POSTMASBURG Manganese Field

Northern Cape Province, South Africa

BRUCE CAIRNCROSS
Department of Geology
University of Johannesburg
PO Box 524, Auckland Park 2195
Johannesburg, South Africa
brucec@uj.ac.za

Figure 2. **View of the road entering Postmasburg, looking south. Bruce Cairncross photo, June 2022.**

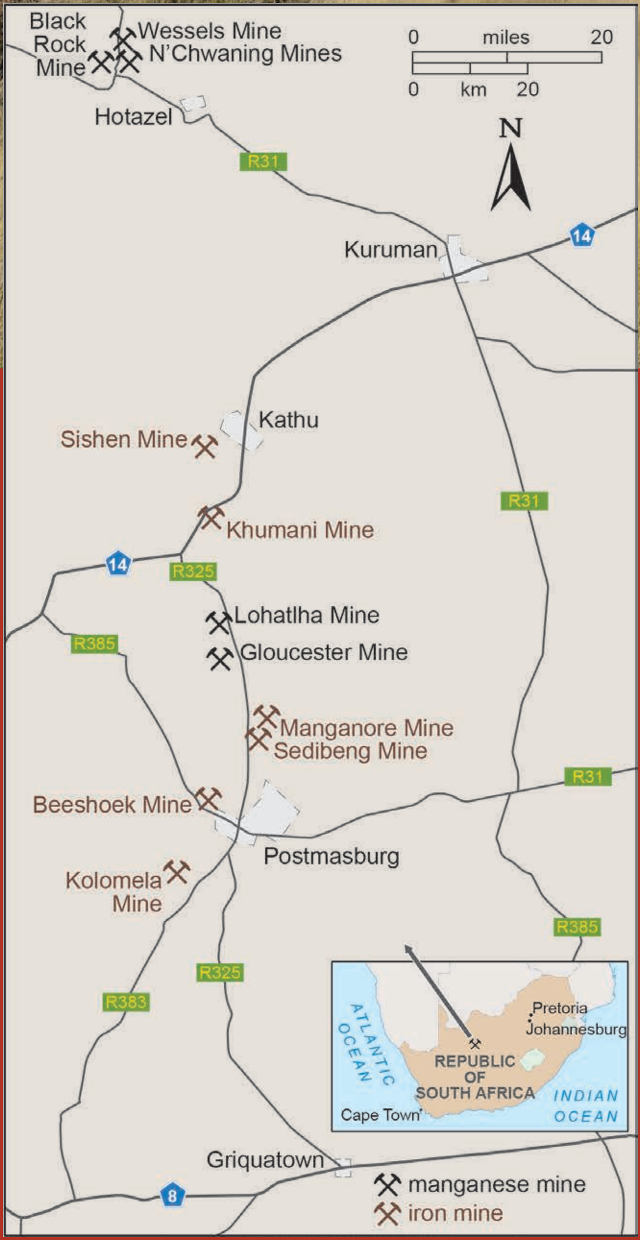

Figure 1. **Location map for Postmasburg in South Africa. Some of the larger mines are indicated as are the main Kalahari manganese field mines; prepared by William Besse.**

Figure 3. **Commemorative South African stamp issued on 28 June 1978. It shows a near-perfectly symmetrical handaxe fashioned from banded-iron stone, excavated at Kathu. Bruce Cairncross collection and photo.**

Dr. Bruce Cairncross, a consulting editor of Rocks & Minerals, *is professor emeritus at the University of Johannesburg.*

THE POSTMASBURG MANGANESE FIELD is not as mineralogically diverse or famous as the more northerly located Kalahari manganese field. Yet, the Postmasburg mines were the precursors that prompted exploration further afield and the subsequent opening of the Kalahari resources. Prior to European endeavors, the discovery of hematite by indigenous Africans close to the present-day town of Postmasburg dates back thousands of years. When the first European explorers arrived in the area in the early nineteenth-century, they found excavations in the hills where ochre was

Figure 4. **Portion of Burchell's route map with "Sensavan or Blink-klip" circled. Burchell visited the area on 18 June 1812. This would become the site of the future Postmasburg. From Burchell (1824b).**

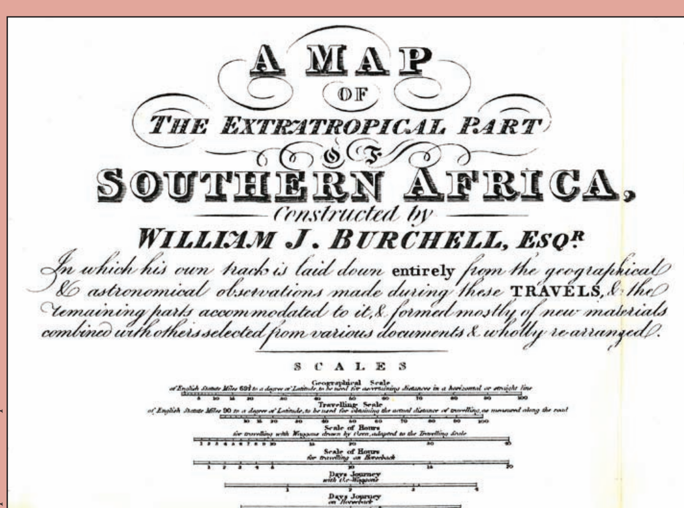

Figure 5. **The legend to Burchell's historic map. The explanation gives several novel scales, not only miles traveled, but also linear miles, the time taken in hours and days to travel the route, in wagons and on horseback. From Burchell (1924b).**

being dug for ornamental purposes and body adornment. More than one hundred years later European geologic exploration revealed the extent of these deposits leading to subsequent exploitation of the manganese and iron ore. From a mineralogical standpoint, the Postmasburg deposits contain forty-one valid species and one type-species (www.mindat.org; accessed October 2023).

Postmasburg is located 131 kilometers south of Kuruman and 195 kilometers west of Kimberley in Northern Cape Province, South Africa (figs. 1 and 2). The town has a population of approximately 30,000, and the economy is driven mainly by the surrounding mining and agricultural sectors. The prevailing climate is semiarid with approximately 2 cm of annual rainfall, a maximum summer temperature in the low- to mid-30s (°C), and an average minimum of 16°C. However, as can be attested by visits to the opencast mines, the temperature can reach the mid-40s during peak summer and fall below zero in the winter.

History

Postmasburg lies within a historic region known as Griqualand West. This was an area inhabited by the Afrikaans-speaking Griquas, but in 1848 it was annexed by the British, and in 1873, along with another settlement, Griquatown, located 150 kilometers west of Kimberley, it was proclaimed a British colony with Kimberley as its capital. When the Union of South Africa was formed in 1910, Griqualand West became part of Cape Province and is now part of Northern Cape Province.

Pre-European History

During the closing stages of the eighteenth-century and early nineteenth-century, European explorers and naturalists were trekking from the Cape Colony into the interior of South Africa, recording their journeys as they moved inland. From a geological-mineralogical standpoint, Lichtenstein (1811–1812) and Burchell (1824a,b) were the most important explorers as they documented pre-European extraction and utilization of iron ore in what is now Northern Cape Province of South Africa and, in particular, the present-day Postmasburg region (figs. 4 and 5).

Long before any European set foot in southern Africa, the indigenous San hunter-gatherers, Khoi herders, and Iron Age Tswana people had discovered important natural resources and used them for millennia (Thackeray, Thackeray, and Beaumont 1983). Within the historic borders of Griqualand West are numerous iron ore, asbestos, and manganese deposits, as well as ornamental stone such as jasper, tiger's eye, and diamonds. It was the hematitic iron ore that was exploited by the African cultures, first for the manufacture of stone tools and then as a source of pigment for body adornment.

To find the earliest evidence of this, one needs to travel to the mining village of Kathu, 60 kilometers north of Postmasburg. Here, at several sites in the townlands and close by, prehistoric deposits dating back 500,000 years to the Early Stone Age occur (Wilkins and Chazan 2012; Wilkins et al. 2012; Walker, Lukich, and Chazan 2014), and although declared Grade 1 National Heritage sites in 2013, they are now threatened by urban expansion. One of the sites, Kathu Pan, was professionally excavated in 1979 by archeologist Peter Beaumont (Hocking 1983; Beaumont 1990). The diggings yielded thousands of stone tools including handaxes sculpted from banded-iron formation, some of which are conserved and curated in the McGregor Museum in Kimberley. Dating of the implements yielded an age range of about 500,000 years (Porat et al. 2010) to Early Pleistocene (1.6 million years old), while the younger, uppermost artifacts date back 120,000

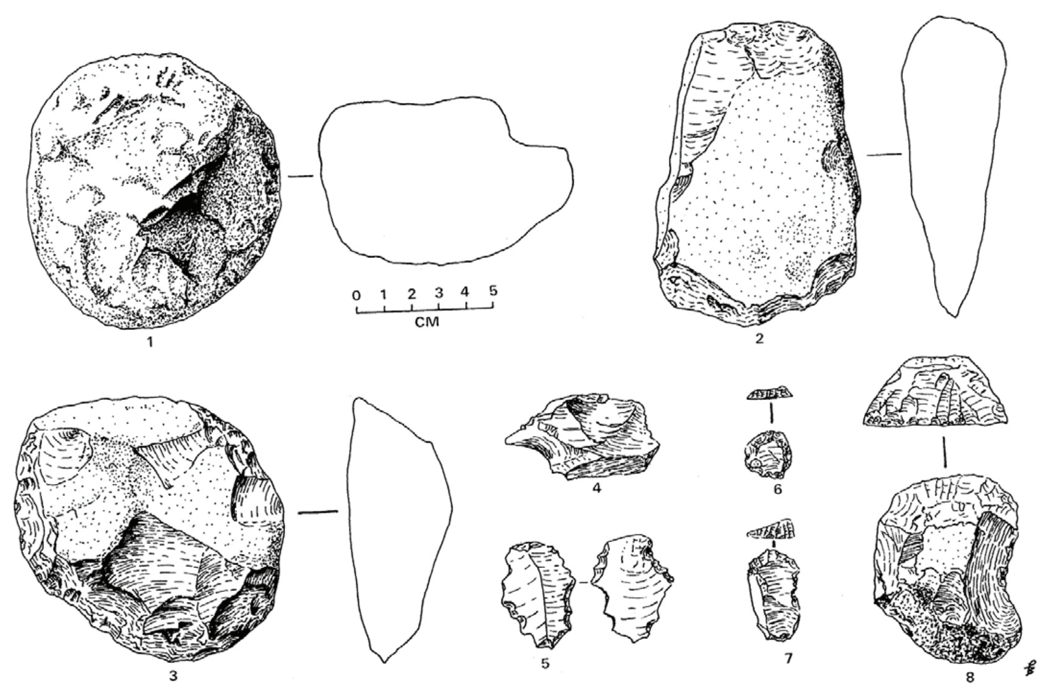

Figure 6. **Sketches of various stone artifacts excavated at Doornfontein, Postmasburg district. These include scrapers, hammerstones, and flakes. From Beaumont and Boshier (1974). Reproduced with permission of the South African Archaeological Society.**

***Figure 7a.* An early photograph of the excavation at Blinkklipkop with two field vehicles in the foreground. From Wagner (1928). Reproduced with permission of the Council for Geoscience, South Africa.**

***Figure 7b.* A modern photograph of the ancient diggings at Blinkklipkop, now a national monument. Bruce Cairncross photo.**

years. One of the handaxes has become famous for its pristine shape and color and is featured on a commemorative South African stamp (fig. 3).

Hocking (1983, p. 7) states: "For Beaumont, the chief interest in finding the younger tools was that with them were lumps of specularite and red ochre of the sort that Southern Africa's people have long prized as cosmetics." Therefore, the use of iron pigment dates back many thousands of years.

Prior to the discoveries at Kathu, Beaumont had been invited in 1969 to excavate potential ancient workings close to Postmasburg on property belonging to Associated Manganese Mines of South Africa Limited. These were located on the farm Doornfontein, 12 kilometers north-northwest of Postmasburg (Beaumont and Boshier 1974). They consisted of mined-out chambers with partially collapsed roof material, and it was estimated that 45,000 tonnes of specularite had been removed to create the void. Radiocarbon dating on charcoal fragments from the lowermost layer yielded ages of 1,120 ± 40 BP. In addition to charcoal, various artifacts were found (fig. 6) together with numerous bone fragments of wild animals including buffalo, zebra, gnu, and lion, none of which are found in the region today other than on game farms.

In addition to Doornfontein, several other pre-European workings were known from the time including the nearby farms at Paling, Gloucester, Mount Huxley, and perhaps most famously, Blinkklipkop, located 5 kilometers northeast of Postmasburg, also a declared National Monument since February 1992 because of its cultural significance (https://sahris.sahra.org.za/node/33166; accessed August 2023). Blinkklipkop (also known as *Gatkoppies* meaning "hole in the hills") is perhaps Postmasburg's best-known historical site for specularite excavation and early human habitation (figs. 7a and b).

Diggings for the red ochre pigment *sibilo* (specularite, a form of micaceous hematite) were made by the San hunter-gatherers and Khoi pastoralists before 800 CE and then in the Iron Age period by the Tswana people (Thackeray, Thackeray, and Beaumont 1983). Lichtenstein (1811–1812) visited the site in 1805 as did Burchell (1824b) in 1812. Burchell stated that the name of the hill given by the local Griqua was "Sensavan" (correctly spelled Tsantsabane, now the name of the local Postmasburg municipality). Burchell (1824b, pp. 255–256) described the activities he observed during his 1812 visit:

> It [Blinkklipkop] is a very remarkable mass of rock rising out from the eastern end of the ridge of hills . . . the only spot where the sibilo is found . . . a shining, powdery iron-ore of steel-grey or blueish luster, and soft and greasy to the touch, its particles adhering to the hands and clothes, and staining them a dark-red or ferruginous color. . . . The mode of preparing and using it, is simply grinding it together with grease, and smearing it generally over the body, but chiefly on the head.

Burchell (1824b, p. 257) went on to describe in detail the mode of occurrence of the hematite:

> The whole rock appeared to be composed of this species of iron ore, mingled in some places with a quartzose rock. The ore is mostly . . . friable and easily falling to pieces, so that the floor of the cavern was found deeply covered with the loose powder. . . . The size of this excavation . . . proves that this powder has been in use during many generations.

Apart from the main excavation, others nearby were also examined by Burchell, and he noted (p. 258): "Here the mineral is more glittering, and contained larger particles of shiny scales." Burchell himself used the sibilo by mixing it with water or oil and using it as a paint in his colored bookplates of the indigenous Khoisan who adorned themselves in the material.

Figure 8 (left). **General view of the outcrop containing various petroglyphs exposed at Beeshoek mine, with the mine in the background. Bruce Cairncross photo, January 1996.**

Figure 9 (above). **Close-up of part of the exposure shown in figure 8. Various geometric patterns are present *(top right),* a rhinoceros *(bottom left),* and various bucks. The circular depressions are cupules produced by hammerstone percussion (Beaumont and Bednarik 2015). Bruce Cairncross photo, January 1996.**

Apart from stone artifacts and animal remains, there are also rich historical stone artworks in the district, with none more impressive than the petroglyphs engraved in shale at Beeshoek, 7 kilometers west of Postmasburg (figs. 8 and 9).

Because of the historical importance of this site and the risk posed by future mining activities, some of the petroglyphs were professionally documented, removed, transported, and preserved at the McGregor Museum in Kimberley (Beaumont 2017). Sediment samples subjected to infrared stimulated luminescence and thermoluminescence analyses produced ages of 2,000–9,000 BP. Engravings of elephants and giraffes suggest a wetter climate at the time of their creation; this would coincide with the more humid mid-Holocene climate (Beaumont 2017). Similar petroglyphs are known from the Tswalu Game Reserve northwest of Kathu (Beaumont and Bednarik 2015).

These archeological investigations had therefore revealed occupation and exploitation over the millennia of various sites in and around Postmasburg and to the north. During Postmasburg's early days, the European community was not involved with any serious geological exploration or extraction of the mineral wealth in the surrounding countryside. As is often the case in South Africa, later colonial mining was located either directly on or nearby the ancient African workings.

European History Nineteenth Century

The first settlement by the Griquas was at Blinkklip in the 1820s (Birkholtz 2019). In February 1880, members of the Griqualand West Border Police unit were stationed at this nascent settlement because Griqualand West had recently been incorporated into the Cape Colony and the government considered the area a favorable site to establish a town. At this time, thirty-eight Europeans were living on the surrounding farms. In 1882, members of the *Gereformeerde Kerk* ("Reformed Church") arrived in the area between Blinkklip and Griquatown and in 1884 built a church on the farm Ploegfontein (Birkholtz 2019, citing Snyman 1983). A new church was constructed on 30 November 1889 when the congregation also decided to establish a town called Blinkklip, named after the historic hill. Following various petitions to the government, the Assistant Commissioner of Crown Lands officially proclaimed the town on 6 June 1892. Permission had been obtained to rename the town from Blinkklip to Postmasburg, after the Reverend Dirk Postma, their church leader who had passed away in 1890 (Hocking 1983). At this time, the town was essentially a center for the local farmers who would travel from around the district to attend Sunday church services.

Iron and, later, manganese were destined to become the focus of geologic exploration and mining in and around Postmasburg. However, discoveries of asbestos, tiger's eye, and jasper in Griqualand West predated this (Hocking 1983). Stow (1873, p. 408) had observed:

> Beyond the Plateau, at Griquatown [south of Postmasburg], a long parallel range of jaspideous rocks comes out from beneath the Campbell Plateau, presenting a wonderful group of yellow, brown, chocolate, and red jaspers [fig. 10], with magnetic and other ironstone, and beautiful seams of blue and yellow crocidolite.

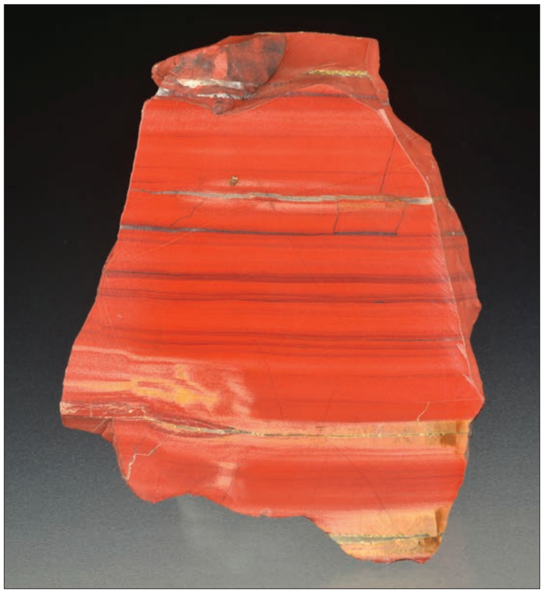

Figure 10. **Polished slab of jasper from the farm Voëlwater 20 kilometers west of Postmasburg; 11.4 cm. Department of Geology, University of Johannesburg collection, Bruce Cairncross photo.**

It was Hinrich Lichtenstein, German physician, explorer, and zoologist, who first described crocidolite and tiger's eye (pseudocrocidolite) in Northern Cape (Lichtenstein 1811–1812). He collected specimens in 1803 and sent them to Europe, and they are now housed in the *Museum für Naturkunde* in Berlin (Master 2018). In the English translation of Lichtenstein's original German work, Plumtre (1812, p. 234) describes how the asbestos was already being used by the colonists:

> . . . they use it very much . . . for rubbing on their houses and walls, first oiling it well. . . . Its particular hardness, and the durability of the blue colour, which resists fire, are very marked characters of it.

Lichtenstein played no further role in exploiting the layers of crocidolite, and it fell to Burchell (1824a) to document the deposits and describe them in detail. He noted that the local Khoisan called it *doeksteen* ("cloth-stone" or "handkerchief-stone") because of its cottonlike texture. During his travels in the South African hinterland, William Burchell not only recorded his observations at Blinkklipkop, but he was also one of the first early travelers to report on "hardened asbestos" (i.e., tiger's eye) south of Postmasburg in the Griquatown district. Burchell (1824a, p. 334) described it as:

> Between the laminae [of banded iron-formation] a beautiful kind of stone is found, sometimes of a blue and sometimes of a silky golden colour. . . . It is a species of asbestos . . . with compact fibres of a flinty hardness. . . . When cut and polished, the stone exhibits a very beautiful appearance.

Thus was tiger's eye first described in detail over two hundred years ago, and it stills finds value as an ornamental gemstone today (fig. 11).

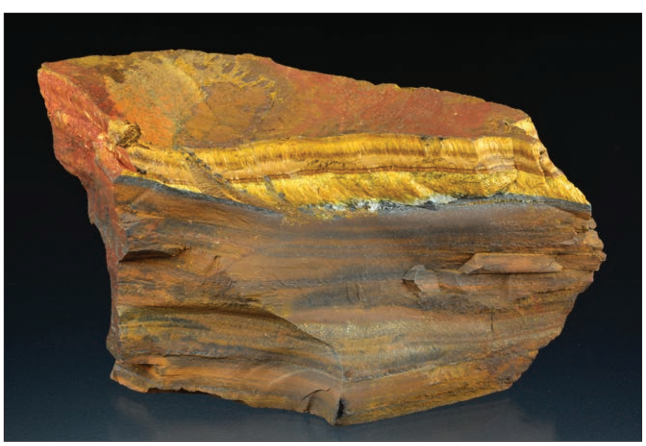

Figure 11. **A band of tiger's eye (pseudocrocidolite) interlayered in the host rock. From an unspecified locality south of Postmasburg; 14.5 cm. Bruce Cairncross specimen and photo.**

European History Twentieth Century

The realization that there were economically viable mineral resources in and around Postmasburg in sufficient quantity to warrant extensive European exploitation came about in the early twentieth-century and activity increased up until the Second World War. Hocking (1983), Snyman (2000), and Samancor (1976) provide detailed historical information for this period, some of which has been summarized by

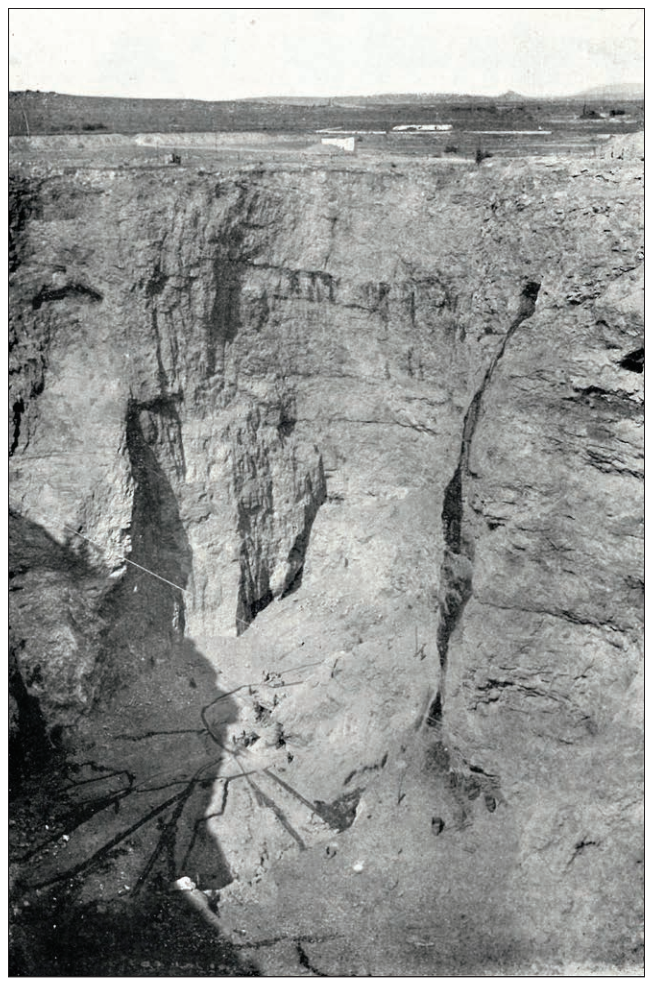

Figure 12. **The West End diamond mine at Postmasburg during its operation in the early 1920s. Note the figures and equipment at the bottom of the pit for scale. From Nel (1929). Reproduced with permission of the Council for Geoscience, South Africa.**

Summary of developments (1872–1940) in the Postmasburg area regarding exploration and mining of manganese and iron ore. Compiled from Hocking (1983), Cairncross, Beukes, and Gutzmer (1997), and Snyman (2000).

Date	Developments
1872–1874	George W. Stow's first geological mapping expedition and subsequent publications (Stow 1873, 1874).
1905–1907	Detailed geological mapping by A. W. Rogers.
1909	Discovery of manganese in the Klipfontein Hills (Eastern Belt of the Postmasburg manganese field) by Henry George Brown.
1922–1924	Discovery of manganese in the Western Belt by Thomas L. H. Shone.
1925	**Union Manganese Mines and Minerals Limited** formed by Thomas Shone, Reggie Shaner, and John-Dale Lace.
1926	First detailed description of the Western Belt manganese deposits by A. L. Hall. **South African Manganese Limited (Samangan,** the forerunner of Samancor) formed by A. J. Bester (Postmasburg attorney) and Niels Langkilde.
1927	**Postmas Manganese Fields Limited** formed by Fritz Marx, Lawrence Gray, and Julius Alexander. **Gamagara Manganese Corporation Limited** formed by A. H. Moore, Norman Wickee, and W. Johns. **Central Manganese Limited** formed by S. Ginsberg, A. S. van Hees, and G. O'Donovan. First small-scale production of manganese.
1927–1928	Detailed mapping and description of the Postmasburg manganese field by Nel (1929).
1928	**Gloucester Manganese Mines (Postmasburg) Limited** formed by Guido Sacco, L. Fatti, and A. and G. Tomaselli (fig. 13). **South African Iron and Steel Corporation (ISCOR)** formed in Pretoria. Wagner (1928) publishes the first description of iron ore from Postmasburg.
1929	**Union Manganese** transformed into the **Manganese Corporation** via an agreement with British Swiss International Corporation. South African Railways extends rail link from Koopfontein, through Postmasburg to Beeshoek (fig. 14).
1931	S. A. Manganese Limited produces the first hematite iron ore from Kapstewel.
1935	**Associated Manganese mines of South Africa Ltd (AMMOSAL)** (fig. 15) formed (now **Assmang)** via the merger of Gloucester Manganese Mines and the Manganese Corporation.
1936	Rail line extended north to Lohathla. S. A. Manganese begins mining at Lohathla.
1938	**African Metals Corporation (Amcor)** formed by H. J. van der Bijl, the start of the ferro-alloy industry in South Africa.
1940	**Black Rock mine** opened in the Kalahari manganese field. Ore trucked 150 kilometers south to Gloucester. Manganese exploration and mining move steadily away from the Postmasburg region to the Kalahari manganese field.

Cairncross, Beukes, and Gutzmer (1997). Snyman (2000, p. 16) perhaps best sums up the earlier history of Postmasburg mining as follows:

> For the first fifty years they [white settlers] were mainly interested in precious stones and metals that would ensure an instant fortune to alleviate the sufferings experienced in a marginal farming area. Although the expectations were met to a limited extent by the discovery of diamonds and asbestos . . . the rural Northern Cape desperately needed something out of the ordinary . . . manganese eventually filled this role.

In 1904, diamond-bearing kimberlite was discovered by a farmer while drilling on his farm, Peiserton, 25 kilometers southeast of Postmasburg (Hocking 1983; Posthumus 2009); this was followed by further diamond discoveries at Makganyene in 1915 on public land and at Postmasburg in 1918–1919 (Snyman 2000). A syndicate was formed and was granted permission to mine diamonds on the town land, but the mining rights were soon obtained by a Johannesburg-based company that named the operation West End mine (fig. 12).

Other diamond ventures included the Postmas mine, located a few kilometers east of the West End mine, and the New Makganyene Mining Company. Captain L. H. Thomas Shone was the mine manager at the Postmas diamond mine (Hocking 1983); he would later play a critical role in future manganese mining. The early part of the twentieth century leading up to the start of World War II saw rapid development and expansion of manganese mining in and around Postmasburg, characterized by the formation, amalgamation, and dissolution of several companies; these events are summarized in the table (above).

After his venture with the West End diamond mine, Captain Shone (fig. 16) was somewhat frustrated with the diamond business and looked further afield for other commodities. It is he who is often credited with discovering the manganese ores in 1922 that now form the Western Belt (see Geology section), and his company, Union Manganese Mines and Minerals Limited, was the first to mine manganese in the region.

However, although Shone's enterprise was the first to commercially exploit the manganese deposits, he was not the first to have recorded manganese in the area. Snyman (2000, p. 13) states: "contrary to the belief that manganese was first discovered in the Northern Cape during the 1920s, the presence of this base metal was noted some 40 years earlier." In 1886 traces of manganese were found in samples from the farm Waterboersdam south of Postmasburg. Ten years later, manganese ore was intersected in a water borehole south of Kuruman, and Rogers (1907) reported on the manganese beds at Black Rock in the Kalahari manganese field but not at Postmasburg.

Figure 13 (above). **Rail tracks and cocopans (mining cars) at the Gloucester mine during the early days of mining. The cocopans were manually pushed by the miners. From Snyman (2000). Reproduced with permission of Desmond Sacco, ASSORE.**

Figure 14 (top right). **A Kerr Stuart 90 horsepower six-wheel diesel locomotive, restored and located at Black Rock, Kalahari manganese field. This was one of four units ordered by The Associated Manganese Mines of South Africa Ltd. on 8 April 1930 (Sabatini 2014). In 1937 this unit was moved to the Gloucester mine where it was operated until 1965. These locomotives operated on the Beeshoek light railway narrow-gauge line at Postmasburg, running 9 kilometers from Beeshoek to Doornfontein and Paling. This was the first diesel railway in South Africa and operated until 1976 (Sabatini 2014). Bruce Cairncross photo, November 2011.**

Figure 15 (bottom right). **The AMMOSAL iron-ore loading bin at Beeshoek mine. Bruce Cairncross photo, January 1996.**

Figure 16. **Captain Shone, wearing a tie and waistcoat, seated on a manganese ore outcrop at Lohathla. From Hall (1926). Reproduced with permission of the Geological Society of South Africa.**

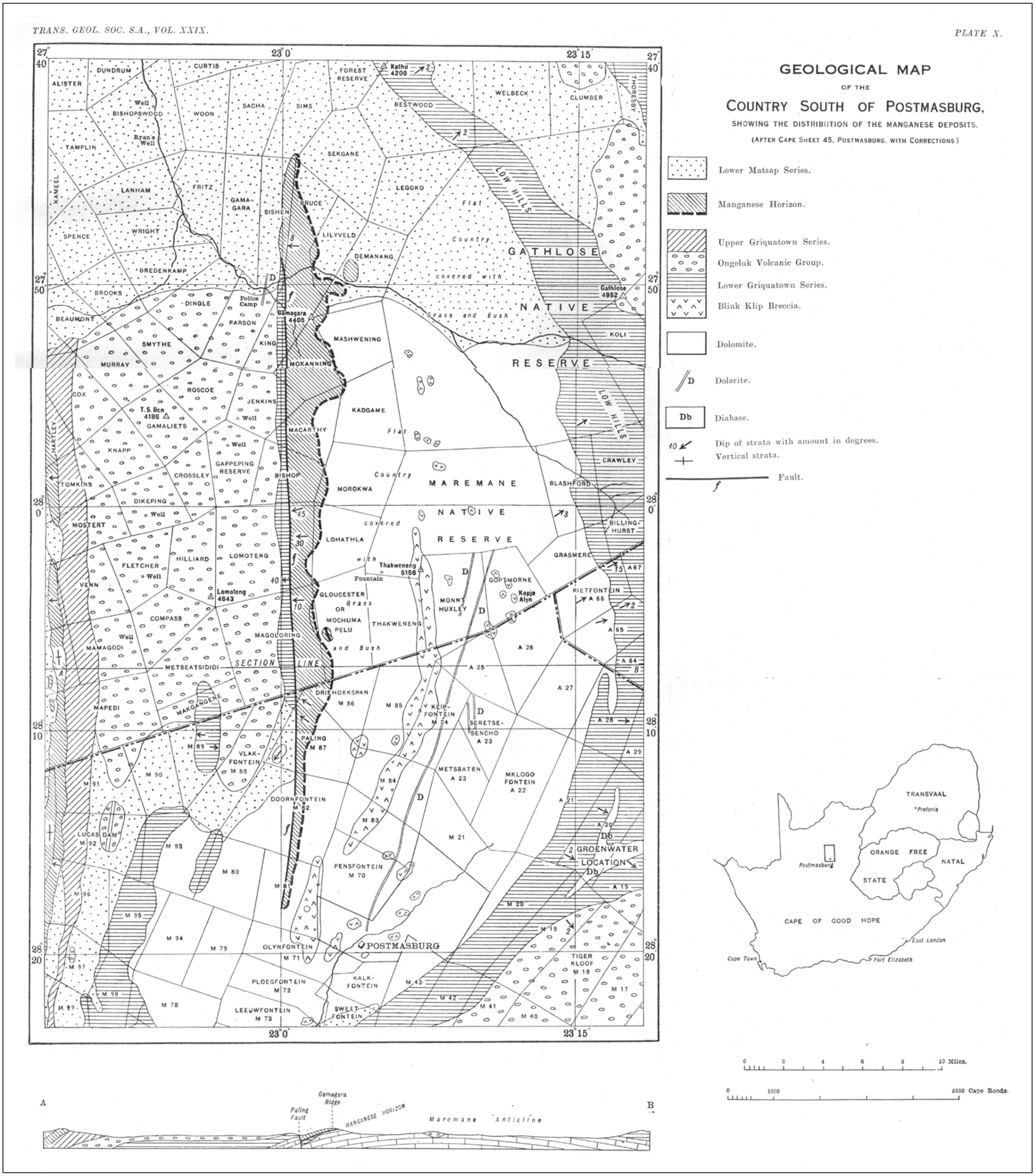

Figure 17. **Hall's map of the Postmasburg manganese field. The geology is similar to that mapped by Rogers but has updated farm names and an east-west cross-section through the sequence. From Hall (1926). Reproduced with permission of the Geological Society of South Africa.**

Figure 18 (left). **Abandoned cocopan at Paling. Until 1979, these were used by the manganese miners to transport ore to the sorting floors. Note the strewn field of silver hematite and manganese rocks. Bruce Cairncross photo, January 1996.**

Figure 19 (above). **A ruined stone "kaia" at Paling. Derived from the IsiZulu word *ikhaya* meaning "home" or "dwelling." This one-room structure was used by the miners as their living quarters. Bruce Cairncross photo, January 1996.**

Geology

The earliest detailed geological mapping in the area was by Stow (1873, 1874) and some thirty years later by Rogers (1906a and 1906b, 1907), although interestingly neither emphasized the importance of the manganese deposits despite clearly documenting the iron ore present.

Stow's 1874 map that accompanied his article contains the first published lithostratigraphic column subdividing the regional geology into named units, some of which have been retained. Stow went on to make important contributions in other fields of geology. Together with Andrew Geddes Bain, he is considered by some to be "the father of South African geology" (Rogers 1937, p. 68; Young 1908).

Following the mining ventures of Shone and others in the early 1920s (see table), the South African Government dispatched the assistant director of the Geological Survey, Dr. A. L. Hall, in 1925 to survey the Postmasburg manganese deposits in detail. The result was the first detailed publication of the deposits (Hall 1926) (fig. 17). At this time, Shone's Union Manganese operations had already opened pits on the farms Doornfontein, Paling (figs. 18 and 19), Driehoekspan, and Bishop.

Wagner (1928, p. 121) provides chemical analyses of ferruginous ore from Driehoekspan that show 20.72 weight percent Fe and 32.51 weight percent Mn. As the mining activities expanded, so did the geologic research, and three

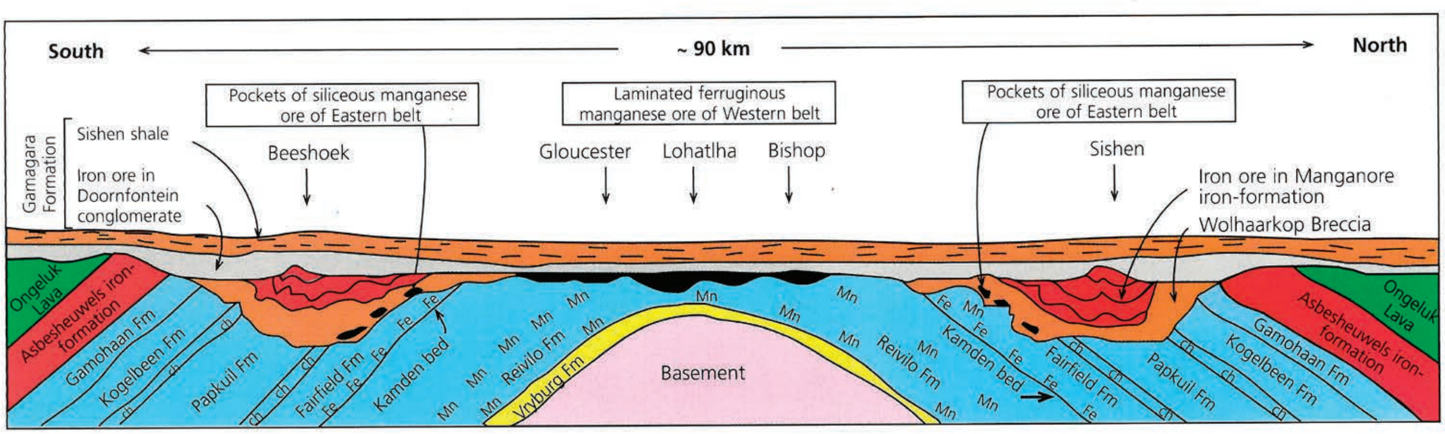

Figure 20. **A north-south geological cross-section through the Postmasburg manganese deposits, viewed toward the west. The Transvaal Supergroup strata (blue, red, and green) overlies older basement (pink). These rocks were uplifted, folded into an anticline, the Maremane Dome, and then planed off, forming a major unconformity. The Gamagara Formation (Doornfontein conglomerate and Sishen shale) were then deposited onto this surface. Two of the dolomite units, the Papkuil and Kogelbeen formations, have slump structures filled with the Manganore Iron-Formation and the Wolhaarkop Breccia. These contain pockets of siliceous manganese ore either side of the dome. Ferruginous manganese ore at Gloucester, Lohathla, and Bishop lie directly on the undulating, karst topography of the Reivilo Formation manganiferous dolomite. See text for details. From Cairncross, Beukes, and Gutzmer (1997). Reproduced with permission of ASSORE.**

Figure 21. **The Beeshoek mine. Bruce Cairncross photo, January 1996.**

***Figure 22.* Core sample of oxidized hematite banded-iron formation, Manganore Iron-Formation, 18 cm, Beeshoek mine. Department of Geology, University of Johannesburg collection, Bruce Cairncross photo.**

years after Hall's seminal paper, Nel (1929) published a geological map and explanation of the Postmasburg manganese deposits. This was followed by the first description of zunyite from Postmasburg, at the time only the second-known worldwide occurrence of the species (Nel 1930). Shortly thereafter Schneiderhöhn (1931) undertook the first systematic petrographic investigation of the ore minerals; other investigations soon followed (du Toit 1933; Truter et al. 1938; Boardman 1940; de Villiers 1944).

Since the early- to mid-twenty-first century geologic investigations, the economic geology of the Postmasburg region has been an ongoing topic of research. Many articles and theses have been published, and reviewing all of these in detail is beyond the scope of this article. One of the most comprehensive summaries was by Cairncross, Beukes, and Gutzmer (1997) with updates by Beukes, Swindell, and Wabo (2016), Cousins (2016), Masangane (2017), Ntlhoro (2017), Fairey et al. (2019), Thokoa (2020), and Bussin (2022), among others.

The regional stratigraphy and geologic structures are depicted in figure 20. The Transvaal Supergroup succession consists of a series of limestones and dolomites with minor clastic interbeds of the Paleoproterozoic Schmidtsdrif and Campbellrand subgroups, unconformably resting on the older Ventersdorp Supergroup volcanics. Above these carbonates, the Asbesheuwels Subgroup iron-formations are in turn overlain by the Ongeluk lavas. This succession underwent deformation producing the Maremane Dome, a major anticline. The Campbellrand carbonates exposed on the anticline limbs underwent weathering and dissolution forming extensive sinkhole and karst topography. A siliceous, chert-rich unit, the Wolhaarkop Breccia, accumulated on the highly undulose

***Figure 23.* The karst topography at Lohathla mine, showing myriad dolomite pinnacles exhumed after the extraction of the intervening manganese ore. Bruce Cairncross photo, May 1992.**

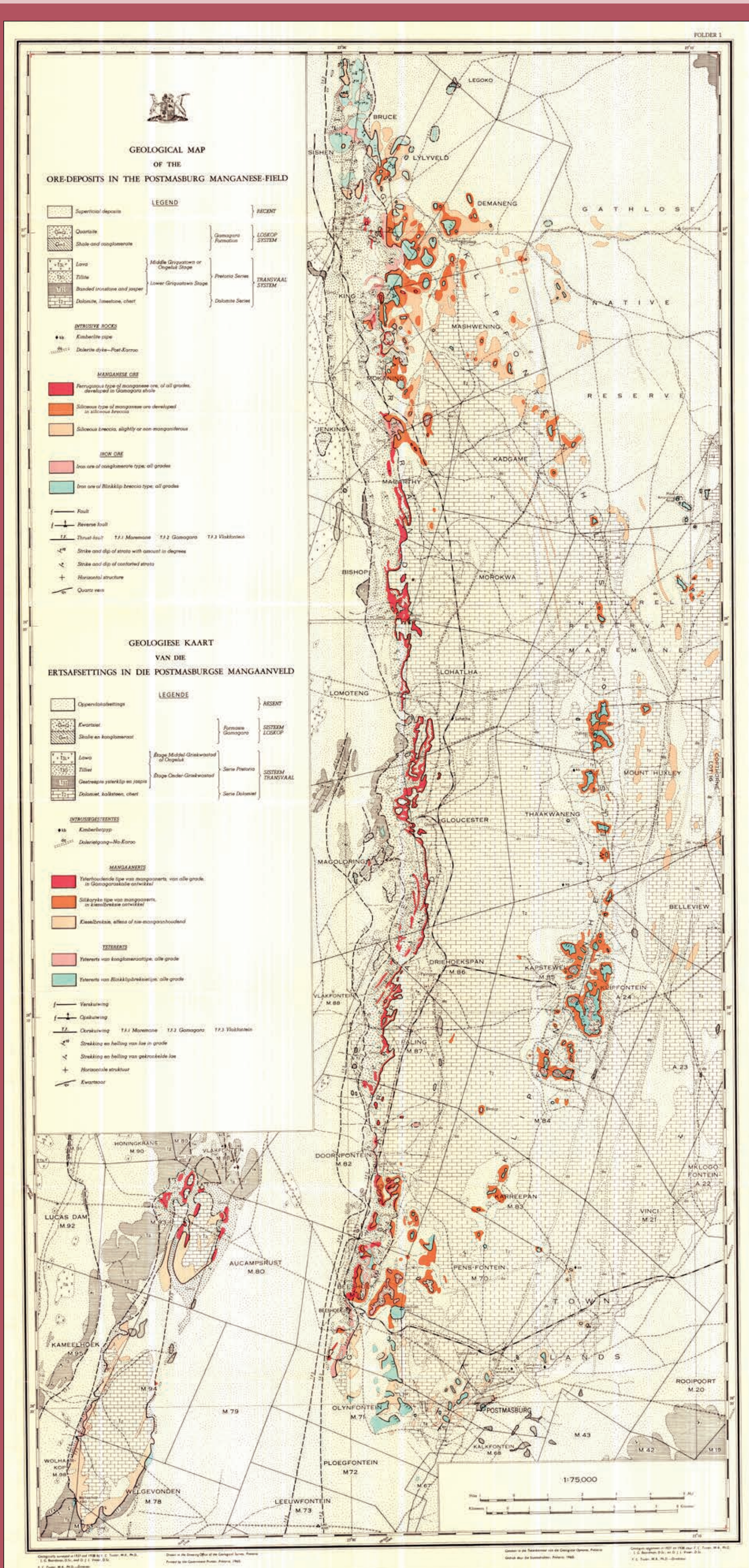

Figure 24. **One of the most detailed geological maps of the Postmasburg region showing both manganese (red, orange, and tan) and iron ore (pink, pale turquoise). The former constitutes the Western Belt and the latter the Eastern Belt. The farm names such as Paling, Driehoekspan, Gloucester, Lohathla, Lomoteng, Bishop, Sishen, and Bruce were used as names for the various mines. Also shown are the Postmas and West End diamond mines north and northeast of Postmasburg. From Boardman et al. (1960). Reproduced with permission of the Council for Geoscience, South Africa.**

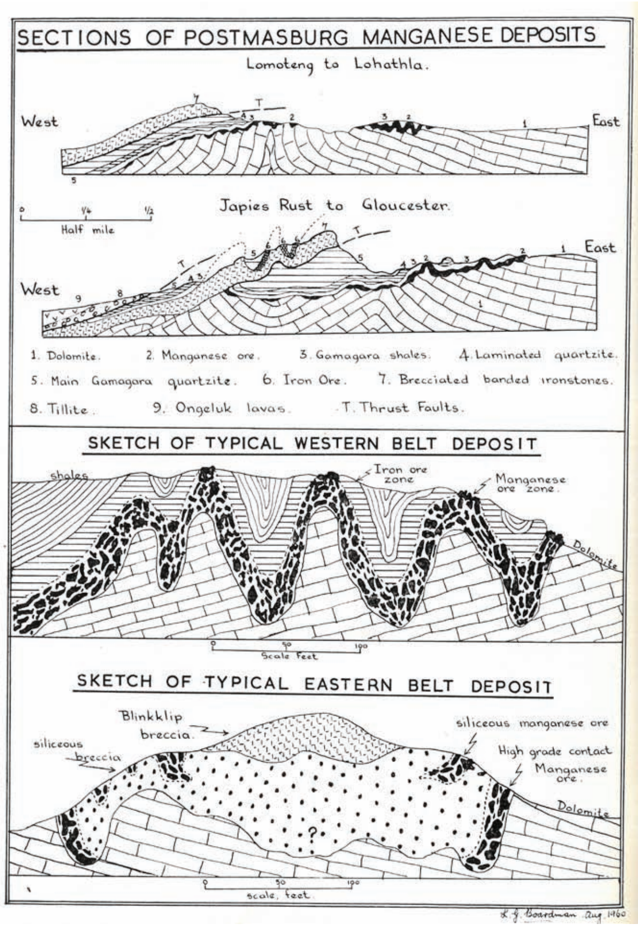

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Figure 25. **Two west-east sketches illustrating the structure and distribution of the manganese deposits over the Maremane Dome and two depicting the morphology of the Western and Eastern Belt deposits. From Boardman (1964). Reproduced with permission of the Geological Society of South Africa.**

karst surface; this breccia is overlain by deformed Asbesheuwels iron-formation, locally called the Manganore Iron-Formation (fig. 20).

The exposed strata were then planed off by erosion leaving a major unconformity that is overlain by the Gamagara Formation, which consists of two units, the basal Doornfontein conglomerate and the overlying alumina-rich Sishen shale (fig. 20). The Manganore Iron Formation (fig. 22) has been interpreted as the ferruginous, lateral, oxidized equivalent of the Kuruman and Griquatown formations that have slumped into and been preserved in karstic topographic depressions and exploited at mines such as Beeshoek (fig. 21) (van Wyk and Beukes 1982).

The formation of the underlying karst topography (fig. 23), caused by the dissolution of the carbonates, was critical in the formation and genesis of the Postmasburg manganese deposits (Gutzmer and Beukes 1996). Two types of manganese ore are intimately associated with the Maremane Dome and are located in two different geographic localities. The **Eastern Belt** consists of siliceous manganese ore in a silica/chert-rich solution-collapse cave breccia, called the Wolhaarkop Breccia. The **Western Belt** is characterized by ferruginous shale/manganese ore that originated as surficial wad accumulations in paleokarst depressions, forming lenticular bedded stratiform units directly above an erosional unconformity (Boardman 1964; Gutzmer 1996; Gutzmer and Beukes 1996) (figs. 24 and 25).

Because of the karst topography and the structural complexity, the manganese deposits are irregularly distributed and tend to be discontinuous as can be seen from the geological cross-section (figs. 20 and 25), particularly the siliceous pods in the Wolhaarkop Breccia: "The nature of these deposits is related to their genesis as possible ancient wad-like concentrations of Mn-oxyhydroxides associated with internal sediment in collapsed karstic cave systems" (Beukes, Swindell, and Wabo 2016, p. 303). In contrast, the iron-rich manganese ores of the Western Belt are more continuous, as they originated as lacustrine sediment deposited in small lakes and depressions on the karstic surface. Because of their lateral continuity, the Western Belt manganese beds were mined continuously for a longer period than the erratically distributed Eastern Belt deposits.

Although the manganese deposits have been mined for decades, there is no universal consensus as to their mode of formation. Inferred processes have included a magmatic hydrothermal origin (de Villiers 1944), metasomatic replacement of host rocks by Mn-rich meteoric water (Nel 1929; Boardman et al. 1960), alkali metasomatism (Moore et al. 2011), and a primary sedimentary origin (Schneiderhöhn 1931)—an interpretation supported by von Plehwe-Leisen and Klemm (1995). Figures 26 and 27 provide a chronological sequence for the formation of the two different modes of orebody formation in the Western and Eastern belts as interpreted by Gutzmer and Beukes (1996).

Mines and Minerals

The South African Department of Mineral Resources lists twelve currently operating mines near Postmasburg located on both the Western Belt and Eastern Belt deposits (https://www.dmr.gov.za/mineral-policy-promotion/operating-mines/northern-cape; accessed September 2023). Historically, the Lohathla and Gloucester mines (figs. 28, 29, and 30) have produced noteworthy specimens and still yield interesting material from the old dumps. Glosam mine is frequently referred to in the literature and on some mineral specimen labels, but that name refers to the village at the Gloucester mine. Snyman (2000, p. 54) states the following:

> One of the few additions [at Gloucester] during the early years was a post office, which was named Glosam (**Glo**uce**s**ter **A**ssociated **M**anganese) in 1937. This later also became the name of the village [in 1953], but the mine retained the name Gloucester.

Western Belt mines therefore include Lohathla, Gloucester, and Bishop, and, in more recent times, Lomoteng, located west of Lohathla and Driehoekspan between Paling and Gloucester (fig. 24). Mines currently operating include Boskop, Doornfontein, Kitso, Japies Rus, Kareepan, Kolomela, Khumani, Lomoteng, Pensfontein, Sedibeng, Sishen, and Sishen South. Most of the currently operating mines exploit the iron-ore deposits because the focus of manganese operations has shifted north to the Kalahari manganese field.

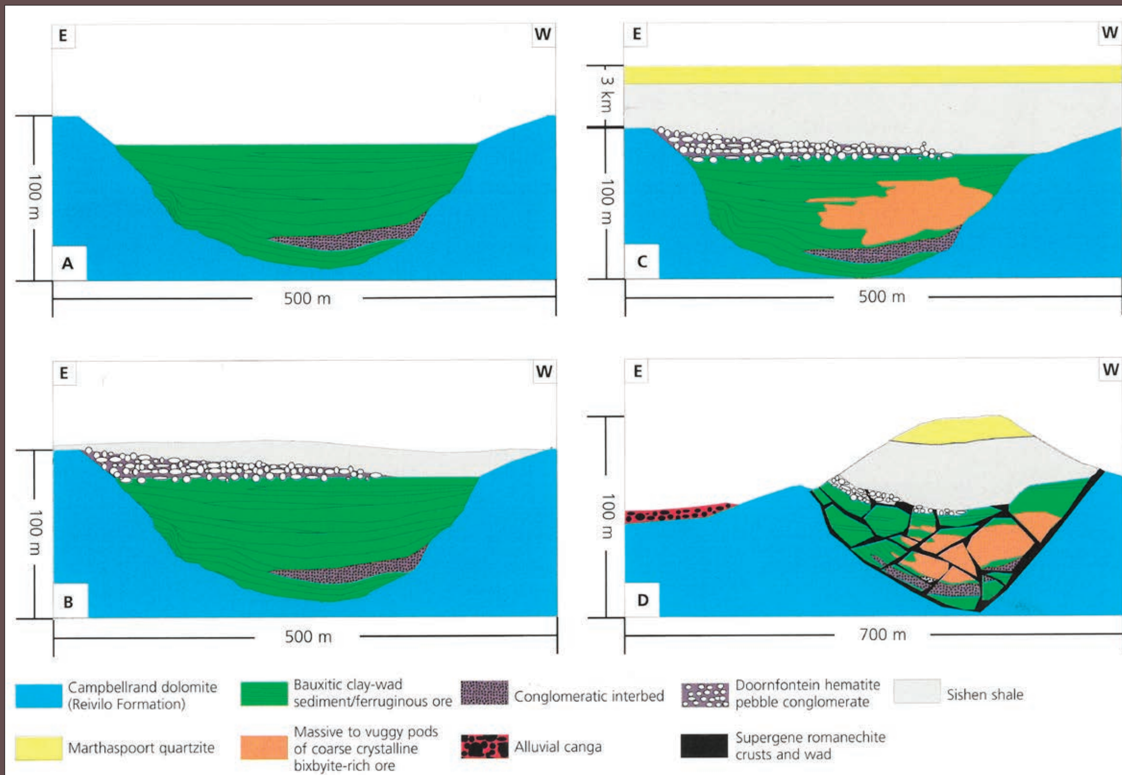

Figure 26. **Formation of the iron-rich manganese ores in the Western Belt. (A) Karst topography forms in the dolomite and is infilled by bauxite-rich clay and iron-manganese wad interbedded with shale and conglomerate. (B) Deposition of the Doornfontein hematite-pebble conglomerate and aluminous shale (the Gamagara Formation). (C) Metamorphism and hydrothermal fluids produce pods of coarse bixbyite-ephesite-diaspore. (D) Recent erosion renews karsting and causes brecciation of the orebody, accompanied by the formation of botryoidal romanèchite and manganese wad. From Cairncross, Beukes, and Gutzmer (1997). Reproduced with permission of ASSORE.**

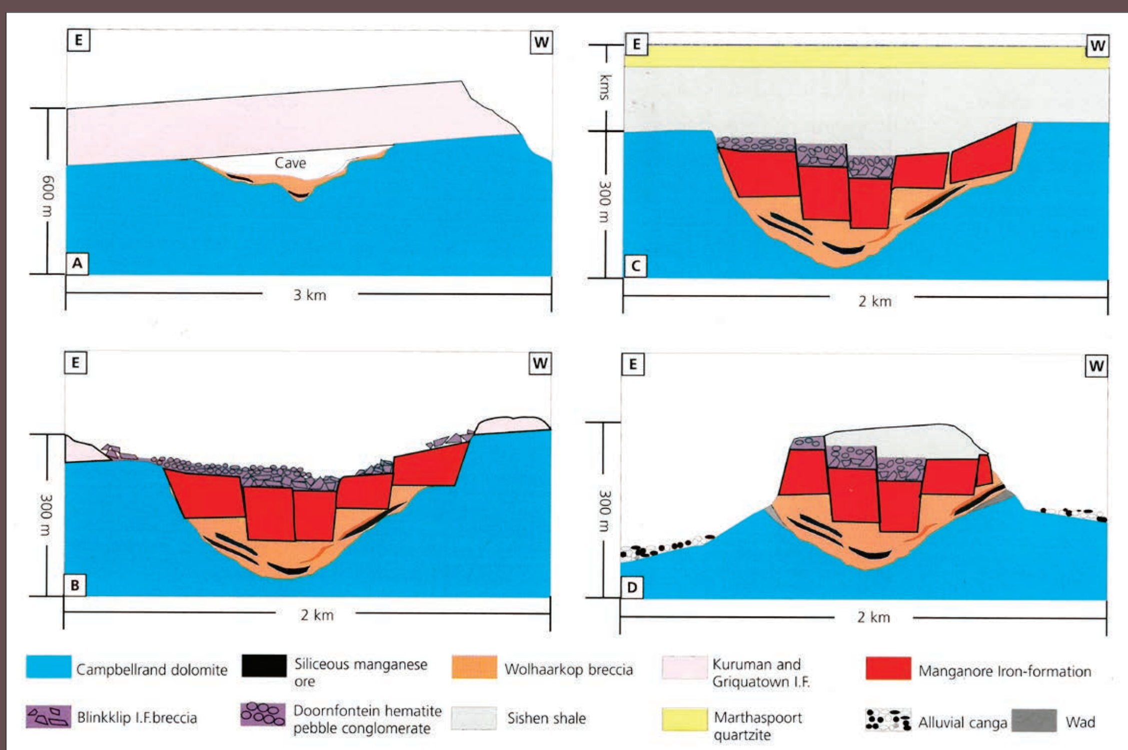

Figure 27. **Formation of the manganese ores of the Eastern Belt. (A) Karst/cave formation in the dolomite, deposition of the Wolhaarkop Breccia, and iron enrichment in the overlying Kuruman and Griquatown iron formations forming the Manganore Iron-Formation. (B) Roof collapse and Manganore Iron-Formation blocks slump into the cave. Reworking of this material forms breccia on top (Doornfontein conglomerate and Blinkklip Iron-Formation). (C) Further collapse and deposition of the Gamagara Formation above (Sishen shale and quartzite). (D) Erosion produces residual hills of Wolhaarkop Breccia and iron-formation. From Cairncross, Beukes, and Gutzmer (1997). Reproduced with permission of ASSORE.**

Figure 28. **Lohathla mine seen in 1961. Piles of manganese ore have been neatly hand-stacked waiting for transport from the mine. Department of Geology archive collection, University of Johannesburg, South Africa. Willem van Biljon photo.**

Figure 29. **Residual karst dolomite pinnacles and stockpiled ore in the foreground at Gloucester mine. Bruce Cairncross photo, July 1995.**

Only the minerals occurring as well-formed crystals and of collector interest are described here.

Amesite, $Mg_2Al(AlSiO_5)(OH)_4$, is a member of the kaolinite-serpentinite group and is found in the Western Belt deposits (fig. 31). It occurs as pseudohexagonal prisms a few millimeters thick and several millimeters long but can range up to several centimeters (Gutzmer 1996). Amesite is found as light green-gray foliated masses intermixed with pink diaspore at the Japies Rus mine. At Bishop, amesite occurs with bixbyite and ephesite (Cairncross and Dixon 1995; Gutzmer 1996). Samples of amesite from Gloucester analyzed by de Villiers (1945b) revealed traces of nickel, although later analysis of samples from Gloucester and Bishop by Gutzmer (1996) did not detect any nickel but rather an enrichment in magnesium.

Boardman et al. (1960) state that ***baryte, $BaSO_4$,*** is relatively common throughout the manganese deposits, particularly in the Eastern Belt. Coarsely crystalline baryte is erratically distributed in the Wolhaarkop Breccia (de Villiers 1944). Veins and lenses of solid baryte are found along the contact of the manganese orebodies and the underlying dolomite, indicating localized hydrothermal fluid flow (Gutzmer 1996). It is seldom found in aesthetic, freestanding euhedral crystals (figs. 32 and 33).

Figure 30. **Entrance to Glosam village at Gloucester mine. The Afrikaans motto under the crest reads *Aarbeid is adel* meaning "Labor is noble." Bruce Cairncross photo, January 1996.**

Bixbyite, Mn_2O_3, is one of the main manganese ore minerals in the Postmasburg manganese deposits, particularly in the Western Belt (Boardman et al. 1960). Well-formed cubic crystals of bixbyite to 3 cm on edge are found in vuggy ore of the Western Belt and were relatively common at Driehoekspan, Doornfontein Gloucester, Bishop, Lohathla, and Paling (figs. 34, 35 and 36). These are associated with diaspore, ephesite, and amesite. Gutzmer (1996, p. 231) analyzed Post-

Figure 31. **Several crystals of pale yellow amesite, largest 5 mm, contained in a cavity lined by cubic bixbyite crystals. Some are cleaved; the main crystal in the foreground is complete. Fragments of dark red mangan-diaspore are present, intermixed with the bixbyite and amesite. Field of view is 16 mm. Paling mine, Postmasburg manganese field, South Africa. Bruce Cairncross specimen and photo.**

Figure 32. **In-situ cavity in hematite exposed in the open-pit mine. Some small well-formed baryte crystals are evident in the top of the vug. Hammer head is 19 cm; Japies Rus mine. Bruce Cairncross photo.**

Figure 33. **Close-up of the baryte crystal cluster shown in figure 36 after removal and cleaning; field of view 4 cm, Japies Rus mine. Bruce Cairncross specimen and photo.**

Figure 34. **Many small cubic bixbyite crystals on bixbyite ore, with pink ephesite above; field of view 2 cm, Lohathla mine (self-collected). Bruce Cairncross specimen and photo.**

Figure 35. **Complex intergrown cubic crystal of bixbyite, 2.8-cm cluster, Lohathla mine. Bruce Cairncross specimen and photo.**

Figure 36. **Bixbyite intergrown with red mangan-diaspore, field of view 2.6 cm, Lohathla mine. Bruce Cairncross specimen and photo.**

masburg bixbyite from Bishop and Gloucester and found "Two distinct varieties of bixbyite . . . iron-poor bixbyite with generally less than 4 weight percent Fe_2O_3 and iron-rich bixbyite with between 10 and 22 weight percent Fe_2O_3." These iron-rich/iron-poor varieties of bixbyite from the Postmasburg deposits were already known (Gruner 1943; de Villiers 1943b, 1983). Miyawaki et al. (2022) have redefined the bixbyite series with manganese-dominant and iron-dominant end members, so both are present here.

Calcite, $CaCO_3$, is rarely encountered in the Postmasburg manganese deposits. It occurs as a secondary mineral in vugs and veins in the local quarries and has been found at the West End diamond mine (figs. 37 and 38).

Diaspore, AlO(OH), was first described from Russia by Haüy (1801), and a detailed crystallographic analysis was undertaken by Smith (1851). Together with two other aluminum-rich minerals, amesite and ephesite, diaspore is the most common gangue mineral in the iron-rich manganese ore (Gutzmer 1996). Diaspore occurs primarily in an aluminous diaspore-kaolinite-pyrophyllite rock (fig. 39), often associated with braunite, although the best specimens are free of matrix and consist of interlocking diaspore crystals (fig. 40). Terminated crystals are rare (fig. 41); most are cleavage fragments.

Large, well-formed diaspore crystals were discovered during initial mining activities in the Postmasburg deposits and attracted mineralogical attention soon thereafter. Hall

Figure 37. **Calcite crystals partly coated by goethite(?), 12.1 cm, West End diamond mine. Allan Fraser specimen, Bruce Cairncross photo.**

Figure 38. **Several clusters of colorless calcite in a small dolomite vug, together with yellow-green-stained dolomite crystals; field of view 5.5 cm, Dolomite quarry 5 kilometers outside Postmasburg. Allan Fraser specimen, Bruce Cairncross photo.**

(1926) initially misidentified the diaspore as rhodonite, but that same year Chudoba (1929) correctly identified it as diaspore, as did du Toit (1933). Both manganese and iron-rich diaspore occur here, with a wide range of compositions recorded by early workers: 1.96 weight percent Fe_2O_3 and 4.32 weight percent Mn_2O_3 (Chudoba 1929), 1.32–1.47 weight percent Fe_2O_3, and 0.11–0.5 weight percent Mn_2O_3 (Nel 1929). Gutzmer (1996), however, reported electron microprobe results of 0.3–0.54 weight percent Fe_2O_3 and 0.3–0.54 weight percent Mn_2O_3 and attributed the higher iron concentrations reported previously to possible hematite inclusions in the diaspore.

Postmasburg diaspore, referred to as mangan-diaspore due to the presence of manganese, is typically wine-red and orange-red to whisky-brown and occurs as lathlike crystals

Figure 39. **Mangan-diaspore scattered in kaolin and pyrophyllite matrix, 6 cm, Doornfontein mine. Francois Retief specimen and photo.**

Figure 40. **An aggregate of well-formed mangan-diaspore crystals, 6 cm, Gloucester mine. Bruce Cairncross specimen and photo.**

Figure 41. **Radiating mangan-diaspore crystals on bixbyite matrix. Some of the crystals are terminated and project into the open cavity, 11.6 cm, Lohathla mine. Bruce Cairncross specimen and photo.**

Figure 42 (top left). **Side view of a 7-cm cleaved mangan-diaspore crystal, 9.7-cm specimen, Lohathla mine; collected in 1978. Bruce Cairncross specimen and photo.**

Figure 43 (top right). **Dark red partly transparent crystals of mangan-diaspore, 7 cm, Gloucester mine; collected in 2022. Bruce Cairncross specimen and photo.**

Figure 44 (left). **Mass of platy, dark red mangan-diaspore with dark gray bixbyite and pink ephesite crystals, 13 cm, Gloucester mine. Francois Retief specimen and photo.**

to 10 cm (fig. 42). It is commonly associated with ephesite and the manganese ore minerals (figs. 43 and 44). Gutzmer and Beukes (1997) suggest that Mn substitutes for Al and that this accounts for the color. Several of the Postmasburg localities have produced attractive specimens including Paling, Sedibeng, Bishop, Gloucester, and Lohathla. The last was a popular site for locals who collected aesthetic specimens from the old dumps. Unfortunately, access is now prohibited.

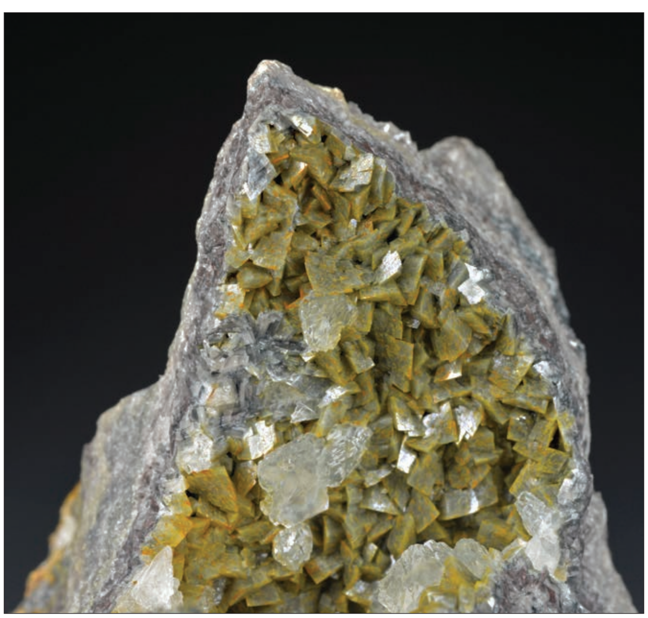

Figure 45. **Olive-green dolomite crystals tinged with orange, with white calcite on dolomite; field of view 4 cm, Dolomite quarry, 5 kilometers outside Postmasburg. Allan Fraser specimen, Bruce Cairncross photo.**

Dolomite, $CaMg(CO_3)_2$, is a common rock-forming mineral in the Postmasburg area, and dolostone forms the underlying lithology to the manganese and iron-bearing strata. Gutzmer (1996) analyzed unweathered dolomite from the Reivilo Formation (fig. 20) and found it contained 2.53–2.85 weight percent Mn_3O_4 and approximately 0.5 weight percent Fe_2O_3. Dolostone is locally quarried for aggregate used along the railway lines as ballast and in gardens. Dolomite crystals are rare and, if present, tend to be only a few millimeters across and confined to cavities within the host-rock dolomite (fig. 45).

Ephesite, $NaLiAl_2(Al_2Si_2O_{10})(OH)_2$, the sodium-rich analogue of margarite, was originally described by Smith (1851) from specimens collected in Turkey and was named for the ancient city of Ephesus. Hall (1926, p. 36) provides the first description of Postmasburg specimens as follows:

> A beautiful delicately rose-coloured mica . . . discovered by Captain Shone on Aarkop (Magoloring), where it occurs in compact dark bluish-grey ore as thick, short, columnar aggregates not unlike little “books” of mica with pseudo-hexagonal outlines, and showing characteristic perfect basal cleavage.

This was originally thought to be manganophyllite (Chudoba 1929), but Nel (1929) provided chemical analyses proving that the chemistry was incompatible with that of

Figure 46 (left). **Cluster of pseudohexagonal red ephesite crystals, field of view 2.3 cm, Gloucester mine. Francois Retief specimen and photo.**

Figure 47 (right). **Pink ephesite with white kaolinite, field of view 1.4 cm, Lohathla mine. Bruce Cairncross specimen and photo.**

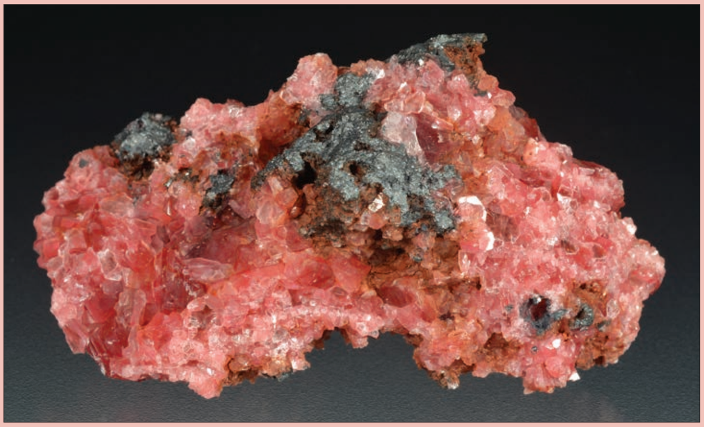

Figure 48 (top left). **A flat surface on manganese ore completely covered by ephesite crystals, 13 cm, Gloucester mine. Bruce Cairncross specimen and photo.**

Figure 49 (top right). **A 15.8-cm specimen of ephesite. Portions of the specimen consist of massive, cleaved crystals while vuggy portions contain freestanding crystals. A small fragment of banded iron-formation is visible in the lower central section, Gloucester mine. Bruce Cairncross specimen and photo.**

Figure 50 (bottom left). **Brecciated manganese ore with fracture surfaces and cavities lined with ephesite, 9.2 cm; self-collected in 1992, Lohathla mine. Bruce Cairncross specimen and photo.**

Figure 51 (bottom right). **Vibrant bright red cleaved ephesite crystals incorporating silver bixbyite ore, 7.5 cm, Gloucester mine. Bruce Cairncross specimen and photo.**

Figure 52. **A 2.9-cm group of sharp, translucent pink ephesite crystals, averaging 0.3 cm across, with minor matrix, Gloucester mine. The associated black mineral is massive "psilomelane." Eugene and Sharon Cisneros specimen and photo.**

Figure 53. **Group of bright pink ephesite, with some of the crystals transparent and gemmy, field of view 9 mm, Lohathla mine. Bruce Cairncross specimen and photo.**

Figure 54. **Vibrant pink ephesite overgrown and intergrown with dark wine-red mangan-diaspore, field of view 3.6 cm, Gloucester mine. Bruce Cairncross specimen and photo.**

manganophyllite and suggested it was a new species of mica. This was confirmed by Coles-Phillips (1931) who received Postmasburg samples from Dr. A. L. Hall.

Gutzmer (1996) reported that Postmasburg ephesite crystals can be up to 4 cm across and can form dipyramidal crystals (figs. 46 and 47). The color varies from vibrant bright red to pale red, pink, and orange-pink (figs. 48–52). Most ephesite specimens consist of masses of cleaved micaceous crystals. Some vuggy samples contain beautiful, transparent, well-formed pseudohexagonal crystals (fig. 53). The most common associated species is mangan-diaspore (fig. 54).

Epidote, $(CaCa)(AlAlFe^{3+})O[Si_2O_7][SiO_4](OH)$, does not readily occur within the manganese deposits but is found in alteration zones in the dolomites. Quartz veining can be pervasive within the dolomite, and quartz crystals are relatively common in other parts of the country where the Transvaal Supergroup dolomites are found. Quarrying of dolomite for road fill aggregate near Postmasburg at Aarkop exposes such quartz veins that locally contain vibrant green epidote on quartz (figs. 55 and 56).

Gamagarite, ideally $Ba_2Fe^{3+}(VO_4)_2(OH)$ (pronounced with the guttural "g": gh-ahm-ah-gh-ahrite), is a barium-manganese-iron-bearing vanadate discovered by de Villiers

Figure 55. **Aggregate of small, radiating elongate epidote crystals on quartz; field of view 3.5 cm, Aarkop; self-collected in June 2022. Bruce Cairncross specimen and photo.**

Figure 56. **Mass of green epidote crystals in a quartz vug, field of view 3 cm, Aarkop. Allan Fraser specimen, Bruce Cairncross photo.**

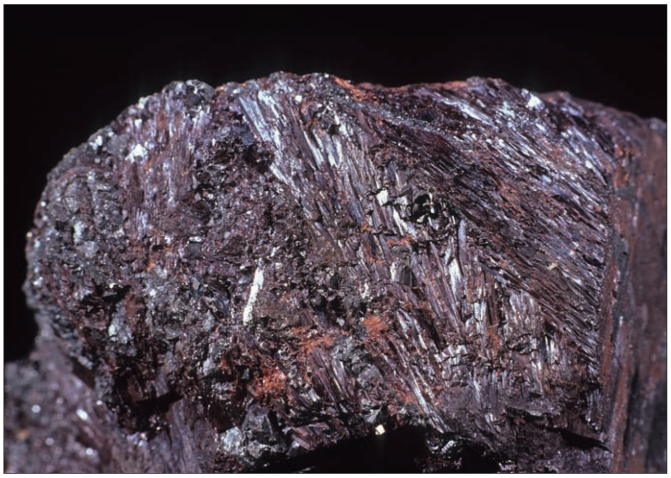

Figure 57. **Dark red, bladed gamagarite crystals, some in semiparallel alignment; field of view 5.2 cm, Gloucester mine. Museum of the Council for Geoscience specimen number MGS 19198. Bruce Cairncross photo, 1993.**

Figure 58. **Cross-section through a spherical mass of goethite. There are clear radiating growth rings evident; field of view 8.5 cm, Gloucester mine. Department of Geology, University of Johannesburg collection, Bruce Cairncross photo.**

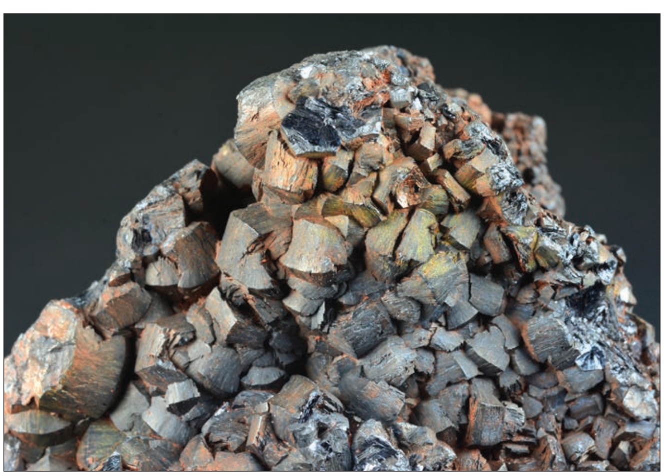

Figure 59. **Curvilinear crystals of lithiophorite, field of view 8.2 cm, Gloucester mine. Bruce Cairncross specimen and photo.**

Figure 60. **Botryoidal, partly weathered and oxidized hematite, field of view 9 cm, Gloucester mine. Department of Geology, University of Johannesburg collection, Bruce Cairncross photo.**

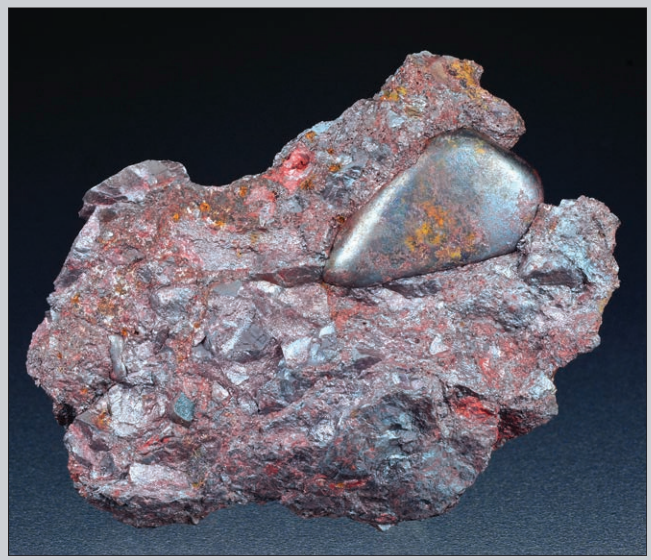

Figure 61. **Well-rounded hematite pebble in hematized iron-formation, 6.2 cm, Japies Rus mine. Bruce Cairncross specimen and photo.**

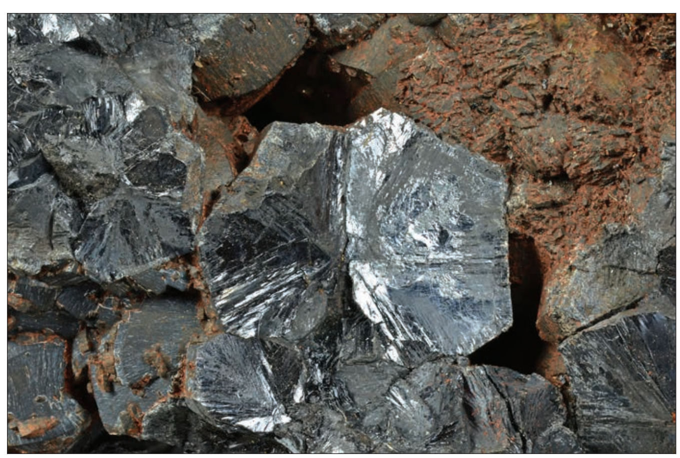

Figure 62. **Close-up of cleaved lithiophorite crystal displaying the typical metallic luster on the fracture surfaces; field of view 2.2 cm, Gloucester mine. Bruce Cairncross specimen and photo.**

Figure 63. **Veins of metallic silver pyrolusite between massive gray romanèchite; field of view 6.2 cm, Gloucester mine. Department of Geology, University of Johannesburg collection, Bruce Cairncross photo.**

Figure 65. **Acicular pyrolusite crystals, 4.3 cm, Gloucester mine. Bruce Cairncross specimen and photo.**

Figure 64. **A few clusters of radiating, flat pyrolusite crystals, 8.2 cm, Kareepan. Bruce Cairncross specimen and photo.**

Figure 66. **A 2.5-cm in diameter section of silver, metallic radiating pyrolusite nucleated on gray romanèchite, undisclosed Postmasburg locality. Bruce Cairncross specimen and photo.**

(1943a) in ore samples from the Gloucester mine (Cairncross 2019). Gamagarite occurs in bixbyite-rich ore as red-brown acicular crystals to 1 cm, intergrown with amesite, bixbyite, diaspore, ephesite, and hematite (fig. 57). For many years Gloucester remained the only Postmasburg locality for gamagarite until Costin et al. (2015) identified it from drill core near the Kolomela mine where it occurs with tokyoite, As-rich tokyoite, and noélbensonite.

Goethite, α-$Fe^{3+}O(OH)$, is relatively common in the Postmasburg manganese field and occasionally forms attractive, radiating columns and bulbous forms coated by brown weathered surfaces (fig. 58).

Hematite, Fe_2O_3, is ubiquitous throughout the Postmasburg region and is the main iron-ore mineral although, unlike in the Kalahari manganese field, very few aesthetic hematite specimens are known. Gutzmer (1996) states that veins of massive baryte, botryoidal hematite, and pyrolusite crosscut the Manganore Iron Formation and the Wolhaarkop Breccia.

Figure 67. **Granular pyrite on a matrix of tiny siderite crystals, together with larger yellow siderite; field of view 2.2 cm, Kolomela mine. Bruce Cairncross specimen and photo.**

Figure 68. **Several quartz crystals radiating from a matrix of drusy quartz; the brown inclusions are likely goethite; field of view 4.5 cm, Postmasburg quarry. Allan Fraser specimen, Bruce Cairncross photo.**

Figure 69. **Pale blue-gray drusy quartz on brown chert matrix, 5.1 cm, Boskop. Allan Fraser specimen, Bruce Cairncross photo.**

Figure 70. **Drusy white quartz on brown chert matrix, 8 cm, Boskop. Bruce Cairncross specimen and photo.**

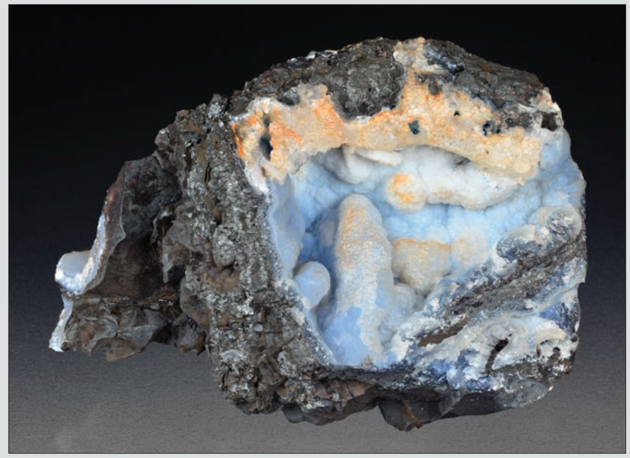

Figure 71. **Pale blue and yellow iron-oxide–hydroxide-stained quartz. The margins of the cavity consist of radiating masses of metallic pyrolusite, 10.2 cm, Boskop. Bruce Cairncross specimen and photo.**

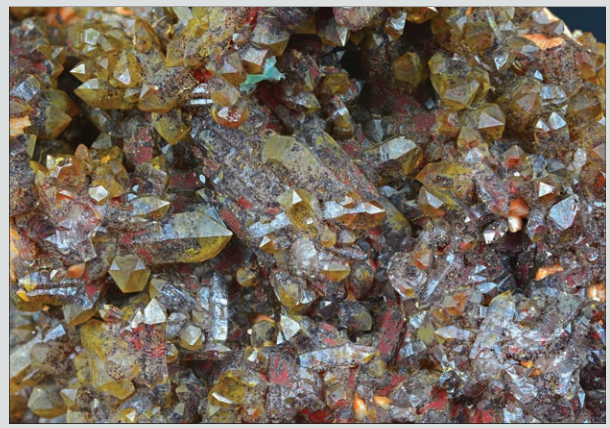

Figure 72. **Close-up of a 9.4-cm specimen comprising a mass of yellow-stained quartz crystals, enclosing red and silver hematite; field of view 2.3 cm, West End diamond mine. Bruce Cairncross specimen and photo.**

Figure 73. **White vein quartz with epidote, 9.1 cm, Aarkop. Self-collected in June 2022. Bruce Cairncross specimen and photo.**

Figure 74. **Gray colliform romanèchite, field of view 6 cm, Gloucester mine. Department of Geology, University of Johannesburg collection, Bruce Cairncross photo.**

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Reniform or botryoidal hematite is found at Gloucester and Paling and at some of the other iron mines such as Kolomela, Khomani, and Sishen South (figs. 60 and 61).

Postmasburg ***lithiophorite, $(Al,Li)MnO_2(OH)_2$,*** was first described by Gruner (1943) as oakite, an obsolete name for lithiophorite (Fleischer 1943). De Villiers (1945a) describes the physical, optical, and chemical properties of lithiophorite from Gloucester mine in detail. It occurs associated with braunite, bixbyite-(Mn), pyrolusite, and minor hematite. It occurs as botryoidal masses and curvilinear crystals composed of highly lustrous silver platy crystals (figs. 59 and 62). Crystals are up to 12 mm across. Gutzmer (1996) notes that lithiophorite is particularly abundant in the supergene ferruginous ores.

Pyrolusite, $Mn^{4+}O_2$, is found in the supergene ores as veins and nodules with romanèchite, cryptomelane, ramsdellite, and lithiophorite (Gutzmer 1996). Some coarsely

Figure 75. **A pile of siderite concretions, the largest 25 cm in diameter, Kolomela mine. Allan Fraser photo.**

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Figure 77. **A 1.5-meter concretion broken open to reveal the drusy siderite crystals in the center, Kolomela mine. Allan Fraser photo.**

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Figure 76. **Siderite with minor quartz and drusy pyrite removed from a siderite concretion; the terminations of many of the crystals have a thin coating of orange goethite, 7.8 cm, Kolomela mine. Bruce Cairncross specimen and photo.**

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Figure 78. **Amber-colored siderite, quartz, and pyrite, 3.1 cm, Kolomela mine. Bruce Cairncross specimen and photo.**

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Figure 79 (left). **Pale brown zunyite crystals contained in pale green pyrophyllite/diaspore matrix, 4.5 cm, Paling mine. Bruce Cairncross specimen and photo.**

Figure 80 (right). **Close-up of the specimen in figure 79. The zunyite is color-zoned and appears to show "phantom" growth patterns, field of view 1.5 cm. Bruce Cairncross specimen and photo.**

crystalline specimens, with crystals of 2–3 cm, form stellate aggregates lying flat on matrix (figs. 63–66).

Pyrite, Fe_2S_3, is a rare mineral in the Postmasburg deposits and has only been found as granular crystals in siderite nodules at the Kolomela mine (fig. 67).

Quartz, SiO_2, is ubiquitous in the siliceous ores, although it is seldom found as large crystals (fig. 68). Most quartz occurs as drusy coatings or as chalcedony that partially lines cavities in the ore (Nel 1929; Schneiderhöhn 1931). Boardman et al. (1960, p. 76) state that "chalcedony and clear opal occur sparingly in the siliceous ore as encrustations and cavity-fillings. In part they alternate in bands and show globular or botryoidal surfaces" (figs. 69–71). Apart from the manganese deposits, quartz crystals have been found at the old West End diamond mine (fig. 72) and local quarries (fig. 73).

Romanèchite, $(Ba,H_2O)_2(Mn^{4+},Mn^{3+})_5O_{10}$, is one of the most abundant of the manganese oxide species in the Postmasburg deposits and occurs together with cryptomelane. It forms colliform and crude botryoidal aggregates (fig. 74).

Siderite, $FeCO_3$, occurs as small, attractive honey-colored crystals to several millimeters across in siderite/dolomite concretions from the Kolomela mine (figs. 75–78). These are considered to be septarian concretions and were exposed during open-pit mining operations at a depth of 110 meters (https://www.mindat.org/photo-795226.html; accessed October 2023).

The first specimens of ***zunyite, $Al_{13}Si_5O_{20}(OH,F)_{18}Cl$,*** from Postmasburg were collected by Rogers in 1905 and later described in detail by Nel (1929; 1930), Spencer (1930), and Vermaas (1952). Crystals 1–7 mm on edge occur as light tan to pale pink tetrahedra, some with orange-red cores, dispersed in a matrix of diaspore, pyrophyllite, and kaolinite, occur on the Doornfontein M82 farm (figs. 79–82).

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Figure 81 (left). **Tetrahedral zunyite crystals displaying the typical color zonation of Postmasburg specimens; field of view 1.2 cm, Doornfontein mine. Francois Retief specimen and photo.**

Figure 82 (right). **Pale brown zunyite crystals in pyrophyllite/diaspore matrix; field of view 2.4 cm, Doornfontein mine. Bruce Cairncross specimen and photo.**

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ORCID

Bruce Cairncross
http://orcid.org/0000-0001-7135-3995

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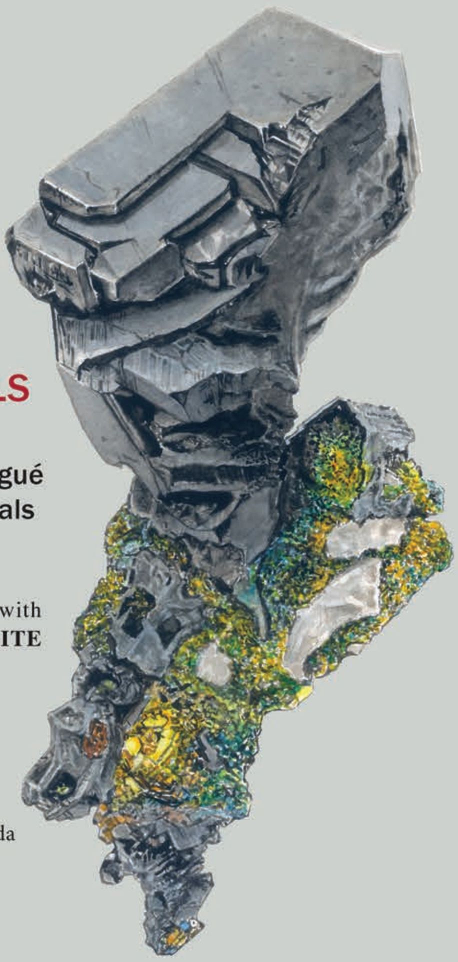

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