Famous mineral localities: Klein Spitzkoppe, Namibia

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Famous Mineral Localities:

KLEIN SPITZKOPPE

NAMIBIA

Bruce Cairncross
Department of Geology, University of Johannesburg,
Auckland Park Kingsway Campus
P.O. Box 524, Auckland Park 2006, South Africa
Email: bc@na.rau.ac.za

Klein Spitzkoppe has been producing topaz crystals for over 100 years. Since the discovery of the pegmatite in 1889, many fine crystals have been collected and thousands of carats of gemstones have been faceted from colorless, transparent, so-called "silver topaz." Most topaz specimens consist of loose crystals, but some rare matrix pieces with microcline and smoky quartz are known. Associated collectable minerals including beryl (aquamarine), green fluorite, phenakite and bertrandite have also been found there.

LOCATION

Klein Spitzkoppe is a granite inselberg ("island mountain") located in southern Damaraland, Namibia, 110 kilometers northeast of the coastal harbor town of Swakopmund. The mountain peak is 1,580 meters above sea level. Approximately 12 km east-northeast of Klein ("small") Spitzkoppe is another granite inselberg, Gross ("large") Spitzkoppe, which has an elevation of 1750 meters above sea level. Both of these mountains form impressive topographic landmarks that can be seen from many kilometers away, rising high above the surrounding Namib Desert calcrete plains. The name "Spitzkoppe" has been spelled several ways in the literature, for example "Spitzkopje" (Heidtke and Schneider, 1976; Leithner, 1984), "Spitzkop" (Mathias, 1962) and the version used in this article, Spitzkoppe. This latter spelling is the one used on the geological maps of the region. *Spitz* is German for "peak" and *koppe* refers to a "hilltop."

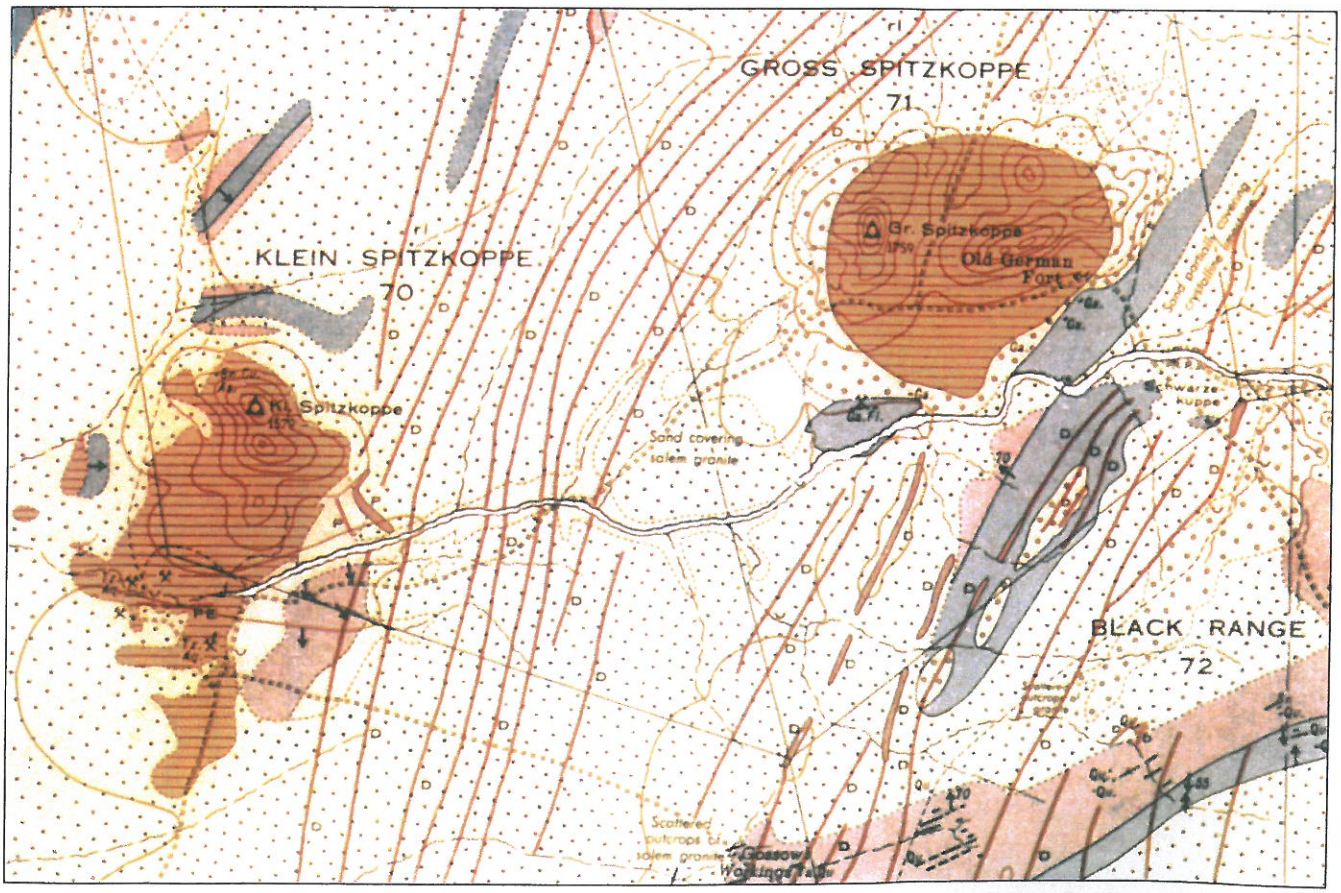
Access to Klein Spitzkoppe is easy, and the locality can be reached using a conventional vehicle. The main paved road that connects Windhoek to Swakopmund (B2) passes south of the Spitzkoppe and both mountains are clearly visible from the road. Approximately 100 km northeast of Swakopmund, a road leads northwest from B2 to the coastal village of Heinties Bay. About 30 km from this turnoff, this dirt road passes close by the Klein Spitzkoppe. Local diggers ply their stocks along this road, and sometimes reasonably good quality specimens can be purchased at fair prices. Some caution should be exercised, however, because more and more specimens from other neighboring localities like Erongo and the Brandberg are being mixed in with the Spitzkoppe material, so buying on site does not guarantee that the pieces come from Klein Spitzkoppe. Most, if not all, of the topaz, aquamarine and other collectable minerals such as fluorite are extracted by the local Damara workers who live in very rudimentary shacks close to their respective diggings. They either dig randomly in the weathered granite outcrops where it is relatively easy to pry crystals loose from their matrix, or they collect topaz from alluvium and alluvial scree. These latter crystals are usually water-worn and are more suited for faceting and jewelry purposes than as mineral specimens.

HISTORY

The two Spitzkoppen have been known since antiquity. Although no archeological evidence exists to prove that the Bushmen

Figure 1. Locality map of Namibia showing the geographic location of Klein Spitzkoppe (red box refers to Fig. 2).

Figure 2. Portion of the historical geological map of the Karibib area, compiled by Frommurze *et al.* (1942). Note the location of Gross and Klein Spitzkoppe (orange), situated 12 km apart, surrounded by eolian (windblown) desert sand (yellow). The location of the topaz and aquamarine workings can be seen on the southwestern flank of Klein Spitzkoppe mountain.



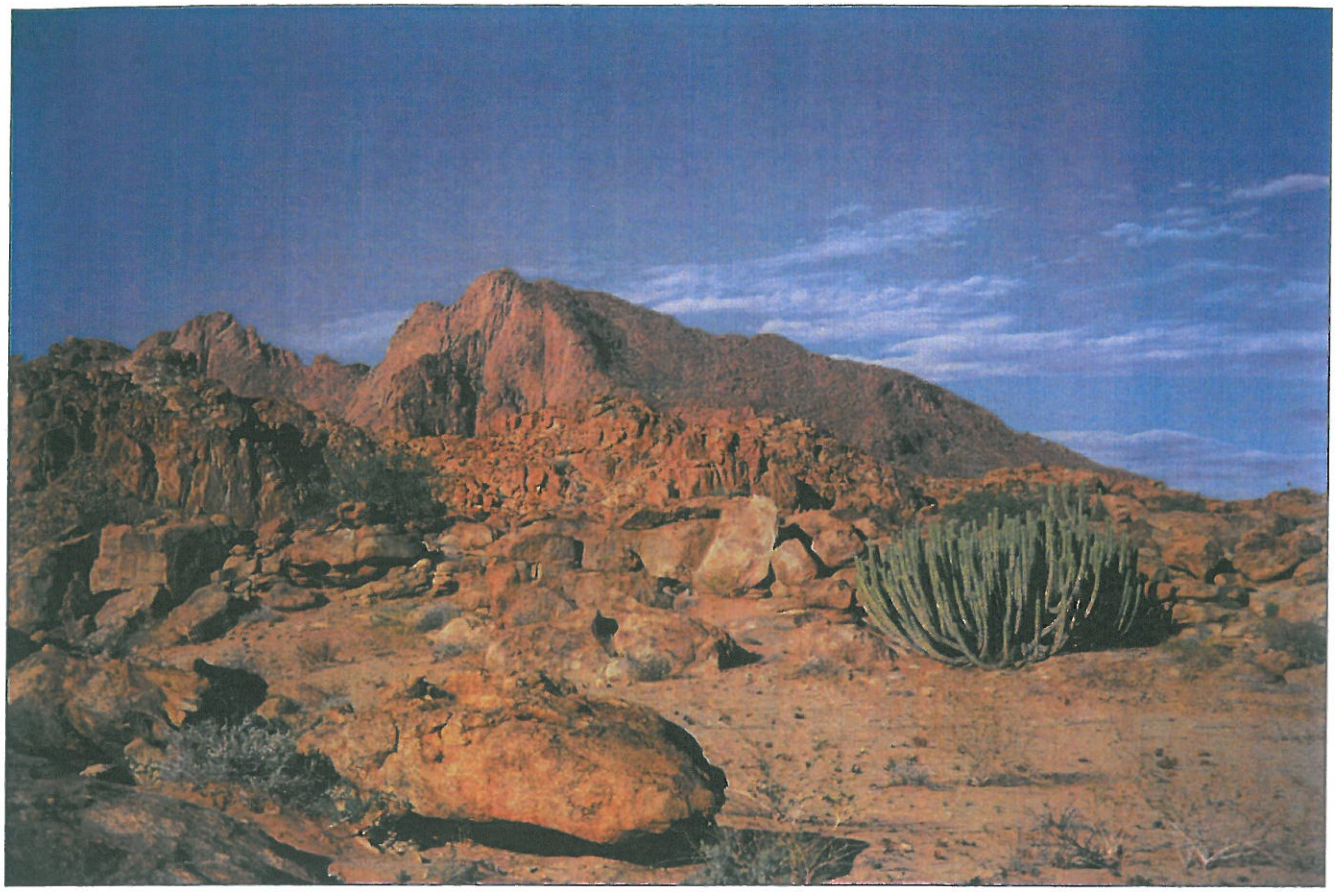


Figure 3. **Klein Spitzkoppe with an indigenous *Euphorbia* succulent bush in the foreground. Bruce Cairncross photo.**

collected crystals, their paintings adorn some of the granite overhangs at Klein Spitzkoppe.

The topaz deposits at Klein Spitzkoppe were first described in the late 19th century German literature by Hintze (1889). At the time, the locality was known as the Keins-Berge, although the Dutch name, "Spitzkoppjes" was already used to name several steep-sided inselbergs and isolated mountains in the Damaraland region. Hintze (1889) received loose crystals of topaz and fragments of beryl from Klein Spitzkoppe that were originally collected by Baron von Steinäcker, but these were passed on to Hintze by G. Gürich. These specimens were used to describe the morphology and crystallographic forms of the Klein Spitzkoppe topaz. The Namibian specimens were described as being reminiscent of crystals from Russia as they showed a similar morphology and were also transparent.

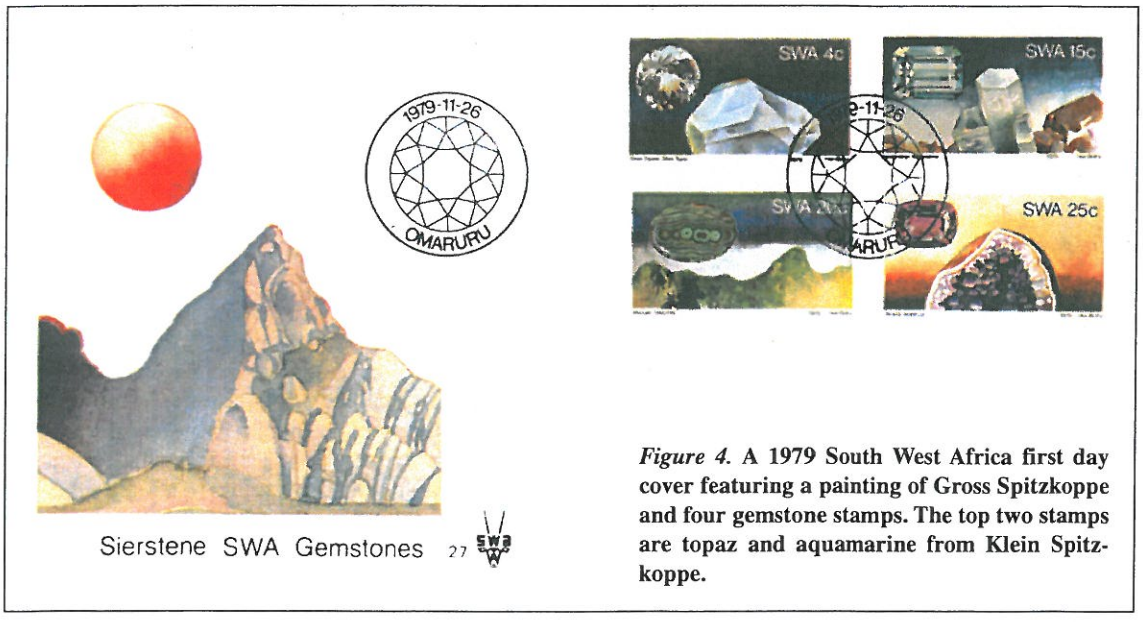


Figure 4. **A 1979 South West Africa first day cover featuring a painting of Gross Spitzkoppe and four gemstone stamps. The top two stamps are topaz and aquamarine from Klein Spitzkoppe.**

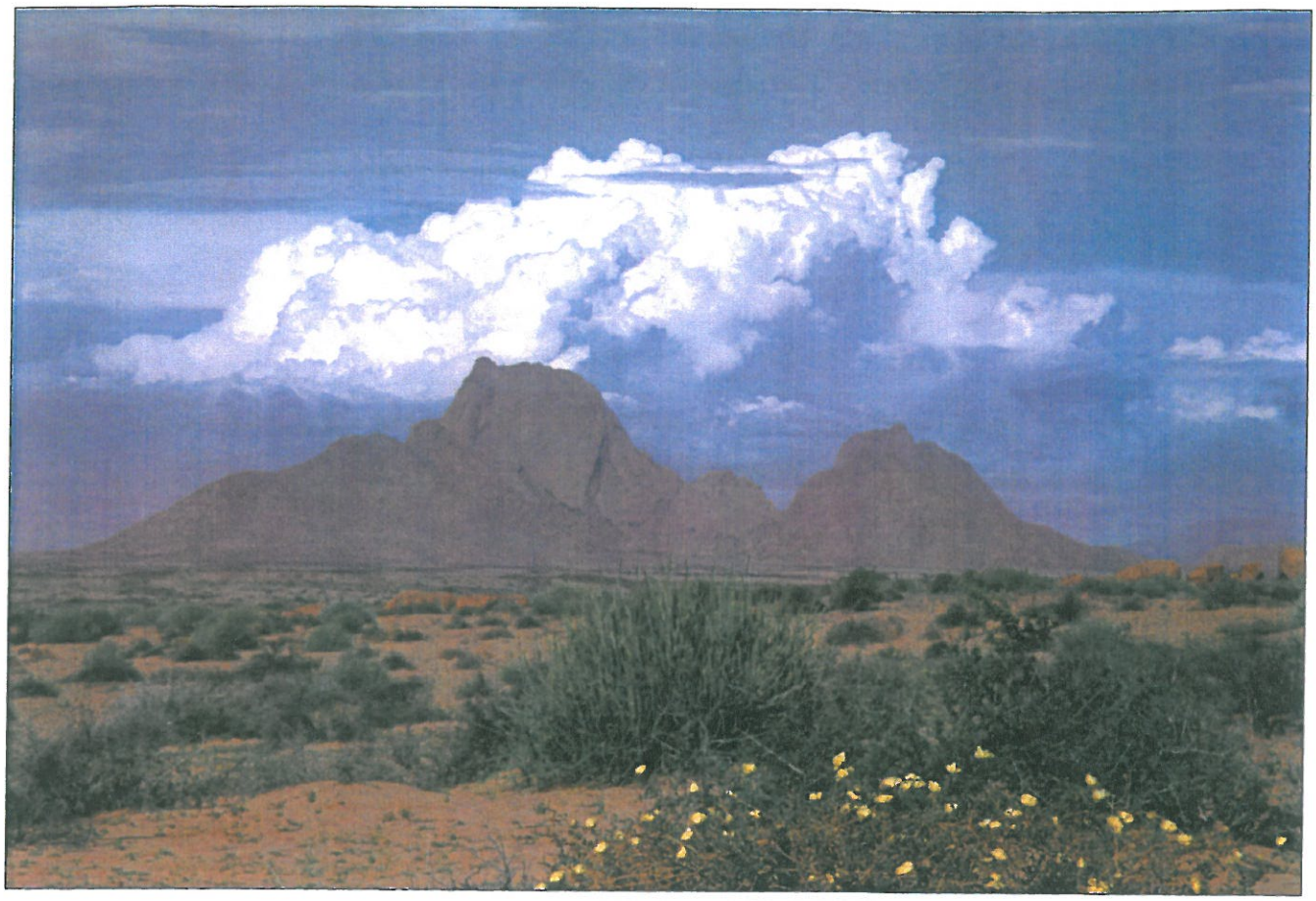


Figure 5. **Gross Spitzkoppe, viewed from the Klein Spitzkoppe, with a rare desert storm brewing in the background. Bruce Cairncross photo.**

The main period of topaz "mining" in Namibia was during the 1930's, and from 1930 to 1938, 34.5 kg of faceting-grade topaz was mined in Namibia, mostly from the Klein Spitzkoppe deposits (Schneider and Seeger, 1992a). In more recent times, production figures have not been systematically recorded and most topaz mining is carried out informally by the Damara diggers. Aquamarine is also extracted from the miarolitic pegmatite cavities in the granite, but is less commonly encountered than the topaz. Although no production figures are available, many carats of aquamarine have also been cut from material collected at Klein Spitzkoppe. Yellow beryl (heliodor) is also infrequently encountered in the pegmatites and some fine gems have been cut from this material as well.

Apart from small-scale, informal gemstone mining, granite was also exploited on a larger scale at Klein Spitzkoppe. Until 1998, the yellow granite, known colloquially as "Tropical Sun," was quarried by one company, the African Granite Company (Pty) Ltd., for building stone. These operations are dormant at present and the company no longer owns the quarries. Blocks of quarried granite are still scattered around on the surface near the quarry. Most of the granite was exported to Germany and Japan where it was utilized for cladding and domestic applications (ASSORE, 1996).

Klein and Gross Spitzkoppe were systematically mapped during 1928, and the regional geology was later revised in 1937. The results of this mapping project were published several years later (Frommurze *et al.*, 1942). A detailed 1:125,000 geological map accompanies the Frommurze *et al.* (1942) report, which provides a brief description of the topaz occurrences at Klein Spitzkoppe, including a detailed map of some of the topaz localities. Prior to this, the two Spitzkoppe mountains had been shown on an older (1923) 1:1,000,000 geological map detailing the central part of Namibia (then South West Africa). This was produced for the Deutsche Kolonial-Gesellschaft für Südwest-Afrika by Reuning (1923) and represents one of the oldest geological maps for the region.

REGIONAL AND LOCAL GEOLOGY

The alkali granites that host the gemstones are late Jurassic to early Cretaceous in age, approximately 135 million years old (Miller, 1992), and have been classified as A-type within-plate granites (Frindt *et al.*, 2004). This group of late to post-Karoo (younger than 140 million years old) intrusive granites into which Klein Spitzkoppe falls, occur over a wide area of Namibia (Haughton *et al.*, 1939; Botha *et al.*, 1979), and other somewhat similar granites contain economic deposits of tin, rare-earth elements, tungsten, copper, fluorite, tourmaline and apatite (Miller, 1992). The host rock to the topaz and aquamarine is a pale gray to pale yellow-brown granite. The granite is medium-grained to coarse-grained and consists predominantly of quartz, plagioclase and microcline, with accessory magnetite, hematite and limonite. Although the granite has a very even and consistent texture and grain size, attributes that are well-suited for building stone (Diehl, 1992), it contains miarolitic pegmatite veins and vugs in which the gemstones and other collectable minerals are found (Jahn, 2001). The pegmatites are commonly narrow (less than 5 cm wide) linear features that cut across the granite. In places, they randomly pinch and swell into cavities varying in size from that of a coffee cup to

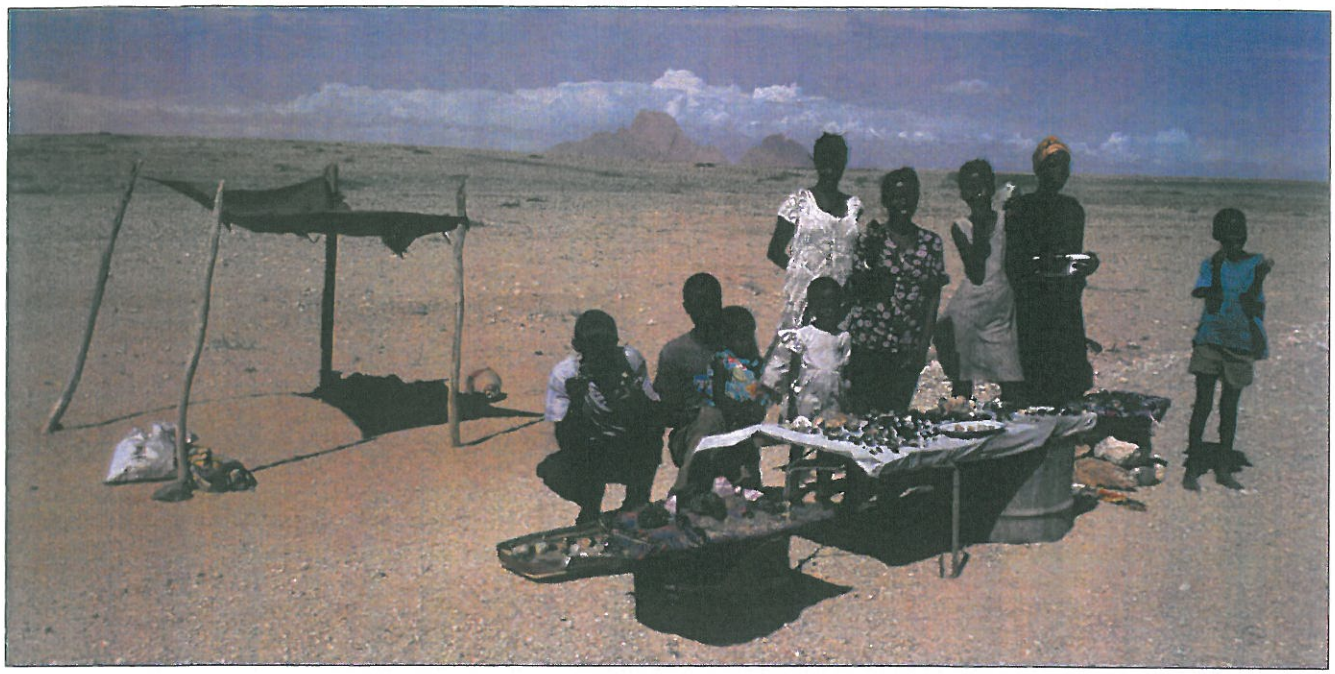


Figure 6. **A group of local Damara diggers selling their specimens on the side of the road. Note that most of the large black schorls on the table are from Erongo, not Klein Spitzkoppe. Bruce Cairncross photo.**

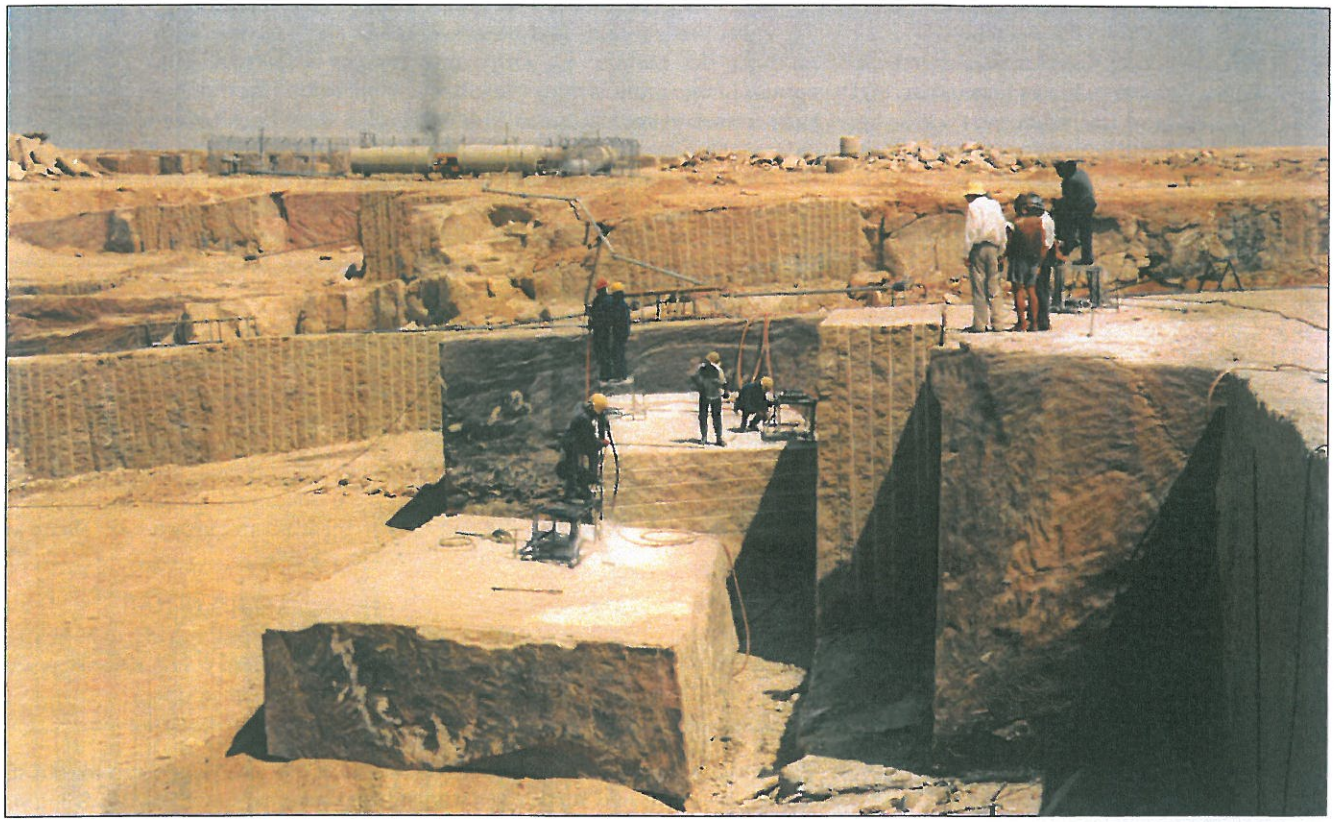


Figure 7. **A 1992 photo of the "Tropical Sun" granite quarrying operation. Photo courtesy of ASSORE.**

football-size. Well-documented pegmatites occur on the eastern and southwestern sides of Klein Spitzkoppe (Frommurze *et al.*, 1942; Schneider and Seeger, 1992a):

> The drusy pegmatites . . . vary in width between 8 inches and 14 inches. The cavities are lined with euhedral crystals of smoky quartz, greenish perthitic orthoclase . . . , blades of dark bottle-green biotite, and crystals of beryl (aquamarine) and topaz. (Frommurze *et al.*, 1942)

These pegmatites seldom exceed 1 meter in width and are usually less than 200 meters along strike. One of the pegmatites

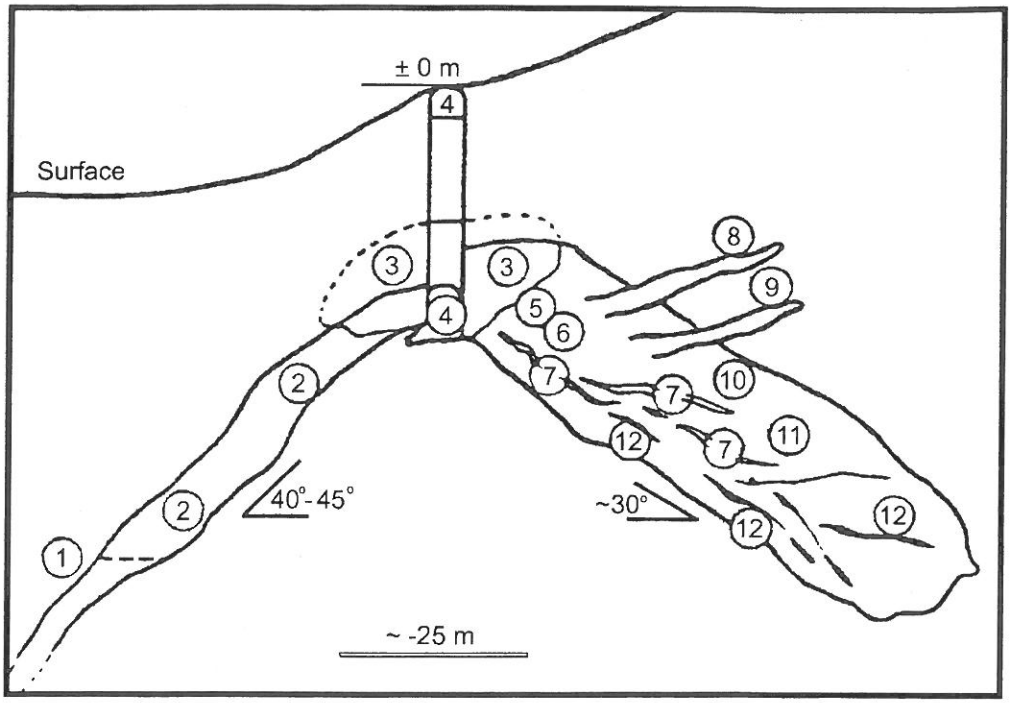


Figure 8. **Generalized cross-section of Stiepelmann's pegmatite by Ramdohr (1940a). Note that dimensions are approximate. The numbered zones in the sketch are: (1) Water table. (2) Open zones in quartz veins with quartz crystals 1 meter long and 35 cm wide that resembled mine timbers. (3) Massive quartz with fine grained albite. (4) Vertical shaft that became declined and less steep with depth until approximately horizontal at the bottom. (5) Orthoclase crystals associated with bertrandite and phenakite. (6) Dense mass of fine-grained mica with dispersed phenakite, bertrandite and leached beryl. (7) Blue beryl in stockwork veins, associated with feldspar. (8 & 9) Two "tubes" with large mica crystals and beautiful, pale blue beryl, quartz and rare fluorite. (10) Location of huge resorbed/altered topaz crystals. [Note: Ramdohr states that topaz crystals measuring 8 × 12 × 15 cm and weighing over 2 kg came from other localities in Klein Spitzkoppe, but that the altered topaz crystals from Stiepelmann's pocket were even larger.] (11) Zone of large amounts of phenakite. (12) Yellow beryl with some pockets and veins of yellow beryl together with yellow fluorspar. From zones 7 to 12 described above, there are aquamarine crystals and golden beryl.**

was mined via an underground shaft at the so-called Hassellund's Camp (Frommurze *et al.*, 1942), and its geometry was observed and described. The veins tend to pinch and swell and, where sufficient space occurs, euhedral crystals of quartz, feldspar and fluorite are encountered. These usually form drusy linings in the cavities. Vugs commonly contain biotite. The topaz and aquamarine tend to be more abundant where associated with the quartz-feldspar assemblage, rather than with biotite.

One remarkable exception, with regard to pocket size, is "Stiepelmann's pegmatite," discovered in the mid-1930's. This is the largest cavity known and produced many specimens (Medenbach, 2001). Ramdohr (1940a) gives a detailed description of the mineralogy and general dimensions of Stiepelmann's pocket, based on descriptions given to Ramdohr by Stiepelmann himself. The zone was approximately 100 meters long, and in places, pockets were up to 20-25 meters wide.

The Gross Spitzkoppe and Klein Spitzkoppe are geologically similar in age and rock type, yet topaz and aquamarine are virtually confined to the Klein Spitzkoppe. No adequate explanation for this difference has been forthcoming, but it has been suggested that the Gross Spitzkoppe may have been "unroofed" and the mineralized upper portion that would have contained trapped, mineralizing fluids has been eroded away (R. Miller, personal communication, 1999).

MINERALS

Albite $NaAlSi_3O_8$

Albite occurs as well-formed white crystals up to 2 cm on edge, with microcline. Most of the albite crystals are transparent to translucent (Beyer, 1980). Epitactic overgrowths of albite are common on many microcline crystals.

Axinite Group $(Ca,Mn,Fe,Mg)_3Al_2BSi_4O_{15}(OH)$

Beyer (1980) reports seeing a single specimen of axinite consisting of a 3-mm purple-brown crystal from a vug, associated with albite, black fluorite (yttrofluorite) and microcline.

Bastnäsite-(Ce) $(Ce,La)(CO_3)F$

During September-October 2004, local diggers re-entered the old Stiepelmann workings and collected specimens (Uli Bahmann, personal communication). One of the species they found, which has been positively identified at the University of Johannesburg, and illustrated here, is bastnäsite-(Ce). The 2.7-cm specimen has two small topaz crystals attached, attesting to its Klein Spitzkoppe pedigree. This is the first reported occurrence of this species from Klein Spitzkoppe. Apart from this new discovery, crystals of phenakite a few millimeters in size were also collected. Apparently, some of these are on matrix but many have been glued onto the rock.

Figure 9. **Bastnäsite-(Ce) crystal, 2.7 cm, with a small topaz attached, from Stiepelmann's workings, Klein Spitzkoppe. Uli Bahmann collection; Bruce Cairncross photo.**

Bertrandite $Be_4Si_2O_7(OH)_2$

Bertrandite occurs as millimeter-size, highly lustrous, tabular crystals found in the so-called "Stiepelmann pegmatite" (Beyer, 1980). It can also be found as anhedral, granular crystals which are difficult to identify visually. Bertrandite forms at the expense of beryl and is paragenetically the last beryllium-bearing species to crystallize. Small, white to colorless crystals on microcline have been described by Frommurze *et al.*, 1942.

Beryl $Be_3Al_2Si_6O_{18}$

Aquamarine and yellow and green beryl are found at Klein Spitzkoppe. Aquamarine is found associated with microcline, smoky quartz, topaz, bertrandite, phenakite and fluorite (De Kock, 1935; Frommurze *et al.*, 1942; Schneider and Seeger, 1992a; Jahn, 2001). Apart from gem-quality aquamarine, other varieties of beryl are also present. These include hexagonal, prism-etched, transpar-

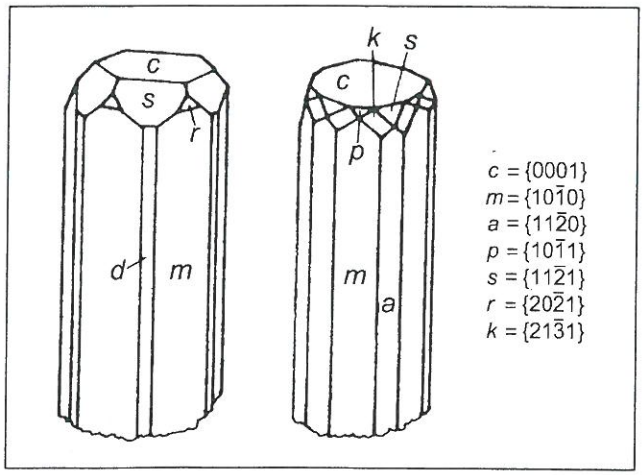


Figure 10. **Aquamarine beryl, crystal drawings of Klein Spitzkoppe specimens (Beyer, 1980).**

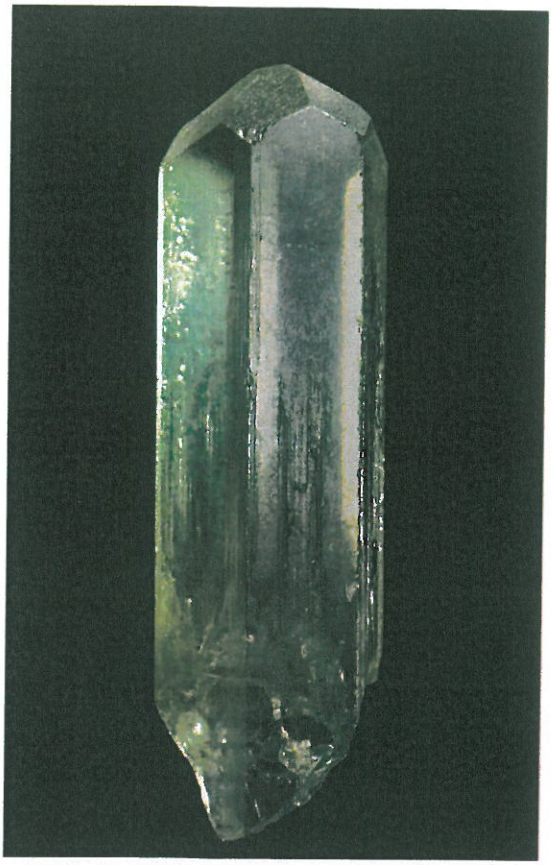


Figure 11. **Green beryl crystal, 8 cm, from Klein Spitzkoppe. William Larson collection; Wimon Manorotkul photo.**

Figure 12. **Beryl—a yellow, complexly terminated crystal, 1.4 cm, from Klein Spitzkoppe. Author's collection and photo.**

Figure 13. **Aquamarine beryl crystals to 6 cm, from Klein Spitzkoppe. Smithsonian collection; Wendell Wilson photo.**

Figure 14. **Aquamarine beryl crystals to 5.5 cm, from Klein Spitzkoppe. William Larson collection; Jeff Scovil photo.**

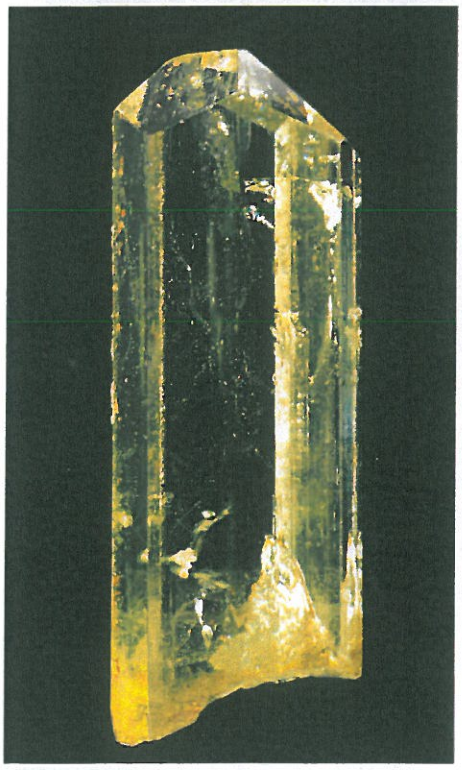
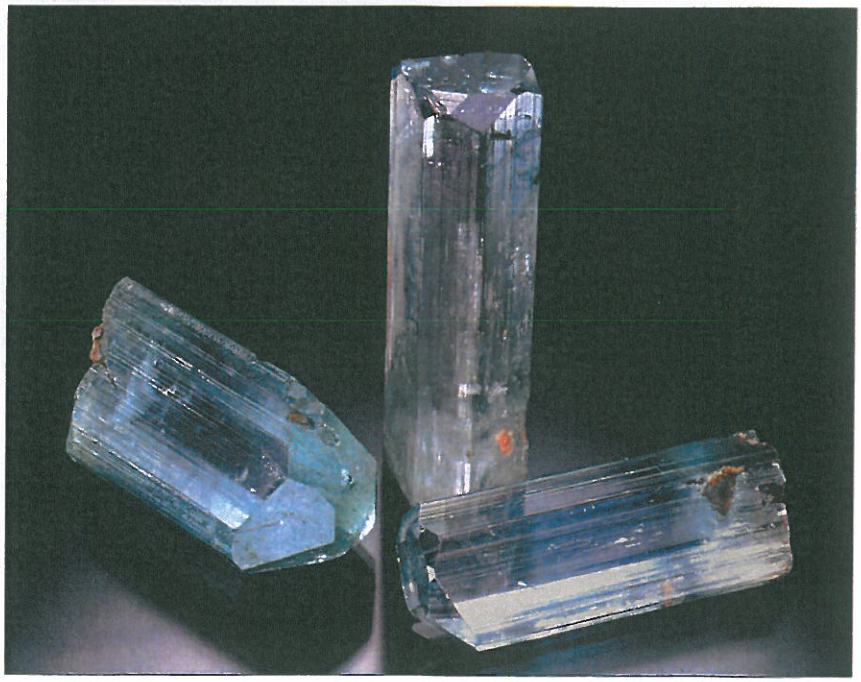


Figure 15. **Beryl—a 3.4-cm yellow crystal from Klein Spitzkoppe. Johannesburg Geological Museum collection, no. 65/116; Bruce Cairncross photo.**



ent to translucent green crystals and also yellow crystals up to 6 cm long (Heidtke and Schneider, 1976). The largest documented aquamarine from Klein Spitzkoppe measures 12 cm long and 5 cm in diameter (Ramdohr, 1940a). According to Frommurze *et al.* (1942):

> The beryl occurs . . . in well-formed hexagonal crystals and is invariably very clear and transparent. The color varies from pale-green to dark sea-green and the bluish-green of precious aquamarine. Occasionally very deep-green varieties approaching emerald, and yellowish varieties known as heliodor are found.

According to Leithner (1984), two crystal habits of beryl have been found:

(1) Hexagonal prisms up to 7 cm long and 1 cm thick with flat (basal pinacoid) terminations. These are usually blue, blue-green and translucent.

(2) Long needle-like crystals, up to 5 mm thick and several centimeters long which are flawless and blue to colorless with

pinacoid and hexagonal bipyramidal terminations. This beryl habit occurs in miarolitic cavities, in crystals replacing feldspar (Beyer, 1980).

One crystal described by Beyer (1980) measures 2 cm, and is completely colorless, except for a rose-red core! Faceted aquamarine from Klein Spitzkoppe in stones over 20 carats is not uncommon.

Yellow beryl has been found in Klein Spitzkoppe pegmatite veins where it is usually associated with fluorite and finely crystalline mica, and it also occurs intergrown with orthoclase (Schneider and Seeger, 1992a; Heidtke and Schneider, 1976; Strunz, 1980). The first known locality for yellow beryl was a pegmatite situated close to Rössing, in the Swakopmund district (Kaiser, 1912). The Rössing material was described by Hauser and Herzfeld (1914); the color ranges from deep golden yellow to pale yellow and yellow-green. Crystals measuring 12 cm along the *c*-axis and up to 5 cm in diameter have been recovered from Klein Spitzkoppe. Some yellow beryl crystals display naturally etched crystal faces, the most common feature being hook-shaped patterns developed on the basal pinacoid faces (Leithner, 1984). Fake specimens of aquamarine are known from Klein Spitzkoppe (see Fig. 12 in Dunn *et al.*, 1981).

Biotite $K(Mg,Fe^{2+})_3(Al,Fe^{3+})Si_3O_{10}(OH,F)_2$

Biotite is virtually ubiquitous in the veins and cavities that occur in the Klein Spitzkoppe granite. It occurs as hexagonal, dark brown to dark green crystals up to 20 cm diameter in some of the larger pegmatites.

Euclase $BeAlSiO_4(OH)$

Euclase crystals up to 5 mm have been identified on one specimen from Klein Spitzkoppe (Beyer, 1980). These are colorless to pale-yellow and transparent, and are associated with microcline, fluorite, hydroxyl-herderite, bertrandite and large quartz crystals.

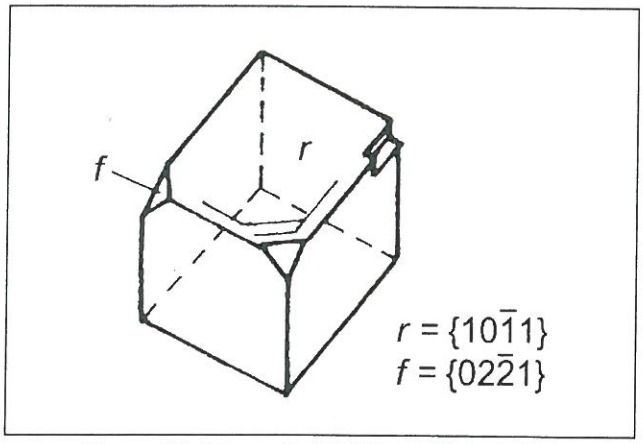


Figure 16. **Florencite-(Ce) from Klein Spitzkoppe, crystal drawing (Beyer, 1980).**

Florencite-(Ce) $CeAl_3(PO_4)_2(OH)_6$

Florencite-(Ce) occurs as small, pale yellow to colorless rhombohedrons and pseudocubic crystals a few millimeters in size (Medenbach, 2001). These were originally called "stiepelmannite," after the Stiepelmann pegmatite in which they were discovered at Klein Spitzkoppe (Ramdohr, 1940b), but that name, along with its species status, is now discredited.

Fluorite CaF_2

Fluorite occurs both at Gross Spitzkoppe and Klein Spitzkoppe, and specimens from the two different deposits should not be confused with each other. Fluorite from Gross Spitzkoppe is associated with tremolite, garnet and calcite in the Karibib Formation marbles (Schneider and Seeger, 1992b). Most of this fluorite is white but its color can also range to deep purple. Pale blue to deep purple fluorite in cubes up to 1 cm have been found there, as well as colorless crystals. Klein Spitzkoppe fluorite, on the other hand, is typically a distinctive and vibrant emerald-green and is in some cases associated with matrix specimens of topaz, microcline and quartz. Some of the fluorite is found intergrown with the topaz. The most common crystal form is cubic, although octahedral habits have also been observed; Stiepelmann's pegmatite yielded both varieties. Associated minerals include topaz, microcline, schorl, albite and goethite. Ramdohr (1940a) described brown, green and colorless fluorite cubes up to 10 cm on edge from Klein Spitzkoppe. The yellow-brown varieties are fluorescent. Several dozen loose, cream-white, 1-cm to 2-cm octahedral fluorite crystals were collected from a small vug in 1998 (Messner, personal communication, 1998). Crystals of black so-called "yttrofluorite" (tveitite-(Y)?) have also been found at Klein Spitzkoppe.

Figure 17. **Vibrant green fluorite cubes, 3.2 cm, from Klein Spitzkoppe. Desmond Sacco collection; Bruce Cairncross photo.**

Goethite α-$Fe^{3+}O(OH)$

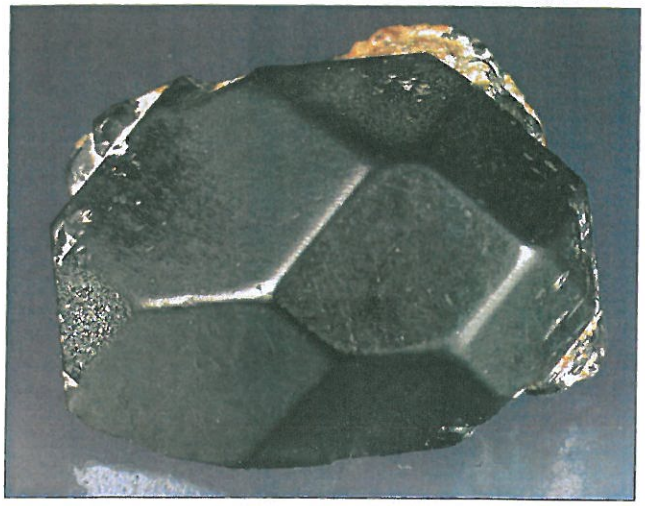
Rare pseudomorphs of goethite after small hematite *eisenrosen* ("iron roses") are known, but are uncommon. Siderite crystals (see below) are commonly found pseudomorphically altered to goethite. Goethite commonly forms brown coatings that have to be cleaned off of some specimens.

Hydroxyl-herderite $CaBe(PO_4)(OH,F)$

Beyer (1980) states that only a single crystal of "herderite" is known from Klein Spitzkoppe, associated with euclase. The identification was based on goniometry, so the mineral is most likely hydroxyl-herderite, inasmuch as true herderite (F > OH) is virtually unknown in nature (Mandarino and Back, 2004).

Figure 18. **Octahedral fluorite crystals on drusy quartz, 4.5 cm, from Klein Spitzkoppe. Author's collection and photo.**

Figure 19. **Yttrian fluorite crystal, 2.1 cm, from Klein Spitzkoppe. Philip Hitge collection, Bruce Cairncross photo.**



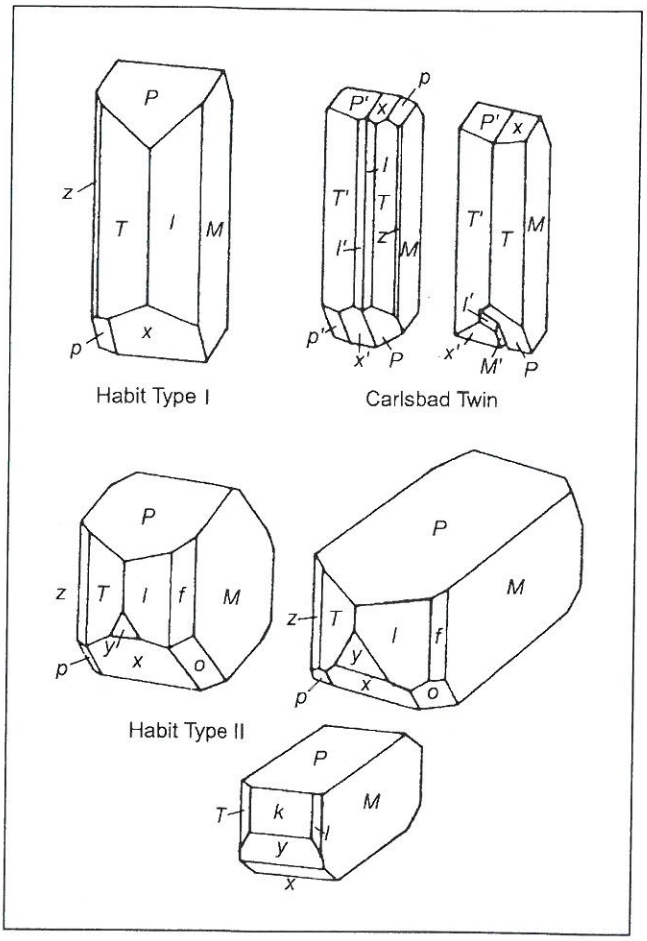


Figure 20. **Microcline from Klein Spitzkoppe, crystal drawings (Beyer, 1980).**

Microcline $KAlSi_3O_8$

Microcline is the most common feldspar at Klein Spitzkoppe. It occurs there as blocky, fist-sized, euhedral crystals up to 15 cm in the miarolitic cavities in the granite. Surfaces of most crystals are smooth and unaltered while others have highly corroded, pitted and etched crystal faces. Baveno twinning is particularly common in the larger crystals. Most of the crystals are pale brown to brownish pink to white. Pale green to medium green "amazonite" varieties are also found, but these are not of comparable quality to the darker green amazonite of localities such as those in Colorado. Microcline is most commonly associated with quartz, topaz, needle-like schorl and, more rarely, ferberite. Where phenakite is found, it is virtually always associated with microcline crystals.

Molybdenite MoS_2

A few crudely-formed hexagonal plates of molybdenite up to 1 cm diameter, associated with biotite and beryl imbedded in microcline, came from one of the pegmatite veins (Beyer, 1980).

Muscovite $KAl_2(Si_3Al)O_{10}(OH,F)_2$

Muscovite is not particularly abundant and rarely occurs in euhedral crystals. Rather, it is present as fine-grained crystals in the granite and pegmatites. An exception is the secondary, pale green form of muscovite that occurs as parallel, intergrown hexagonal plates and rosettes in vugs associated with fluorite.

Phenakite Be_2SiO_4

Small, 2-mm to 3-mm, transparent phenakite crystals have commonly been found in Stiepelmann's pegmatite (Frommurze

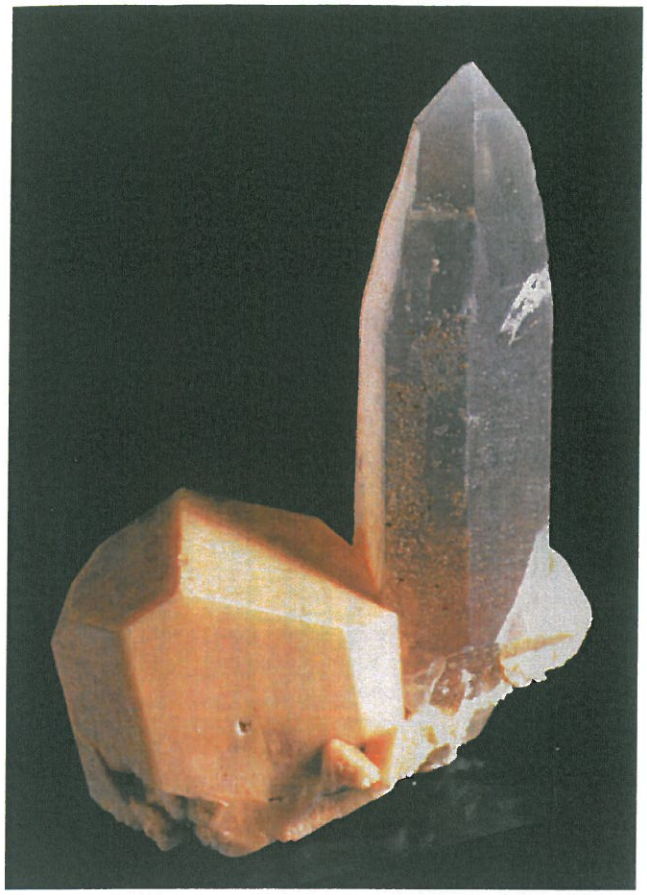


Figure 21. **Microcline feldspar with quartz, 2.8 cm, from Klein Spitzkoppe. Author's collection and photo.**

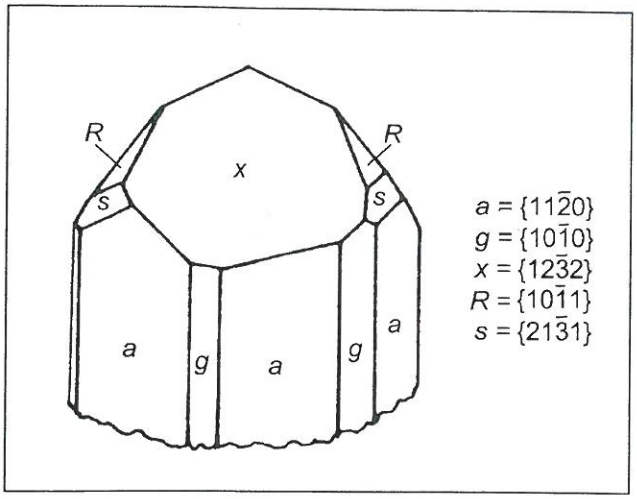


Figure 22. **Phenakite from Klein Spitzkoppe, crystal drawing (Beyer, 1980).**

Figure 23. **Phenakite crystals (the largest is 7 mm) with microcline, from Klein Spitzkoppe. Museum Africa collection; Bruce Cairncross photo.**

et al., 1942). These occur on microcline and distorted quartz crystals (Beyer, 1980). Some of these phenakite crystals are bright yellow in color. Pale blue-green crystals can be found on euhedral microcline where they form trigonal prisms and bipyramids. Aggregates of pale yellow phenakite crystals up to 10 cm in diameter have been found where beryl has been noticeably leached, providing the source of Be (Ramdohr, 1940a). Beyer (1980) also reported phenakite as well-terminated, lustrous, centimeter-long crystals 2–3 mm thick.

Quartz SiO_2

Quartz is one of the most common minerals found at Klein Spitzkoppe. It occurs in several habits and is associated with most of the other species (Beyer, 1980). Loose, smoky quartz crystals are synonymous with the locality and these vary from pale gray to virtually opaque black.

Quartz occurs with topaz, microcline, fluorite, albite and siderite. Dauphiné twins and Japan-law twins have been reported but are rare; the latter may actually be intergrown crystals and not Japan-law twins *per se*. Rose quartz is infrequently found as massive lumps in isolated veins, and sometimes encloses beryl crystals (Ramdohr, 1940a). No euhedral or subhedral rose quartz crystals have been described. Sceptered quartz, partly amethystine, is periodically collected, but not very often. Quartz crystals have also been found with inclusions of fine, acicular schorl (relatively common) and rutile (rare).

Rutile TiO_2

Rutile is very rare at Klein Spitzkoppe and has been reported as small, needle-like crystals enclosed in topaz (Beyer, 1980) and in quartz.

Scheelite $CaWO_4$

Scheelite is also rare at Klein Spitzkoppe. One specimen consists of yellowish, greasy-lustered, tetragonal, bipyramidal scheelite crystals associated with fluorite, siderite and quartz (Beyer, 1980). Another has been described associated with microcline and bertrandite (Beyer, 1980).

Schorl $NaFe^{2+}_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$

Very little colored, gem-quality tourmaline has been found in the Klein Spitzkoppe pegmatites, in contrast to the fine elbaite that is mined in the neighboring Karibib-Usakos Li-pegmatites. Very dark green to blue-green prismatic crystals up to 2 cm long have been found rarely at Klein Spitzkoppe. Schorl varies from small, needle-like prisms to pencil-sized crystals and is associated with quartz, topaz (sometimes as inclusions in both), microcline, aquamarine and fluorite. Several years ago, striated, blue prismatic aquamarine crystals were collected that are partially filled by acicular schorl crystals. Nowadays, much of the schorl that is purported to originate from Klein Spitzkoppe has in fact been collected in the nearby Erongo Mountains.

Figure 24. **Siderite crystals, partially replaced by goethite, 5.8 cm, from Klein Spitzkoppe. Author's collection and photo.**

Figure 25. **Smoky quartz with topaz, 3.6 cm, from Klein Spitzkoppe. Author's collection and photo.**

Siderite $Fe^{2+}CO_3$

Siderite is the only carbonate mineral found at Klein Spitzkoppe. The rhombohedral, chocolate-brown crystals are partially to completely replaced pseudomorphically by goethite. These crystals are generally less than 1 cm and occur scattered about on microcline and attached to quartz crystals. Siderite is also found as aggregates composed of euhedral crystals 2 to 3 cm in size, but some larger crystals originated from the Stiepelmann deposit.

Topaz $Al_2SiO_4(F,OH)_2$

The more famous occurrences of topaz worldwide have been fairly well documented (e.g., Hoover, 1992; Menzies, 1995), but Klein Spitzkoppe is usually only briefly mentioned in these and other topaz-related publications. The reasons for this are probably twofold. Firstly, very little has been published on the Klein Spitzkoppe granite, and even less has been written about the pegmatites and topaz *per se*. The notable exceptions are the articles that have appeared in the German literature (Ramdohr, 1940a and 1940b; Leithner, 1984; Beyer, 1980) and a few others. Secondly, other famous topaz localities such as those in Brazil, the U.S., the Commonwealth of Independent States, Pakistan and Madagascar (Menzies, 1995) have most likely eclipsed the Namibian deposits because they are better known, thanks to their abundance at mineral shows, in museum exhibits and in private collections.

Figure 26. **Topaz on quartz, 6.8 cm, from Klein Spitzkoppe. Marcus Grossmann specimen; Jeff Scovil photo.**

Figure 27. **Topaz, 4.5 cm, perched on a smoky quartz crystal, from Klein Spitzkoppe. Desmond Sacco collection; Bruce Cairncross photo.**

Figure 28. **Topaz crystal, 3.9 cm, from Klein Spitzkoppe. Canadian Museum of Nature collection; Jeff Scovil photo.**

Figure 29. **Topaz—a pale yellow, 10.5-cm crystal (484.8 gms) from Klein Spitzkoppe. Colored topaz such as this one, are considerably rarer than the colorless varieties. Desmond Sacco collection; Bruce Cairncross photo.**

Another mitigating factor in the popularity of Klein Spitzkoppe topaz popularity may be that it is rarely found as matrix specimens, but rather as loose, single crystals.

Topaz can be found in several localities in Namibia (Schneider and Seeger, 1992a), but, as mentioned, the first recorded discovery was from Klein Spitzkoppe during the 1880's (Hintze, 1889). All of the topaz thus far recovered has been found in miarolitic, syngenetic pegmatites in the Mesozoic alkali granite (Menzies, 1995). Topaz is probably the best-known gem species from Klein

Figure 30. **Topaz—three crystals from Klein Spitzkoppe. Most of the specimens collected have been broken off of their pegmatite host rock; removing specimens intact on matrix is extremely difficult. The crystal on the right is 5 cm. Author's collection and photo.**

Figure 31. **Blue topaz crystal, 5 cm, from Klein Spitzkoppe. William Larson specimen; Wimon Manorotkul photo.**

Figure 32. **Topaz on quartz, 9.4 cm, from Klein Spitzkoppe. Martin Zinn collection; Jeff Scovil photo.**

Figure 33. **Topaz crystal, 3.5 cm, from Klein Spitzkoppe. William Larson specimen; Wimon Manorotkul photo.**

Spitzkoppe, and justifiably so. Crystals over 10 cm in length are well-known and Ramdohr (1940a) reports one specimen measuring 8 × 12 × 15 cm and weighing over 2 kg. Loose, colorless crystals of 1–2 cm in length are abundant, and bags full of this material have been collected in the past (Bürg, 1942; Anonymous, 1946). Much of the topaz occurs in alluvium and in ephemeral fluvial deposits close to Klein Spitzkoppe. The crystals are invariably colorless, the so-called "silver topaz," although other color variations do occur, notably pale blue and pale yellow. Most of the color variations, whether natural or artificially induced, are produced by color centers activated by irradiation (Hoover, 1992). This includes the various shades of yellow, brown and blue. Blue colors are usually produced by electron or neutron bombardment (D. Burt, personal communication, 1997). Less valuable yellow or brown shades can be removed by heating. Exposure to sunlight will destroy much of the yellow and brown coloration, which may explain why most of the Klein Spitzkoppe topaz collected from

Figure 34. **Topaz and other minerals on a large, 20.5-cm, matrix specimen from Klein Spitzkoppe. Pale-brown, Baveno twinned orthoclase crystals are associated with two large topaz crystals and several smaller ones, and a smoky quartz crystal in the center foreground. Small, pale green fluorite crystals are attached on the rear of the specimen. Rob Smith collection; Bruce Cairncross photo.**

Figure 35. **Doubly terminated topaz crystal on smoky quartz, 6.5 cm, from Klein Spitzkoppe. William Larson specimen; Wimon Manorotkul photo.**

exposed, weathered surfaces is colorless. An exception to the irradiation effect is the red-pink variety of topaz which owes its unique color to the presence of Cr^{3+} (Hoover, 1992).

Transparent crystals have been faceted into fine gems (Cairncross *et al.*, 1998). Not all crystals are gem-quality, inasmuch as internal fractures and macroscopic inclusions are very common. Several topaz habits are known, and five commonly occurring variants have been described by Beyer (1980):

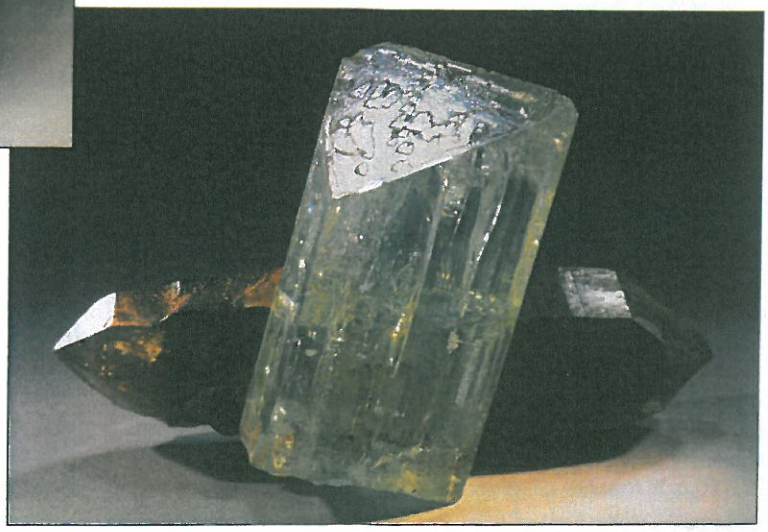


Figure 36. **Topaz—a 5.2-cm crystal attached to a doubly terminated smoky quartz crystal from Klein Spitzkoppe. Desmond Sacco collection; Bruce Cairncross photo.**

Figure 37. **Topaz, an 8 × 8-cm crystal attached to a 13.5-cm dark smoky quartz crystal from Klein Spitzkoppe. Desmond Sacco collection; Bruce Cairncross photo.**

Figure 38. **Topaz—a rare pale-blue, 2.8-cm multiply terminated crystal from Klein Spitzkoppe. Author's collection and photo.**

Figure 39. **Topaz on smoky quartz, 4.5 cm, from Klein Spitzkoppe. William Larson collection; Wimon Manorotkul photo.**

Figure 40. **Transparent topaz, 3.8 cm, on granite matrix from Klein Spitzkoppe. Desmond Sacco collection; Bruce Cairncross photo.**

Type I topaz consists of simple forms and is usually colorless.

Type II topaz includes complex prismatic habits and is usually colorless.

Type III topaz consists of complex, prismatic, stubby yellow crystals.

Type IV topaz displays simple prismatic forms, is usually yellow in color, and is associated with unaltered microcline.

Type V topaz is characterized by long, thin prismatic crystals having a yellow color.

Types I and III are always transparent, with highly lustrous crystal faces. These occur in vugs in and on microcline, occasionally associated with black schorl. Type V is the last habit to crystallize and is always associated with needle-like crystals of aquamarine and highly corroded microcline feldspar. The types I and II are associated with large quartz crystals, biotite, pale green fluorite, tourmaline and rutile. Outstanding specimens of gem-quality, euhedral topaz crystals perched on or partially overgrown by highly lustrous smoky quartz are among the most sought after

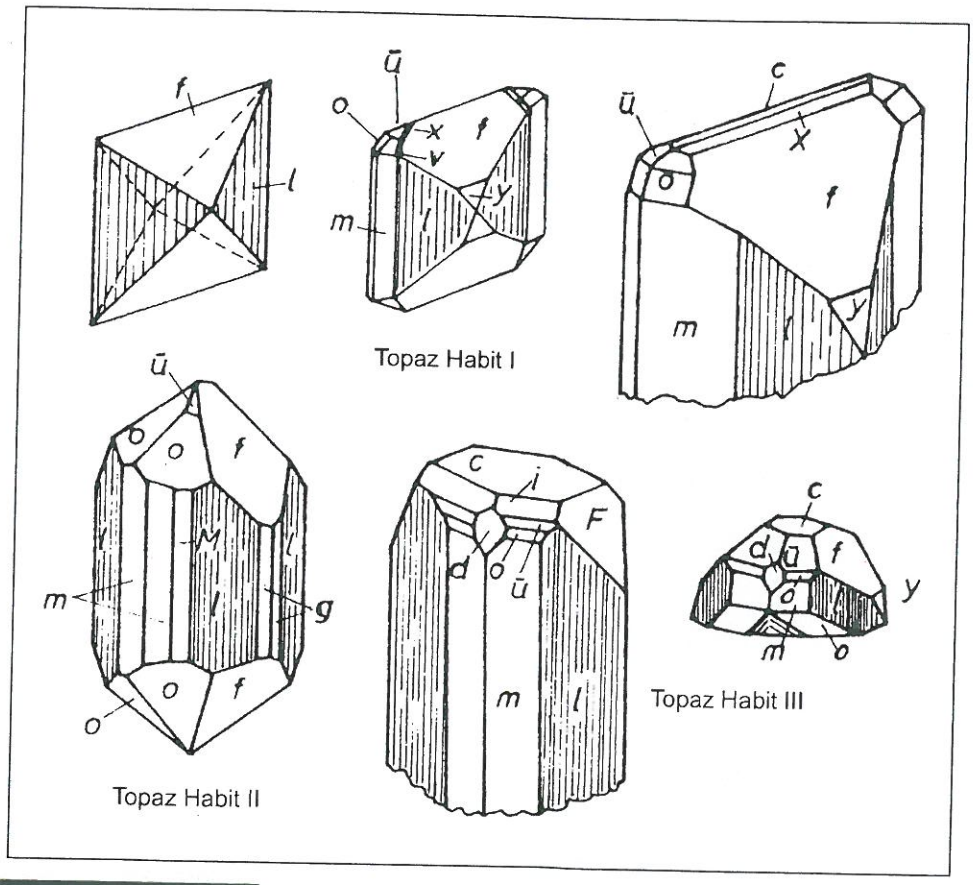


Figure 41. **Topaz from Klein Spitzkoppe, crystal drawings (Beyer, 1980).**

Figure 42. **Topaz—a large, 12.1-cm (761 gm), heavily striated and etched crystal from Klein Spitzkoppe. Author's collection and photo.**

collector pieces from this locality (Cairncross, 2000). Other desirable matrix specimens consist of topaz on white or pale yellow microcline. In some rare instances, topaz and sea-green fluorite are found together, but this association is rare.

It is interesting to note that the crystal morphology of the topaz is easily recognized and very well copied by the local diggers who like to fashion topaz look-alikes from fluorite.

Detailed crystallographic descriptions of the forms and habits of Klein Spitzkoppe topaz have already been systematically undertaken and previously published (Hintze, 1889; Ramdohr, 1940a; Beyer, 1980).

OTHER MINERALS

Other, less common mineral species that have been reported from the Klein Spitzkoppe occurrences include bixbyite, chabazite, columbite, euxenite-(Y), gibbsite, nacrite, opal (hyalite), pyrophyllite, talc, ferberite and zircon. As far as could be determined, these have generally not been found in collector-quality specimens.

Some copper-bearing minerals have been found at a cassiterite prospect located on the northwestern flank of Klein Spitzkoppe (Frommurze *et al.*, 1942). An excavation was made into a green-colored gossan prior to 1940. Cassiterite crystals associated with vuggy quartz have been found in this oxidized zone. Lining the walls of cavities were microcrystals of scorodite, chenevixite, shattuckite, chrysocolla and malachite. The scorodite occured as ". . . well crystallized tiny crystals sometimes projecting into cavities," while the chenevixite ". . . occurs in veinlets and cavities . . . with a colloform structure" (Frommurze *et al.*, 1940). The supergene sulfides include microscopic aresenopyrite, covellite and chalcocite.

CURRENT STATUS

Topaz, and to a lesser degree aquamarine, continue to trickle out from the Klein Spitzkoppe pegmatites. The crystals are either collected from weathered granite pegmatites or alluvium, or they are removed from the miarolitic cavities by the local native artisans.

Figure 43. **Front page of the local *Republican* Newspaper, April 16, 1999. The top headline reads "a black Easter," referring to Namibian road deaths over the Easter weekend. The lower headline reads "Gruesome murder at Spitzkoppe," referring to the murder of a German tourist at the Gross Spitzkoppe.**

No large-scale mining of topaz or aquamarine is envisaged in the foreseeable future. But, because the veins are dispersed over a fairly wide area rather than being concentrated in a small zone which could easily be mined out, the supply of gem rough, as well as specimen-grade crystals, will most likely continue for some time.

Visitors to the Gross and Klein Spitzkoppe areas should exercise reasonable caution and should not explore remote parts of the mountains alone. Several years ago, in April 1999, a German tourist was murdered at Gross Spitzkoppe. This was the first incident of its kind in the area, and is probably unlikely to recur, but visitors should be aware of it nonetheless.

The land that contains the Klein Spitzkoppe pegmatites is State-owned, and it is necessary to obtain the relevant prospecting licenses in order to legally explore and dig for specimens. Namibian law also requires a permit for the export of gemstones and minerals from the country.

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