PALAEONTOLOGICAL ASSESSMENT: SITE VISIT REPORT

GATKOP CAVE ON FARM RANDSTEPHANE 415 KQ NEAR THABAZIMBI, LIMPOPO PROVINCE

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1. SUMMARY

The historically and archaeologically important site of Gatkop Cave on farm Randstephane 455 KQ, some 25 km ESE of Thabazimbi, Limpopo Province, lies within an extensive iron ore prospecting area that is currently being investigated by Aquila Resources (Aquila Steel (S. Africa) Pty Ltd), Thabazimbi. The large cave is excavated into Precambrian dolomites of the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup). A one-day palaeontological site visit was commissioned to assess the cave for fossiliferous deposits like the bone-bearing breccias that are well known from dolomitic cave sites elsewhere in Limpopo (Makapanasgat Valley) and elsewhere in the Cradle of Humankind World Heritage Site.

Several dolomitic breccia units of various ages, degrees of cementation and sedimentary facies are exposed within Gatkop Cave. They include examples with a component of extraneous (*i.e.* extra-cave) material such as ferruginous cave earth, gravel or soil. However, no occurrences of bone-bearing breccia were identified during the site visit. Dolomitic host rocks of the Malmani Subgroup show fine lamination but no well-developed stromatolitic domes or columns. It is concluded that the palaeontological sensitivity of the Gatkop Cave site is probably low.

The site is situated some four kilometres SSW of the main iron ore prospecting area and over 600m lower in elevation. Any unrecorded palaeontological heritage resources here are therefore unlikely to be directly or indirectly affected by prospecting or any subsequent mining activity. Protection of the cave site on archaeological and cultural heritage grounds, as recommended by the cultural heritage assessment practitioner (Miller 2011), should in turn safeguard any fossil remains in the area. No special measures to protect fossil heritage are therefore warranted here.

The broader Aquila Resources prospecting area near Thabazimbi is largely underlain by Precambrian marine sediments of the Transvaal Supergroup (Malmani Subgroup dolomites, Penge Formation ironstones) and also by continental red-beds of the younger Waterberg Group in the north. Bushveld Complex granites crop out in the eastern sector. Apart from microbial mats, fossils are unknown from the Waterberg Group, while granites are invariably unfossiliferous. These Precambrian bedrocks are extensively mantled with colluvial (slope) deposits and soil on low palaeontological sensitivity. The Penge Formation ironstones that are targeted by prospecting are not known to contain macroscopic fossil remains, although microbial fossils are probably present. The Malmani Subgroup dolomites and associated sediments are well-known elsewhere for their stromatolite biotas, and also contain a range of microfossils. However, these rocks are generally poorly exposed in the prospecting area and the stromatolites are of widespread occurrence. Nevertheless any dolomite rock exposures showing well-developed stromatolites should be safeguarded from damage during prospecting and mining activity. Good examples should be reported to SAHRA for recording by a professional palaeontologist. These recommendations should be included in the Environmental Management Plan for all prospecting and mining projects within the study area.

2. INTRODUCTION & BRIEF

The company Aquila Resources (Aquila Steel (S. Africa) Pty Ltd), Thabazimbi, is currently prospecting for high grade iron ore on the farms Donkerpoort 448 KQ, Randstephane 455 KQ and Waterval 443 that are situated some 21 to 27 km east of the mining town of Thabazimbi, Limpopo Province (Fig. 1). A Phase 1 Cultural Heritage Resources Assay of the prospecting area has been conducted by Sidney Miller of African Heritage Consultants cc, Magalieskruin (Miller 2011). This survey identified Gatkop Cave on the farm Randstephane 455 KQ as a site of high cultural heritage significance as well as having potentially high palaeontological heritage significance. To quote from Miller's report (*ibid*., p. 6):

> Secondly it is a dolomitic cave, opening to daylight, and from the outside appears to be of significant size. It therefore may contain breccia similar to that found at the Mokopaan Cave known as the Cave of Hearths. It is advised that a palaeontologist is asked to investigate this cave's potential.

The interior of the cave - which is dark and apparently infested with histoplasmosis (cave disease) - does not appear to have been investigated by Miller. However, it should be noted that this is a site of considerable cultural, historical and archaeological significance, as recognised in the study of Iron Age archaeology of the Rooiberg region, Limpopo, by Hall (1981). Gatkop Cave probably played a role as a refuge site from Mzilikazi's Ndebele impis during the early nineteenth century Mfecane, and perhaps also later following the arrival of the European trekboers. It is apparent that the archaeological resources within the cave – such as the wooden kraals and abundant pottery recorded by Hall in the large entrance chamber - have since been considerably degraded. Surface scatters of archaeological material are still apparent in front of the mouth of the cave. These include ostrich eggshell beads, abundant shards of Iron Age pottery assignable to the Late Iron Age (Hall's 1981 Rooiberg Unit 3, approximately dated to the Fifteenth Century) as well as Middle Stone Age flakes of ferruginous quartzite (Amanda Esterhuysen, Madelon Tusenius, pers. comm., 2011).

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, 1999, include, among others:

- geological sites of scientific or cultural importance
- palaeontological sites
- palaeontological objects and material, meteorites and rare geological specimens

Following Miller's (2011) recommendation, a palaeontological assessment of Gatkop Cave was commissioned by PGS Heritage & Grave Relocation Consultants, 906 Bergarend Street, Waverley, Pretoria. The site visit was carried out on 12 December 2011 by the author, accompanied by two experienced field archaeologists: Dr Amanda Esterhuysen (Department of Archaeology, Wits) who has worked extensively at various cave sites in the Makapansgat Valley and elsewhere in the Cradle of Humankind World Heritage Site, and Madelon Tusenius (MA in Archaeology, University of Stellenbosch).

It should be noted that this report does *not* represent a comprehensive palaeontological heritage assessment of the entire Aquila Resources prospecting area. However, general remarks are made on the fossil record of the main bedrock units represented inside the propecting area. Given their low overall palaeontological sensitivity, a more detailed palaeontological assessment of the prospecting area is not regarded as warranted.

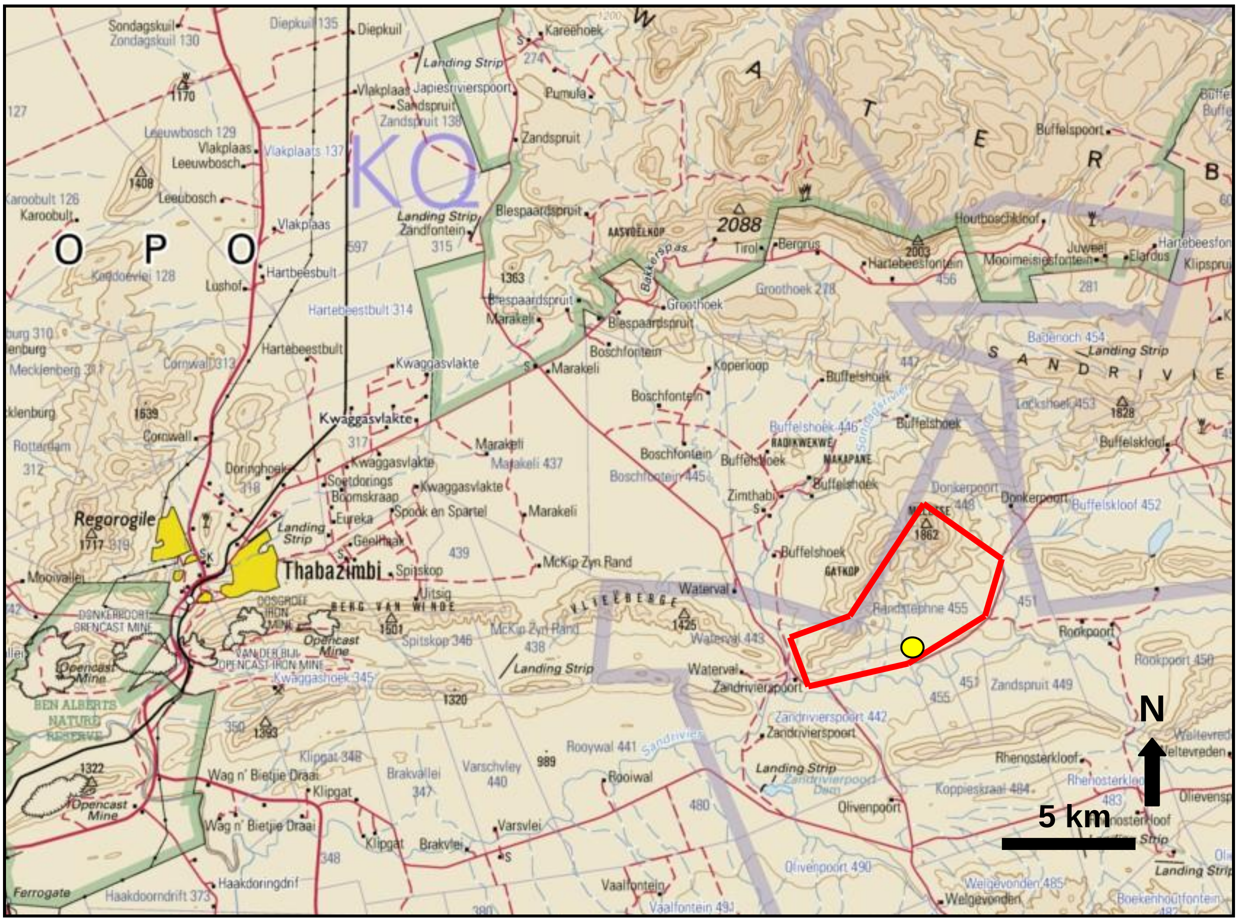

Fig. 1. Extract from 1: 250 000 topographical map 2426 Thabazimbi showing approximate location of the Aquila Resources prospecting area on the farms Donkerpoort 448 KQ, Randstephane 455 KQ and Waterval 443 to the east of Thabazimbi (red polygon). The location of Gatkop Cave on Randstephane 455 is indicated by the yellow dot. Original map courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray.

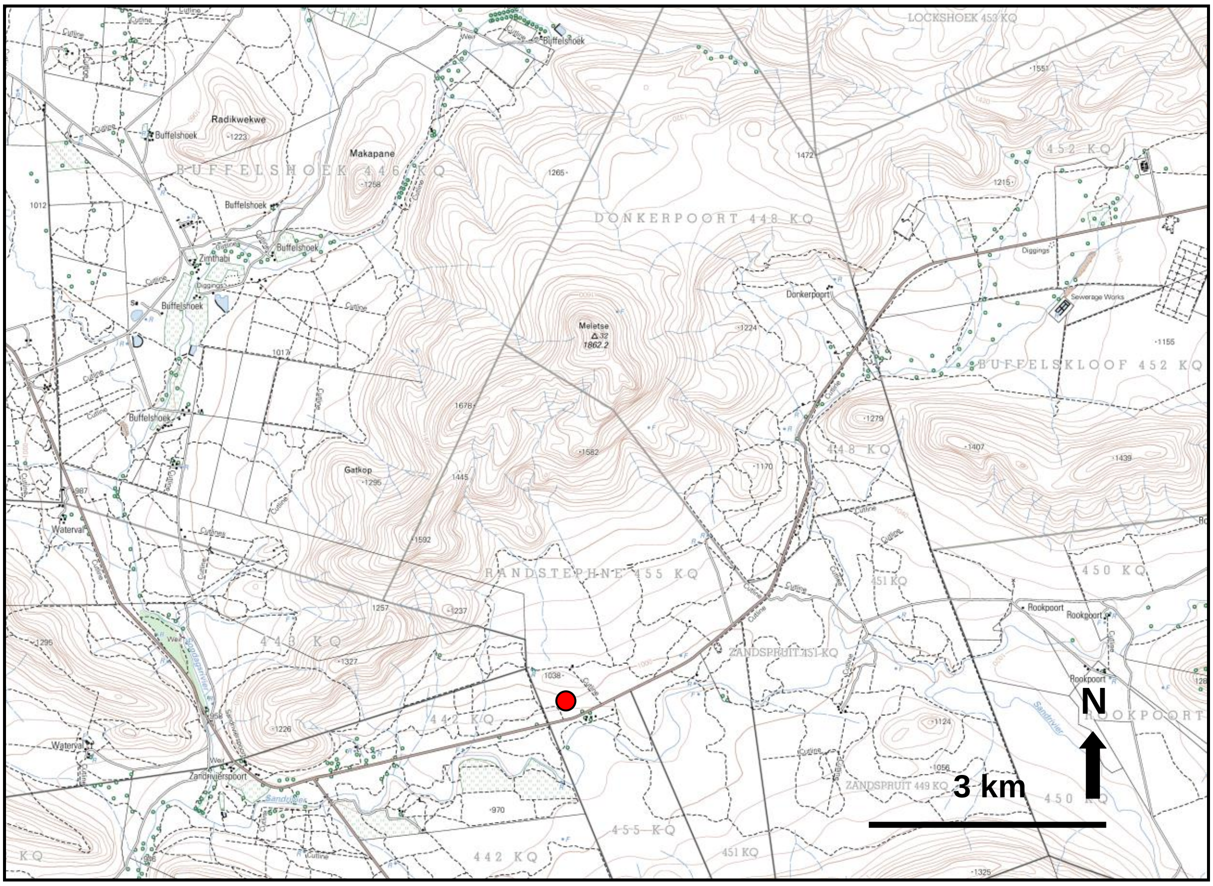

Fig. 2. Extract from 1: 50 000 topographical sheet 2427 DA Sandrivierspoort (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing location of Gatkop Cave on farm Randstephane 455 KQ, north of the Zandrivierpoort to Donkerpoort dust road (red dot, 24º 37' 05.2" S, 27º 39' 08.4" E).

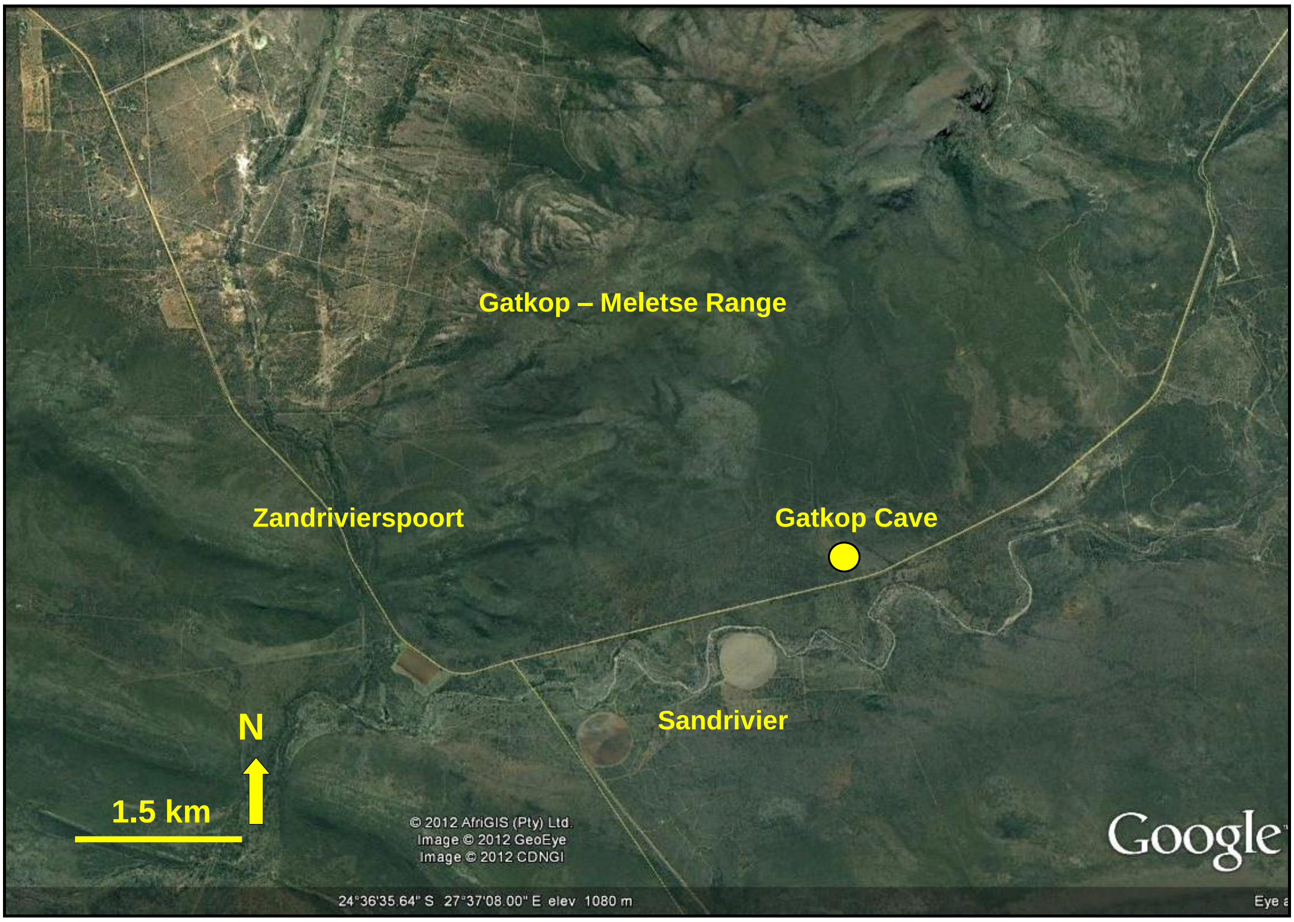

Fig. 3. Google Earth© satellite image of the study area 25 km east of Thabazimbi showing location and setting of Gatkop Cave on the low, southern foothills of the Gatkop – Meletse mountain range, just north of the Sandrivier.

3. GEOLOGICAL BACKGROUND

Gatkop Cave (24º 37' 05.2" S, 27º 39' 08.4" E**)** is a sizeable dolomitic cavern set in gently sloping, semi-arid thornveld terrain on the southern foothills of the Gatkop – Meletse mountain range, Limpopo Province (Fig. 8). The site is situated some 25.5 km ESE of Thabazimbi and just north of the Zandrivierspoort – Donkerpoort dust road (Figs. 2, 3). The winding Sandrivier, a tributary of the Crocodile, flows 0.4 km to the south. The mouth of the cave emerges through dolomite crags at *c*. 1000m amsl and is well shaded by sizeable trees (Fig. 9). General levels of bedrock exposure in the area are low due to extensive mantle of rocky colluvium and soil.

The geological context of Gatkop Cave is shown on the 1: 250 000 geological map 2426 Thabazimbi (Council for Geoscience, Pretoria) which has a very brief sheet explanation printed on the map itself. The relevant section of the geological map is shown in Fig. 4 below. The Gatkop – Meletse mountain range and its southern foothills, where Gatkop Cave is situated, are built of Precambrian dolomites and associated marine sedimentary rocks that are assigned to the **Malmani Subgroup** (**Chuniespoort Group**) within the **Transvaal Supergroup**. The Transvaal Supergroup rocks here lie on the southern, east-west trending limb of a roughly L-shaped outcrop area centred on Thabazimbi, forming part of the north-western margin of the huge Transvaal Basin (Eriksson *et al.* 2006). The 2 km-thick Malmani Subgroup succession consists of a series of formations of stromatolitic and oolitic carbonates (limestones and dolomites), cherts and black carbonaceous shales. These marine sediments were laid down in a range of supratidal, intertidal and subtidal settings over a major epicontinental carbonate platform in Late Archaean to Early Proterozoic times, roughly 2.55 to 2.50 Ga (billion years ago). The individual Malmani formations are not mapped at 1: 250 000 scale, so the rocks represented at the Gatkop Cave site have not been identified at that level. Key references among a very extensive literature on the "Transvaal Dolomites" include papers by Button (1973, 1986), Eriksson *et al.* (1993), Eriksson *et al.* (1995), Eriksson & Altermann (1998), Catuneanu & Eriksson (1999), Moore *et al.* (2001), Eriksson *et al.* (2006), as well as Sumner & Beukes (2006).

The Malmani Subgroup carbonates are overlain by banded ironstones (BIF) and cherty shales of the **Penge Formation** of the Chuniespoort Group, dated approximately 2.5 Ga (Eriksson *et al.* 2006). These are the target rocks for the current prospecting for high grade haematite iron ore in the study area by Aquila Resources. They crop out along the crest of the Gatkop – Meletse range, well above the Gatkop Cave site in both stratigraphic and topographic terms. The contact between the Penge ironstones and underlying Malmani carbonates was extensively karstified in Precambrian times. The genesis of the Thabazimbi iron ores has been discussed by Van Deventer *et al.* (1986).

As shown on the geological map (Fig. 4), the Transvaal Supergroup rocks east of Thabazimbi show a general southerly dip and have been tectonically repeated by a couple of north-verging thrust faults. Gatkop Cave lies along the line of one of these major thrust faults and probably owes its genesis to high levels of bedrock fracturing and consequently enhanced groundwater movement along the fault plane.The Transvaal dolomites have been thrust northwards by Waterberg-age tectonism over younger granites of the **Bushveld Complex** (3G1, **Lebowa Granite Suite**) as well as over still younger continental sediments of the Mid Proterozoic **Waterberg Group** (W1s, W1a). Fluvial red beds of the last succession form the spectacular massif of the Waterberg to the northwest of the study area.

Intrusion of the Early Proterozoic Bushveld Complex followed by isostatic compensation and much later Tertiary crustal depression led to the basining of the Transvaal Supergroup rocks. Differential erosion of the upturned edge of the Transvaal Supergroup outcrop has generated a distinctive topographic pattern characterised by inward-dipping ridges and valleys surrounding the Bushveld Complex (King 1963, Moon 1988). This pattern is known as *Bankenveld* topography and is well seen to the east of Thabazimbi in the area between the Waterberg in the north and the Boshoffsberge of the Bushveld Igneous Complex in the south.

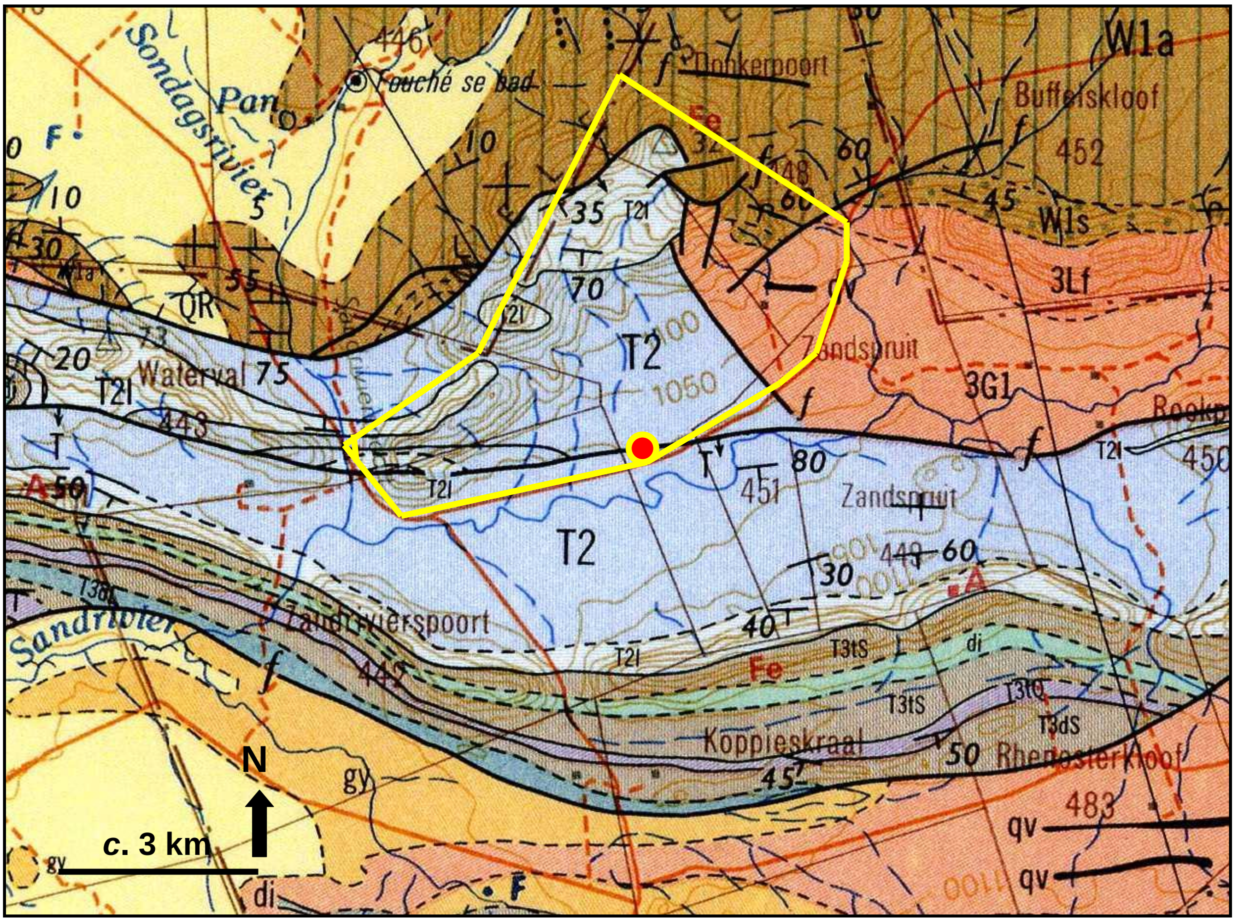

Fig. 4. Extract from 1: 250 000 geology map 2426 Thabazimbi (Council for Geoscience, Pretoria) showing location of Gatkop Cave (red dot) along a major east-west trending thrust fault (thick black line). The Aquila Resources prospecting area is shown approximately by the yellow polygon. T2 (medium blue) = Transvaal dolomites of the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup); T2l (pale blue) = banded ironstones of the Penge Formation (Chuniespoort Group). 3G1 (red) = granites of the Lebowa Granite Suite of the Bushveld Complex. W1a, W1s (brown) = continental sediments of the Waterberg Group. Note several major faults in this region.

Surface and subsurface dissolution of the relatively soluble Malmani carbonate rocks has generated a wide range of karstic weathering features at varying scales such as elephant skin weathered surfaces, pavements, potholes, sinkholes or dolines, shafts or avens and caves (*e,g.* Marker 1988, Buttrick *et al.* 1993). The formation of caves within the Transvaal dolomite outcrop area and of their notoriously complex sedimentary infills has been studied in some detail, not least because of their palaeontological and palaeoclimatological significance (*e.g.* Turner 1980, Maguire *et al.* 1980, Latham 1999, Partridge 2000, Latham *et al.* 2003, Partridge *et al.* 2006, and extensive references in these articles). Notable examples include the Plio-Pleistocene hominin-bearing cave infills within the Cradle of Humankind World Heritage Site. These fossiliferous caves are mainly situated in Gauteng and Northwest Province but also include several important sites in the Makapansgat Valley in Limpopo (Hilton-Barber & Berger 2004, Bonner *et al.* (eds) 2007). A highly schematic outline of cave formation, infilling and erosion is presented in Fig. 5 (from Hilton-Barber & Berger 2004).

3.1. Geology of the Gatkop Cave site

A detailed description of Gatkop Cave lies outside the brief for the present study; only a short, illustrated account of some of the geological features observed during the site visit is presented here. The various types of caves and cave openings found in the Transvaal dolomites are illustrated by Brain (1958) (Fig. 6). Gatkop Cave, situated on the gentle lower slopes of the Sandrivier Valley with a short, fairly wide and moderately sloping side entrance, is intermediate between Brain's types D and E. The approximate phase of development seen in Gatkop Cave is shown very schematically in Fig. 7 (From Brain and Watson 1992).

The regional dip of the Transvaal Supergroup rocks in the study region is towards the south (Fig. 4). However, well-exposed medium-bedded Malmani dolomites at the cave entrance show a moderately steep local dip to the northeast (Fig. 9). The south-facing entrance is littered with large, angular blocks of dolomite, some of which show well-developed elephant-skin weathering suggesting protracted exposure to the elements. The coarse rubble of fallen blocks with interstitial soil and hillwash continues down into a large main or entrance chamber, descending gently to the NE. The long axis of the chamber probably extends more-or-less NW-SE, parallel to the regional strike of the bedrocks (This orientation is assumed for the purposes of the present description). The main chamber of the cave is still largely open, with only a relatively limited sheet or cone of coarse blocky debris extending into it from the short but fairly wide side entrance (Fig. 10). The cave therefore does not appear to have been open to the exterior over a very long time interval in contrast with, for example, the cave systems in the Makapansgat Valley and at Swartkrans. Above a steeply sloping pile of large fallen blocks (collapse breccia) at the NW end of the main chamber there is a higher-lying subchamber that hosts a sizeable colony of bats and is floored with a soft carpet of bat guano. One or more small, open shafts that might possibly lead to lower-lying chambers are present in the NW part of the main cave.

The Malmani Subgroup host rocks consist of medium- to thin-bedded, pale grey to buff dolomites, dipping to the northeast, with numerous bands, lenticles and clots of yellowish to grey secondary chert and occasional thin grey mudrocks (Fig.11). Bedding is generally tabular, but often obscured by high levels of tectonic brecciation related to the major thrust fault zone along which Gatkop Cave developed (Fig. 12). Around the cave walls, especially on south-western side, the dolomite bedrock is obscured by a variety of cream to rusty-brown speleothems built of calc tufa or dripstone (sometimes termed travertine; *cf* Fig. 6). These speleothems include dense arrays of small stalactites on the roof and ridged to rippled flowstones on the walls and floor (Fig. 12). Sheets and irregular layers of flowstone locally overlie massive to bedded gravels and reddish finer sediments on the cave floor (Fig. 18). These fine ferruginous sediments are sometimes referred to as "cave earth". They probably consist of a mixture of allochthonous soil or hillwash *plus* aeolian dust together with autochthonous chert debris and terra rossa (*i.e.* iron-rich, insoluble residuum from dolomite dissolution). Thinly-laminated flowstone interbedded with reddish gravelly "cave earth" can be seen near the main entrance (Fig. 16).

Good, water-worn sections through dolomite breccias are preserved against the south-western face of the main chamber, with recent reddish-brown, fine-grained silty "cave earth" deposits banked up against them (Fig. 15). The dolomite clasts are variously subrounded to angular with a brownish matrix. These well-cemented breccias, either clast- or matrix-supported, clearly belong to an early phase of cave infilling. A meter-thick band of highly ferruginised and / or cave earth - rich breccia occurs within a downward-projecting roof buttress on the north-eastern wall of the main cave (Fig. 17). It is unclear whether any extraneous clasts, such as gravels of banded ironstone, are present within this zone. Lenticles of rubbly, vuggy dolomite breccias with pebble- to cobble-sized clasts, some apparently rounded, are exposed in the same area.

The most substantial breccias observed in Gatkop Cave are found on the steep walls of the north-western "upper" or bat-infested subchamber in the NW. The exposures are heavily draped in cobwebs (Figs. 13, 14). Some of the breccia bodies are plastered against the well-bedded Malmani dolomite bedrock. Other lenticles or bands of well-cemented breccia appear to be conformable and interbedded with the dolomitic bedrocks, but they probable infill bedding-parallel erosional cavities. The breccia clasts – exclusively composed of dolomite and chert - are poorly size-sorted, chaotically organised and often subrounded, implying a degree of water transport. These breccia exposures are ancient and water-worn. They are capped and cemented locally by pale, laminated flowstone (Fig. 14).

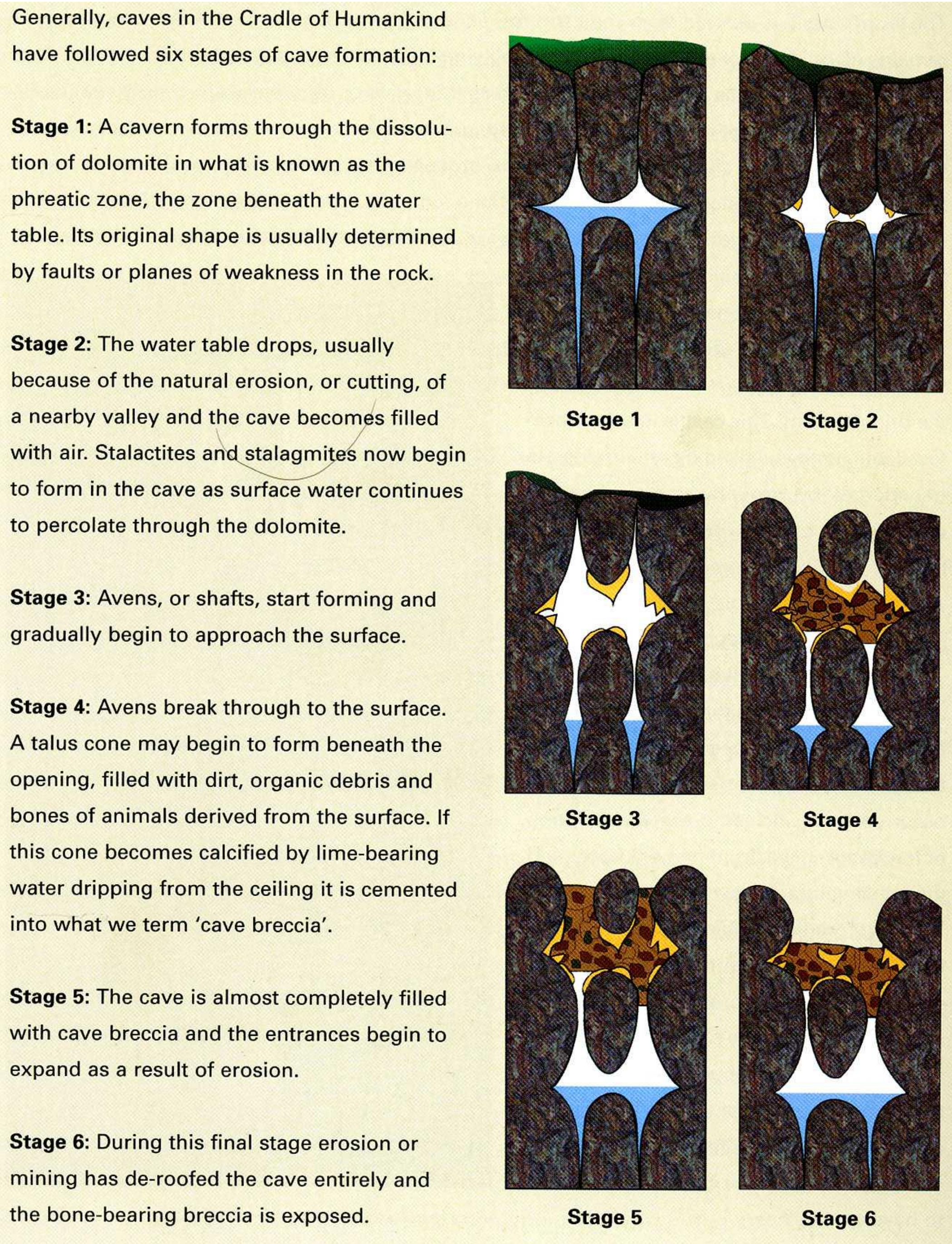

Fig. 5. Simplified scheme to explain the successive stages of cave formation, infilling and eventual exposure of cave sediments by erosion in dolomitic terrain (From Hilton-Barber & Berger 2004).

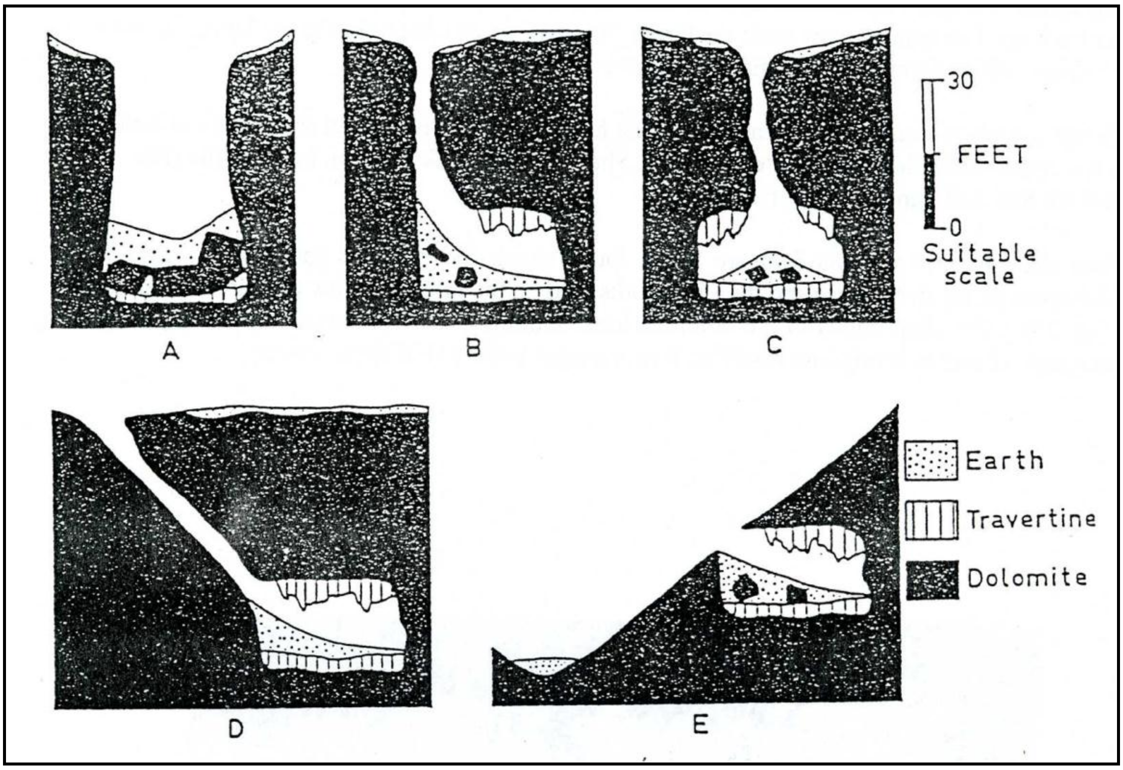

Fig. 6. A range of different cave openings recognised in the Transvaal dolomites by Brain (1958). Gatkop Cave situated at a shallow depth below the gently sloping land surface is intermediate in form between types D and E.

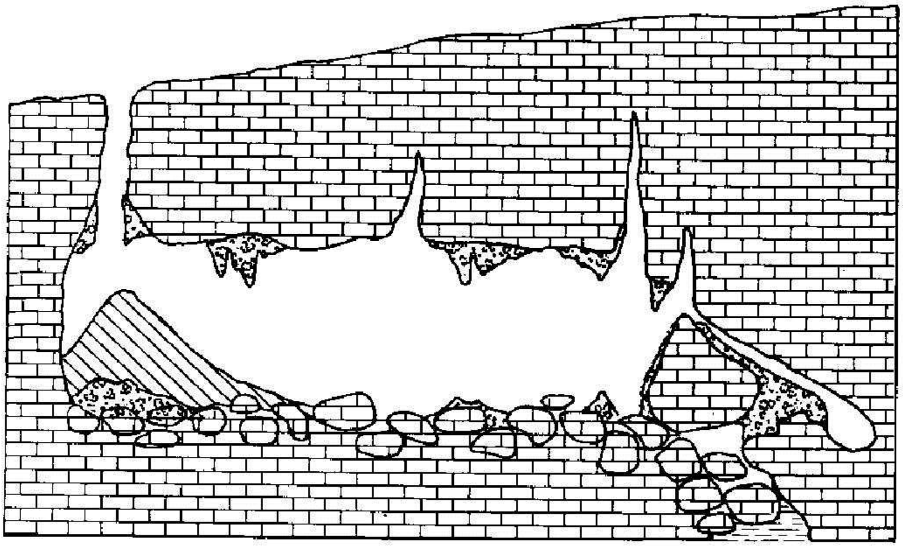

Fig. 7. Schematic section through a dolomite cave at a similar early level of development to Gatkop Cave (From Brain & Watson 1992). As yet only a small portion of the main chamber has been infilled with sediment. The floor of the main chamber is carpeted with large dolomite blocks and residual chert inherited from the initial phase of cave formation by solution within the phreatic zone as well as subsequent roof collapse after the cave became air-filled. A relatively small debris cone composed of angular dolomitic rubble as well as soil, gravel, animal and plant remains and other material washed in from the exterior extends across the chamber floor from the single entrance to one side. Parts of the floor, side walls and roof of the original cave are lined with calc tufa, deposited from solution, including sheet-like flowstones as well as tapering stalactites and stalagmites. Vertical shafts or avens enlarged by solution along joints or other fractures extend up towards the surface. Some of these will eventually break through to create secondary entrances to the cave.

Fig. 8. View of thornveld vegetation surrounding Gatkop Cave site, looking NNE towards Meletse peak. The mountains here are capped by banded ironstones of the Penge Formation while the slopes and foothills are built of Malmani dolomites.

Fig. 9. South-facing entrance to Gatkop Cave showing rubble of fallen blocks extending into the cave interior and NE-dipping Malmani dolomites which host the cave system. The rusty old sign warns visitors of the danger of cave disease (histoplasmosis).

Fig. 10. Main chamber of Gatkop Cave showing talus or scree of large, angular dolomite blocks extending from the entrance situated in the southwest. Petite archaeologist for scale.

Fig. 11. Grey, thin-bedded, horizontally-laminated Malmani dolomites with slightly projecting, irregular lenticles and blobs of less soluble secondary chert (Scale = 16 cm).

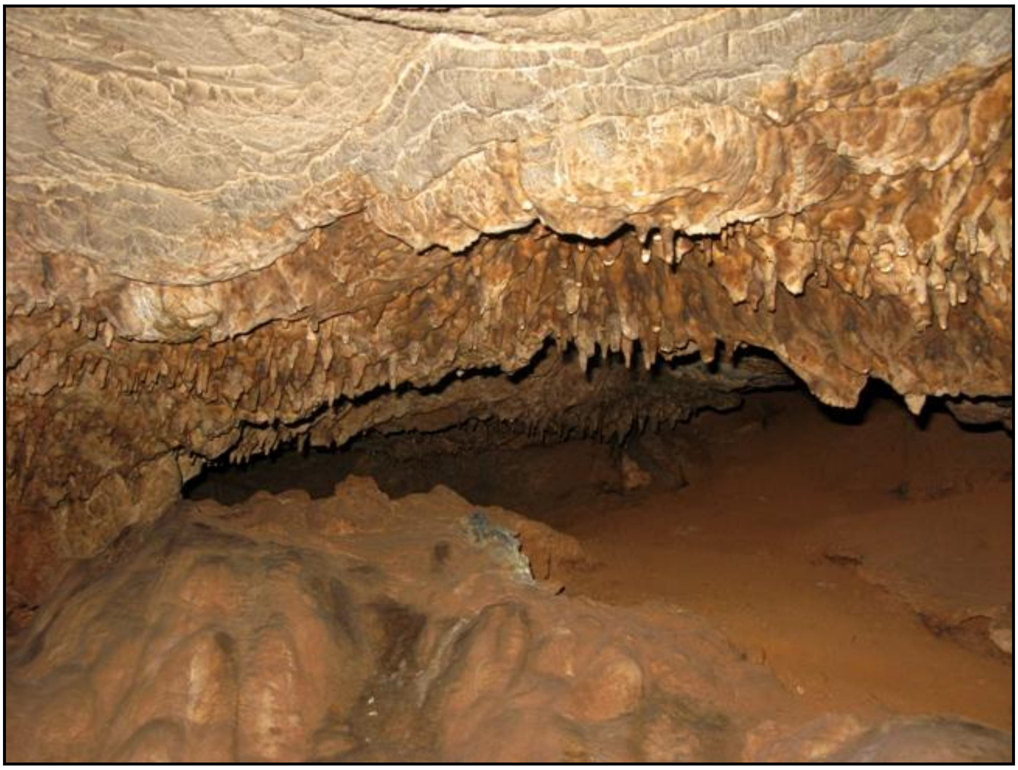

Fig. 12. South-western margin of the main chamber showing roof of grey, brecciated dolomite covered with dense arrays of small stalactites (mostly broken). The floor of the cave here is mantled with reddish-brown cave earth overlying smooth to rippled flowstone.

Fig. 13. Side wall of upper chamber in NE showing thick (*c.* 1m) horizon of well-cemented early dolomite breccia that is apparently sandwiched between thin-bedded, steeply-dipping dolomite beds.

Fig. 14. Detail of breccia horizon in previous figure showing chaotic, clast-supported fabric, with poorly- sorted but moderately well-rounded dolomite and chert clasts. The pale banded rock above is carbonate flowstone that locally caps and cements together the underlying breccia.

Fig. 15. Reddish-brown cave earth abutting against poorly-sorted, well-cemented dolomite breccia in the SW wall of the main chamber (Hammer = 30 cm). Dolomite clasts here are angular to subrounded and clast- to matrix-supported (possible debris flow origin).

Fig. 16. Thin lenticle of pale, well-laminated flowstone and reddish-brown, well-cemented, gravelly cave earth intercalated between thick-bedded grey dolomite near the main cave entrance.

Fig. 17. Horizon (*c*. 1m thick) of highly ferruginised breccia and reddish-brown material (possibly cave earth) overlying well-bedded Malmani dolomites, NE margin of main chamber (Scale = 16 cm).

Fig. 18. Horizon of dolomite gravels overlain by interbedded reddish cave earth and pale flowstone layers, NE end of the main chamber The succession is capped by a thicker, dirty flowstone horizon (Hammer = 30 cm).

4. PALAEONTOLOGICAL HERITAGE

4.1. Fossils in the Transvaal Supergroup

The **Malmani Subgroup** platform carbonates of the Transvaal Basin host a variety of stromatolites (microbial laminites), ranging from supratidal mats to intertidal columns and large subtidal domes. These biogenic structures are of biostratigraphic as well as palaeoecological interest; for example, the successive Malmani dolomite formations are in part differentiated by their stromatolite biotas (Eriksson *et al.* 2006). There is an extensive literature dealing with the Malmani stromatolites, including articles by Button (1973), Truswell and Eriksson (1972, 1973, 1975), Eriksson and MacGregor (1981), Eriksson and Altermann (1998), Sumner (2000), Schopf (2006), among others. Microbial filaments and unicells have been reported from stromatolites of the Transvaal Supergroup (Eriksson & MacGregor 1981, MacGregor 2002 and refs. therein). Short accounts of stromatolites associated with Transvaal dolomite exposures in the Cradle of Humankind World Heritage Site, including the Makapansgat Valley, Limpopo, have been given by MacGregor (2002) and Maguire (1998). Finely-laminated Malmani dolomites are exposed both within and in the immediate vicinity of Gatkop Cave. The lamination may well be of microbial origin. No examples of domical or columnar stromatolites were observed here.

Macrofossils have not been reported from banded ironstones of the **Penge Formation** such as crop out along the crest of the Gatkop – Meletse range and that are the target of current ore prospecting activities there. It is of note that biological mediation of banded ironstone deposition has been proposed by some authors. Possible fossilised microbes, including tantalizing “siliceous nano-cucumber structures”, have been reported from BIF facies in the Transvaal Supergroup of the Northern Cape and elsewhere (Klemm 1979, Hälbich *et al.* 1993).

4.2. Fossils in Late Caenozoic cave deposits

In accordance with the brief for this palaeontological site visit to Gatkop Cave, attention focused mainly, but not exclusively, on breccias within the cave infill. Some of these deposits, by analogy with breccias in dolomite caves in the Cradle of Humankind and Makapansgat Valley for example, might be bone-bearing and thus of considerable palaeontological interest. Within the fossiliferous breccias the bone clasts may appear variously white, or secondarily reddened by ferric compounds, or even stained black by manganese minerals. The biostratigraphy and taxonomy of the rich Late Pliocene to Pleistocene mammalian faunas, including micromammal and hominin remains, that have been recorded from dolomite cave infills in the South African interior have been reviewed by authors such as Brain (1981), Klein (1984), McKee *et al.* (1995), Maguire (1998), Partridge (2000), Tobias (2000), and Avery (2000). Accessible, well-illustrated accounts of these fossil assemblages are provided by MacRae (1999) as well as Hilton-Barber and Berger (2004). Caves such as Sterkfontein have in addition yielded well-preserved fossil plant remains, including petrified (calcified) woods, pollens and spores (Bamford *in* Bonner *et al.* 2007, pp. 91-101).

Very useful accounts of the accumulation of fossiliferous cave breccias and cave taphonomy within a southern African context have been provided by Brain (1981), Maguire *et al.* (1980) and Partridge (2000), among others. These authors emphasize the important role played by carnivores, such as hyaenas, leopards and owls, in mammal bone accumulation within caves. Passive introduction of skeletal remains into caves through open shafts acting as fossil traps as well as the redistribution of bones within the cave system by gravity and water flow also played important roles.

It should be noted that not all breccias associated with dolomite caves are fossiliferous. Breccias may owe their origins variously to (1) energetic sedimentary processes in the original depositional basin (*e.g.* debris flows), (2) episodes of palaeokarst formation during Precambrian times, (3) fracturing of host rocks along major fault planes (as seen, for example, at Gatkop), as well as (4) deposition during the early to late phases of cave formation and subsequent cave infilling (*e.g.* roof-fall or collapse breccias, talus and debris cone breccias, or breccias formed by secondary reworking of debris cone material). Fossil-bearing breccias often contain extraneous (*i.e.* extra-cave) material such as soil, cave earth and gravels in addition to dolomitic and chert debris. In the present case, this extraneous material might include occasional gravel clasts of banded ironstone and reddish, ferruginous soils that typify the area. During the present site visit, attention therefore focused on breccia horizons or lenses that do not consist exclusively of dolomitic and cherty debris. None of the breccia bodies inspected, including those containing an extraneous component such as reddish-hued cave earth, appear to contain recognisable macrofossil remains, however.

5. CONCLUSIONS & RECOMMENDATIONS

Several dolomitic breccia units of various ages, degrees of cementation and sedimentary facies are exposed within Gatkop Cave. They include examples with a component of extraneous (*i.e.* extra-cave) material such as ferruginous cave earth, gravel or soil. However, no occurrences of bone-bearing breccia were identified during the site visit. Dolomitic host rocks of the Malmani Subgroup show fine lamination but no well-developed stromatolitic domes or columns. It is concluded that the palaeontological sensitivity of the Gatkop Cave site is probably low.

The site is situated some four kilometres SSW of the main iron ore prospecting area and over 600m lower in elevation. Any unrecorded palaeontological heritage resources here are therefore unlikely to be directly or indirectly affected by prospecting or any subsequent mining activity. Protection of the cave site on archaeological and cultural heritage grounds, as recommended by the cultural heritage assessment practitioner (Miller 2011), should in turn safeguard any fossil remains in the area. No special measures to protect fossil heritage are therefore warranted here.

The broader Aquila Resources prospecting area near Thabazimbi is largely underlain by Precambrian marine sediments of the Transvaal Supergroup (Malmani Subgroup dolomites, Penge Formation ironstones) and also by continental red-beds of the younger Waterberg Group in the north. Bushveld Complex granites crop out in the eastern sector. Apart from microbial mats, fossils are unknown from the Waterberg Group, while granites are invariably unfossiliferous. These Precambrian bedrocks are extensively mantled with colluvial (slope) deposits and soil on low palaeontological sensitivity. The Penge Formation ironstones that are targeted by prospecting are not known to contain macroscopic fossil remains, although microbial fossils are probably present. The Malmani Subgroup dolomites and associated sediments are well-known elsewhere for their stromatolite biotas, and also contain a range of microfossils. However, these rocks are generally poorly exposed in the prospecting area and the stromatolites are of widespread occurrence. Nevertheless any dolomite rock exposures showing well-developed stromatolites should be safeguarded from damage during prospecting and mining activity. Good examples should be reported to SAHRA for recording by a professional palaeontologist.

These recommendations should be included in the Environmental Management Plan for all prospecting and mining projects within the study area.

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8. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company *Natura Viva* cc. He is a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape, Gauteng, Limpopo and the Free State for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

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