Cars, trains, electricity, electric appliances, coins... All these things that are essential to our lives are made of various mineral resources resting underneath the Earth's surface. This special issue reports on the current state of mining, including what kind of resources exist in the world and how mined minerals are used, as well as on the Hitachi Construction Machinery equipment used at mining sites.

Illustrations by Tokuhiro Kanoh
Basic Mining Knowledge in Pictures

Even if you have a general idea of what mining consists of, you’ve probably never seen the mining process or a mining site in person and there are many things you don’t know about it. How and in what ways are minerals excavated and used in the manufacture of products? Let’s start with some basic mining knowledge.

Digging up Mineral Resources that Improve Human Lives

Simply put, a mine is a place where people excavate for ‘ore’ As long as it’s where people excavate for ore, it’s called a mine, whether in the mountains or on flat land. So what is this ore? The word ‘ore’ describes rock that is economically worth digging up because it contains minerals rich in valuable metals that contribute to people’s lives and industry. Gold ore, which contains gold, and iron ore, which contains iron, are well-known examples, but rock that contains silver, copper, tin, zinc, aluminium or rare metals like manganese and nickel that have become much talked about in recent years is also called ore. ‘Mining’ is the work of digging up ore from the mineral deposits where it is found. In the case of copper, the actual copper to be mined makes up only about 0.3 to 1% of the overall ore. Excavated ore requires a process called ‘beneficiation’ which separates useful minerals from the rest of the ore. The useful minerals collected through beneficiation are called ‘concentrates’ and after they are transported to smelters by truck, rail, pipeline or boat, they undergo another process called ‘smelting.’ Through this process the minerals are made into metals and can then finally be used as materials for various products we use in our daily lives, ranging from buildings and vehicles to smartphones.

Broadly speaking, there are two methods of excavating ore: ‘surface mining’ and ‘underground mining’ (see images on the right). Hand drilling develops a large-scale mining using machinery has become commonplace. The progress of technology has had a large impact on the mining of mineral ore. In recent years projects have even begun for mining seafloor resources such as hydrothermal deposits. When we look at the world’s primary mining countries on the other hand, we see that each country has unique characteristics. For example, China produces a lot of lead and zinc. Chile produces copper and, Australia produces iron, bauxite and uranium. China is also characterized by its abundance of rare metals like manganese and tungsten. These days, African countries like Zambia and South Africa have been gaining attention as well. Zambia’s economy in particular is supported by copper and Hitachi Construction Machinery is focusing on the country by establishing local production, sales, and service bases, for example.

Today, the mining industry has been exploring sustainable development and uses. There are initiatives to minimize the negative influence on the surrounding environment and produce new value, such as by rehabilitating a mine through greening and stabilizing it after its closing or by using it as a location for tourism. Daily progress is being made to improve the efficiency and productivity of mining as well. Work safety, through the automation of machines that run in mining sites and the promotion of operation by centralized management systems.
Hitachi Construction Machinery advances global mining sites

Hitachi Construction Machinery manufactures ultra-large hydraulic excavators and dump trucks that operate at mining sites. In addition, Hitachi also supports mining operations in a range of ways, such as by providing systems and after-services.

Responding to Special Mining sites Needs with “One Hitachi”

At mining sites, which require high productivity, long production stops due to machinery failure are unacceptable. Furthermore, the roads used for transporting minerals are unpaved and frequented by service vehicles as well. Advanced technology ensuring safety, durability, productivity and more is required of machinery operating in the harsh environment of a mine.

The biggest strength in Hitachi Construction Machinery’s mining business is that all development and production are concentrated in Japan. The keyword is “One-Hitachi: Sonosuke Ishii, president of Mining Group says the following.

“Our company marshals the comprehensive strength of the Hitachi Group to develop and manufacture products for mining. By concentrating our hubs in Japan, we can collaborate with the research and development divisions of all the companies within the Hitachi Group and make maximum use of the various products and technologies that the Group possesses.”

For example, the group jointly developed the technology featured in its dump trucks for transporting loads safely and safely (see page 9 about High-Performance Stability Control Technologies), applying automobile technology owned by Hitachi, Ltd. The dump trucks’ Autonomous Haulage System (AHS), too, uses Hitachi, Ltd. technology, such as the railway traffic control system it has developed over many years.

Different mining sites have different priorities: at some the performance of dump trucks on inclines is taken very seriously, whereas others require braking power for going down slopes with loads of ore. To accomplish all this, Hitachi Construction Machinery doesn’t just buy from another manufacturer to install key parts of dump trucks like the AC drive system, but develops them with Hitachi Group technology. Being able to adjust to specifications required by our customers’ sites because of this is a big strength of ours,” explains Ishii. The benefits of “One Hitachi” are truly maximized this way.

Expansion of Solution Business from Component Manufacture to Remanufacture

When it comes to responding to customers’ needs, we would like to call attention to the Fleet Management System (FMS) that monitors the position and movement of multiple vehicles in real time to achieve their optimal allocation. This system contributes in various ways, such as by improving safety and productivity at mining sites, reducing running costs, and solving labor shortages.

At the same time, Hitachi Construction Machinery is also focused on its solution business, which revolves around the value chain. This solutions business is not limited to the sale of machinery, but responds to various customer needs, such as by providing and remanufacturing parts, renting machinery, and providing cost management service. In 2016 the U.S.-based company H-E Parts, which provides service solutions for machinery and equipment, became part of Hitachi Construction Machinery Group, and in 2017 the Australian company Bradken, a major manufacturer of cast parts for mining machinery, did so as well. This created a structure for boosting HCM’s solution business. “We used to be limited to the upstream processes of mining, but when H&E Parts and Bradken joined HCM, we became able to offer comprehensive services” (Ishii).

Hitachi Construction Machinery will continue to stay on top of new developments and extensively respond to its customers’ needs.

Hitachi Construction Machinery manufactures ultra-large hydraulic excavators and dump trucks that operate at mining sites.
The Continuing Evolution of Mining

Taking Apart the Autonomous Haulage System for Dump Trucks!

Hitachi Construction Machinery is expanding its Fleet Management System (FMS), which monitors the status of various vehicles operating at a mine in real time and manages their allocation, to surface mining sites in countries. HCM’s Autonomous Haulage System (AHS) is based on this FMS and has opened up a new world of driverless, autonomously operating dump trucks for mining sites. How will this technology, which embodies the capabilities of the Hitachi Group, change the future of the mining industry? We tried to find out based on what Tomohiko Yasuda, Assistant Vice-president of the Client Solution Business Division, told us.

Is it true that AHS uses Hitachi’s railway technology?

Yes. AHS uses a system that lets trains run safely without bumping into each other.

AHS is a system that contributes to productivity, safety and cost optimization by autonomously steering dump trucks based on FMS signals. The path from the loading location for surface soil or ore to the unloading location is divided into several sections and when a dump truck has reached the beginning of one of these sections, it is told whether it can continue based on FMS signals. This framework is based on Hitachi’s know-how for dividing railway tracks into sections with multiple signaling mechanisms to let trains run safely.

Is complete automation possible?

In the future, “proceeding, stopping, turning” will likely all be done without drivers.

Dump trucks featuring AHS receive FMS signals that let the system automatically control departures, stops and steering operations to accomplish fully autonomous driving. Thanks to know-how in railway traffic control system cultivated by Hitachi, Ltd., 50 or more dump trucks could probably be run autonomously. The trucks also have driver seats, so that they could be steered and driven by a human in the unlikely event of a problem.

Can the trucks drive safely without humans?

They don’t make mistakes or get tired like humans.

Human operators create the possibility of mistakes, reckless driving, accidents due to exhaustion or inattentiveness, etc. AHS does not cause such problems based on human factors. Furthermore, because Hitachi Construction Machinery dump trucks are equipped with an advanced chassis stabilization control technology and run safely, with little chance of skidding, they are safe to operate without a driver. Features such as travel route recognition and obstacle detection additionally increase safety at mining sites.

Can the introduction of AHS solve labor shortages?

Yes. AHS uses a system that lets trains run safely without bumping into each other.

AHS enables optimal driving that does not strain dump truck chassis or the roads on which they run, so damage to dump trucks based on extreme use and wear on road surfaces can be avoided, which lowers maintenance costs. Stable driving without excessive acceleration and deceleration also helps reduce fuel costs. Because AHS is expected to contribute to safety, its introduction results in ceaseless operation and productivity increases.

Can this lower maintenance costs?

Because it reduces the burden on vehicles and the roads they run on, it can reduce costs significantly.

AHS maintains a high standard of driving safety and reduces damage to dump trucks. The smoothing of extreme acceleration and deceleration also reduces fuel costs. Because AHS does not get tired or make mistakes, it is also safe to operate in the unlikely event of a problem.

Towards the Development of Sustainable Mining

Mining also has aspects that negatively impact the Earth. But mining companies don’t simply dig through the ground and flatten mountains, they are committing to a variety of measures with the goal of conserving biodiversity and water resources and creating employment for local workers. Hitachi Construction Machinery is also supporting this with a framework for managing mining sites, which involves measures for preserving biodiversity and water resources and creating employment for local workers. Through this framework, Hitachi is striving to contribute to solving labor shortages. On the other hand, it probably generates employment for engineers who handle the traffic control system. Since automation increases on-site safety, it is also effective in easing the notion that the mining industry is dangerous.

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