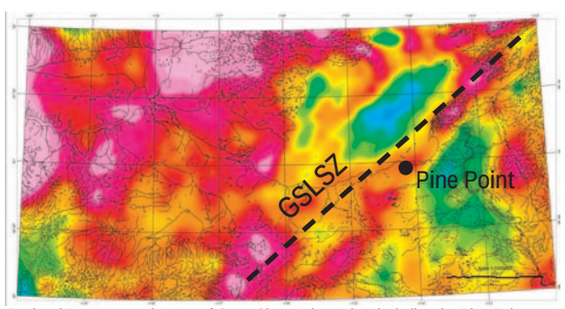
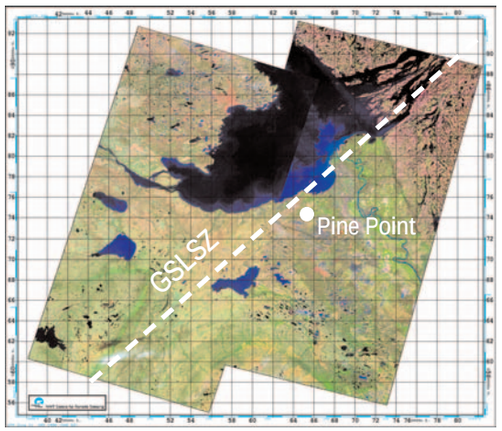
Exploration Techniques

Regional aeromagnetic and gravity surveys and the use of **remote sensing imagery** (RADARSAT-1 in northern Alberta) can be highly successful in the identification of regional structural features controlling the localization of MVT deposits, however, geophysical exploration on the deposit scale can be challenging. Geophysical surveys combining **induced polarization/resistivity** techniques with reflection seismics have been proposed by some explorationists. Seismic surveys are expensive but can be highly useful. Often mineralized zones are not directly visible on the seismograms, but larger associated structural and/or collapse features are. The magnetic contrast between the carbonate host rock and the Pb-Zn deposit is often too low to permit the successful use of **aeromagnetic** surveys and the usually low percentage of interconnected iron sulphides in these deposits generally mitigates against **electromagnetic** techniques. **Gravity** surveys similarly are often not useful unless the deposit is large, since the increased porosity associated with the mineralization and usually low percentages of iron sulphides produce a small density contrast between the host rock and mineralized zones. Exceptions to the above generalizations do exist for specific deposits. **Regional alteration** is not characteristic of MVT deposits and when minor alteration does exist, it is usually restricted to their immediate vicinity. Alteration haloes therefore are usually not useful in searching for this type of deposit.

Faulted and locally porous, dolomitized middle Devonian Methy Formation, Whitemud Falls, Clearwater River, NE Alberta.



Regional Bouguer gravity map of Great Slave Lake region, including the Pine Point district, southern N.W.T.



Mosaic of Landsat remote-sensing imagery of the Great Slave Lake region, southern N.W.T., showing Pine Point and Great Slave Lake Shear Zone (GSLSZ).

Status of MVT Project

As of February 2002, fieldwork examining exposures of carbonate rock and/or core has been conducted in northern Alberta and southern N.W.T. In the N.W.T., core and carbonate bedrock around the Pine Point deposit and south to the Alberta border have been investigated. Fieldwork in northern Alberta focused on those areas around Ft. McMurray and at Vermillion Chutes on the Peace River where carbonate bedrock exposures exist.

In northern Alberta and southern N.W.T., much subsurface information on carbonates exists as a result of years of petroleum exploration. The thrust of the MVT project in northern Alberta during year two will be the examination of selected core.

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EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey | C.S. Lord Northern Geoscience Centre

The Potential for Carbonate-Hosted Pb-Zn (MVT) Deposits in Northern Alberta and Southern Northwest Territories

Open space filling by dolospar with associated Pb-Zn mineralization. Ore from the past-producing Pine Point mine on the south shore of Great Slave Lake., N.W.T.

Introduction

The carbonate-hosted Pb-Zn (MVT) project falls under the auspices of the Geological Survey of Canada's Targeted Geoscience Initiative program and is of two years' duration (March 2001- March 2003). Participating agencies are the Alberta Geological Survey, the Geological Survey of Canada, Calgary, and the C.S. Lord Northern Geoscience Centre, N.W.T.

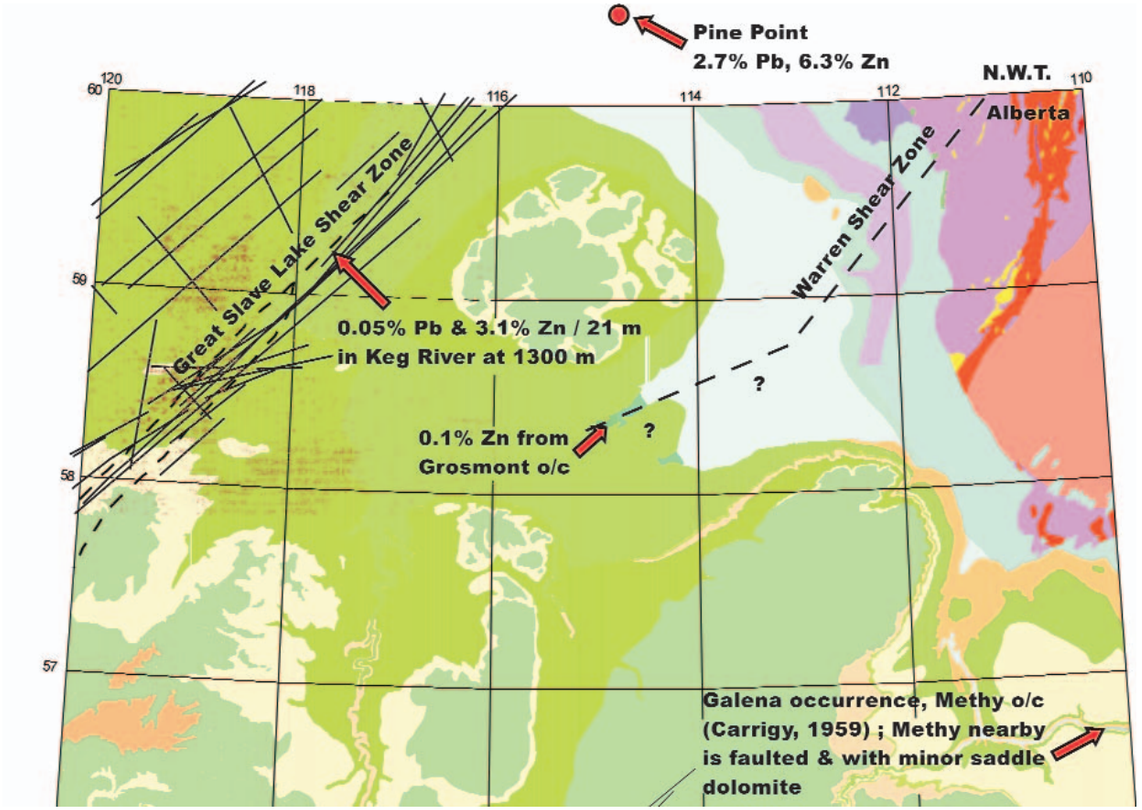
Mississippi Valley Type Pb-Zn Deposits

Mississippi Valley Type (MVT) lead-zinc deposits occur in carbonate host rocks, which are commonly dolomitized. Economic minerals consist mainly of galena and sphalerite, and tend to occur as open-space fillings in breccias (replacement of host rocks is usually not significant). The deposit type is named after the Mississippi River valley region in central U.S.A., where several classical MVT districts were first described. Over seven deposits of this type have been found in Canada (Pine Point and Polaris, N.W.T., Nanisivik, Nunavut, Newfoundland Zinc, NLD., Monarch-Kicking Horse and Robb Lake, B.C., and Gays River, N.S.).

Study Region and Stratigraphy

The study region for the MVT project lies in northern Alberta and southern N.W.T. This region extends south from the southern shore of Great Slave Lake to latitude 56° 30' in northern Alberta (approximately Ft. McMurray). In both northern Alberta and southern N.W.T., mid-to upper-Devonian-age carbonates constitute the stratigraphy of interest.

The past-producing Pine Point mine in the southern N.W.T. is contained within the study region of this project. It is the deposit to which other potentially prospective areas of northern Alberta and southern N.W.T. will be compared.



Geological map of northern Alberta with selected known mineral occurrrences and structural features.

Origin of MVT Deposits

The Pine Point ore district has been considered as the type example of what is referred to as the sedimentary-diagenetic model for the origin of MVT deposits. In this model, basin-derived fluids are driven by sediment compaction and acquire heat, metals, and other solutes by brine leaching en route through the basin. Modifications to this model exist involving variations in the fluid-driving mechanism, source of metals, chemistry of the solutions, and mode of metal precipitation. Fluid inclusion studies from mineralized zones in MVT deposits indicate that the metal-bearing brines are similar to petroleum field brines. Support for this lies in the fact that Pb and/or Zn mineralized zones are not uncommon in petroleum reservoirs and hydrocarbons are not uncommon in MVT deposits. This has important ramifications for the MVT project, since large amounts of subsurface data associated with petroleum exploration exist in northern Alberta and southern N.W.T. Thus an important component of this project is the mining of this database for information relevant to MVT exploration.

Characteristics of MVT Deposits

For the explorationist, an important characteristic of MVT deposits is their tendency to occur in districts. MVT deposits are diverse, making exploration for them difficult, since criteria from one district often cannot be utilized in another. MVT deposits as a group can only be characterized in general terms but when present they could indicate a favourable exploration environment. Common features of these deposits include the following:

- Deposits preferentially occur in dolostone with associated evaporites and organics in platformal carbonate sequences on basin flanks.
- Ore and gangue mineralized zones are commonly stratabound.
- Principal ore and gangue minerals typically include galena, sphalerite, pyrite, sparry dolomite, calcite, and quartz.
- MVT deposits are not associated with igneous rock.
- Deposit regions may be areas of broad uplift and associated basin subsidence, with associated faulting serving as conduits for fluids, metals, and heat.
- Deposits typically display evidence of carbonate host rock dissolution (carst and breccias).
- Fluid inclusion data from mineralized zones indicate that the mineralizating fluids were dense, saline (10-30 wt % total dissolved solids), aqueous solutions enriched in sodium and calcium chlorides.
- Many deposits occur in platformal carbonates adjacent to basinal shales.

In northern Alberta, minor Pb and/or Zn occurrences are known to occur in faulted platformal carbonates, which, in the northeast, locally display evidence of host rock dissolution associated with minor amounts of saddle dolomite.