

## JULY 2008 Talk:

### **'I am Rich Potosí, the Treasure of the World'**

The town of Potosí lies at the foot of Cerro Rico (Rich Mountain) de Potosí in the *department*, (province), also named Potosí in the south-west of Bolivia. Potosí and a number of other towns established on or near mines in the west of the country lie on a mineralised belt of land stretching throughout west Bolivia north into Peru and south into Argentina. The mineralised zone and mines have long been significant for the presence of a number of metals, particularly tin, but at some locations such as at Potosí, Cerro Rico has been much more significant for silver.

Total production of silver over the centuries has been impossible to certify since for purposes of avoiding taxation much would not have been reported but over the four centuries of its operation the mine is believed to have produced more silver than any other mine in the world, at least until the 20<sup>th</sup> century. Silver production has latterly declined and over the last few decades the mine has been producing mainly other metals, tin, copper, bismuth, zinc, tungsten and lead.

As part of his work with HOPE Worldwide, Graham Ogle is the Program Manager for the International Diabetes Federation Life for a Child Program. The Program has supported diabetes care for 140 children and youths in Bolivia for five years. In the course of his work the speaker had occasion to travel to Bolivia in May this year and visited three cities, including Potosi where five of these youths live. Accordingly the speaker was able to spend some time touring the town and climbing over and into the mountain to examine various of the workings and mining work.

Commencing his lecture the speaker referred first to a picture he displayed of the Potosí coat of arms which was designed not long after the town was founded in 1545, the full text of which reads *'I am Rich Potosí, the Treasure of the World, King of the Mountains, Envy of Kings'* Much of Bolivia is on the altiplano and Potosí is at a height of about 4,000 meters with the mountain rising another 700 meters. Accordingly working or even visiting the mine is very exhausting, especially for any outsiders and tourists who are not acclimatized to the altitude.

Cerro de Rico is not a single mine but a series of many workings, the mountain by now being honey-combed by shafts, adits and tunnels and has lost about 60 - 70 meters of its original height. The mountain is geologically referred to as the Cerro Rico Stock and is a body of highly-altered silicified and pyritised volcanic rock intruded into the original country rock of layered Ordovician shales and Tertiary volcanics. It is a porphyry of phenocrysts of corroded quartz and altered relics of plagioclase, sanidine and biotite in a strongly altered dense ground-mass which has been infiltrated by many well-developed hydrothermal polymetallic veins which strike steeply north-east to south-west. The veins are comprised of galena, sphalerite, pyrite, complex silver sulphides, wolframite and cassiterite in a gangue of quartz, tourmaline, alunite, cerussite and siderite. Silver minerals predominated in the upper levels of most veins whereas today's workings lower down are recovering more copper and tin minerals. This was convenient for the early miners and mining since silver was the main metal of interest for centuries but by the 20<sup>th</sup> century the production of a number of other metals, tin, copper, bismuth, zinc, tungsten and lead became more economically significant. Today a number of small and larger groups, cooperatives and consortiums are working various of the still-productive deposits. Occupational health and safety issues are still very inadequately handled, and tragically many miners die young from silicosis.

The presence of ore deposits in the altiplano tin belt were known to the Incas who well before the arrival of the Spanish conquistadores were already mining silver in places. According to legend the Inca king Huaina Capac traveling through the area in 1462 admired Cerro de Rico and in pronouncing that there must be much silver in its bowels directed a mining expedition there. The miners however were scared away by hearing 'thunderous noises' and it is from the Quechua word *potocsi* meaning 'thunder' that the name of the town was acquired although an alternative story is that the name was derived from the similar Quechua word *potojchi* meaning 'fountain of silver'.

A hundred years later the Spanish had arrived in what is now Bolivia and in 1545 a Quechua Indian by the name of Diego Gualca - then a servant for the Spanish captain Juan de Villaroel - rediscovered the Cerro de Rico orebodies by virtue of chasing some lost llamas up the mountain. In camping for the night and lighting a fire he was impressed to observe in the morning that a small rivulet of silver had emerged from the rocks he had used to line the campfire. He reported to his employer who registered claims on the area and commenced mining operations first on the three hundred foot outcrop Gualca had discovered on the mountain's western flank. Gradually other groups of miners arrived, finding and mining other outcrops on the mountain and started to establish the town of Potosí at its foot.

Surface ore was very soft and for many years it was possible to produce silver by using a technique established by the indians of building small furnaces called *guairachinas* which dispensed with the need for any bellows system by simply building them with the open side facing into the wind.

Reports by Spanish visitors from these times described scenes of "fifteen thousand indian wind-ovens glowing like stars on the mountain slopes each night". After some three decades of working surface deposits ores had been exhausted and sub-surface ores were proving more difficult to smelt so silver production declined but by 1574 a new 'patio' process first developed in Mexico was introduced at Potosí. This involved cold amalgamation of ore with mercury which was readily available from mines in Peru at Huancavelica although later was imported from Europe. Ore was mixed with the mercury in large troughs or patios and stirred by the feet of indian slave labourers the resulting amalgam being treated by roasting to drive off the mercury.

Production of silver and later other metals with the amount of profits made from these have waxed and waned considerably over the centuries with at intervals the application of new, improved or changed mining or mineral processing methods. Accordingly working conditions for the labourers also waxed and waned but it is generally regarded as having been very poor and Potosí has been said to have been one of the most deadly mines in the world with an unknown number but probably in the millions of people having died there. At times labourers may have been paid wages but with periods of reduced profits the local Quechua people would have been simply conscripted under a '*mita*' system imposed by the mine owners but supported by the Spanish authorities who wanted production, and duties of 20% to continue. The *mita* system decreed that  $\frac{1}{7}$  th of all indians from the ages of 18 to 45 years in all villages for hundreds of kilometers around had to work in the mines. Slaves from elsewhere in the then Spanish Empire, notably Africans, were brought in to work at Potosí from time to time but these usually quickly died from the conditions. Statements made by observers from time to time have inferred that the amount of silver produced from Potosí would have been sufficient to have "built a bridge over the Atlantic to Spain, but that a bridge of bones could have been built back".

By the early 1600s Potosí had a population of 150, 000 to 200,000 and was possibly the biggest city in the world at that time, certainly the biggest in the Americas. There were 'boom' periods

with all manner of luxury goods being imported from all over the world. Silver from Potosí provided half the world's supply for two hundred years. It was carried to the coast by llama trains and to avoid travelling around Cape Horn, was shipped north to the west coast of Panama, carried overland to the east where it was joined by supplies of gold looted from the Aztecs and loaded onto ships for transport to Spain.

Over this period of the 1600 and 1700s Spanish ships were a target for pirates and on one occasion Sir Francis Drake and a party of his men intercepted an overland shipment at Panama but discovered that there was too much bullion for them to carry off and took only the gold having to leave all the silver behind!. A number of pictures were shown by the speaker of the treasure chests that were used to transport bullion, of silver ornaments, artefacts and coins, noting that the huge supply of silver caused the Spanish to indulge in wasteful extravagances with military adventures and also affected the world economy considerably over the period due to inflation.

In having described the mine and background to the mining over the centuries Graham Ogle proceeded to show a images of the town of Potosí, the nearby and much finer provincial capital city of Sucre to which much of the wealth from Potosí flowed and views of scenes of interest in the countryside. Such scenes included a 'Cretaceous Park' with a number of quite good models of dinosaurs and a nearby dolomite quarry with dinosaur footprints on one rock face. Then there were images of the speaker scrambling over the Cerro de Rico mountainside, accompanied by local guides entering a few of the tunnels and adits, many of which were far from being horizontal. A feature of the current mine working and reflecting the local people's superstitions is the presence in various places within the workings of a number of statues of local representations of a devil-like figure who has to be placated with offerings of food and wine in the hope that this would prevent cave-ins or other bad occurrences if not improve the prospects for finding rich ore.

A large number of minerals have been recorded from Cerro de Rico but it has only been during the 20<sup>th</sup> century that collections of specimens have been built up. Secondary minerals may not have formed in quantity due to the high altitude and low temperatures and almost all the minerals to be found today are of primary, hydrothermal origin. Berndtite and ottemannite,  $\text{SnS}_2$  and  $\text{Sn}_2\text{S}_3$ , are type minerals from the mine although large specimens of these are not known. Otherwise a number of images of a selection of Cerro de Rico mineral specimens were shown by the speaker notably including a number of specimens of phosphophyllite,  $\text{Zn}_2\text{Fe}_{2+}(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$ , which is considered to be the most famous mineral from Bolivia. In the 1960s miners blasted into a vugh containing a large amount of phosphophyllite many crystals of which were sadly broken in the blasting or trampled by the miners. Whilst the mineral may have been turning up in small amounts elsewhere in the workings from earlier times it was from this one finding that most specimens came on to the market.

Graham Ogle acknowledged Wilson and Petrov's Mineralogical Record article (1999;30:9-36) as the source of much of the background information of the talk. In answering a number of questions after his lecture Graham Ogle advised collectors to be wary of buying specimens from 'Potosí' without specifying the Cerro de Rico mine since the name may refer not only to the town but also to the province and therefore to other mines in the area. There is also a Potosi in North America.