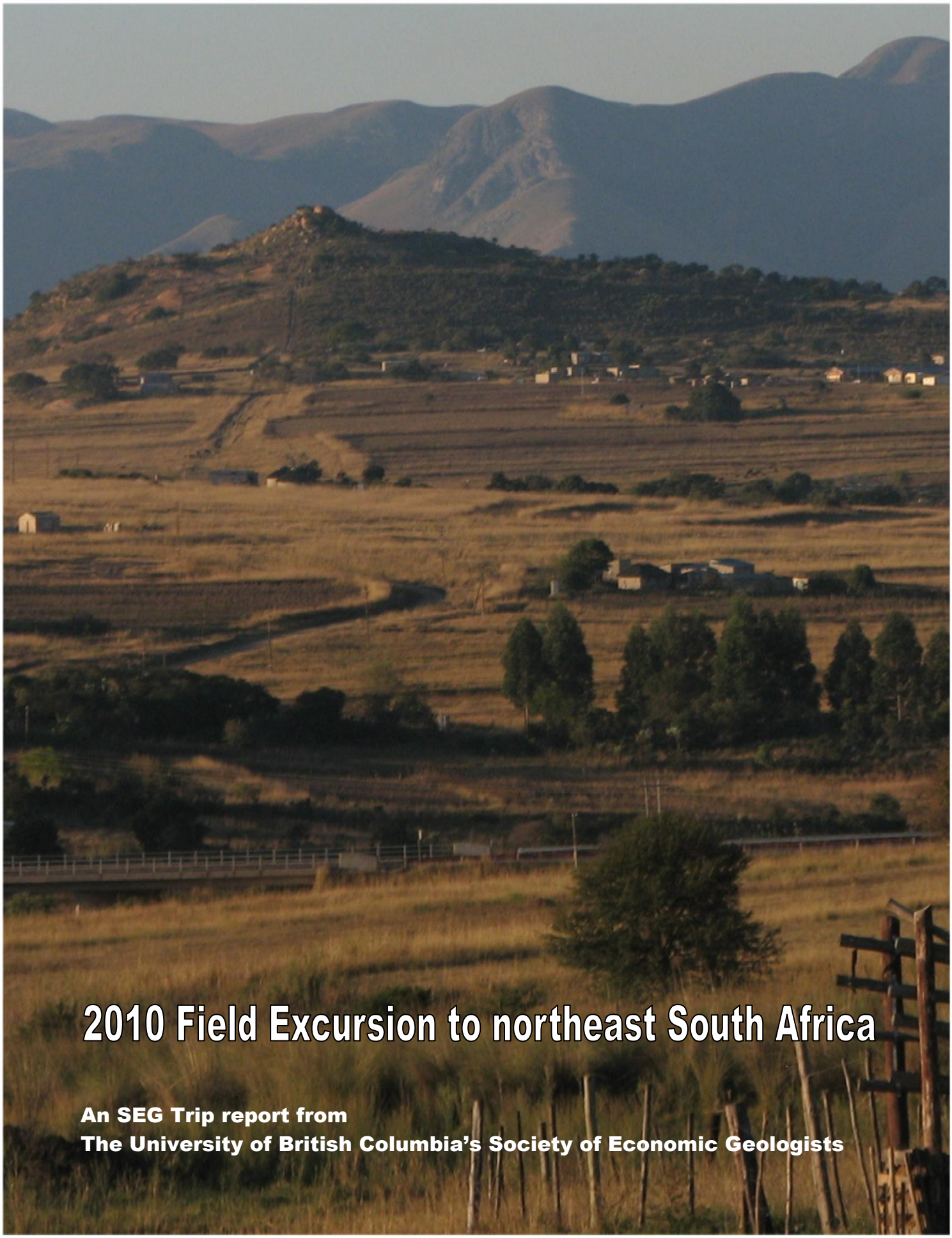


2010 Field Excursion to northeast South Africa

An SEG Trip report from
The University of British Columbia's Society of Economic Geologists

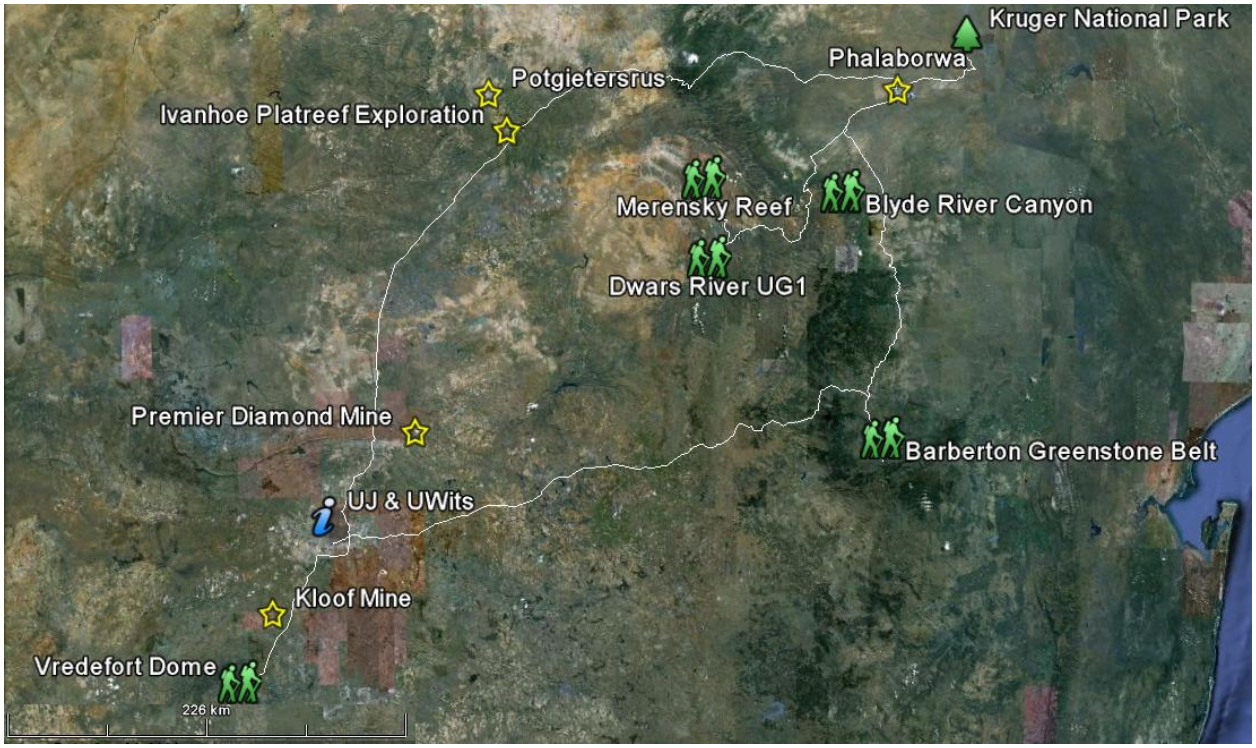
Foreword

The University of British Columbia's student chapter of the Society of Economic Geologists (UBC-SEG) seeks to promote better understanding and deeper interest in the science of economic geology. Our activities are aimed at advancing our members' comprehension of mineral deposits and how geological science is applied to exploration, evaluation, and production. With this goal in mind we organize courses, meetings, field trips, lectures, and literature. We place great value in the experience of fellow geologists and strive to develop stronger links between students and professional geoscientists in industry, academia, and government.

Over the past ten years the UBC Ore Deposits Field Trip has enjoyed great success, creating an opportunity for enthusiastic students and industry participants to interact and experience world-class geology. It is also an opportunity to visit a variety of mineral deposits and regions while gaining a hands-on understanding in a short period of time. The trip to South Africa was attended by nine UBC-SEG students, six members of industry, and one regional geologist from the BC Ministry of Energy, Mines, and Petroleum Resources. Focuses for the 2010 trip were to understand the structure, emplacement, and economic importance of the Bushveld Complex and Witwatersrand basin. To achieve this goal we visited several mines and important field locations including: the universities of Johannesburg and of the Witwatersrand, Cullinan Diamond Mine, Ivanhoe's Platreef exploration project, Anglo Platinum's Potgietersrus platinum mine, Foskor's Phalaborwa phosphate mine, Merensky Reef and UG-2 discovery outcrops, the Dwars River layered chromitite, the Barberton greenstone belt, Sheba and Agnes gold mines, the Vredefort meteorite impact crater, and Gold Fields' Kloof gold mine. During our tour we were assisted by many local geologists and during our University visit by the South African student chapter of the SEG (SASSEG). We would like to express our sincerest appreciation for this kind support and from the generous financial support we received from industry.

The following report was written by student participants of the trip. Compilation and editing by Shawn Hood.

Contents



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Back row, left to right: Trust Muzondo (guide at Potgietersrus), Paul Wojdak, Kathryn Lucas, Mikkel Schau, Amy Budinski, Shawn Hood, Leanne Smar, Greg McKenzie, Russell Myers, Dave Nickerson, Linda Dandy, Ayesha Ahmed. Bottom row: Will Lepore, Jaime Poblete, Tatiana Alva, Santiago Vaca, Peter Daubeny.

May 24th – University of the Witwatersrand and Johannesburg

We arrived in Johannesburg late in the evening on May 23rd. After a restful sleep and a long driving misadventure through Johannesburg we arrived at the University of the Witwatersrand. Here students, members of the South African Students SEG chapter (SASSEG), had organized a series of lectures on South African geology.

Our first presenter, Professor Terrance McCarthy, provided a succinct, all encompassing presentation centered on South Africa which began in the Archean and touched on everything from the origins of life, mineralization in the Bushveld complex, the gold-endowed Barberton greenstone belt, giant basins such as the Witwatersrand, and the emergence of humankind from sites near Johannesburg. A real highlight was Terrance's ability to provide time correlations between major points in geological history and the corresponding biological activity at the time.

The next presentation was given by Professor Judith Kinnaird. Judith focussed on the ~65000 km^2 Bushveld complex, emplaced between 2054 and 2060 Ma. Judith explained the differences between the various compositional layers within the Bushveld: the upper zone which contains mainly vanadium, the critical zone which is the most economic of all the horizons and contains dominantly chromium and platinum, and the lower zone which is made of ultramafic olvine and orthopyroxene packages.

The final presentation of the evening was given by our very own Paul Wojdak. Paul spoke to the group about the overall geology and accretion history of British Columbia and the tectonic setting for the most prevalent deposit types in province. He provided case studies on many deposits including discovery histories, geologic setting, and exploration/mining history. We were very grateful to Paul for his offer to present as we were able execute a real information exchange between Canadian and South African geologists.

We then made our way to the University of Johannesburg where we were treated to what would become a very familiar dining experience: braai. We ate sausages, pap (maize-type grits), and chakalaka (tomato based stewed chutney) and drank beer to help us cope with jet-lag. Our thanks to Ashley Gumsley and Luisa Broccado of the SASSEG for their organization of our day's activities.

(Ayesha Ahmed, MDRU, Carlin Au Vectoring)

May 25th – Premier's Cullinan Diamond Mine

After a warm welcome by students of the SEG student chapter of the University of Johannesburg the day before, we had to wake up early to complete the drive from Johannesburg to Cullinan Diamond Mine, ~50 km NE of Pretoria. The visit to Cullinan was first class, thanks especially to the personal attention paid by Theo van Strijp, a Geotechnical engineer in charge of guiding us during our visit.

Our visit started with a complete presentation on the geology and mining history of Cullinan. We were then led on a tour around several levels of the underground mine until level 763 (m below surface). Following our underground experience we took part in a final discussion, a delicious lunch and a glamorous visit (with wine in hand) to the diamond store.

Mining at Cullinan started in 1902 as the Premier Transvaal Diamond Mine by Thomas Cullinan. The Mine became famous due to its production of the world's largest diamonds including the biggest one ever found: the 3106 carat Cullinan diamond, uncovered in 1905. From 1917 until 2008 it was operated by De Beers at which point it changed hands to the Petra Diamond Cullinan Consortium. The mine operated continuously except between 1932 – 1945 when it was closed due to the Great Depression. Underground mining started in 1947; the current mining method is underground – mechanized block caving with an annual production of 2.3Mt and grades of 0.906 carats/ton.

Geologically, Cullinan is an oval shaped Kimberlite pipe approximately 1000m $\times$ 500m diameter on surface, with a surface area of 32ha. The pipe diameter is decreasing progressively with depth and the maximum pipe depth is 1200m. Regionally The Cullinan kimberlite pipe occurs within the stable 3 billion year old Kaapvaal Craton and intrudes rocks of the Transvaal Supergroup (Pretoria and Rooiberg Groups), the Bushveld Complex and the younger Waterberg Group. Locally Cullinan is hosted in three principal kimberlite facies, locally termed the Brown, the Grey and the Hypabyssal Kimberlite. Diamond grades vary considerably within the pipe: higher grades are associated with brown kimberlite, followed in descending order, by Hypabyssal and gray kimberlites. The kimberlite pipe is cut by a 75m thick gabbro sill at a depth of 385 m. The thermal metamorphism made the kimberlite locally harder and led to destruction of diamonds in the contact zone.

(Tatiana Alva-Jimenez, MDRU, Footprints of Porphyry Cu deposits)

May 26th - Ivanhoe's Platreef Project

On May 26th, we visited Ivanhoe Nickel & Platinum's Platreef Project on the outskirts of the town of Mokopane. This was the only exploration-stage stop on our trip. Our guides to the geology of the platreef were: David Broughton, Executive Vice President of Exploration, Sello Kekana, General Manager of the Mokopane Operations, and Devine Hadebe, Project Geologist. We arrived at 11:00 and were greeted with tea, followed by a presentation on the Platreef.

The Platreef is located in the Northern Limb of the Bushveld Complex, believed to be a faulted continuation of the Eastern Limb of the Bushveld Complex. However, the Northern Limb differs from the Eastern Limb in several important respects. Firstly, it is missing much of the lower stratigraphy present in the Eastern Limb. Of the four "zones" that make up the Bushveld Complex (Lower zone, Critical zone, Main zone, and Upper zone, listed from oldest to youngest), the Northern Limb is missing the two bottommost units. Secondly, while the Eastern Limb boasts high-grade ore in relatively narrow reefs (the Merensky and UG-2 reefs), the Northern Limb exhibits lower grades over much greater thicknesses. Additionally, chromite in the Northern Limb appears only as stringers, not the decimeters-thick layers seen in the Eastern Limb. Finally, the base metal content of the Northern Limb is significantly higher than that of the Eastern Limb.

Platreef ore occurs in two of four pyroxenite layers sandwiched between a hanging wall of Main Zone gabbros and norites (with a mottled anorthosite base) and a footwall composed of a mixed zone of chill margin pyroxenite, granofels, and granite. The stratigraphically lowest P1 pyroxenite layer (variable medium-grained feldspathic pyroxenite with calc-silicate rafts, occasional granite and granofels xenoliths) is generally low-grade, but high-grade mineralization does occur sometimes at the top, where it forms part of the Upper Mineralized Zone in association with the P2 layer above it. The P2 layer is coarse-grained pyroxenite with patches of serpentinite alteration and blebby sulfide mineralization. This is the high-grade zone.

Ivanhoe's platreef exploration project areas are located along strike from Anglo Platinum's Mogalakwena Pt mine (see the following section for details of Anglo's mine). The Turfspruit project area was the subject of a 1999 - 2006 open pit resource exploration program that resulted in 187 000 m of drilling over 574 holes. From 2007 - 2009 an underground resource

exploration program was conducted totalling 62,000 m over 44 holes. An underground solution to extraction is especially important as the proposed open pit area overlaps the nearby town of Mokopane and would require town approval for relocation. 2010 will continue this underground resource exploration program, with 14,000 m planned in 11 new holes. A 2006 resource statement lists tonnage and grades for the Turfspruit project area as follows: 372.7 Mt indicated, grading .2% Ni, .15% Cu, .33 g/t Pt, .45 g/t Pd, and .09 g/t Au; 403.7 Mt inferred, grading .16% Ni, .11% Cu, .38 g/t Pt, .45 g/t Pd, and .09 g/t Au. In the Macalacaskop project area: 251.0 Mt inferred, grading .17% NI, .11% Cu, .52 g/t Pt, .55 g/t Pd, and .10 g/t Au.

After the presentation, we were treated to a lunch, followed by another presentation on the Central African Cu Belt and Ivanhoe's projects in the Democratic Republic of Congo and Zambia. Following this presentation, we had the opportunity to examine core, during which we enjoyed a game of "Spot the Chromite Stringer". We also learned that while Sello was helping to host our visit, his wife had been admitted to hospital in Pretoria that day, where she was hours away from giving birth to their first child, a daughter.

Towards the end of our afternoon at Ivanhoe, Sello treated us to an unexpected tour of the on-site diamond exploration sample-processing facilities and introduced us to Natasha Botha, lab manager for the diamond exploration program. Natasha described the heavy-mineral separation process employed at the lab and showed us a diamond she had recently found in a sample. Despite Ayesha's valiant stab at learning where the samples were collected, we were denied this knowledge and will sadly not be rushing out to stake adjacent claims or collect our own diamondiferous samples.

Some of Ivanhoe's diamond exploration equipment

This concluded our visit. As we were leaving we heartily encouraged Sello to rush off to Pretoria to (hopefully) witness the birth of his baby daughter. Meanwhile, we were off to our accommodations, the Getaway Gateway Guesthouse in Polokwane.

(Kathryn Lucas, Age/Origin of Quesnellia Basement)

MAY 27th – Anglo Platinum's Potgietersrus Platinum Mine

From our guesthouse in Polokwane, we travelled ~100km to the Potgietersrus Platinum mine, Magalakwena section, just west of the town of Potgietersrus. Potgietersrus is the only deposit in the Platreef currently being mined as an open pit. Upon driving into the complex we were struck by the absolute enormity of the mining operations.

Chief engineer Vijay Kumar and his main geologists Trust Muzondo and Bonjani Mdingi presented the geology of the deposit along with the exploration history and geologic complications of extraction. Although mining in the area dates back to the copper age (~2000 years ago), the first blast to form the open pit at Potgietersrus didn't occur until 1992. A combination of drilling and modeling indicate that the ore body is very complex -- different from the layer cake type stratigraphy typical of the Merensky Reef.

The platreef is divided into three horizons: A, B, and C (from bottom to top). Horizons A and B carry the highest grade at the Potgietersrus mine and are composed of pyroxenite to gabbro host rocks. The economic horizons are not stratigraphically continuous which makes exploration and production a difficult task. Additional challanges include the lack of local water supply (the mine is currently using second hand water from Mokopane and Polokwane for processing), a lack of suitable waste and tailings dumps, and the need for a larger smelter to handle output.

The group surveys one of the Potgietersrus open pits

After a good run of the geology, we headed out to the open pit where we were able to observe the difference between the A, B, and C horizons of the platreef. Our final (and most exciting) stop at the Potgietersrus mine were the dumps. Here we hammered away and collected far too many samples of massive diopside, chalcopyrite and pyrrhotite.

From the mine we traveled back towards Polokwane to the giant smelter and robotically operated labs just outside the city. We were greeted by some of the highest security I had seen at one of these operations; no cameras allowed unfortunately. After a short safety presentation, our host Paul van Manen, engineer at the smelter, led us to the robotics lab where we met Johan Leroux, head of mechanical engineering. Johan would be our tour guide for the next hour. Needless to say, many of us did not know what to expect but we were all impressed. 14 robots operate simultaneously on duplicate samples for a turnaround time of 2.5 days. The lab is calibrated for Pt, Pd, and Rh by fire assay with Pb collection. Base metals are

analyzed through XRF. The lab operates at ~15000 samples (including lab duplicates)/ month, and has achieved a maximum record of 18700 samples in a month. This lab is clearly the way of the future.

After our time in the robotics lab, Paul organized a driving tour of the smelter. Unfortunately, the smelter was down for the day so we were not able to enter and get the full picture. Our driving tour however, was very informative. We learned about where the trucks come in, how material is off-loaded and transported around various areas of the site. We saw the main furnace which reaches a temperature of nearly 1500°C, and large slabs of slag waste. We were also told that the main problem the smelter faces is fluctuation in power. The smelter often works at ½- ¾ power due to government restrictions.

(Ayesha Ahmed, MDRU Carlin Au Vectoring)

May 29th and 30th - Kruger National Park

After spending the first few days focussing on geological tours, the Kruger National Park was an opportunity to meet the varied flora and fauna of the country. This park is located in eastern South Africa along the international boundary with Mozambique. Crossing the Phalaborwa entrance to the park we could already experience the wildness of the park. And just a few kilometers ahead we observed the first animals: herds of impala and some solitary elephants.

A herd of impala are startled by the passing vehicles

When we arrived to Letaba (our accommodation inside the Kruger Park) we immediately went for a night safari with our guide Cecilia. What we saw was incredible: hippos, hawks, impalas, owls, elephants, and hyenas. These last were also surrounding the hotel electrical fence as we prepared our dinner; seeming little puppies hoping for some friendly feed. Despite all our fabulous animal sightings, though, we were still waiting for the king.

The next day was spent touring the park separately. In the evening the group reconvened and went on a guided sunset safari, searching for more animals and great picture spots. The animal parade continued: giraffes, rhinos, buffalos, eagles, and crocodiles. Our safari guide Cecilia acted as chauffeur and nature interpreter as she explained the Kruger facts of life such as that impalas are the most common animal in the park and a main source of food for predators.

A spotted hyena surveys our dinner preparations

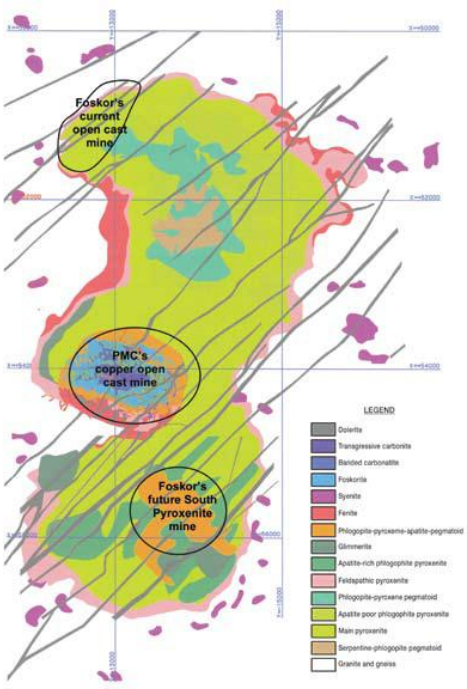
King of the animals!

Suddenly, Cecilia turned right onto a secondary road and we arrived to the edge of a cliff and great lookout of the Letaba river. On the other side a herd of buffalo were grazing peacefully... and finally it was there! A young lion crouching in the pastureland, skinny and hungry, looking steadily at the buffalos. He was waiting for the best moment to attack and claim his prize. As darkness came we had to drive off; hopefully he made it…

(Jaime Poblete, MDRU, Cerro Bayo Epithermal deposit)

May 31st - Foskor's Phalaborwa Phosphate Mine

After two wild days on safari in Kruger National Park, we were ready to get back to the incredible geology on offer from South Africa. Waiting for us was a tour of Foskor's phosphate mining operations on the Phalaborwa Igneous Complex – a 2.06 Ga, vertical, kidney-shaped volcanic pipe measuring 1.5 - 3.5 km wide and 6.5 km long and resulting from successive alkaline intrusions of pyroxenite, spectacularly coarse-grained phlogopite-pyroxene-apatite pegmatoids and the transgressive, copper-bearing carbonatite. Foskor mines phosphate from both apatite and pyroxenite within the deposit and produces a concentrate of 37.5% P_2O_5 onsite, used for subsequent production of phosphoric acid and fertilizers.



Local geologic map for Phalaborwa

Prior to beginning our tour with mine geologists Hennie Coetzee and Razzia Adam, we drove up to a viewing platform atop an old waste pile for a bird's eye view of the various mining operations within the complex. There are 3 active mining operations, all with overlapping mineral-specific rights by both Foskor and Palabora Mining Company (PMC). From the North and South Pyroxenite pits, PMC retains rights to the overlying vermiculite ore bodies, while Foskor mines the underlying phosphates. The North Pyroxenite pit has been mined for phosphate-bearing ore since 1966 with 509 and 296 Indicated and Inferred million tons of ore at 7.07 and 6.77 % P_2O_5 respectively, remaining. 35K tons of Foskor's daily 70K ton mill throughput comes from the North Pyroxenite pit at a strip ratio of 1:1. The Southern Pyroxenite pit is currently being stripped of its upper vermiculite ore body by PMC, with phosphate-rich tailings providing 15K tons of daily mill throughput, but will soon account for 66% Foskor's production once Foskor begins actively mining. Phosphate resources of 2.276, 1.148 and 1.491 million tons of Measured, Indicated and Inferred resources at 6.7, 6.3 and 6.26% P_2O_5 respectively, are contained within this coarser-grained pegmatoid body. Within the central transgressive carbonatite complex at Loolekop where PMC is mining copper, previously from open cast methods, now through block-caving beneath the open pit floor, Foskor currently receives approximately 20K tons of phosphate rich tailings daily from PMC's active tailings dam.

Massive pegmatoidal diposide, magnetite, phlogopite and apatite crystals from Foskor's high-grade stockpiles

Foskor's phosphate resource remaining in PMC tailings dams are 238.3 and 48.8 Measured and Indicated million tons at 6.7 and 6.6% P_2O_5 respectively.

The Central Carbonatite Pit at Loolekop, Phalaborwa

Following an overview of the North Pyroxenite Pit, with an explanation of geology and operations, Hennie gave us what we really wanted: an hour alone with our hammers and the high-grade stockpiles. We were more than content to comb the boulders of pegmatoidal diopside, phlogopite, apatite, magnetite and carbonatite as we prospected for the perfect mineral specimen and the elusive baddeleyite crystal. Being that this was South Africa and we were on the fence line of Kruger, Hennie's main concerns for our safety were, of course, the marauding herd of water buffalo seen nearby and whomever was responsible for the numerous elephant tracks we had crossed as we drove to the dumps.

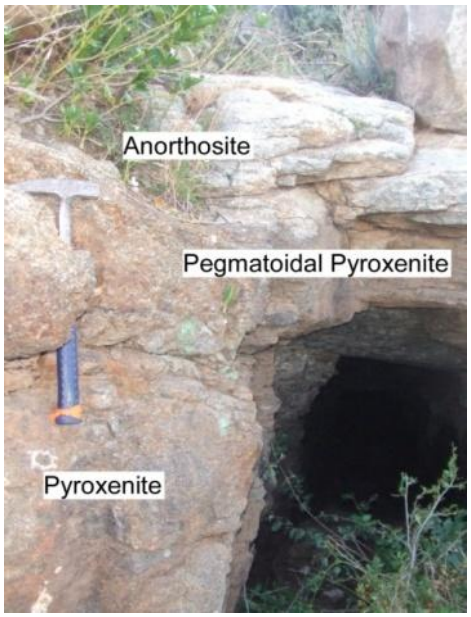
(Will Lepore, MDRU, Long Canyon deposit)

June 1st - Merensky Reef

After touring Phalaborwa we headed into the Bushveld under the charge of Russell Myers. Our main objective was to visit outcrops and adits to better understand Bushveld style PGE mineralization.

To this end we visited the discovery outcrops for the Merensky reef orebody and the Upper Group 2 Reef (UG2). Around the Merensky Reef area Russell pointed out the presence of hills with subrounded summits; some of these structures represent pipes of pegmatoidal pyroxenite which have been mined for PGEs, as has the nearby "Kennedy Vale" pipe, currently mined by Xstrata – Lyon Ferrochrome.

There's PGEs in them thar hills



At the UG2 outcrops it was possible to see the important stratigraphic relationships at the mineralization contact: a pyroxenite body, followed by a pegmatoidal pyroxenite layer ≤ 30 cm thick, capped by anorthosite. The pegmatoidal pyroxenite layer is an important guide which indicates proximity to the mineralization. At the first outcrop, the chromitite layer is ≤ 0.5 cm; at the UG2 discovery outcrop this chromitite layer is ~20 cm thick. Although the relative stratigraphic sequence is preserved in the area, the thickness of the economic chromitite layer varies greatly.

(Santiago Vaca, MDRU, Alkalic Porphyry Systems)

June 2nd - Dwars River

The Dwars River outcrops represent a layered intrusion complex composed of intercalated chromatite and anorthosite layers. The chromite rich layers are from 1 to 40 cm thick, containing ~ 30% chromium and are rich in PGEs and vanadium. These rocks are 2060 million years in age. The Dwars River is considered a geological wonder of the world; for this reason this site has been declared a National Monument in South Africa.

Bifurcation in chromitite layer. Awesome sweater for scale

Magnetite layers in anortho-pyroxenite rocks

After leaving Dwars River we travelled to another interesting piece of Bushveld layered pseudo-stratigraphy. Here we saw layers of vanadium rich magnetite ≤ 2 m thick with euhedral crystals ~ 1cm large, interlayered with anorthosites. The anorthosites contain minor mineralization: ~1% disseminated pyrite-chalcopyrite. When observed closely in the sunlight, magnetite crystals appeared to show cleavage, a characteristic not associated with magnetite. After a group discussion, we were quite puzzled as to how magnetite could be exhibiting perfect cleavage. Upon further investigation back at the guesthouse, Russell discovered that the magnetite in this area commonly exsolves ilmenite. This exsolution gives the appearance of cleavage. A true “AHA!” moment.

(Santiago Vaca, MDRU, Alkalic Porphyry Systems)

June 3rd and 4th – Barberton Greenstone Belt, Sheba Gold Mine, and Agnes Mine

The Barberton Greenstone Belt hosts some of the world's oldest geological features. Over a span of two days, the group toured the geology of the Barberton Greenstone Belt with Dr. Dion Brandt, a local geological consultant and Barberton geology enthusiast. Beginning in the town of Barberton, we drove through the Barberton mountainland near the Swaziland border and made roadside stops. These stops included the oldest known biolaminae on earth (~3.2 Ga), herringbone cross-bedding of the Moodies Group (3.3-3.2 Ga), and cryptic folded Fe-rich chert breccia of the Fig Tree group. Lunch was had at the top of a large hill overlooking the Komati River, namesake of komatiites. The afternoon was spent looking at the komatiite and spinifex type localities, Archean pillow basalts, and a roof pendant of basaltic material within a TTG suite which includes intrusions as old as 3.4 Ga. These outcrops were located on farm properties and required the farmers' permission to open gates. The majority of the outcrops visited on the first day are slated to become UNESCO World Heritage sites, a project which Dr. Brandt has been undertaking the past few years.

Dr. Dion Brandt presents the local geology of the Barberton area

Visible gold in a sample from the Sheba Au mine

The second day was devoted mainly to visiting two of the area's 350+ gold mines. In the morning we were greeted by Chris Rippon, geologist at Sheba Mine, presently owned by Barberton Mines Limited. The mine has been in operation since the 1800s, and boasts some impressive ore grades, up to 250 g/t Au. The property is located north of the Eureka syncline between the Kaapvaal and Nelspruit granites. Underground workings are connected to another gold mine nearby, Fairview Mine, owned by the same company. During our visit we examined maps and extraordinary hand samples in the mine's small museum, which used to serve as the original owner Edwin Bray's office in the 1880s. The group was then led to the Golden Quarry, where we were permitted to explore the mined out caves of one of the world's richest gold deposits, a carrot-shaped ore body mined to 300m.

Free gold (at 6 g/t) and refractory ores (10-20 g/t up to 100 g/t) are currently being mined at intersecting fractures and shear zones out of a 400-500m shaft at Zwartkopje; the previous shaft, at a maximum of 3 km, is no longer in use. Rutile dating has helped to constrain the age of gold mineralization at ~3.1Ga. Sheba extracts approximately 8000 tonnes of ore per month.

Agnes gold mine, near Barberton, was our afternoon stop. On arriving we met our guide Andrea Botha. After being equipped with gumboots, hard hats and head lamps, we walked to the Concession Creek adit and began our tour of the underground mine.

Agnes mine was discovered in 1883 during the Barberton gold rush. The original prospectors in the area were gold panners who had seen visible gold in quartz. Concession Creek is where the “reef” gold was first discovered. Agnes was recently bought by Ergo Mining on the premise that the old tailings would provide a new resource, given modern methods of extracting gold from sulfides. Production at the mine is expected to more than triple by the end of 2011 (from 18,000 tons to 53,000 tons a month, with gold production rising from 23,000 oz to 78,000 oz a year), through a new entity to be known as Galaxy Gold Mining. The increase in production will come via the use of the Biox treatment process, whereby gold is extracted with the help of bacterial action.

Agnes is a site of historical interest and the mine operations are divided into a commercial sector and a tourism sector. The commercial sector grades 3.6-6.0 g/t and the tourism sector grades 16.3 g/t. In the commercial sector, mining is entirely mechanized, but in the tourism sector, there is significantly less mechanization, in order to maintain the historical integrity of the site and allow for tours by the public.

On the tour, we saw another variety of wildlife to add to our tally from Kruger: the horseshoe bat, a non-flocking cave dweller species so named because its lip is horseshoe-shaped. Many, many photos were taken of these cute little bats hanging upside-down, trying unsuccessfully to have a quiet nap in the face of our paparazzi tactics. We also learned about (and saw, from a comfortable distance) sporoli fungus, a white fungus that thrives on decayed wood and is a threat to humans when it invades via an open wound and grows its tentacles through the body's tissues. We stayed very far away from this particular form of wildlife.

After the tour, we learned to pan gold in Concession Creek from Danny Brink, a local gold panner who competes professionally on the gold panning circuit and placed 2nd in the "Traditional Pan" and "Veterans" categories in the South Africa National Gold Panning Championships in October 2009. The largest nugget of gold to ever be found in Concession

Creek was 5 kg. Forty-five minutes of panning by us generated multiple small flakes of gold in our pans, but sadly no nuggets.

Evening saw us back at the Gold Nugget Guesthouse in Barberton, where we enjoyed a traditional braai under the thatched roof of the Guesthouse's poolside rondavel.

(Intro and Sheba: Leanne Smar, MDRU, Structural Metamorphism of the Wopmay Orogen)
(Agnes: Kathryn Lucas, Age/Origin of Quesnellia Basement)

June 5th and 6th - Vredefort Dome

The town of Parys is located about 90 kilometres south-west of Johannesburg near the centre of Vredefort Dome. The 2 Ga Vredefort Dome impact crater is 300 km in diameter and the 9 km wide impactor approached from the south-east at an angle of about 19.5°. The southern crater wall has been mostly obliterated likely due to the angle of impact and the removal of the upper 20 km of strata. Vredefort Dome represents the deeper remnants of an impact crater. As you travel from the centre which is mostly mantle peridotite you eventually cross lower crustal rocks and then upper crustal rocks near the inner crater rim.

We travelled at 6 am June 5th from Barberton for a 4.5 hour drive to Parys to meet with Cobus van Rensburg who lives in Parys and is one of the key geologists in transforming Vredefort Dome into a UNESCO world heritage site. Cobus currently works for Gold Fields but has been part of the five year process to turn the world's oldest impact feature into a protected site.

Petroglyphs on a granophyre dyke near the town of Parys

Once meeting up with Cobus in Parys at around 1 pm we first stopped at a granophyre dyke located near the centre of the crater. Petroglyphs of rhinoceros, eland and giraffe have been sketched into the granophyre dating back to 1250 BC. The granophyre is strongly silicified, dark grey and extends several hundred metres linearly to the northwest.

The next stop featured siliceous quartzites of the Witwatersrand Supergroup; these sediments are overturned, presumably due to the force of impact. This location was also our lunch stop, kindly organized by Cobus. We next visited several old mine workings also within the Witwatersrand Supergroup. Only 35 kg of gold was produced in total from all mine workings within the Vredefort Dome impact crater. Waste rock, tailings, railway tracks and concrete cylinders are littered around the mine site, and old open shafts and adits related to these old workings pose a real hazard for those people travelling to the region for weekend recreation.

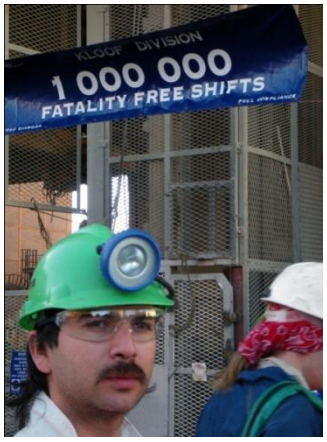
Overturned quartzite

At the next stop we visited a small road outcropping of the Ventersdorp Supergroup which consists of 2.7 Ga flood basalts which have also been completely overturned. We spent the evening at Dome Lodge which lies within the inner crater rim and the outer crater rim within the Witwatersrand Supergroup.

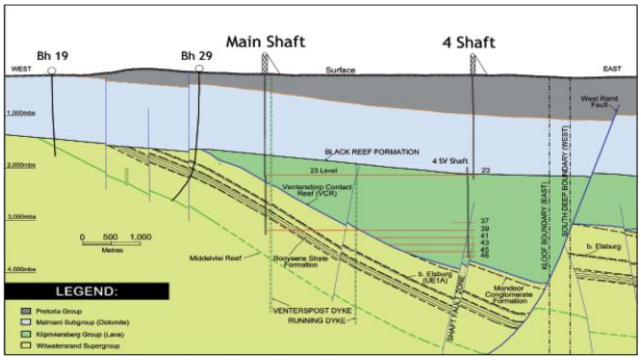
The next day Cobus was busy with his daughter's birthday so we investigated two sites: a road cut containing shatter cones and a pegmatite quarry containing pseudotachylites. Our first stop was at a road cut where the University of Johannesburg was running a 3 day field course for their first year students investigating features of the Vredefort Dome. This stop contained shatter cones within a fine grained shale. Our final stop was at the pegmatite quarry which displayed pseudotachylites containing large breccia clasts which can be seen in the adjacent photo. Pseudotachylites can also be found outside the impact crater and are typically only visible at depth within an impact crater. We spent the remainder of the day eating lunch and driving to Kloof mine for our tour the next day.

(Greg McKenzie, MDRU)

June 7th – Gold Fields' Kloof Au Mine



Gold Fields' Kloof mine is located about 60 km west of Johannesburg on the main Western Rim of the Witwatersrand basin. The group arrived at the Gold Fields campus in the late afternoon of June 6th; accommodations and dinner at the Kloof Academy had been organized for us by Cobus van Rensberg, saving us an early morning drive to the mine for the following day. After a short sleep we awoke and met geologists Tumi Komape and Jaco Dixon at 6 am to prepare for our underground tour. While gearing up with jumpsuits, boots, emergency air supply and headlamps we met chief Geologist Khaya Sibeko for a safety demonstration and production overview.



Gold mineralization in the Witwatersrand Basin is believed to be a remobilized gold paleoplacer. At the Kloof main shaft grades of up to 100 g/t are mined from the Ventersdorp contact reef, a lithostratigraphic entity part of the Venterspost Conglomerate Formation that separates the underlying Witwatersrand Supergroup sediments from the overlying Ventersdorp Supergroup volcanics. Reserves calculated for 2009 are 53.2 million oz at a grade of 6.2 g/t; total orebody resource estimate is 79.0 million oz. There are currently over 14 000 employees at Kloof and the life of mine has recently been extended to 2030.

Our underground tour took place 2 300 m below surface where current operations are mining out the #4 pillar, the main shaft pillar. We descended down from surface at a velocity of 15 m/s, arriving at our destination in roughly 3 minutes. At this depth the heat was quite stifling, about 35 °C, and grew hotter as we travelled away from the main shaft and towards the currently producing adits. To see the current area of mining we needed to make good use of our elbow and knee pads, travelling through a combination of ladders, walking tunnels and crawlspaces, eventually arriving at the contact reef. At this point we were pouring sweat and panting, but there was a huge smile on every face as samples were knocked off and Tumi and Jaco patiently explained the geology before us. An incredible experience, but the conditions left many of us wishing for the cool breeze of a mountainous northern field area.

(Shawn Hood, MDRU, Minto Cu-Au Deposit)

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2010 Annual International Trip Report