SoilMicroscopy

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Introduction

Soil microscopy is possibly the best technique for understanding the soil genesis. Although, the micromorphology is not still extended to the soil-researcher community. This could be due, on the one hand, the difficulty in the interpretation of the microscopy images of soils and, on the other hand, the troublesome in the making of the thin sections. The latter could be solved by the settlement of an official laboratory (supported by the International Society of Soil Science), which makes the thin sections of soils sent by researchers throughout the world. We are trying to smooth the first difficulty by the elaboration of a course in soil microscopy. It is a complete course that begins with a program (OpticalMine, presented in this Congress) with the aim of study how and why optical properties are presented by soil materials under the transmitted light petrographic microscope. The second program (SoilMicroscopy) is presented in this communication and it tackles the description of all the features presented in the soil thin sections. A third program (SoilMicromorphology) deals with the interpretation of the microscopic features, learning to read in the signs that the soil forming processes have left in the microscopic level of the soil. Finally, different programs have been developed (IlluviaSols, CO_3Sols and HydroSols, presented in Eurosoil 2004) dealing with the application of the micromorphological aspects in the development of certain soil-forming processes.

The application

A computer programme for teaching the principles of soil thin section description based on the ISSS "Handbook for Soil Thin Section Description" (Bullock, et al., , 1985) has been developed. Its aim is to provide an additional method for self-teaching of soil micromorphology in a fast and easy way.

OpticalMine 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/micgraf/indexw.htm

The following points are discussed in SoilMicroscopy:

1. Introduction (principles of micropedology, sampling, principles of thin section preparation).

2. Basic components (minerals and organics).

3. Groundmass (voids, aggregates, microstructures, c/f related distributions and birrefringent fabrics).

4. Pedofeatures (textural, depletions, crystallines, amorphous, fabric, excrements, compounds; and coatings -Figure 1-, hypo-coatings, quasi-coatings, infillings, nodules, intercalations, deformed and fragmented pedofeatures).

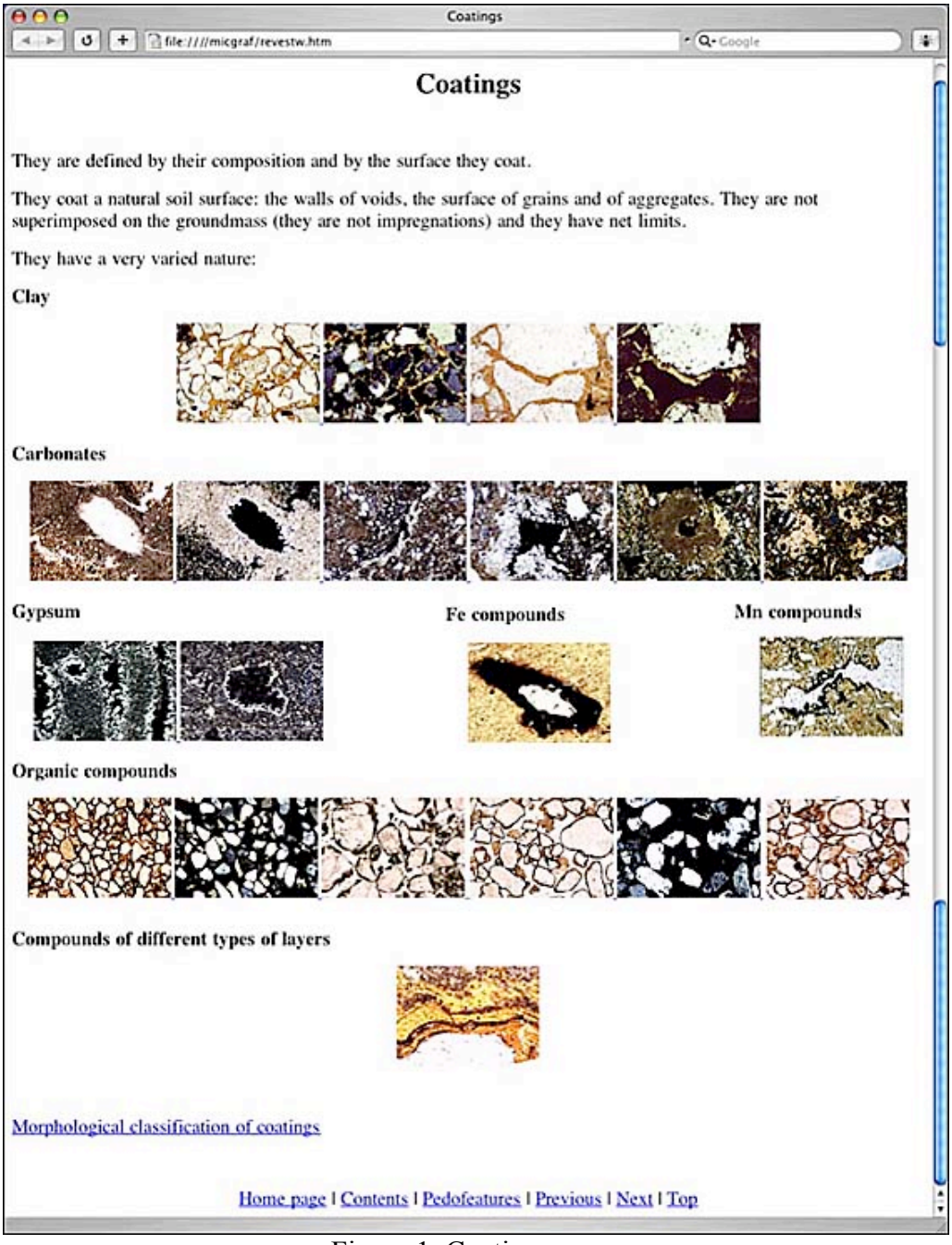

Figure 1. Coatings page.

SoilMicroscopy contains about 485 pages, 1110 pictures and some video extracts, having a total size of 124.8 MB.

The user will have to answer some questions concerning the identification of a soil features, which is shown in a picture. Thus, the software evaluates the knowledge of the student.

A general test is included, giving to the students the possibility of evaluation themselves (Figure 2).

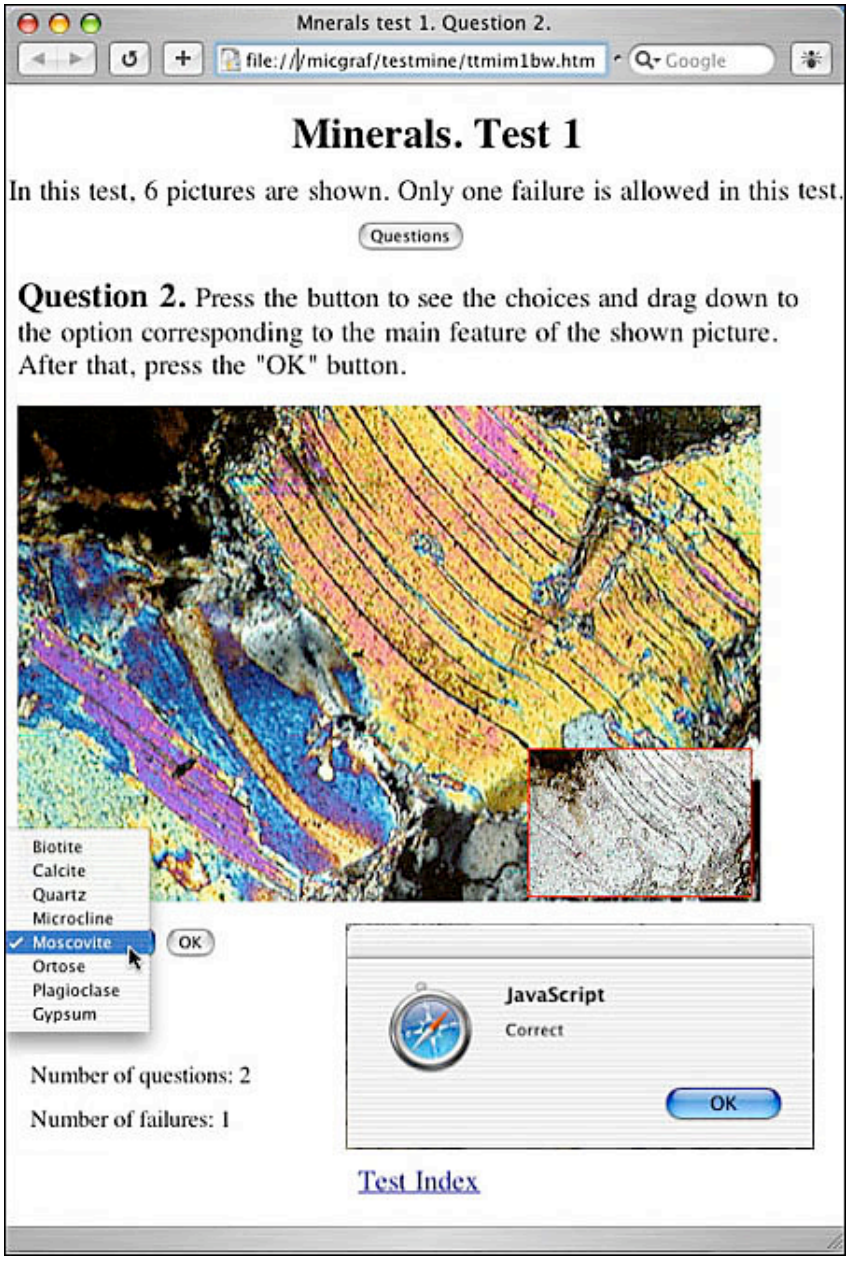

Figure 2. Test example.

Some scripts related to the Figure 2 are given below.

Script 1.

```
<HTML>
<HEAD>
<TITLE>PagBase Test Pedofeatures. 2</TITLE>
```

```
</HEAD>
<BODY BGCOLOR="#ffffff">
<FORM>
<SCRIPT LANGUAGE="JAVASCRIPT">
var textPreg = "  number of questions: ";
var textAciertos = "\r  number of correct answers: ";
var textFallos = "\r  number of failures: ";
var fallados = 0;
var contador = 1;
var fintest = 0;
function empezar(){
   WinOpen("ttedr1aw.htm");
}
function terminar(){
   location.replace("../testindw.htm");
}
function WinOpen(nombre){
   open(nombre,"Window1","toolbar=no,scrollbars");
}
function ChecFallos() {
  if (fallados>=2) {
    alert("Two failures!.\rUnsuccessful test.\rThe results are: \r" + textPreg + contador  + textAciertos
+ (contador - fallados) + textFallos + fallados);
   fallados=0;
    contador=0;
    terminar();
   fintest = 1;
}}
</SCRIPT>
<P><CENTER><B><FONT SIZE="+3">Pedofeatures. Test 1</FONT></B></CENTER></P>
<P><FONT SIZE="+1">In this test, 6 pictures are shown. Only one failure is allowed in this
test.</FONT></P>
<P> </P>
<P><input type="button"name="WindowButton" value= "Questions" onclick=" empezar()"></P>
<P> </P>
<P> </P>
<P> </P>
<P><CENTER> </CENTER></P>
<P><CENTER><A HREF="../testindw.htm"><FONT SIZE="+1">Index Test></FONT></A>
</CENTER>
</FORM>
</BODY>
</HTML>
```

Script 2

```
<HTML>
<HEAD>
<TITLE>Test pedofeatures 1. Question 1.</TITLE>
</HEAD>
<BODY BGCOLOR="#ffffff">
<SCRIPT LANGUAGE="JAVASCRIPT">
function DisplayItem (IstOption){
var i = IstOption.selectedIndex
if (i==0)
{ alert("Correct"); location.replace("ttedr1b.htm");}
else  {alert("Incorrect");
location.replace("ttedr1b.htm");window.opener.fallados=window.opener.fallados+1;window.opener.C
hecFallos();}
}
function pulsado(IstOption){
```

```
if (window.opener.contador==1)
 {
DisplayItem(IstOption)
window.opener.contador=window.opener.contador+1
}
else self.close()
}
</SCRIPT>
<B><FONT SIZE="+3">Pedofeatures. Test 1</FONT></B></CENTER></P>
<P><B><FONT SIZE="+2">Question 1. </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 &amp;quot;OK&amp;quot; button.</FONT></P>
<P><IMG SRC="testmed/te1a.gif" ALIGN="BOTTOM" WIDTH="500" HEIGHT="335"
NATURALSIZEFLAG="3"><BR>
<FORM>
<SELECT NAME="IstOption">
<OPTION SELECTED>Textural coatings of clay
<OPTION>Textural coatings of silt
<OPTION>Textural coatings of sand
<OPTION>Carbonate coatings
<OPTION>Gypsum coatings
<OPTION>Cryptocrystalline and amorphous coatings of Fe and/or Mn compounds
<OPTION>Amorphous coatings of organic matter
<OPTION>Compound coatings
<OPTION>Carbonate hypo-coatings
<OPTION>Gypsum hypo-coatings
<OPTION>Cryptocrystalline and amorphous hypo-coatings of Fe and/or Mn compounds
<OPTION>Amorphous hypo-coatings of organic matter
<OPTION>Depletion coatings of Fe and/or Mn
<OPTION>Textural quasi-coatings of clay
<OPTION>Textural quasi-coatings of silt
<OPTION>Textural quasi-coatings of sand
<OPTION>Carbonate quasi-coatings
<OPTION>Gypsum quasi-coatings
<OPTION>Cryptocrystalline and amorphous quasi-coatings of Fe and/or Mn compounds
<OPTION>Textural infillings of clay
<OPTION>Textural infillings of silt
<OPTION>Textural infillings of sand
<OPTION>Carbonate infillings
<OPTION>Gypsum infillings
<OPTION>Carbonate crystals
<OPTION>Gypsum crystals
<OPTION>Carbonate nodules
<OPTION>Gypsum nodules
<OPTION>Cryptocrystalline and amorphous nodules of Fe and/or Mn compounds
<OPTION>Amorphous nodules of organic matter
<OPTION>Fragmented and deformed pedofeatures
</SELECT>
<INPUT TYPE= "button" VALUE= "OK" onclick= "pulsado(this.form.IstOption);">
</FORM>
<SCRIPT LANGUAGE="JAVASCRIPT">
document.write ("Number of questions: " + (window.opener.contador - 1))
document.write ("<P>Number of failures: " + window.opener.fallados)
</SCRIPT>
</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. Additionaly, the students can be calificated with this software; the highest score is 10 points and each wrong answer is penalized by two points (Figure 3).

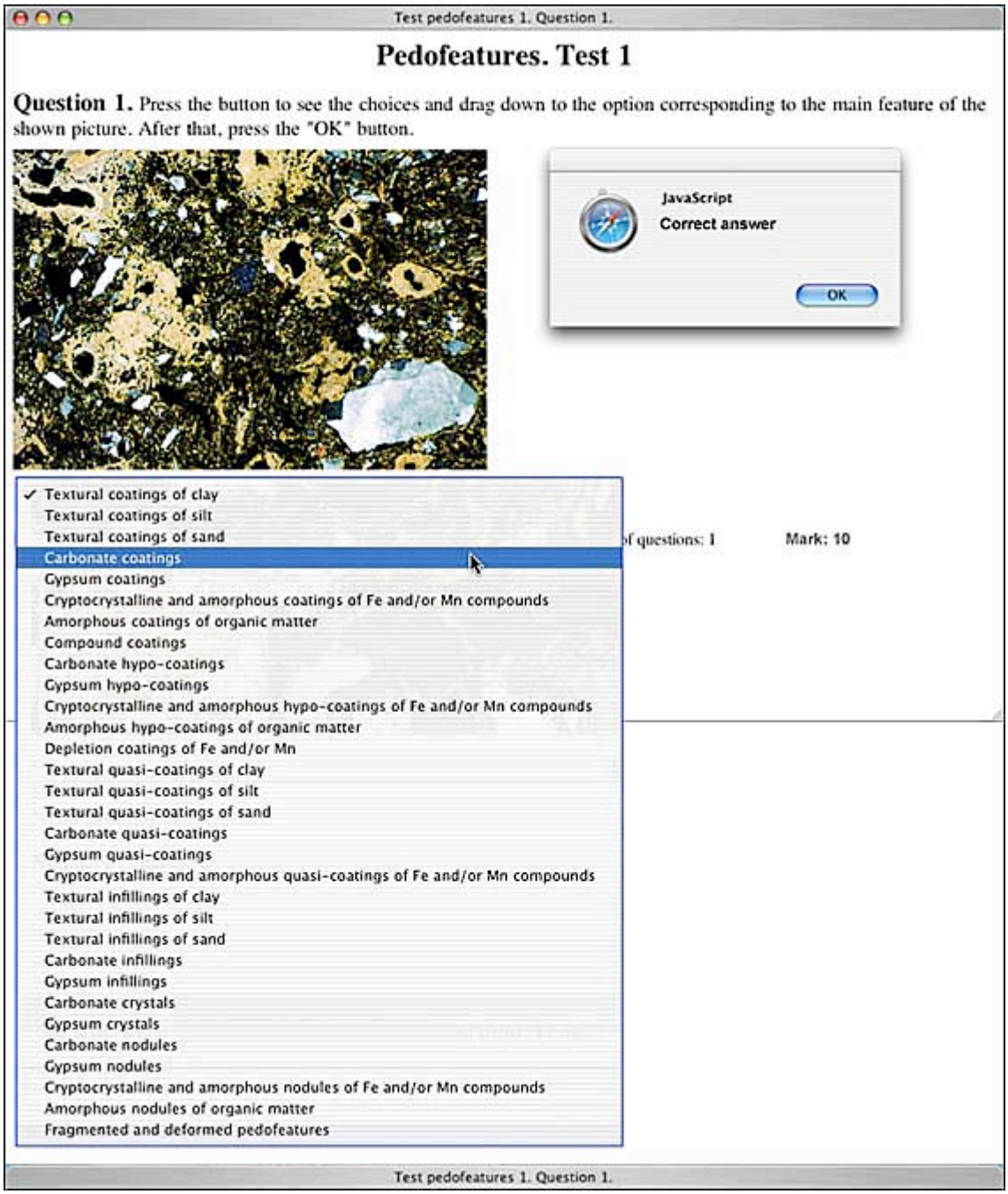

Figure 3. Example of pedofeatures test

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	55 %
Satisfied	23 %
Acceptable	19 %
Disagreement	3 %
Very disagreement	0 %
No opinion	0 %
Attainment of objectives	
Totally	32 %
Enough	47 %
Sufficient	17 %
Scarce	3 %
Null	0 %
No opinion	1 %
Marks obtained	
First class	26 %
Second class	49 %
Pass	16 %
Fail	9 %
Population	204 students

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

Experience with previous similar programmes has demonstrated that its strong points are: easy accessibility, interactive nature, large variety of examples, clear visualization of concepts and adequate tests**.**

References

Aguilar, J.; Dorronsoro, C.; Stoops, G.; Fernández, J. 1996. Interactive computer programme for self-teaching of soil thin section description. 10th International Working Meeting on Soil Micromorphology. Moscow, Russia.

Aguilar, J.; Fernández, J.; Stoops, G.; Dorronsoro C.; Dorronsoro, B. 1998. Micropedology. 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.