# Minerals of the Pine Point lead-zinc deposits Northwest Territories Canada.

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Lead-zinc mineralization in the Pine Point district, Northwest Territories, first attracted economic attention more than a century ago from prospectors on their way to the Klondike gold rush. The mineralization consists of lens-shaped bodies of galena and sphalerite, which are restricted to interconnected paleokarst networks in a coarsely dolomitized Middle Devonian barrier reef complex. Because of its remote location and lack of precious metals, mining was not initiated until the 1960s. Mining at Pine Point contributed both to the development of northern Canada and to the classic ore-deposit model for Mississippi Valley-type deposits. *

Although few mineral specimens were recovered during exploration or throughout the twenty-four years of active mine life, many of the open pits still remain accessible. In recent years, Pine Point has yielded excellent specimens of calcite as well as galena, sphalerite, and dolomite.



Location and Physiography

The Pine Point mining district is centered about 15 kilometers (9 miles) southwest of the geographical landmark of Pine Point on the south shore of Great Slave Lake and approximately 90 kilometers (56 m east of the regional center of Hay River, Northwest Territories (fig. 1). The local topographic relief does exceed 15 meters (50 feet), and the landforms are dominated by Pleistocene glacial deposits and postglacial strand lines (Alldrick et al. 1981).

[FIGURE 1 OMITTED]

Exploration History and Mining

As mentioned, credit for the discovery of the lead-zinc deposits near Pine Point is usually ascribed to prospectors on their way to the Klondike gold rush (Bell 1929) who learned of the occurrence from "the Indians of the locality" to whom it was "long known" (Bell 1899; Bell 1929). A staking rush developed ir

winter of 1898 based on the belief that the mineralization carried high values of gold and silver. As rela by Bell (1929):

> In the dead of night, dog-teams carrying gold-seekers stealthily left Fort Resolution. They were tracked by others, missionaries and traders took part, and soon the area was staked far and wide, for the good of the Church and for private gain. There was great disappointment the following summer, when the visit of a Geological Survey party, and the receipt of the first accurate assays, revealed the fact that the deposits, while interesting fr the standpoint of their content in lead and zinc, were apparently devoid of precious-metal values.

As alluded to above, Dr. R. Bell of the Geological Survey of Canada visited the area in 1899 and concl that despite the significant lead and zinc mineralization, in the absence of any significant precious-met values the deposits were too remote from civilization to warrant development (Bell 1899).

Several phases of exploration were carried out in the late 1920s and again in the 1940s and 1950s, including the sinking of shafts and pits and considerable drilling (fig. 2); these efforts delineated severa million tons of lead-zinc ore (LeBourdais 1957; Carr, Beauregard, and Hager 2003). By 1958, Cominco had identified one of Canada's richest known lead-zinc districts (Anonymous 2005).

[FIGURE 2 OMITTED]

Production was initiated in late 1964 by Pine Point Mines, Ltd. (controlled and operated by Cominco). I Point was an open-pit operation (fig. 3), extracting ore from at least thirty-six separate pits, with an ove footprint of 60 x 20 kilometers (fig. 4). The processing plant produced separate lead concentrate (assa about 75 percent lead) and zinc concentrate (about 57 percent zinc) on-site by froth flotation after crus and grinding the ore. The concentrates were shipped south by rail to the Cominco smelter at Trail, Brit Columbia, and also to Japan, Germany, and the United States (Carr, Beauregard, and Hager 2003; Anonymous 2005).

[FIGURES 3-4 OMITTED]

To support the mining operation, the Canadian government, between 1962 and 1965, built the only rai in the Northwest Territories; it went from Roma (west of Peace River), Alberta, to Pine Point. Similarly, Taltson hydroelectricity station was commissioned in 1965 just north of Elsi Falls on the Taltson River, 270 kilometers (170 miles) east of Pine Point; it was constructed primarily to supply power to the minin operation. The town of Pine Point (fig. 5) was built between 1963 and 1965 and had a population of ab eighteen hundred at its peak (Anonymous 2005; Carr, Beauregard, and Hager 2003).

[FIGURE 5 OMITTED]

Pine Point was operated until June 1987, when closure was forced by weak base-metal prices in conjunction with high recovery costs. Some 4.48 million metric tons of zinc and 1.95 million tons of lea been produced from 64.3 million tons of ore during the twenty-four years of the mine's life (Rhodes et a 1984; Sangster 2005), equivalent to a gross value of more than $7 billion (U.S.) at current metal prices town was officially closed on 1 September 1987; both the town and mine sites have since been reclain (Carr, Beauregard, and Hager 2003; Anonymous 2005), and almost all of the ore pits are now flooded 6).

[FIGURE 6 OMITTED]

The history of the Pine Point area is well described by the "staple thesis" of Harold A. Innis, in which th settlement and development of Canada were driven by the abundance of natural resources (Innis 193; Natural resources are still a major force for economic development in the Northwest Territories, of whi recently developed diamond mines north of Great Slave Lake are a good example (Anonymous 2004)

Geology

Regional Setting

The Pine Point mining district is located in the Middle Devonian (Givetian age) Presqu'ile barrier reef complex, which outcrops just south of Great Slave Lake and extends west into the subsurface of the Western Canada Sedimentary Basin in northeastern British Columbia, subparallel to the MacDonald basement fault (Kent 1994; Adams, Rostron, and Mendoza 2000). The Presqu'ile barrier reef develope across the north end of the Elk Point Basin, a carbonate-depositing sea that transgressed the continer platform as a southeast-trending depression from northeast British Columbia to southern North Dakota 1994). The growth of the reef eventually isolated the Elk Point Basin from the open sea, allowing the H River Shale Basin to develop north of the Presqu'ile barrier and also allowing the development of evap facies in the then-restricted hypersaline Elk Point Basin to the south (Kent 1994; Meijer Drees 1994; A Rostron, and Mendoza 2000). In addition to the lead-zinc resources of the Presqu'ile reef, the Elk Poin Basin hosts the world's largest potash (potassium chloride) deposits, extensive rock salt (sodium chlor deposits, and a number of significant oil and gas fields.

Property Geology and Mineralization

Pine Point corresponds to the classic Mississippi Valley-type (MVT) ore-deposit model: epigenetic lead mineralization (precipitated from dense basinal fluids at temperatures ranging between 75[degrees] an [degrees]C) in platform carbonates and lacking genetic affinities to igneous activity (Leach et al. 2001) Indeed, observations of Pine Point helped develop this model (e.g., Beales and Jackson 1966). The cl model for MVT ore deposits is presented by Anderson and Macqueen (1988) and by Sangster (1996); recent refinements may be found in Leach et al. (2001). The geology of the deposits at Pine Point was summarized by Adams et al. (2000) as follows:

> The host rock consists of typical carbonate reef complex facies, underlain by platformal carbonates and a sequence of anhydrites and redbeds. A thick package of shale caps the Presqu'ile barrier The carbonate host rock at Pine Point was initially dolomitized to permeable dolostones at or near the seafloor by Devonian seawa (Qing 1998). During burial, the original carbonates were pervasively neomorphosed by hydrothermal fluids to medium grained dolomite in the lower section of the Pine Point Formation The same fluid precipitated the Presqu'ile dolomite.... During the main mineralization stage, galena, sphalerite, marcasi and pyrite were deposited. Simultaneously, dissolution, fracturing and collapse of carbonates and sulphides accompanied the precipitation of saddle dolomite (Krebs and Macqueen 1984). The ore bodies are restricted to interconnected paleokarst networks found in lower sections of the epigenetic Presqu'ile dolomite, which crosscut the reef facies and occur principally along hingelines, subparallel to the McDonald fault zone.

The age and origin of the strata-bound mineralization at Pine Point remain contentious despite widesp consensus as to the presence of at least two fluids and deposition temperatures between 65[degrees] 94[degrees]C. As reviewed by Leach et al. (2001), Pine Point is the only large MVT district where there major difference between the age of mineralization determined by radiometric methods (Upper Devoni and that interpreted from the results of paleomagnetic techniques (Upper Cretaceous).

Minerals for the Collector

As with most MVT deposits, Pine Point shows a relatively restricted range of mineral species and is

dominated by calcite, dolomite, galena, and sphalerite. Several common mineral species occur as min trace phases, or they are not sufficiently well crystallized or well preserved to be of much interest to th collector. These include anhydrite, chalcopyrite, goethite, marcasite, pyrite, and siderite. Minerals rarel reported from the Pine Point mining district include bianchite, cerussite, fluorite, hexahydrite, hemimor melanterite, pyrrhotite, rozenite, and smithsonite. The natural organic material pyrobitumen is occasior encountered, filling small rugs or cavities (fig. 7).

[FIGURE 7 OMITTED]

Pine Point has produced excellent specimens of calcite and of galena as well as interesting sphalerite, gypsum, saddle dolomite, sulfur, and occasional crystals of barite, as described below.

Barite is relatively rare at Pine Point. Large tabular crystals have been found on the waste dumps (Car Beauregard, and Hager 2003) and were also known to have come from the now-flooded X-15 pit. The crystals are occasionally gemmy (fig. 8).

[FIGURE 8 OMITTED]

Calcite is typically white or amber in color and shows a rich diversity of crystal forms at Pine Point. Cor morphologies include simple rhombohedra (fig. 10), some of which are almost cubiform (fig. 9); modifie rhombohedra (fig. 11); "nailhead spar" (fig. 12); and scalenohedra (fig. 13). Overgrown and stacked cr also occur (fig. 14). The calcite crystals are commonly found on a matrix of saddle dolomite. Interpene and contact-twinned calcite crystals are abundant; in the most common mode of twinning, the twin plai the basal pinacoid (0001), and the twin axis is parallel to the c-axis (figs. 15, 18).

[FIGURES 9-15, 18 OMITTED]

Dolomite is usually white or cream in color, although pinkish specimens are known. Typically, it occurs millimeter-sized aggregates of rhombohedra with highly curved faces (saddle dolomite, fig. 16). Dolom forms the matrix for many specimens of calcite or sphalerite.

[FIGURE 16 OMITTED]

Galena from Pine Point was discussed previously in Rocks & Minerals in some detail by Lasmanis (19 Well-crystallized galena occurs as centimeter-sized cubes or cuboctahedral crystals (fig. 17), most of v are closely associated with sphalerite (fig. 19). Twinned galena crystals are common; typically these a multiple spinel-law twins: twin plane (111), twin axis [111] (figs. 20, 21).

[FIGURES 17, 19-21 OMITTED]

Gypsum is uncommon and occurs as elongated, bladed, clear crystals (fig. 22) as well as transparent cleavage fragments.

[FIGURE 22 OMITTED]

Sphalerite occurs mainly as colloform massive-sulfide ore with intermixed galena (figs. 24, 25). Sphale crystals occur as millimeter-sized black tetrahedra, typically associated with dolomite and/or galena (fi

[FIGURES 23-25 OMITTED]

Sulfur occurs as individual crystals to several centimeters in size (fig. 26), particularly toward the west the Pine Point mining district (Carr, Beauregard, and Hager 2003).

[FIGURE 26 OMITTED]

Collecting Notes

Tysons' Fine Minerals, Inc., has made four collecting trips to Pine Point in the period since the claims h by Cominco were allowed to lapse. Unfortunately, almost all of the open pits are full of water, and salv collecting is limited to the few pits that still have benches above the water table. Collecting can be con from late May to early September. The summer months, with nearly twenty-four-hour sunlight, can be hot, and the locality is quite white in overall impression. The biting insects (mosquitoes, black flies, dee flies, horseflies, and no-see-ums or biting midges) are found in abundance from shortly after the spring

until temperatures hit freezing. Anyone wishing to collect at Pine Point needs to check the current statu the claims with the Mining Recorder's Office in Yellowknife and obtain the consent of the current claim holders. There is considerable back break from blasting along the open-pit walls, and the walls and be are dangerous.

In the few pits that are still accessible, the following collectible minerals have been found in recent yea calcite crystals in a variety of habits with numerous twins (some calcite fluoresces white/yellow under shortwave ultraviolet radiation); galena crystals and galena/sphalerite combinations in the form of stala or stalagmites; sphalerite/ dolomite combinations with both white and pink dolomite; gypsum crystals ir combination with calcite; and pyrite/ marcasite. Some of the calcite and some of the banded sphalerite/dolomite/galena ore are suitable for making eggs and spheres (fig. 27). All of the minerals sl signs of weathering; for example, the calcite crystals are etched, and the pyrite/marcasite is partially al to various iron sulfates. There is abundant evidence that the Pine Point mining district was a world-clas locality for specimens of calcite and galena with various associated minerals. It is a pity that few of the presumably thousands of specimens encountered during mining were preserved.

[FIGURE 27 OMITTED]

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