°) slant. Enough acetone is applied to moisten the entire etched surface with any excess acetone collecting at the lower elevation. A sheet of 3 ml acetate is then gently laid on the etched surface in a manner that permits the acetone to distribute itself evenly between the surface of the ball and the acetate.

One or two milliliters of acetone is sufficient for making an average coal ball peel. Excessive acetone between the acetate and the coal ball may cause bubbling and wrinkling in the peel. The acetone partially dissolves the acetate and consequently allows it to flow in and around the cell walls which stand in relief upon the surface.

As the acetone evaporates the raised parts of the etched surface becomes firmly imbedded in the lower surface of the cellulose acetate and will break away from the coal ball when the peel is removed.

Drying time is dependent upon temperature, air circulation, and quantity of acetone involved but 10 to 30 minutes is the range. Insufficient drying time results in a faint print; excessively dry peels may be difficult to remove. The peel is removed by pulling up on the acetate that overhangs the edge of the coal ball. Care should be taken to get the peel off in one piece.

The peel is now ready to be identified with the coal ball and preparator. This is usually done with an envelope for the peels from each coal ball segment and a numbering system for the individual peels. Envelope storage helps keep the peels flat enough for gross examination.
Slides for microscopic examination may be made of selected peel parts in the following manner.

1. Procure a roll of transparent cellulose acetate adhesive tape of a width to accommodate the size of peel segment being mounted.
2. Cut out the desired section of the peel and position its shiny side on the sticky side of the tape. Be careful to leave a border of tape on all edges of the peel.

3. Mount the tape and peel on a microscope slide and trim off excessive tape.

The slide is now ready for use. The peel section is flat and is held down by a cover thin enough to permit inspection under a 43X objective lens.

A recent college text on paleobotany that is suitable for a high school reference book is the following:

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Maps of Selected Coal Ball Peels Showing Some Commonly Found Structures.

STEM OF A PRIMITIVE FERN

STEM OF SPHENOPHYLLUM

SEED OF CORDITES

LEAF OF CORDITES

attachment

Photographs from
Paleontology
Laboratory, Harvard
University

*International ages have not been established. These are regional (Laurentian) only. Boundary Picks were based on dating techniques and fossil records as of 1999. Paleomagnetic attributions have errors. Please ignore the paleomagnetic scale.