MetalPAT

The MetalPAT project brings together a large group of professionals spread over the Interreg France-Switzerland region. The numerous collaborations set up between the project partners and the end-users involved contribute to the success of the project through the exchange of knowledge and experience.

The project partners

This fifth newsletter is published late. We apologise for this delay. This is partly due to the fact that we wanted to present important changes to the MiCorr⁺ application that have just been released.

- **COLLABORATION BETWEEN METALPAT'S PARTNERS**

At the end of the 2nd project supported by the *Communauté du Savoir* (CdS - http://www.communautedusavoir.org/), IFOM-Pat, we had a prototype for identifying heritage metals from their macroscopic description, optimised thanks to the workshops dedicated to the selected issues (modern metals, metals with surface treatments, composite objects with metals combined with organic materials and archaeological metals). Since then, colleagues from the Haute Ecole Arc Gestion (HEG-Arc) have been working on an online version to be integrated into the MiCorr⁺ application in the form of a third "By visual inspection" search engine.

SEARCH

A corrosion form / corrosion model in MiCorr database

By keywords

By visual inspection

By stratigraphy representation

The three MiCorr⁺ search engines, with the new "By visual inspection" engine in the centre.
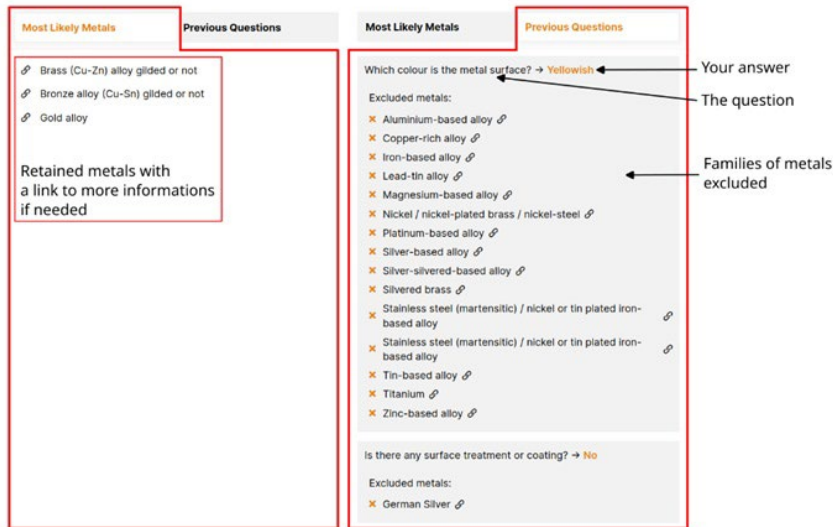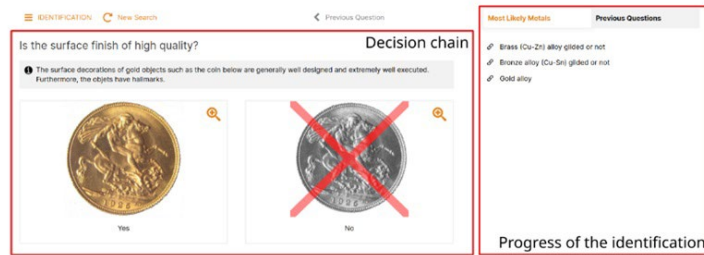
In addition to the results deduced from the questions/answers in the decision-making chain used for the prototype, the user has access to two levels of information enabling him/her to progress in his/her identification: the a priori probable families of metals and the results of the successive selections following the answers given.

"By visual inspection" search engine interface.

The CdS supported us for a third consecutive time in 2022. The AID-Metal project aimed to test and optimise this search engine in situ on real application cases (condition reports, inventory campaigns, etc.). Numerous improvements were made, but it also showed the need to create an administrative platform allowing MiCorr⁺ administrators to make the required optimisations themselves.

In the long term, it is planned that a link will be associated with the results of the identification. This link, inserted in the artefact sheets, will make it possible, as the initiators of the search engine wished, to retrace the identification path of the metal of the artefact studied.

The HE-Arc (CR and G), the LMC-Iramat and the LAPA have continued their partnership to further optimise the "By stratigraphy representation" search engine. After the creation of two observation modes to be filled in independently, the "Find similar" function was reworked. This allows users of the search engine to compare a constructed stratigraphy with those in the MiCorr⁺ database to help them in their diagnosis.

The comparison is now made at several levels:

- Between stratigraphies observed according to the same mode (binocular or cross-section) or according to the two available modes;
- From the stratigraphies of the database entries and/or those of the user's profile;
- By taking or not taking into account the positioning of the strata with respect to the residual metal.
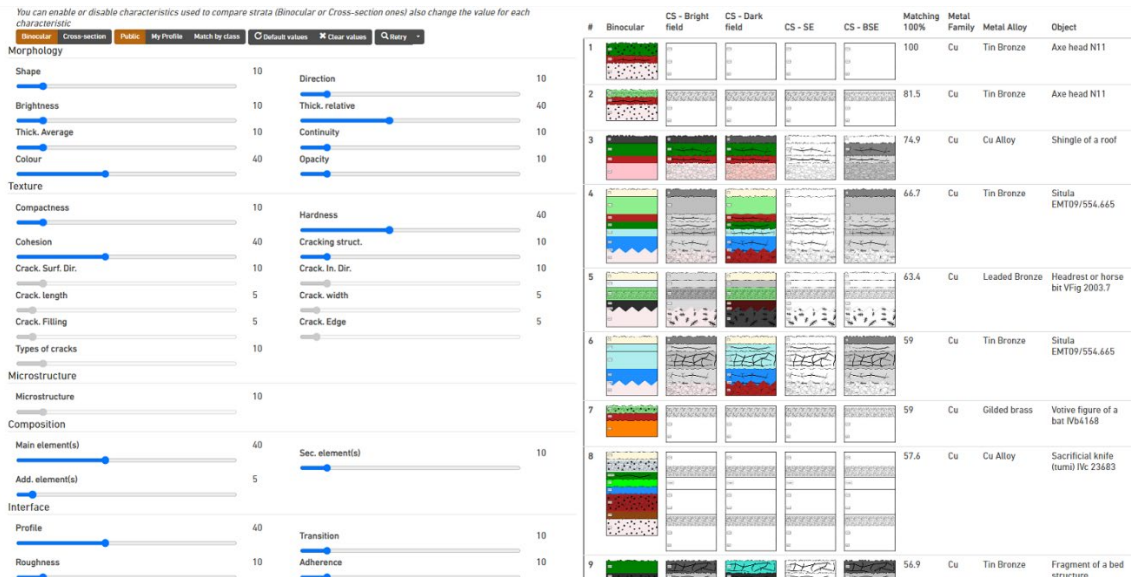
Screenshot of the results of the "Find similar" function

The percentages of similarity (matching 100%) given take into account the default values of the strata sub-characteristics (on the left above). These values give a relative weight to each stratum parameter/sub-characteristic and are derived from the professional expertise of conservators (binocular mode) and scientists (cross-section mode). In the case of specific research work, or in general depending on the interest of the end-user to give more or less weight to a certain parameter, these values can be modified in order to decrease or accentuate their impact on the results obtained during the search with the "find similar" tool. Furthermore, any interested user can access the calculation of the percentages obtained via the tool ▼ (to the right of the Retry button). An Excel file can be downloaded, giving the details of this calculation.

In parallel, the artefact sheets were reviewed (order of existing sections, addition of new sections (non-invasive analysis, correspondence between binocular and cross-sectional stratigraphies of the same artefact), contents, etc.). The correspondence between stratigraphies at different levels of observation is an essential step in the diagnosis of materials under study, as we shall see later.
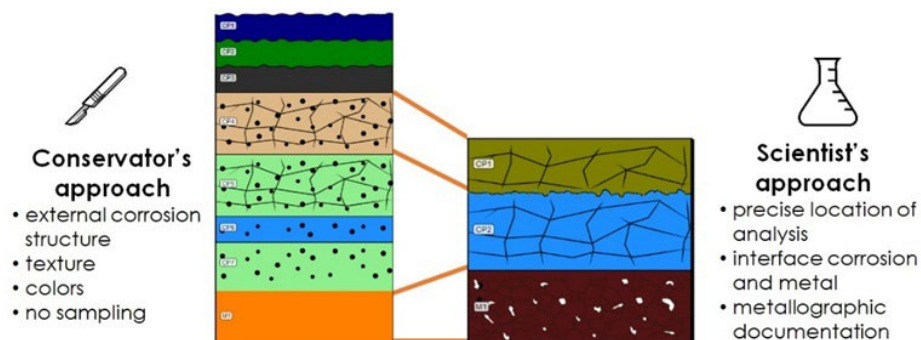
Correspondence of MiCorr⁺ stratigraphies in binocular mode and in cross-section of an axe from the Granges Feuillet site, deposit n°2, Salins-les-Bains.

- **COLLABORATION WITH END-USERS**

The collection managers participated, as planned, in the various workshops of the AID-Metal project aimed at optimising the "By visual inspection" search engine currently

under development. As the workshops were focused on the collections themselves, they provided an opportunity for fruitful exchanges between the participants from the Interreg region, who, as always, contributed in a very proactive manner. The search engine was also successfully tested with early stage researchers from the European ITN-CHANGE (change-itn.eu) project, during a training school in Neuchâtel.

Practical application of MiCorr⁺'s "By visual inspection" search engine by MetalPAT end-users during workshops held, from left to right, at the Musée Historique Lausanne, the Centre de Conservation et d'Etude des Musées de Lons-le-Saunier, the Musée d'Ethnographie de Genève and the Musée d'Horlogerie de Morteau.

In terms of collaboration with end-users - conservators - several series of objects were studied, including artefacts from Latenium. The aim was to examine copper-based objects that had developed a lake or mixed lake-terrestrial patina under partial or total anaerobic conditions. This work was entrusted to Léopold Rémy, a student in the master's programme Archaeology, sciences for archaeology, University of Bordeaux Montaigne, France. After having studied under binocular microscope and on cross-section the two characteristic forms of corrosion encountered and now inserted into the MiCorr⁺ database, we were able to show that the other artefacts of the corpus, observed non-invasively under binocular microscope in collaboration with colleagues at the Laténium, did indeed present one, the other or the two pre-studied forms of corrosion, thus facilitating the diagnosis of these objects.

The same work was carried out on Bronze Age objects, still copper-based, showing a delamination of the surface corrosion layers.

On the left, an awl and axe from the Granges Feuillet site, deposit no. 2, Salins-les-Bains and on the right, a pin from Kehrsatz, Bern showing surface delaminations.

Naïma Gutknecht (NGU), conservator and research assistant at the HE-Arc CR, and Valentina Valbi (VVA), conservation scientist and post-doc at the LMC-IRAMAT, were able to work in parallel and together on this corpus, without being able to determine precisely the causes of this alteration. If the axe from the Granges Feuillet site, deposit no. 2, Salins-les-Bains, was observed in cross-section, the awl could not be sampled. Through simple binocular observation of the latter (non-invasive) and on the basis of the strong correspondence with the stratigraphy in binocular mode of the axe from the same site, as well as the presence of the stratigraphy of the material observed in cross-section, we were able to better diagnose the alteration of the awl and to apprehend its development in the core of the material.
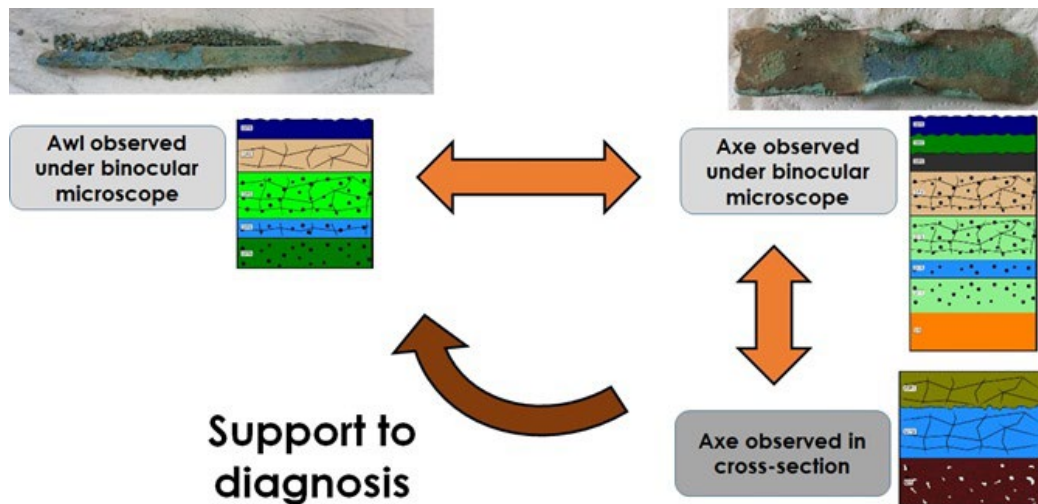
Diagram of the diagnosis of the awl from the Granges Feuillet site, deposit n°2, Salins-les-Bains, observed under binocular microscope, from the stratigraphy under binocular microscope and on cross-section of the axe from the same site.

The table below, already presented in newsletters 3 and 4, shows the progress of the work carried out by type of material.

Materials	Research theme	Canton / department	End-user[1] and corpus	2021		2022	
				Semester1	Semester2	Semester3	Semester4
Iron	Atmospheric corrosion of cast iron	Territoire Belfort	UTBM / factory poles				
	Crevice corrosion	Canton de Vaud	SMRA / ring				
		Département du Doubs	MBAA / buckle plate				
	Corrosion of composite objects	Canton du Jura	SAP / knifes				
		Département du Doubs	MBAA / knifes				
	Metallurgic studies	UTBM / LAPA	Inrap				
			MCAH / semi-finished objects				
Copper	Delamination of corrosion products	Canton de Berne	SACB / pin				
		Canton de Vaud	SMRA / ear pick & fibula				
		Département du Jura	CCE LS / axe				
	Lake corrosion and corrosion in humid environment	Département de Saône et Loire	Inrap (Autun) / craft				
		Canton de Neuchâtel	Laténium / pins				
	Metallurgic studies / typical corrosion	Canton de Vaud	MCAH / situla and other containers				
		Etat de Fribourg	SAEF / bracelets				
		Canton de Genève	MAHG / coins				
	Metal soaps	Canton de Berne	Foundation HAM / composites				
		Département du Haut-Rhin	MNAM / car parts				
Silver	Horn silver	Canton de Berne	SACB / coin				
	Technological study	Canton du Valais	ABSM / shrine				
Modern metals	Zinc pest	Département du Haut-Rhin	MNAM / car parts				

Legend: Technology · Corrosion mechanisms · Conservation · In progress · Planned

Summary of the collaborations initiated with end-users - conservators.

[1] ABSM : Abbaye de Saint-Maurice ; CCE-LS : Centre de conservation et d'étude des Musées de Lons-le-Saunier ; Fondation HAM : Fondation matériel historique de l'armée suisse à Thun ; Inrap : Institut national de recherches archéologiques préventives ; Laténium : Parc et musée d'archéologie de Neuchâtel ; MAHG : Musée d'art et d'histoire de Genève ; MBAA : Musée des Beaux-Arts et d'archéologie de Besançon ; MCAH : Musée cantonal d'archéologie et d'histoire de Lausanne ; MNAM : Musée national de l'automobile de Mulhouse ; SACB : Service d'archéologie du Canton de Berne ; SAEF : Service archéologique de l'Etat de Fribourg ; SAP : Section d'archéologie et paléontologie du Jura ; SMRA : Site et musée romains d'Avenches ; UTBM : Université Technologique de Belfort-Montbéliard.

The artefact sheets in the MiCorr⁺ database have been completely revised to incorporate information from both modes of observation, the non-invasive analyses carried out, and any stratigraphic correspondences established.

In order to facilitate the work of enriching the MiCorr⁺ database, the MetalPAT partners are currently putting in place a procedure for facilitating the submission of artefact sheets, for proofreading by a reading committee, for correction and for validation before they are put online.

- **COMMUNICATIONS**

Publication

Degrigny C., Dillmann P., Gaspoz C. and Neff D., Exploitation and dissemination of MiCorr as a diagnostic support tool for heritage metals, Murray, A., & Vila, A. (2022). Diagnosis: Before, During, After. CONSERVATION 360º, (2), 459. https://doi.org/10.4995.360.2022.657201
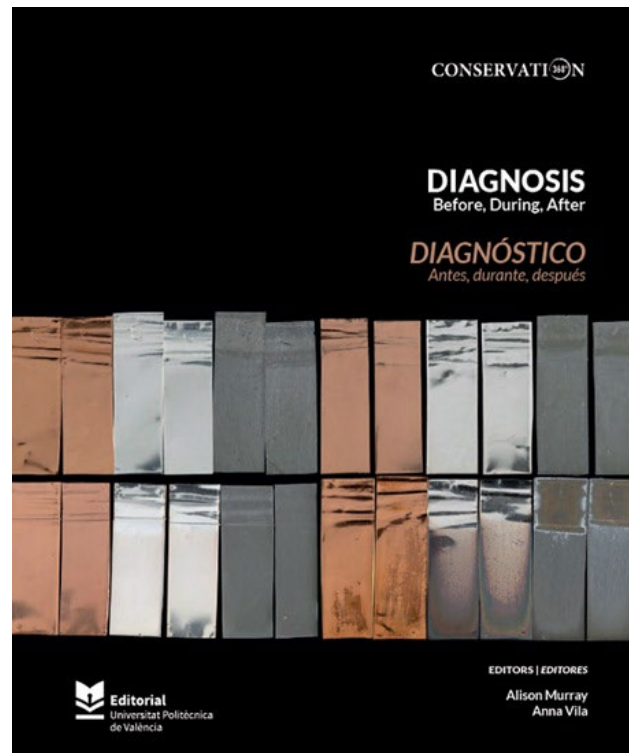
Presentation

- Presentation by N. Gutknecht and V. Valbi at the InArt2022 conference: "MiCorr - A transdisciplinary tool for the documentation and the diagnosis of corrosion forms on heritage metal artefacts: Building bridges between conservation professionals and material scientists" held from 28 June to 1 July 2022 in Paris (France). A paper must be submitted.