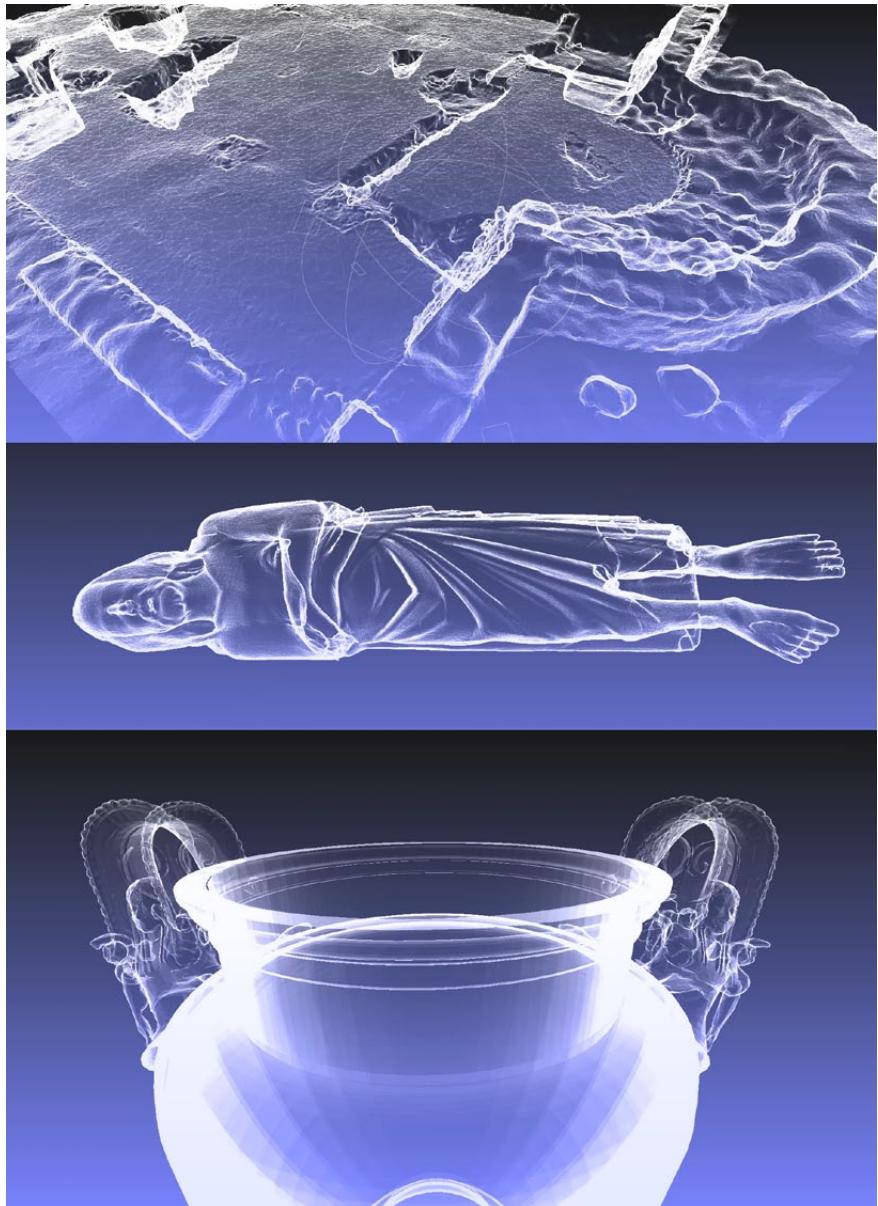


3D Measurements. Critical Advances in the field of Archeology and the Preservation of National Heritage Monuments and Artifacts.

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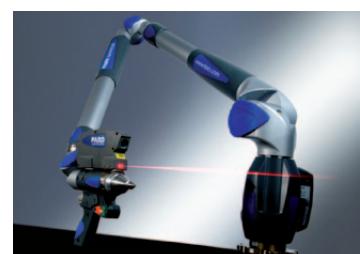
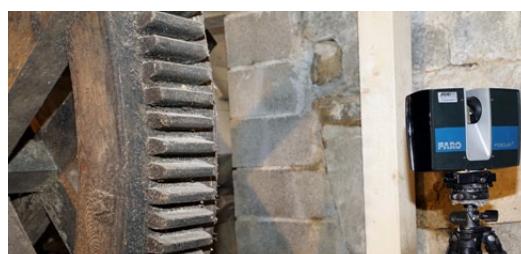
State of the Art Technology, International Experience

Since 1979, Archéotech SA specializes in archeological and architectural surveys. Archéotech SA's list of credits contains thousands of surveys, notably of art works, and archeological sites both in Switzerland and abroad.

Partner with many international leaders in the field of laser measuring, Archéotech SA has at its disposal a vast holding of short and long-range 3D laser scanners, capable of creating images of areas that range from a few microns to several kilometers and drones equipped with different metric cameras. Archéotech SA is also the owner of software and powerful workstations that are fitted with retro-designed equipment, all of which is constantly updated.

With 3D laser digitization, it is ten times faster to produce aerial surveys than with any other 3D scanner previously used, and this with unmatched accuracy. Archéotech SA's data bases are immediately operational and ready for analysis and the creation of plans, cross-sections, projections, volumes, 3D modeling, virtual tours ...

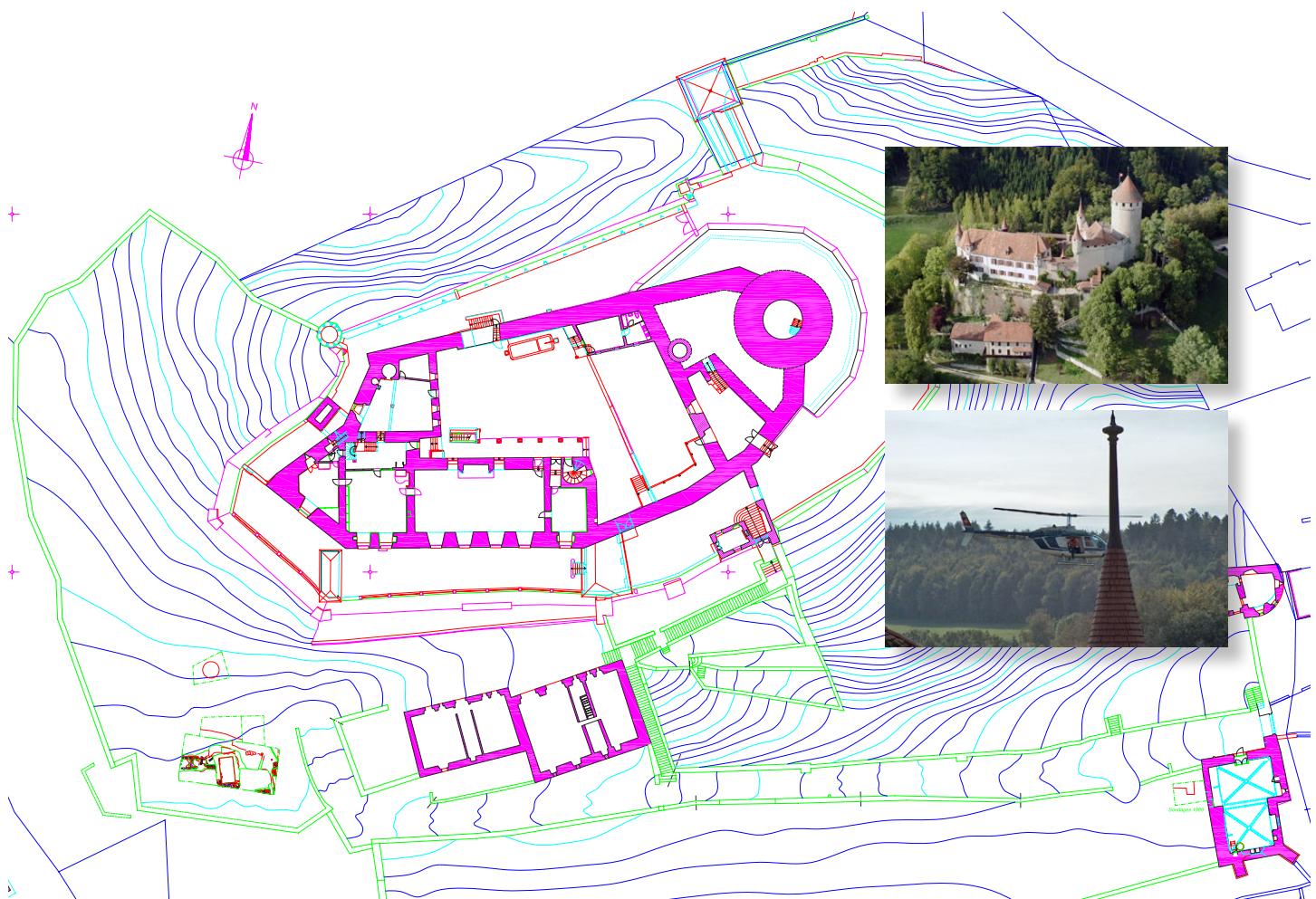
Archéotech SA 's competitive edge stems from a large pool of experts in many fields; archeology, architecture, geomatics, photography and virtual imaging.



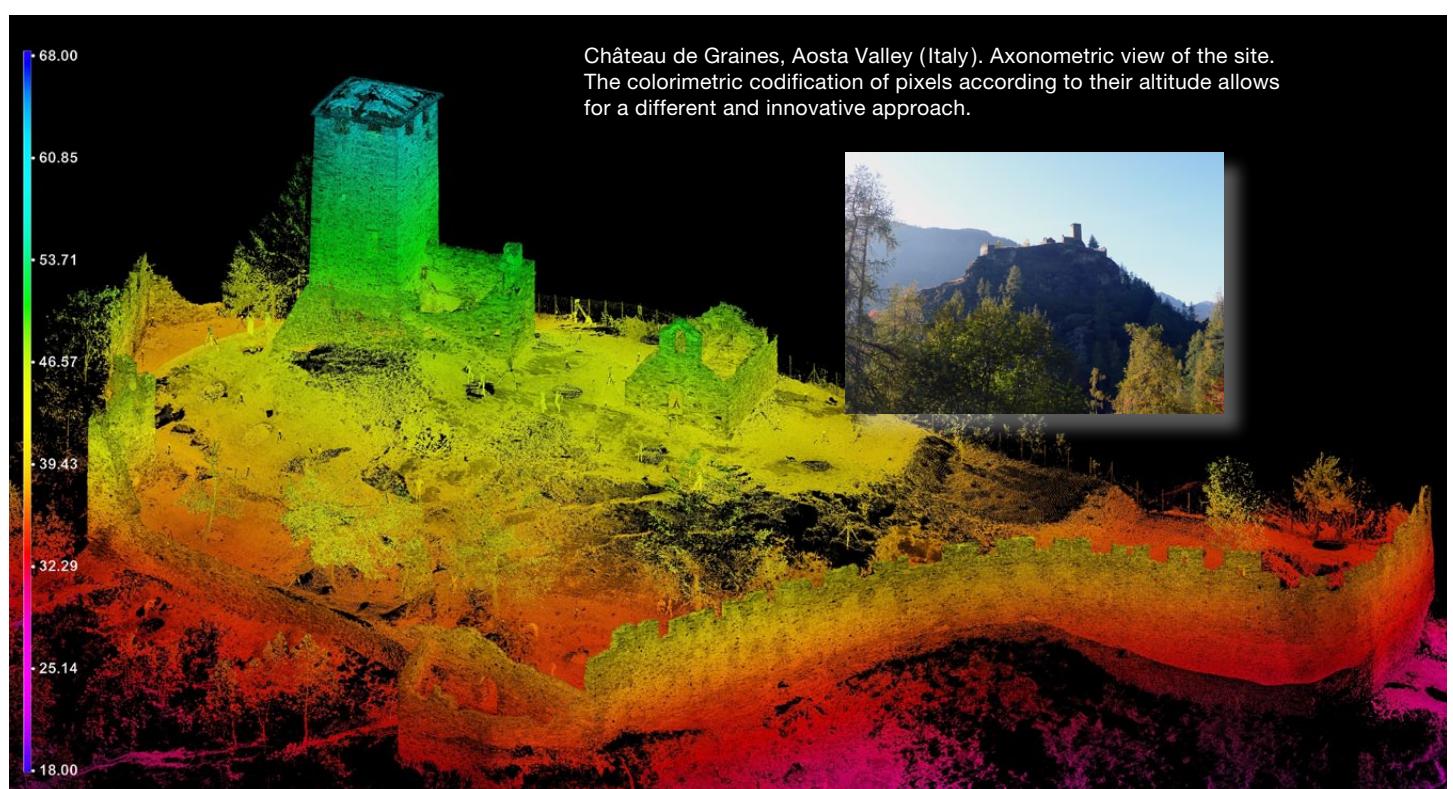
Archéotech SA is a member of CIPA / ICOMOS (International Committee for Architectural Photogrammetry). Our company is also a registered member of the C2RMF (Center for Research and Restoration of the Museums of France, the Louvre, Paris).

Site Topography

Aerial or terrestrial measurements in complex environments, with or without dense vegetation, our 3D laser digitization guarantees unprecedented results never before attained.



Château de Lucens (VD, Switzerland). The elaboration of the topographical survey of this site was greatly facilitated thanks to the laser measurements which were immediately available to our customers at the very instant the images were taken.

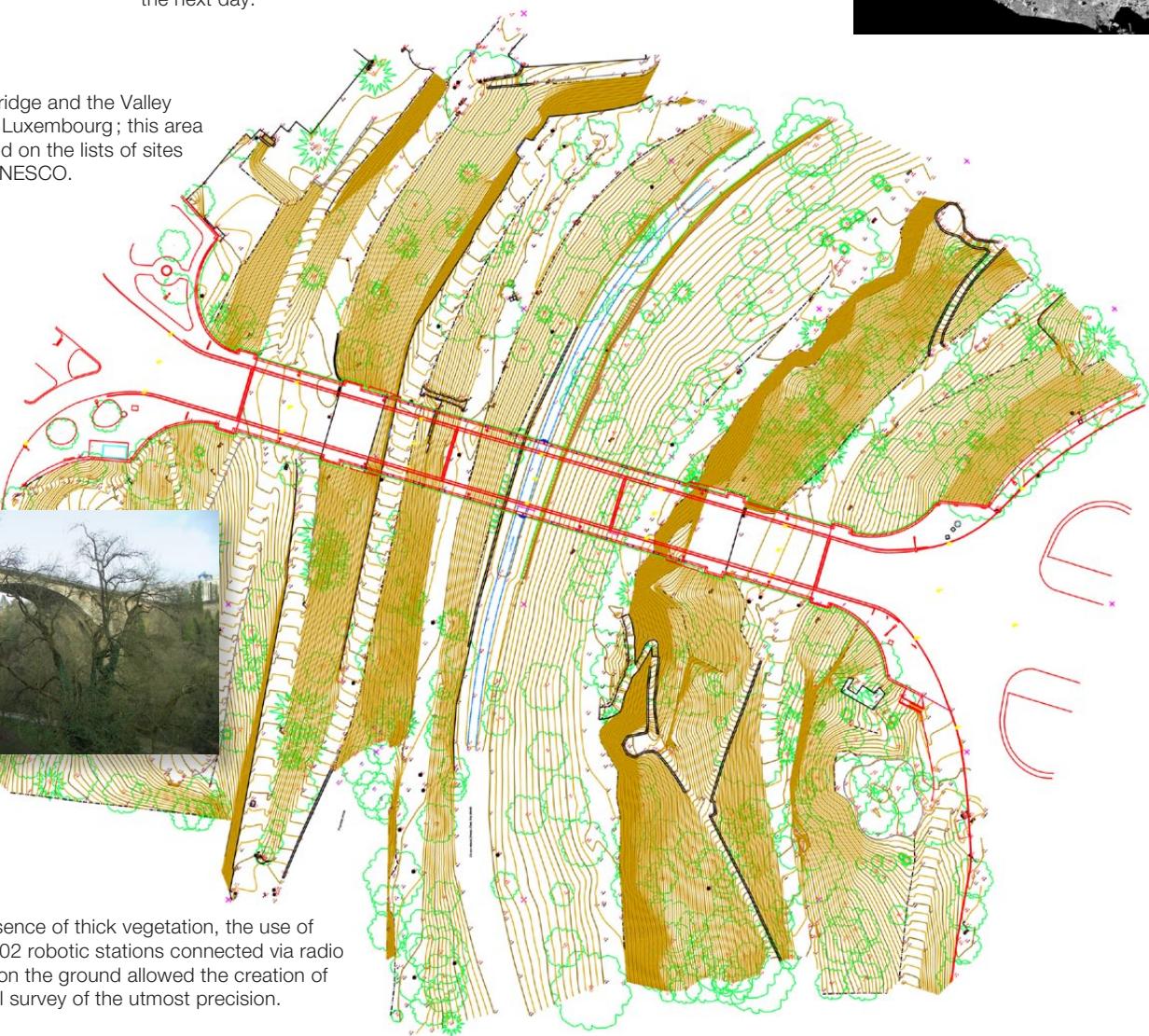




The Adolphe Bridge and the Valley of the Petrusse, Luxembourg; this area has been placed on the lists of sites protected by UNESCO.

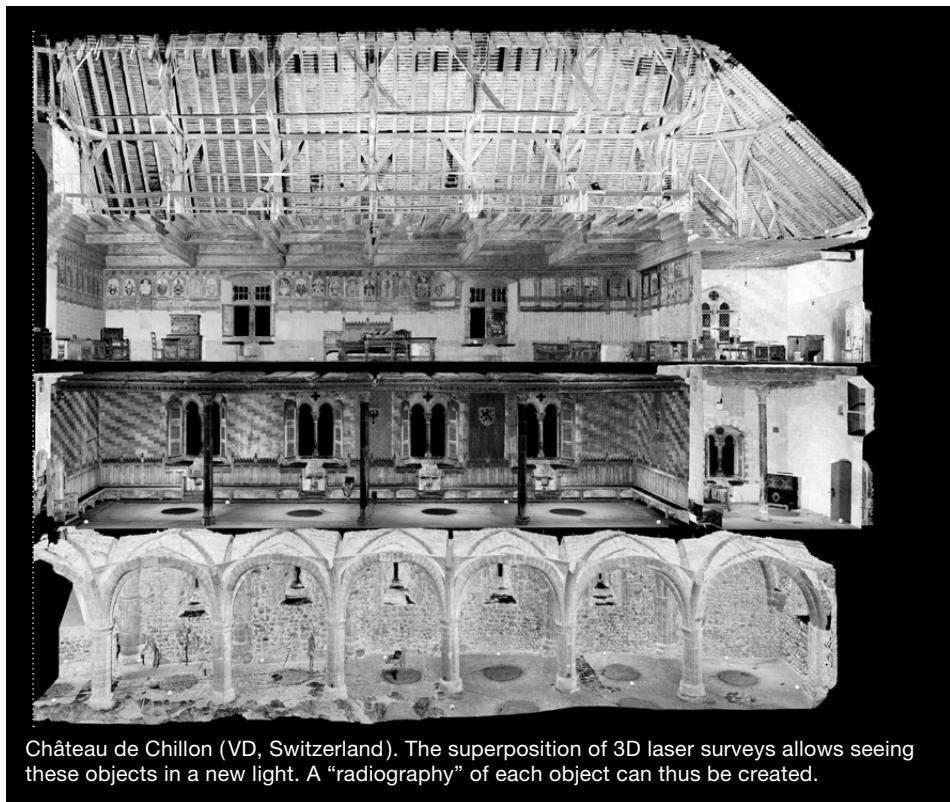


Due to the presence of thick vegetation, the use of Leica TCRA 1202 robotic stations connected via radio to a computer on the ground allowed the creation of a topographical survey of the utmost precision.

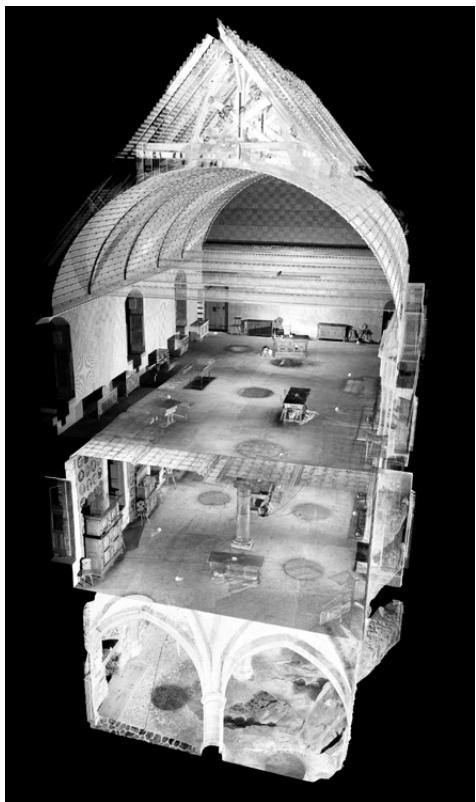


Historical Monuments

The days of time consuming draftsmanship is a thing of the past. Within just a few hours, both exterior and interior surveys of any site can be completed. It is now quite simple to obtain uniform and highly detailed data for each building.



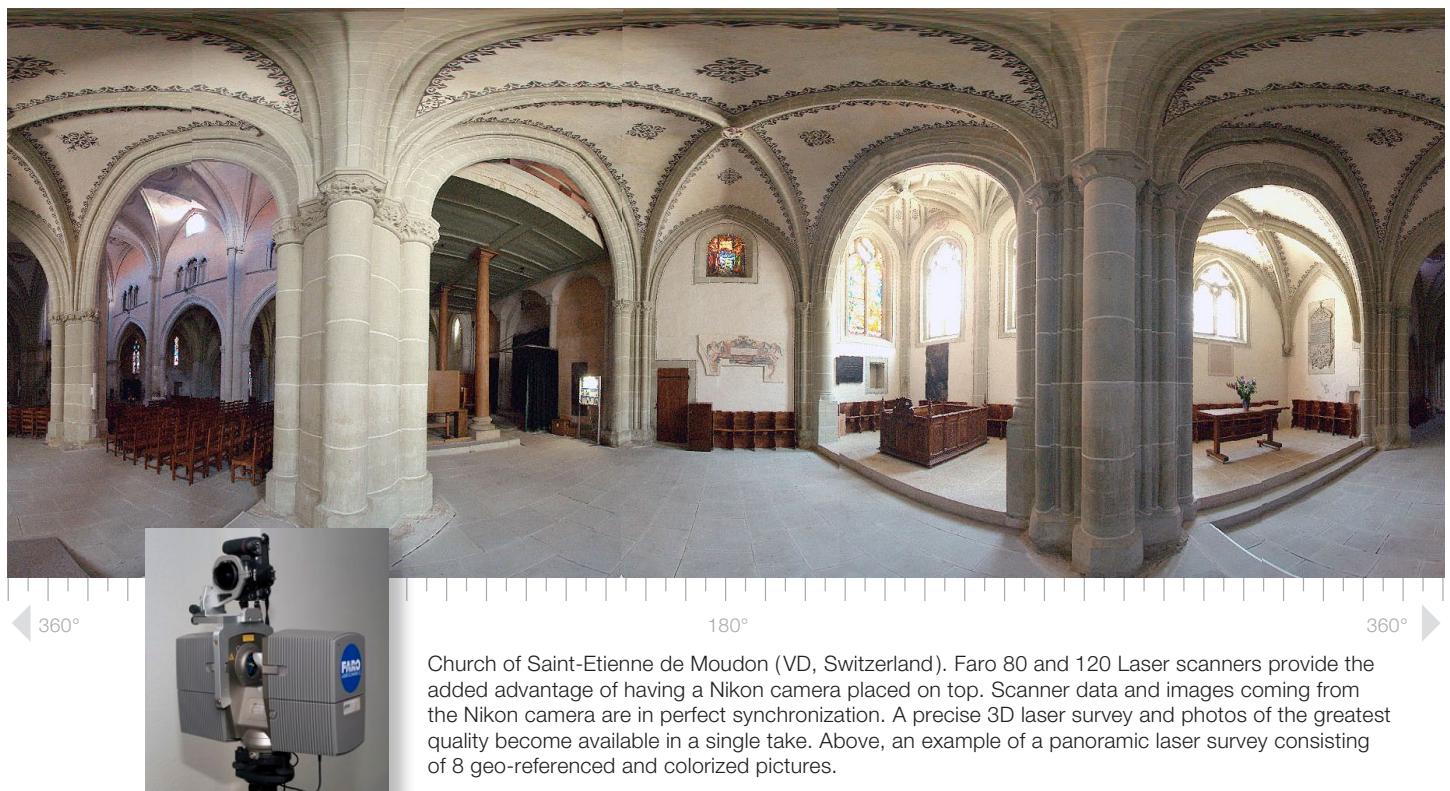
Château de Chillon (VD, Switzerland). The superposition of 3D laser surveys allows seeing these objects in a new light. A “radiography” of each object can thus be created.



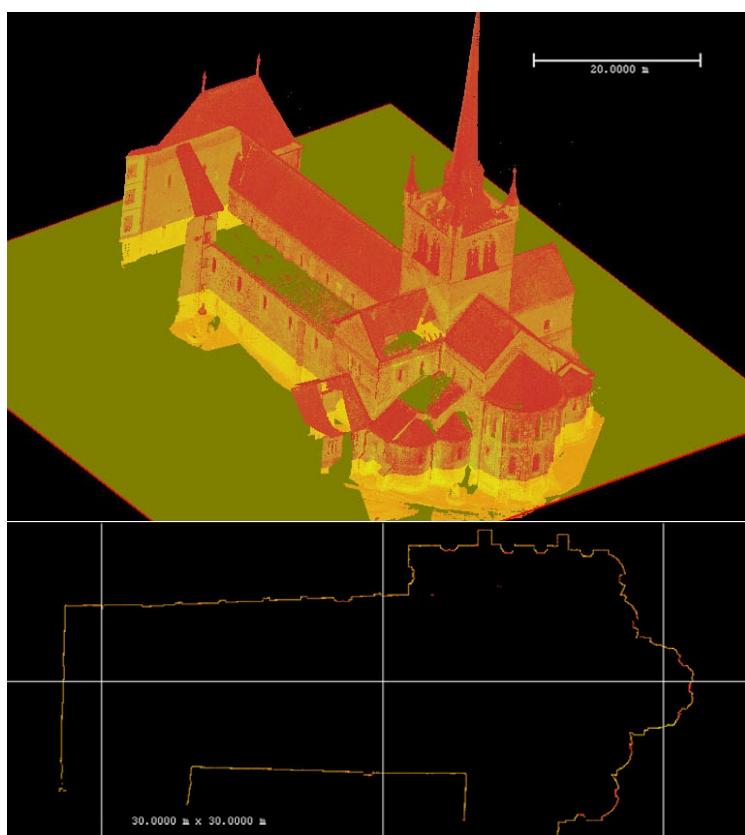
The computerized images of the facades on the moat of this building were executed from 150 meters away with the use of a long distance Trimble GS200 scanner that is capable of capturing images from afar. The cluster of dots thus obtained is rich in geo-referenced data. This procedure facilitates vector restitution.



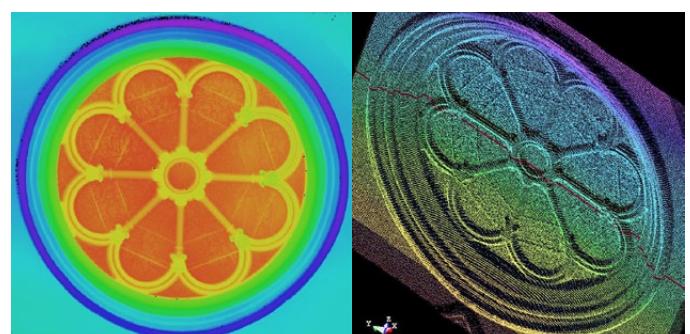
In an effort to best meet the terms and conditions specified by our clients, Archéotech SA favors pertinent and rational data capture methodologies. The data thus collected is always coherent and can be processed and put to use immediately.



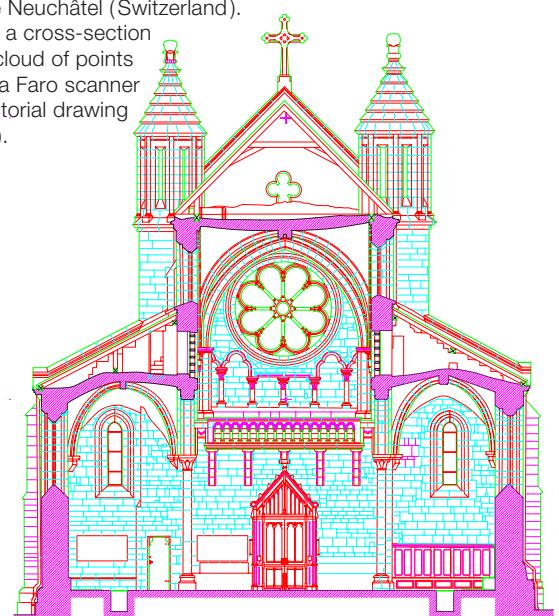
Church of Saint-Etienne de Moudon (VD, Switzerland). Faro 80 and 120 Laser scanners provide the added advantage of having a Nikon camera placed on top. Scanner data and images coming from the Nikon camera are in perfect synchronization. A precise 3D laser survey and photos of the greatest quality become available in a single take. Above, an example of a panoramic laser survey consisting of 8 geo-referenced and colorized pictures.



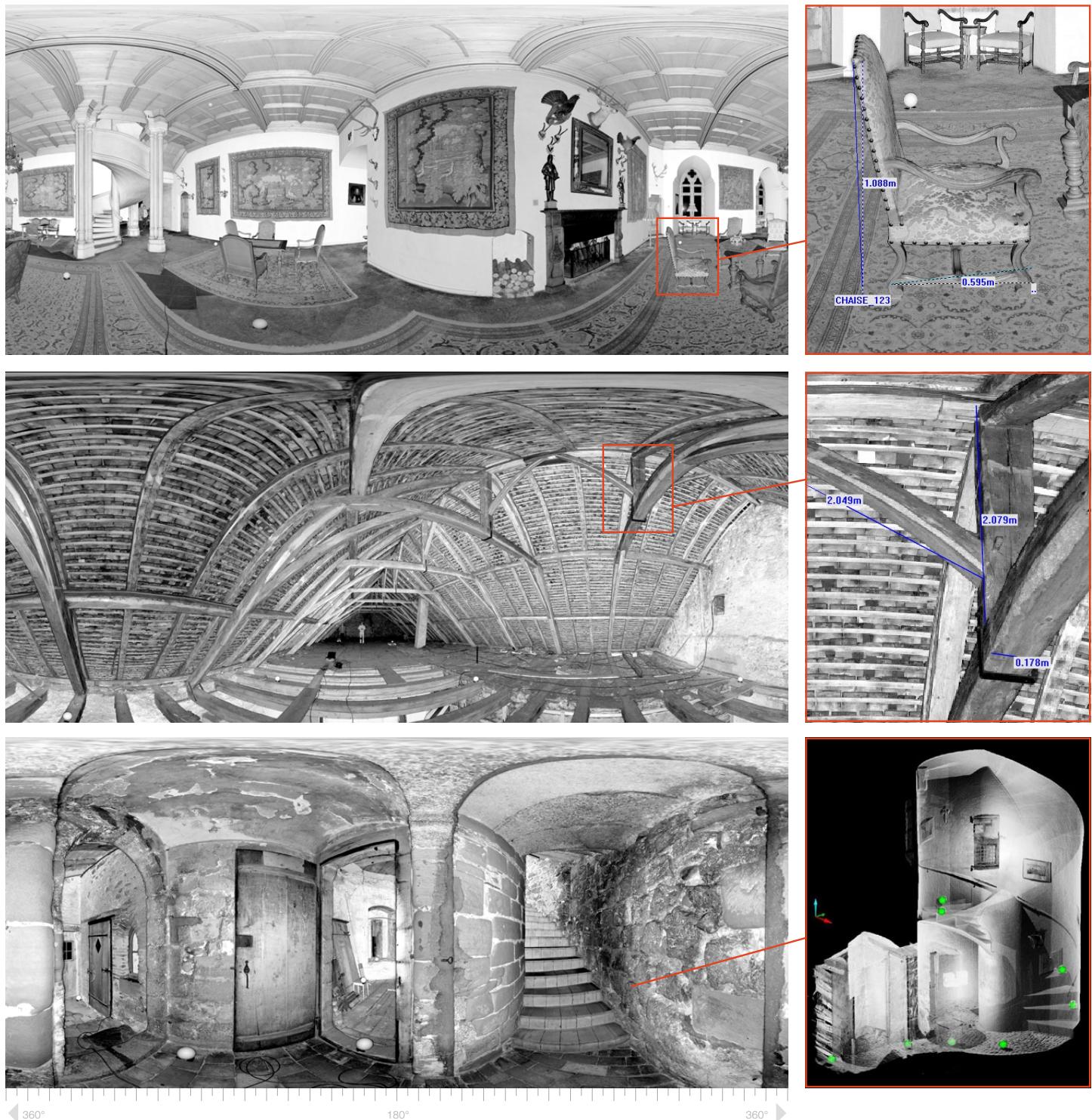
Abbatiale de Payerne (VD, Switzerland). Horizontal and vertical profiles can be traced at any location of either a building (above) or an object. Surveys made with 3D lasers offer many new fields of investigation, most particularly the observation of anomalies in the construction of the building.



Collégiale de Neuchâtel (Switzerland). Extraction of a cross-section based on a cloud of points obtained by a Faro scanner (above). Vectorial drawing (on the side).



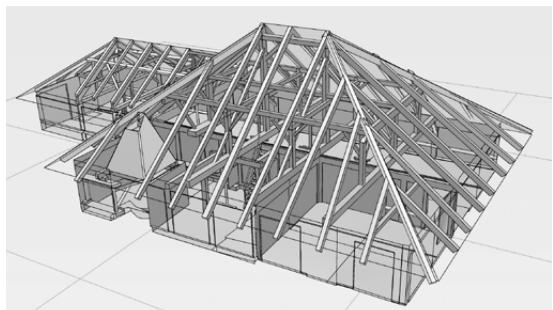
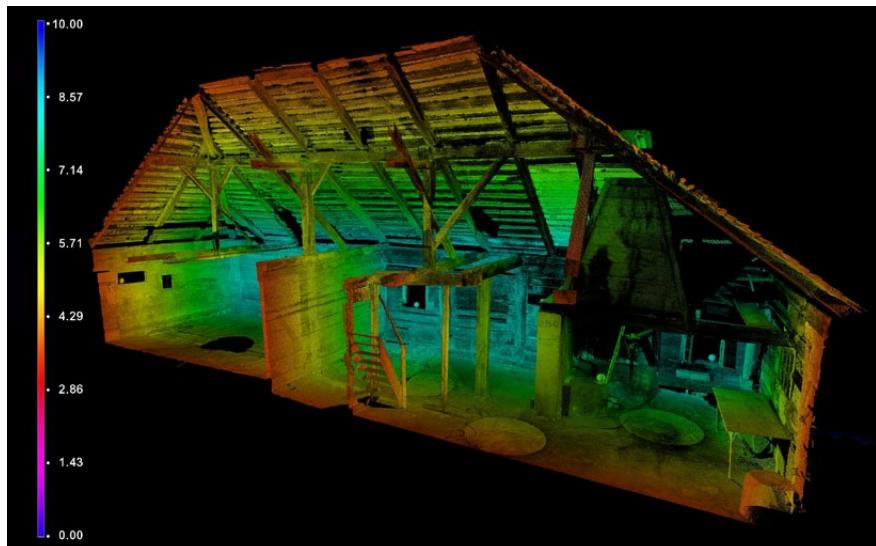
The structures of the building and all the objects (furniture, tapestries, paintings, etc.) are scanned. Each dot contained in the produced image is geo-referenced. It is easy, from a computer, to extract measurements and surfaces of all visible elements.



Château de Grandson (VD, Switzerland). Panoramic views captured by a Faro Photon 120 Laser scanner. With our free software, it is possible to stroll through a building and to extract measurements and surfaces of all the elements that are visible by moving from one view to the next as if one were in a virtual game. Aside from the precise geometric content, this type of survey can also be used to create a computerized inventory of the contents (furniture, paintings, objects and infrastructures).

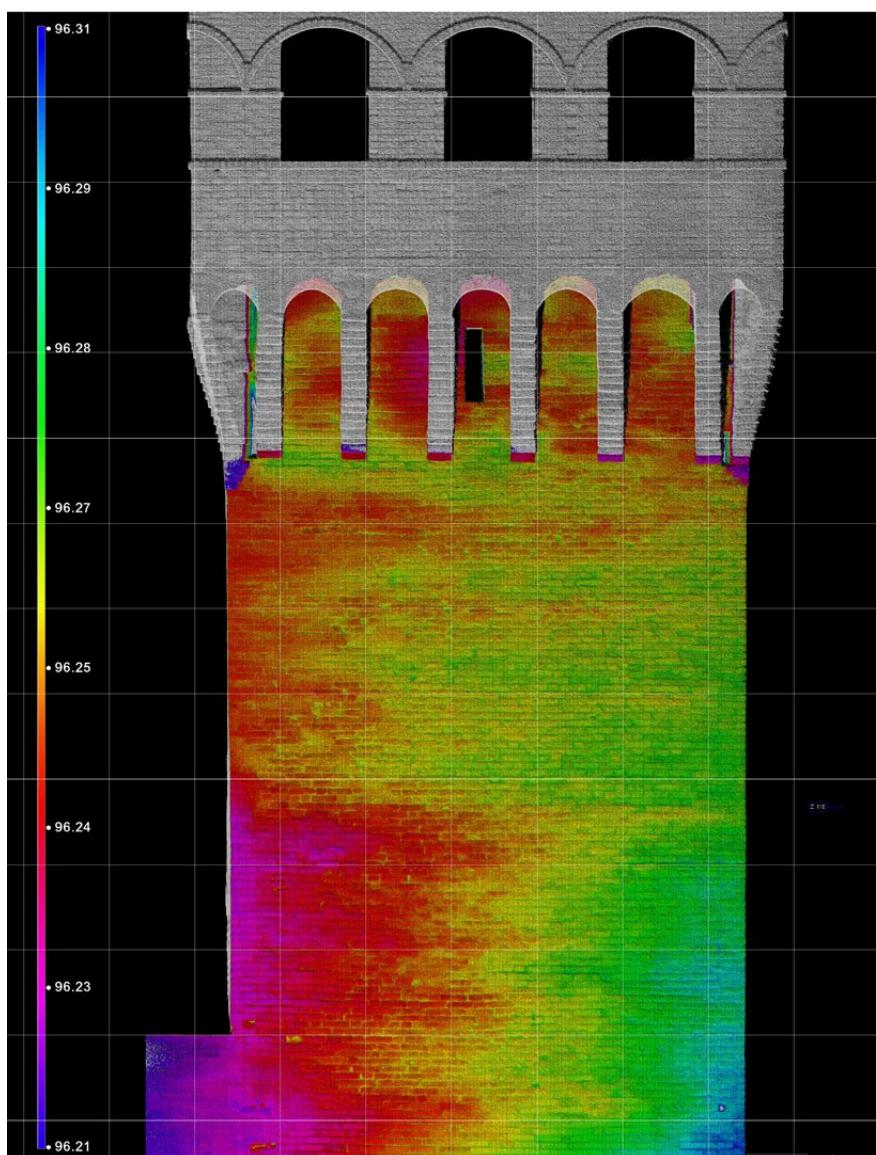
Our files come with free software that allows our customers to visualize in 3D, at any given time, any area that has been measured, as, for example, this staircase.

3D laser scanning metric technologies provide precise measurement of very complex structures. This technology can also produce a detailed cartography capable of detecting any erosion on a façade surface.



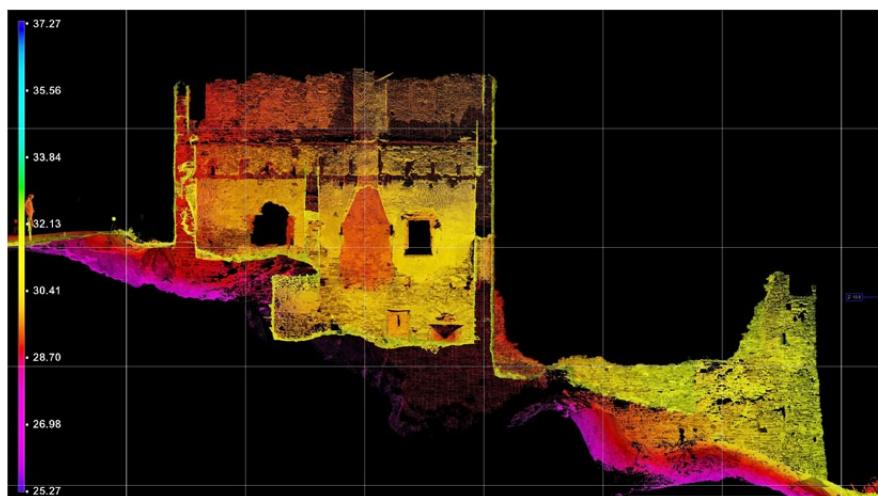
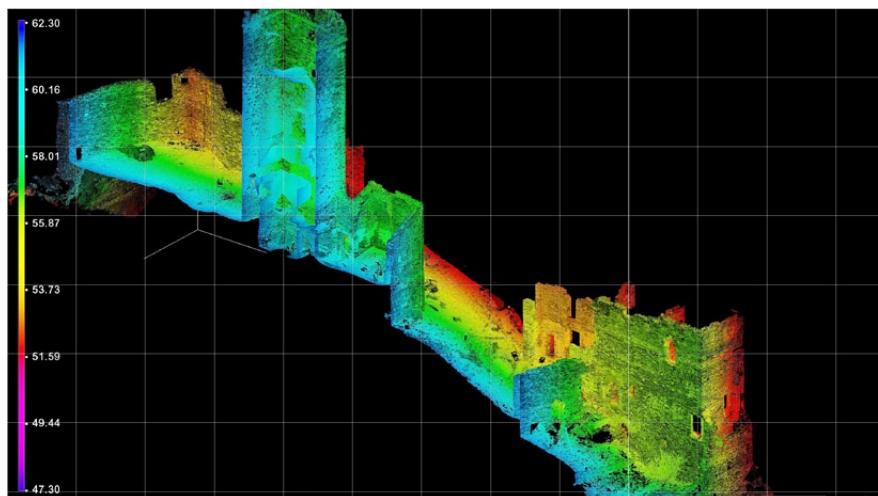
Chalet du Crêt, Moléson (FR, Switzerland). Built in 1690, this chalet is the oldest high-pasture chalet in the county of Gruyères. 3D lasermetric surveys are perfectly adapted to this type of study. Laser survey (above) and 3D modeling of the structure (on the left).

Château of Vufflens (VD, Switzerland).
Built with bricks early 15th century by stonemasons from Lombardy, Italy. The erosion of the facing of the façade required the replacement of several thousand bricks. The high quality digitization of the elevations was realized with Faro 80 and Faro 120 scanners.
A brick by brick survey of the entire structure was thus obtained, with an automatic cartography of the façade erosion. This procedure has eliminated the need for an otherwise lengthy and costly installation of scaffoldings.

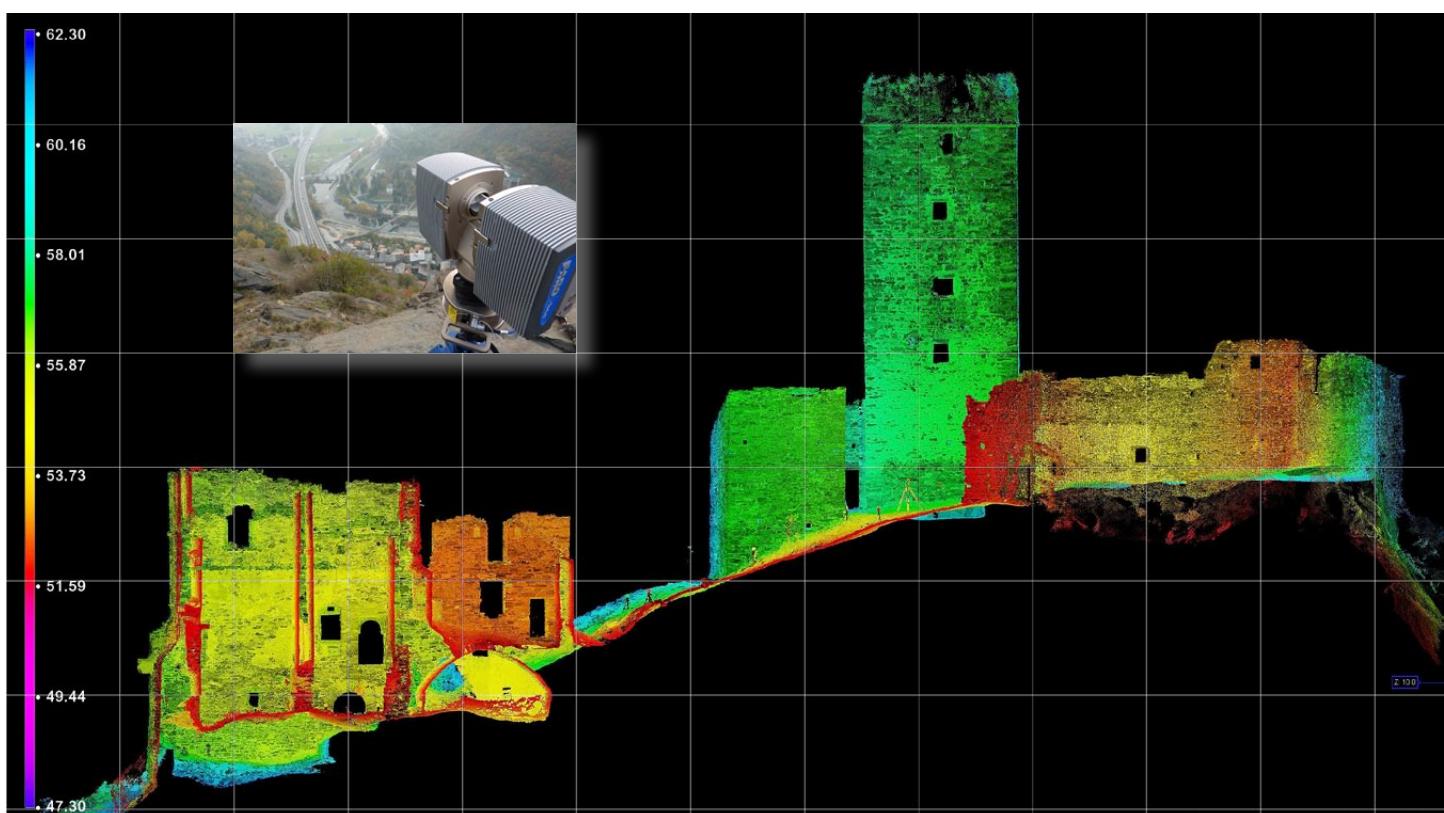


Endangered National Heritage Sites

Measurements in areas of difficult access are made easier. Data indispensable to the work of archeologists is provided in the form of ortho-images. The gradual deterioration of the ruins can be studied at regular intervals.

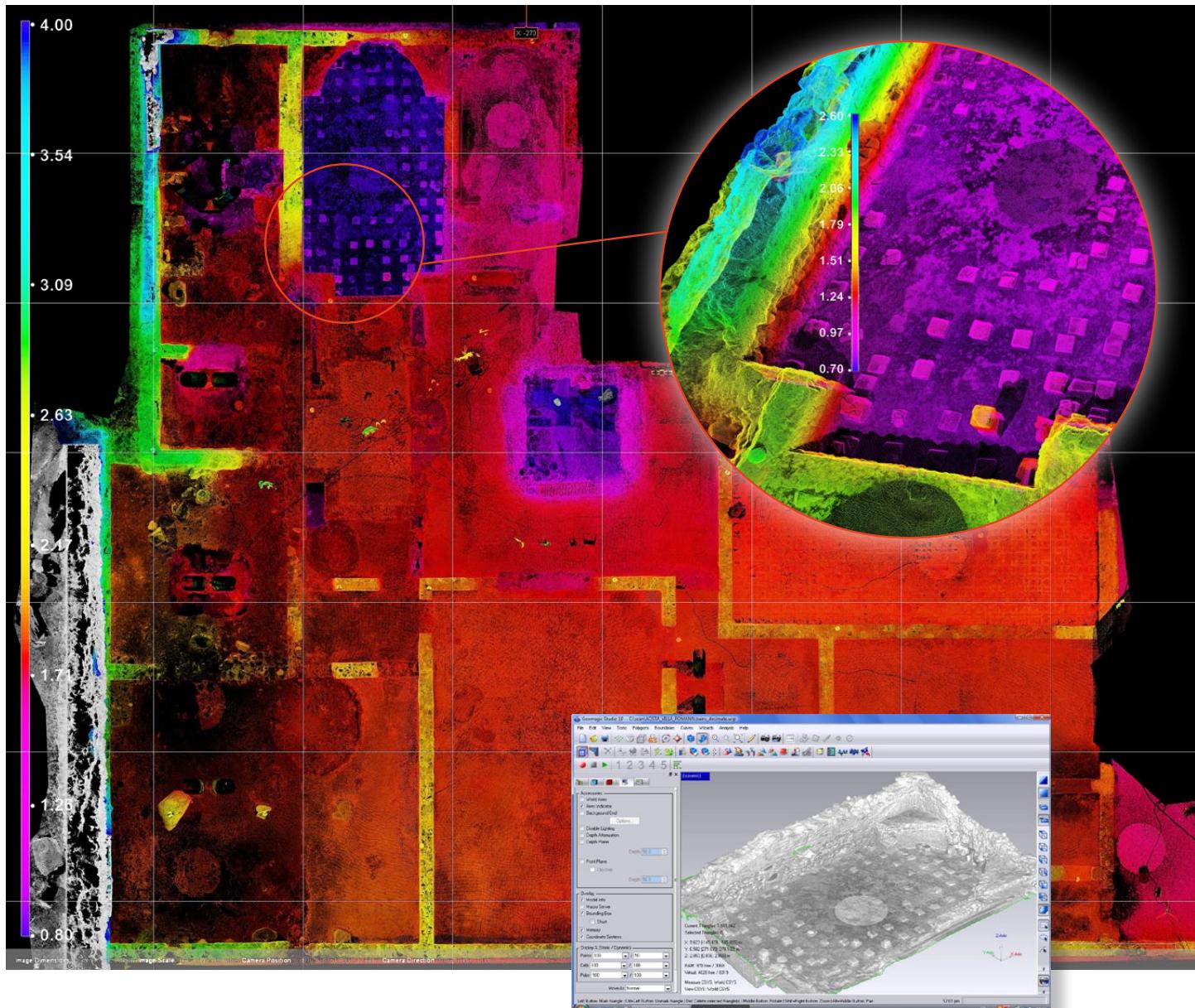


Site of the Château de Montjovet-Saint-Germain, Valley of Aosta, Italy. The entire structure of this ruin, which measures more than 150 meters long and is perched on top of an inaccessible hill, was measured in less than a week. With this type of survey, and once the data has been gathered, a representation in the form of ortho-images can be provided to the archeologists in charge of the study.

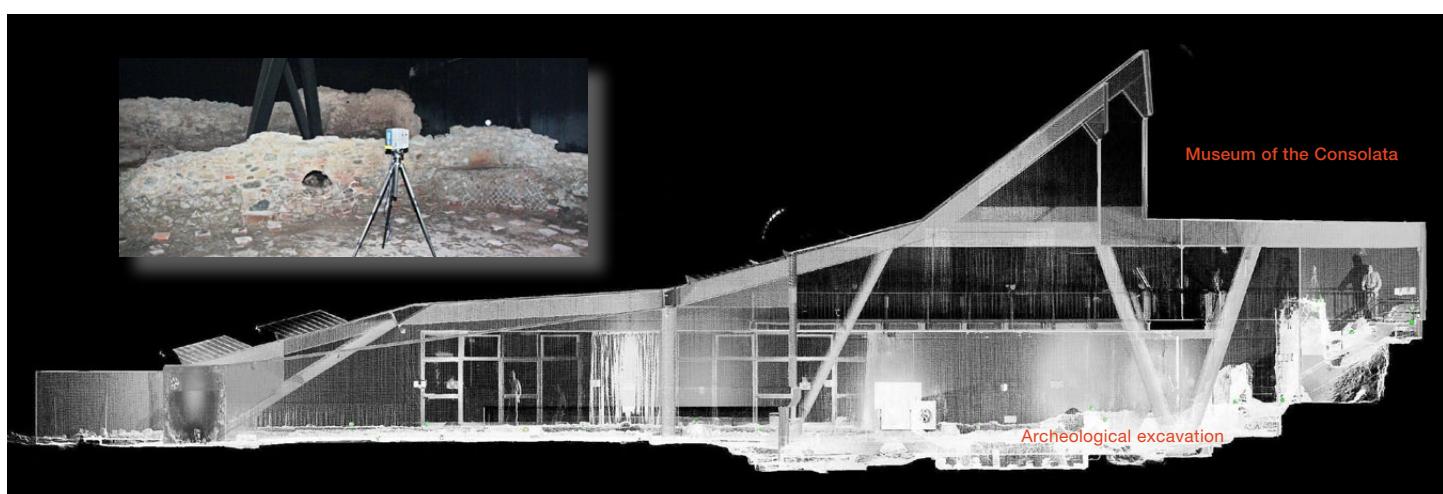


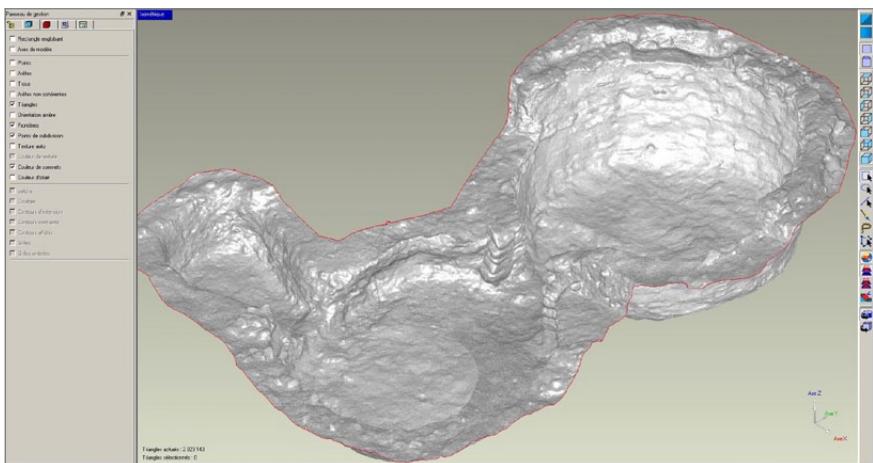
Archeological Excavation Sites

Speed and precision through 3D surveys are the trademark of today's archeology. Horizontal and cross-sectional profiles as well as ortho-images are extracted from computer models produced in Geomagic.

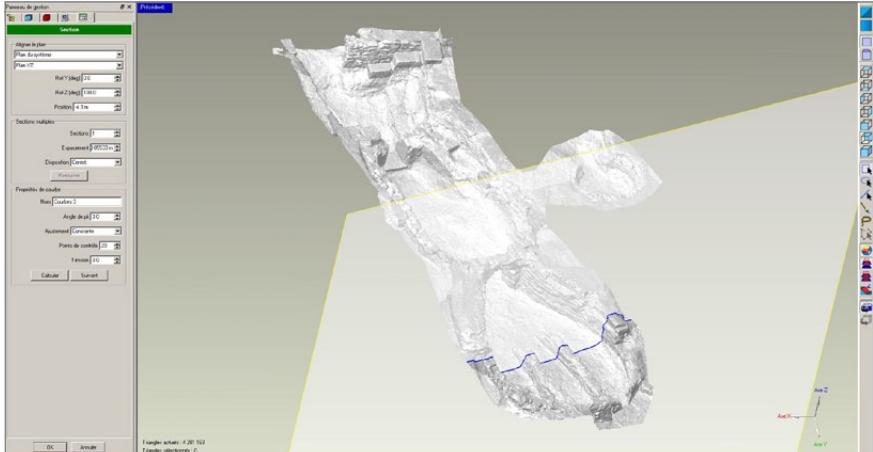


Roman villa of the Consolata, Aosta (Italy). The 3D laser metric survey of this archeological excavation of the Roman villa and its museum were created in less than a day. The site's excavation was modeled into a 3D model in Geomagic. Horizontal and cross-section profiles, as well as ortho-images, were automatically processed. This data is usable in current DAO software.

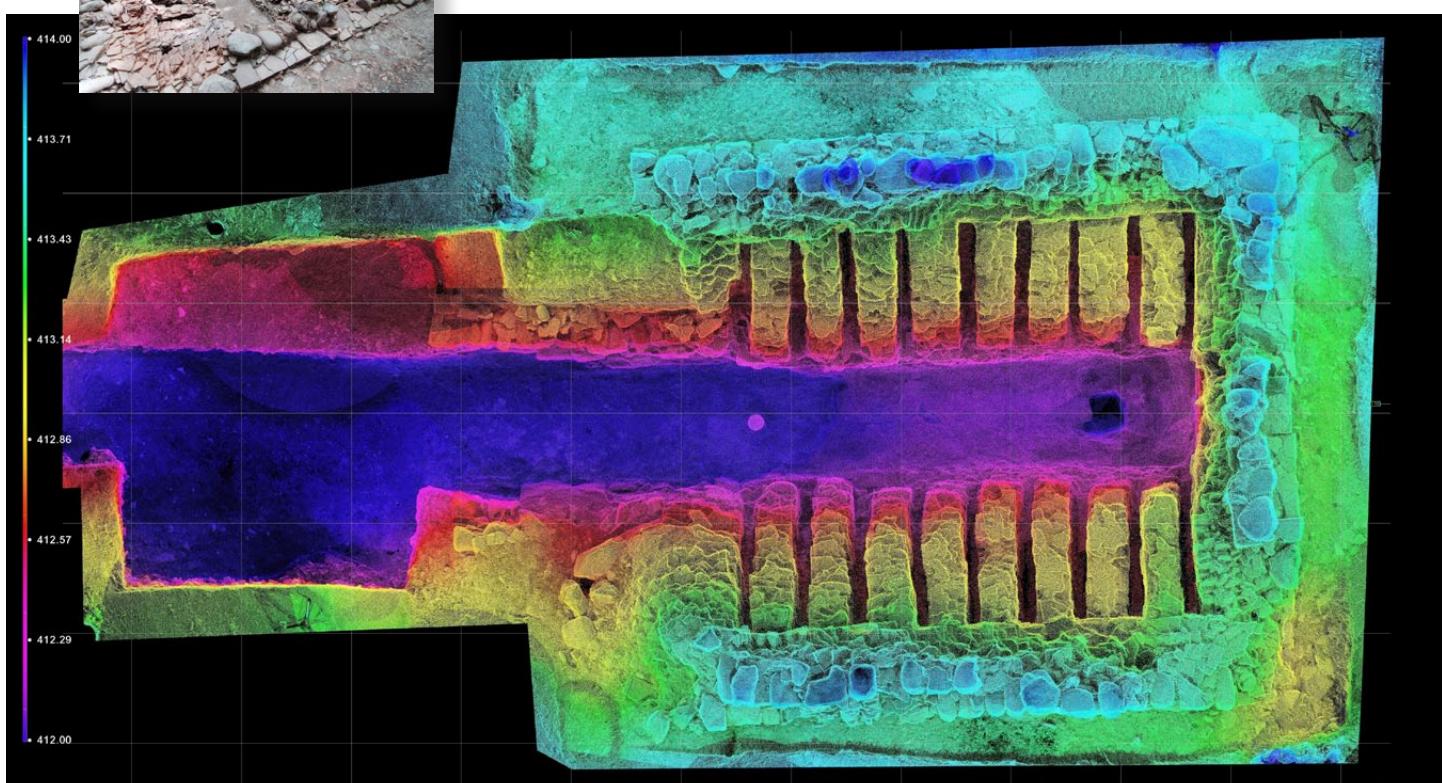




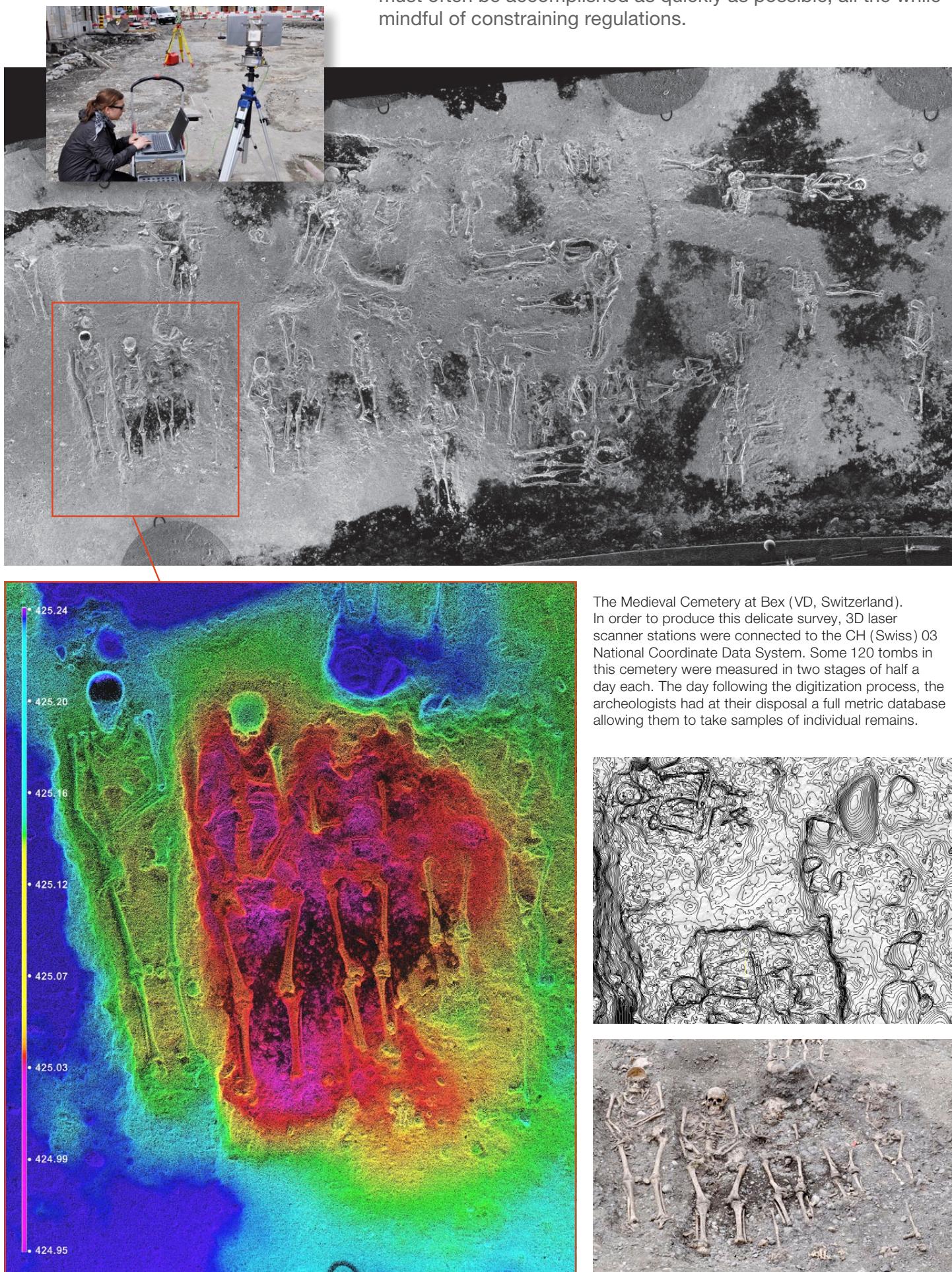
Pottery kilns of Beaucaire / Nîmes (France). Each of these three kilns was surveyed with 3D laserometry and then modeled in Geomagic. The horizontal and cross-view profiles were extracted automatically (on the right) and quickly stored onto DAO software for analysis. The survey of these three kilns was completed in less than a day.



Gallo-Roman kiln for roof tilers at Chancy (GE, Switzerland). The 3D laser digitization is particularly efficient for this type of fragile site that requires extreme precaution.



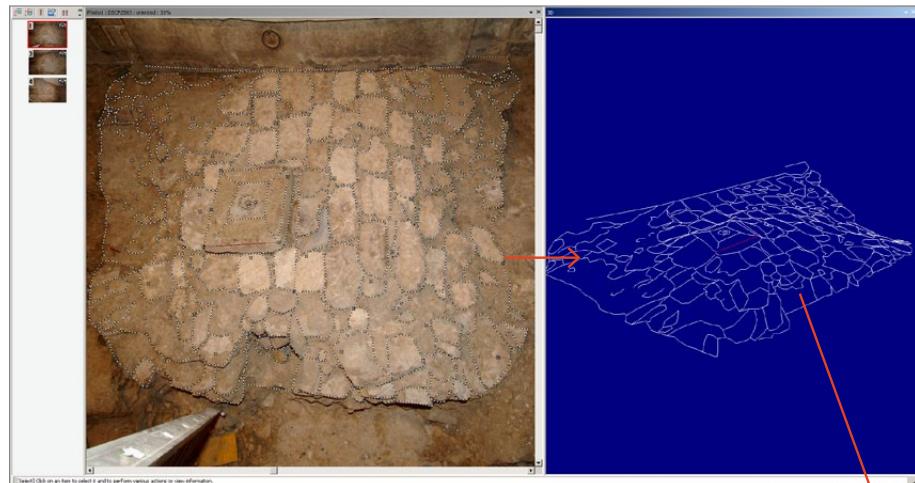
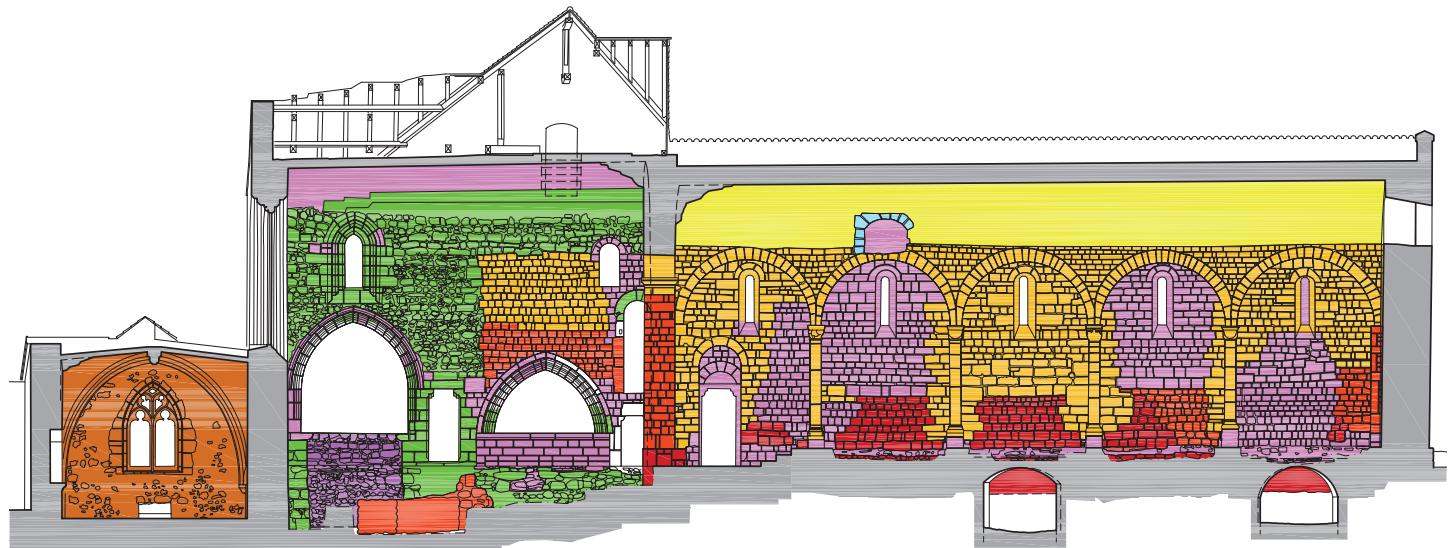
Major roadwork and the construction of art works often bring to light remnants of the past. Intervention on the discovered sites must often be accomplished as quickly as possible, all the while mindful of constraining regulations.



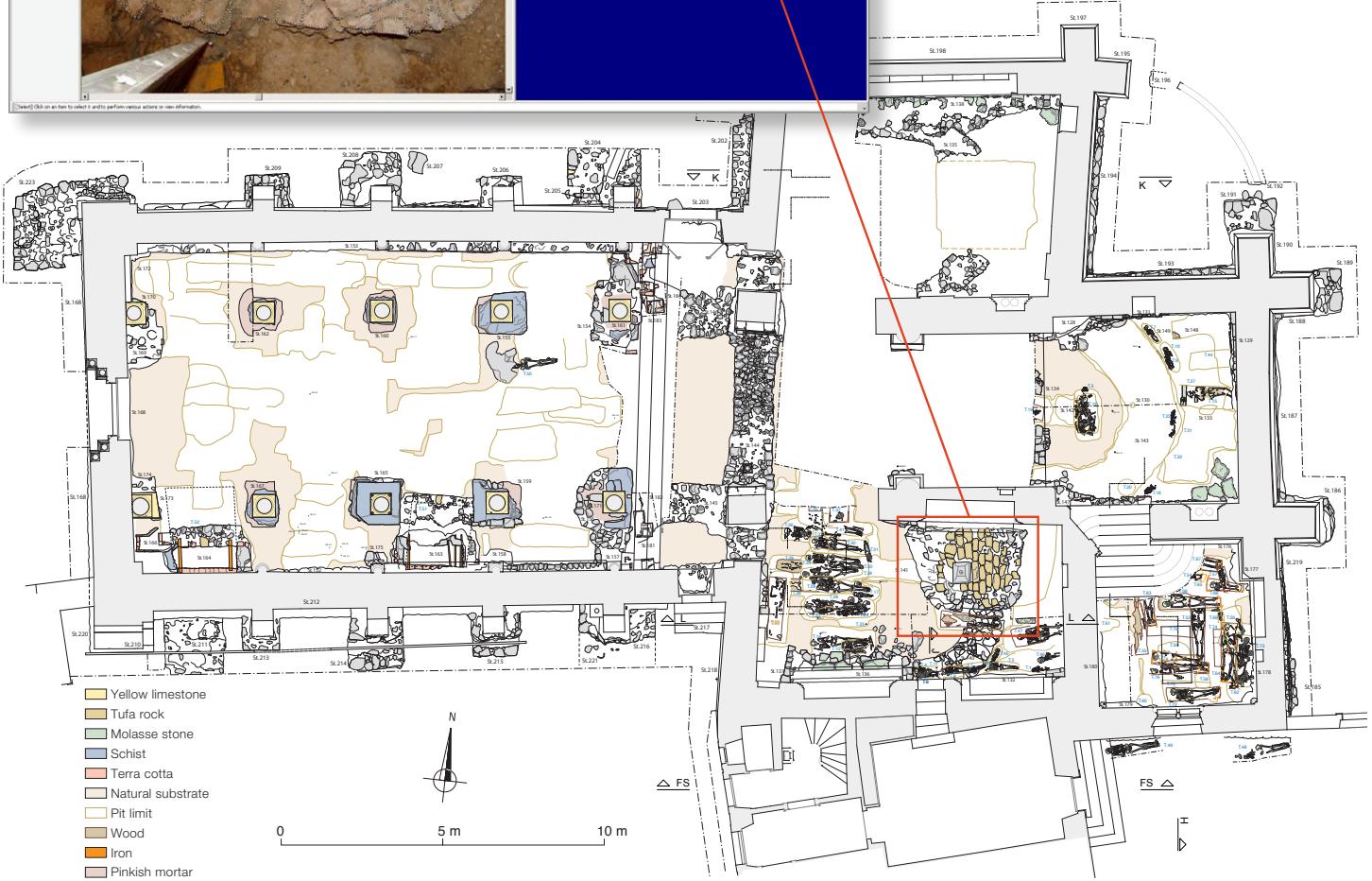
The Medieval Cemetery at Bex (VD, Switzerland). In order to produce this delicate survey, 3D laser scanner stations were connected to the CH (Swiss) 03 National Coordinate Data System. Some 120 tombs in this cemetery were measured in two stages of half a day each. The day following the digitization process, the archeologists had at their disposal a full metric database allowing them to take samples of individual remains.

Archeological Excavation Sites and Building analysis

The investigation of archeological sites is generally conducted in several stages. Establishing an important network of critical programs is necessary in order to integrate each measured area of a site into an overall scheme managed by Autocad.

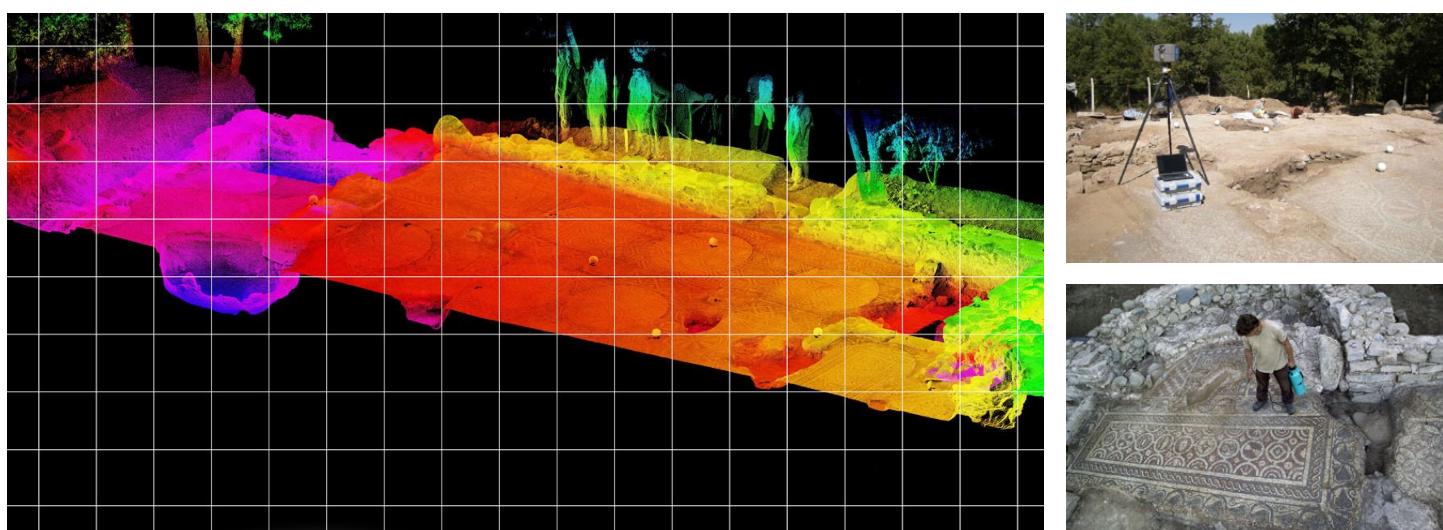


Church of Saint-Jean at Grandson (VD, Switzerland). Surveys, analyses and archeological digs. Throughout this operation which was conducted in several stages, the surveys of the entire structure were executed with EOS Photomodeler System (example on the side). The images of each area were integrated into overall plans managed by Autocad. Above, vector drawing of the D-D longitudinal section, view looking south. Below, vector drawing of the archeological plan.



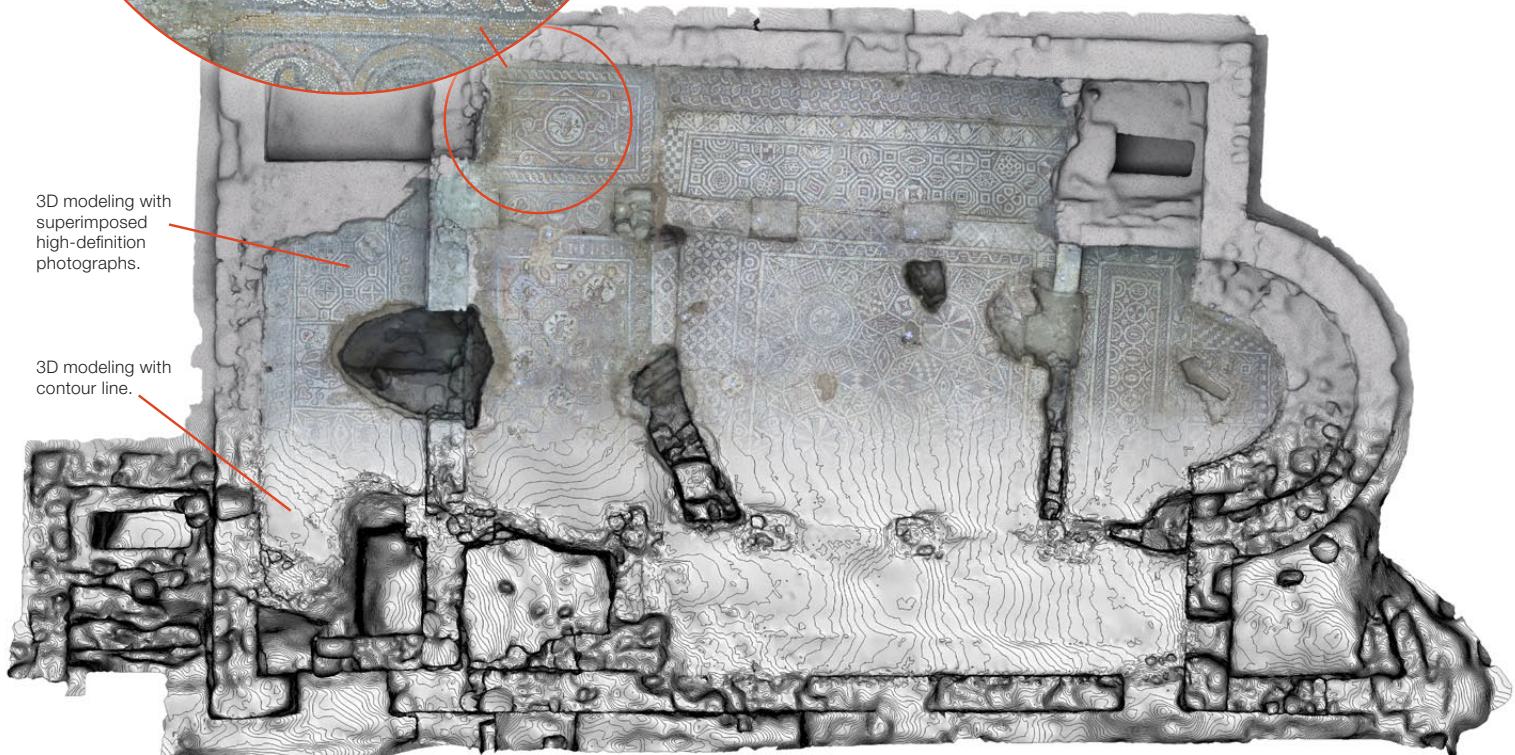
Mosaics

For the reconstitution of the whole Derelict site, high quality imagery was achieved thanks to several high-resolution, photogrammetric pictures. These photos were then placed over the 3D model created by laser surveys.



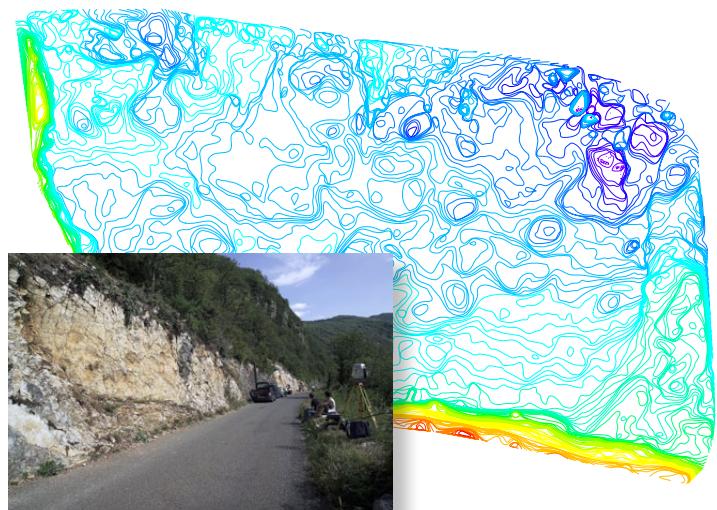
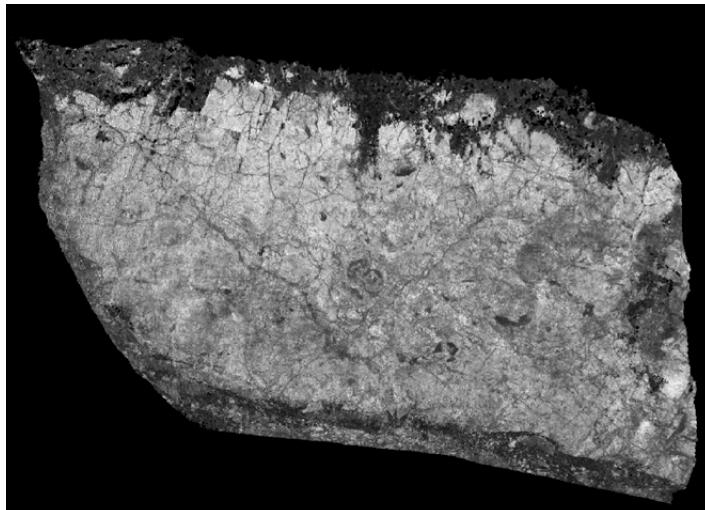
Site and Mosaics of the Paleochristian Church at Derecik (Büyükorhan, Bursa Province, Turkey). Survey, excavation, study and restoration.

The time-lapsed Faro Photon 120 scanner which was used to produce this delicate survey is very efficient. The excavation site was measured in a single day using 30 different angles in order to insure measurements of the utmost precision. The scanner stations were connected to the site's database through a series of spherical reference points utilizing a complete Leica TCRM 1105 station. In order to produce a high quality imagery of the mosaic, 45 photo-grammetric pictures, each with a resolution of 14 million pixels, were shot with a Kodak DCS14NX camera. A 3D model of the excavation was generated in Geomagic. The photos were then placed over the 3D model using a 3DSMAX software. As is the case with all our 3D models, this particular model can be viewed through the free-of-charge Meshlab software.
<http://meshlab.sourceforge.net>



Paleontology and Anthropology

Measurement technologies and 3D digitization avail scientists with new investigation tools, especially during discovery and reconstruction stages.

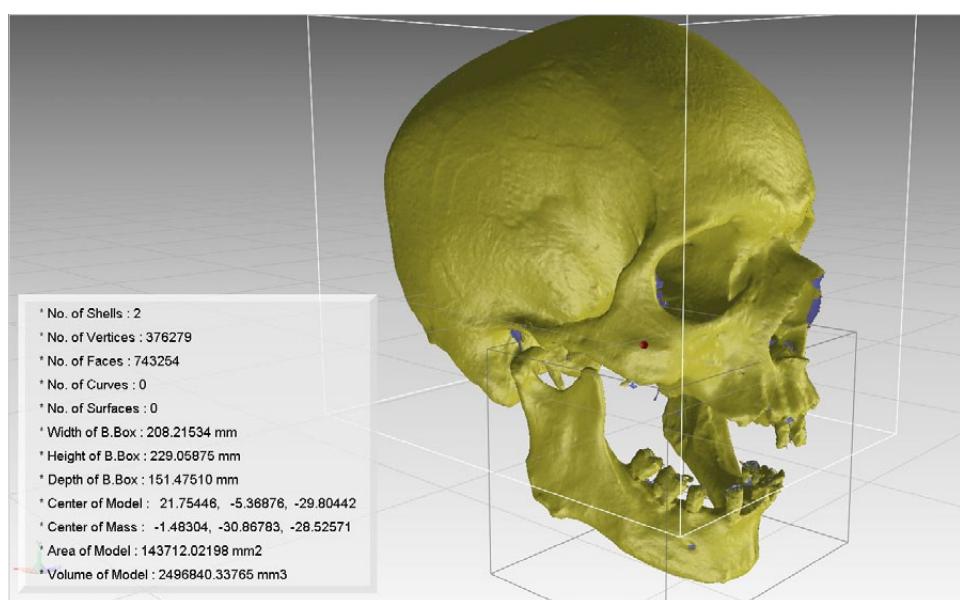


Sites of dinosaur trails in Coisia (France). This chance discovery was made during the widening of the road. This site houses three slabs of dinosaur tracks. The tracks were measured in a single day using laserometry technology with a density of 25 points per square centimeter. According to the National Center for Scientific Research, these dinosaur tracks are quite possibly the largest discovered to date.

View of the same area of detail of a surface measuring approximately two meters by two meters, with a different positioning of virtual lighting (above).



Three dimensional measurement of a skull for the purpose of forensic identification. Archéotech SA proceeded with the 3D digitization of the skull, presumably of an Englishman who had lived in the 18th century. Based on this data, University of Southampton's Anthropological Institute succeeded in reconstructing the man's face.

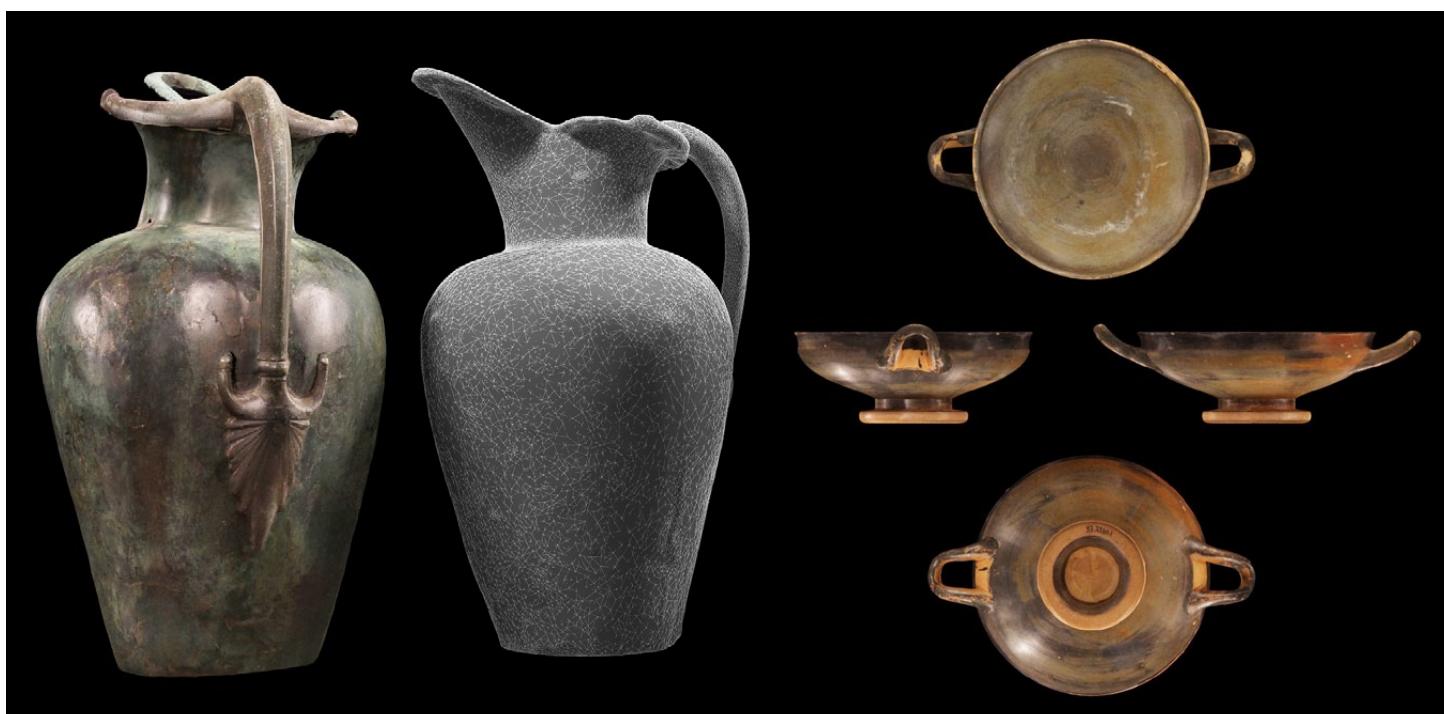


Archeological Furnishings

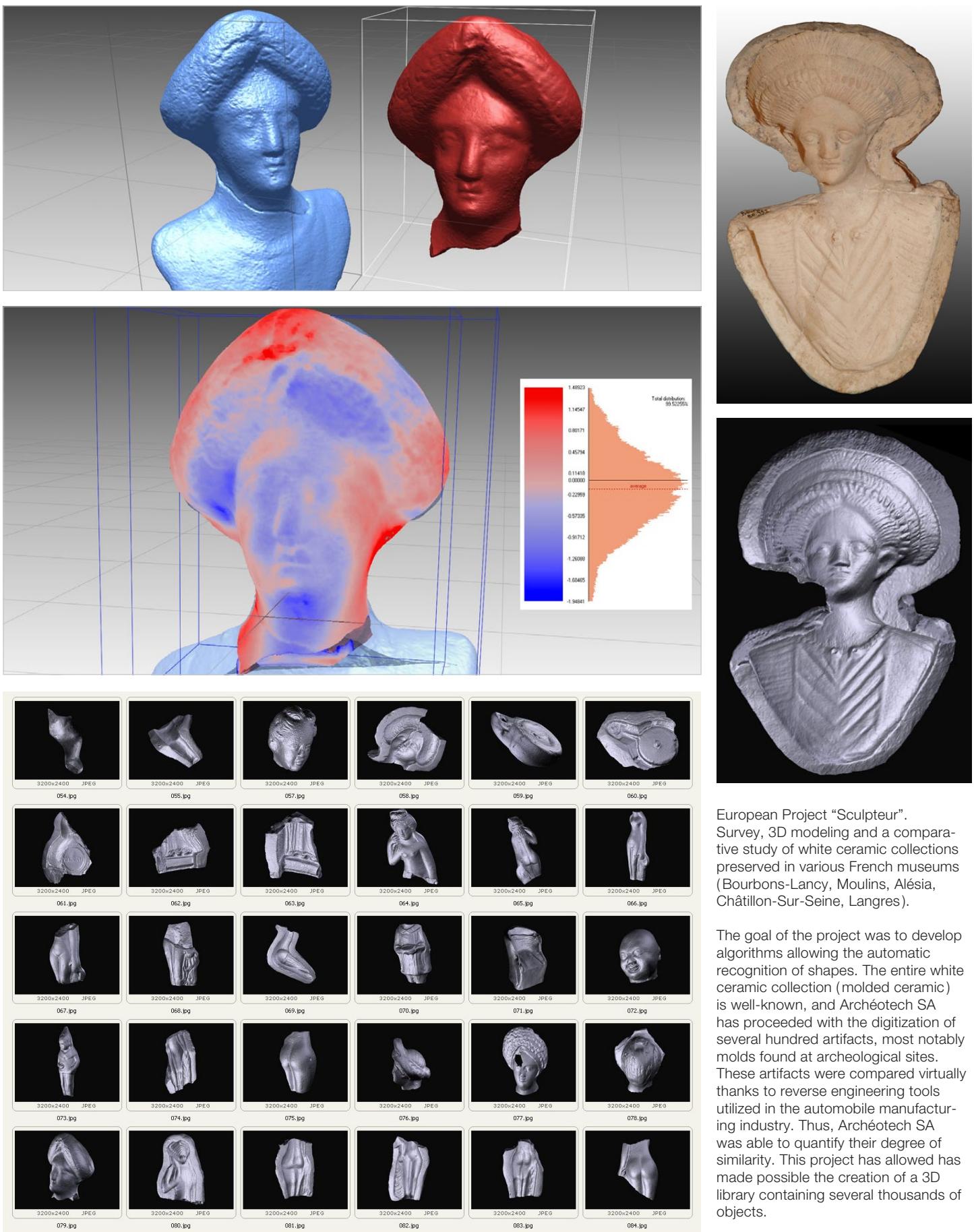
The digitization of a large vase in Vix required the application of specific methods. The principal difficulty was that the vase's size involved measuring its architectural aspects while detail levels such as the frieze and handles required tools used in goldsmithing.



Vase and Prince's Tomb at Vix, Chatillon-Sur-Seine (France). Made some 530 years before the modern era in Magna Grecia (Southern Italy), the Vix crater is the largest bronze work known until now from the Greek world. In the framework of Project Divine, this work was entirely digitized and modeled in an attempt to bolster the new museographic guide system with a 3 Dimensional support. The major issue when measuring the vase was its very size, which required methods specific to architecture while the level of detail in the frieze and handles entailed techniques particular to goldsmiths.



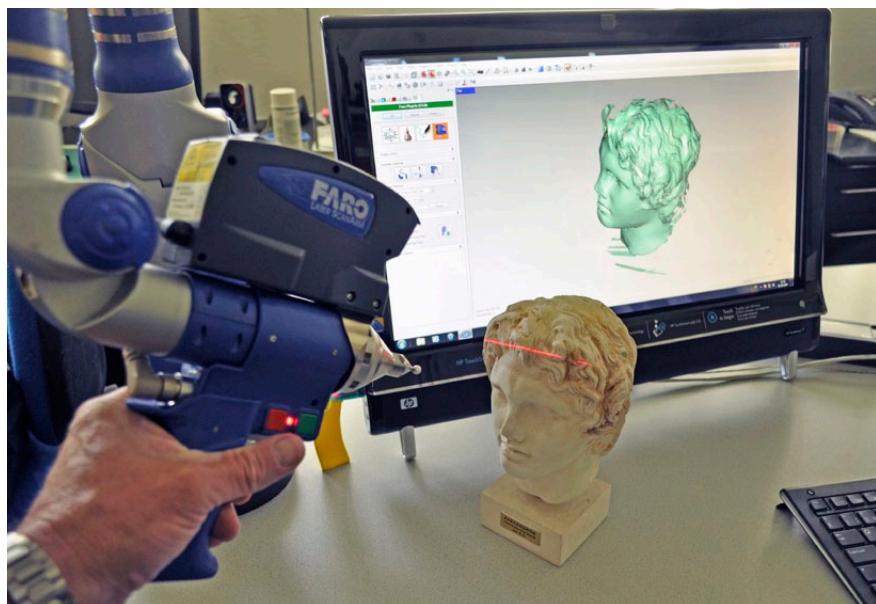
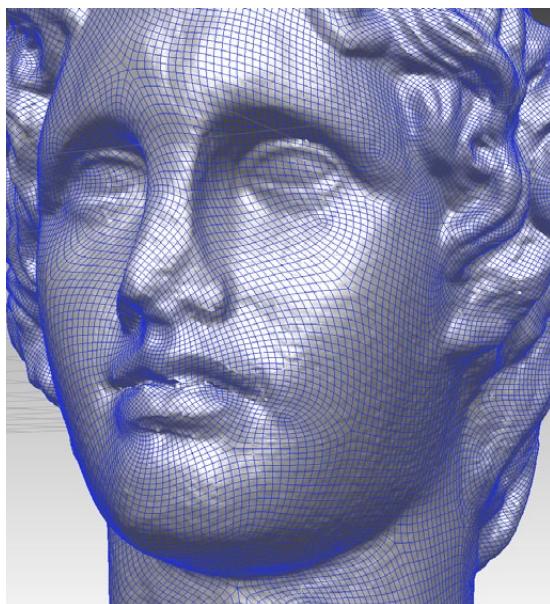
3D laser digitization can be helpful for comparative studies of objects. Algorithms that allow the automatic recognition of shapes and Reverse Engineering are used to make a virtual comparison of artifacts and to determine their degree of similarity.



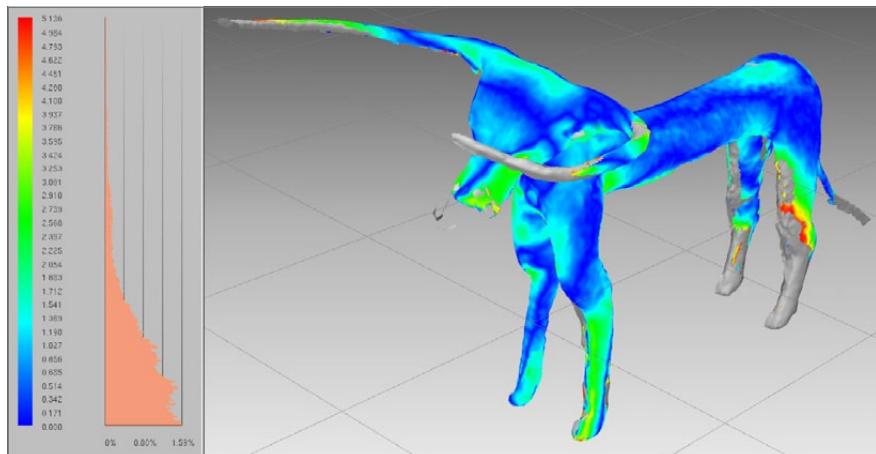
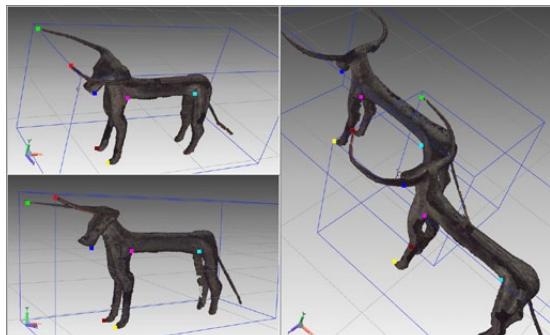
European Project "Sculpteur".
Survey, 3D modeling and a comparative study of white ceramic collections preserved in various French museums (Bourbons-Lancy, Moulins, Alésia, Châtillon-Sur-Seine, Langres).

The goal of the project was to develop algorithms allowing the automatic recognition of shapes. The entire white ceramic collection (molded ceramic) is well-known, and Archéotech SA has proceeded with the digitization of several hundred artifacts, most notably molds found at archeological sites. These artifacts were compared virtually thanks to reverse engineering tools utilized in the automobile manufacturing industry. Thus, Archéotech SA was able to quantify their degree of similarity. This project has allowed has made possible the creation of a 3D library containing several thousands of objects.

Laser digitization allows for the geometric comparison of art objects and facilitates a mapping of their differences. An exciting field of inquiry in the authentication of copies originals and the verification of laboratory analyses.

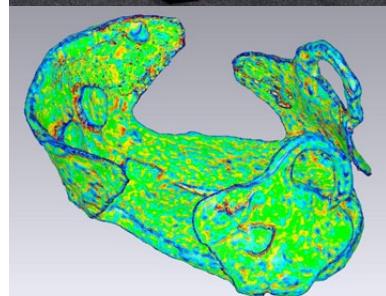
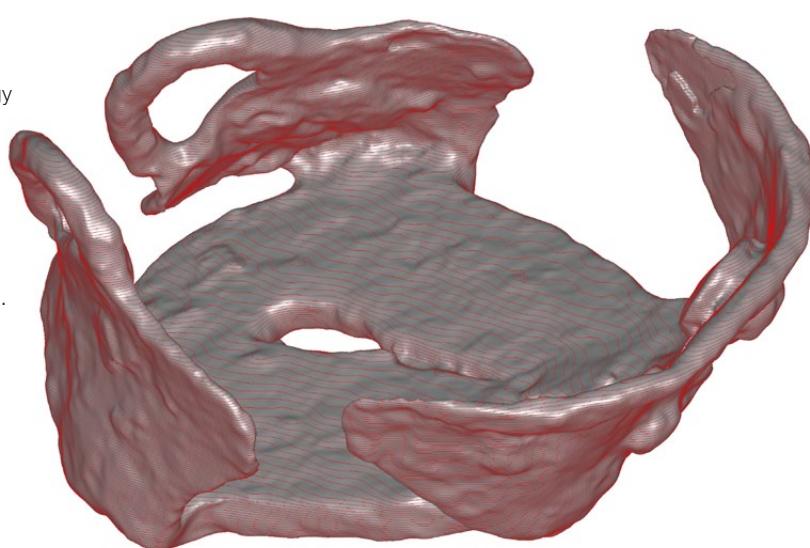


The Faro Platinum Arm is fitted with a laser Line Probe III sensor and is capable of capturing objects with unmatched accuracy and precision.



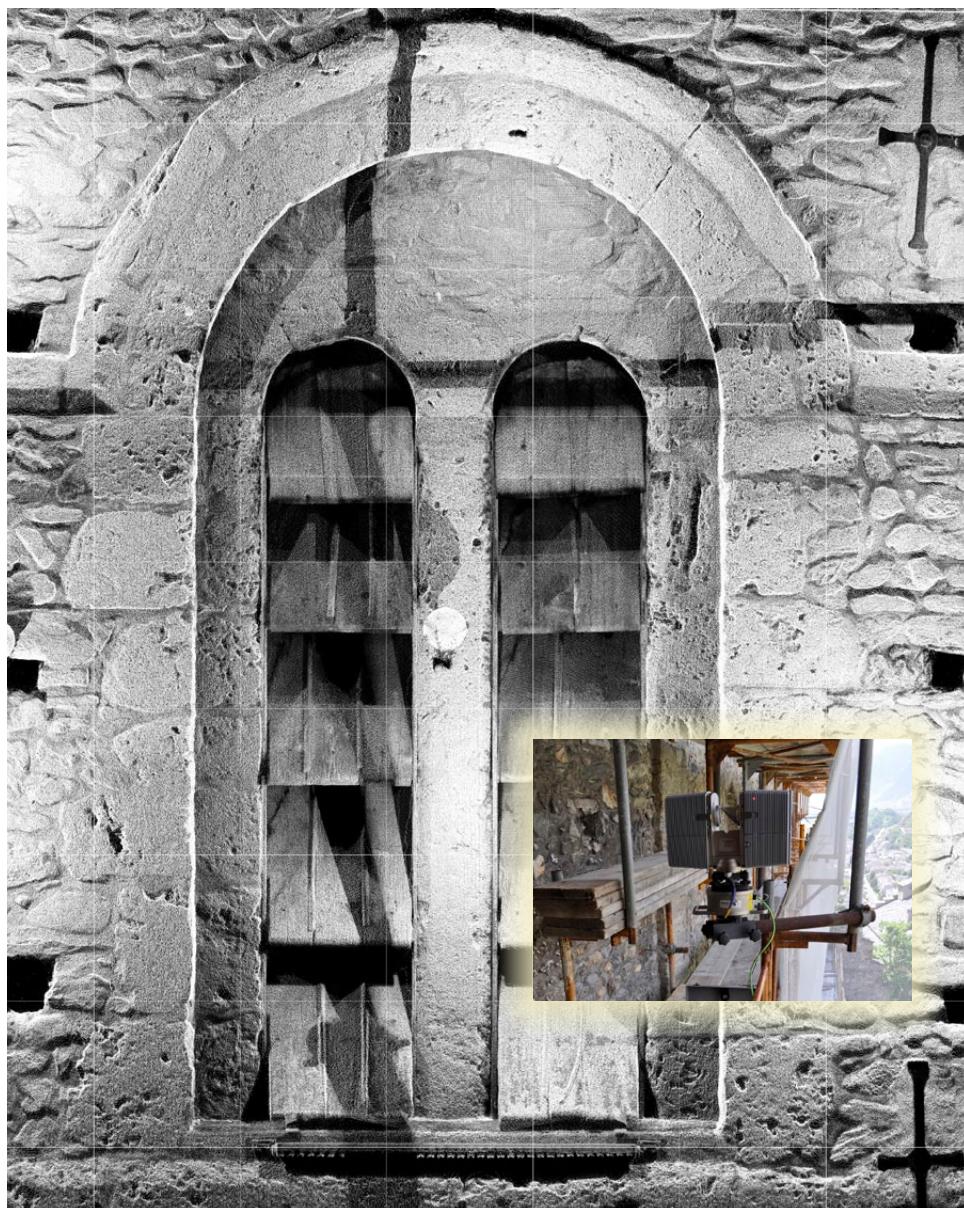
The Geneva Museum of Art and History (GE, Switzerland). Digitization and geometric comparison of two bronze oxen from Mesopotamia. The cartography of variances underscores the likeness of the two objects while detecting a difference in the left hind leg. A laboratory analysis established that one of the pieces may have been already restored in antiquity.

The Sion Cantonal Museum of Archeology (VS, Switzerland). Digitization of an iron hipposandal from the Roman Period whose conservation can no longer be guaranteed due to the advanced corrosion of the metal.

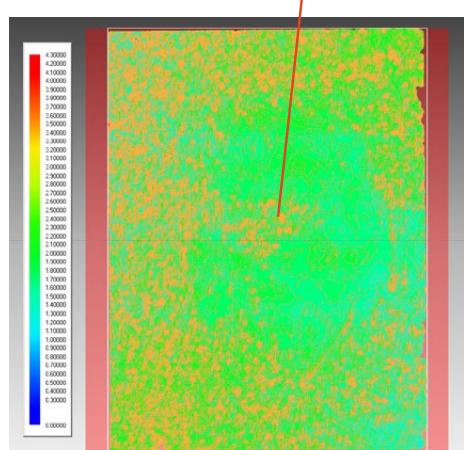
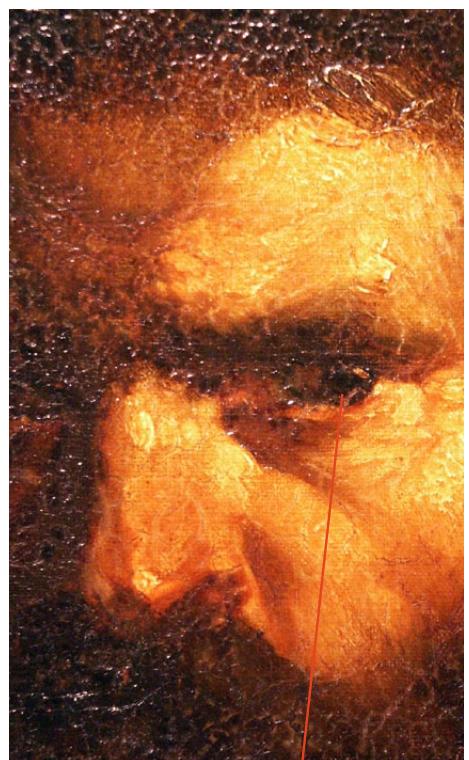


Details

The sensors on our 3D scanners can attain high-precision levels. Levels of detail invisible to the naked eye can be detected. New prospects for the exploration of non virtual reality are a source of great interest among restorers and specialists in charge of National Heritage protection.



Château de Valère, Sion (VS, Switzerland). High quality digitization of the cut stones around openings (opposite). Thanks to a dynamic compensatory system developed when measurements were taken at CERN, it is now possible to digitize with high precision from a scaffolding.



Thomas Henry Museum, Cherbourg-Octeville (France). Systematic digitization of the art work of Francois Millet. 3D mapping of a painting highlights the idiosyncratic style found in the artist's work (above).

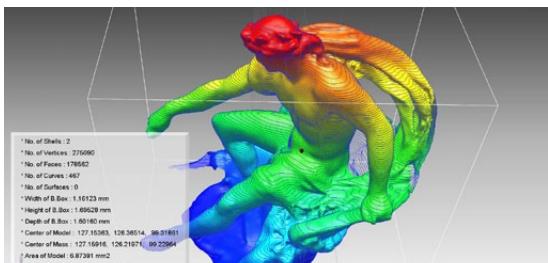
Sculptures

The digitization of the 14 statues of the Apollo Basin at Versailles provided the geometric foundation for carrying out a reproduction of the whole set. Each statue was modeled and replicated in Forex, molded and reproduced in plaster as a model for sculptors.



Apollo Basin, Palace of Versailles (France).

Upon a request emanating from a Taiwanese Foundation whose purpose is the diffusion of western art, the Gilles Perreault Art Assessment Group based in Paris was commissioned to create a reproduction of this group of statues (14 x 14 meters). Archéotech SA digitized the entire set of 14 statues from the edge of the basin (the basin's diameter is approximately 100 meters), in order to provide the sculptors of the Perrault Studio with an exact geometric database. Each statue was then modeled in Rapidform software. In collaboration with the Serex Plastic Production Company of Puidoux, our firm calculated profiles corresponding to the thickness of the Forex plates that were to be manufactured. The plates were then cut out and glued together in order to reconstitute the form of each statue. Upon this base, the Perrault Studio sculptors applied a layer of clay with which they reconstituted each decorative detail. The archetypes were then molded and reproduced in hard plaster to serve as models for marble reproduction in sculptors' studios in Carrara, Italy.



On the left, from top to bottom, long distance laser digitization of the group of statues; 3D model of each statue in Rapidform; 3D model of the entire group of statues; 3D model of Apollo and its reproduction in white Forex; statues reproduced in Forex.

Top of page : detail of a 3D model generated in Rapidform.

(Above) Decorative details reproduced by the Gilles Perrault Studio by placing a layer of clay on the statues made of Forex.



For conservation purposes, copies have been made of original treasures from the Pascal sepulcher of the Maigrauge Convent. A large number of specialized experts collaborated on this exhaustive and detailed project that combined craftsmanship and state of the art technology.



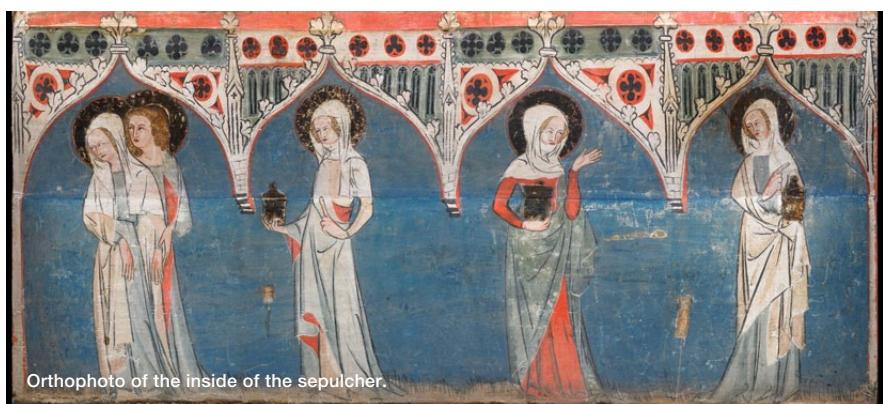
Structure of the 3D computer model.



3D computer model with texture.



Painted copy of the manufactured wooden statue.



Orthophoto of the inside of the sepulcher.



Pascal sepulcher of the Maigrauge Convent, Fribourg (FR, Switzerland).

Digitization and facsimile reproduction of the wooden chest and its paintings and the statue of Christ (14th century).

The contents were then reproduced to scale, in high-definition, on a surface similar to the original finish that served as a coating backdrop to the walls of the copy. The statue of Christ was manufactured in poplar wood using a CNC (numerical control) milling machine that belongs to the School of Engineering in Geneva. An art restoration specialist applied a copy of the original polychromy on its surface. The Christ statue and sepulcher are

amongst the most important Gothic sculptures and paintings on wood in Switzerland. For conservation purposes, they have been replaced with copies. The wooden chest and its paintings as well as the Christ sculpture were digitized and physically reproduced in three dimensions. The paintings on the walls of the wooden chest were measured with photogrammetry, and the different shots were then assembled and adjusted.

3D-4D Modeling

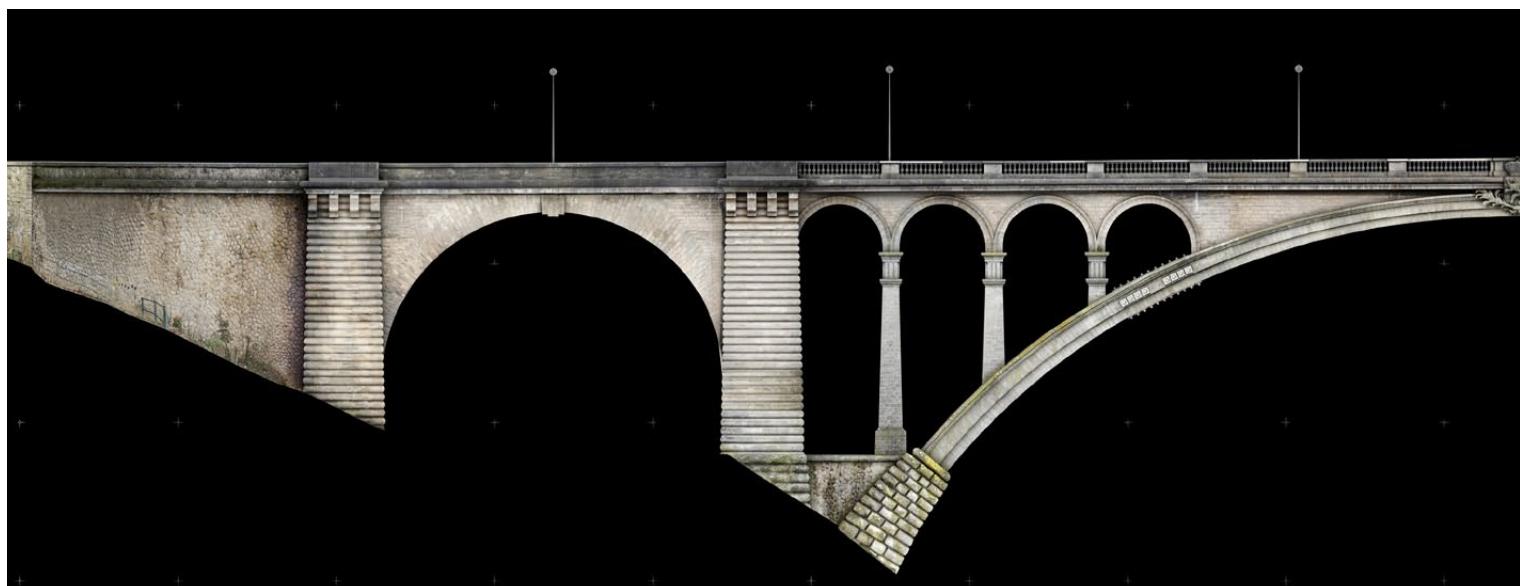


Pillar of Saint-Landry, Cluny Museum, Paris (France).
Laser metric survey of one segment of the pillar (above).

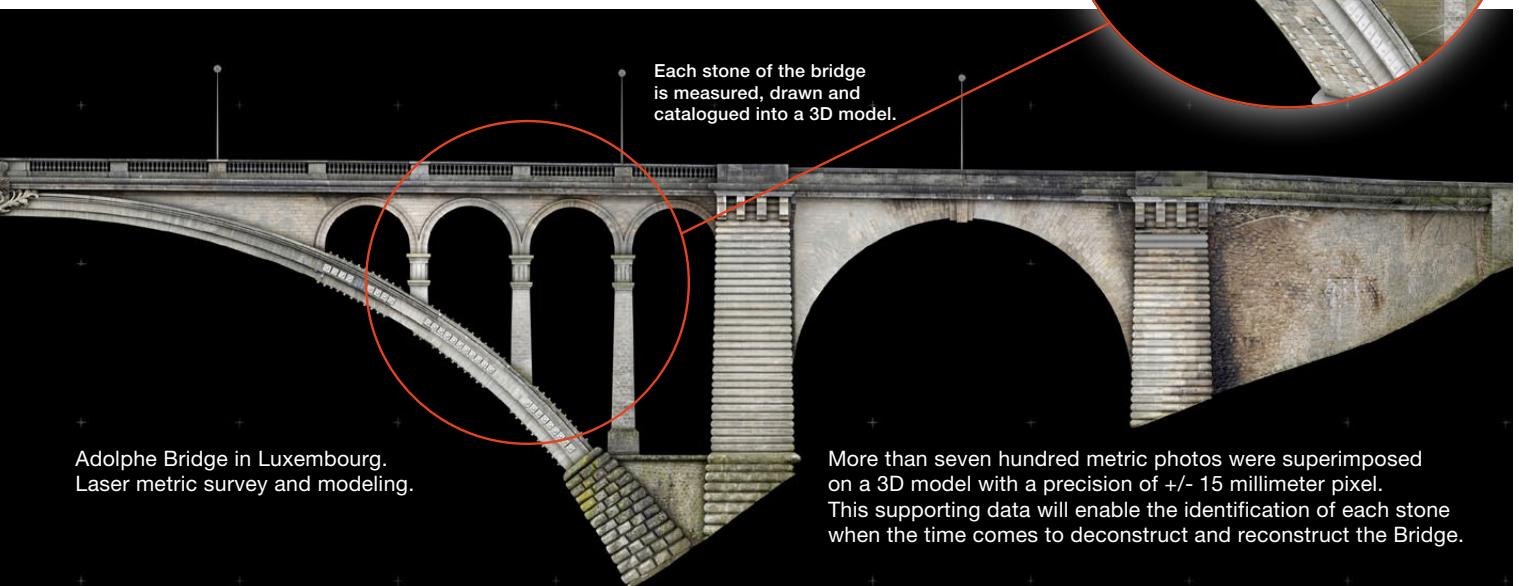
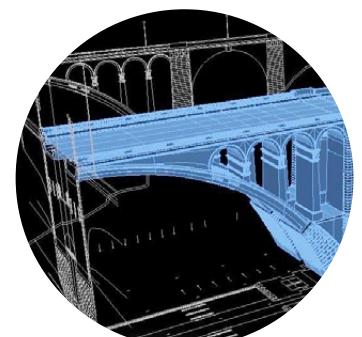
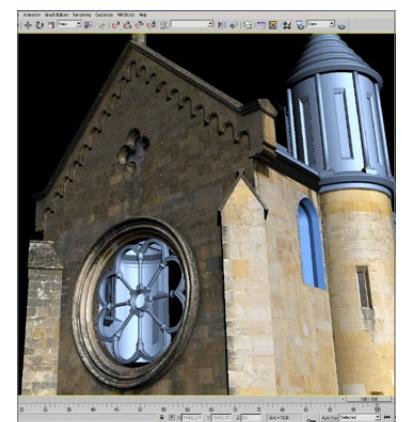
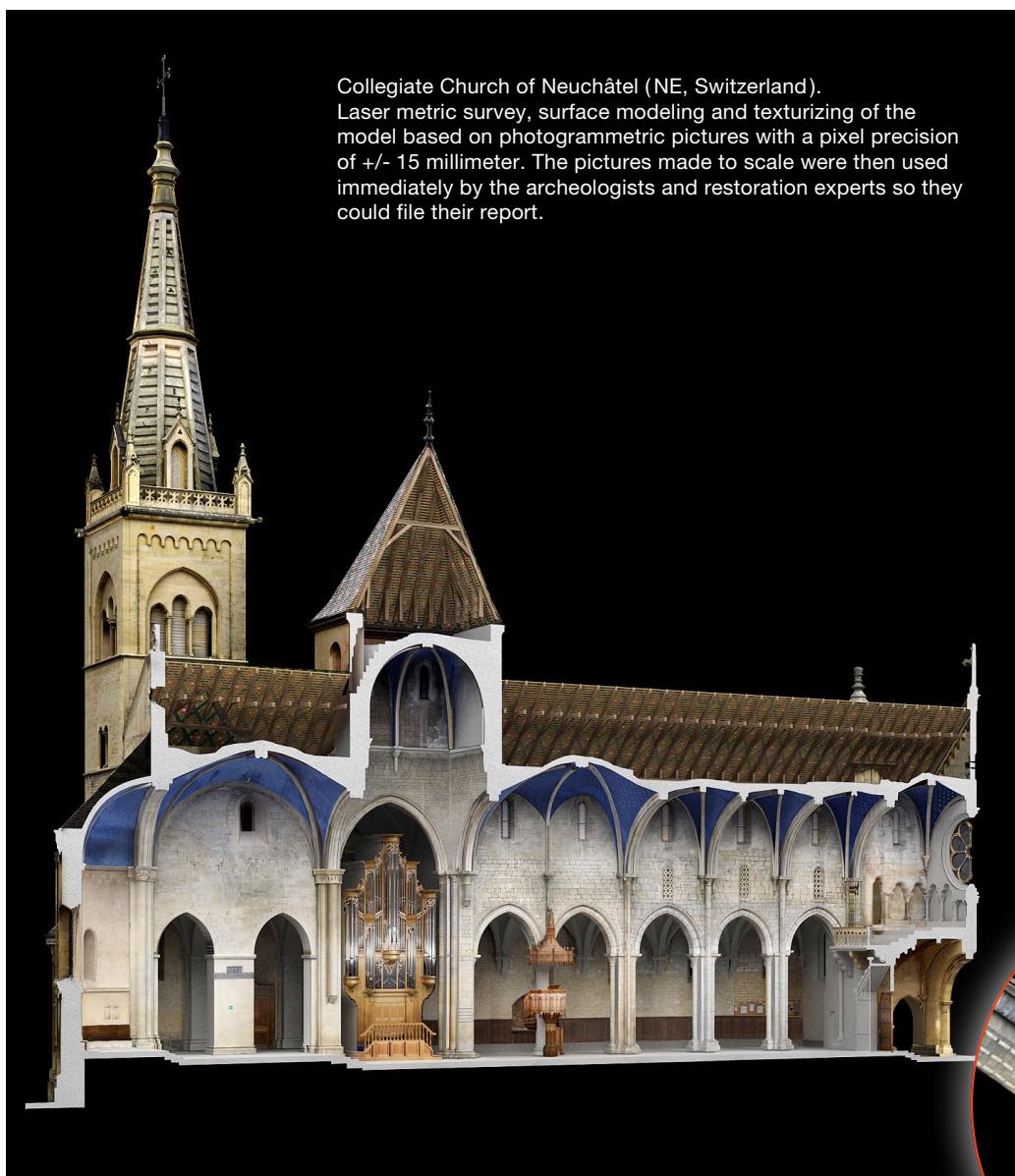
South gate of the Lausanne Cathedral (VD, Switzerland).
Laser scanning metric survey and elaboration of a
textured 3D model in high-resolution (on the right).

4D modeling incorporates time dimension.
3D models are set in motion in order to produce
animations and virtual visits.

3D-4D computer modeling highlight the tiniest fragments,
from micro-details revealing tool marks to high-definition textured
surfaces. Sculptures and buildings, either entirely or partially,
can thus be reproduced as facsimiles.

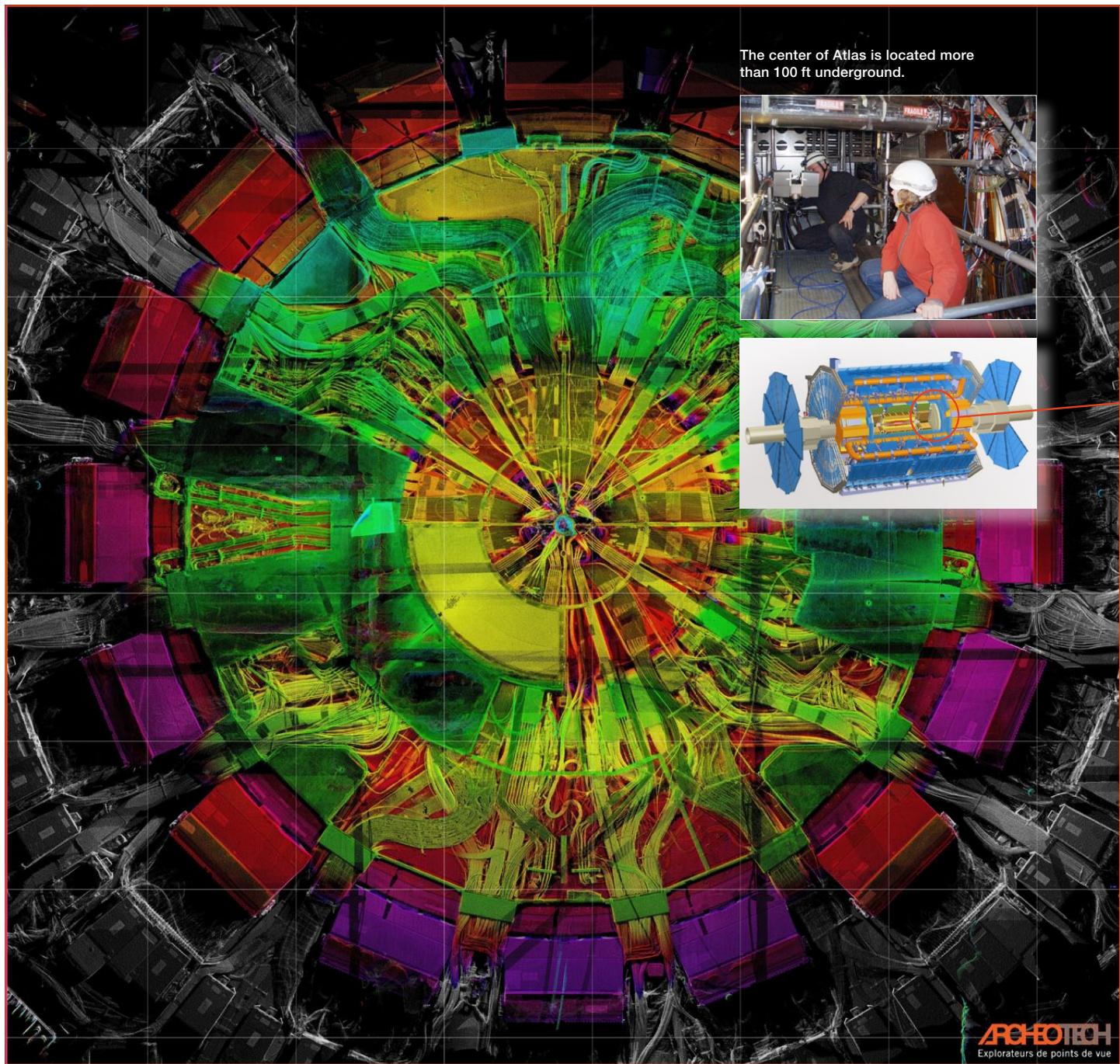


The high resolution of our surveys, with surface modeling and texturizing of objects, give a different perspective on works that are part of the national heritage: a level of precision and attention to detail sought after by archeologists and art restorers.



Keeping Pace with Future Advancements

A 3-D laser metric survey was conducted in the heart of Atlas, a first for CERN. The objectives: mapping out the cabling to the very millimeter, measure the residual spaces that can still be used for fitting the infrastructure necessary to new sensors.



"The implementation of this project is a first for the involved services at CERN, especially in regard to performance improvement and studies in the next generation of detectors".

Christian Lasseur, head of the geodetic services at the CERN, Meyrin.

CERN at Meyrin (Geneva) in its metrology and positioning department BE/ABP/SU, for the research and development of new PH/DT detecting devices, and in particular for integrating ATLAS PH/ADO, have commissioned Archéotech SA to do a laser metric survey of different sections at the heart of ATLAS. The objectives were to obtain a cartography with millimeter accuracy and to detect the residual spaces which can still be used to fit the infrastructures necessary to new sensors. Twelve measuring

stations were spread out on three levels. Two point clouds, each one totaling almost a billion 3-D laser points, were recorded. The principal difficulty lay in the lack of step back, the complex access nature, the unsteadiness of the scaffolding and particularly the necessity of equipping each station with inframillimetric georeferencing. The size of the generated files also presented problems that needed to be resolved. HKD Géomatique SA collaborated with Archéotech SA on this project.