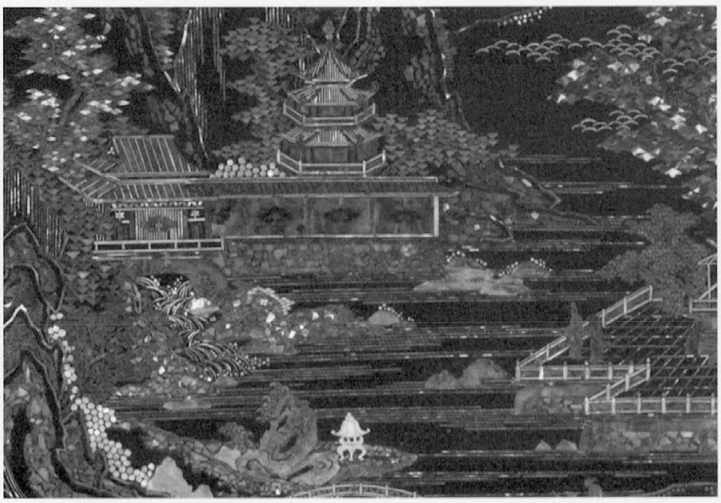
楼閣山水螺鈿箪笥

平成18・19年度修復事業



所蔵：キョッソーネ東洋美術館

キョッソーネ東洋美術館

楼閣山水螺鈿箪笥

勝又智志

1. 概要

名　　称：楼閣山水螺鈿箪笥
所　　蔵：キョッソーネ東洋美術館（イタリア）
時　　代：19世紀　江戸時代
法　　量：幅32.6cm　奥行18.5cm　高27.7cm
修復期間：平成18年6月～平成20年3月

2. 形状・技法

木製黒漆塗り、薄貝螺鈿、指物造、六段抜き通し形式の引き出しが付く小箪笥、底裏に円形二段型の脚が付く、総体を黒漆で塗り、正面及び背面に楼閣山水の図、天板は雲に鳳凰、引き出しの両面には四季花鳥図が薄貝の螺鈿で表され、貝表面には繊細な針描が施されている。薄貝に使用される貝は輝きの強い鮑貝とおだやかな色調の夜光貝の2種類を使用し、雲や楼閣には金箔、花鳥には銀箔の裏彩色を施した薄貝を使用しており、華やかな輝きの箪笥である。（図1. 2. 3. 4. 5）

3. 損傷状態

1. 長期に渡る乾燥のため構造材である木地が収縮し、各所に亀裂、変形を生じさせている。天板は中央と右中程の2カ所で大きく縦方向に亀裂が入り左右の2カ所で変形が見られる。特に左半分は最大5㎜ほどの木地の反りが大きく生じ、側面から木地の木口が完全に確認できる状態である。（図6. 7）天板に接する銀杏面は中央から上下に分離し表面の薄貝螺鈿の装飾が崩れ落ちている。又正面及び背面の楼閣山水図を囲む花菱輪違文で飾られた窓枠部は、本体構造材に貼り付ける形式のため構造材の収縮に追従できず、中央部で上下ともに木地から亀裂を生じ、山形に盛り上がるように折れ曲がった状態である。（図8. 9）特に正面下部の亀裂部分は部材のはみ出しが大きく、これを保存するためと思われる黄褐色の接着材が充填されているが十分な配慮がなされていないため周囲を汚損している。（図10）六段ある引き出しは格段ともに内部側板の上部に打損が見られる。又底部には使用に伴う擦れが生じ下地が露出している。（図11）
2. 本体底部四隅に円形二段型の足が付く、4本のうち背面左は二段ともに欠失しており半円球状の後補材が白木のまま添えられている。又背面右は下段の材が新補されているが形状が異なり不自然な状態にある。（図12）本作には印籠を納めるための区割り用の黒塗りの木枠が2個、引き出しの飛び出しを防止する目的と考えられる底裏に紐通しの溝が刳られた板が一枚、真田紐一本が付随するが引き出し底部分に見られる内容品の形跡が木枠の物と一致せず、形状及び漆塗りの品質から判断しても制作当初からのものではないことから、後世、印籠箪笥として使用するために付随したものと考えられる。
3. ほぼ全面を飾る薄貝螺鈿は、亀裂と木地収縮のため各所で剥離、剥落が進行しており危険な状態

である。

4. 塗膜表面に長年の汚れが付着しており本来の艶を失っている。銀杏面周辺には光沢のある部分が見られる。

4. 修復仕様及び修復作業工程

1. 修復前に現状を詳細に写真撮影した。記録媒体はデジタル保存とした。
2. 破損の状態を記録するとともに材料や構造について調査を行い、作業手順を整理した。
3. 剥落の危険がある箇所は、雁皮紙を正麩糊を用いて仮止めした。(図 13)
4. 表面に固着した汚れは精製水を含ませた綿布及び綿棒を用いて除去した。破損した周囲には接着材と思われる光沢のある皮膜が残留していたが、エタノールと酢酸エチルを使用しこれを取り除いた。また、内部に発生した黴については消毒用アルコールを用いて拭きとり今後の発生を抑えた。(図 14)
5. 黴や紫外線などの影響により劣化した塗膜は、溶剤で希釈した生漆を筆を用いて浸み込ませ余分な漆を紙で拭き上げ、塗膜の補強を行った。(図 15)
6. 本体天板部に生じた木地乾燥による変形を修正するために、内部に杉材を張り巡らせた合板製の外箱を制作した。(図 16) 器物抽斗の最上段に水分を含ませたスポンジを挿入し、箱内部の湿度を 60%から徐々に 90%前後の高湿度の環境に移行させ、乾燥し硬化した木地に柔軟性をあたえた。(図 17) 更に上部より芯張りにて圧力を加える事で胴張状に膨らんだ天板を可能な限り平面の状態とする矯正作業を繰り返した。(図 18)
7. 前年度の木地矯正により天板に生じた変形部が、作業環境である湿度 50 ～ 60%の状況においても 1㎜ほどの浮き上がりに収まった事を確認し、接着作業に取りかかった。(図 19. 20) 天板の接着作業は正面及び背面側板中央上部に生じた破損部に直接接する箇所であり、同時に接着することが望ましいことから、この破損部を切開し形状を整える作業を先行した。当該箇所は薄貝の装飾を伴った状態で逆 V 字型に 3㎜程隆起しているため、塗膜及び薄貝の修復中の剥離を予防するため雁皮紙による仮止めを厳重に行った。次に浮き上がっている木地の隙間に極薄の鋸を差し込み、元の形状に収まるまで余分な木部を徐々に削り落とす作業を繰り返し、加湿をしながら圧を加えることで表面の塗膜及び薄貝の損傷を最小限にとどめながら器物の面に安定させることができた。(図 21. 22) 天板と側板に生じた亀裂から小麦グルテンと生漆を調合した麦漆を溶剤で稀釈し、スポイトを用いて数回に分けて流し込んだ。余分な麦漆を溶剤で拭き取り、加湿用の箱に 3 時間程度入れることで、麦漆の硬化を促進した。麦漆の粘調が最も高まった頃合をはかり、芯張りとハタガネを用いて上方と両側面の 3 方行より適度な圧を加え接着作業を完了した。(図 23. 24) 翌日、圧力によって浸み出した麦漆を取り除き、更に 2 週間芯張りによる圧力を継続した。また、正面及び背面中央下部に生じた亀裂は、正面側の内部に充填された接着剤を刀で削り落とした後、それぞれ上部破損と同様の形状修正を行い、接着した。天板部については形状が安定した段階で上下を反転し、天板裏に生じた亀裂から再度麦漆を充填させ、芯張りによる圧を加え続けた。
8. 破損部の接着が安定した後、亀裂部及び木地と下地の欠損部に麦漆に 60 メッシュで篩を掛けた木粉と麻の繊維を混ぜ合わせた刻苧を充填した。乾燥後ヤスリと刀で形状を修正した後再度 80 メッシュで篩い掛けした木粉と麦漆で充填を行った。(図 25)
9. 薄貝の剥離は比較的大きな貝が使用された正面及び背面に多く発生していた。本作は黒漆塗りの上に膠と思われる透明度のある薄い接着材料が使用されている事から、膠による修復を行った。また、欠失した箇所については現状のままとした。膠は粒膠の接着強度の強い種類を使用し、10%前後の濃度で使用した。筆を用いて含浸した後、余分な膠をぬるま湯で拭き取る作業を数回

繰り返し、貝裏に十分な膠が充填されたのを確認した後、芯張りにて圧力を与えた。(図26) 貝が安定した事を確認した後、更に麦漆を剥離した貝の周囲にある塗膜の亀裂に含浸させ、同様に芯張りにて接着を施した。(図27. 28)

10. 亀裂及び木地と下地の欠損部に施した刻苧表面を整えるため、カーボンを混入した漆下地を施した後、更に研ぎを行い、生漆を蒔絵筆で薄塗りし、珪藻土の微粉を蒔いた。乾燥後黒漆に生漆を合わせた呂瀬漆で珪藻土粉を固め、現状塗膜に近い艶と色を与えた。(図27)
11. 本体底部の円形二段型の脚部の内、欠失した2カ所については檜材で削りだし、形状を整え生漆で摺漆した後、麦漆で接着し破損箇所と同様に蒔地仕上げとした。(図30. 31)
12. 引き出しの内外に生じた傷や塗膜の破損は、深く大きな箇所には刻苧を行い、浅い傷と判断される箇所については漆下地で形状を整えた。
13. 塗膜及び貝の際にカーボンを混入した漆下地を箆付けし溶剤でふき取る作業を行い、剥落防止処理とした。(図32)
14. 全体を再度クリーニングし修復後の確認を行った。
15. 修復後の写真を撮影し全ての修復作業を完了した。

5. 調査

本作の螺鈿の特徴として裏彩色による金銀の薄貝の使用が認められるが、薄貝の裏に施された箔の成分を分析するため蛍光X線分析を行った。(図33) 分析は東京文化財研究所において、早川泰弘氏によって行われた。

目視で観察する限り、正面及び背面に使用された金箔と引き出しの一部に使用された金箔に色味の相違が見られた。又、引き出しには銀箔もしくは錫箔が使用されている可能性が考えられた。分析の結果、純度98～99%の金箔が主に使用され、引き出しの一部に純度85～90%のやや青みを帯びた金箔を使用していた。銀色箔は純度の高い銀であることが判明した。詳細な分析結果は末尾に添付した。

更に木地の構造を分析するため透過X線撮影を行った。(図34. 35. 36) 撮影は東京文化財研究所において、松島朝秀氏によって行われた。

破損した部分を観察すると、木口部分に見られる春材と秋材が明快で、緻密な材料であることがわかる。このことから使用された木材は、針葉樹材であり、漆塗りの素地として一般的に使用されていた檜材であると考えられる。小箪笥の木取りは箱の場合と異なり、各面の木口同士を接合し木地が収縮した際、引き出しが抜けやすいよう配慮されている。上下とも角部分には7本の木釘が見られ、側板を底板と天板で挟み込むように、28本の木釘で固定していることが解った。又、天板と正面及び背面の窓状の枠は薄い檜材を本体に貼り付けたものであり、本体の木地収縮に対し破損しやすい構造となっていることが解った。

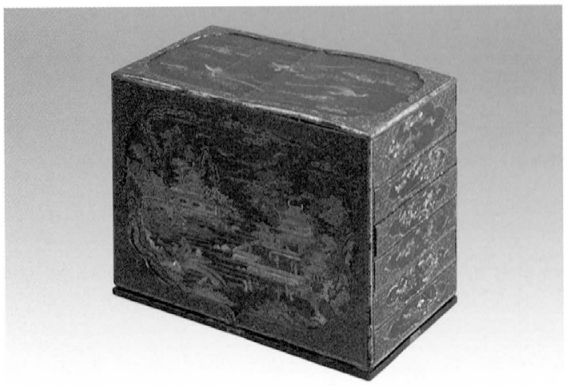


図1　修復前　全景
Fig. 1 Before restoration, overall view

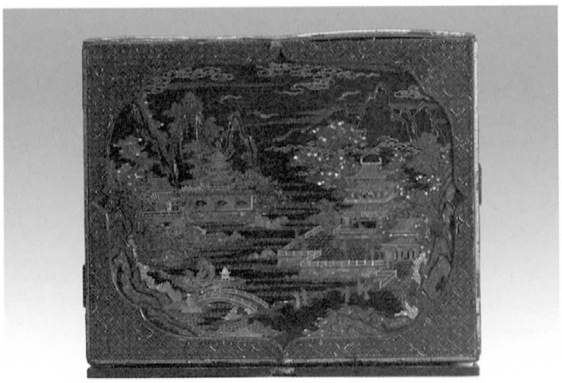


図2　修復前　背面
Fig. 2 Before restoration, back

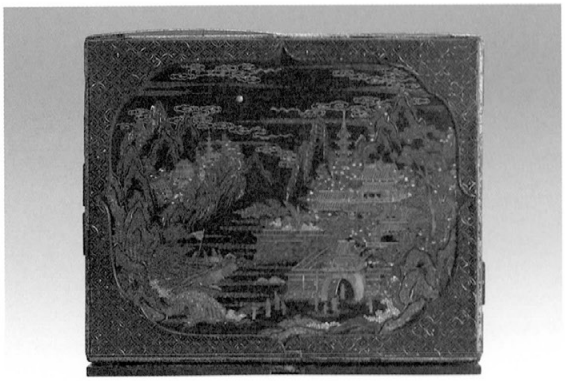


図3　修復前　正面
Fig. 3 Before restoration, front

図4　修復前　左側面
Fig. 4 Before restoration, left side

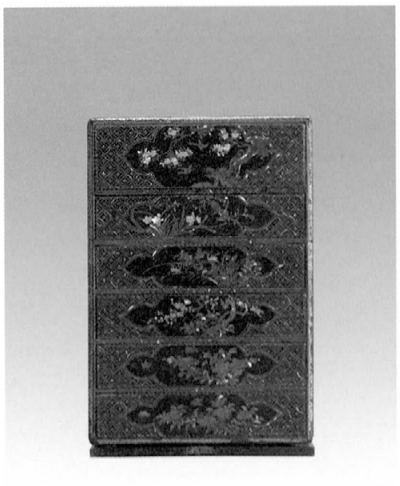


図5　修復前　右側面
Fig. 5 Before restoration, right side

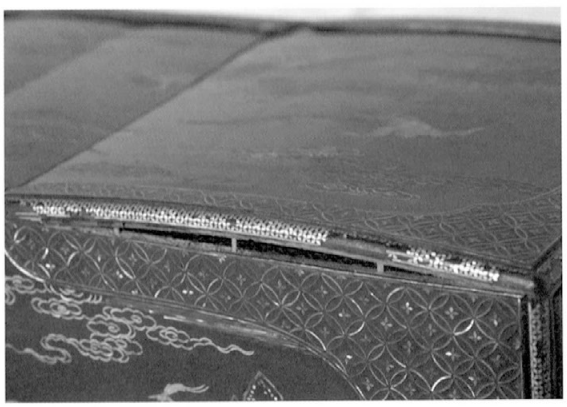


図6　背面　天板
Fig. 6 Back, top board

図7　正面　天板

Fig. 7 Front, top board

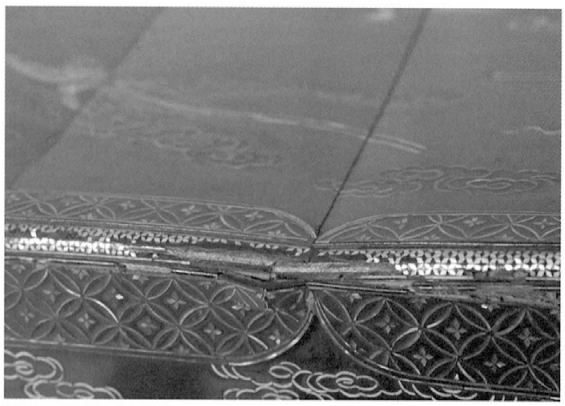


図8　背面　銀杏面

Fig. 8 Back, planed off edge

図9　正面　下部

Fig. 9 Front, lower edge

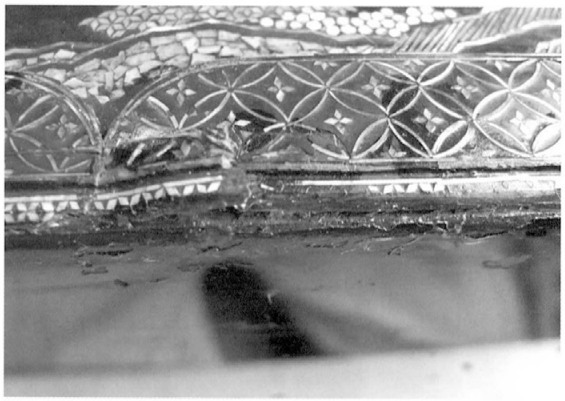


図10　正面　下部

Fig. 10 Front, lower edge

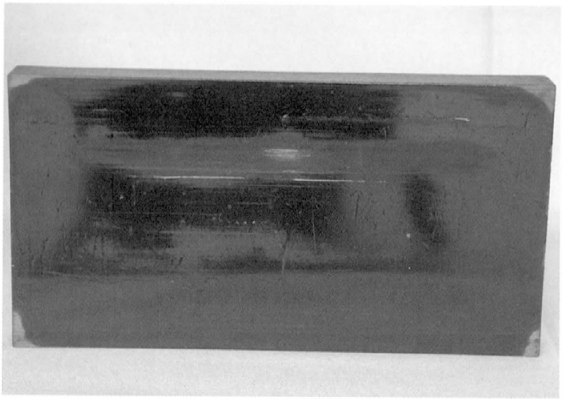


図11　引き出し底裏

Fig. 11 Bottom of a drawer

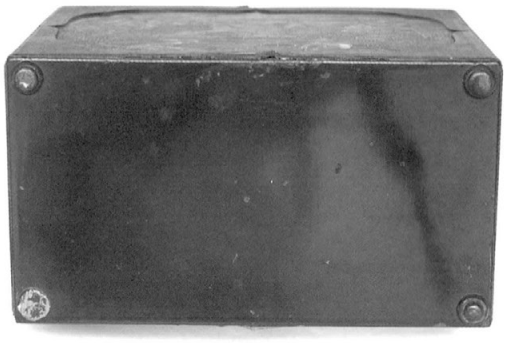


図12　本体底

Fig. 12 Bottom of the body

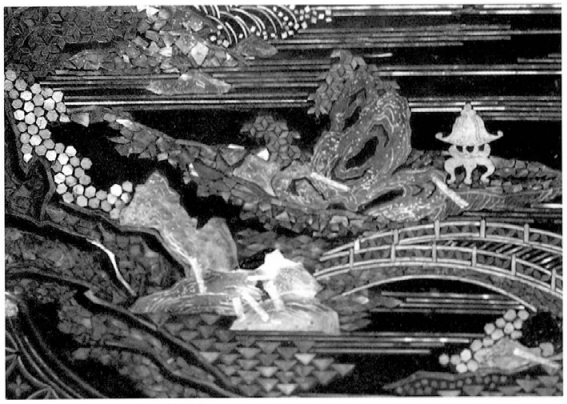


図13　背面　螺鈿剥離部

Fig. 13 Back, lifted *raden*

図14　掃除

Fig. 14 Cleaning

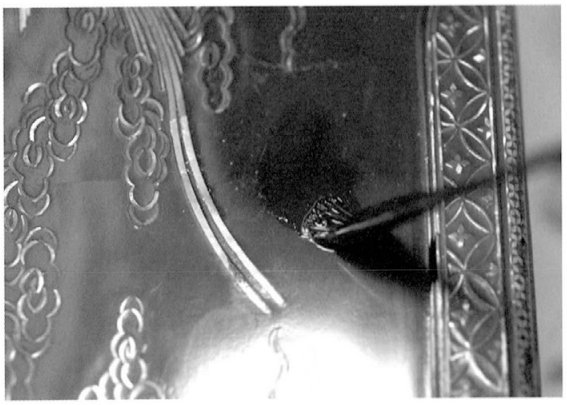


図15　漆固め

Fig. 15 Consolidation

図16　加湿用箱

Fig. 16 Humidifying box

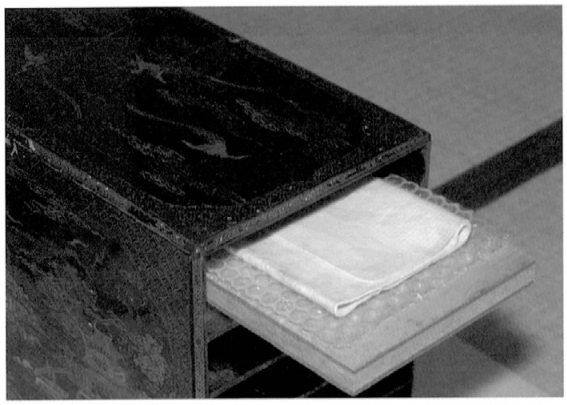


図17　内部　加湿

Fig. 17 Applying humidity from the inside of a drawer

図18　形状修正

Fig. 18 Using *shimbari* sticks to flatten the surface

図19　天板　加湿前

Fig. 19 Top board, before humidifying

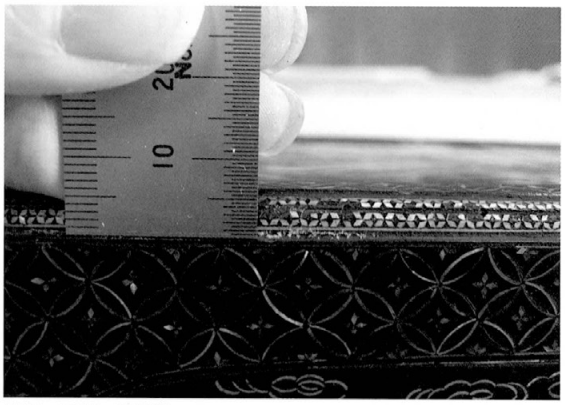


図20　天板　加湿後

Fig. 20 Top board, after humidifying

図21　仮止め

Fig. 21 Temporary fixing

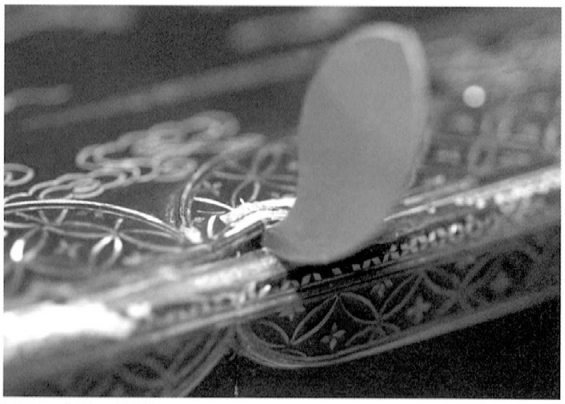


図22　木地　調整

Fig. 22 Adjusting the substrate

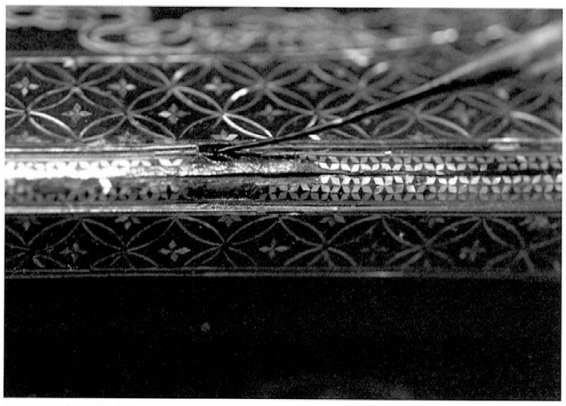


図23　麦漆含浸

Fig. 23 Impregnating *mugiurushi*

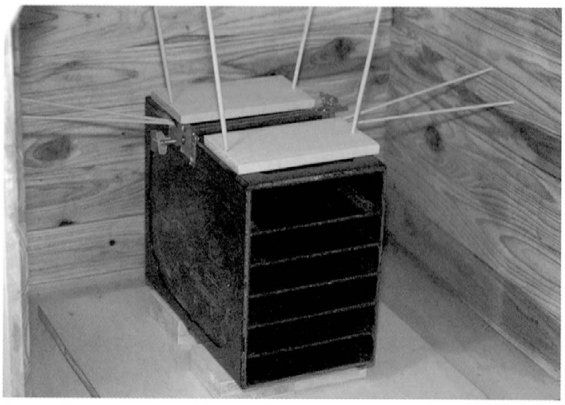


図24　芯張

Fig. 24 *Shimbari*

図25　刻苧充填

Fig. 25 Filling with *kokuso*

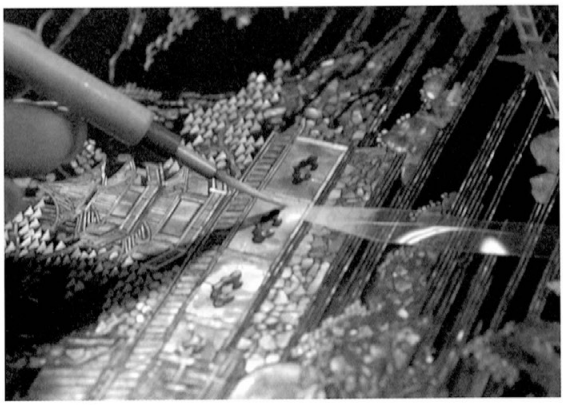


図26　膠含浸

Fig. 26 Impregnating animal glue

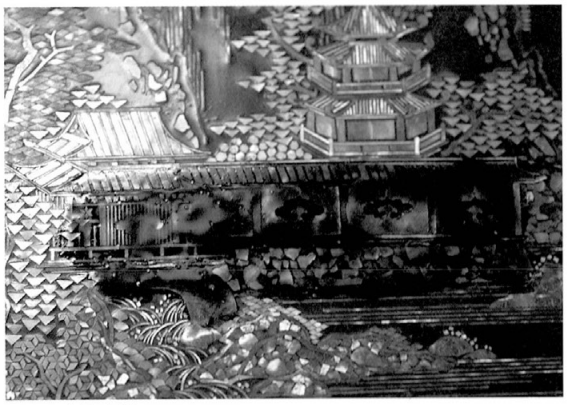


図27　麦漆含浸

Fig. 27 Impregnating *mugiurushi*

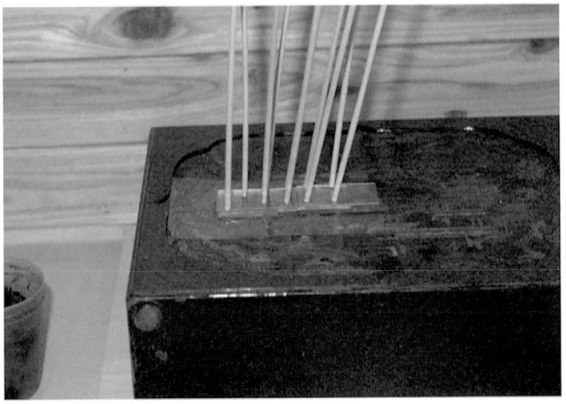


図28　芯張

Fig. 28 *Shimbari*

図29　蒔地

Fig. 29 *Makiji*

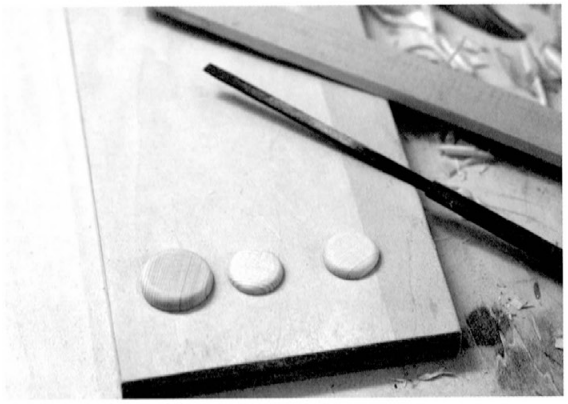


図30　脚部成形

Fig. 30 Shaping parts of a leg

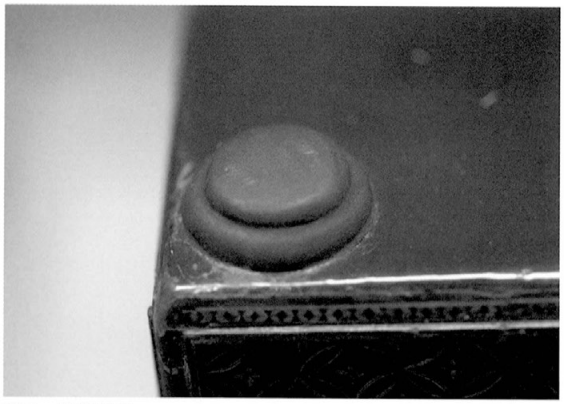


図31　脚部接着

Fig. 31 Attaching a leg

図32　際錆

Fig. 32 *Kiwasabi*

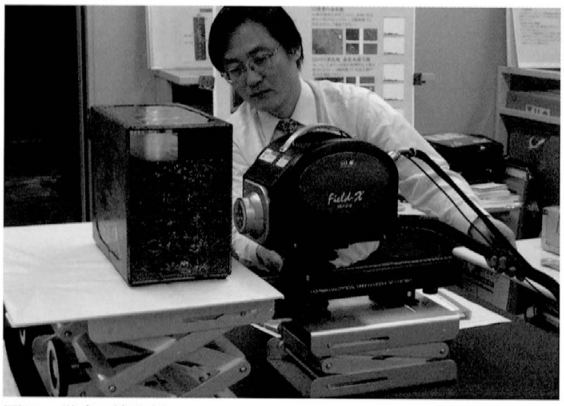


図33　蛍光X線分析

Fig. 33 Preparing for X-ray fluorescence analysis

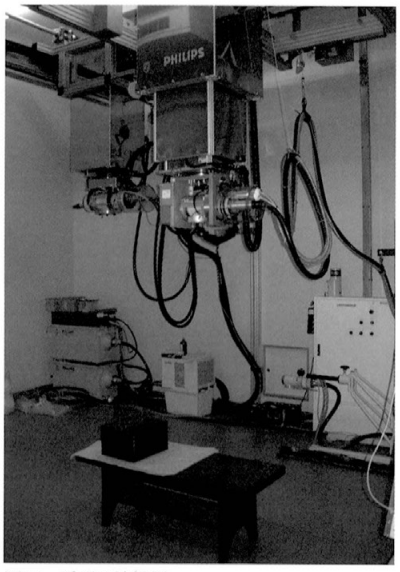


図34　透過X線撮影

Fig. 34 Preparing for radiography

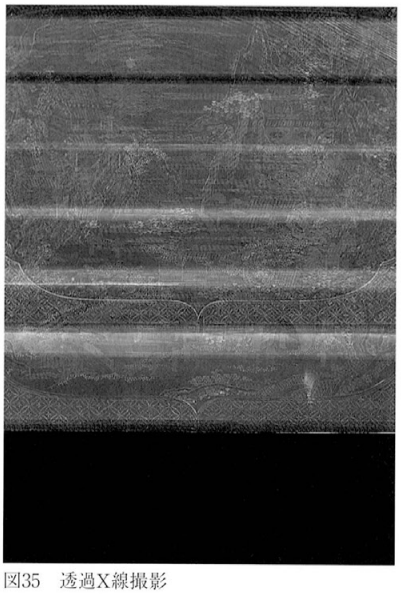


図35　透過X線撮影

Fig. 35 Radiograph

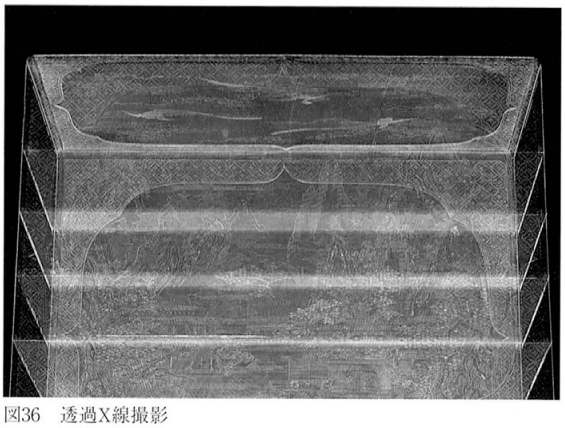


図36　透過X線撮影

Fig. 36 Radiograph

キョッソーネ東洋美術館所蔵

樓閣山水螺鈿箪笥の蛍光X線分析結果

早川泰弘

【分析日時・場所】 平成20年1月22日㈫、東京文化財研究所　第2化学実験室

【分析装置・条件】 装置：ポータブル蛍光X線分析装置 SEA200（セイコーインスツルメンツ）
X線管球：Rh（ロジウム）
管電圧・管電流：50kV・100μA
X線照射径：φ2㎜（Alフィルタ付きコリメータ使用）
測定時間：100秒
測定雰囲気：大気
装置ヘッド～資料間距離：約10㎜

【分析結果】
・得られた蛍光X線強度を一覧表に示した。
・今回の測定結果に関しては、下記の事項を十分考慮した上で、測定結果の解釈が必要である。
(1) 蛍光X線分析では試料に含まれている元素を特定することはできるが、その構造（化学式）を知ることはできない。
(2) 今回の測定では、有機物（主元素C, N, O, H）や染料などの検出は行えない。
(3) 無機物であっても、軽元素（例えばAl, Si, S, Clなど）の検出は行えない。
(4) 得られた蛍光X線強度は表面からある深さまでの組成情報である。
（金属銅の場合：数10μm程度）
(5)単一部位の測定結果だけからは、複数の元素が混合されているのか、それらが層状に存在しているのかの判断はできない。
(6) 蛍光X線の検出効率はエネルギーによって大きく異なるため、元素間での蛍光X線の強度比は実際の濃度比とは一致しない。

キョッソーネ東洋美術館所蔵　楼閣山水螺鈿箪笥の蛍光X線分析結果

No.	測定箇所	色	蛍光X線強度(cps)				
			カルシウム Ca-Kα	鉄 Fe-Kα	銅 Cu-Kα	銀 Ag-Lα	金 Au-Lβ
1	灯篭	金	90.3	7.0			2.6
2	屋根上の鯱	金	33.3	41.2			0.6
3	旗	銀	25.9	33.3		1.8	
4	植物	金	70.2	24.3			1.5
5	下地	赤茶	12.8	63.9			
6	水仙	銀	63.8	13.3		1.7	
7	鈴虫	金	111.9	12.7		2.1	2.2
8	鈴虫	金	95.8	15.9		2.0	2.3
9	杜若	銀・青	99.3	15.3		1.9	
10	杜若	銀	86.3	12.6		1.9	

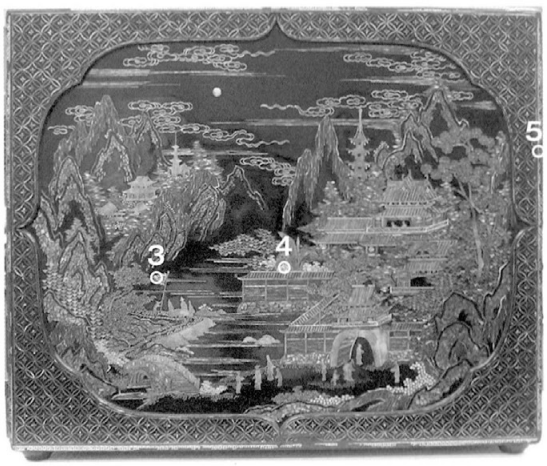
【分析結果に関するコメント】

・測定箇所1,2,4の金色部分から検出されたのは、Caと少量のFeおよびAuだけである。Caは最上層の貝殻、Feは下地や黒漆中に含まれている鉄分に由来していると考えられる。これらの箇所からAgやCuはほとんど検出されず、純度の高いAuが使われていると判断できる。ファンダメンタル・パラメータ法を用いて定量計算を行うと、これらの箇所のAu純度は98-99%以上、厚みは0.2-0.4μm程度と計算される。

・測定箇所3,6,9,10の銀色部分から検出されたのは、Caと少量のFeおよびAgだけである。これらの箇所からAuやCuはほとんど検出されず、純度の高いAgが使われていると判断できる。Agの検出強度が低いため銀の純度および厚みを精度よく計算することはできなかった。

・測定箇所7,8の金色部分からは、Ca、FeとともにAuおよびAgの両元素が検出された。ファンダメンタル・パラメータ法を用いて定量計算を行うと、これらの箇所の材料はAu85-90%（残りはAg）、厚みは0.2-0.3μm程度と計算された。

キョッソーネ東洋美術館　樓閣山水螺鈿筆筒の蛍光X線分析ポイント
Measuring points for X-ray fluorescence analysis



表面
Front

裏面
Back

左側面
Left side

右側面
Right side

On the Restoration of *Cabinet with Drawers with Chinese Landscape by Raden Technique*

Satoshi Katsumata

Name of the object: *Cabinet with Drawers with Chinese Landscape by Raden Technique*
Collection: Museo d'Arte Orientale "Edoardo Chiossone"
Period of manufacture: 19th century, Edo period
Dimensions: Width 32.6cm Depth 18.5cm Height 27.7cm
Duration of restoration: June 2006 – March 2008

1. Structure

This is a small cabinet made by assembling boards (*sashimono*). It has 6 drawers which can be pulled out either to the left or right. The legs on the bottom consist of two round shapes placed on top of each other. The entire cabinet is coated with black urushi. The design on the front and the back is that of a landscape, while that on the top board is of phoenixes and clouds. Thin *raden* shell pieces are used to depict the design of seasonal flowers and birds on the left and right sides of the drawers. There are delicate carved lines (*harigaki*) on the surface of the shell pieces. Two types of shells are used for *usugai raden*: abalone, which has a brilliant shine, and turban shell whose color is somewhat subdued. Gold leaf has been applied to the reverse side of the thin shell pieces used for the clouds and landscape and silver leaf for those of the birds and flowers. All create an exquisitely gorgeous cabinet (Figs. 1, 2, 3, 4, 5).

2. Conditions of damage

1. The wooden substrate, which is the structural material of the cabinet, has shrunk over the years due to dryness. Because of this, there are cracks and distortions. The top board, in particular, has 2 large cracks at the center and about half way to the right that run vertically; there are distortions at the left and right. Especially on the left half, the wooden substrate has warped back approximately 5 mm at maximum so that one can see from the side the cut end of the of the wooden board used for the substrate (Figs. 6, 7). The planed off edge of the body in contact with the top board has become separated at the center and the *usugai raden* decoration on the surface has been lost. Moreover, the cartouche on the front and the back, which surround the design of a landscape with buildings and which are decorated with a motif of overlapping circles with a four-petal flower in each section, have cracked at the center in such a way that they protrude forward (Figs. 8, 9). This is thought to have occurred because they had been attached to the substrate but could not follow the shrinkage of the substrate wood. The part of the crack on the lower portion of the front protrudes much. A brownish adhesive was used, it seems, to protect this part, but because not enough care was taken in its application, the adhesive has soiled the surroundings (Fig. 10). Damage is found on the upper portion of the inner side boards that make the drawers; this is apparent on all six. The bottom has become

abraded due to use and the foundation is exposed (Fig. 11).

2. Of the four legs on the bottom corners of the cabinet that consist of two round shapes placed on top of each other, the left one at the back is missing and a semi-cylindrical plain wooden is used in its place. Although the lower portion of the right leg at the back has been repaired and a new one attached, its shape is different and appears unnatural (Fig. 12). Two black wooden frames for holding *inro*, a board with a ditch at the bottom used to prevent the drawers from popping out, and the cord used to tie the paulownia box accompany the cabinet. But the marks left by the contents of the cabinet at the bottom of the drawers do not match those of the wooden frames. In addition, judging from the shape and the quality of the urushi coating, rather than being original, they seem to have been added later in the history of the cabinet when it was used as an *inro* cabinet.
3. *Usugai raden* pieces that decorate the cabinet almost completely have become lifted or detached due to cracking and shrinkage of the substrate.
4. The surface of the coating film has become soiled over the years and has lost its luster. There is, however, some luster remaining around the planed off edge.

3. Restoration

1. Photographs were taken with a digital camera prior to restoration work in order to keep a detailed record of the condition.
2. The conditions of damage were documented and the materials and structure were investigated in order to plan the work procedure.
3. Places where there was risk of the *raden* pieces and coating film becoming detached were faced with *gampi* paper and wheat starch paste (Fig. 13).
4. Cotton cloth and cotton swabs moistened with purified water were used to clean the surface. A glossy film thought to have been that of an adhesive was found around the damaged areas. This was removed by using ethanol and ethyl acetate. Molds that had grown on the inside were wiped off with sterilizing alcohol to prevent future growth (Fig. 14).
5. In order to reinforce the coating film that had deteriorated because of molds and ultraviolet ray, raw urushi diluted with a solvent was applied with a brush. Excess urushi was wiped off with paper (Fig. 15).
6. In order to correct the distortion that had occurred on the top board due to the drying of the wooden substrate, an outer box whose interior was covered with plywood of Japanese cedar was made (Fig. 16). A moistened sponge was inserted into the uppermost drawer to gradually raise the humidity inside from 60% to about 90%. This gave the substrate, which had become hard because of drying, resiliency (Fig. 17). Moreover, by applying pressure from above by using the *shimbari* technique, the swelling of the top board was corrected. This process was repeated several times to make the surface of the top board as flat as possible (Fig. 18).
7. Confirming that, in the working environment of 50–60% humidity, the lifting at the distorted portions of the top board which had been corrected the previous year had settled at about 1mm, the work of adhering was started (Figs. 19, 20). Since this would involve working directly on the damaged portions found at the front and on the upper central portion of the back board, it was desirable to work on these two places at the same time. So the damaged portions were cut open to adjust the shape. Since the portions in question had risen approximately 3 mm in an up-side-down V-shape together with the thin

shell piece decoration, facing with *gampi* paper was done carefully in order to prevent detachment of the coating film and the thin shell pieces during restoration. A very thin saw was then inserted into the gap in the substrate that had become lifted in order to scrape off little by little the wood that had protruded until the original shape was obtained. This process was repeated several times. By applying moisture and pressure, it was possible to stabilize the wood (Figs. 21, 22) and keep the damage to the coating film and the shell pieces at a minimum. Next, *mugiurushi* made by mixing wheat gluten and raw urushi was diluted with a solvent. This was impregnated with a dropper into the cracks that had appeared on the top board and the side boards. Excess *mugiurushi* was then wiped off with a solvent. The cabinet was then put into a humidifying box for 3 hours in order to promote the hardening of *mugiurushi*. When the viscosity of *mugiurushi* seemed to have reached its maximum point, *shimbari* and clamps were used to apply pressure appropriately from three sides, from the top and the sides (Figs. 23, 24). On the following day, excess *mugiurushi* that had seeped out when pressure was applied was wiped off. Pressure applied by using the *shimbari* technique was continued for 2 more weeks. After scraping off the adhesive that had been used on the inside of the front with a knife, the cracks on the front and on the lower central part of the back were placed back and treated in the same way as the damaged upper part. The cabinet was turned up side down when the condition of the top board had become stable. Then *mugiurushi* was impregnated again from the cracks that had formed on the reverse side of the top board. Pressure continued to be applied by using the *shimbari* technique.

8. When the damaged parts had been adhered and stabilized, the cracks and the missing areas of the substrate and foundation were filled with *kokuso*, which was made by adding to *mugiurushi* saw dust that had been sifted through a 60-mesh sieve and hemp fibers. Once this had hardened, the shape was adjusted by using a file and a knife. This was followed by filling a mixture of sawdust, this time sifted through an 80-mesh sieve, and *mugiurushi* (Fig. 25).
9. Detachment of thin shell pieces was found especially on the front and back where comparatively large pieces had been used. Since a highly translucent, thin adhesive like animal glue had been used on top of the black urushi coating, animal glue was also used for restoration. It was decided not to restore the parts where the shell pieces were missing. Pellet-type animal glue with strong adhesive power was used at about 10% concentration. After impregnating it with a brush, excess animal glue was wiped off with lukewarm water. This was repeated several times. Once enough animal glue had been applied to the reverse side of the shell pieces, pressure was applied by using the *shimbari* technique (Fig. 26). When the shell pieces had been stabilized, *mugiurushi* was impregnated into the cracks of the coating film around the parts where the shell pieces had fallen. These parts were similarly adhered by using the *shimbari* technique (Figs. 27, 28).
10. In order to adjust the surface of *kokuso* that had been applied to the cracks and the missing areas of the substrate and foundation, urushi foundation to which soot had been mixed was applied and then the surface was polished. This was followed by a thin application of raw urushi using a *makie* brush and a sprinkling of the finest *Wajima jinoko*. When this had hardened, *rose urushi*, a mixture of black urushi and raw urushi, was used to consolidate the *jinoko* that had been applied and to make the surface as close in luster and color as possible with the surrounding coating film (Fig. 29).
11. For the missing leg, cypress wood was carved and the shape adjusted. After rubbing in raw urushi (*suri urushi*) it was adhered with *mugiurushi* and sprinkled with gold powder (Figs. 30, 31).
12. Parts that were missing and damage to the coating film found inside and outside the drawers which

were deep were treated with *kokuso*. Those that were shallow were treated by applying urushi foundation.

13. In order to prevent detachment, urushi foundation into which soot had been mixed was applied with a spatula to the edges of the coating film and shell pieces. After that, excess urushi was wiped off with a solvent (Fig. 32).
14. The entire cabinet was cleaned again and the restoration work was inspected.
15. Photographs were taken after restoration.

4. Investigation

A characteristic of the *raden* on this object is that shell pieces on whose reverse side gold and silver had been applied (*urasaishiki*) were used. So X-ray fluorescence analysis was conducted to analyze the components of the leaf applied to the reverse side of the thin shell pieces (Fig. 33). Analysis was conducted by Hayakawa Yasuhiro at the National Research Institute for Cultural Properties, Tokyo.

When observed with the naked eye, there was a difference in the tone of color between the gold leaf on the front and the back with that on a part of the drawers. Moreover, there was also a possibility that silver leaf and perhaps tin leaf had been used for the shell pieces on the drawers. As a result of analysis it was found that most of the gold leaf was 98 to 99% pure gold while a slightly bluish gold with purity of 85 to 90% was used on shell pieces on some parts of the drawers. It was also made clear that silver leaf was also of high purity. A record of the results of analysis is attached at the end of this report.

Radiography was also taken to analyze the structure of the wooden substrate by Matsushima Tomohide, also at the National Research Institute for Cultural Properties, Tokyo (Figs. 34, 35, 36).

Observation of the damaged parts showed that wood of very fine quality had been used since the distinction between springwood and summerwood was clear. This suggests that wood of a coniferous tree was used and that this is cypress which was normally used to make substrates on which urushi was coated. In general, the direction of the grain for small cabinets and that for boxes differ. In other words, in assembling this cabinet care had been taken to joint cut ends of wood to each other so that it would be easy to pull out the drawers even when the substrate shrunk. Since there were 7 wooden nails on each of the corners, 28 wooden nails had been used to fix the side boards from the top and the bottom. Thin cypress wood had been attached to the body to make the cartouche-shaped frames on the top board, the front and the back, making these parts vulnerable to damage caused by shrinking of the wooden substrate of the body.

Results of X-ray Fluorescence Analysis of *Cabinet with Drawers with Chinese Landscape by Raden Technique*

Yasuhiro Hayakawa

Date and place of analysis: January 22, 2008 (Tuesday)
Chemistry Laboratory 2
National Research Institute for Cultural Properties, Tokyo

Apparatus and conditions for analysis

Apparatus: Portable X-ray fluorescence spectrometer SEA200 (Seiko Instruments Co. Ltd)
Target: Rh (rhodium)
Tube voltage, current: 50kV • 100 μA
X-ray radiation diameter: ϕ 2 mm
Measuring time: 100 sec.
Measuring atmosphere: Air
Distance between the apparatus and the sample: approximately 10 mm

Analytical results

- X-ray fluorescent intensity obtained is presented in the table that follows.
- The following points should be taken into careful consideration when interpreting the measured results.
  (1) It is possible to find the elements contained in the sample, but it is not possible to identify the chemical structure.
  (2) It is not possible to detect organic substances (major elements C, N, O, H) or dyes in the measurement.
  (3) It is not possible to detect light elements even if they are inorganic substances (ie. Al, Si, S, Cl).
  (4) The x-ray fluorescent intensity obtained shows an average composition from the surface to a set depth (for metallic copper, approximately several 10μm in depth)
  (5) It is difficult to determine only from a single measurement whether several elements are combined or whether they are in layers.
  (6) Since the detection efficiency of x-ray differs greatly by energy, the ratio of the x-ray intensity among the elements is not consistent with the actual concentration ratio.

Table: Results of x-ray fluorescence analysis of the Cabinet

No.	Measuringpoints	Color	x-rayintensity(cps)				
			Calcium Ca-Kα	Iron Fe-Kα	Copper Cu-Kα	Silver Ag-Lα	Gold Au-Lβ
01	Garden lantern	Gold	90.3	7.0			2.6
02	Top of the roof	Gold	33.3	41.2			0.6
03	Banner	Silver	25.9	33.3		1.8	
04	Plant	Gold	70.2	24.3			1.5
05	Foundation	Reddish-brown	12.8	63.9			
06	Narcissus	Silver	63.8	13.3		1.7	
07	*Suzumushi*	Gold	111.9	12.7		2.1	2.2
08	*Suzumushi*	Gold	95.8	15.9		2.0	2.3
09	Iris	Silver, Blue	99.3	15.3		1.9	
10	Iris	Silver	86.3	12.6		1.9	

Comments on the analytical results

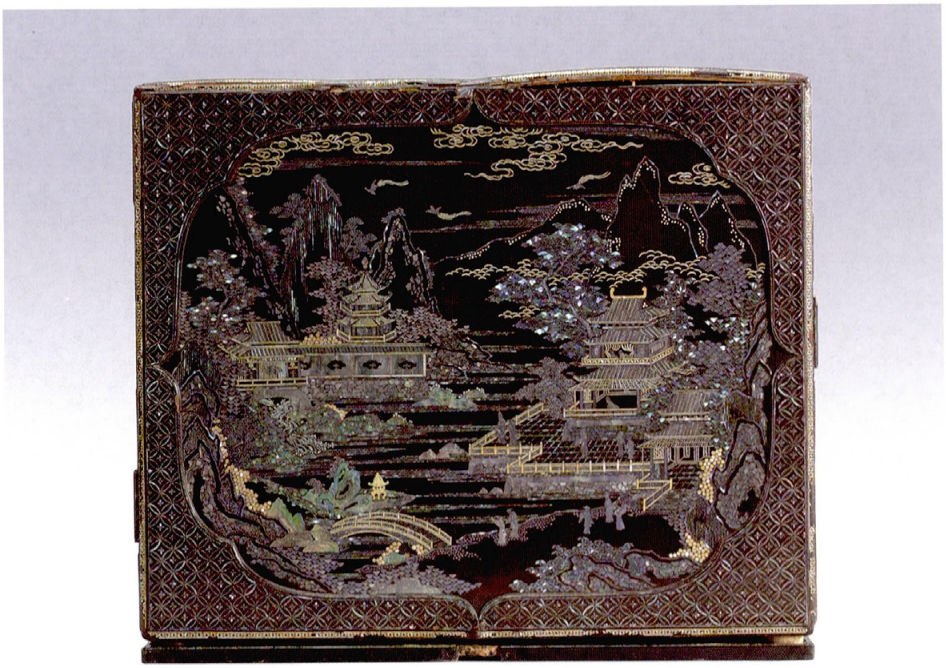
- Only Ca and a small amount of Fe and Au were detected from the gold of the measuring points 1, 2 and 4. It is believed that Ca comes from the uppermost layer of shell, while Fe comes from iron contained in the foundation and black urushi. Almost no Ag or Cu was detected from these points, suggesting that Au of high purity was used. Using the fundamental parameter method to calculate the concentration, it was found that Au of these points is 98-99% in purity and 0.2-0.4μm in thickness.
- Only Ca and a small amount of Fe and Ag were detected from the silver of the measuring points 3, 6, 9 and 10. Almost no Au or Cu was detected from these points, suggesting that Ag of high purity was used. It was not possible to calculate the purity or the thickness of silver since the detected intensity of Ag was low.
- From the gold of the measuring points 7 and 8, Au and Ag were detected along with Ca and Fe. Using the fundamental parameter method, it was found that the material used at these points is 85-90% gold (the rest being silver) and that its thickness is approximately 0.2-0.3μm.

楼閣山水螺鈿箪笥（キヨッソーネ東洋美術館）

Cabinet with Drawers with Chinese Landscape by Raden Technique
（Museo d'Arte Orientale "Edoardo Chiossone"）

修復前　全景
Before restoration, overall view

修復後　全景
After restoration, overall view



修復前　正面
Before restoration, front

修復後　正面
After restoration, front