

## A look at the history of mining: From the Stone Age to Herbert Hoover



by Jessica Elzea Kogel  
2013 SME President

Mankind has engaged in the extraction of minerals and metals throughout human history. Our first exposure to this idea is as elementary school children when we learn that human cultural history is divided into three distinct periods: the Stone Age, the Bronze Age and the Iron Age. We are taught that these periods reflect technological advancements related to the discovery and manipulation of earth materials and their impact on human civilization. The lesson is clear; human culture is bound to the availability of minerals and metals, and our prehistoric ancestors depended on mining just as we do today.

It all began simply enough. During the Stone Age, humans fashioned tools from a variety of rocks, including flint, chert, basalt and sandstone. These materials were initially collected as loose rocks and, as demand grew, openpit and underground mining methods were developed. Several of these prehistoric mine sites are still in existence today. The Neolithic flint mines near Mons, Belgium are one of the most extensive and earliest examples of large scale mining (covering an area of about 100 ha or 250 acres). This site is also of interest because it shows the transition from openpit to underground shaft mining. Several other notable Neolithic flint mines in Europe are Grimes Graves and Cissbury in Britain.

Initially, early humans were motivated to mine for survival. They focused their efforts on manufacturing utilitarian objects such as tools, hunting implements and storage vessels. Eventually, as they became more skilled at survival (partially because of efficiencies gained by using tools), they turned their attention to using earth materials for uniquely human endeavors, such as adornment, art, spiritual practices and ritual.

At some point, and it is difficult to imagine how or why it happened, early humans discovered that certain minerals can be used to make paint. From natural pigments, such as manganese oxide, hematite and goethite, early artists created life-like images of bison, deer, mammoth and other Paleolithic animals. Some of the best preserved paintings from this age are found on cave walls deep beneath the Pyrenees.

These paintings are quite sophisticated in terms of composition, perspective, color, depiction of movement and the use of carefully nuanced light and shadow. Herds of pronged antelope-like creatures gallop in full stride across uneven cave wall surfaces toward an unknown destination. Bears, lions, panthers and hyenas are also captured in expertly rendered images that offer a glimpse into an unfamiliar and mysterious prehistoric world.

What compelled these artists to dig minerals out of the ground, grind them to fine powders, mix them with various binders (animal fat, saliva, water, blood) and apply them to cave walls hidden from view is unknown. Perhaps it was for purely narrative reasons or perhaps there was a mystical or ritualistic motive. The cave painters prized the strong colors derived from ochre minerals and historians believe that they travelled long distances to secure a reliable supply of earth pigments. In fact, wherever cave paintings have been discovered there are usually ochre deposits in the region. These, along with the first flint deposits, are believed to be some of the earliest sites of historical mining activity.

The Stone Age eventually gave way to the Bronze Age when early man discovered the technique of smelting. During this period, the knowledge and skills necessary to work metal and ore deposits were developed. Theories about the origin of ore deposits began emerging at this time, as well. The earliest theories were proposed by Greek and Roman philosophers and were informed by a world view based on myth, superstition and religious beliefs. Scientific observation was not yet part of the human experience, so the earliest theories tended to be based on fantasy and imagination. For example, these ancient philosophers proposed that the earth was a living organism and that ore genesis was the result of metallic exhalations due to metabolic processes. Other versions of the "living" earth proposed that ore deposits grew from seeds within the earth or that the ores were part of a vast subterranean tree system with roots that extended into the center of the earth.

Now fast-forward to the 16th century. By then alchemists believed that celestial influences such as the sun and planets generated ore deposits. Georgius Agricola, a German scholar, rejected this view and wrote *De Re Metallica*

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# Two Peabody mines reach safety mark; Pair of mines hit one million hours without a lost time incident

**PEABODY ENERGY** announced that employees at two of its mines, the Bear Run Mine in Sullivan County, IN and the Kayenta Mine in Navajo County, AZ, have each reached the safety milestone of one million hours without a reportable or lost-time injury.

The Bear Run Mine's year-to-date 0.0 incidence rate compares to a 3.17 incidence rate per 200,000 hours worked among U.S. mines, based on the latest data.

"I'm proud of the Bear Run team for their tremendous industry leadership in safety," said Peabody President – Americas Kemal Williamson. "Safety is a core value, part of our mission and a way of life for all of us at Peabody."

The Bear Run Mine is the largest surface mine in the eastern United

States and shipped 7 Mt (7.7 million st) of coal in 2012. The mine serves industrial facilities and customers that provide power for millions of residents in northern, central and southern Indiana, as well as electric co-ops and utilities far beyond the region.

The Kayenta Mine's year-to-date 0.47 incidence rate is 85 percent lower than the average U.S. incidence rate per 200,000 hours worked, based on the latest data.

"Kayenta's results reflect an intense safety culture that is part of Peabody's mission," Williamson said. "These results demonstrate our continued focus on teamwork, training, communications and best practice. I'm proud of our team for working toward our safety vision of achieving zero incidents of any kind."

The Kayenta Mine, has a history of excellence in safety. The mine has achieved more than one million hours without a

reportable incident four separate times.

The Kayenta Mine shipped 6.8 Mt (7.5 million st) of coal to the Navajo Generating Station near Page, AZ this past year. Approximately 98 percent of the mine workforce is Native American, and mining operations annually inject more than \$115 million in direct benefits to tribal economies. The mine also annually contributes \$1.3 million in tax revenues to reservation schools.

This past year was the safest in Peabody Energy's history. The company delivered a 1.82 safety rate per 200,000 hours worked, a 9-percent improvement from 2011 levels. Through first quarter, seven Peabody operations in the Americas platform operated without a reportable incident.

Peabody Energy is the world's largest private-sector coal company and a global leader in sustainable mining and clean coal solutions. The company serves metallurgical and thermal coal customers in more than 25 countries on six continents. ■



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## Kogel: Mining's history is rich as is SME's

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in 1530, which laid the groundwork for modern theories of ore deposition. This important work was not widely read until 1912, when it was translated from Latin into English by Herbert Hoover and his wife, Lou Henry Hoover, who was a geologist and Latin scholar.

Herbert Hoover was not only the president of the United States, but he was also the 1920 president of AIME. So, by tracing the history of mining from prehistoric times to the 20th century, we arrive at SME's doorstep through AIME. This endpoint to a journey spanning human history is a testament to the importance of minerals as a foundation of human culture. It is also a testament to the longevity and relevance of SME as an organization serving the mining profession. Mining will continue to support human culture as it evolves by providing the raw materials needed for technological advancement. Today, however, most people do not recognize the importance of minerals as our early ancestors intuitively did. ■