THE CREATION OF A MAGNIFICENT SUITE OF PERIDOT JEWELRY: FROM THE HIMALAYAS TO FIFTH AVENUE

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The ultimate value of a gemstone suite lies not only in the cost and quality of the materials themselves, but also in the selection of the rough, the quality of the faceting, and the intricacy of the setting in a well-designed and well-manufactured suite of jewelry. This article chronicles the creation of a fine suite of peridot jewelry from the mine in the Himalayas to the manufacture of the necklace, bracelet, ring, and earrings. Eight kilograms (40,000 carats) of peridot rough from the Sapat Valley region of Pakistan was purchased in early 2004. Following the assessment of the rough, careful preforming and faceting produced a precisely matched suite of Asscher-cut peridots. The suite comprises 54 gems ranging from 3.57 to 18.30 ct, for a total weight of 350.40 ct. Van Cleef & Arpels in Paris designed the jewelry, and the New York atelier of Van Cleef & Arpels manufactured the five pieces.

Assembling even one matched pair of gems for earrings can be a difficult process. Assembling an elaborate matched suite—for a necklace, bracelet, ring, and earrings—is the ultimate challenge. Typically, a matched suite is compiled by selecting gems that have essentially the same color, clarity, dimensions, and cutting proportions from a large group of faceted gems. The greater the number of gems to choose from (e.g., hundreds to thousands), the faster a large or intricate matched suite can be assembled. Elaborate suites may take years to complete if they are not intentionally cut from the rough. As gems of the appropriate size, shape, color, and clarity are purchased or come from the cutting factory, they are added one at a time to the suite. Re-cutting of gems that are close in appearance is often necessary. Only rarely does a gem dealer–cutter have the opportunity, take the time, or incur the cost to intentionally fashion a large set of precisely matched gemstones for a jewelry ensemble from a large parcel of rough.

This article describes and chronicles the making of just such an ensemble, the magnificent peridot, diamond, and platinum jewelry suite shown on the cover and in figure 1. The availability of a continued supply of large, fine peridots from a relatively new locality in Pakistan provided the material needed to compile the stones for this suite, which were expertly preformed and faceted by two master craftsmen. Although many excellent books and articles explain the details of jewelry manufacture (see, e.g., Untracht, 1982; Revere, 2001), few also explore the intricacies of creating a suite of haute couture jewelry, as is provided here by a unique visit to the workshops at Van Cleef & Arpels. This article takes the reader from the mines high in the Himalaya Mountains of Pakistan, through the assessment of the rough and the cutting of the faceted gems, to the design and creation of the final jewelry suite.

THE SAPAT VALLEY PERIDOT DEPOSIT IN PAKISTAN

In the early 1990s, the famous Arizona peridot mines supplied 80–95% of the world's peridots;

See end of article for About the Authors and Acknowledgments.

GEMS & GEMOLOGY, Vol. 40, No. 4, pp. 288–302.

Figure 1. This unique suite of peridots and diamonds set in platinum was designed and manufactured by Van Cleef & Arpels. The necklace contains 31 faceted peridots ranging from 3.78 to 13.78 ct, with a total weight of 228.22 ct; the ring stone weighs 18.30 ct; the peridots in the earrings range from 3.57 to 4.55 ct, with a total weight of 24.31 ct, and the bracelet contains 16 matching peridots weighing a total of 79.57 ct. The custom-cut Pakistani peridots were provided by Fine Gems International, Helena, Montana. The diamonds (D-E color, VVS clarity) were supplied by Van Cleef & Arpels. Photo by Harold & Erica Van Pelt.

most of these weighed less than 1 ct, and only rarely did they reach 3 ct (Federman, 1992). Although Burma/Myanmar has long been known to produce some beautiful large faceted peridots (as, historically, has Egypt), such stones have never been consistently available in large quantities.

In 1994, however, extraordinary amounts of fine, large gem peridot entered the international gem and mineral markets (Koivula et al., 1994a; Federman, 1995; Milisenda et al., 1995; Frazier and Frazier, 1997). This new source of peridot was in Pakistan: near Sapat Nala, in the Sapat Valley, Mansehra district, North West Frontier Province (Kausar and Khan, 1996; Hammer, 2004—see figure 2). According to Jan and Khan (1996, p. 17), "the peridot occurs in pockets and veins located in shear zones in partially serpentinized dunitic host rocks." The mine is situated in the western Himalaya Mountains at an elevation of 4,500 m (15,000 feet) above sea level. Koivula et al. (1994a) reported that the mine could be reached by a seven-hour horseback ride and a two-day hike from the closest populated area, Basham Village. The typical route through the Jalkot Valley to the mine is potentially very dangerous and not recommended for nonlocals.

This discovery—along with current production of smaller stones from China, Vietnam, Ethiopia, Tanzania, and Myanmar, as well as Arizona—has transformed peridot into even more of a "mainstream" gemstone for jewelry manufacture around the world. The Pakistani peridot is far cleaner and larger than the Arizona material and typically is more uniform in color than the Burmese material. One of the author's international manufacturing suppliers reported faceting nearly half a million carats of Arizona peridot during the last 15 years, with no more than a handful of clean (nearly flawless) stones over 10 ct produced; the average size of relatively clean faceted stones was about 2 ct. However, over the last three years, his operation has faceted more than 30,000 carats of Pakistani peridot; 35% of the production has been over 5 ct, with nearly one third of these in the 10–20 ct range. The author has even seen the occasional faceted peridot from Pakistan that exceeded 100 ct. As an additional example of the prolific nature of this mine, the author recently examined a beautiful, well-matched Pakistani peridot necklace, ring, and earring suite comprising 16 faceted peridots with a total weight of more than 400 ct. The continued production of large, fine pieces of

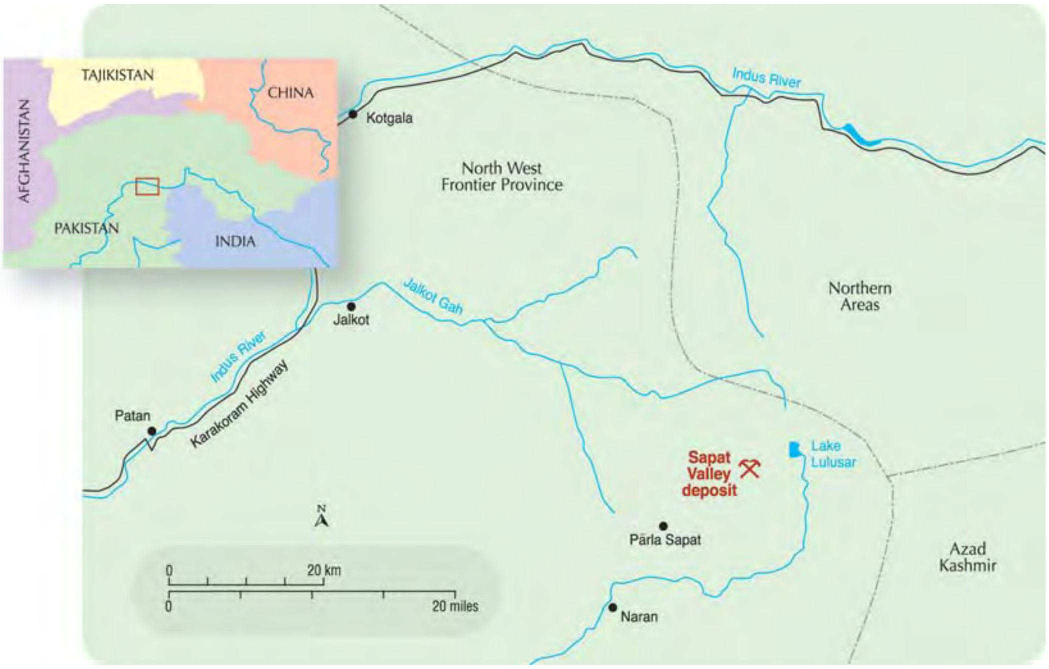


Figure 2. The peridot deposit is located in the Sapat Valley, Mansehra district, North West Frontier Province, Pakistan, about 240 km (by air) north-northeast of Peshawar. The route through Jalkot Valley is dangerous and is not recommended for nonlocals. Note that certain borders in this area are in dispute.

rough from Pakistan has had a significant impact on the jeweler's ability to create attractive designs containing numerous large matched peridots.

GEMOLOGY OF PERIDOT FROM PAKISTAN

As noted above, peridot from Pakistan often occurs as large gemmy crystals. With the exception of the occasionally occurring black acicular inclusions of ludwigite-vonsenite, which are unique to peridot from Pakistan (Koivula et al., 1994b; Milisenda et al., 1995; Peretti and Gübelin, 1996), the gemological properties of Pakistani peridot are consistent with those of peridot from other geographic localities. They are summarized in table 1.

ASSESSMENT AND ACQUISITION OF THE PERIDOT ROUGH

Eight kilograms (40,000 carats) of gem-quality peridot rough from the Sapat Valley, Pakistan, was purchased in February 2004 by an experienced manufacturer. Figure 3 shows some of the larger pieces from this parcel, which yielded a number of the gems in the jewelry suite. Sellers of gem rough typically start with a high asking price, recognizing that they will have to negotiate down. The purchaser must carefully study each piece in the parcel, determining the shape, size, and cutting yield, as well as market demand and the potential selling price of the cut gems, before making an offer. An accurate assessment and a little luck can produce a profit; a miscalculation can result in a loss.

Many of the steps in determining the yield and potential value of the faceted gemstones expected from a rough parcel overlap and are repeated during the sawing and preforming stages (see below). Once the identity of the gem mineral is established (again, see table 1), the rough is examined for color, transparency, and inclusions. Some dealers use a lightbox (again, see figure 3), while others use only a portable, high-intensity flashlight such as one utilizing a xenon light bulb and lithium batteries. The latter produces reliable results in either the field or the office. (For more information on identifying gems in the field, see Boehm, 2002.)

TABLE 1. Properties of peridot from Pakistan[a].

Property	Description
Refractive indices[b]	n_x = 1.648–1.653 n_y = 1.663–1.671 n_z = 1.683–1689
Birefringence[b]	0.035–0.038
Specific gravity[b]	3.29–3.37
Spectroscope spectra	Typical peridot Fe^{2+} absorption[b]: distinct, yet diffuse absorption bands at about 453, 477, and 497 nm, as well as a weaker band at about 529 nm (the last often seen only in large stones)[c]
Internal features	Acicular inclusions of ludwigite-vonsenite[b,c,d]; veils (fingerprints, feathers) composed of tiny fluid inclusions, and growth structures[b]

[a]*The gemological properties of Pakistani peridot are consistent with those of peridot from other geographic localities, with the exception of the ludwigite-vonsenite inclusions (which have not been reported in peridot from any other locality).*
[b]*Milisenda et al., 1995.*
[c]*Koivula et al., 1994b.*
[d]*Peretti and Gübelin, 1996.*

It is important to note that while artificial light is ideal for assessing inclusions, natural daylight is vital when judging color quality. Estimating the color of the completed faceted gem requires a thorough understanding of the relationship between the color observed in the rough crystal and the final face-up color. An excellent discussion on this difficult and complicated subject, as well as other aspects of evaluating gem rough, can be found in Sevdermish and Mashiah (1996). However, when assessing gem rough, there is no substitute for years of experience.

By carefully studying the 8 kg of peridot rough, it was estimated that a 20% recovery of faceted gems (or 8,000 carats) could be produced. Although there were many large pieces of rough (up to 35 g), the presence of inclusions and fractures in nearly all the large crystals meant they would need to be sawn into smaller pieces. Therefore, it was expected that 8–10% of the cut gems would weigh under 1 ct; 10–15% would weigh 1–2 ct, 40–50% would weigh 2–5 ct, and the remaining approximately 25–40% would be stones in the 5–20 ct range. The final average yield of approximately 6,500 ct of faceted stones was 16.2%, slightly lower than the original estimate. Of special significance to this article, the author and the manufacturer decided that an extraordinarily well-matched suite of gems could be cut from the parcel due to the uniformity of color.

Figure 3. This representative selection shows 330 g (1,650 ct) of the larger peridot pieces from the 8 kg (40,000 ct) parcel, from which some of the gems seen on the cover and in figure 1 were cut. The rough has been placed on a light-box (typically composed of a translucent white plastic top, illuminated from below with fluorescent lighting), which is often used to evaluate colored gem rough. Photo by Jeff Scovil.

DESIGNING THE GEMS

If properly executed, the cut of a gemstone showcases the gem's inherent beauty in vibrant color and radiating brilliance. A skilled cutter, or lapidary, can take a seemingly unattractive piece of rough and transform it into a beautiful gemstone. Likewise, an unskilled lapidary can ruin a stone with poor cutting and color orientation, resulting in a dull, unattractive, misshapen gem. Excellent cutting—in both planning and execution—is therefore essential to bringing out the maximum beauty of a gemstone.

A good gem cutter typically fashions a piece of rough for maximum weight retention, while also trying to maximize beauty. This is frequently an ongoing struggle, as the cutter must strike a balance between beauty—which depends on proper cutting proportions, symmetry, and color orientation—and the higher price that a greater weight may bring. Preforming (or pre-shaping), the process of grinding a piece of rough into the approximate shape of the finished stone, is a critical step in maximizing the value of a parcel of rough. In fact, many successful buyers of gem rough are exceptional preformers, and will often personally pre-shape most or all of the parcels of rough they purchase.

The initial steps in the processing of colored stones and diamonds differ significantly. In the "manufacture" of diamonds, a master cutter (or marker) marks the precise cleaving and/or sawing locations on the exterior of the rough diamond crystal using indelible ink ("India ink"). Thereafter, the various processing steps are carried out by different individual professionals, such as the sawyer, cleaver, bruter, and polisher (see, e.g., Watermeyer 1991; Sevdermish and Mashiah, 1996; Caspi, 1997).

In contrast, the colored stone preformer or designer alone typically undertakes nearly all of the processing steps. With many colored gems, this includes breaking (cobbing) or cleaving (of those gems having cleavage), sawing, preforming, and girdling (shaping). Once the preform is produced, it is turned over to the master cutter. He or she is responsible for the placement of the facets and achieving the final polish.

Most of the original 8 kg of peridot rough was preformed in the United States by the manufacturer, who is also a master preformer. The peridots prepared for the jewelry suite described in this article, as well as many other large and important stones

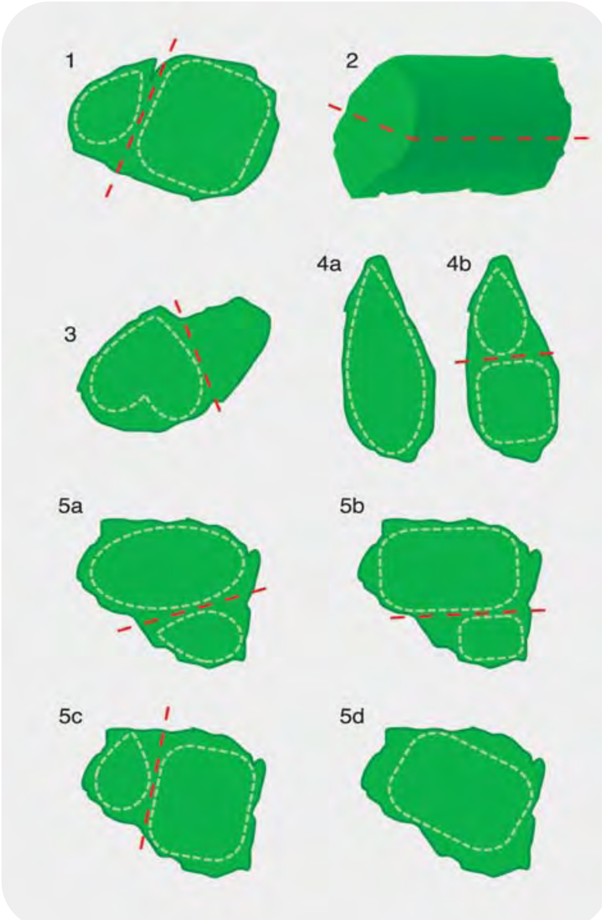


Figure 4. These diagrams illustrate various preform decisions that might be made during the sawing process. The red dashed lines show where the stones would be marked for saw cuts; the white dashed lines indicate the shapes of the gems that would be fashioned from the resulting pieces. Image 1 shows the sawing direction through a veil. Image 2 shows a thick crystal that could be sawn into two pieces from which matching emerald cuts might be faceted. In diagram 3, the red dashed line indicates where this piece would be sawn to remove the included section on the right. The elongated pear shape in 4a might be difficult to sell, so the preformer could decide to cut two smaller gems (4b). In diagram 5, four possible choices are shown for the same piece of rough; factors such as depth, cavities or indentations, and inclusions could influence the final decision. Adapted from Sevdermish and Mashiah (1996).

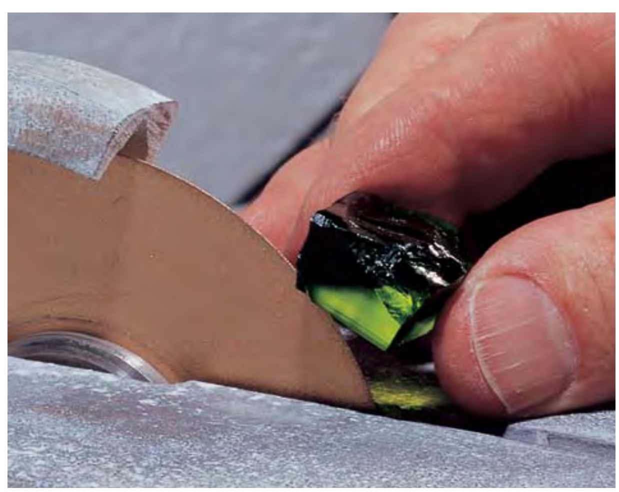
from the same parcel, were faceted by a European-trained master cutter with 30 years of faceting experience, who now lives in the U.S. Most of the remaining stones were cut in China.

The major design element of the matched peridot suite—the shape, size, and number of gems—was decided early in the preforming process. The Asscher cut (an early emerald cut with very wide corners, a high crown, and a deep pavilion) was selected for its classic look. Although this cutting style accentuates color and brilliance, it also highlights any inclusions present in the gem. Therefore, it was critical that only loupe-clean pieces of rough be used. As the necklace suite neared completion, a trapezoid shape was added as the "center" stone to add interest to the design.

Examination and Marking of the Peridot Rough. The peridot rough was first sorted into parcels based on size. Each size-specific parcel was next examined on a fluorescent light-box and sorted again for clarity using the unaided eye. Then, each piece of peridot rough was held very close to an intense incandescent light source. A bright, bare light bulb can be used for this last step, but many professionals prefer a fiber-optic light. Gently rotating the piece of rough, the preformer observes the colors from different directions; locates fractures and solid inclusions; and visualizes the final shape, size, and table location of the finished gem. The location of the table is critical in determining the face-up color of many faceted gems, because in pleochroic gem materials different colors are seen in the different crystallographic directions.

From this initial evaluation, the preformer can often predict the final weight and monetary value of the completed gemstone—in many cases, even

Figure 5. Sawing is one of the most important steps in gem cutting. The first series of cuts are made through cracks or veils ("fingerprints") in the rough. Here, the preformer uses a high-speed, liquid-cooled saw with a 0.2 mm thick diamond blade on one of the peridots. Photo by Jeff Scovil.



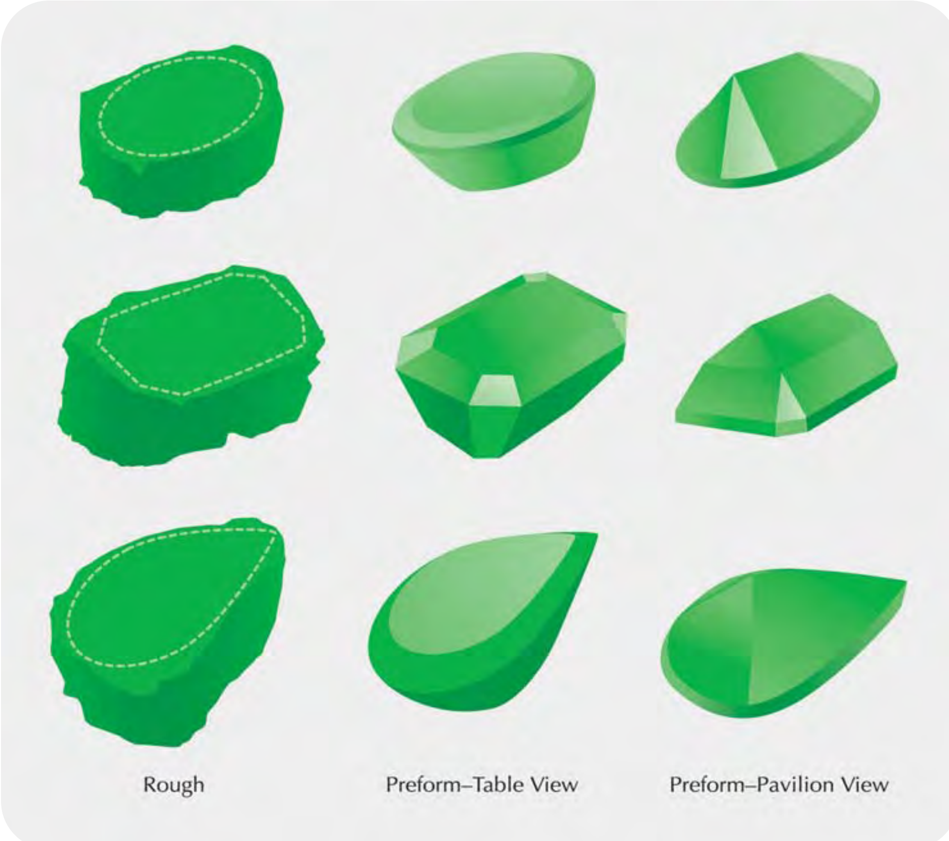


Figure 6. At the preforming stage, the preformer visualizes the shape, proportions, and table location of the finished gem. These idealized diagrams illustrate the transition from rough to finished preform for three popular shapes. Adapted from Sevdermish and Mashiah (1996).

before the first saw cut or grinding. Much of this assessment is done without the aid of magnification, although some preformers use a head-loupe, such as an OptiVisor. During this process, the preformer uses indelible ink to mark areas containing inclusions, deep indentations, and cavities that need to be sawn away, usually directly along fractures and veils, and to plan the final gems (figure 4).

Cobbing of Gem Rough. Another method of removing poorly colored, opaque, included, and/or fractured material (as well as other adhering minerals or matrix) from facetable gem rough is *cobbing*. This can be done by striking the rough with a small metal hammer to remove unwanted areas (Epstein, 1988) or by using a specially designed pair of steel pliers. If the unwanted area does not traverse the piece of rough, pliers are not used because facetable areas may be accidentally crushed or removed. These situations call for the use of a trim-saw (Sevdermish and Mashiah, 1996). Many preformers prefer to use only a saw with expensive gem rough, because it is far more controllable. All of the peridot rough described in this project was trimmed with a saw.

Sawing the Peridot Rough. Following the ink markings (again, see figure 4), the lapidary makes the first cuts using a high-speed, liquid-cooled saw with a sintered diamond blade (figure 5). The blades used for the peridot were a mere 0.2 mm thick. Although somewhat difficult to maneuver (they bend very easily, causing the saw cut to stray off the marked line), these thin blades save material and improve yield.

Next, the preformer evaluates each piece of sawn rough to determine if additional saw-cuts are necessary to produce finished stones with a minimum of weight loss. This is done by again holding the sawn piece up to a bright light to check for any remaining inclusions. If inclusions are still present, the preformer decides whether to remove them by sawing or grinding. Some rough requires multiple saw cuts to produce the desired shape.

Most gem cutters believe that sawing is the most important step in controlling the yield of the rough. Once the sawing of the peridots was completed, all the pieces that lent themselves to Asscher cuts were selected out of the parcel.

Grinding the Preforms. At this stage, the preformer again examines each piece of sawn rough to determine the ideal shape and proportions that can be cut from it (figure 6). As has been pointed out, in many cases this is an ongoing struggle and compromise between weight retention and beauty. In

Figure 7. The sawn piece of rough is then ground against a diamond-impregnated wheel to produce the approximate shape and proportions of the finished gemstone. This step is crucial to the design of the final gem. Photo by Jeff Scovil.

creating the peridot jewelry suite, weight retention was much less of a consideration, since the intent was to create the most precisely matched set possible from the original parcel. The beauty, uniqueness, and rarity of such a suite would more than compensate for the reduced yield.

Figure 8. As the preforms were completed, they were laid out to check for consistency of color (hue, tone, and saturation) from one stone to the next and, for the necklace, to ensure the smooth graduation from large to small sizes. This photo shows the beginning stages of this process; as more preforms were completed they were added, and some (including a few of those shown here) were removed. Photo by Jeff Scovil.

The next step in the preforming process involves grinding the sawn rough into the approximate shape of the finished gem (figures 7 and 8). In this case, three diamond-impregnated wheels—coarse, medium, and fine grit—were used to preform the peridot rough.

Some of the questions the preformer must consider are: Will the culet meet the edge of the rough so as to have the proper total depth, while not wasting too much material? (If not, another shape must be created from this particular piece of rough, and another sawn piece must be chosen for the jewelry suite.) Will the face-up color orientation match the color of the rest of the suite? Is there enough material under the proposed table to enable cutting the proper angles, so that the gem will not be too shallow or windowed? (If not, a smaller stone must be shaped.)

If the stone has great value—for example, a large natural-color ruby—the preformer may first grind the table into place and give the rough to the cutter to polish the table. This enables a clear view into the stone so that a better assessment of color, including distribution and clarity, can be made before the rest of the stone is preformed.

After the table is in place, the sawn rough is ground into the desired shape. While it does not have to be perfect, it does need to follow closely the shape and proportions desired for the final faceted gem (again, see figures 6 and 8). With the peridot suite, care was taken to ensure that the opposing sides of the preforms were parallel. The preformer also made certain that all the proportions (such as crown and pavilion angles, crown height and pavilion depth, table size, even girdle thickness, etc.) were consistent from one preform to the next. Minor corrections needed for these proportions could be made later by the faceter.

Any cracks and inclusions not removed during the sawing process are dealt with at this stage. The peridot suite required very clean stones, so all (or nearly all) inclusions were sawn or ground out of the preforms. However, with gem material for which some inclusions are allowable (such as emeralds), or with very expensive material (such as natural-color Mogok rubies), inclusions are left in the preforms, but the cut is designed to make them as inconspicuous as possible. For example, the performer tries not to place inclusions at or near the culet because they will reflect throughout the fin-

Figure 9. Once preformed, the pieces were delivered to the master cutter. Shown here is the slightly modified, classic Swiss jam-peg system that was used to facet the peridot suite. Photo by Jeff Scovil.

ished stone when viewed in the face-up position.

Some shapes are easier to sell than others, so it is often better to choose a more popular shape even if it results in a greater weight loss from the original rough. The girdles can be rough-cut by hand on the preforming grinder (again, see figure 7), or they can be cut using a girdle-grinding machine. The initial girdling (shaping) of the peridots in this suite was done during the preforming stage.

Once the peridot suite preforms were completed, they were laid out to be sure that the hue, tone, and saturation of the stones matched and, for the necklace, that the transition from large to small sizes was smooth (again, see figure 8). The preforms for the necklace were then sorted into "matched" pairs and delivered to the master cutter with instructions that each pair of opposing stones must have parallel sides and be precisely matched.

Placement and Polishing of the Facets. Several different kinds of faceting approaches and equipment choices exist (see, e.g., Sinkankas, 1984; Sevdermish and Mashiah, 1996). A slightly modified version of the classic Swiss jam-peg faceting system (with copper laps charged with diamond powder) was used to facet this peridot suite (figure 9). Although the jam-peg system is primitive in appearance, an experienced lapidary can produce extraordinarily well-cut gemstones with it, and various versions have long been used by many of the finest cutters in the world. The beauty of the system lies in the fact that it allows flexibility in choosing facet angles and, for the experienced jam-peg cutter, it is faster than the protractor-type (index) system, in which the dop is held mechanically at specific angles (Sinkankas, 1984).

The jam-peg system used to facet the peridot suite includes a dop-stick that is held in the cutter's hand. The flat end of the dop-stick, or rod, has the preformed stone attached by either cold or hot cementing (wax also can be used, as was the case with the peridot suite). The cutter presses the end holding the gem against the diamond-charged, horizontally rotating cutting lap, while the other (pointed) end of the dop-stick is "jammed" into a chosen hole (actually a shallow depression) that corresponds to a particular facet angle relative to the cutting wheel. These holes are precisely placed in a solid surface called an arc (A in figure 10), which was curved metal in the case of the peridot suite project, although other systems employ a flat-surfaced arc, which may be made of either wood or metal. The arc is attached to the table by a vertical support. By positioning the pointed end of the dop-stick into different holes of the jam-peg arc, the cutter determines the angles and position of the facets.

The dividing head (C in figure 10) determines the circumferential angles, as well as additional angles of altitude. A simple octagonal dividing head is adequate for square and rectangular emerald cuts (and was used in the cutting of the peridot suite), whereas a more complex dividing head is required for other shapes (see, e.g., Sevdermish and Mashiah, 1996).

The first step is to facet the crown. The facets are initially formed using a rough-textured lap to remove material quickly. This generates heat, so the rotating lap is cooled with water. The next step is undertaken with a final cutting lap, or pre-polish lap, which removes much less material but produces a slightly smoother, yet still rough surface. This allows the cutter to create all the facets at the desired angles and sizes. Once the crown is faceted, an ultra-high polish is achieved using a copper lap charged with very fine diamond powder (up to 50,000 grit). Because very little material is removed during the polishing process, much less heat is generated, so water for cooling is not necessary during this final step (for the peridots, however, oil was mixed with the fine diamond powder).

After faceting of the crown is complete, the stone is removed from the dop-stick and cleaned of all adhesive. It is then remounted with the dop-stick perpendicular to the table, so that the uncut pavilion is exposed and the stone is centered on the dop's longitudinal axis. Once the stone is attached and centered on the dop, the cutter repeats the process of placing and polishing facets. The polishing of the girdle is the final stage in the faceting process while the stone is still on the dop-stick.

Sorting, Matching, and Slight Re-Cutting of the Suite. As each matched pair (opposing stones) in the necklace was completed, they were carefully checked to ensure that the color and all proportions were essentially the same. Minor deviations in proportions were remedied by slight re-cutting. Any other objectionable differences would cause the stone to be rejected, and another would be cut to replace it in the suite. The same quality-control process was undertaken for the stones in the bracelet and earrings. As the finished gems were completed, they were positioned to simulate the actual jewelry set (figure 11). The layout was then evaluated to ensure that hues, tones, saturations, and shapes matched, and that there was a smooth transition in sizes in the necklace.

Once we were satisfied with the 54 faceted peridots (which ranged from 3.57 to 18.30 ct, for a total of 350.40 ct), the suite was ready for the next major phase: the design of the jewelry, the cutting of the diamonds, and the manufacture of the finished pieces.

THE DESIGN AND MANUFACTURE OF THE JEWELRY SUITE

The completed matched suite of unset peridots was sold to an American client, who desired well-designed and finely crafted jewelry. Suwa (2001) stated that the highest quality of jewelry fabrication (representing just a few percent of the total market) is accomplished by marrying a well-planned design concept to the highest standards of craftsmanship using the finest materials and taking the necessary time. A superior design is not only aesthetically pleasing, but it also results in a finished piece that is comfortable to wear while it holds the gems securely. For these peridots, the client chose Van Cleef & Arpels to design and manufacture the jewelry.

A Brief History of Van Cleef & Arpels. The venerable firm of Van Cleef & Arpels began in 1896, with the marriage of Estelle Arpels, daughter of Leon, a gem trader, and Alfred Van Cleef, the son of a diamond merchant from Amsterdam. Alfred joined his new brothers-in-law to create a jewelry house. The success of this collaboration allowed them to move,

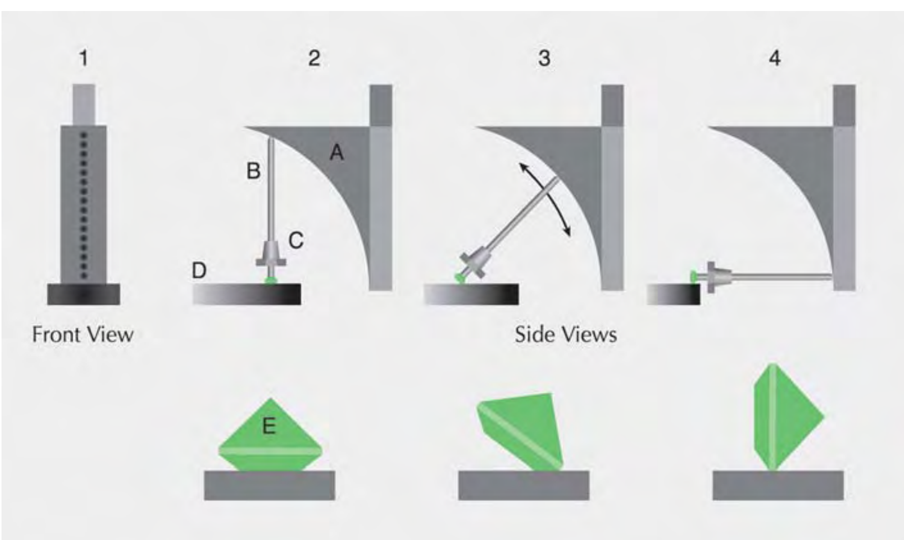


Figure 10. With the jam-peg system, the cutting angles are achieved by using the arc as illustrated here. Image 1 is a front view of the arc, showing the precisely placed holes into which the pointed end of the dop-stick is "jammed." Images 2–4 show the jam-peg process from the side, with A *the arc,* B *the dop-stick,* C *the octagonal dividing head,* D *the cutting lap, and* E *the gem. The position of the dop-stick when cutting the table of a stone is illustrated in image 2, with 3 showing the position for cutting the crown facets (with a similar position, but different angles, for the pavilion facets), and 4 the position used for the girdle. Adapted from Sevdermish and Mashiah (1996).*

in 1906, to the Place Vendôme in Paris, an area renowned for its elegance and luxury, and the headquarters remains located there today.

Van Cleef & Arpels's clients have included royalty and Hollywood legends, as well as other discriminating clientele. In 1956, VCA was designated "official supplier to the Principality" of Monaco, and a decade later their designs were selected from more than 50 proposals for the crown to be used at the coronation of Farah Pahlavi, who was to marry the Shah of Iran.

To this day, Van Cleef & Arpels is renowned for its innovative designs and techniques such as the "invisible setting," in which the prongs are hidden beneath the crown of the gemstone. The company prides itself on using only the highest-quality gems in their superbly crafted jewelry.

Creation of the Design at the Van Cleef & Arpels Paris Atelier. A designer at the Paris atelier was commissioned to produce two very simple yet sophisticated design renderings. The goal was to create a distinctive and attractive suite of jewelry to showcase the peridots. The degree of manufacturing difficulty was not considered as important as the final design.

The first illustration consisted of a modern design composed of uneven lateral baguette diamonds set between the Asscher-cut peridots. The second rendering, the one ultimately chosen by the client, consists of paired baguette diamonds set parallel to one another between the main gemstones in the necklace, and single baguette diamonds between the peridots in the bracelet and earrings, as well as in the back of the necklace. The ring contains two rows of baguette diamonds on each side of the shank, and baguettes on the peridot gallery (figure 12).

Handcrafting the Jewelry at the Van Cleef & Arpels New York Atelier. After the design was approved, the director of production in the New York atelier consulted his foreman to determine which jewelers would work on which pieces of the suite (i.e., the necklace, bracelet, earrings, or ring). The selection was made based on each jeweler's particular area of expertise. The jewelers selected to manufacture various parts of the suite specialized in hand fabrication and, with the exception of the ring, were the in-house experts for making hinges and joining mechanisms. Five different master jewelers worked on the suite, spending a combined total of more than 900 hours.

Figure 11. The final selection of cut peridots resulted in this matched suite comprising a total weight of 350.40 ct, with the 54 pieces ranging from 3.57 to 18.30 ct. Photo by Harold & Erica Van Pelt.

Making the Settings. The suite was handmade from a standard platinum alloy consisting of 95% platinum and 5% ruthenium. Pure platinum is soft, whereas platinum alloys are more durable and thus increase the wearability. The settings for all of the peridots include upper and lower galleries (sometimes referred to as bezels) that are joined by four prongs (figure 13). The outside measurements of the upper galleries were made smaller than the outer dimensions of the peridot—so that when finished, no metal would be visible from a top view except for the top portions of the tapered prongs. The upper and lower galleries were made from platinum sheet. Then, the prongs were made by hand using rectangular wire to fit the gallery to the peridot at the appropriate angle.

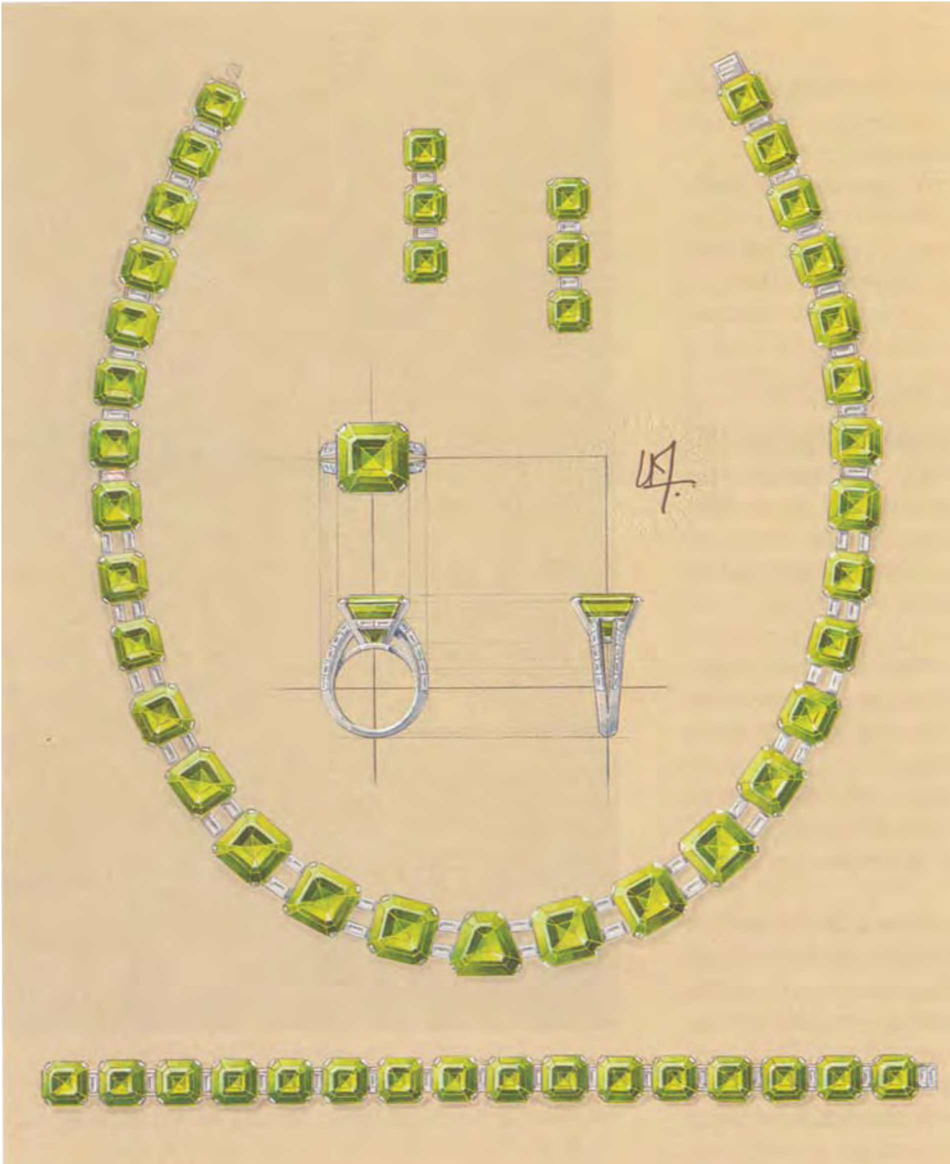


Figure 12. A color rendering of the jewelry suite was created by the Van Cleef & Arpels design team in Paris. This composite image of the designs shows the plans for the necklace, bracelet, ring, and earrings. © Van Cleef & Arpels.

After the gallery pieces and prongs were formed, they were filed, pre-polished, and assembled (figure 14). In contrast to gold, platinum is much more resistant to polishing because of its extreme density. However, platinum also holds its luster through assembly and soldering, so the settings required minimal additional polishing during the finishing process.

The jewelers then made the settings for the baguette diamonds in the necklace, earrings, and bracelet. The metal consisted of two precisely formed pieces of platinum placed on either side of the diamond to secure it, with a channel-type setting running the length of the narrow ends of the baguettes (that, again, was the only metal visible from the top view).

Creating the Hinges and Connectors. Next, the jewelers hand-fabricated the hinges and connectors (figure 15). The connection in a piece of jewelry actually marries the stones and metal. It is extremely important in couture craftsmanship to hide the connections as much as possible, so they are not visible to the unaided eye and do not detract from the essence of the design.

To construct the bracelet, two platinum tubes were attached to the peridot settings and one to the setting for each of the baguette diamonds. Platinum hinge wires were inserted through the tubes to join the bracelet segments. After the bracelet was joined, it was flexible and smooth, moving laterally with no play and evenly following the contour of the wrist when worn.

For the necklace and earrings, special connections were used that when joined can move in two directions, so the necklace lies comfortably on the contour of the neck and the earrings move and dangle freely.

Figure 13. The peridot settings were hand fabricated from sheet and wire platinum. They are composed of upper and lower galleries, and four prongs. The base of the setting, or the lower gallery, is cut out with a jewelers saw. The bearing—a notch cut in each prong with a setting burr—serves as a "seat" for properly positioning and securing the gem. (Note that this schematic diagram is to clarify terminology only; it does not represent the actual peridot settings.)

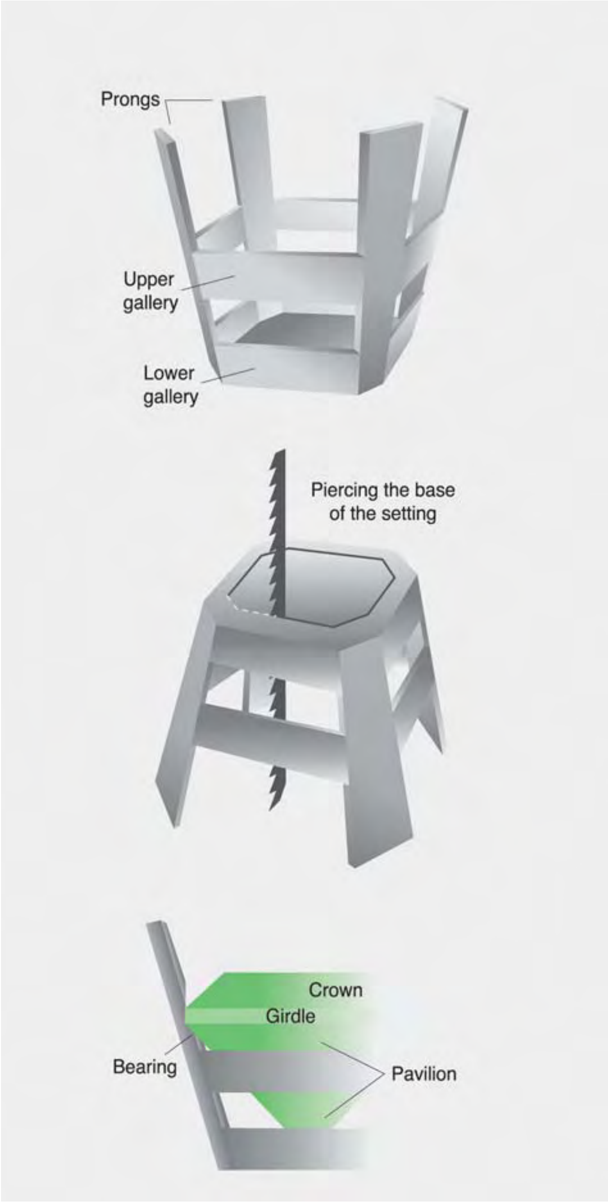


Figure 14. The setting (gallery and prongs) for each of the peridots was handmade to fit that stone. This photo shows the process underway. One tray holds the actual stones placed table-down over a color copy of the rendering; above this is a second tray with another copy of the rendering on which the settings have been placed in their proper position. The master jeweler then files and shapes each setting by hand to ensure the proper fit of the specific gem (inset). Photos by Robert Weldon.

Figure 15. The jeweler hand-fabricates the hinges and connectors for the suite. For the bracelet, two platinum tubes were attached to the peridot settings and one to the settings for the baguette diamonds. Platinum hinge wires were inserted through the tubes to "join" the bracelet; the ends were then flanged. Photo by Robert Weldon.

Figure 16. To set the peridots, a bracelet section comprising three main settings, with baguette diamonds separating the peridots, was put into a shellac stick on the end of a wooden handle. This stick allows the jeweler to firmly hold the section in one hand, while setting the gems using the appropriate tools. Photo by Robert Weldon.

The Finishing Steps. After the fabrication and assembly were completed, the jewelry items were detailed, polished, and finished by the in-house finishing expert. This was done before the peridots and diamonds were set, because polishing various parts prior to assembly enables the jeweler to achieve a mirror finish on areas that would not be easily accessible once all the gems were set.

Upon completion of the individual jewelry settings for the peridot suite, VCA turned to the diamonds. To supply the precisely cut diamonds required, the company either had existing baguettes recut to their specifications or had them specially cut from the rough. Not only were the diamonds cut to the proper length, but in areas where the necklace curves (essentially, the front half) and in the ring, the ends of many of the diamonds also had to be fashioned to the proper angle so they would fit perfectly into the settings. Incorporated into the suite's various jewelry pieces are more than 90 diamonds, with a total weight of approximately 21 carats. All are D-E color and VVS or better clarity.

After the finishing process, the settings, diamonds, and peridots were given to two different setters—one for the diamonds and another, who specializes in large colored stones, for the peridots (figure 16). More time and care is required to set peridots—than, for example, sapphires—because of their only fair to good toughness and $6\,^1/_2$–7 hardness.

The colored stone setter begins by vertically tapering the outside of the prongs; the bearings are then cut with a setting burr, and the peridot is placed at the proper height and evenly in the prong bearings (figure 17). At this point, the prongs are

Figure 17. Using a sanding wheel on a flexible shaft-motor, the setter vertically tapers the outside of the prongs holding the peridots (left). Bearings are then meticulously cut in each prong slightly above the upper gallery wire where the peridot will finally be seated (center), and the peridot is carefully positioned in the prong bearings (right). Photos by Robert Weldon.

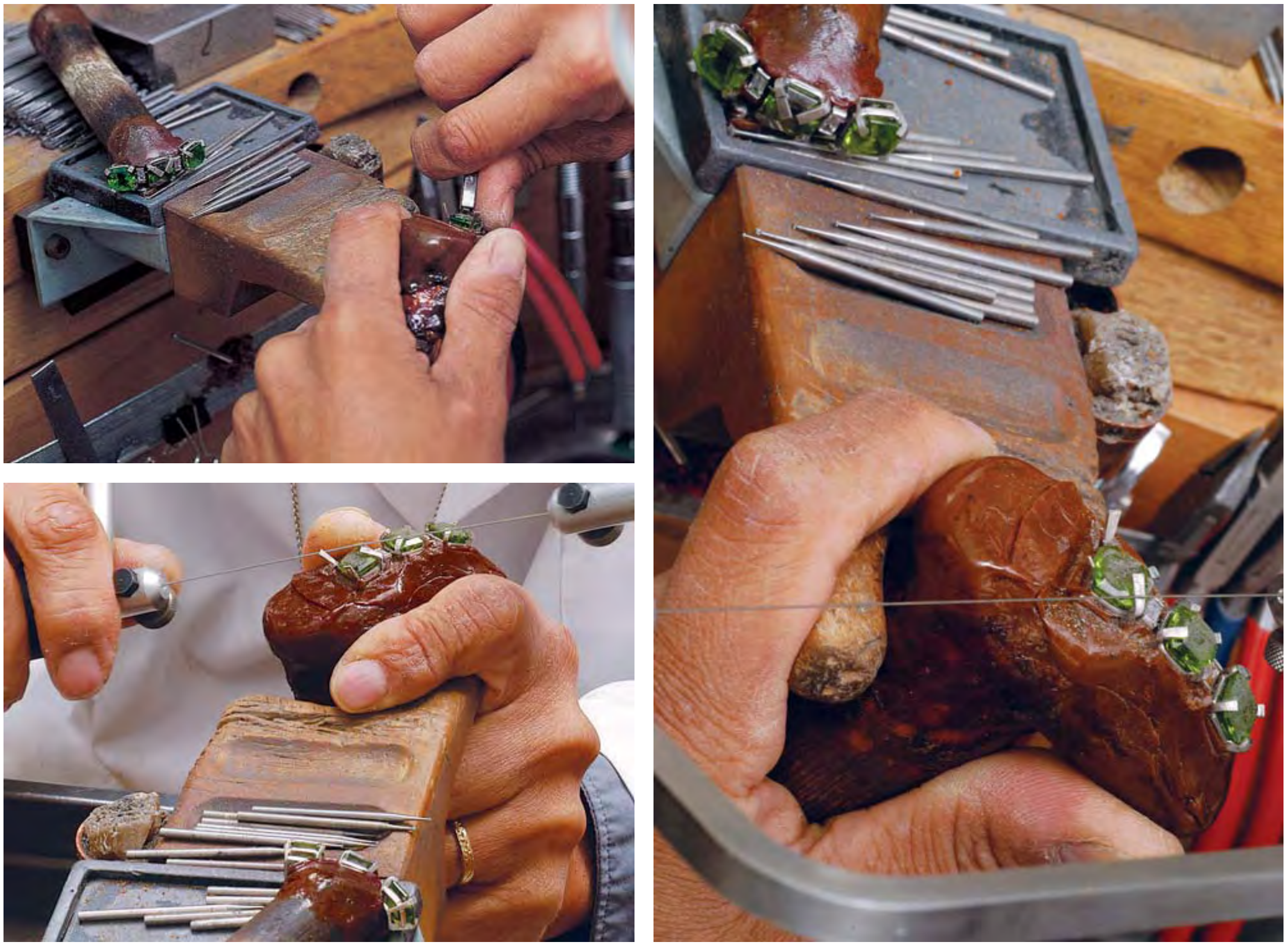


Figure 18. The setter uses a prong-pusher to bend the prongs one at a time over the crown at each corner (upper left). The prongs are then carefully shortened using a jeweler's saw (lower left and right). Photos by Robert Weldon.

pushed, one at a time, over the corners of the crown. A jeweler's saw is used to cut the prong to the correct length (figure 18). Great care is taken to keep the saw blade from touching the peridot, as this would damage it. Last, the prongs are filed and polished.

The primary goal was to set the peridots as low as possible without letting the culets extend below the bottom gallery. After setting, they were perfectly even and at the same height in each multistone piece.

Making the Ring. Although the above procedure was applied for the necklace, earrings, and bracelet, a somewhat different process was used for the ring. This mounting started with a model that was precisely hand-carved from a special wax used exclusively for items with intricate detail. The master wax model was then cast in platinum and the platinum perfected by filing and polishing. To create the sharpest and most precise details, which are not possible with lost wax casting, the ring was completed by hand fabricating the remaining components. Sheet and wire platinum were used to create the upper and lower galleries and the four prongs that would encase the peridot. The upper portion of the inside ring shank was then carefully crafted (figure 19). After the components were soldered, the peridot and all 24 specially cut diamonds were fitted prior to pre-finishing, polishing, and then setting.

CONCLUDING THOUGHTS

During the past 30 years, the gem and jewelry industries have been blessed with a plethora of new gem deposits around the world, yielding extraordinary qualities and quantities of a wide variety of gemstones. The discovery in the early 1990s of the Sapat Valley peridot deposit is an exceptional example. The consistent availability of large, fine pieces of rough from Pakistan has had a significant impact on the jeweler's ability to create beautiful designs

Figure 19. The main component of the ring was lost wax cast in platinum. The setting for the peridot (comprising the upper and lower galleries, and four prongs) was hand-fabricated from platinum sheet and wire. The upper inside-shank section was carefully fit to the ring (inset), before soldering and trimming. Photo by Robert Weldon.

with important stones. The added benefit of an expert preformer and faceter, as well as the talented designers and craftspeople at Van Cleef & Arpels, enabled the creation of the matched necklace, bracelet, ring, and earring suite described in this article. If the gem dealer, cutter, and jeweler are innovative and look for such opportunities, extraordinary jewelry can be produced.

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ACKNOWLEDGMENTS: The author thanks the staff of Van Cleef & Arpels (in Paris and New York) for their extraordinary professionalism and kind cooperation. He also thanks Mark and Lainie Mann for very useful information regarding the manufacture of jewelry, and Erica and Harold Van Pelt, Jeff Scovil, and Robert Weldon for their exceptional photographs. The author holds a shared copyright with the photographers and GIA on all the photographs in this article.

REFERENCES

Boehm E. (2002). Portable instruments and tips on practical gemology in the field. *Gems & Gemology*, Vol. 38, No. 1, pp. 14–27.

Caspi A. (1997) Modern diamond cutting and polishing. *Gems & Gemology*, Vol. 33, No. 2, pp. 102–121.

Epstein D.S. (1988) Amethyst mining in Brazil. *Gems & Gemology*, Vol. 24, No. 4, pp. 214–228.

Federman D. (1992) Gem profile: Arizona peridot: Desert green. *Modern Jeweler*, Vol. 90, No. 5, pp. 39–40.

Federman D. (1995) Gem profile: Pakistan peridot. *Modern Jeweler*, Vol. 94, No. 8, p. 14.

Frazier S., Frazier A. (1997) The perils of peridot pursuit. *Lapidary Journal*, Vol. 50, No. 12, pp. 18–23.

Hammer V.M.F. (2004) The many shades of Pakistan's green gemstones. In *ExtraLapis English No. 6: Pakistan—Minerals, Mountains & Majesty*, Lapis International, LLC, pp. 64–71.

Jan M.Q., Khan M.A. (1996) Petrology of gem peridot from Sapat mafic-ultramafic complex, Kohistan, NW Himalaya. *Geological Bulletin, University of Peshawar*, Vol. 29, pp. 17–26.

Kausar A.B., Khan T. (1996) Peridot mineralization in the Sapat ultramafic sequence, Naran-Kohistan, Pakistan. *Geologica*, Vol. 2, pp. 69–75.

Koivula J.I., Kammerling R.C., Fritsch E., Eds. (1994a) Gem News: Peridot from Pakistan. *Gems & Gemology*, Vol. 30, No. 3, p. 196.

Koivula J.I., Kammerling R.C., Fritsch E., Eds. (1994b) Gem News: More on peridot from Pakistan. *Gems & Gemology*, Vol. 30, No. 4, pp. 271–280.

Milisenda C.C, Bank H., Henn A. (1995) Peridot aus Pakistan. *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, Vol. 44, No. 2/3, pp. 33–42.

Peretti A., Gübelin E.J. (1996) New inclusions in Pakistani peridot: Vonsenite-Ludwigite needles. *Jewel Siam*, Vol. 6, No. 6, pp. 68–69.

Revere A. (2001) *The Art of Jewelry Making: Classic & Original Designs*. Sterling/Chapelle, New York, 144 pp.

Sevdermish M., Mashiah A. (1996) *The Dealer's Book of Gems and Diamonds*, Vols. I and II. Kal Printing House, Israel, 1004 pp.

Sinkankas J. (1984) *Gem Cutting: A Lapidary's Manual*, 3rd ed. Van Nostrand Reinhold Co., New York, 365 pp.

Suwa Y. (2001) *Gemstones: Quality and Value, Volume 3—Jewelry* (English edition). Sekai Bunka Publishing Inc., Tokyo, 144 pp.

Untracht O. (1982) *Jewelry Concepts and Technology*. Doubleday Books, New York, 864 pp.

Watermeyer B. (1991) *Diamond Cutting*, 4th ed. Publ. by the author, Johannesburg, South Africa, 405 pp.