

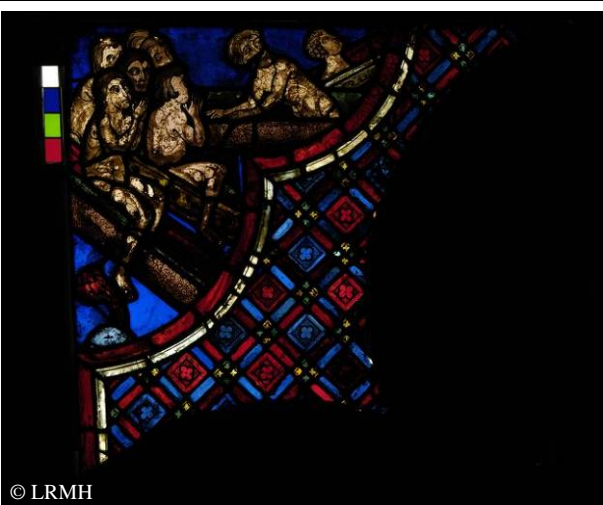
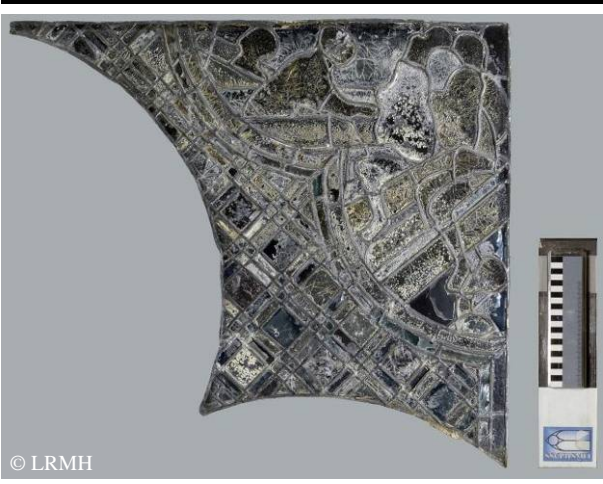



	<b>CONSTGLASS</b>	
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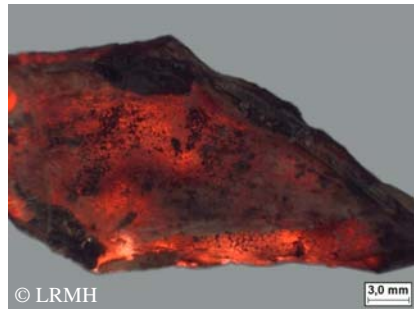
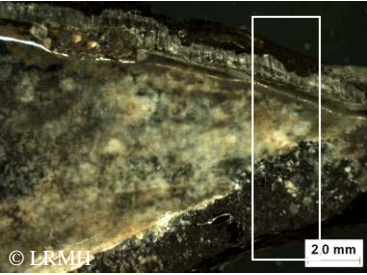
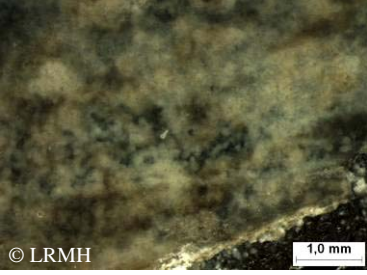
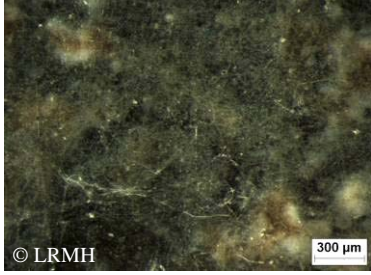

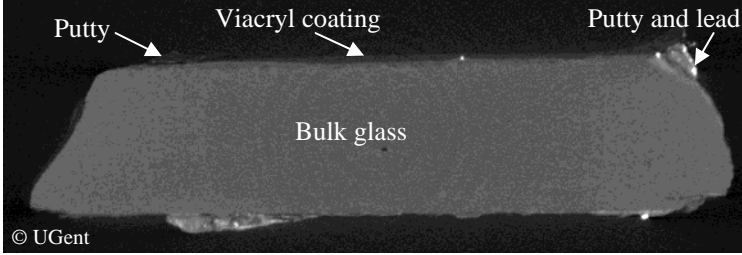
## 1- Pilot Object



<b>Pilot object:</b>	<i>The Last Judgement</i> , BOURGES <b>Bay 4, panel 9</b>	
<b>Picture</b>	<div data-bbox="312 595 917 1097">  <p>© LRMH</p> </div> <div data-bbox="312 1097 917 1581">  <p>© LRMH</p> </div>	
		<p><b>Identification of the panel :</b></p> <p>Bay: 4  Panel: 9  Internal face, transmitted light  External face, reflected light</p> <p><b>Treatment :</b></p> <ul style="list-style-type: none"> <li>- <b>1981</b>, by <b>Mauret</b> studio.</li> <li>- Product: polyurethane resin (80% Viacryl<sup>®</sup> SM564 + 20% Desmodur<sup>®</sup> N75).</li> <li>- Application: with a soft brush after cleaning by a solution of EDTA + ammonium bicarbonate on glass and lead.</li> </ul>

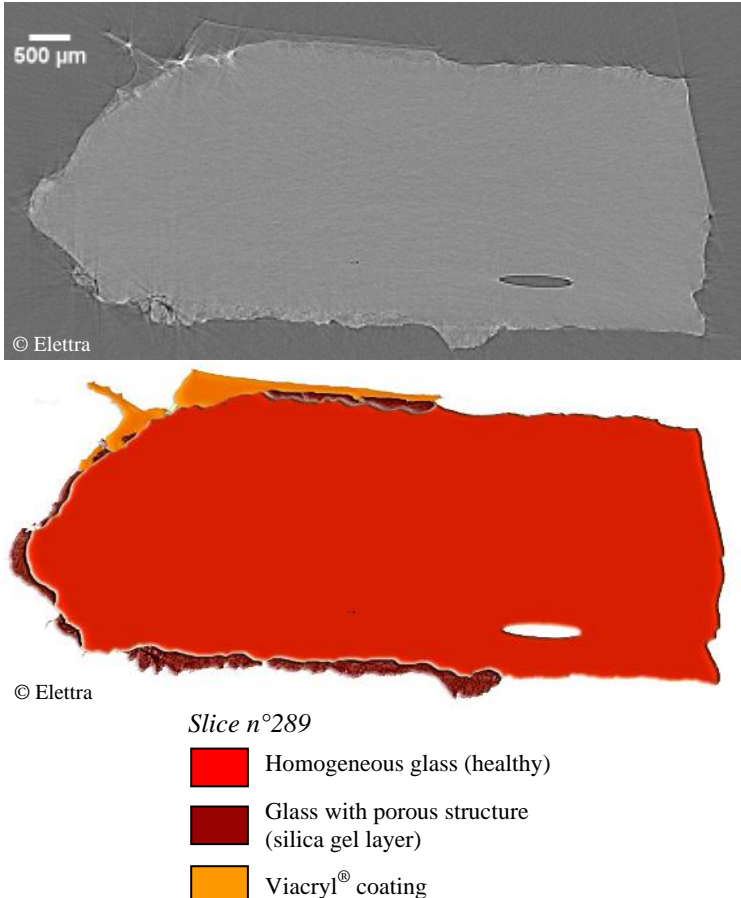
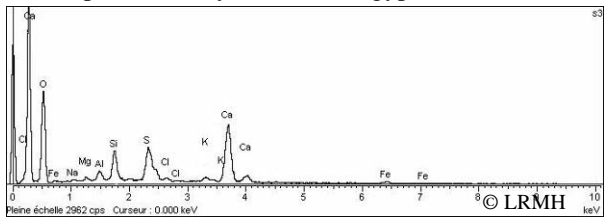
	<b>CONSTGLASS</b>	
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## 2-Results




<b>Sample reference:</b>	<b>BOU_b4p9_E_v1:</b> red glass with Viacryl <sup>®</sup> coating on external face. Located in a protected area.
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Questions	Techniques	Answers
<b>Morphology</b> - What is the morphology of the weathered coating? - How is the bonding between coating and glass?  <p>© LRMH 3,0 mm</p>  <p>© LRMH 3,0 mm</p>	<b>Optical Microscope (LRMH)</b>	 <p>© LRMH 20 mm</p> <p>No visible deterioration, no macro-cracks, no yellowing or milky aspect.</p> <p>But, with a higher magnification, micro-cracks are visible.</p> <p>White rectangle locates the area of tomography slices.</p>  <p>© LRMH 1,0 mm</p>  <p>© LRMH 300 µm</p> <p>Corrosion products under the Viacryl<sup>®</sup> are old and seem not to disturb it.</p>
	<b>SEM (LRMH)</b>	 <p>© LRMH 35 1500 µm 42 17%</p> <p>The SEM confirms the microscope observations. There is no macro-cracks, and the corrosion products (C) are only on the surface of the Viacryl<sup>®</sup> (V).</p>
	<b>Desktop tomography (U-Ghent)</b>	<p>Good adhesion of the coating, even on putty or on the edge of the piece of glass.</p>  <p>© UGent</p> <p>Slice of the piece of glass</p> <p>Labels in image: Putty, Viacryl coating, Bulk glass, Putty and lead</p>


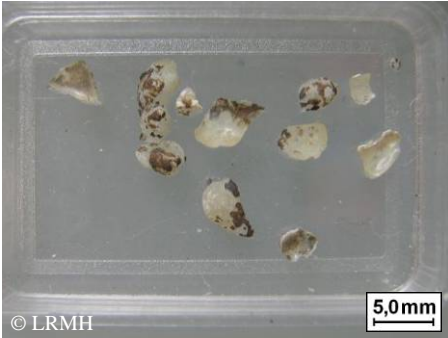
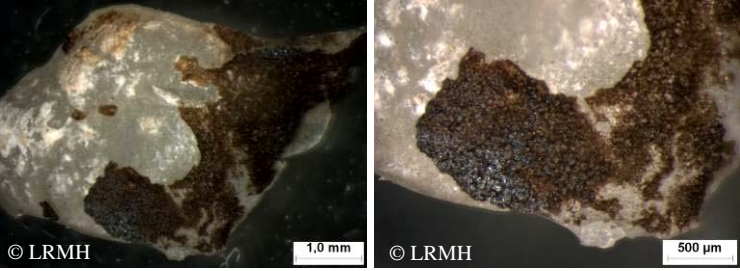
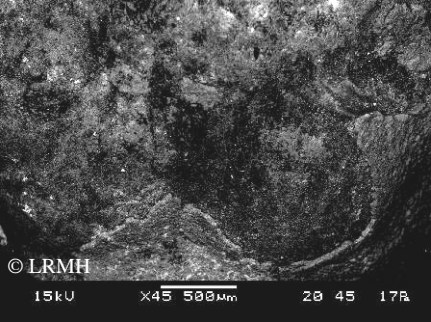
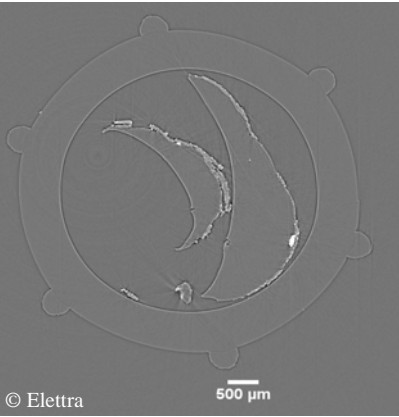
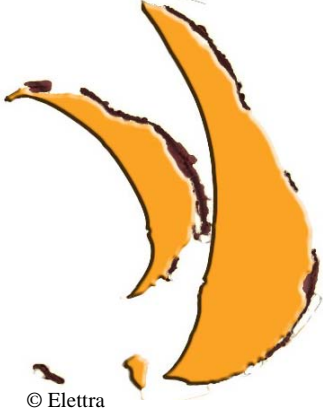


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	<b>Phase-contrast tomography on Synchrotron (Elettra)</b>	<p>The Viacryl<sup>®</sup> takes the shape of the glass surface, whether it is altered or not. The thickness of the film varies. When the coating is well preserved, the adhesion is conserved.</p>  <p>© Elettra</p> <p>© Elettra</p> <p><i>Slice n°289</i></p> <ul style="list-style-type: none"> <li>Homogeneous glass (healthy)</li> <li>Glass with porous structure (silica gel layer)</li> <li>Viacryl<sup>®</sup> coating</li> </ul>
<b>Chemical Composition</b> - What is the chemical composition of the alteration products?	<b>SEM/EDX (LRMH)</b>	<b>Calcium sulphate neo-crystallisations (gypsum)</b>  <p>© LRMH</p>
<b>Organic component composition</b> <b>Microbiology</b> <b>Reversibility</b> <b>Re-treatability</b>	<i>Not foreseen in this case, see samples of bay 13.</i>	

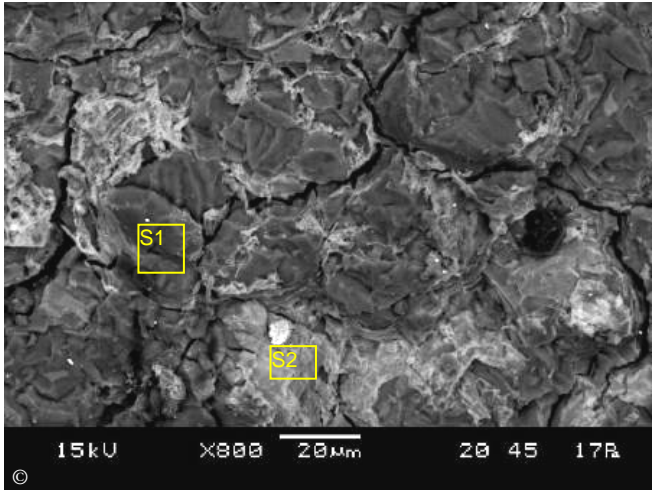
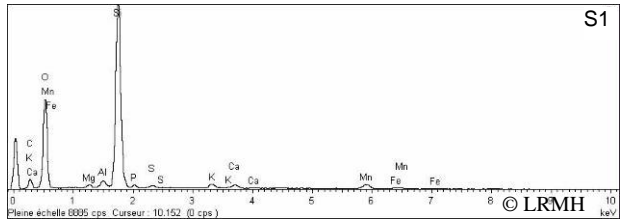
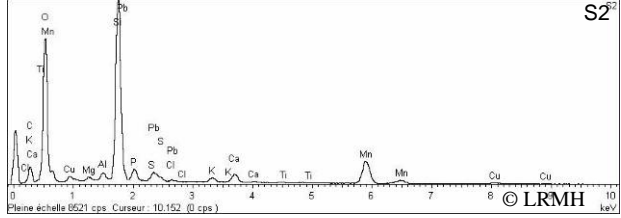





	<b>CONSTGLASS</b>	
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**Sample reference:** *BOU\_b4p9\_E\_v9 : flakes of Viacryl® with corrosion products (on dark red glass)*

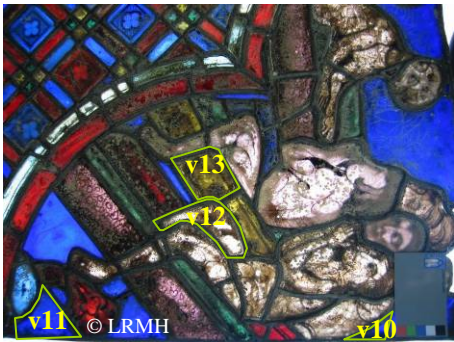
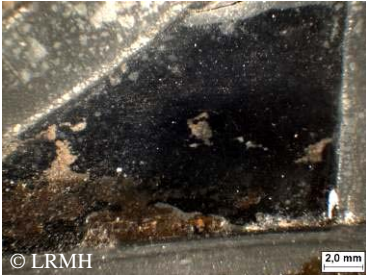
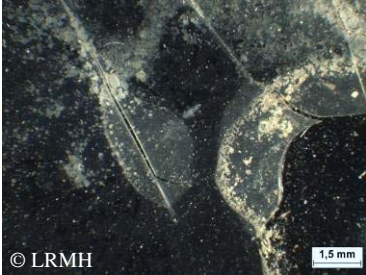
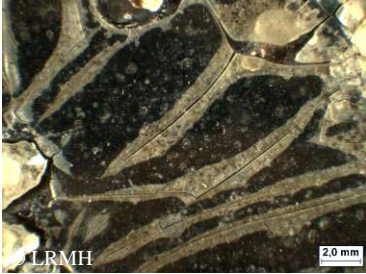
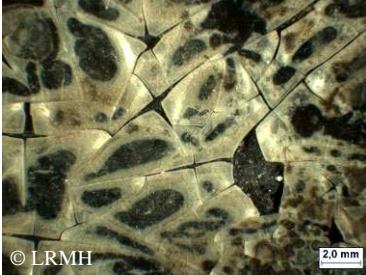
Questions	Techniques	Answers
<b>Morphology</b> - What is the morphology of the weathered coating? - How is the bonding between coating and glass?  	<b>Optical Microscope (LRMH)</b>	<p>Important deterioration of the film: bubbles, macro-cracks, flaking, discoloration (yellowing), loss of transparency (milky aspect).</p>  <p>When sampling, corrosion products came with Viacryl® flakes.</p>
	<b>SEM (LRMH)</b>	 <p>It indicates there are not only corrosion products but also gel layer on the flake.</p> <p>Brown products are thicker than white products and the gel layer.</p>
	<b>Desktop tomography (U-Ghent)</b>	<p><i>Not foreseen in this case</i></p>
	<b>Phase-contrast tomography on Synchrotron (Elettra)</b>	  <p>The adherence of the Viacryl is strong enough to tear off gel layer fragments or corrosion products, but not healthy glass.</p> <p>  Viacryl coating   Gel layer fragments and/or corrosion products </p>

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<b>Chemical Composition</b> - What is the chemical composition of the alteration products?	<b>SEM/EDX (LRMH)</b>	<ul style="list-style-type: none"> <li>- Calcium sulphate neo-crystallisations (gypsum)</li> <li>- Altered glass (gel layer), with more or less manganese:</li> </ul>   
<b>Organic component composition</b> <b>Microbiology</b> <b>Reversibility</b> <b>Re-treatability</b>	<i>Not foreseen in this case, see samples of bay 13.</i>	

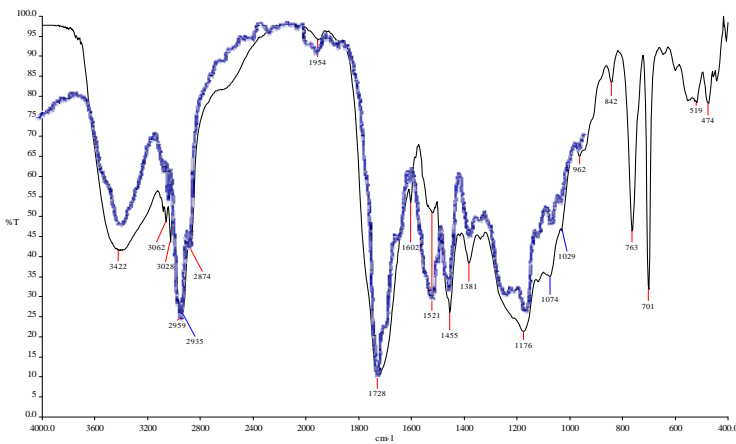
	<b>CONSTGLASS</b>	  
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**Sample reference:** BOU\_b4p9\_E\_v10 to v13 : samples of Viacryl® with different visual aspects

Questions	Techniques	Answers
<b>Morphology</b> - What is the morphology of the weathered coating? - How is the bonding between coating and glass? 	<b>Optical Microscope (LRMH)</b>	<p><i>v10: Healthy blue glass</i>  Good adherence of the Viacryl®, because of the protection by putty. The film is still soft and well conserved.</p>  <p>© LRMH 2.0 mm</p> <p><i>v11: Healthy blue glass</i>  When Viacryl® is less protected; bubbles and cracks appear, with more or less flaking. Start of corrosion products development. Viacryl® is hard, breakable and its adherence is bad with healthy glass.</p>  <p>© LRMH 1.5 mm</p> <p><i>v12: Weathered beige glass</i>  There are also bubbles and cracks but Viacryl® is lifted on the edges of flakes only. It is yellowed and has a milky aspect. Viacryl® is hard, breakable but its adherence is good with weathered glass (large part of the flakes).</p>  <p>© LRMH 2.0 mm</p> <p><i>v13: Weathered yellow glass</i>  The Viacryl® is flaking. Viacryl® is hard, breakable but its adherence is good with weathered glass (middle of the flakes).</p>  <p>© LRMH 2.0 mm</p>
	<b>SEM</b>	<i>Not foreseen in this case, see samples above</i>
	<b>Desktop tomography</b>	
	<b>Phase-contrast tomography on Synchrotron</b>	



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<b>Organic component composition</b> - What is its chemical evolution?	<b>FTIR</b> (LRMH)	 <p><i>FTIR spectra of Viacryl® films. The black spectrum corresponds to a flake sampled in 2009 on the panel 13 (naturally weathered Viacryl® film) ; the blue spectrum was undertaken by Jean-Marie Bettembourg in 1983 on a test sample made in 1981 (naturally aged during 20 month in a box, so considered as a fresh sample).</i></p> <p>The weathered Viacryl® film presents a major reduction of the secondary amid functions (peak at 1527 cm<sup>-1</sup>), and an increase of primary amides (a major peak around 1680 cm<sup>-1</sup> and a low pic at 1603 cm<sup>-1</sup>). It corresponds to a phenomenon of hydrolysis of the polymer. These results are coherent with those obtained in 1983.</p>
	<b>RAMAN</b>	Not needed here : FTIR is sufficient
<b>Microbiology</b>		<i>Not foreseen in this case, see samples of bay 13.</i>
<b>Reversibility</b>		
<b>Re-treatability</b>		

**Conclusion:** Viacryl® is still present on most of the pieces. Its degradation state is different regarding the environment and the support (weathered glass or not, color of the glass). In most of the cases, the film could tear off the gel layer, or even healthy glass. The removal of the coating is recommended with ethanol gel. No re-treatment, but a protective glazing is recommended to be installed.