

IlluviaSols

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Introduction

The clay illuviation process has a major role in the formation of soils. It affects to many soils belonging to different classes and it provides some distinctive features to each soil, normally with profiles divided in horizons strongly contrasted by their morphological, physical and chemical characteristics.

IlluviaSols is a program with educational purposes to introduce the students in the soil illuviation processes. This software belongs to a course developed for the soil-genesis teaching. Some computer other programs of this course are presented in this Eurosoil 2004: OpticalMine, SoilMicroscopy, CO₃Sols and HydroSols.

The application

IlluviaSols has been re-worked using the heterogeneous (Windows, Mac, Linux, etc) languages HTML and JavaScript from a first version implemented in Hypertalk for Apple Macintosh computers, which was presented in the 10th International Working Meeting on Soil Micromorphology (Aguilar et al., 1996) and in the 16th World Congress of Soil Science (Aguilar et al., 1998).

The program is available in both English and Spanish versions and it can be found at:

<http://edafologia.ugr.es/iluv/indexw.htm>

IlluviaSols is composed of texts, figures and microphotographs, the user will have to answer some questions concerning the identification of eluviation/illuviation processes and features, which is shown in a picture. Thus, the software evaluates the knowledge of the student (Figure 1).

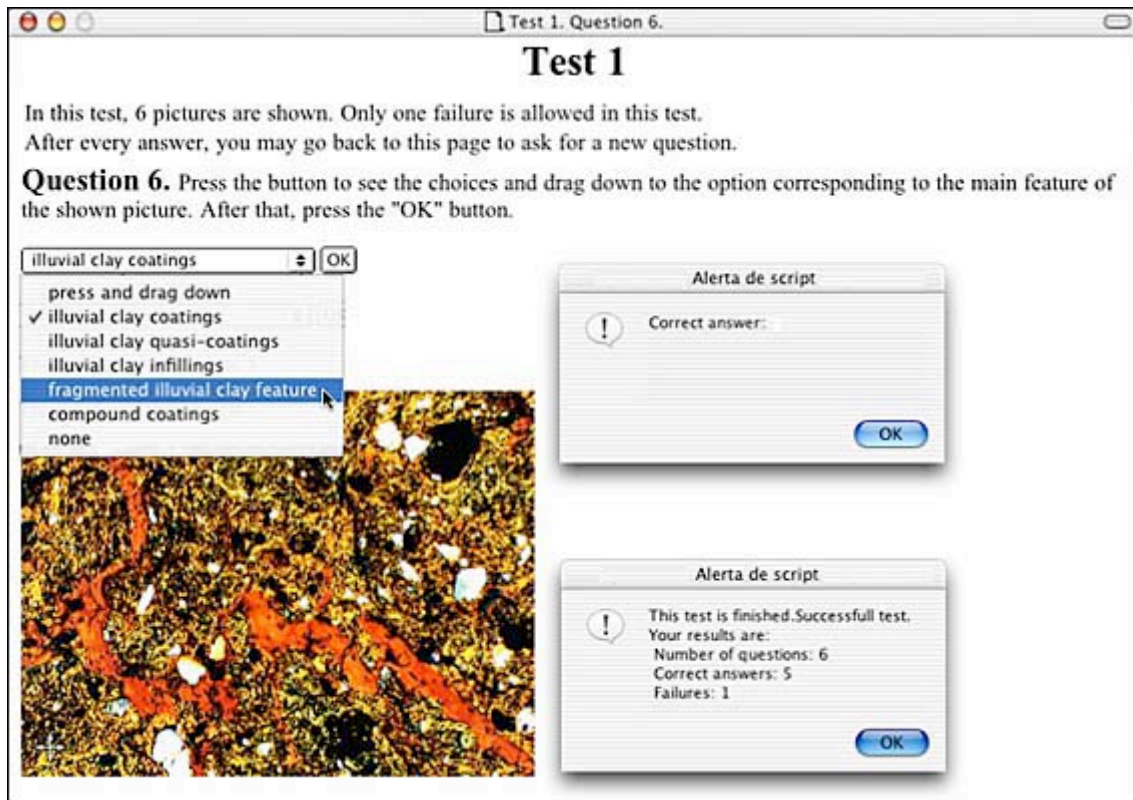


Figure 1. Test example.

Some scripts related to the Figure 1 are given below.

Script 1

```

<HTML>
<HEAD>
<TITLE>Test 1. Home</TITLE>
</HEAD>
<BODY BGCOLOR="#ffffff">
<FORM>
<P><!--NOEDIT-->
<SCRIPT LANGUAGE="JAVASCRIPT">
<!--
var textPreg = " Number of questions: "
var textAciertos = "\r Correct answers: "
var textFallos = "\r Failures: "
var fallados = 0
var contador = 1
function WinOpen(nombre){
open(nombre,"Window1","toolbar=no,scrollbars");
}
}
function empezar() {
switch (contador)
case 1: WinOpen("test1aw.htm");
break
case 2: WinOpen("test1bw.htm");
break;

```

```

        case 3: WinOpen("test1cw.htm");
        break;
        case 4: WinOpen("test1dw.htm");
        break;
        case 5: WinOpen("test1ew.htm");
        break;
        case 6: WinOpen("test1fw.htm");
        break;
default:
    alert("This test is finished.\Successful test.\rYour results are:\r" + textPreg +
(contador - 1) + textAciertos + (contador - fallados - 1) + textFallos + fallados);
    }
}
//-->
</SCRIPT>
<!--/NOEDIT--></P>
<P><CENTER><B><FONT SIZE="+3">Test 1</FONT></B></CENTER></P>
<P>&nbsp;</P>
<P><FONT SIZE="+1">In this test, 6 pictures are shown. Only one failure is
allowed in this test.</FONT></P>
<P><FONT SIZE="+1">After every answer, you may go back to this page to ask for
a new question.</FONT></P>
<P>&nbsp;</P>
<P><input type="button" name="WindowButton" value= "Questions"
onclick="empezar()"></P>
<P>&nbsp;</P>
<P><input type="button" name="WindowButton" value="Results"
onclick="alert(textPreg + (contador - 1) + textAciertos + (contador - fallados - 1) +
textFallos + fallados)"></P>
<P>&nbsp;</P>
<P>&nbsp;</P>
<P><CENTER>&nbsp;</CENTER></P>
<P><CENTER>
<A HREF=" ../ttindexw.htm"><FONT SIZE="+1">Index Test</FONT></A>
</CENTER>
</FORM>
</BODY>
</HTML>

```

Script 2

```

<HTML>
<HEAD>
<TITLE>Test 1. Question 6.</TITLE>
</HEAD>
<BODY BGCOLOR="#ffffff">
<P><!--NOEDIT-->
<SCRIPT LANGUAGE="JAVASCRIPT">
function ChecFallos() {
    if (fallados>=2) {

```

```

    alert("Second failure!\rUnsuccessful test.\rYour results are:\r" + textPreg +
contador + textAciertos + (contador - fallados) + textFallos + fallados);
    fallados=0;
    contador=0;
}
function DisplayItem (IstOption){
var i = IstOption.selectedIndex
if (i==2)
{ alert("CORRECT"); self.close();}
else{alert("Incorrect");
self.close();window.opener.fallados=window.opener.fallados+1;window.opener.
ChecFallos();}
}
function pulsado(IstOption){
if (window.opener.contador==6)
{
DisplayItem(IstOption)
window.opener.contador=window.opener.contador+1
}
}
else self.close()
}
</SCRIPT>
<!--/NOEDIT--></P>
<P ALIGN=CENTER><B><FONT SIZE="+3">Test 1</FONT></B></P>
<P><B><FONT SIZE="+2">Question 6. </FONT></B><FONT
SIZE="+1">Press the button to see the choices and drag down to the option
corresponding to the main feature of the shown picture. After that, press the
&quot;OK&quot; button.</FONT></P>
<P><!--/NOEDIT-->
<FORM>
<SELECT NAME="IstOption">
<OPTION SELECTED>press and drag down
<OPTION SELECTED>illuvial clay coatings
<OPTION>illuvial clay quasi-coatings
<OPTION>illuvial clay infillings
<OPTION>fragmented illuvial clay feature
<OPTION>compound coatings
<OPTION>none
</SELECT>
<INPUT TYPE="button" VALUE="OK" onclick="pulsado(this.form.IstOption);">
</FORM>
<SCRIPT LANGUAGE="JAVASCRIPT">
document.write ("The number of questions is: " + (window.opener.contador - 1))
document.write ("<P>The number of failures is: " + window.opener.fallados)
</SCRIPT>
<!--/NOEDIT--><p></P>
<P><IMG SRC=" ../media/test1f.gif" WIDTH="400" HEIGHT="300"
ALIGN="BOTTOM" NATURALSIZEFLAG="3">
</BODY>
</HTML>

```

The presented software allows both the self-learning of the students and their self-evaluation. For the self-evaluation of the knowledge acquired by the student, test suite is provided. Additionally, the students can be calificated with this software; the highest score is 10 points and each wrong answer is penalized by two points.

The program has 145 pages with 197 pictures with a size of 24.1 MB.

IlluviaSols is divided into six parts. Each of these parts is presented in an interactive way and explains the different topics of the part under consideration.

1 Formation: genesis, stages and factors

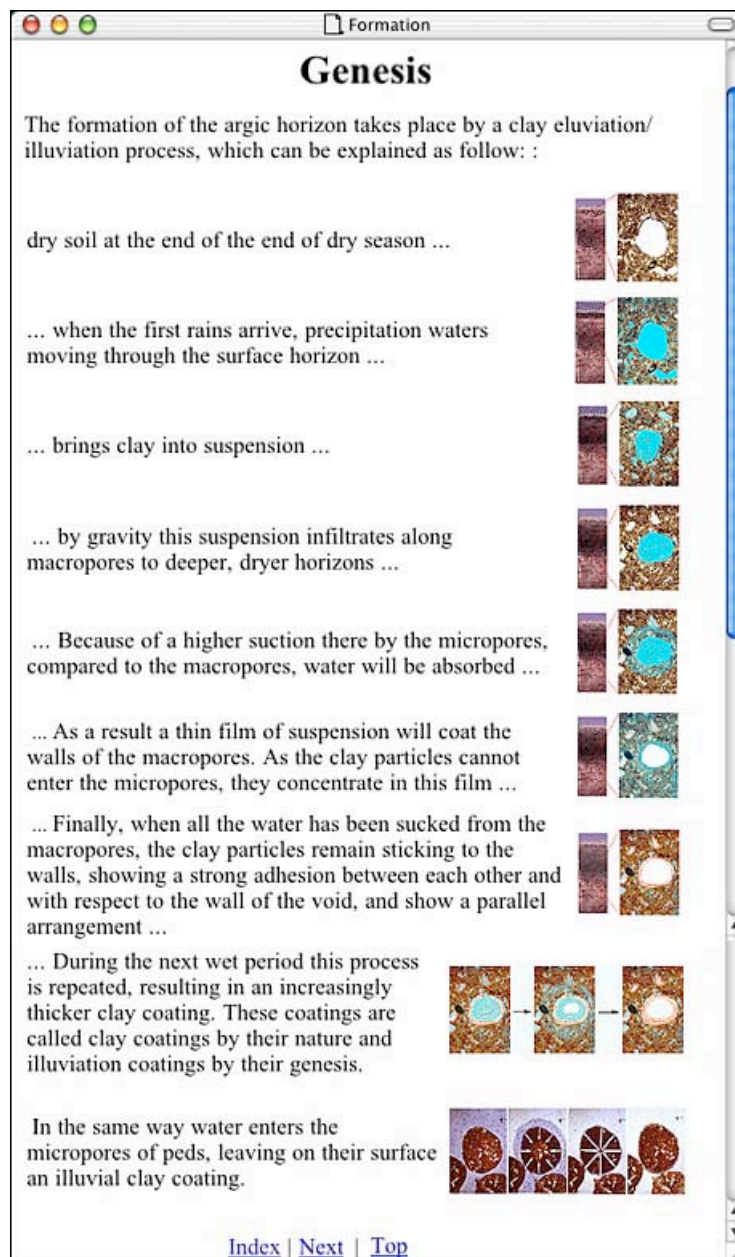


Figure 2. Genesis page.

2 Properties of the acumulations of illuvial clay: optical properties and locations

3 Micromorphological classification. In this part following features are shown: coatings, hypo-coatings, infillings and fragments. Every existing types is shown and subdivided according to its internal particle size and fabric.

Classification of accumulations of clay illuvial

At a microscopic level, illuvial clay accumulations are classified according to their particular characteristics.

Morphological classification

- **Coatings.** These are pedofeatures that coat the surfaces of voids, grains or aggregates. These films are called clay skins and in Brewer's terminology (1964) cutans and argillans.
 
- **Quasi-coatings.** These are related to surfaces of voids but not immediately adjoining them.
 
- **Infillings.** These are formed of clay material. Two types can be established according to whether they completely fill the pore or not (dense or loose).
 
- **Fragments.** They are remains of illuvial clay accumulations, deformed by pedological processes.
 

Classification according to particle size

Depending on whether the accumulations are made up of pure clay or this is accompanied by silt-sized particles, two main types can be distinguished:

- Limpid clay
- Impure clay



Classification according to internal fabric

- **Non-laminated.** Homogenous masses are a common type of illuvial clay accumulations.
 
- **Microlaminated.** Frequently, illuvial clay accumulations show a fine lamination, alternating thin (<30 microns) laminae of limpid clay with different colourings.
 
- **Compound layered.** Alternating layers of two or even more components.
 

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Figure 3. Example of micromorphological classification page.

4 Types of clay illuviation: first illuviation (typical) and hydromorphic illuviation.

5 Pedoturbation: mechanical, biological and cryoclastial perturbations.

6 Recognition in field and in laboratory: techniques and confusions.

A specific high-security navigator (soile v.1.0) has been developed to examine students; our navigator does not allow some non-desired options of usual navigators (navigator menu, refresh of the current page, access to the source code, access of the history of visited pages, etc), and it provides automatic recording of the results.

Didactic evaluation

The program has been evaluated by a group of students and the results are summarized in Table 1. The evaluation reveals the high acceptance and the good marks obtained, so the method is considered as highly effective.

Acceptance by the student	
Evaluation of the practices	
Very satisfied	63 %
Satisfied	26 %
Acceptable	8 %
Disagreement	2 %
Very disagreement	0 %
No opinion	1 %
Attainment of objectives	
Totally	42 %
Enough	31 %
Sufficient	21 %
Scarce	4 %
Null	1 %
No opinion	1 %
Marks obtained	
First class	42 %
Second class	28 %
Pass	23 %
Fail	7 %
Population	215 students

Table 1. Results of the evaluation test made by the students.

References

Aguilar, J.; Fernández, J.; Dorronsoro, C. 1996. Interactive computer programme for demonstration of micromorphological aspects of clay illuviation processes in soil. 10th International Working Meeting on Soil Micromorphology. Moscow, Russia.

Aguilar, J.; Fernández, J.; Dorronsoro, C.; Stoops, G.; Dorronsoro, B. 1998. Clay Illuviation in soils. 16th World Congress of Soil Science. Montpellier. France.

Bullock, P.; Fedoroff, N.; Jongerius, A.; Stoops, G. Y Tursina, T. 1985. Handbook of soil thin section description. Waine Research Publishing, Albrighton, U.K.