



Guernica
Pablo Picasso
Technical Studies
Conservation–Restoration Department



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Guernica

Pablo Picasso

Technical studies

The multiple techniques used in this project offer precise information on the constituent materials of Pablo Picasso's *Guernica*. The response of these materials varies when they undergo radiation pertaining to the different ranges of the electromagnetic spectrum. Each study (visible imaging, VIS; ultraviolet imaging, UV; X-rays, RX; and infrared reflectography, IR) gives different and supplementary data to provide a full range of information, the results of which are described below.

1. VISIBLE IMAGING

The macrophotographic images under visible light (VIS) enable the work to be studied meticulously, shedding light on the details of the support, the preparation and the paint layer. Moreover, studies with visible light have opened up the possibility of gaining an in-depth appreciation of the different alterations the work has undergone across its life-span, as well as different aspects related to Picasso's technique. Technically, *Guernica* is made with an oil-based paint on linen and jute canvas.

1.1. The support

The canvas is a one-piece fabric, not usual in works of this size, with a simple, taffeta-type fabric ligament, a tight weft thread, and comprising two fibre types: linen warp fibres and jute weft fibres. In fact, it was Jaume Vidal who usually framed Picasso's canvases, and was possibly the person who readied and tautened it on the stretcher inside the artist's studio.

The perimeter shows numerous alterations from the multiple tacks pinned in and taken out of the canvas attached to the stretcher over the years. When mounting the original stretcher, in the absence of wedges, the canvas had to be stretched tight to further accentuate its quality as a large-scale canvas.

Among the documents conserved by the Museum of Modern Art (MoMA), in New York, reports show the existence of damages in 1957, prompting them, in the same year, to attach reinforcement strips around the edges.

In some cases, the ground layer forms part of the composition, and Picasso left it exposed in certain figures. It is precisely in these areas where details of the weave of the fabric can be discerned (Fig 1).



Fig. 1. Some of the areas where the ground layer forms part of the composition.

1.2. The paint layer

Picasso painted Guernica within an extremely short time frame. After finding out through the international press that the town of Gernika had been bombed, he started on the piece, working on the preparatory drawings and sketches side by side while he amended and transformed the work directly on the canvas.

He began to apply successive paint layers which would quickly alter the composition; there are discernible areas where the paint was applied more lightly and fluidly, in contrast to other thicker passages. In some areas, liquid pigment can be seen running off after brushstrokes, which can be appreciated in the visible light study and through infrared reflectography.

Other large areas can also be observed with splatters on the polychrome, and, attributed to the way in which Picasso applied paint, are uniformly spread in certain areas. In others, however, they only appear sporadically.

In the area of the horse, specifically, these splatters appear in the form of different-sized black drips (Fig. 2). In the same figure, run-offs can be seen in the jaw area, demonstrating the artist's fluid technique in certain points (Fig. 3).



Fig. 2. A close-up of the black splashes on the horse's tail.



Fig. 3. A close-up of the running paint on the horse's jaw, the result of the fluid painting technique applied.

In specific areas, the naked eye can observe brushstrokes or precise, underlying details, veiled with thin layers of paint. One such detail illustrating this technical resource is related to the face of the woman in the window, in which black paint runs off and has been deliberately covered by the artist with a fine layer of paint; a layer so thin that with the naked eye we can see Picasso's rectifications (Fig. 4).



Fig. 4. Black splashes of paint covered by Picasso on the face of the woman in the window.

1.3. Cracks, craquelure, micro-fissures and losses of media

Through an in-depth analysis of the conservation state of the work, we can often observe alterations such as cracks, craquelure and micro-fissures (Fig 5). These deteriorations have occurred through the handling of the painting and the number of times it has been rolled for transportation over the years, a result of the touring exhibitions it participated in before hanging inside MoMA in New York.

In 1957, to alleviate these problems and to strengthen the edges, a treatment to reinforce the pictorial layer with a wax-resin was carried out.



Fig. 5. Details of the craquelure found on the horse's body.

A series of cracks are also conspicuous. Firstly, a long horizontal crack which runs below the bull's head and across the nose of the woman with the dead child in her arms. (Fig. 6-7-8). Associated with this crack is the detection of losses and re-painting in certain points, as well as consolidation material.

Also noticeable is a large vertical crack on the horse's neck, showing losses to the paint layer, small craquelure running along it, and points where wax-resin has filtered through.

In many cases, the biggest cracks were treated on the back of the canvas with wax and glued Japanese paper reinforcements, which were added in the restoration process carried out in 1964.

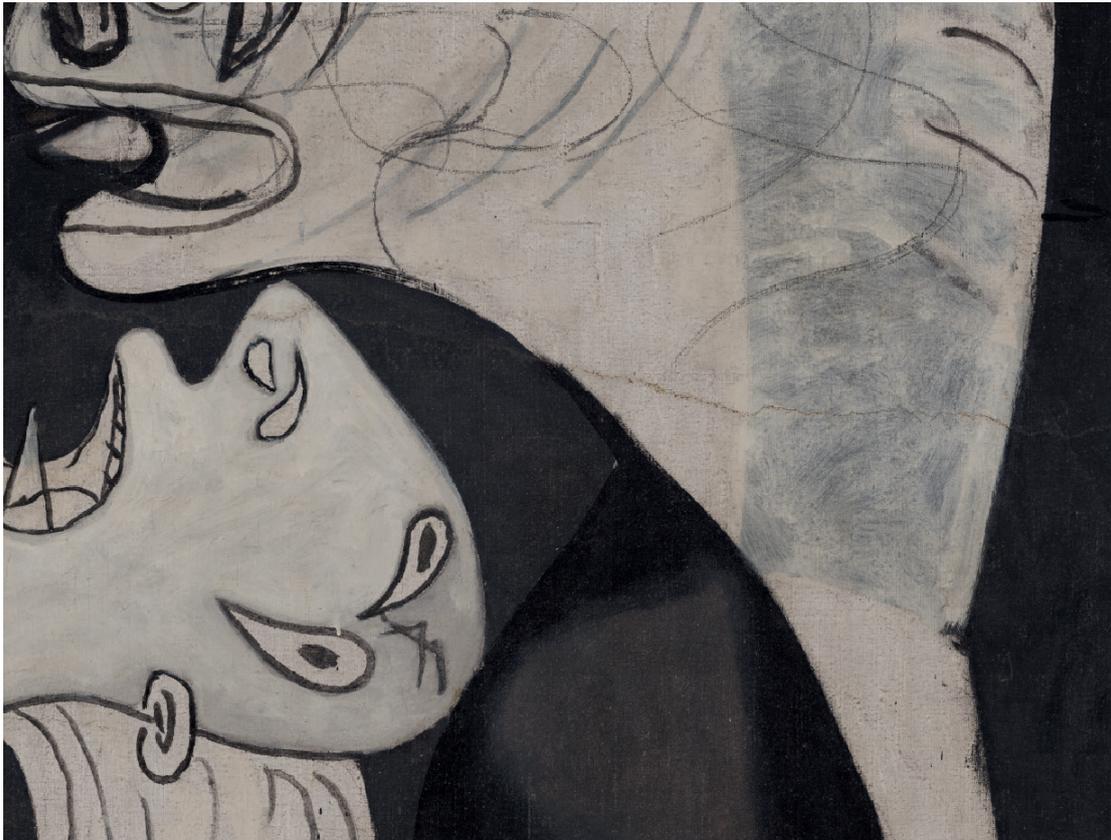


Fig. 6. General view of the horizontal crack found below the bull's head and on the woman.

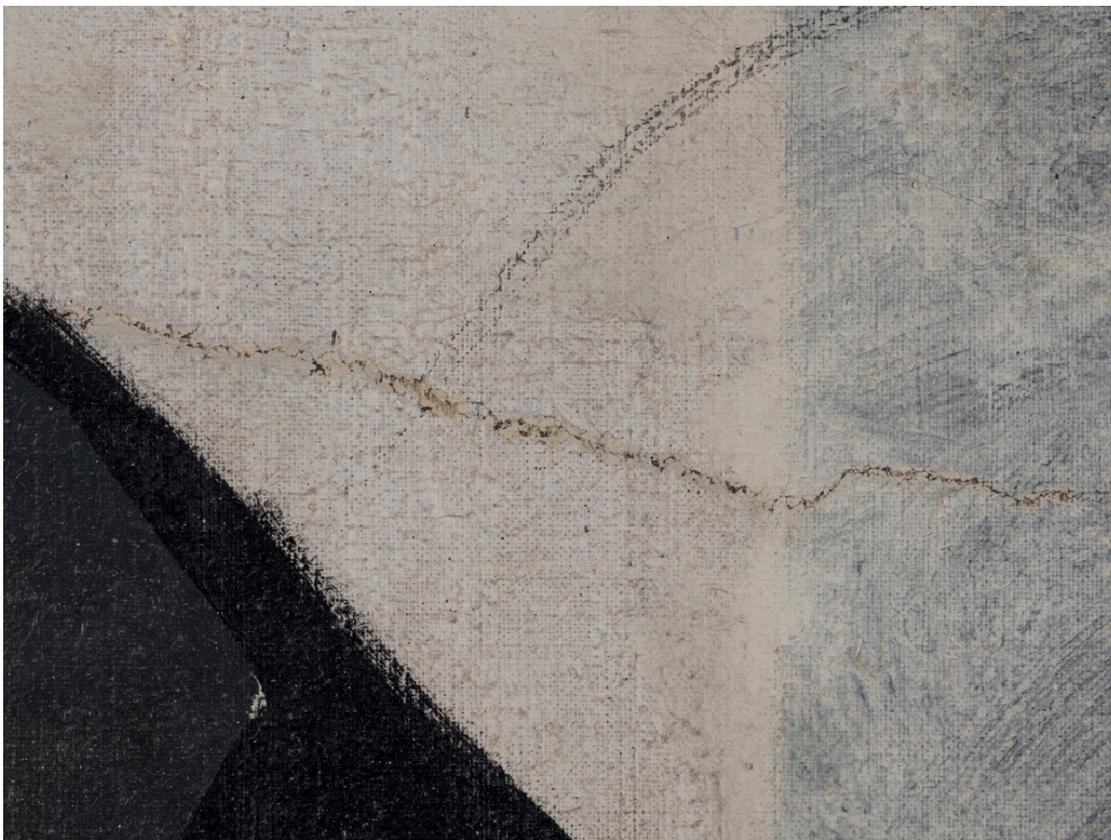


Fig. 7. A close-up of the horizontal crack found below the bull's head and on the woman.



Fig. 8. A close-up of the horizontal crack found below the bull's head and on the woman holding the dead baby, running across her nose.

On certain dark areas of the work, widespread craquelure can also be discerned, generally affecting broad areas of the canvas. (Fig. 9).



Fig. 9. Detail of the micro-craquelure on the black paint.

A number of paint abrasions have been found across the whole surface of the work and are the result of strains on the support, its preparation, and the layer of colour, caused by dismantling the painting and rolling and mounting it anew in its transfer to and from the different sites documented.

Macrophotography gives us some idea of the losses of polychrome that are normally associated with cracks and craquelure. In most cases they even reach the support, leaving the canvas exposed (Fig. 10-11).



Fig. 10. Close-up of the losses associated with cracks, found on the hand of the woman coming through the window.



Fig. 11. Close-up of the paint loss, revealing the support of the work.

Another example of paint losses can be found at the top edge of the canvas, where we can see micro-losses, revealing the white background corresponding to the ground layer (Fig. 12).



Fig. 12. Details of micro-losses at the top of the work.

Furthermore, in the areas at the edge of the work, with the white ground layer, there is a considerable increase in the loss of materials, compared with the rest of the paint surface (Fig. 13).



Fig. 13. Close-up of the bottom left corner, where losses to the ground and paint layers can be observed.

1.4. Surface wax-resin

There is a large amount of wax on the surface of the work; it is more concentrated in some areas, while in others we note that it is more widely spread. The presence of wax is the result of the restoration treatment carried out at MoMA in 1957. Given the brittle preservation state of the work at that time, and after it was moved and transferred on numerous occasions, a decision was made to consolidate the paint film. In order to stabilise it, avoid immediate losses of media and determine cracked areas, the whole canvas was treated with a mix of melted wax and resin, which was used on the back of the canvas by applying heat, thus providing a consistency in the ground and paint layers, and making the support more solid.

This system, which followed the restoration criteria of the time, had one drawback in that the mix seeped through the whole canvas, passing through the front in areas where the paint losses left the fabric uncovered, which is why it appears on the surface. Therefore, the treatment is irreversible. On the sides especially, there is a striking accumulation of wax-resin covering the pictorial surface¹.

¹Pilar Sedano et al.: "Report on the state of conservation", A Study on the State of Conservation of Picasso's Guernica. Madrid: Museo Nacional Centro de Arte Reina Sofía; Ministry of Education and Culture, 1998, p. 83.

The appearance of the wax-resin follows a set pattern and is revealed in different forms: it is not uncommon to find wax which has seeped through the areas with losses, which means that they completely covered with reinforcement material. Occasionally, the wax goes beyond the loss areas to create yellowish surfaces, to differing intensities. A large part is concentrated on the sides after strips were placed on the outer edges of the canvas (Fig. 14).



Fig. 14. Concentration of wax in the top right corner. In many points, the thickness of the wax is so great that it often appears with strong craquelure and with some dirt stuck to the surface.

Such an accumulation of wax can be seen more clearly on the white surfaces, whereas, in general, it is more difficult to discern in darker areas, such as black backgrounds. In being able to make comparisons with other studies, it can be identified more accurately. In this case, as we will see below, ultraviolet fluorescence provides us with a great deal of information on the amount of wax accumulated on the paint surface, and its exact location.

On the black and dark grey areas, it is not detected by the naked eye, particularly when there is only a small amount and a thin layer of wax. In these cases, there is an uneven surface, which is generally matte (Fig. 15-16).



Fig. 15. Wax-resin on the paint losses, moving beyond them in certain points to uniformly spread across the whole canvas. It is, however, more common on the sides (close-up of the bottom right of the canvas).



Fig. 16. Details of the wax that has seeped through from the back.

1.5. Reintegration

Many of the losses detected in the work were treated previously, as shown by the ample paint reintegration and colour retouching. Many of them can be seen either with the naked eye or with ultraviolet light. In some cases, this reintegration can exceed the limits of the area with media loss and invade areas with the original paint (Fig. 17).



Fig. 17. Reintegration covering the original polychrome. In certain white areas, the reintegration can sometimes be found with light shifts in colour and often exceeds the limits of the paint losses. In the image on the left, an overview, we can locate the large-scale reintegration on the center of the image, on the white part of the window above the woman who enters hastily from the right. In the image on the right, we can see close-up details of the reintegration.

² José María Cabrera; María del Carmen Garrido: "A technical study of Guernica", Newsletter from the Museo del Prado. Madrid: Museo del Prado, 1981, p. 147.

1.6. Paint residues from the act of vandalism in 1974

On 28 February 1974, the canvas was attacked with acrylic paint. The act was perpetrated by a member of the artists' group the Art Workers' Coalition, Tony Shafrazi, who spray-painted the words "Kill Lies All" in large letters. The Paraloid B-72-based varnish was applied in 1962 in MoMA and meant the acrylic paint could be removed without serious damage to the original².

Nevertheless, macrophotographs have enabled us to detect a series of tiny reddish paint residues, virtually imperceptible to the naked eye. In some cases, they can be seen as splashes, and in others, less commonly, they appear as fissures (Fig. 18).



Fig. 18. Tiny dots of red paint residue from the act of vandalism in 1974.

2. ULTRAVIOLET IMAGING

The study with ultraviolet light (UV) is normally used to identify the presence of retouching or chromatic additions which are not from the original, the use of binding agents and varnishes, and the state or thickness of the protective paint layer. This is made possible through the different responses the materials sometimes have to ultraviolet light, determined by the specific properties in each component.

The study with ultraviolet light also provides interesting technical information on the work. For instance, it reveals that there are different types of white in the composition, identified through different degrees of intensity in their response to fluorescence. There is also a difference between the white of the ground layer, which Picasso deliberately left visible in broad areas, and the different layers of white used to carry out the work (Fig. 19).



Fig. 19. Different fluorescence between the white of the ground layer, which Picasso left visible, and the layers of overlaid white.

In the case of *Guernica*, this type of study reveals past restorations carried out at MoMA, in New York, and clearly demonstrates the presence of wax-resin on the surface — as previously mentioned — a result of the consolidation treatment carried out. Moreover, broad colour retouching which covers paint losses is also visible.

2.1. Reintegration and retouching

The surface of the work demonstrates colour retouching from different periods to hide deterioration and losses. Given the disparate response to ultraviolet light, paint reintegration was probably carried out at different points and with different kinds of materials. We can differentiate between paint reintegration to cover the losses of media and the repainting that exceeds the limits of these losses. The first ones are in a highly opaque, dark violet hue, whereas the second ones are clearer and more invasive, overlaying the original paint (Fig. 20).

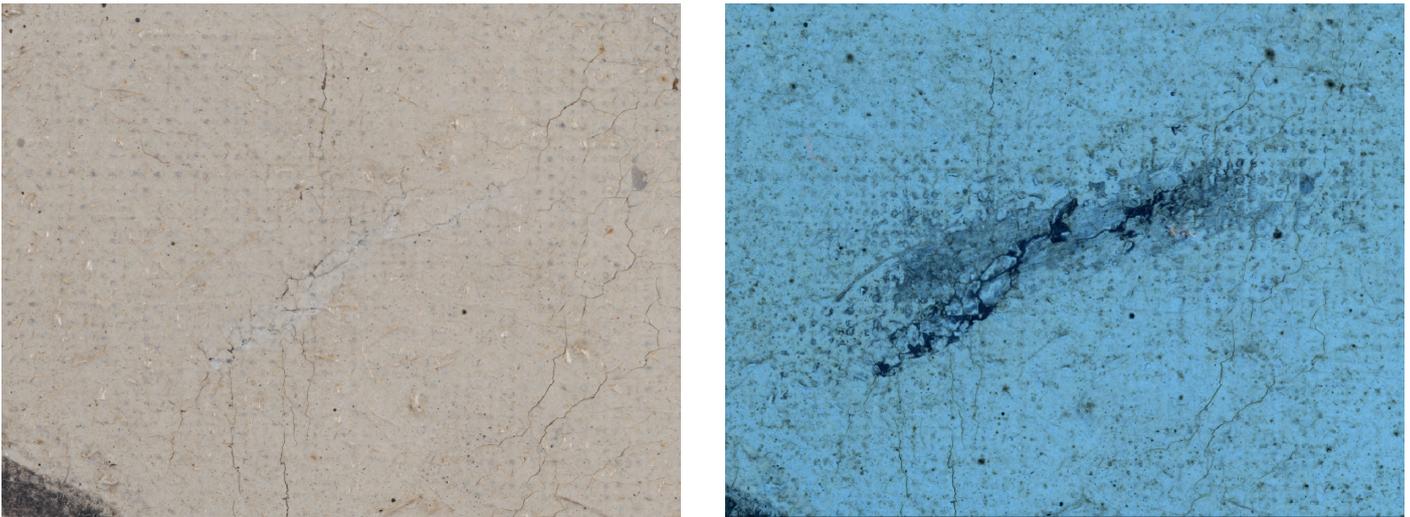


Fig. 20. Comparison between visible light and ultraviolet light. With visible light, the reintegration, in this instance, is almost indiscernible, whereas with ultraviolet light the reintegration and repainting are highlighted. This retouching is found above the horse's knee, located below the woman hastily entering from the right.

2.2. Wax-resin

The traces of wax that have seeped from the back through losses to the paint layer, fissures and cracks on the surface are distributed evenly over the surface of the canvas, although more markedly on the edges (Fig 21). In many instances, although this can be identified by the naked eye in the study with visible light, with ultraviolet radiation the results can be seen more clearly since the thinner layers on the surface can also be distinguished (Fig 22-23).

Finally, there are points where yellowish marks can be seen on the pictorial surface, corresponding to the accumulation of dirt stuck to the wax.

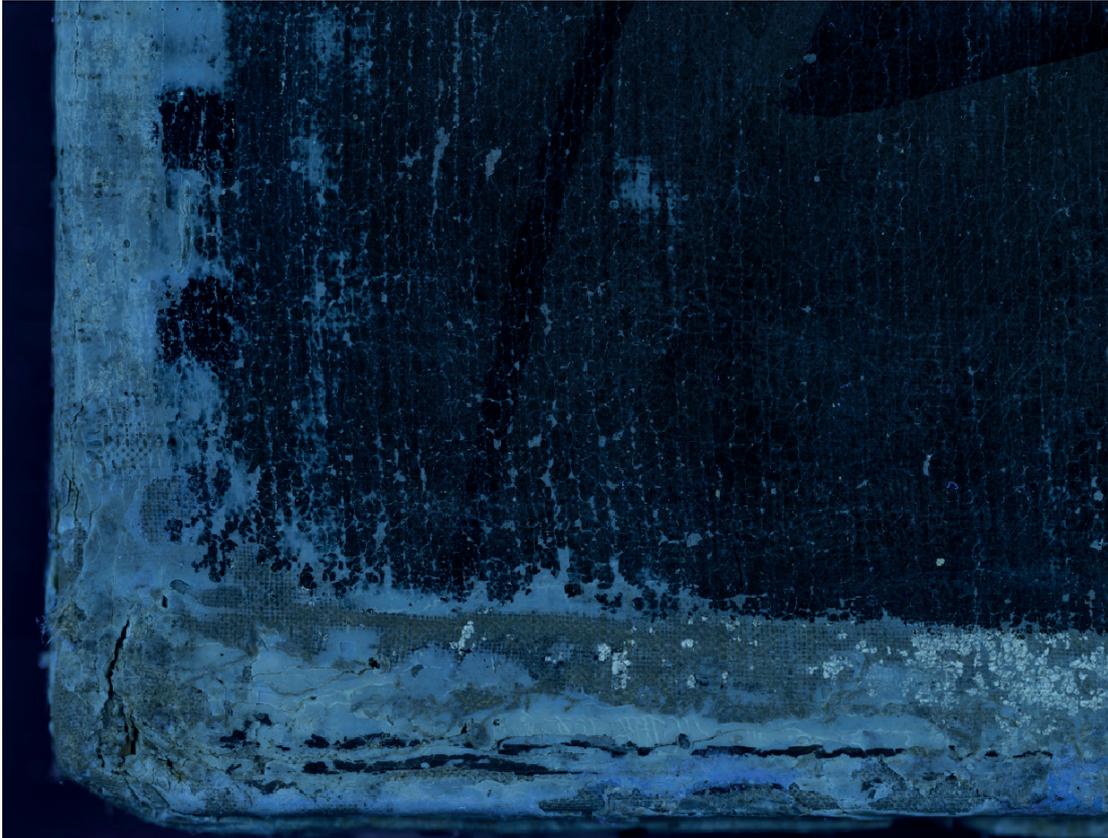


Fig. 21. Significant amounts of reinforcement material found on the bottom left corner of the canvas.

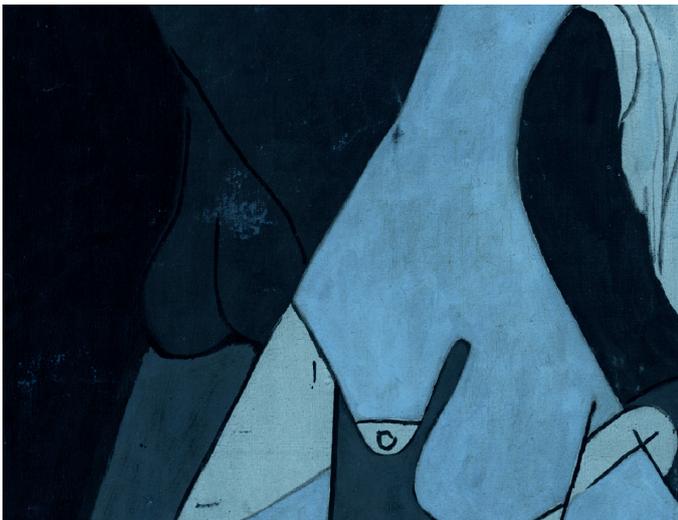


Fig. 22. Wax accumulated on the area of the bull.



Fig. 23. Wax on the surface of the painting, through the craquelure on the dead soldier's hand.

3. X-RAY IMAGING

In paint studies, x-rays enable an in-depth analysis to be obtained on every stratum of the work, thus enabling the scope of determined abrasions to be studied.

From virtually the time they were invented, x-rays (XR) have been used in the study of artworks. Their range in the electromagnetic spectrum is between ultraviolet radiation and gamma radiation, and, with the exposure of a radiographic film, they provide information about every constituent element.

Producing an x-ray on a large-scale work is particularly demanding in view of the technical difficulties of both the process and the handling of a work of such size. *Guernica* unquestionably presented a huge challenge for the Museo Reina Sofía, and would not have been possible without the invaluable contribution of Spain's Instituto del Patrimonio Cultural (Institute of Cultural Heritage). (Fig. 24).

This project posed a huge challenge across the board: it was the first time we came up against a 27 m² x-ray formed in just one shot. An added complication was the fact that we couldn't do any test shots because the film plate was going to be housed in the moveable support that was to move the work; replacing or changing it was impractical because it would involve manoeuvring that had been ruled out from the very start. This adventure was only made possible through the management of the Area of Physical Studies at the Instituto del Patrimonio Cultural, made up of Araceli Gabaldón and Tomás Antelo, with the contributions of Maca Vega and Miriam Bueso³.

Special care was taken in the process of handling and moving the work in order to guarantee its safety at every turn. Any movement was made with a movable support — designed specifically — to keep vibrations to an absolute minimum; this played a key role in the mission as it housed the x-ray film plate before the work was placed on it.



Fig. 24. Installing the x-ray film plate on the movable support (left) and preparing the x-ray equipment, with *Guernica* at the back of the room (right).

³ Jorge García Gómez Tejedor: "Strategies applied to the study of the state of conservation of Picasso's *Guernica*", *La ciencia y el arte. IV. Ciencias experimentales y conservación del patrimonio*. Madrid: General Technical Secretariat. Publications Centre. Ministry of Education, Culture and Sport, 2013, p. 182.

3.1. Structural elements

The structure of the current Guernica stretcher can be seen clearly — it is in a good state of conservation and is made up of a grid of twenty crossbars.

Nevertheless, it must be noted that this stretcher does not correspond to the original, which was replaced in the intervention that took place in 1964 at MoMA. The original stretcher, once assembled, measured 350.50 cm. (349 cm. on the right-hand side) x 776 cm., while the current one is 349.30 x 776.6 cm. The current strips are 7.81 cm. x 3.51 cm. thick, whereas the originals were 7.76 x 3.50 cm.

This discrepancy has meant the edges of the work are not parallel with the composition, which means part of the ground layer is exposed.

On the whole perimeter of the work we can see different metallic elements joining the stretcher and keeping the canvas taut, and through a greater degree of radiographic absorption, they are seen more clearly on the x-ray film (Fig. 25-26).

The joint between the inner and outer strips is movable, and positioned with threaded bolts with an adjusting nut and flanked with metal pins as a guideline, similar to those seen in the corners of the stretcher. The inside crossbars are attached with four screws in each one.

The “L-shaped” pieces are found in the four corners of the work and correspond to the mechanism used to open and close the stretcher.

On the perimeter, the canvas is tacked down, although at some points there are also nails of differing lengths.

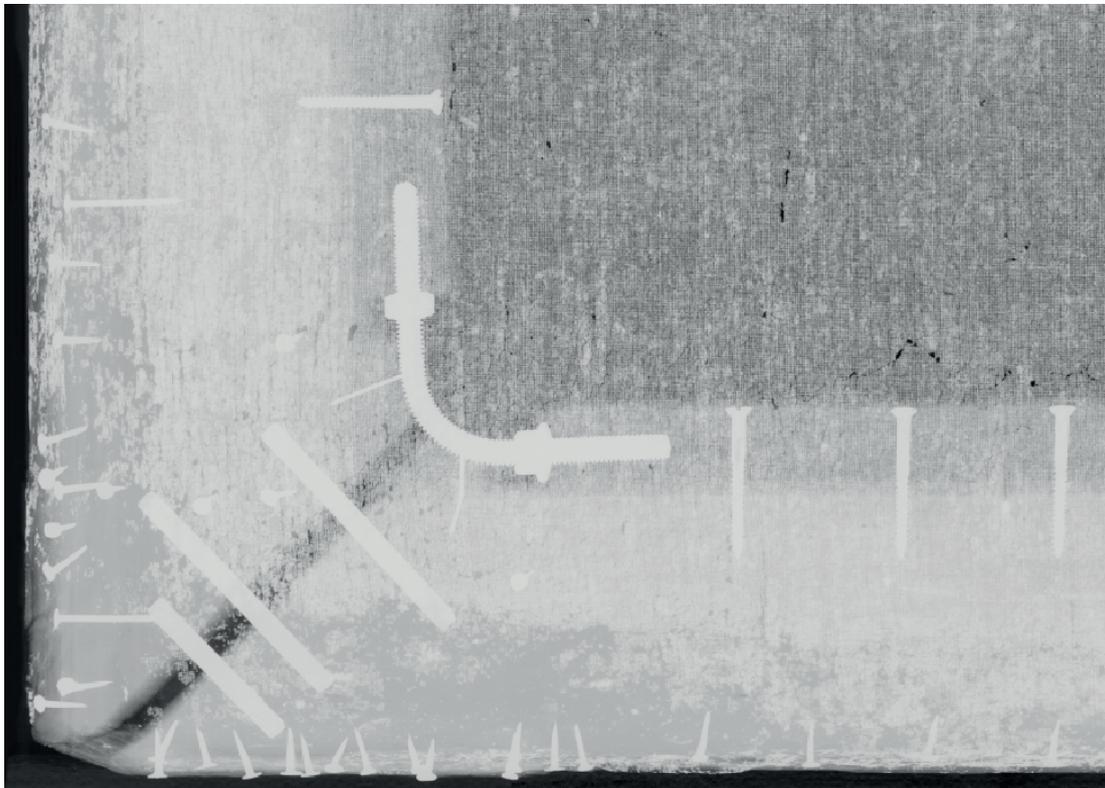


Fig. 25. Close-up of the bottom left corner where the screws, the tacks and the nails holding the canvas in place on the stretcher can be seen.

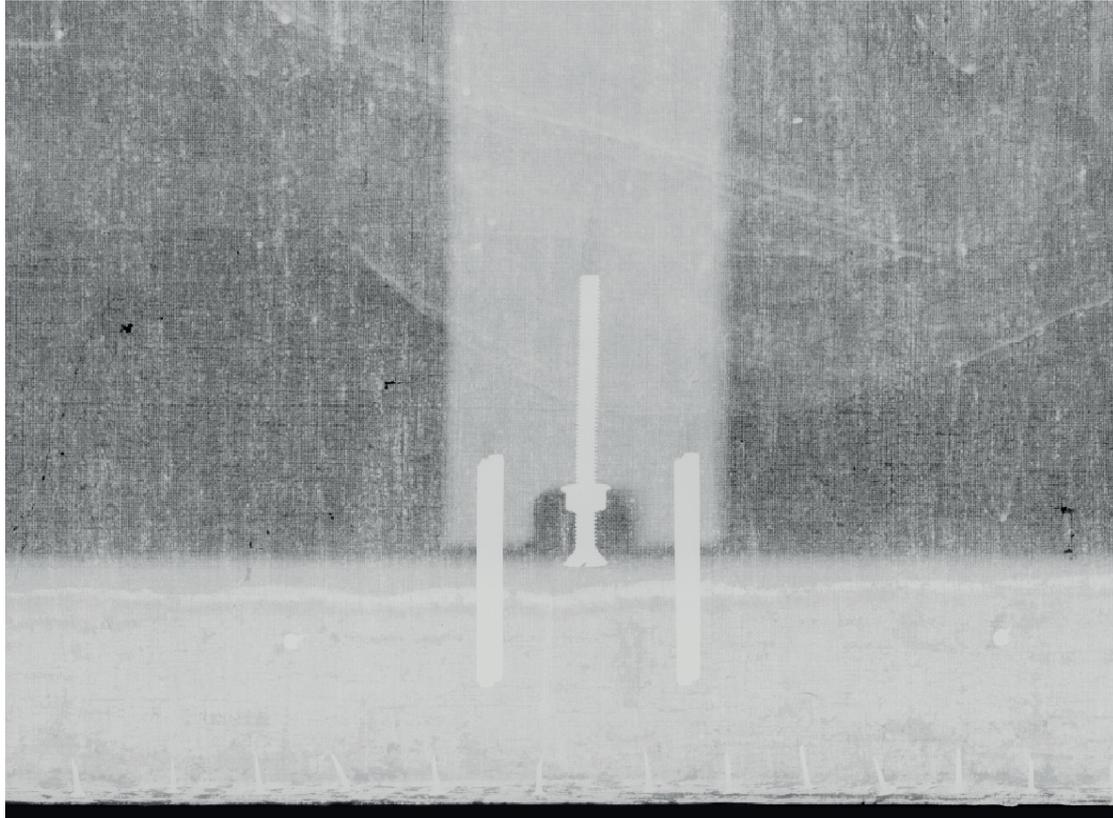


Fig. 26. Details highlighting the clamping system between the perimeter strips and the crossbars.

3.2. Cracks, fissures and losses to the paint layer

The large number of fissures, craquelure and losses of media appear in highly defined lines and forms, even in dark colours, which are more difficult to make out with visible light, and enable us to study their morphology and the patterns they follow. The losses covered with retouching are seen more clearly than in a study with visible light because they are often hidden by the paint (Fig. 27).

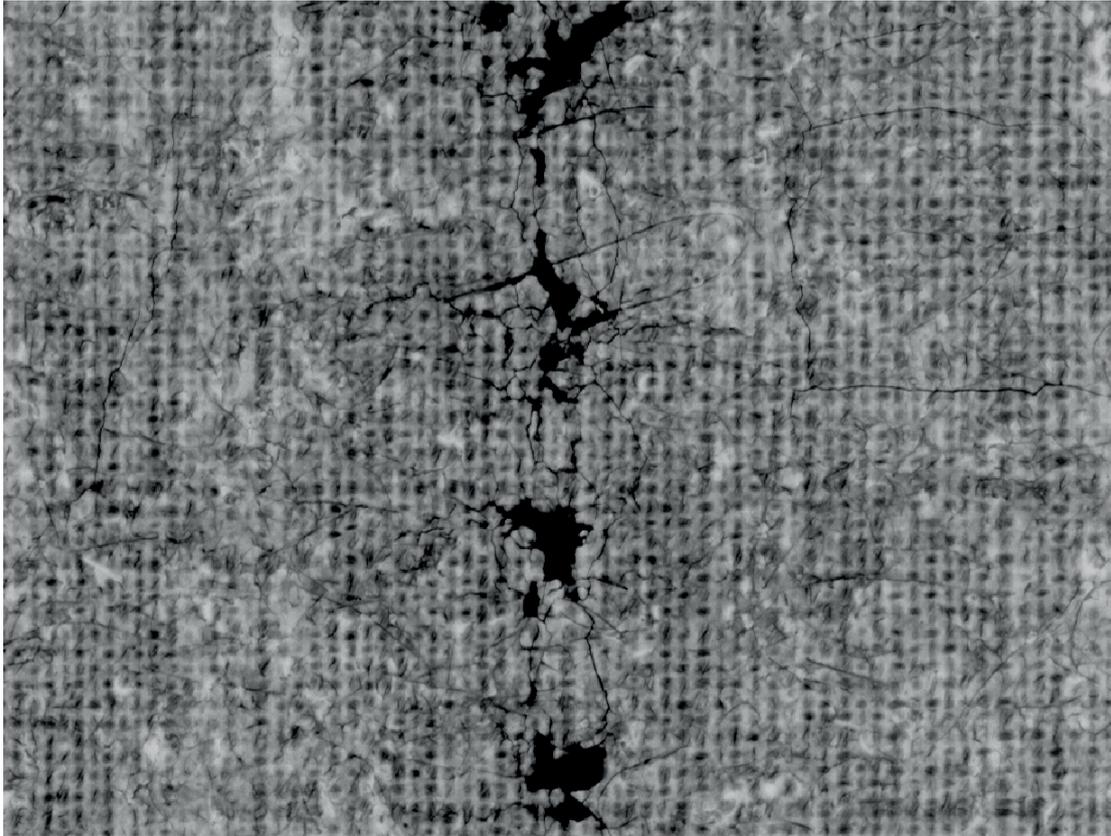


Fig. 27. Details of the losses seen through x-rays. These are found on the horse's neck.

3.3 Support and preparation

The x-ray study clearly identifies the technical aspects of the support, for instance details of the weave of the canvas, providing information on its characteristics (Fig. 28).

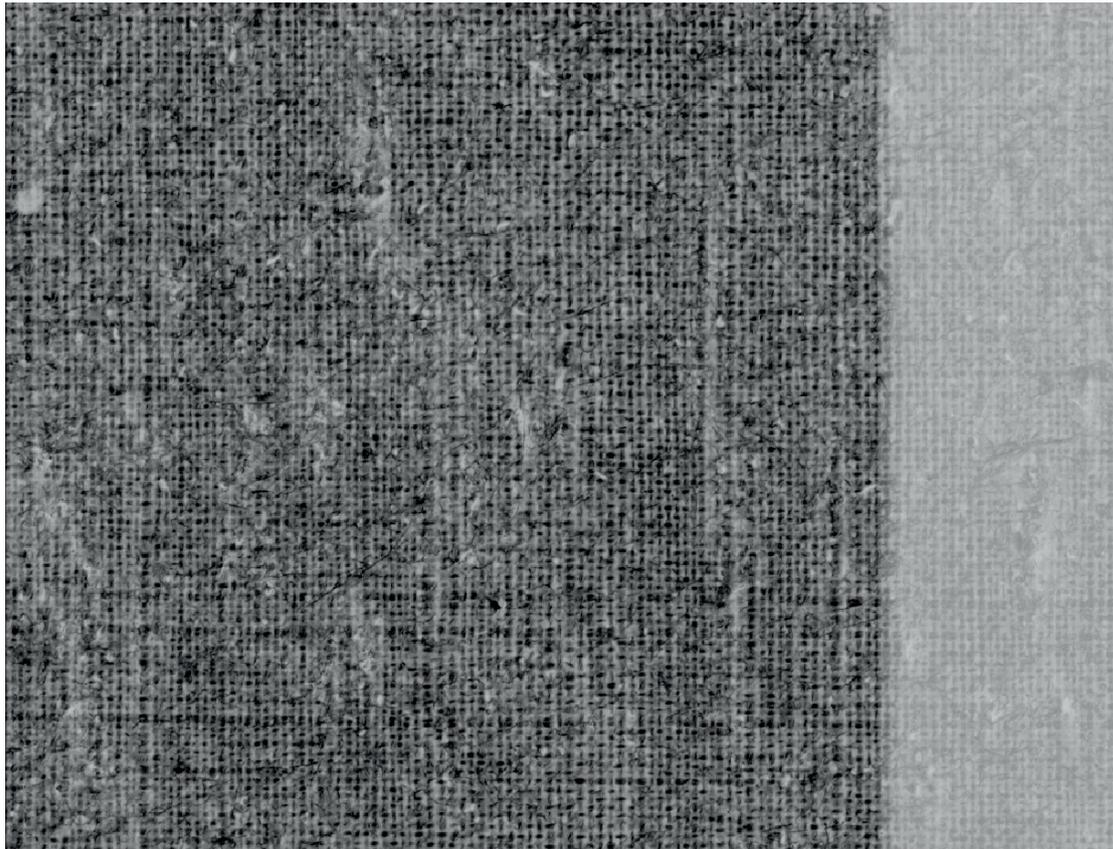


Fig. 28. This image shows how the canvas has been woven with a simple, taffeta-type, fabric ligament, with a weft thread for each warp thread.

In the x-ray, we can see a series of broad horizontal strokes, which possibly correspond to the those produced when spreading the ground layer on the canvas (Fig 29).

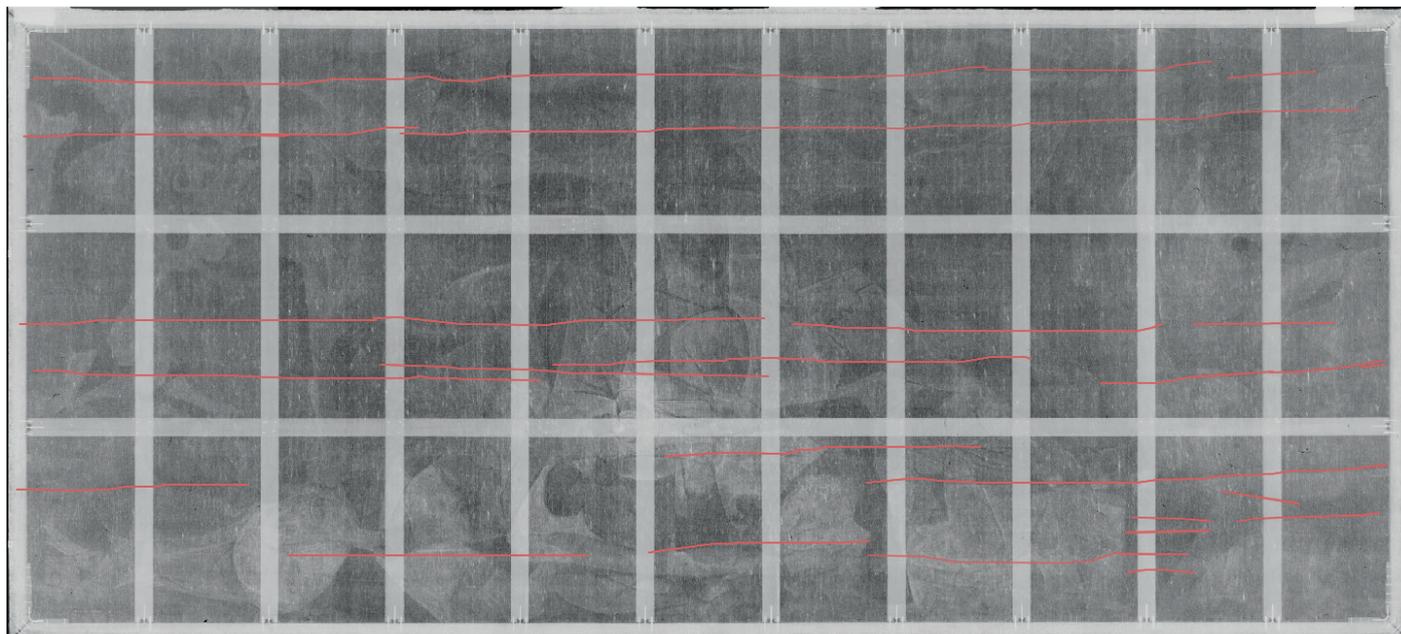


Fig. 29. Diagram of the movement of the horizontal strokes discerned in the x-ray of Guernica and identified as the application of the ground layer.



Fig. 30. Slanting strokes corresponding to the application of the ground layer.

4. INFRARED REFLECTOGRAPHY

The ability of the infrared wavelength to look through the paint layers enables the middle or first layers to be detected, with the collected information dependant on the thickness and characteristics of the materials used in overlapping layers. Infrared reflectography (IR) has been used to examine art objects since the 1960s, enabling, above all since it was digitalised, the discovery of underdrawings, corrections to the composition and hidden details such as signatures or inscriptions.

4.1. A comparative study of Dora Maar's photographs

The advancement of Picasso's painting was documented by the photographs Dora Maar took while the artist was painting the work. In these series, we can clearly see compositional changes the artist executed at successive stages, changes that show up in infrared images, and which in turn show other undocumented, intermediate steps.

From Dora Maar's photographs we had obtained images which work as the basis of this part of the project.

Below is a series of comparisons between the adapted sequences of images of Dora Maar's photographs, ordered in chronological stages, and the results from the images captured using infrared reflectography. Each of Dora Maar's photographs features a red box highlighting the area of the study subject. The images obtained through infrared reflectography use blue lines which reveal underlying images and are spotlighted through this technique.

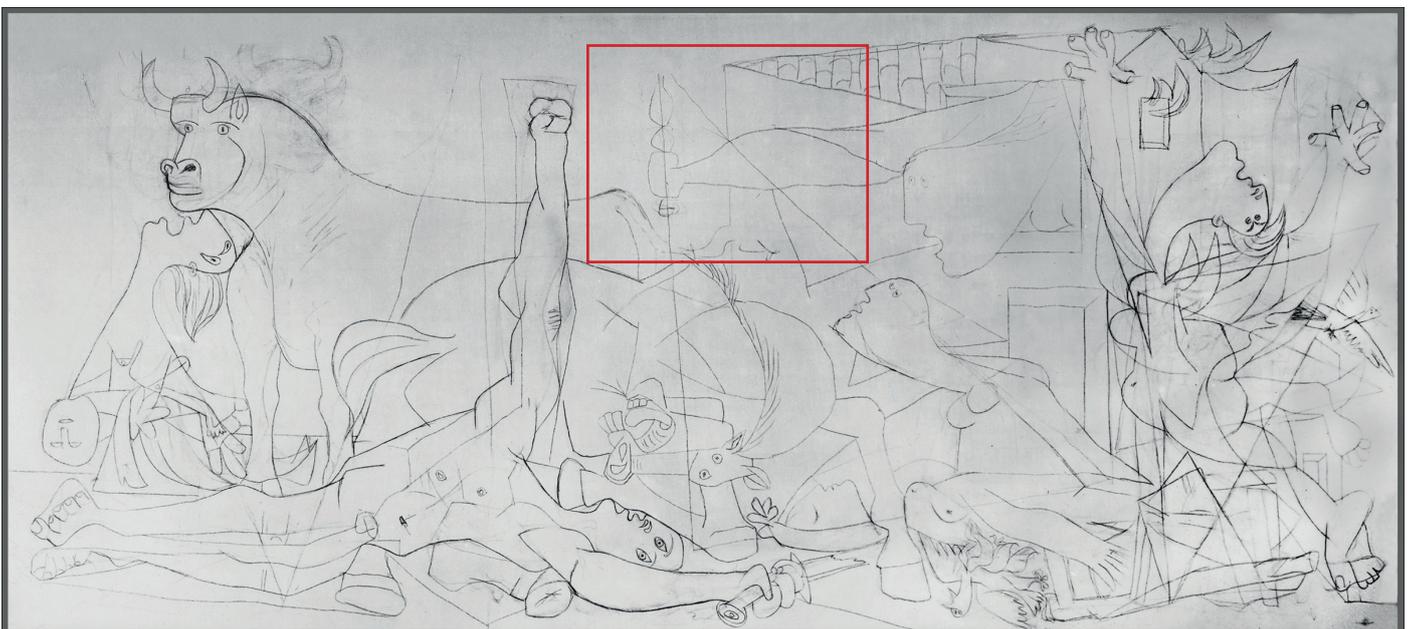


Fig. 31. Overview of the first stage of Guernica's creation.

Clear structural lines can be identified in this technique, and were used by Picasso from the moment he began to work on the canvas; geometrical forms that divide the space into triangles. The compositional lines are maintained — and are either visible or suggested — depending on how the work evolves and through any changes made. The clearest example is the diagonal line which, setting off from the lamp light, splits the right half of the painting in two. This is discernible in the final composition (Fig. 32).



Fig. 32. Composition lines.

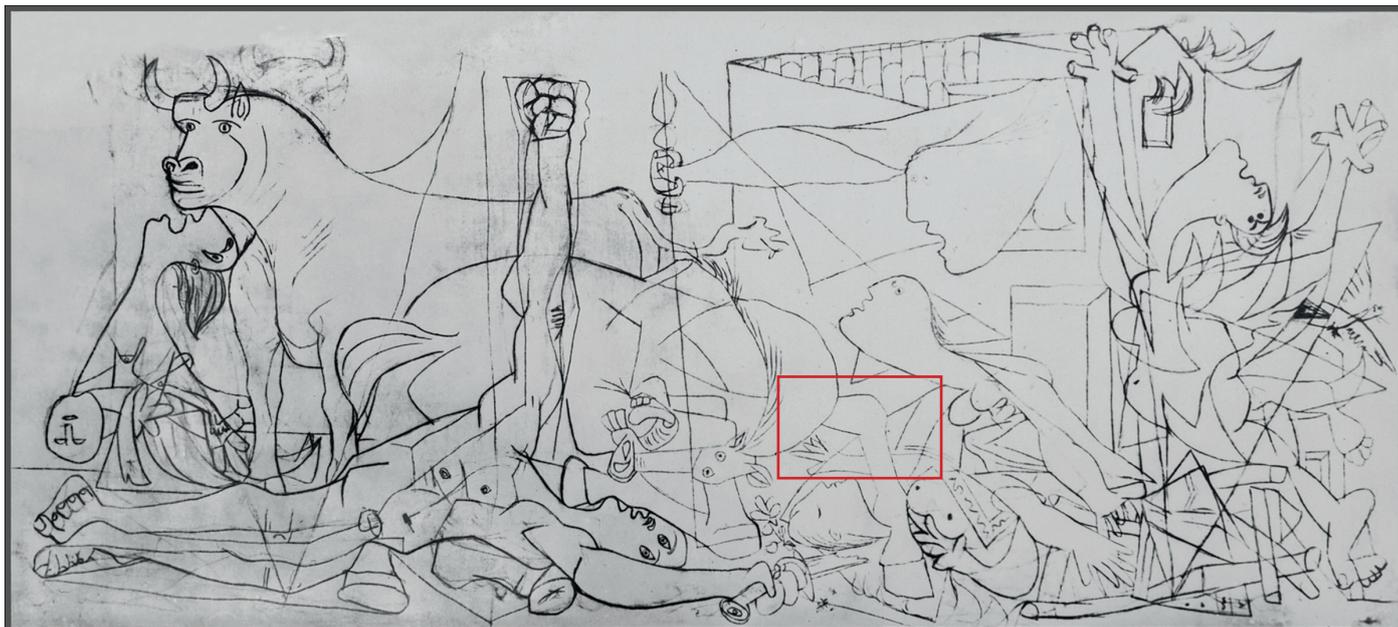


Fig. 33. Overview of the second stage of Guernica's creation.

The hand, wrist and right forearm of the figure of the woman in a previous composition phase can be detected. (Fig. 33). The detail is maintained between photographs 2 and 3, taken by Dora Maar. In subsequent stages, this detail was modified and the arm hangs down, occupying a space that begins with a significant agglomeration of forms which is progressively simplified (Fig. 34).



Fig. 34. Details of the early composition stages of the work, in which we can see the silhouette of a hand next to the horse's leg. In the image on the left, the hand can just be made out, and in the image on the right this area has been delineated, outlining this detail to show the figure more clearly.

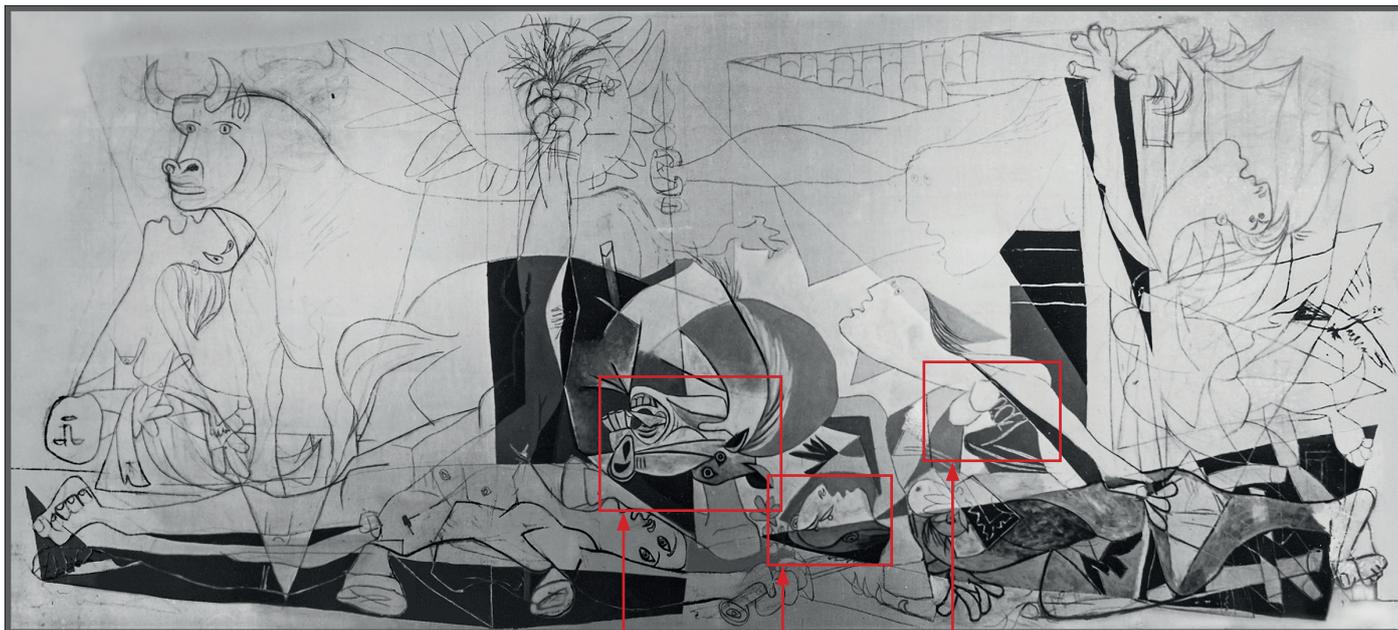


Fig. 35. Overview of the third stage of Guernica's creation.

Fig. 36

Fig. 37

Fig. 38

We can see the lines which correspond to the horse's head in two previous stages, precisely as they appear in photographs 3 and 4. The different perspectives are mixed, and Picasso inverted the head by keeping a series of forms which recur in both drawings (Fig. 36).



Fig. 36. Detail of the inverted horse's head, which can be seen through infrared reflectography, and alongside it the same image with drawings outlining the area in order to gain a better idea of the forms.

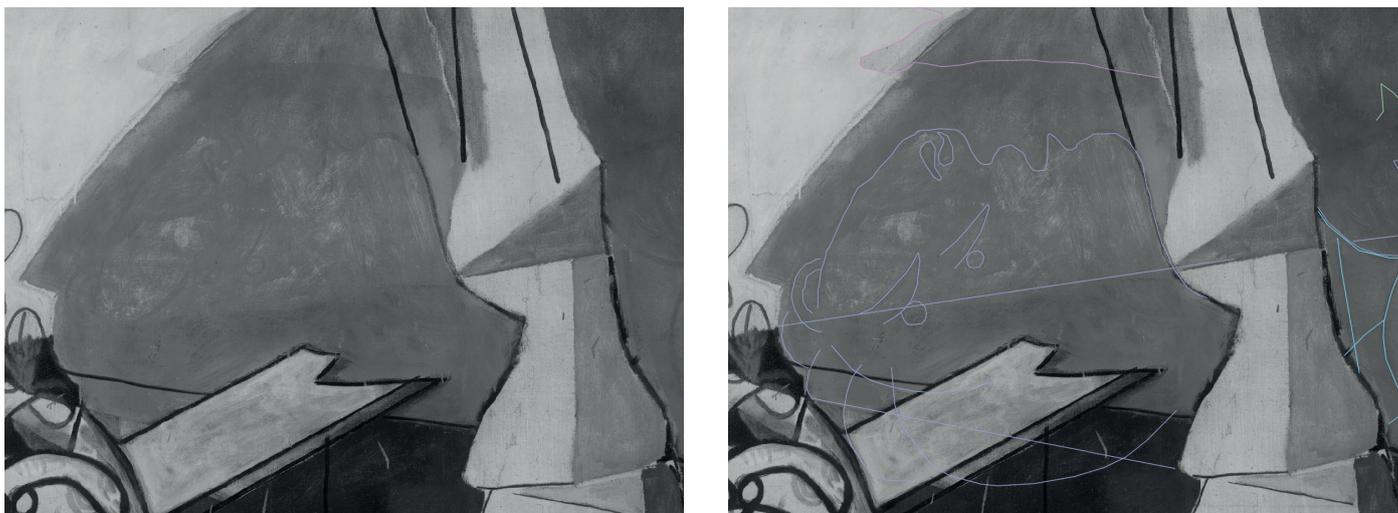


Fig. 37. The woman's face at the bottom, next to the dead soldier's sword. In the image on the left we can see the face of the woman through infrared reflectography. On the right, this is delineated with drawings, outlining this detail to show the figure more clearly.

The profile of the face of a supine figure can be seen. The image remains from photographs 3 to 6, but is later covered with plain hues, thus making it disappear from the work's final composition. We can also see the darker plane that crosses through the head, corresponding to the triangular form seen in photograph 3 (Fig. 37).



Fig. 38. The pleats on the dress of the woman who enters hastily from the right. In the image on the left we can see the progression of the pleats through infrared reflectography. On the right, this figure is delineated with drawings to gain a clearer view of the figure.

There are curved and straight strokes, which possibly correspond to the pleats from the dress of the woman, as seen in photographs 2 to 4. The strokes are made on a dark background and were finally covered with white (Fig. 38).



Fig. 39. Overview of the **fourth stage** of Guernica's creation.

This stage sees the appearance of a circular figure with eyes, a mouth and triangular forms in the outline, as seen in photograph 4, taken by Dora Maar. Picasso later decided to remove it from the composition (Fig. 40).



Fig. 40. Details of the circular figure which could correspond to a silhouette. In the image on the left we can see the circular figure with eyes, a mouth and triangular forms, while on the right this area has been delineated with a drawing to highlight this detail.



Fig 42

Fig 43

Fig. 41. Overview of the **fifth stage** of Guernica's creation.

The dead soldier's hand, on the bottom left, is a case in point of the figures maintained through the composition changes. From photographs 2 to 4, these lines correspond to the dead soldier's foot and leg; from 5 onwards, the position of the figure is inverted and the area becomes his arm and hand (Fig. 42).



Fig. 42. The hand and foot of the dead soldier. The hand corresponds to the final image and the blue lines highlight the image of the underlying foot through infrared reflectography.

Certain triangular forms can be appreciated at the bottom and others in clearer shades. These could be related to details of the flames and displaced arm of the woman wailing up at the sky.



Fig. 43. The result of the image with infrared reflectography, with a drawing outlining a previous positioning of the arm of the woman wailing up at the sky in the stages prior to the execution of the work.



Fig. 44. Overview of the sixth stage of Guernica's creation.

Infrared reflectography reveals multiple lines with an underlying white layer in the area of the recumbent soldier. This area has been heavily worked upon, and at first the figure lay face down before being turned to face upwards; this change, however, was not carried out until well into the composition. A large number of eyes in different forms and positions also emerge, some corresponding to those which appear in photographs 5 to 8, and others to undocumented, intermediate stages (Fig. 45).



Fig. 45. The figure of the head face down, which was later turned over. The image on the left shows the face of the recumbent soldier through infrared reflectography. In the image on the right, this area is delineated with a drawing outlining this detail in order to gain a clearer picture of the position of the soldier lying face down. Moreover, not only do we see the changing figure, but also the different designs of the eyes, mouth, nose and hair.



Fig. 46. Overview of the seventh stage of Guernica's creation.

In the darker areas, the sketches tracing the compositional changes of the work cannot be discerned. The covering of these layers is heavier than with the whites and greys — permeable to infrared radiation — as shown in previous images.



Fig. 47. Overview of the eighth stage of Guernica's creation.

This form, which can be seen in the analysis with infrared reflectography, relates to the foot in the preliminary stages of composition, precisely as it appears in photographs 1 to 8. In the final stage, it was modified slightly to make it wider. (Fig. 48).

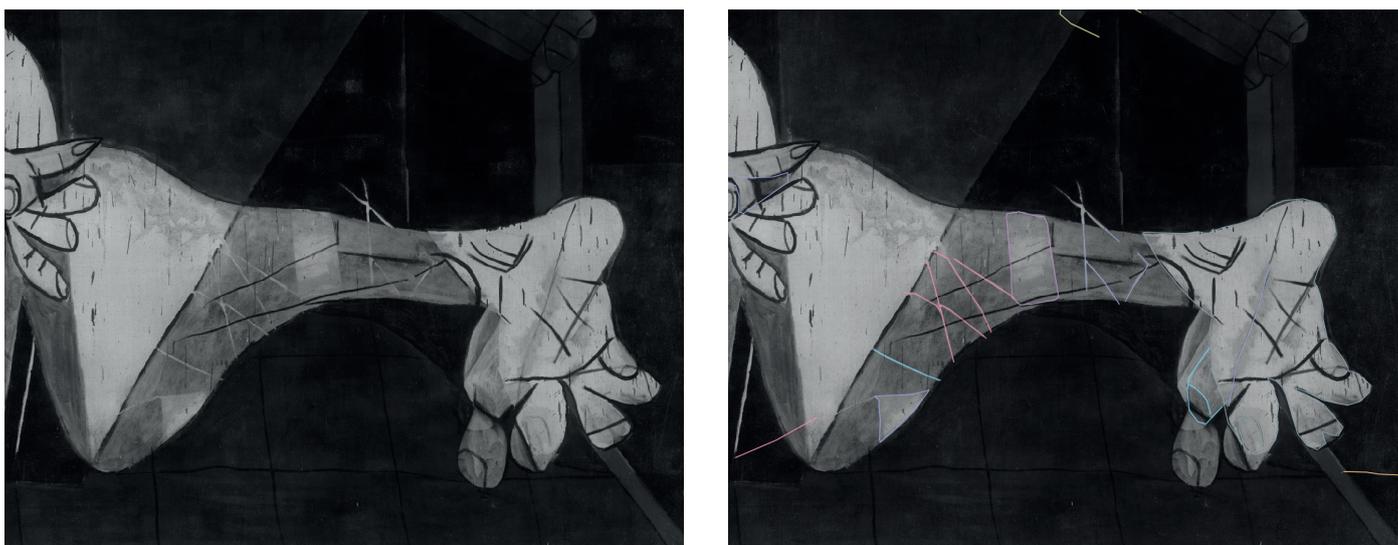


Fig. 48. The foot of the woman at the bottom right of the work. The image on the left has been obtained through infrared reflectography, while the one on the right delineates the area in question, outlining this detail to gain a clearer idea of the previous position of the foot.



Fig. 49. Overview of the final stage of Guernica's creation.

The alterations maps shown on this website also reflect the underlying compositions corresponding to different stages of Picasso's creative process while he worked on Guernica, and, although unrelated to Dora Maar's images, they do still provide us with indispensable information for the study.

Therefore, in the image obtained with infrared technology we can see the different eyes on the bull's head, some of which are hidden by a layer of white paint covering them. They do not correspond to those seen in Dora Maar's photographs, but rather to an intermediate stage, possibly situated, temporarily, between photographs 5 and 6 (Fig.50).

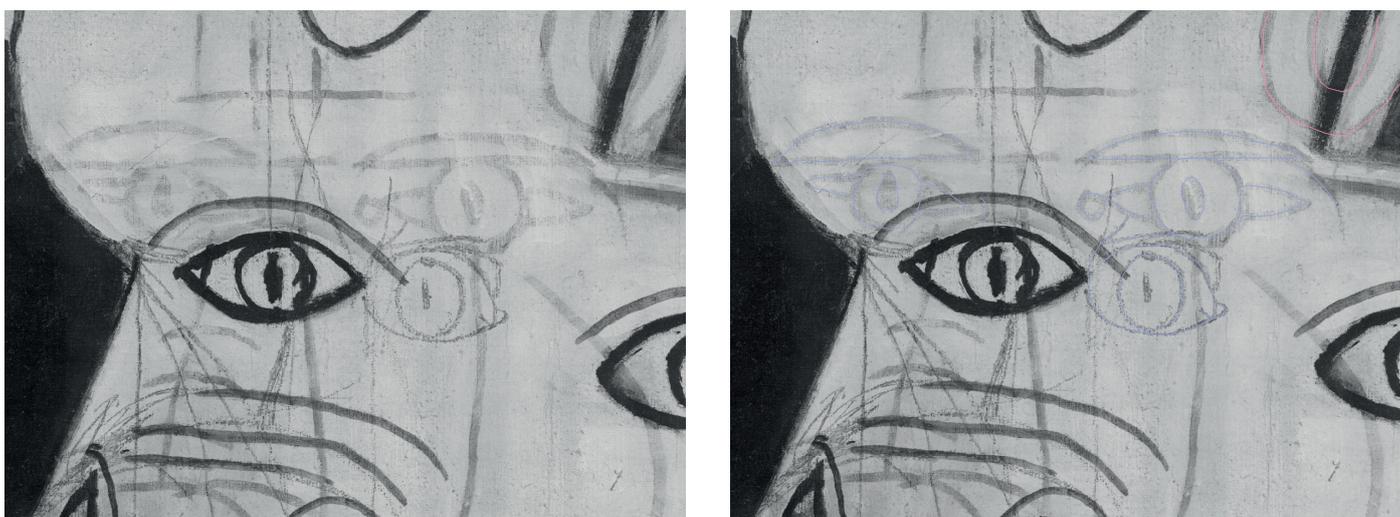


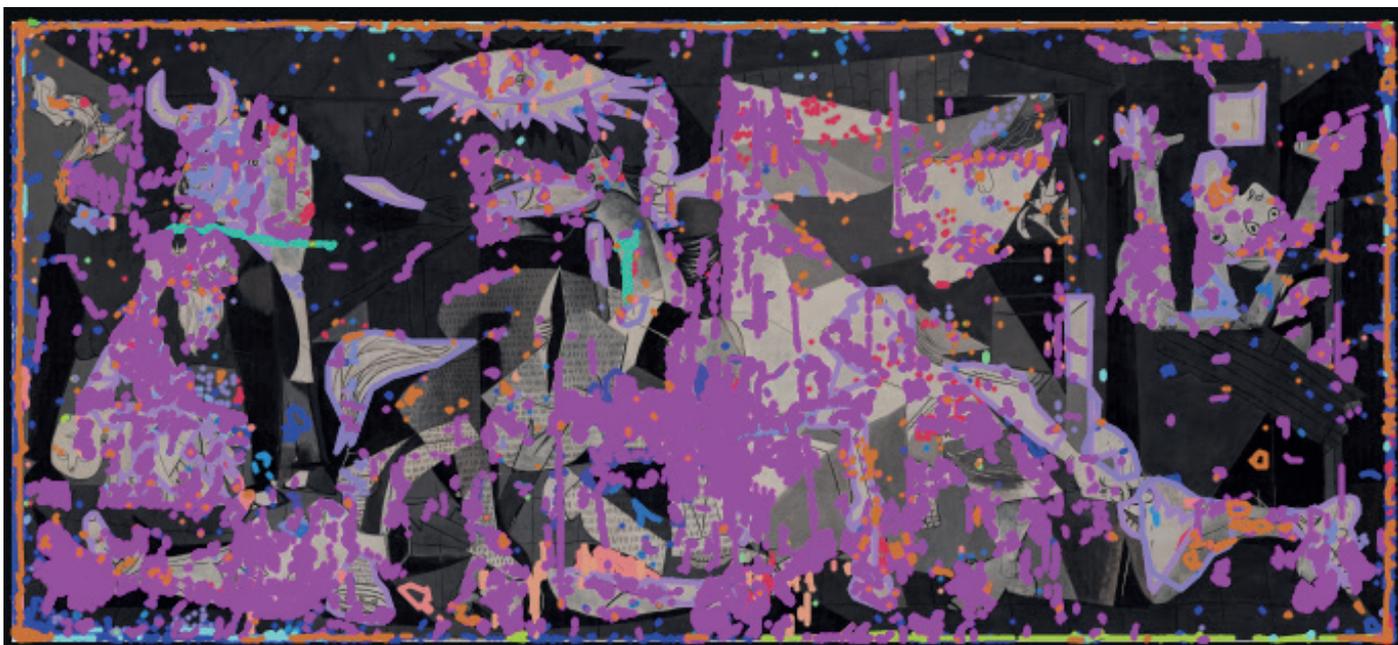
Fig. 50. A close-up of the different eyes on the bull's head.

5. STATE OF CONSERVATION: ALTERATIONS MAPS

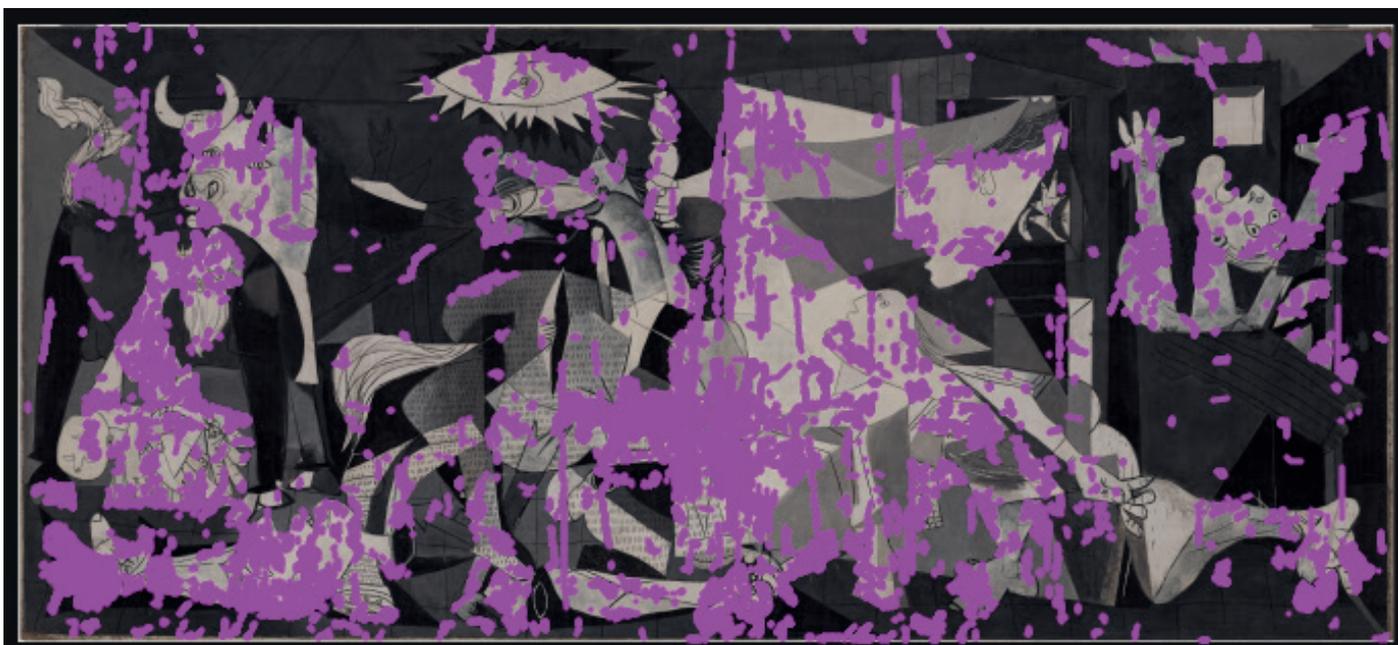
Below are the results of reports on the state of conservation of the work through the use of alterations maps. These can be checked by browsing the images on this website.

5.1 Results of the studies

The result of visible imaging with all alterations and technical data:



Craquelure detected through visible light:



Losses detected through visible light:



Paint residues from the act of vandalism detected through visible light:



Reintegration and retouching seen through visible light:



5.2 Results of the technical studies with ultraviolet light

The result of ultraviolet imaging with all alterations and technical data:



Wax detected through ultraviolet light:



Reintegration and retouching seen through ultraviolet light:



5.3 Results of the technical studies with infrared reflectography

The result of infrared reflectography with all alterations and technical data:

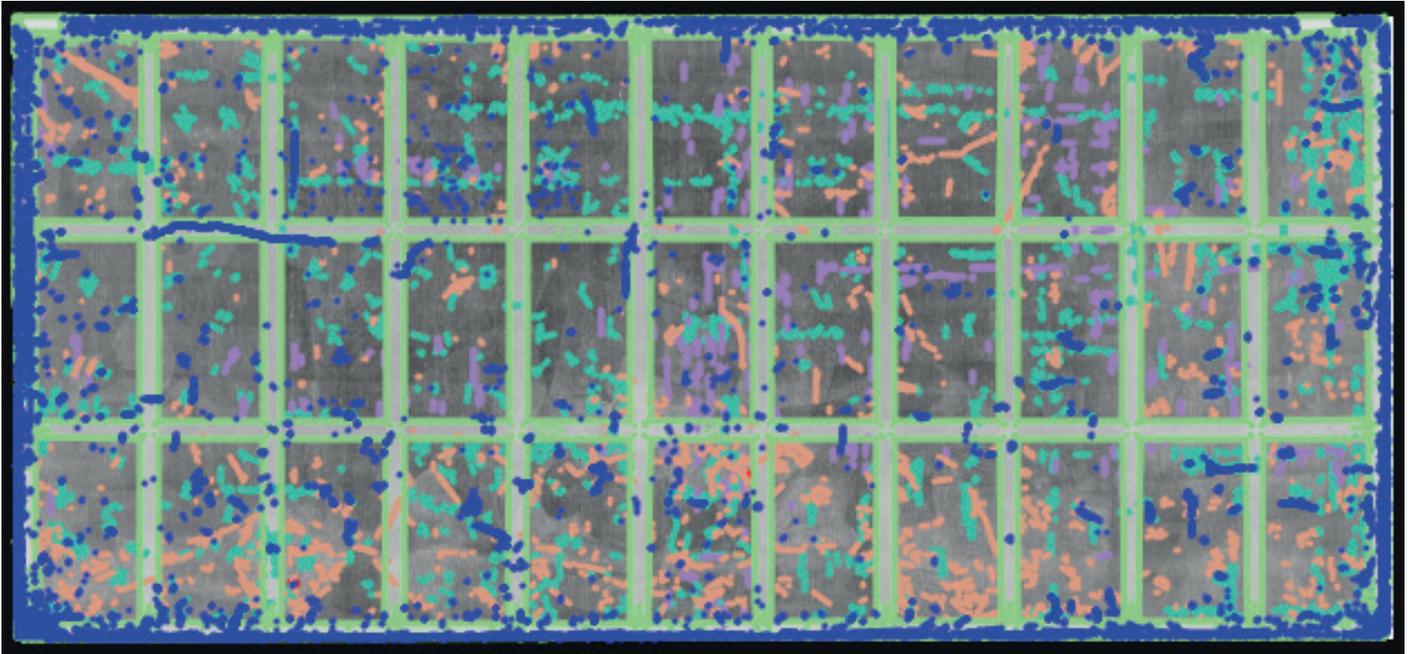


Compositional changes seen under infrared reflectography:

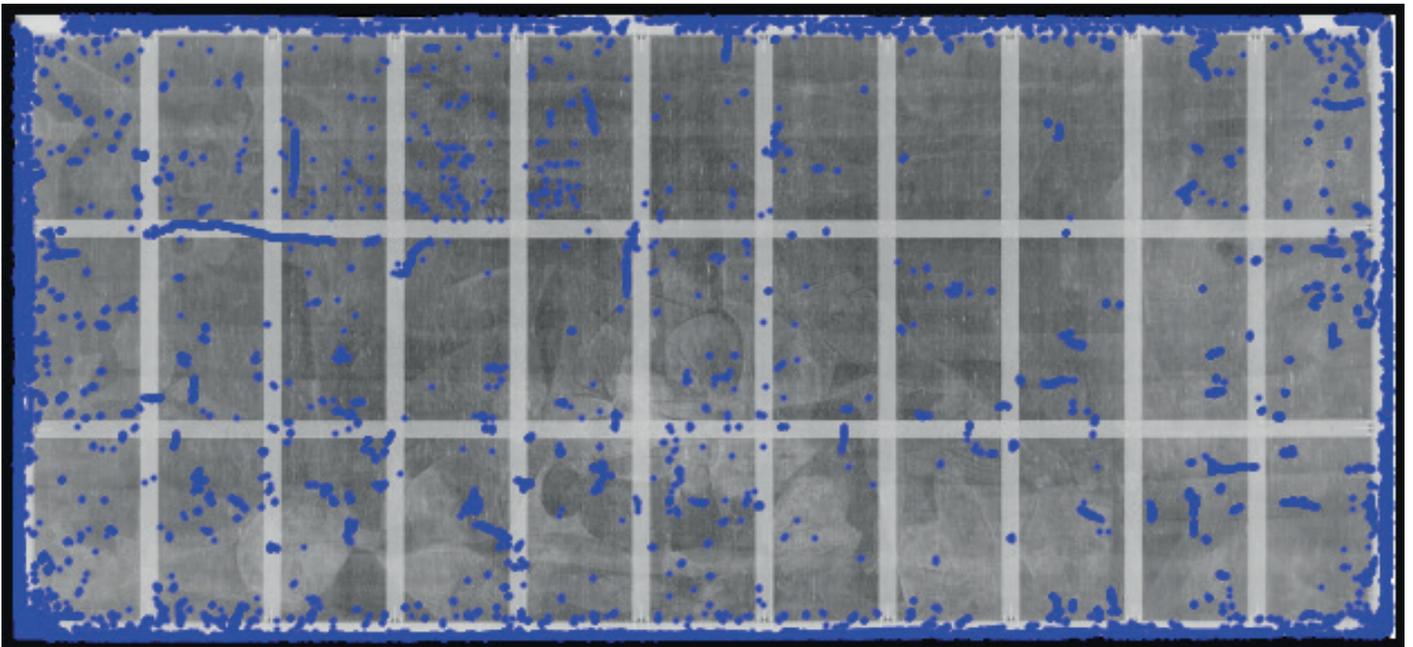


5.4 Results of technical studies with x-rays

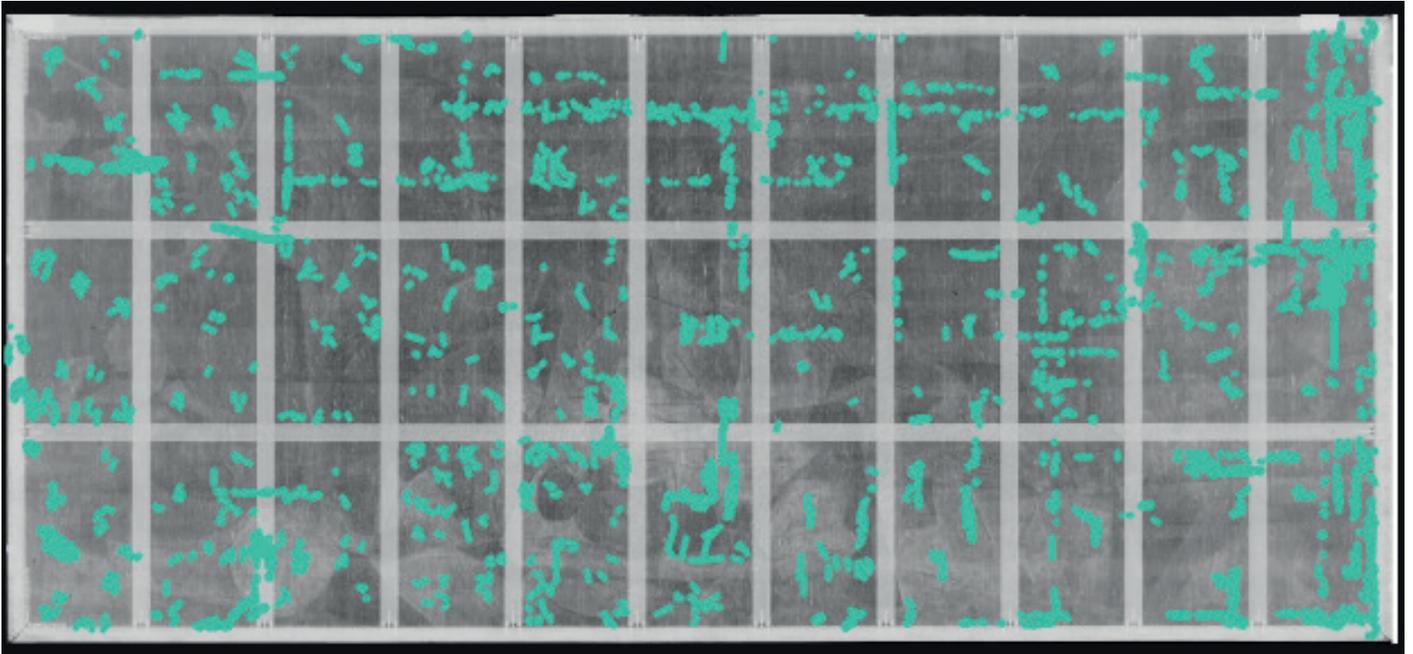
Result of x-ray imaging with all alterations and technical data:



Losses seen through x-ray imaging:



Cracks seen through x-ray imaging:



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