

Northern Branch of ArchSoc: Artefacts



Outing to the Vredefort Impact Site – 27 August 2022

Thirty-two members and friends of ArchSoc attended this outing departing by bus from the Origins Centre at Wits University. During our journey to Parys in the north-western Free State tour leader Professor Roger Gibson introduced us to the geological phenomena of the region.

The area encompassing the current Provinces of Gauteng, Northwest, Mpumalanga, Free State, Limpopo and parts of the Northern Cape and Botswana comprised the Kaapvaal craton, one of the earliest continents on Earth. The oldest rocks in the Kaapvaal craton, are those near Barberton dating from about 3.5 billion years ago. The rocks near Johannesburg and Vredefort date from about 3.3 to 3.1 billion years BP.



Source – physics.stackexchange.com

Around 3.07 to 2.71 billion years ago the central parts of the Kaapvaal continent around Johannesburg and Vredefort seem to have been dominated by a shallow sea. The sediment deposited into this Witwatersrand Sea was swept there by strongly flowing rivers originating in high mountains located towards the west and northwest.

About 200 million years later, the pattern of sedimentation in this sea changed. The previous mud layers were gradually replaced by coarse quartz sands and coarse gravels, containing minute grains of gold. The discovery in 1886 of these solidified gold-bearing layers, called conglomerate, resulted in the establishment of Johannesburg and the mining of the area in and around the Witwatersrand. It is estimated that 40% of all gold recovered over the centuries originated from these gold mines

Turning off the N1 onto the R59 towards Parys and Vredefort, we approached the impact site where some 2020 million years ago, an asteroid (consisting of rock) or a comet

(consisting of ice and some rock) slammed into the earth. This is the biggest meteorite surface yet found on Earth. Its impact was twice as big as the impact that killed the dinosaurs 65 million years ago. For these reasons, part of the Vredefort Dome was declared South Africa's seventh World Heritage Site in 2005.

At the time of impact there were no people, animals or even plants as we know them today on earth. The only living organism was a type of algae, like the green slime sometimes seen in dams.

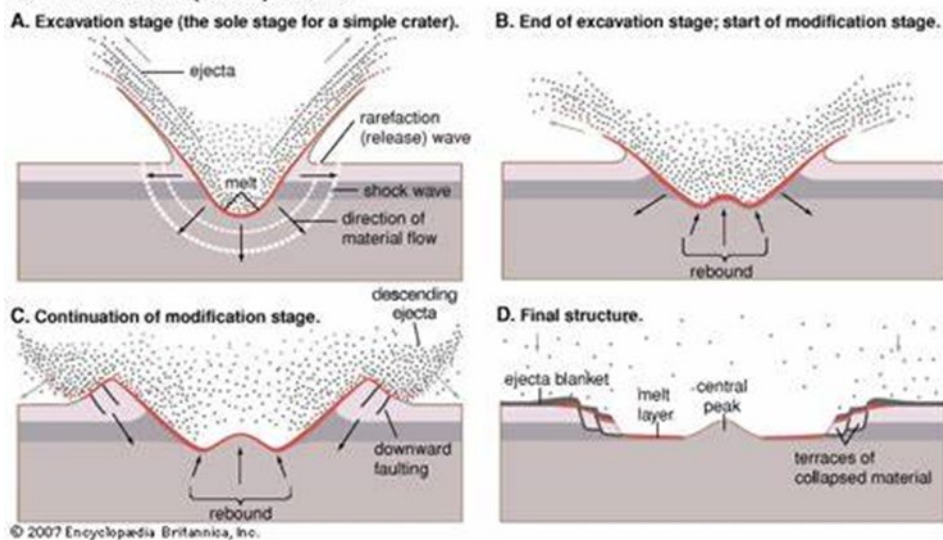
In those far-off times, the actual impact site was several kilometres higher than the present land surface. A bolite (fire ball) measuring at least 5 to 8 kilometres across, crashed into the earth at a minimum speed of 40 000 km per hour.

The energy released upon this collision was equivalent to the explosion of almost 100 million tonnes of TNT. To put it into perspective, the explosions of the two atomic bombs that destroyed Hiroshima and Nagasaki in 1945 were the equivalent of 20 000 tonnes of TNT. If such a bolite were to crash into the earth today, it would destroy all living creatures.

The momentum of this bolite would have driven it at least 10 kilometres deep into the earth where being severely compressed, it exploded. The seismic events caused by the impact would have registered a magnitude of 14 on the Richter Scale.

Within two minutes of the impact, the resultant shock wave caused huge amounts of rock to vaporise totally and several thousand cubic kilometres of rock to be melted into the impact and surrounding zones. At that moment, the impact crater had a diameter of about 100 kilometres and a depth of between 30 and 40 kilometres.

Formation of a complex impact crater



Source – homework.uoregon.edu

However, within a mere 10 minutes after the impact, the crater walls would have collapsed, and the compressed crater floor rebounded as the tremendous compression of the shock wave passed upwards and outwards. The crater then bottomed out at a depth of 1-2 kilometres and widened to a diameter of about 250 to 300 kilometres. See sketch below detailing the formation of a complex impact crater.

The impact of this collision on the environment was massive, with dust injected into the upper atmosphere and global cooling taking place for several years, perhaps even for as long as a decade.

The impact caused the gold-bearing Witwatersrand rocks to sag and downfault into the ring basin around the central uplift, which prevented the Witwatersrand gold reef from being eroded over the last 2000 million years.

From Parys we crossed the Vaal River on the R53 travelling a short distance towards Potchefstroom (Tlokwe) before turning south along a gravel road. We stopped on a low hill overlooking the scenic landscape of the Vredefort Conservancy with the Vaal River meandering below.



Members listening attentively to Professor Gibson at the Schurwedraai bend of the Vaal River.

Here Professor Gibson explained the geology of the Vredefort Dome. The rocks that were buried deep within the crust before the impact are found in the centre of the Dome. They are mostly *granite gneisses* more than 3 000 million years old. Both Parys and Vredefort are built on gneisses that have been mined for granite in many quarries.

The hills of the Vredefort mountain land consist of hard white *quartzite* rock, with the valleys in between made of softer *shale*.

Some thin layers containing a little gold were once mined from these rocks near the historic little hamlet of Venterskroon, some 31 kilometres west of Parys.

The name *Vredefort Granophyre* is the name given to the black crystallized impact melt-rock that flowed into cracks in the rocks below the crater.



Professor Gibson pointing out Vredefort Granophyre, a crystallized impact melt rock, containing broken pieces from many rock types.

We then proceeded to a disused granite quarry where we viewed examples of the granite mined for the export market. The market collapsed when the Italians decided the granite did not meet their specifications.



Visit to a disused granite quarry where the granite was mined for the export market.

Following a convivial lunch at a farm in the Vredefort Conservancy, we departed for our last stop, a rock engraving site on the nearby farm Daskop.

These engravings were pecked on a series of rocks protruding from a dyke extending about 80 meters. Unlike many sites where rocks were engraved close to streams or rivers, such waterways are absent here. Nevertheless, the shape of the dyke might have served as an

allusion to the mystical water snake, often present in the San or Khoekhoen belief system, and hence might have been why the engravings were made at this site. All the engravings are of animals and none of geometrical shapes.



Engraving of a rhino.



Engraving of a hippo.

The Vredefort Dome and Conservancy offer visitors a wide array of interesting attractions: geological outcrops, Anglo-Boer War battlefields, beautiful scenery, and the Vaal River, as well as remnants of old gold mining activities. With fine dining available in Parys, and numerous bed and breakfast establishments available both in Parys and on nearby farms, all participants agreed the area warrants further visits.

Report and some photos by SJ de Klerk.

This report was much improved through access to Uwe Reinhold and Roger Gibson's excellent book entitled *Meteorite Impact! The Danger from Space and South Africa's Mega-Impact – The Vredefort Structure*. Berlin, Springer. 2010.