

## Metallic Mineral Occurrences and Opportunities in Alberta

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### Introduction

Alberta's mineral production in 1986 amounted to half the Canadian total. Most of this value was due, however, to petroleum and coal (93%), with industrial minerals making up the balance (7%). We believe that the lack of large-scale metallic production may indicate an undeveloped opportunity rather than a lack of geologic potential.

### Major Regions

Alberta has four major regions with metallic mineral potential: the exposed and shallow buried Precambrian Shield, the Athabasca Basin, the Rocky Mountains and Foothills, and the Interior Platform (Figure 1).

**Precambrian Shield.** The exposed Shield (Figure 1) is located in the extreme north-eastern part of the province. Exposed crystalline basement (Figure 2) is about 15,000 km<sup>2</sup> in area, and the Shield area buried under less than 1000 m of cover is about 67,000 km<sup>2</sup>. Information on this region comes mainly from Alberta Geological Survey publications which include: bedrock descriptions and maps (Godfrey, 1986a), structure and metamorphism (Langenberg, 1983), geochemistry (Goff *et al.*, 1986), geophysical expression (Sprenke *et al.*, 1986) and mineral showings (Godfrey, 1986b). The geology beneath the Athabasca Group was described by Wilson (1986). Efforts to define the geology of the basement under Phanerozoic cover (Figure 2) will depend heavily on extrapolation of information from the exposed area. The Precambrian Shield of northeastern Alberta has potential for gold, silver, copper, nickel, lead-zinc, platinum group elements and possibly rare earths (R.A. Olson, pers. comm.). Gold values have been reported in Shield samples from drill-holes penetrating the Athabasca Group, south of Lake Athabasca and from a drillhole

penetrating Devonian strata north of Fort McMurray (Wilson, 1987).

**Athabasca Basin.** The Athabasca Basin of northern Saskatchewan is the premier uranium mining camp in the world. The basin extends into northeastern Alberta and is an active area of exploration for uranium. The Athabasca Basin contains four formations in Alberta comprising the Athabasca Group. The target area of mineralization is the unconformity beneath the Athabasca Group. Indicators for both Key Lake and Cluff Lake type mineralization likely are present in Alberta (Wilson, 1986, 1987).

**Rocky Mountains and Foothills.** Geology of the Rocky Mountains and Foothills of southwestern Alberta is complex. Potential exists for such commodities as lead-zinc, copper, and magnetite. Although a large part

of the region is occupied by national parks where exploration is not permitted, there are large tracts outside the parks that can be explored.

**Interior Platform.** The largest region of the province with metallic mineral potential is the Interior Platform. It consists of flat-lying Phanerozoic rocks. Devonian carbonates of north-eastern Alberta may provide a favourable setting for lead-zinc mineralization. This potential is suggested by the presence of favourable rock types, solution collapse structures, mineralized regional formation waters and proximity to the Pine Point deposits (Dubord, 1987; 1988, this issue, p. 120). Formation waters (Figure 1) have been studied for some time in Alberta and have been identified as a possible potential source of calcium, lithium and magnesium (Hitchon, 1984).

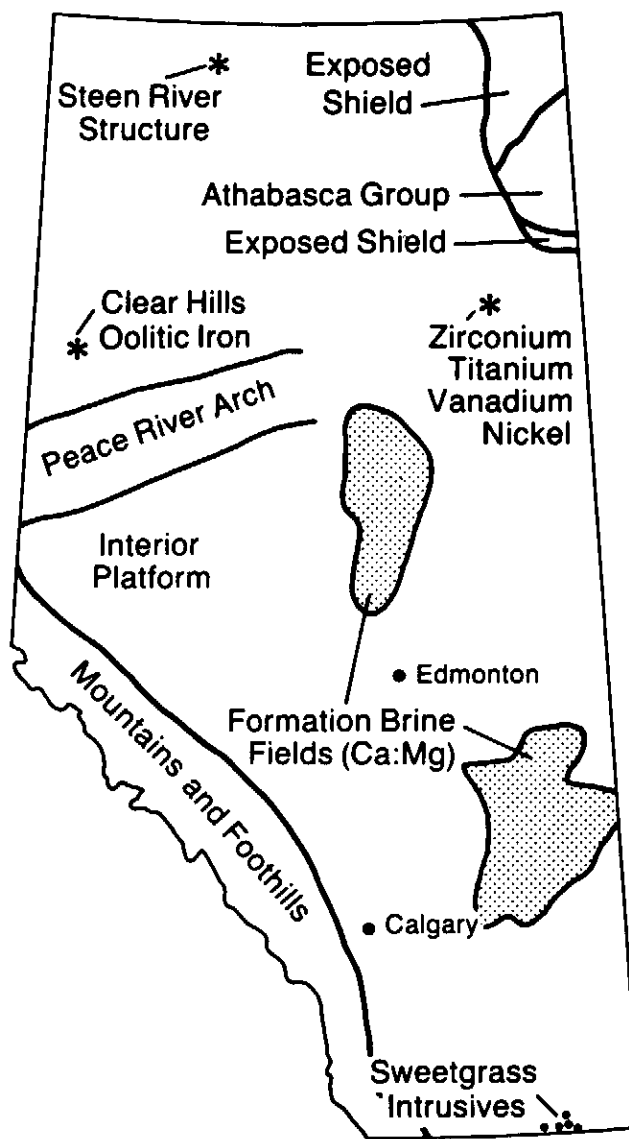


Figure 1 Alberta has four major regions of metallic mineral potential: Precambrian Shield (crystalline basement), both exposed and at shallow depths beneath younger cover rocks; Precambrian Athabasca Group sedimentary rocks; Rocky Mountains and Foothills; and Interior Platform. The commodities, and possible sources and locations, vary widely.

Gold has been recovered from Alberta's rivers for over a century and has been produced from paleoplacers in upland areas. Interest in gold and its production has increased sharply in the last ten years as a result of by-product recovery from major gravel operations in the Edmonton area and primary recovery from a few small operations on the North Saskatchewan River (MacGillivray *et al.*, 1984). The Clear Hills iron deposit occurs about 80 km northwest of Peace River in northwestern Alberta (Figure 1). It occurs in sandstones of late Cretaceous age and contains over a billion tons of possible reserves, with proven reserves (by strip mining) of 180 million tons averaging 35% iron (Hamilton, 1980). In addition to uranium in the Athabasca Basin, some potential exists for roll-front type uranium deposits in Cretaceous or Tertiary sandstones of Alberta. The huge tailings ponds resulting from development of Alberta's oil sands deposits are known to be concentrations of various heavy minerals. These tailings may literally be man-made world-class deposits of titanium and zirconium (Figure 1) (Trevoy, 1984). Potential may also exist for vanadium and nickel recovery from bitumen (Figure 1).

#### Tectonic features

There are also a number of interesting geological features with possible mineral potential. These include the Peace River Arch, the Steen River Structure and the Sweetgrass Arch (Figure 1; also see Podruski, 1988, this issue, p. 94). The Steen River Structure is a roughly circular area in northern Alberta with anomalously shallow depth to basement. Although the feature is of uncertain origin and relatively little information is available, it has been the focus of some exploration interest.

#### Conclusion

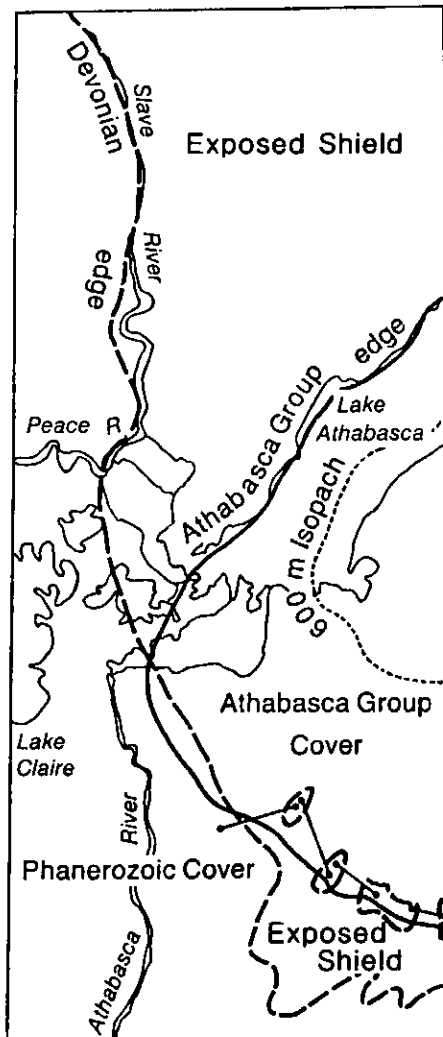
In summary, Alberta has no current large-scale metal mining, but it does have potential for a variety of metals (Table 1). As the geological understanding of the province increases we believe some of this potential will be realized and other significant opportunities will be recognized.

#### References

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**Table 1** Metallic minerals from a variety of sources have potential for development.

Commodity	Possible Source		
	Direct	By-Product	Formation Water
Gold	*		
Iron	*		
Lead-Zinc	*		
Uranium	*		
Zirconium		*	
Titanium		*	
Vanadium		*	
Nickel		*	
Magnesium			*
Lithium			*



**Figure 2** Precambrian Shield crystalline rocks are exposed in northern Alberta. The area covered by Precambrian-aged Athabasca Group sedimentary rocks and by Phanerozoic sedimentary rocks also has metallic mineral potential.

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