Minerals from the Goboboseb Mountains: Brandberg Region, Namibia

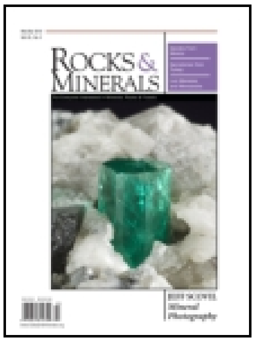
Article *in* Rocks & Minerals · January 2006

DOI: 10.3200/RMIN.81.6.442-457

2 authors:

Bruce Cairncross
University of Johannesburg

Uli Bahmann



Rocks & Minerals

ISSN: 0035-7529 (Print) 1940-1191 (Online) Journal homepage: http://www.tandfonline.com/loi/vram20

Minerals from the Goboboseb Mountains: Brandberg Region, Namibia

Bruce Cairncross & Uli Bahmann

Minerals from the Goboboseb Mountains

Brandberg Region, Namibia

Figure 1. A group of amethyst-tipped quartz, 4.5 cm. Uli Bahmann specimen.

BRUCE CAIRNCROSS
Department of Geology
University of Johannesburg
PO Box 524, Auckland Park 2006
Gauteng, South Africa
brucec@uj.ac.za

ULI BAHMANN
PO Box 873
Halfway House 1685
Gauteng, South Africa
ubahmann@baitsa.co.za

All scenic and specimen photos by Bruce Cairncross

Some of the finest prehnite and quartz, including amethyst, in southern Africa has been collected in the past few decades in the Brandberg region, Namibia. Excellent quartz specimens display a wide variety of habits such as scepters, reverse scepters, and other forms that add to the appeal of specimens from the area. The quartz is well known for its luster, clarity, and phantoms of amethyst and smoky quartz zoned in single crystals. The quartz may contain fluid inclusions to 2 cm.

Dr. Bruce Cairncross, a consulting editor of Rocks & Minerals, *is a professor of geology and chairman of the Department of Geology at the University of Johannesburg, South Africa.*

Uli Bahmann is a collector of southern African minerals and has a special interest in the minerals of Namibia, particularly from Erongo and the Brandberg region.

Namibia is a well-known mineral-producing country that has provided many spectacular specimens. Vast tracts of the country are in semiarid to desert climate that, in some areas, produces 100 percent rock outcrops, making it relatively easy to explore for minerals and mineral deposits (Schneider 2001). The Brandberg Mountain is no exception. It is an imposing feature in central Namibia where it is located approximately 220 kilometers west-northwest of Karibib in Damaraland, forming a prominent landmark jutting above the surrounding Namib Desert plains (Mendelsohn et al. 2003). It is the highest mountain in the country, rising 2,573.1 meters above sea level at its highest peak, Königstein. Brandberg is German for “burnt mountain,” and the local Damara name is *Daureb*, meaning the same, both alluding to the red color of the granite rocks at sunrise. The local Herero name is *Omukuruwaro*, meaning “fire mountain” (Pager 1999). Sometimes the term Brandberg is loosely used to mean the general area of the Brandberg Mountain and its surrounding terrain; it can thus refer to a geographical area and/or a geological feature.

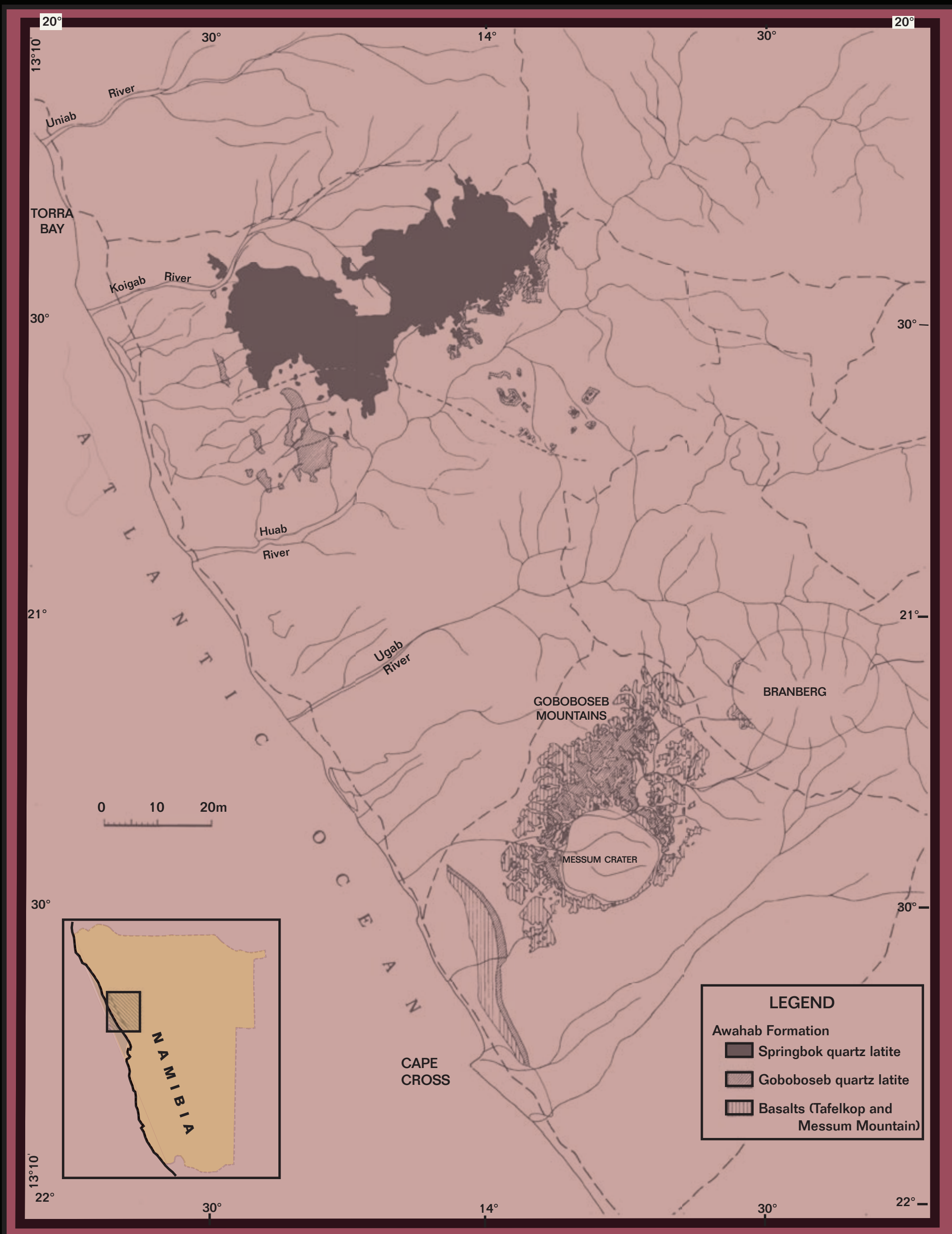


Figure 2. **The location of the Goboboseb Mountains west of the Brandberg Mountain within the regional setting of Namibia (Milner and Ewart 1989).**

The Brandberg Mountain is also a site of cultural importance and has been designated a national monument in Namibia. It has some unique flora, such as the Brandberg Acacia tree. However, the rocks of the Brandberg Mountain are perhaps most famous for their rock art. There are more than forty-five thousand individual rock paintings scattered around one thousand caves and under rock overhangs in the mountain (Pager 1999). The most famous and controversial is the White Lady, discovered on 4 January 1917 by Reinhardt Maack while he was surveying the upper reaches of the Brandberg Mountain in Tsisab Gorge. It was Breuil who coined the name White Lady for the figure, and he also interpreted the painting as being of Mediterranean origin (Breuil 1955). However, later work has shown that the painting is in fact male and probably of African origin (Harding 1968; Townley Johnson 1979); no foreign cultural artifacts have ever been found in the cave excavations. The painting, along with others in the mountain, is now generally believed to have been painted by the San people.

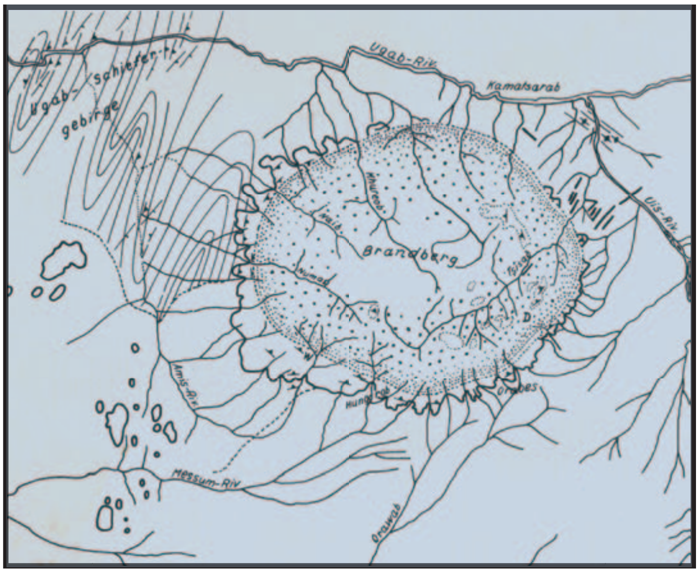


Figure 3. **One of the oldest maps of the Brandberg/Goboboseb region showing geomorphology and drainage patterns (Cloos and Chudboa 1931).**

Having established the geographical and cultural credentials of the Brandberg Mountain, it must now be stated that the Brandberg Mountain per se is not the actual locality for the bulk of the quartz, amethyst, and prehnite. Although some quartz and amethyst have been clandestinely collected in the mountain (which is illegal, as it is a national monument), the specimens that are seen at mineral shows around the world come from a different geographical area and geological setting located west of the Brandberg Mountain. This region is collectively referred to as the Goboboseb Mountains and includes such topographic features as the Messum crater and *Tafelkop* ("Table Mountain"). It is the latter locality, Tafelkop and its surroundings, that is the source of the fine quartz and prehnite specimens. However, the name *Brandberg* has become such an entrenched locality name, used by dealers and collectors alike, that it remains in use, even for the title of this article! The general geology of the Brandberg Mountain will be briefly reviewed so as to compare it with the very different Goboboseb rocks.

Geology

Brandberg

The Brandberg Complex is Jurassic-Cretaceous in age, 25 kilometers across, and composed primarily of granite (Hodgson 1972; Diehl 1990). It is one of a series of about twenty intrusions that form part of the Damaraland Alkaline Province. These intrusives occur in a northeast-southwest-trending lineament (Cloos and Chudboa 1931; Prins 1981). The Erongo Mountain and the Okorusu Complex, two other famous Namibian mineral-producing localities, form part of this suite of rocks. The Brandberg Mountain is essentially an erosional remnant that protrudes from less-resistant, older granites and metasedimentary rocks into which it was originally emplaced. These older Precambrian rocks surround the Brandberg Mountain on its southern, eastern, and northern flanks. To the west, however, younger (Permian) clastic sedimentary rocks abut the mountain. As one progresses further west, away from the Brandberg Mountain, these sedimentary sequences are overlain by younger Cretaceous (132-million-year-old) volcanic rocks of the Etendeka Group (Ewart et al. 1998a, b).

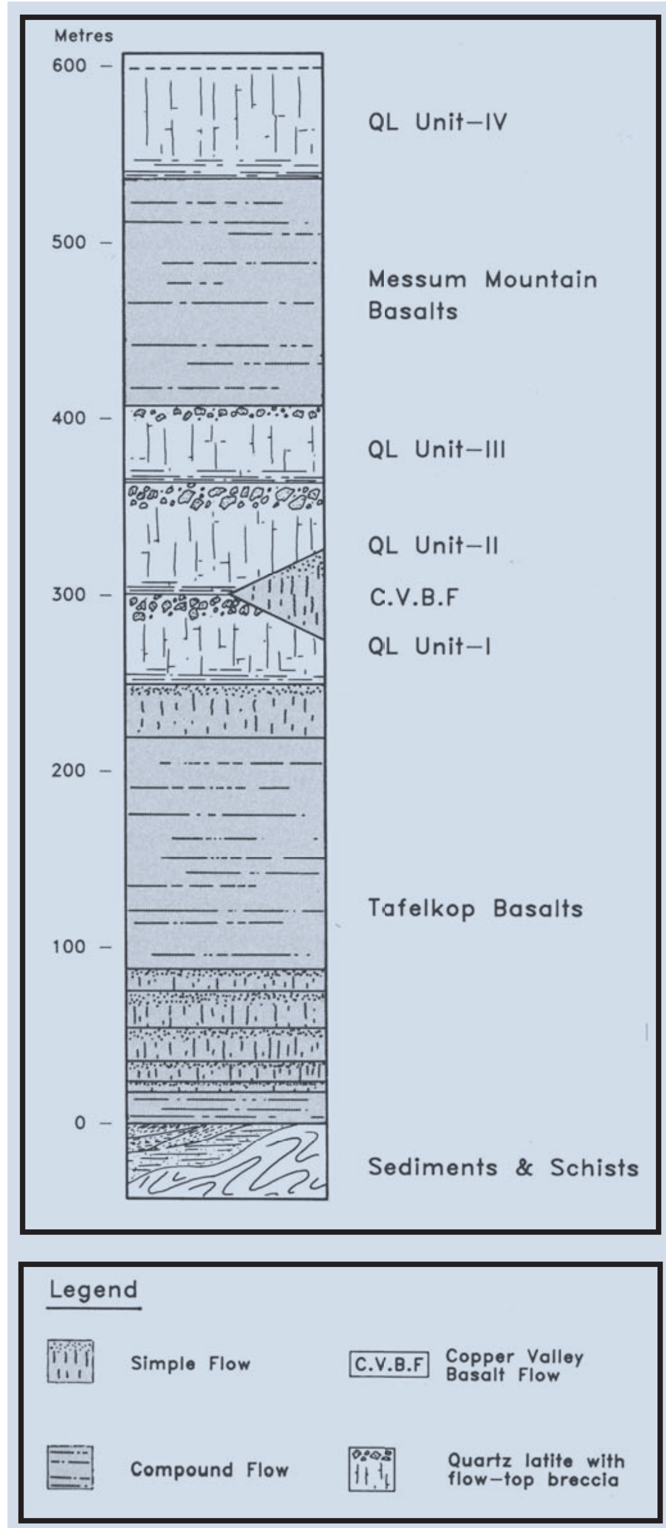


Figure 4. **Stratigraphy of the Goboboseb Mountains illustrating the different layers in the volcanic succession (Milner and Ewart 1989).**

Figure 5. **A view of Tafelkop (on the skyline) from the track leading to the diggings. A *Welwitchia mirabilis* plant is in the foreground. The stony terrain is typical of the area.**

Figure 6 **(left). The Brandberg Mountain as seen looking east from Tafelkop. Shown are the dark and light horizontally layered rocks at the foothill of the mountain and remnants of the basalt lavas abutting up against the Brandberg Mountain. Rudimentary homes of the local diggers are in the foreground.** *Figure 7* **(right). A typical basketball-sized geode in the basal basalt. It is vugs such as these, and those smaller and larger, that yield the mineral specimens.**

Goboboseb Mountains

The Goboboseb Mountains cover an area of 1,100 square kilometers (Milner and Ewart 1989). These rocks are assigned to the Awahab Formation and consist of interbedded basalts and quartz latites that form part of the 132–135-million-year-old Etendeka Group (Ewart et al. 1998a). The regional geology of the Goboboseb Mountains is subdivided into three geological members. The oldest, at the base, is the Tafelkop Basalt Member. This is a 250-meter-thick unit that consists of multiple superimposed basalt flows that range from 5 to 30 meters thick. Some of the flows are characterized by amygdaloidal flow tops. Amygdules vary in size from a few millimeters to geodes more than 1 meter across. This member forms the base of Tafelkop, west of the Brandberg Mountain, and yields most of the mineral specimens.

Above the Tafelkop Basalt Member are three quartz latite lava flows (I, II, and III), assigned to the 100–150-meter-thick Goboboseb Quartz Latite Member. (Latites are volcanic rocks intermediate between andesites and trachyte.) The lowermost one has been dated at 129.8 million years +/- 3.8 million years (Ewart et al. 1998a). Above this member are 130 meters of basalt, the Messum Mountain Basalt Member, overlain by the uppermost Springbok Quartz Latite Member. In the southern region of the Goboboseb Mountains

Figure 8. **Analcime crystal, 3 cm, associated with prehnite, specimen 12.8 cm. Uli Bahmann specimen.**

Figure 9. **Drusy analcime crystals with prehnite and calcite, 6.8 cm. Bruce Cairncross specimen.**

lies the Messum Crater. This contains various igneous rocks such as gabbro, granite, syenite, and rhyolite of the Messum Igneous Complex. The Messum Crater is both intrusive and extrusive, and the source of the Goboboseb rocks is believed to come from Messum (Ewart et al. 1998a). Milner and Ewart (1989) consider the "Goboboseb Mountain volcanics . . . an integral part of the Messum 'volcano' and . . . the Tafelkop basalt sequence to have originally formed a broad shield volcano centered on the present Messum Complex."

Access to the Site

The best map to use to get to the diggings is the 1:50 000 topographical sheet titled *Copper Valley 211AB*, printed by the Government Printer in Windhoek, Namibia. Anyone planning a trip to the diggings should be sure to have a roadworthy vehicle and plenty of water to drink, especially during the summer months when temperatures regularly soar over 40°C (104°F). Visitors to the site usually stay overnight

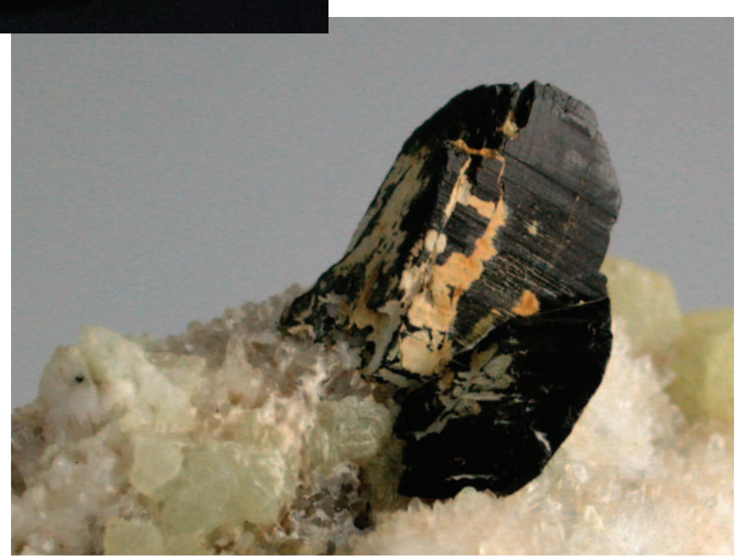


Figure 10. **Babingtonite crystal, 2.1 cm, associated with drusy quartz and prehnite. Bruce Cairncross specimen.**

Figure 11. **A relatively large cluster of epidote crystals, 5 cm. Uli Bahmann specimen.**

Figure 12. **A rare sceptered barite, 3.2 cm. Uli Bahmann specimen.**

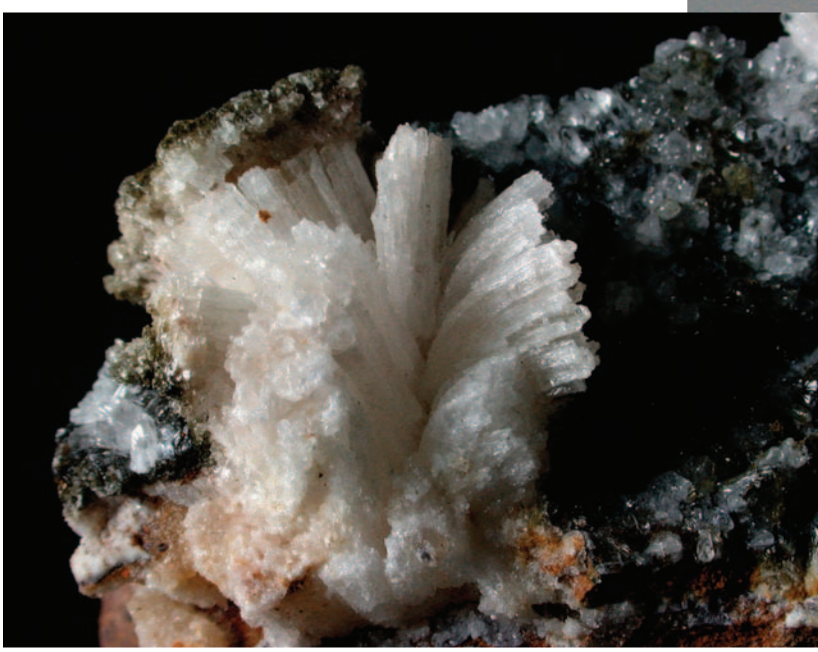


Figure 13. **A 2.4-cm spray of gypsum crystals in a calcite-lined vug. Uli Bahmann specimen.**

in the old tin mine village of Uis, which offers various forms of accommodations.

General access to the outcrops containing the amethystine quartz is relatively easy. Even so, the terrain consists of boulder-strewn surfaces, and care should be taken when driving, as flat tires can be a hazard. Conventional automobiles can be used, although it would be preferable to use an off-road vehicle with high ground clearance, but four-wheel drive capabilities are not required. One drives along a reasonable dirt road (C35) from Uis to Henties Bay. A few kilometers from Uis, a secondary road (DR2342) branches off northwestward toward the defunct Brandberg West mine. This road passes between the Brandberg Mountain on the east and the Goboboseb Mountains to the west. On route, the main Brandberg Mountain can be seen on the right side of the road. In the distance toward the northwest, a large flat-topped *koppie* (hill), Tafelkop, is clearly evident, together with other similar hills. This is the area where the quartz and prehnite are excavated.

Approximately two-thirds of the way to the Brandberg West mine (70 kilometers northwest of Uis) a narrow track turns off to the left, followed by another a few kilometers after the first. Sometimes the local diggers place rudimentary signposts on the road with rather ingenious crystal drawings showing where to turn. These tracks meander toward Tafelkop, passing through a dry wash that is populated by *Welwitchia mirabilis* plants, prehistoric conifers that are indigenous and unique to the Namib region. The local diggers' dwellings become visible, scattered along the foothills of Tafelkop and the surrounding hills. These are very basic

Figure 14. **A large matrix specimen, 18.2 cm, with two semispherical prehnites on calcite. Desmond Sacco specimen.**

Figure 15. **Hematite-stained quartz associated with calcite; field of view 4.8 cm. Uli Bahmann specimen.**

shelters, most constructed from plastic sheeting covering rudimentary wooden frames. The landscape is bleak and desolate, and food and water have to be trucked in from Uis, 70 kilometers away.

The basalts form the flat-topped hills, and the crystals are dug from amygdules and geodes in these lavas. The diggers use hand tools such as sledgehammers, chisels, and crowbars as well as other rudimentary tools. In the past, more sophisticated compressesors and jackhammers were used; these were usually provided by dealers who contracted with the locals to work the site on their behalf. However, this is not happening at present (2005). The rock is extremely hard, and extracting crystals is an arduous task. Matrix specimens are relatively rare compared to loose crystals that are easily snapped off from their tenacious matrix. Many of the cavities are empty vesicles, whereas others may contain only small colorless quartz crystals. Finding good-quality, large amethyst or smoky quartz is not easy and requires much effort, as most of the easily accessible pockets have been worked out long ago. Different outcrops in the region produced different types and habits of quartz, so there is some migratory activity, even extending as far south as the Messum Crater.

The diggers will offer their specimens to anyone who arrives; some negotiating of prices is standard procedure, but the people are reasonable. Timing a visit is important. If a trip is planned, it should be before any other collectors or dealers have visited; otherwise, there may not be much to purchase.

The bulk of the prehnite is not found at the exact same diggings as the quartz. To get to the prehnite site, the track winds around behind the west side of Tafelkop through a small valley and then connects to another dirt track that provides access into Copper Valley. The track passes a house where one of the diggers used to live while mining specimens. Prehnite excavations are clearly visible alongside the track as it leads down to this house, and on the western flanks of Tafelkop, excavation scars reveal previous diggings. New cavities need to be opened to find good-quality green prehnite, as those exposed to the sun soon get bleached and pale.

Figure 16. **Prehnite, epidote, and quartz, 8.7 cm. Uli Bahmann specimen.**

History of Discovery

Although the original discovery of amethyst west of the Brandberg Mountain has been attributed to Gawie Cloete in the 1950s, he did not actively collect until the 1980s

Figure 17. **A prehnite-lined geode with quartz, 12.2 cm. Bruce Cairncross specimen.**

Figure 18. **Prehnite attached to quartz, 5.4 cm. Bruce Cairncross specimen.**

(Herbert Haug, pers. com., 2005). However, a few decades prior to this, Menzer (1936) described amethyst from the Brandberg area, while he was working as an assistant at the University of Berlin, now Humboldt University. Menzer describes having received amethyst crystals from “Herrn” Brusius of Idar Oberstein in 1936. The amethyst was a beautiful dark purple color, suitable for jewelry making. The

Figure 19. **Quartz crystal, 10 cm, with a myriad of fluid inclusions and other internal vapor veils. Herbert Haug specimen.**

crystals also had typical color zoning and visible fluid inclusions. Menzer donated Brandberg crystals to the Museum of Natural History in Berlin at the time, but these specimens can no longer be found there, either because they were lost during the turmoil of Allied bombing in World War II or because the labels may have been lost (Schneider and Jahn 2001). From the late 1930s until the 1980s, no significant quantities of specimens were collected, but the occasional specimen did surface—I (BC) have one purchased in 1975, indicating that some digging, albeit on a small scale, was taking place. During the past twenty-five years several tracts of land were legally pegged and claimed by Cloete, Hartman, and other mineral entrepreneurs such as Raath, Greeff, and Bachran who began legally working the area (Schneider and Jahn 2001). Once word spread that good-quality specimens were being found and money could be made, local Damara diggers claim-jumped and started collecting on the pegged sites as well as in surrounding areas. This resulted in some of the legal claim holders abandoning their workings. Recently (2005), however, properly coordinated workings have been introduced, and these operations appear to be yielding some fine specimens (Rob Smith, pers. com., 2005). They are headed up by Windhoek mineral entrepreneur Andreas

Figure 20. **Doubly terminated, doubly sceptered quartz, 8 cm. Herbert Haug specimen.**

Figure 22. **An aesthetic cluster of quartz crystals with a doubly terminated main crystal, 9 cm. Uli Bahmann specimen.**

Figure 21. **A unique doubly terminated Japan-law twinned quartz, 7.6 cm. Uli Bahmann specimen.**

Palfi, who has recruited the assistance of Ras Greeff to mine properly claimed areas. They are systematically excavating and drilling into the outcrop using jackhammers, an arduous task because once the softer, weathered basalt and mineral specimens have been removed, the fresh unweathered rock is extremely hard to work and does not easily yield its mineral treasures. Even so, some fine dark purple amethyst was recovered during the first part of 2005. Some of the local diggers have been contracted to dig for these legal claim holders; others continue to dig in their own areas.

Minerals

Analcime, $NaAlSi_2O_6 \cdot H_2O$, occurs together with prehnite, quartz, calcite, and heulandite in the prehnite diggings. It is fairly common in the basalts and occurs as opaque, white trapezohedra to 1 cm across. It tends to cluster in aggregates. Some specimens are snow-white with a frosted surface, but this may be an artifact of the cleaning process that most prehnite specimens are subjected to (see under prehnite).

Babingtonite, $Ca_2(Fe^{2+},Mn)Fe^{3+}Si_5O_{14}(OH)$, is a pyroxenoid (Roberts, Campbell, and Rapp 1990) and is found

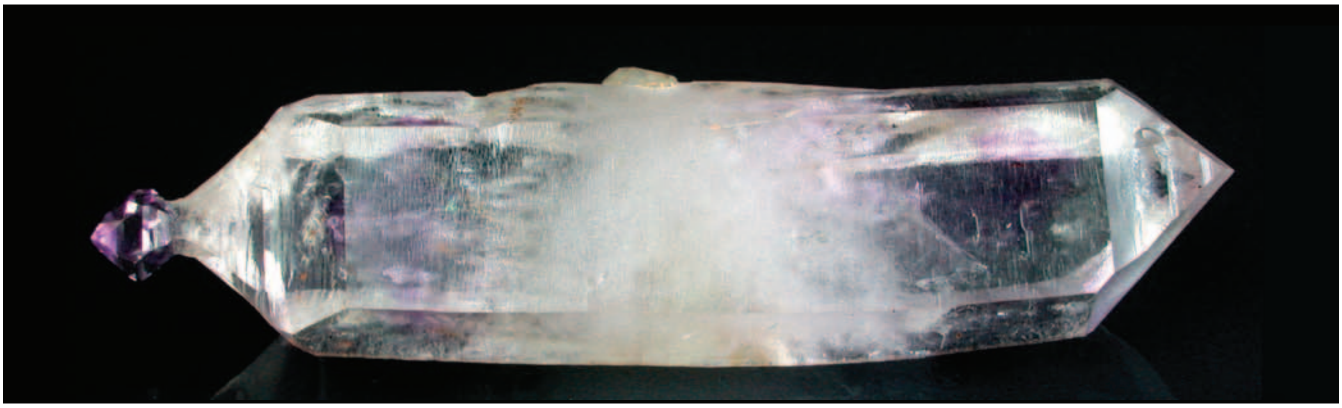


Figure 23. **A doubly terminated, distorted pale amethyst faden quartz, with a gemmy Herkimer-like amethyst scepter on one termination, 6.9 cm. Bruce Cairncross specimen.**

Figure 24. **A 5.2-cm specimen of doubly terminated, doubly sceptered quartz, one of which is smoky quartz, with hematite-included crystals projecting out from the central portion. Uli Bahmann specimen.**

exclusively with prehnite and/or quartz in the Goboboseb Mountains. It tends to form dark green to black aggregates with crystals 2–5 mm in length. Schneider and Jahn (2001) illustrate such an occurrence on page 48 of their publication. The specimen featured here (fig. 10) appears to be unique, as it is freestanding and 2.1 cm long. This particular specimen is associated with drusy quartz and small, spherical prehnites.

Barite, $BaSO_4$, is reported by Schneider and Jahn (2001). It is rare, and what appears to be a unique specimen, a sceptered barite on a barite prism in the Bahmann collection, is illustrated here for the first time (fig. 12). Smaller (less than 1-cm), gray-white, tabular barite crystals associated with calcite and quartz in small geodes have periodically been found.

Calcite, $CaCO_3$, is a common associated species in the prehnite vugs and also occurs as drusy linings in some of the amethyst geodes. It typically forms stubby scalenahedra that form drusy coatings in the cavities. Most calcite gets dissolved off the prehnite during the acid cleaning process that is used on the majority of the specimens.

Celadonite, $K(Mg,Fe)(Fe,Al)Si_4O_{10}(OH)_2$, forms blue-green amorphous crusts and rims on and around the perimeter of some amygdules and geodes. Celadonite is relatively common in other basaltic lava flows containing amethyst geodes (Gilg et al. 2003). Some of the so-called celadonite may be chlorite, but this has not been quantitatively identified.

Chrysocolla, $(Cu,Al)_2H_2Si_2O_5(OH)_4{\cdot}nH_2O$, has been reported from the Copper Valley area together with prehnite, quartz, and epidote.

Copper, Cu, is not common in the area, although some native copper specimens have been collected in Copper Valley west of Tafelkop. Copper mineralization is known from melaphyres and sandstone dikes in the lava flows. An excellent Copper Valley arborescent copper specimen with drusy quartz is on public display in the Geological Survey of Namibia Museum in Windhoek.

Epidote, $Ca_2(Fe^{3+},Al)_3(SiO_4)_3(OH)$, occurs sporadically in the prehnite zones. It typically occurs as dark green to black aggregates of small (less than 2-mm) crystals, associated with prehnite and quartz. Other, more robust epidote specimens consist of radiating groups of crystals clustered together.

Goethite, α-$Fe^{3+}O(OH)$, is commonly present as thin films and coatings on other species. It also forms earthy-colored inclusions in quartz crystals.

Figure 25. A scepter of *fenster* (window) quartz, 10 cm, with clay inclusions. Herbert Haug specimen.

Figure 27. Amethyst crystal, 5.1 cm, coated with drusy quartz. Uli Bahmann specimen.

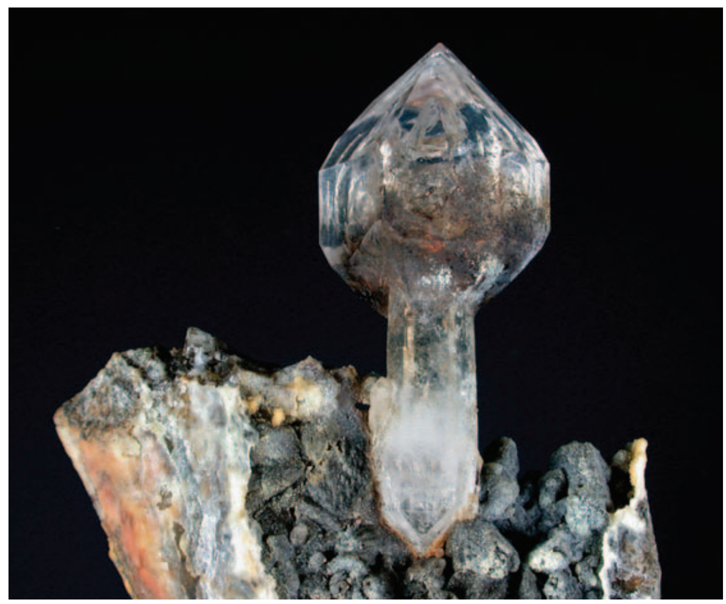


Figure 28. Doubly terminated quartz scepter, 3.7 cm, on matrix. Uli Bahmann specimen.

Figure 26. A 6.5-cm matrix cluster of goethite-stained quartz overgrown by drusy white quartz. Uli Bahmann specimen.

Figure 29. An 18.5-cm group of fenster quartz. Uli Bahmann specimen.

Figure 30. **A matrix specimen, 4.5 cm, of vermiform, distorted quartz, and pale amethyst. Uli Bahmann specimen.**

Figure 31. **Combined amethyst–smoky quartz scepter, 7.4 cm. Note the phantom amethyst of the prism projecting up into the scepter. Uli Bahmann specimen.**

Gypsum, $CaSO_4$, is rare from the Goboboseb Mountains but has on occasion been found as curved, divergent sprays associated with calcite.

Hematite, α-Fe_2O_3, does not occur as large, freestanding crystals in the Goboboseb Mountains. Rather, minute platelets of hematite are found as formless inclusions, veils, and defining phantoms in quartz. These inclusions are metallic silver or black, and also bright red. When the latter-colored variety occurs in water-clear quartz, it makes very attractive specimens. Some finely crystalline hematite can be found associated with quartz, but this is rare.

Figure 32. **A dark smoky quartz scepter on an amethyst prism, 7.2 cm. Herbert Haug specimen.**

Heulandite, $(Ca,Na,K)(Al_2Si_7O_{18})\cdot 6H_2O$, has been reported by von Bezing (2006). Whether the heulandite is the calcium, potassium, sodium, or strontium end-member is unknown.

Laumontite, $CaAl_2Si_4O_{12}\cdot 4H_2O$, has been reported by von Bezing (2006).

Prehnite, $Ca_2Al_2Si_3O_{10}(OH)_2$, is one of the premier minerals from the Goboboseb Mountains and justifiably so (Cook 1999; Cairncross 2000; Schneider and Jahn 2001; Cairncross 2004). This mineral made an impact on the international mineral shows in the early 1990s, although it is a well-known old locality. Color variants range from pale green to colorless, usually on those specimens that have been exposed to the sun for extended periods, as this causes color fading. The best prehnite is a pale to medium apple-green; some specimens display a pale aquamarine blue-green coloration. The habit is virtually always spherical to subspherical whorls of aggregate crystals, either clustered together on matrix or scattered randomly on the host rock. They range from 1 to 10 cm across. The best specimens are highly lustrous. After being collected, coatings of secondary minerals such as goethite are cleaned off either by mechanical means or by using

Figure 33. **An etched and corroded clear quartz scepter on a smoky quartz prism, 3 cm. Uli Bahmann specimen.**

Figure 35. **An unusual specimen of sceptered quartz attached at right angles to doubly terminated quartz, associated with calcite, 4.9 cm. Uli Bahmann specimen.**

Figure 34. **Two sceptered quartz crystals, 6.9 cm. Note that both scepters have amethyst at the termination and smoky quartz at the base of the scepter. Uli Bahmann specimen.**

various chemical and acid treatments. Some of these operations are successful; others are not. Some prehnite develops a dull luster and yellow coating after the cleaning process due to re-precipitation of iron from the cleaning solutions. Associated minerals are calcite, clear colorless quartz, epidote, analcime, and, rarely, babingtonite. Beautiful geodes lined with prehnite and with secondary quartz overgrowths are also occasionally collected. Although the prehnite and amethyst are found in the same geological formation and almost the same geographic locality, it is fairly rare to find large specimens of both together. Some amethyst and colorless quartz crystals do have small balls of prehnite attached or partial coatings of prehnite, but these associations are not common.

Pumpellyite, $Ca_2MgAl_2(SiO_4)(SiO_7)(OH)_2 \cdot H_2O$, is relatively rare but known from several specimens in private collections. It occurs as small, dark brown, spherical aggregates nestled in quartz and associated with prehnite. The generic formula for pumpellyite is given here, as the specimens have not been quantitatively analyzed to determine whether they are the ferrous-, ferric-, magnesium-, or manganese-rich species.

Pyrite, FeS_2, has been reported by von Bezing (2006).

Quartz, SiO_2, is the most abundant mineral and occurs in several varieties in the Goboboseb deposits, namely amethyst (Henn 1993), smoky quartz, clear quartz (rock crystal), and brown clay-included *fenster* (window) quartz. Combinations of these colors in single crystals give the Brandberg quartz their very typical and sought-after color zoning and internal phantoms.

Many specimens have been dug from the rock, most as single, loose crystals, others as composite groups; matrix specimens are relatively rare because it is easier to break the crystals off the rock than to remove them with matrix. When the geodes occur in slightly weathered or chemically altered basalt, it is possible to remove portions of the rock with the crystals intact. “Floater” quartz crystals are fairly common. Crystals less than 3 cm are common and relatively cheap. However, quartz crystals more than 30 cm long, often doubly terminated, are occasionally found. The Sacco collection has a single crystal measuring 35 cm, and the Bahmann collection also has outstanding large specimens. Gas-bubble fluid inclusions are fairly common; some of the larger ones are up to 1 cm in diameter, and it is not unusual for quartz

Figure 36. **A general view looking south. In the distance (left) is the home of Ras Greeff who is busy systematically working the outcrop of the hill on the right—a dirt road is winding up to the horizontal line of the mining operation. Weathered basalt boulders are scattered in the foreground.**

Figure 37. **One of the local diggers offering specimens for sale. The one box contains smoky quartz; the other has pale amethyst specimens. In the background is one of the authors (UB) busy at his vehicle.**

Collecting Update

During August 2005, we visited the Brandberg-Goboboseb region to get an update on the status of specimen production. After visiting Uis, we drove the road that leads from Uis to the Brandberg West mine and turned off at the track that leads to diggings. The drive is slow because the terrain is relatively rough.

As one approaches the landmark Tafelkop, evidence of diggings can be seen on the scree slopes of the surrounding hills. There is now a clear "hierarchy" of living quarters in the area—the familiar makeshift houses of the local Damara diggers, and then a relatively new camp owned by Johann Cotze (deceased 3 August 2005) who has pegged several claims in the region. The house of Ras Greeff, who is working with Andreas Palfi, can also be seen, located a kilometer or so away from the informal diggers village. Any form of human habitation or mining stands out in the landscape because the surface is devoid of any vegetation whatsoever—it consists of rubble-strewn rock that has been weathering from the lavas for millennia.

The amount and intensity of diggings has declined somewhat in recent times, and there are now only about ten to fifteen informal houses in the local settlement. We arrived just before midday when the temperature was already well into the mid-30's(C). At first, the place looked deserted, but then people slowly started to emerge from their abodes. The heat of the day is not conducive to smashing on hard basalt, so most of the digging takes place during the early morning hours and late afternoon, when it is somewhat cooler. We were soon approached by the diggers with their ubiquitous cardboard beer flats containing crystals that they had for sale. The process was extremely orderly, and each person waited for us to approach them, rather than inundating us with their specimens.

Some relatively new discoveries included Herkimer-like quartz on drusy white quartz that had not been seen before. There was also a mixture of various pale amethyst, colorless quartz, some relatively dark amethyst, color-zoned amethyst, and smoky crystals as well as a few oddities with scepters and reverse scepters. One can barter with the prices; it is a fallacy that these diggers demand astronomical prices—some very nice specimens can be bought for very fair prices. The largest crystal we were offered was about 20 cm; most tend to be smaller, cabinet- to miniature-sized.

After about an hour of looking, we drove to the foothills of Tafelkop where Gert Bachran has his camp. He first mined specimens here in 1990, and he uses his establishment during his sporadic visits to the diggings. We then drove to the workings of Andreas Palfi and Ras Greeff. They, too, have a permanent camp set up on the lower slopes of the hill where they are excavating for amethyst. Matrix specimens are scarce because it is almost impossible to liberate any geodes from the host rock. Their specimens are usually either single crystals, small groups, or crystals on slabs of matrix pried out of the vugs. Andreas mentioned that he wants to work on a plan to use portable diamond saws in an attempt to cut the geodes out of the rock. After a few hours at the site, we departed for the west coast town of Swakopmund. In conclusion, one can still travel to the Goboboseb diggings and purchase reasonable specimens at reasonable prices. ❑

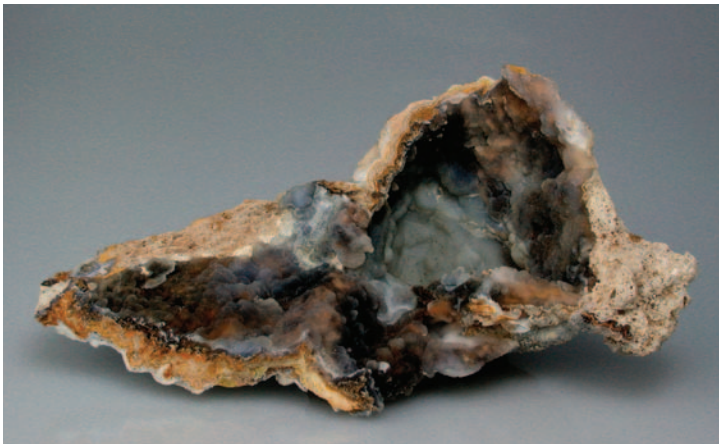


Figure 38. **Chalcedony-lined geode, 11.4 cm. Uli Bahmann specimen.**

Figure 39. **Siderite crystals, 7.6 cm. Uli Bahmann specimen.**

Figure 40. **Matrix amethyst and quartz, 8.4 cm. Uli Bahmann specimen.**

crystals to have several inclusions present. Vapor cavities are common and impart interesting internal textures to the quartz, either as scattered veils or as clusters of parallel vapor tubes. Doubly terminated crystals are common, and beautiful scepters occur, with reverse scepters being found as well. Some doubly terminated crystals have scepters at either end. Combinations of clear quartz, smoky, amethyst, and hematite-included crystals on single specimens are fairly common.

A fluid-inclusion investigation was undertaken on the Goboboseb quartz. The quartz contains abundant fluid inclusions, which often impart a milky appearance, in particular at the base of the crystals. The size of the fluid inclusions varies from very small (less than 10 μ) to more than 100μ under the microscope, but some bubbles are up to 1 cm in diameter. All the inclusions show the same liquid-vapor ratio. Most inclusions have either an elongated, rounded, or perfect negative quartz crystal shape. The inclusions invariably contain an aqueous liquid phase and a vapor bubble. Some fluid inclusions contain one or more (unidentified) solid phases. The salinity of the fluid inclusions was determined by freezing/melting experiments and found to be about 5 weight percent NaCl. The fluid-inclusion temperature of homogenization is approximately 201°C (392°F) at the time of crystallization.

Chalcedony occurs as botryoidal and mamillary linings in some geodes.

Siderite, $Fe^{2+}CO_3$, is not very common and occurs as small, dark chocolate-brown rhombs on matrix. Alternatively, some plates of interlocking crystals, which are rare, have been collected.

Conclusion

The minerals of the Goboboseb Mountains have been known for many years. Quality quartz, amethystine quartz, and prehnite continue to trickle out from Tafelkop and the surrounding basalt outcrops. Finally, amethyst and prehnite specimens should ideally be correctly labeled as coming from "Goboboseb Mountains, west of the Brandberg Mountain, Damaraland, Namibia."

ACKNOWLEDGMENTS

We are grateful to Herbert Haug and Desmond Sacco for allowing the photography of their minerals. Dr. Jan-Marten Huizenga, of the Department of Geology at the University of Johannesburg, kindly undertook the fluid-inclusion studies on the quartz specimens. We thank John S. White and John Rakovan for their critical reviews and constructive criticism that substantially improved the manuscript. Marie Huizing provided invaluable editorial review as well.

REFERENCES

Breuil, H. 1955. *The* White Lady *of the Brandberg*. London: Trianon Press.

Cairncross, B. 2000. *The Desmond Sacco collection: Focus on southern Africa*. Johannesburg: D. Sacco.

———. 2004. *Field guide to rocks and minerals of southern Africa*. Cape Town, South Africa: Struik New Holland.

Cloos, H., and K. Chudboa. 1931. Der Brandberg. Bau, Bildung

Figure 41. **Dark pumpellyite aggregate, 7 mm, associated with prehnite and quartz. Uli Bahmann specimen.**

Figure 42. **Two doubly terminated quartz crystals, one with amethyst and smoky inclusions plus streamers of hematite, 5.2 cm. Uli Bahmann specimen.**

Figure 43. **A transparent quartz with red hematite inclusions, 4.2 cm. Herbert Haug specimen.**

und Gestalt der jungen Plutone in Südwesafrika. *Neues Jahrbuch für Mineralogie und Geologie und Paläontologie, Beigelegter* 66B:1–130.

Cook, R. B. 1999. Connoisseur's choice: Prehnite, Brandberg, Namibia. *Rocks & Minerals* 74 (3): 178–80.

Diehl, M. 1990. *Geology, mineralogy, geochemistry and hydrothermal alteration of the Brandberg Alkaline Complex, Namibia*. Geological Survey of Namibia, Ministry of Mines and Energy memoir 10.

Ewart, A., S. G. Milner, R. A. Armstrong, and A. R. Duncan. 1998a. Etendeka volcanism of the Goboboseb Mountains and the Messum Igneous Complex, Namibia. Part 1: Geochemical evidence of Early Cretaceous Tristan plume melts and the role of crustal contamination in the Paraná-Etendeka CFB. *Journal of Petrology* 39:191–225.

———. 1998b. Etendeka volcanism of the Goboboseb Mountains and the Messum Igneous Complex, Namibia. Part 2: Voluminous quartz latite volcanism of the Awahab magma system. *Journal of Petrology* 39:227–53.

Gilg, H. A., G. Morteani, Y. Kostitsyn, C. Preinfalk, I. Gatter, and A. J. Strieder. 2003. Genesis of amethyst geodes in basaltic rocks of the Serra Geral Formation (Ametista do Sul, Rio Grande do Sul, Brazil): A fluid inclusion, REE, oxygen, carbon, and Sr isotope study on basalt, quartz and calcite. *Mineralium Deposita* 38:1009–25.

Harding, J. R. 1968. Interpretation of the "White Lady" rock painting of South West Africa: Some considerations. *South African Archaeological Bulletin* 23 (90): 31–34.

Henn, J. 1993. Amethyst von Brandberg, Namibia. *Lapis* 10:44–48.

Hodgson, F. D. I. 1972. The geology of the Brandberg–Aba Huab area, South West Africa. PhD thesis, University of the Orange Free State, Bloemfontein, South Africa.

Mendelsohn, J., A. Jarvis, C. Roberts, and T. Robertson. 2003. *Atlas of Namibia—A portrait of the land and its people*. Cape Town, South Africa: David Philip.

Menzer, G. 1936. Über amethyste von Brandberg in Deutsch-Südwestafrika. In *Zentralblad Mineralogie, Geologie, Paläontologie*, abst. A, 289–90.

Milner, S. C., and A. Ewart. 1989. The geology of the Goboboseb Mountain volcanics and their relationship to the Messum Complex, Namibia. *Communications of the Geological Survey of Namibia* 5:31–40.

Pager, S-A. 1999. *A visit to the* White Lady *of the Brandberg*. Windhoek, Namibia: Typoprint (Pty) Ltd.

Prins, P. 1981. The geochemical evolution of the alkaline and carbonatite complexes of the Damaraland Igneous Province. In *Annals University of Stellenbosch* (South Africa), series A1, 3:145–278.

Roberts, W. L., T. J. Campbell, and R. Rapp Jr. 1990. *Encyclopedia of minerals*. 2nd ed. New York: Van Nostrand Reinhold.

Schneider, G. 2001. Namibia's geologie—Bilderbuch der Erdgeschichte. In *Namibia Zauberwelt edler Steine und Kristalle*, ed. S. Jahn, O. Medenbach, G. Niedermayr, and G. Schneider, 8–16. Haltern, Germany: Bode Verlag GmbH.

Schneider, G., and S. Jahn. 2001. Der Brandberg und die Mineralienfunde in seiner Umgebung. In *Namibia Zauberwelt edler Steine und Kristalle*, ed. S. Jahn, O. Medenbach, G. Niedermayr, and G. Schneider, 33–49. Haltern, Germany: Bode Verlag GmbH.

Townley Johnson, R. 1979. *Major rock paintings of Southern Africa*. Bloomington: Indiana University Press.

Von Bezing, K-L. 2006. *Namibia minerals and localities*. Haltern, Germany: Bode Verlag GmbH. ❏