The Hermsdorf mine is one of two mines operated by specialist industrial minerals group, Geomin Erzgebirgische Kalkwerke, the second one being Lengefeld. The company also has a third mine under development, Hammerunterwiesenthal, for which it is currently assessing fleet options.

The underground mine exploits calcitic marble from a deposit located in the eastern Erzgebirge (literally, Ore Mountains) to the southwest of the village of Hermsdorf. The first documented mention of marble production dates back to the year 1581. At that time the marble was widely used as a building material and for decorative sculpture. The underground activities started in 1880 in the Fiskalischer Bruch (Fiscal Quarry), when production was mainly a raw material for quicklime production, which was used mainly in agriculture and in the steel industry.

Geology and formation

The age of the marble deposit at Hermsdorf is still debated. Lithostratigraphically, the thick sequence of interlayered marble and phyllite is ascribed to the Herold Formation as part of the Thum Group. This would correspond to a Cambrian age of approximately 510 million years. The deposit is situated in the upper Herold Formation.

The underlying rocks of the deposit are Precambrian gneisses of the Preßnitz Group and Proterozoic metagranitoids as well as Cambrian lithologic equivalents of the Breitenbrunn Formation (muscovite schists). Besides these originally late Cadomian igneous rocks and their subsequent prograde metamorphism, the footwall of the marble unit (quartz-rich phyllites and hornblende-chlorite schists of the lower Herold Formation) represents originally submarine basic volcanic rocks subsequently affected by retrograde greenschist-facies metamorphism.

The deposit comprises six calcitic white marble horizons (ko, k2-k5) and one grey horizon (k1). The marble is thought to have a marine sedimentary protolith. The carbonate sedimentation took place under turbulent conditions. One reason for this interpretation is the rough surface relief of horizon ko (the deepest marble occurrence in the deposit) with high variations in thickness and parallel splitting into several marble layers. These observations suggest a rapid change of depositional conditions. The k1 horizon is characterised by similar but more distinct features. In the former about 30-40 m thick reef limestones act as cores of tectonically developed horst structures. In contrast, the k1 horizon has partly been downthrown at synsedimentary graben-like structures.

Such deep sedimentation basins provided the environment for the development of four white marble horizons (k2-k5) with changing facial features and varying thickness. Caused by post-metamorphic brittle tectonic deformation, the white marble horizons were divided into fault-bound separated blocks being tilted and thrust between the horst structures.

The tectonic features of the deposit are of particular importance. The main foliation of the wall rocks forms a girdle fabric with axes...
striking E-W. Large SW-NE trending fault zones, which are thought to be related with Upper Carboniferous post-kinematic volcanic activity, divide the phyllites of Hermsdorf into several blocks with displacements of up to 40 m. The central part of these blocks has been downthrown as a graben and covered with rhyolites, which preserved the upper Herold Formation (including the marble deposit) from erosion.

The white marble from Hermsdorf dominantly consists of calcite with variable but low contents of quartz and phyllosilicates. The metamorphic foliation is traced by oriented crystals of quartz, chlorite and white mica as well as by grain size variations of the calcites resulting in a banded marble structure. The marble is free of bacterial and organic components and does not contain any graphitic inclusions.

**Mining method summary**

The mining activities comprise mining of residual marble occurrences in older parts of the mine and the contemporaneous exploitation of unexplored parts of the deposit. The current underground workings are developed between the existing mine area and the Fiscal Quarry as well as in the north and east of the older workings. Marble is presently mined up to 190 m deep.

Room widths are at a maximum of 8 m and room heights at a maximum of 9 m, with the pillar planes a minimum of 8 m x 8 m. The thickness of the rock between two levels is 5 to 6 m, depending on rock characteristics, and the thickness of the hanging wall rock some 2 to 4 m. At Hermsdorf, the mine uses a modified open stoping technology with square pillars. The technology is independent from conventional mine levels and fits best with the tectonically disrupted blocks of marble. Underground preparation, development and mining are passing the material back into the ore car behind it. Czech-made and Flotman drills were used. At that time a shaft was used to take material out; and the five production levels were connected by shafts as well as steep ramps equipped with winches.

Following the modernisation programme beginning in the early 1990s, the mining method was changed to LHD with underground truck; initially with two loaders (GHH LF6 and LF7) and Paus/GHH (MK15) trucks. Whereas formerly, the battery locos could only handle 4% grades; underground trucks and LHDs can cope with grades of up to 22% making it much easier to access the best material. The increased mine efficiency is reflected in the workforce figures and production rates – formerly 130 employees and production of 120 t/d; to the current rate of 320-330 t/d with only 31 employees. This huge productivity increase is largely the result of the switch to LHD/truck mining techniques. Heidkamp then sold the mine in 2008 to Schön+Hippelien Group, a large natural stone quarrying group based in Satteldorf.

The current fleet has five loaders and four trucks. Drill rigs include older Tamrock and Secoma models, with the third machine a new diesel-electric Atlas Copco Boomer 281, which is the most productive in terms of advance rates. It also has an enclosed air cab, which is much more comfortable for the operator. It is designed with service access in mind with easy access points, allowing for a short turnaround. The diesel-electric system also allows for fast relocation from face to face, which can be as much as 1 km. The 281 can drill 3 m holes in only 50 seconds, with a 43 mm diameter. Each face has up to 50 holes; with the hole pattern determining the blast result, with the most central hole containing the most charge. The detonator is connected to the other hole.
charges via time sets, ie millisecond delays – the more the time sets, the smaller the resulting blasted rock; up to half second time sets, which would result in large blocks.

Explosives cartridges from EPC are used and placed by hand, with only one central electric detonator. ANFO is then pumped into the holes using a Multicar explosives delivery truck.

The most advanced machine at the mine is a new LHD, the Atlas Copco Scooptram ST7, which is the first to have been delivered to Germany in June 2011, with a second machine now also operating at a new fluorspar operation in the same region. The ST7 service intervals are longer than the older LHD models; while it requires fewer spare parts at the same time due to better wear rates on parts. The ST7 also has air conditioning in the cab, lower noise levels, improved lighting and more efficient emergency/alarm systems. The machine also has better traction control, which is easier on the tyres, meaning less tyre changes. But perhaps the most significant difference in the current climate is in terms of fuel efficiency – the ST7 achieves 10 l/h with a water-cooled 193 hp, 6.7 l Cummins Tier 3 engine. The older LHDs typically only achieve 20 l/h and have air cooled Deutz engines. In power efficiency terms, the ST7 on-board computer calculates the optimum power needed at any one time during operations, allowing for these fuel savings and lower emissions; as opposed to operating on full throttle most of the time.

Key safety features include spring-applied, hydraulically released (SAHR) brakes, automatic brake testing with diagnostics and logging and an oil-free cabin environment. Safety is further enhanced by three emergency machine stop buttons and a system that applies the brakes, blocks steering, and prevents bucket movement when the cabin door is open. The ST7 has a tramming height of 2,160 mm and a width of 2,280 mm.

IM spoke with one of the ST7 operators, Dirk Thiele, who commented: “The new machine is very fast, especially on corners. The noise levels in the cab are much less and the air conditioning makes it very comfortable. It is also very easy to load in more difficult faces using the onboard traction control. The machine is also the only one to have automatic gears, meaning you can concentrate only on the main task of loading instead of driving.” No major repairs have been required on the ST7 since it started operating.

The whole mining area covers 24 ha. As stated, there is no shaft, with a decline only, and all of the material trucked out via the ramp and no crusher located underground. The maximum haulage distance is some 1.7 km from the deepest point in the mine. This is currently 596 m above sea level relative to the mine surface at 713 m above sea level. This is an average of 117 m depth, but it varies up to 190 m depending on the surface topography across the mine.

Room heights can be as much as 9 m

property. Geomin has an Atlas Copco Diamec 212 exploration rig that is used for near mine and underground core drilling for reserve extensions.

Production and quality control

Multiple working faces – as many as 30 – are used to allow the ability to blend marble qualities to achieve the desired final result. Most of the final product is a ground calcium carbonate (GCC) for the paint industry, where it forms a filler. The waste material is a dark phyllite slate.

The mine does not operate at night, but in two daytime eight hour shifts – 6am to 2pm; and 2pm to 10pm, with two blasts towards the end of the second shift. Each blast produces about 200 t of material with about 320-330 t of marble needed per day to feed the plant. As stated, the mine operates a conventional room and pillar method, with 8m by 8m pillars and 6m by 4.5 m drifts; and a maximum roof height of about 9 m if the thickness of the marble seam warrants it. The drifts are not horizontal as development undulates to following the high purity marble horizons. Any required scaling is either done manually or using the older Tamrock rig. Bolting is conducted using split sets; mainly using the older Secoma rig.

The blasted marble is driven out via the ramp to the plant and unloaded onto a grizzly and a main primary jaw crusher. Following drying and subsequent sorting by an automated optical control, the high fineness of the final product is realized by two one-compartment ball mills. Windsifter plants and magnetic separators further contribute to a high-quality product.

The material coming from the different faces in the mine is constantly monitored for whiteness and brightness via sample taken to the on-site lab. The marble is manually inspected following the jaw crusher to separate dark and light material. Some faces are sufficiently good quality for the material to be used directly but many require blending.

The processing plant produces calcium carbonate fillers with diverse grain sizes for a variety of uses. The filler trademark is Saxolith. The calcitic fillers of Hermsdorf are characterized by high fineness and a high degree of whiteness. The product is sold via associated marketing company SH Minerals – after the main paint filler market, others include construction grouts and plastic fillers. The ball mills can reduce the product size down to as little as 2 microns, known as the Saxolith 2HE product.

Additionally, Geomin produces marble and other local rock gravel for external sources. It is distributed under the Saxorund brand. IM