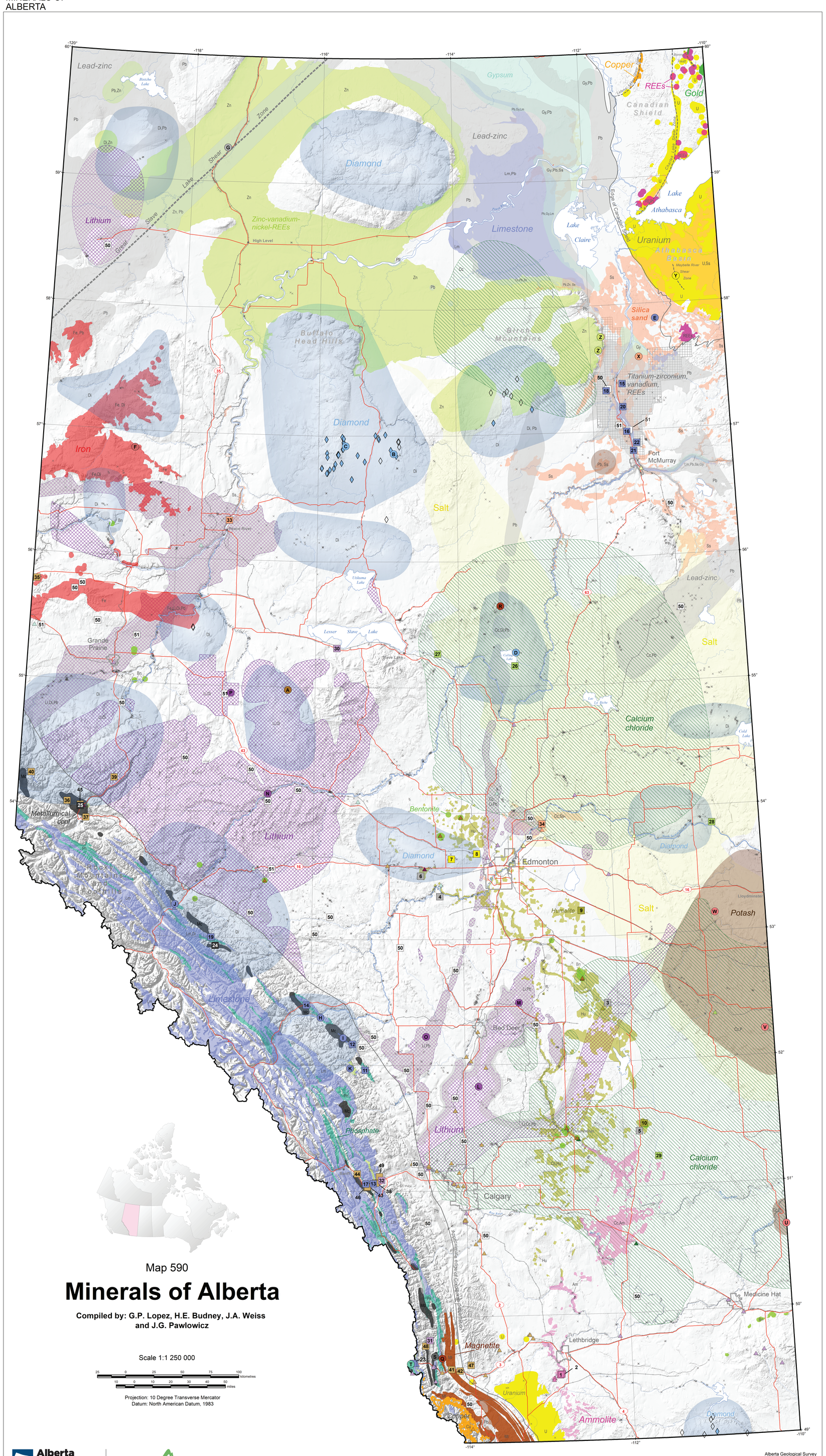
MINERALS OF
ALBERTA



PRODUCERS

Ammolite	1	Aurora
	2	Power Pole
Fly ash *(by-product of coal power generation)*	3	Battle River (Forestburg) plant
	4	Genesee power plant
	5	Sheerness power plant
	6	Sundance plant
Gold (placer) *(by-product of sand and gravel production)*	7	Onoway
	8	Villeneuve
Humalite	9	Dodds coal mine
	10	Sheerness coal mine
Limestone and/or dolomite	11	Clearwater
	12	Cougar Ridge (Prairie Creek)
	13	Exshaw
	14	Fish Creek (Nordegg)
	15	Fort Hills†
	16	Fort McMurray west†
	17	Gap
	18	Horizon†
	19	McLeod (Cadomin)
	20	Muskeg
	21	Parsons Creek
	22	Steepbank
	23	Summit Lake
Metallurgical coal	24	Cheviot
	25	Grande Cache
Salt and calcium chloride	26	Calling Lake
	27	Mitsue
	28	Riverview
	29	Sunnynook
Shale	30	Drift Pile†
	31	Racehorse†
	32	Seebe
Silica sand	33	Peace River Silica
	34	Sil
Stone	35	Bay Tree
	36	Beaverdam†
	37	Edco Hill
	38	Jura Creek†
	39	Kakwa†
	40	Lick Creek† (Kakwa)
	41	Lundbreck Falls†
	42	Oldman River†
	43	Pigeon Mountain†
	44	Rundle Stone
	45	Sheep Creek
	46	Sprayfalls
	47	Summerview†
	48	Viceroy
	49	Yamnuska
Sulphur *(by-product of oil and gas processing)*	50	Gas plant
	51	Oilsands processing
Sand and/or gravel, peat and marl	×	Industrial pit

† denotes projects with no production in 2018

PAST PRODUCERS

Ammolite	△	Lead-zinc	▲
Bentonite	△	Limestone or dolomite	▲
Building stone	△	Marl and tufa	△
Calcium, magnesium brine	△	Pumicite	△
Clay	△	Salt	△
Copper	△	Silica sand	△
Fly ash	△	Sodium sulphate	△
Humalite	△		

SELECTED EXPLORATION PROJECTS

Bentonite	A	Swan Hills**
Diamond	B	Buffalo Head Hills
	C	Buffalo Hills
	D	Calling Lake
	◊	Kimberlite/ultrabasic intrusion; contains diamonds
	◊	Kimberlite/ultrabasic intrusion; no diamonds found
Dolomite	E	Richardson**
Iron-vanadium	F	Clear Hills**
Lead-zinc	G	Alberta Zinc Project
Limestone	H	Brazeau
	I	Clearwater
	J	Folding Mountain
	K	Ram Falls
Lithium	L	Central Clearwater**
	M	Exshaw West**
	N	Fox Creek**
	O	North Rocky**
	P	Sturgeon Lake**
Magnetite (heavy minerals)	Q	Burmis (Marasek)*
	R	Pelican Mountain*
Metallurgical coal	S	Grassy Mountain
Phosphate	T	Crowsnest- Alberta
Potash	U	Medicine Hat
	V	Provost
	W	Vermilion
Silica sand	X	Firebag***
Uranium	Y	Maybelle River, Dragon Lake
Zinc-vanadium-nickel-REE	Z	Buckton***, Buckton South**

*NI 43-101 non-compliant resources.
**NI 43-101 compliant resources.
***NI 43-101 compliant resources with potential economic viability supported by a preliminary economic assessment.

SELECTED PROSPECTIVE AREAS

Am	Ammolite	Li	Lithium
Bn	Bentonite	Mt	Magnetite
Cc	Calcium chloride	Mc	Metallurgical coal††
Cu	Copper	Ph	Phosphate
Di	Diamond	P	Potash
Au	Gold	REEs	Rare earth elements (REEs)
Gy	Gypsum	Salt	Salt (NaCl and storage caverns)
Hu	Humalite	Ss	Silica sand
Fe	Iron-vanadium	Ti	Titanium-zirconium, vanadium, REEs
Pb	Lead-zinc	U	Uranium
Lm	Limestone and/or dolomite	Zn	Zinc-vanadium-nickel-REEs

For clarity, the following prospective areas are not displayed on the map but are available in the digital dataset: bromine, iodine, stone, marl and tufa, peat, and sand and gravel.

††Other coal rank areas and coal zones distribution maps are available for viewing at www.ags.aer.ca/coal-in-alberta.

Basemap Legend

City, urban area
Roads - highway
Railway
River
Lake

This map presents a current view of producers, past producers, selected exploration projects, and geological areas prospective for the exploration of mineral deposits. Materials included are metallic and industrial minerals, diamond, ammolite, metallurgical coal, and humalite, as well as minerals that may be recoverable as by-products of industrial processes such as sulphur.

This map is a view of more detailed digital files that include additional mineral occurrences and materials, such as peat, bromine, iodine, building stone and, sand and gravel, and subdivides the prospective areas based on deposit type, geological unit, depth, exploration stage and other attributes. The digital files should be consulted to resolve boundary edges on overlapping regions. No attempt was made to quantify or rank mineral prospectivity or potential.

Producer: a mineral concentration from which ore grade material currently is being extracted. Public and private surficial dispositions for material extraction are included for completeness and are labelled as industrial pits.

Past producer: a mineral concentration from which ore grade material has been extracted in the past.

Exploration project: an exploration property with a mineral concentration that has been drilled or investigated, and may warrant further exploration or development. May or may not have a mineral resource estimate.

Prospective area: a region geologically favourable to host mineral occurrences and therefore, favourable for the exploration of mineral deposits. Prospective areas were qualitatively defined using geological unit extents from geological maps and 3D geological models and informed by mineral occurrence datasets, geochemical data, mineralogy data, resource estimates, mineral tenure agreements, and satellite imagery.

Detailed methodology, data sources, descriptions, and bibliography are provided in the Map Information PDF document available for download with the map and digital files.

Digital files for this map and mineral occurrence data are available for viewing or download at **www.ags.aer.ca**, through the Alberta Interactive Minerals Map (AIMM) and on the AGS Open Data Portal.

Information related to minerals permits, leasing and maintenance can be found at Alberta Energy.

DESCRIPTIONS

The geological units mentioned here are described in the Alberta Table of Formations and the Bedrock Geology of Alberta and Surficial Geology of Alberta maps which are available at the Alberta Geological Survey's website **www.ags.aer.ca**.

AMMOLITE has been extracted by surface collecting or open-pit mining for jewelry and specimen-collection in the province since the 1960s. Currently, two major producers extract ammolite by mechanized open-pit mining near Lethbridge. Prospective areas for ammolite are the Upper Cretaceous Bearpaw Formation shale beds along river valleys in southern Alberta.

BENTONITE was mined west and southeast of Edmonton, and also near Drumheller, for the production of drilling mud, foundry sand, iron ore pellets, pet waste absorbent, agricultural/chemical carriers, geotechnical barriers and cosmetics. Prospective areas for bentonite are in near-surface Upper Cretaceous Horseshoe Canyon, Bearpaw, and Wapiti formations throughout Alberta.

CALCIUM CHLORIDE and associated compounds containing magnesium, potassium, and bromine are found in calcium-rich formation brines. Currently, calcium chloride is extracted from brines pumped to the surface from the Middle Devonian Winnipegosis and Keg River formations. Primary uses include anti-icing, de-icing, dust control, road stabilization, and in manufacturing oilfield fluids. Prospective areas for calcium chloride include the Upper Devonian Beaverhill Lake Group in southern Alberta and the Middle Devonian Elk Point Group in north-central Alberta.

CLAY AND SHALE were extracted at various times for manufacturing bricks, ceramics (e.g., tile, pottery, and crockery) and light-weight aggregate. Today, clay and shale are mainly produced from surface industrial pits for construction and cement manufacturing near Edmonton and Calgary.

COPPER occurs in different types of deposits associated with other metals throughout Alberta. Copper-silver occurrences were found in stratabound, stringer, and disseminated occurrences in quartzite, quartz arenite, and green argillite conglomerate of the Mesoproterozoic Grinnell Formation, and less frequently in the Mesoproterozoic Appekunny, Siyeh, Sheppard, Gateway, and Roosville formations in the Rocky Mountains and Foothills. The Grinnell Formation is highly prospective for copper-silver because mineable deposits occur within an equivalent stratigraphic unit in Montana. Copper-gold occurrences are reported in sulphide-bearing amphibolite within the Paleoproterozoic Slave granitoid in the Precambrian Shield of northeastern Alberta of which the most prospective area is along the Leland Lakes Shear Zone. Copper-lead-zinc occurrences have been documented in tholeiitic - alkali basalts in the Rocky Mountains southwest of Lethbridge. Small-scale copper, lead and zinc mining occurred between 1900 and 1910 in a basaltic dike at Coppermine Creek, now within Waterton Lakes National Park. Prospective areas for copper-lead-zinc deposits are in the Mesoproterozoic Purcell Group lavas and intrusions in southwestern Alberta.

DIAMOND –bearing kimberlite and related ultrabasic alkaline rocks occur as clusters of pyroclastic and volcaniclastic rocks, and dikes and sills of Late Cretaceous to Paleocene age. Prospective areas for diamonds occur within the known diamond-bearing kimberlite fields in the Buffalo Head Hills and Birch Mountains, and also where alluvial diamond occurrences are found, and where the chemistry of kimberlite indicator minerals (such as garnet, clinopyroxene, olivine, ilmenite and chromite) collected from glacial and alluvial sediments, suggest a nearby kimberlite source.

FLY ASH powder is produced as a by-product in coal-fired power generation. Fly ash is collected from power generation stations located in central and southeastern Alberta to use in the manufacturing of cement and concrete for building construction and cementing of oil and gas wells.

GOLD occurs in different types of deposits throughout Alberta. Gold occurs in placer deposits as small-size grains (flour gold) usually in association with other economic metals such as silver and platinum-group minerals (PGEs). Placer gold is often found along a stretch of the North Saskatchewan River near Edmonton. Elsewhere in Alberta, placer gold occurs in modern streambed sediments in the Peace, Athabasca, and Red Deer rivers, and alluvial placers and preglacial sand and gravels in northern and central Alberta. Placer gold is currently being recovered as a by-product in two sand and gravel operations west of Edmonton. Gold, accompanied by base metals, occurs in quartz-tourmaline veins, stockworks and masses, spatially related to granitoids or shear zones in metasedimentary rocks in northeastern Alberta. Prospective areas for gold-base metals deposits are in the Paleoproterozoic Waugh Lake Group and the Leland Lakes shear zone in the Canadian Shield. Gold, silver, and PGEs geochemical anomalies were reported in the Upper Devonian Waterways and Lower Cretaceous McMurray formations northeast of Fort McMurray.

GYPSUM deposits are widespread in the province and occur as extensive beds or lenses in Devonian and Triassic evaporite units. However, there is no development yet due to the depth or remoteness of the resource. Prospective areas for gypsum are in near-surface Elk Point Group and Fort Vermilion Formation strata in the northeast.

HUMALITE is extracted from open-pit sub-bituminous coal mines and processed into liquid and dry soil conditioners, and drillings fluid additives. Prospective areas for humalite are in shallow coal zones of the Upper Cretaceous Horseshoe Canyon Formation in central to southern Alberta.

IRON-VANADIUM ironstone deposits were evaluated by industry in northwestern Alberta (Clear Hills project) for producing carbonyl iron powder and vanadium electrolyte. Several other iron-rich ironstone occurrences were found near the surface in the greater region. Prospective areas for the exploration of additional iron-vanadium ironstone deposits are in the Upper Cretaceous Bad Heart and Dunvegan formations in northwestern Alberta.

LEAD-ZINC occurrences were found in carbonate rocks at surface in the Rocky Mountains, and, in the early 1900s, lead and zinc ore was extracted from adits in the Oldman River mine, near the border with British Columbia in southwestern Alberta. Other occurrences in carbonate rocks were found in core from oil and gas wells in northwestern Alberta. Prospective areas for lead-zinc deposits include Devonian carbonate platform strata near documented lead-zinc occurrences in northwestern and southwestern Alberta, in relation to hydrothermal dolomite, spatially related to reefs or regional structures. Other types of lead-zinc occurrences were reported in siliciclastic rocks in the Mesoproterozoic Sheppard Formation in the mountains of southwestern Alberta. Alberta is considered highly prospective for lead-zinc because mineable lead-zinc deposits occur within equivalent stratigraphic units of the Western Canadian Sedimentary Basin in British Columbia and the Northwest Territories.

LIMESTONE AND/OR DOLOMITE are mined from several locations in the Rocky Mountains and Foothills, and in the Fort McMurray area. Limestone is used to manufacture high-calcium quicklime (for cement), hydrated lime, pulverized limestone, screened limestone, building stone, and crushed rock aggregate. Dolomite is primarily used for aggregate, building stone, neutralizer, desulphurization and filler. Prospective areas for limestone and dolomite are in Cambrian–Triassic carbonate strata in the Rocky Mountains and Foothills, and in Devonian strata in northeastern Alberta.

LITHIUM occurs as a dissolved element in some oil field brines in the province. Currently, these brines are extracted by the oil and gas industry, and once the hydrocarbons are removed, the remaining lithium-rich water is injected back into the subsurface as wastewater. Lithium-rich oil field brines in the Upper Devonian Swan Hills, Leduc, and Nisku formations have been identified by industry in west-central and southern Alberta. Prospective areas for lithium are in the subsurface Upper Devonian formation brines east and southeast of Grande Prairie and near Red Deer, and in Middle Devonian formation brines in northeastern Alberta.

MAGNETITE and other heavy minerals such as titanium dioxide occur in sand and sandstone beds found near-surface along the foothills west of Lethbridge and north of Calling Lake. The Burmis project located in the Foothills was explored as a potential source for iron ore for steelmaking, and magnetite for use in the coal industry. The Pelican Mountain project was explored as a source of titanium oxide. Prospective areas for magnetite and heavy minerals are in the Upper Cretaceous Belly River Group in southwestern Alberta and the Upper Cretaceous Wapiti Formation in north-central Alberta.

MARL AND/OR TUFA were mined in Alberta for both cement making and agricultural liming. Both marl and tufa contain calcium carbonate derived from glacial drift or bedrock; marl generally forms in freshwater at ponded spring discharge sites, and tufa forms at well-drained sites. Marl and/or tufa are produced from surface industrial pits.

METALLURGICAL COAL is currently mined near Hinton and Grande Cache. It is primarily used in iron smelting and steelmaking. An open-pit metallurgical coal mine is proposed in southwestern Alberta (Grassy Mountain project). Prospective areas for metallurgical coal are in bituminous coal fields along the Rocky Mountains and Foothills.

PEAT has been harvested in Alberta for horticultural purposes since the 1960s. Active peat harvesting surface pit operations exist in many areas of central and northern Alberta.

PHOSPHATE occurs in sedimentary rock beds that may extend over tens to hundreds of kilometres along the Rocky Mountains and Foothills. Prospective areas are in the Upper Devonian–Mississippian Exshaw Formation, Permian Johnston Canyon and Ranger Canyon formations, Jurassic Fernie Formation, and the Triassic Spray River Group. The Crowsnest-Alberta project occurs in the Fernie Formation. The province is considered highly prospective for phosphate because potentially mineable phosphate beds occur in British Columbia that extend into Alberta.

POTASH occurrences were found in oil and gas wells and mineral exploration drilling. Alberta is prospective for potash because mineable deposits occur within the same strata in Saskatchewan. Industry has identified potash intersections that warrant further exploration near Provost, Vermilion, and Medicine Hat. Prospective areas for potash occur in the Devonian Prairie Evaporite Formation in east-central and southeastern Alberta.

RARE-EARTH ELEMENTS (REEs) were documented in various alkaline granite and pegmatite units in the Canadian Shield. REEs also occur as a secondary commodity in other mineral deposits such as phosphate and Zn-V-Ni-REEs black shales. Prospective areas for REEs are the Mesoarchean–Paleoproterozoic Taltson basement and Marguerite River complexes in the Canadian Shield, Permian–Jurassic phosphate-bearing strata in the Rocky Mountains and Foothills, Cretaceous Fish Scales Formation in the north, near-surface Zn-V-Ni-REEs black shale deposits in the Upper Cretaceous Second White Specks shale in the northeast, in the Lower Cretaceous Loon River Formation in the northwest, Jurassic Fernie shales, and Devonian–Mississippian shales of the Exshaw and Banff formations in the Rocky Mountains and Foothills. REEs also occur in oil sands processing streams and in coal fly ash.

SALT is solution-mined from salt beds at Riverview and is used to make de-icing, water softening, food and preservation products. Also, salt is extracted to create artificial caverns for storage of petroleum products by the upstream petroleum industry in east-central and northeastern Alberta. Prospective areas for salt production, and also creation of caverns, are in the lower and upper Lotsberg, Cold Lake, and Prairie Evaporite formations in northeastern and east-central Alberta.

SAND AND GRAVEL is the primary source of aggregate in Alberta with over 2500 sand and gravel surface pits operated by private companies and public departments. Primary uses include road construction, road maintenance, snow and ice control, abrasives, filtration beds, concrete, and landscaping.

SILICA SAND is produced from Lower Cretaceous sandstone in the Peace River area and from Holocene unconsolidated sand deposits northeast of Edmonton. Industrial uses include glass, fibreglass, and proppant (for hydraulic fracturing). A silica sand surface mine (Firebag project) is proposed north of Fort McMurray for the production of proppant. Prospective areas for silica sand are in the Lower Cretaceous Paddy Member of the Peace River Formation in the northwest, silica-rich unconsolidated sand deposits at shallow depth in central Alberta, the Lower Cretaceous McMurray, Grand Rapids, and Pelican formations in the northeast, and in sand dunes and glaciofluvial outwash sediments throughout the province.

SODIUM SULPHATE was mined in southeastern Alberta for manufacturing kraft paper, glass, detergents, textiles, and chemicals, but production discontinued in 1991.

STONE is mined in west-central to southwestern Alberta. Common end products include building stone, dimension stone, landscaping stone, rip rap aggregate, road base building material, and sand for cement making. Rock types include shale, sandstone, granite, limestone, and dolomitic siltstone.

SULPHUR is extracted from crude oil and natural gas processing. It is primarily used for producing fertilizer and secondarily for metallurgical purposes. It occurs naturally in conventional natural gas, crude bitumen, crude oil, and coal. Current production is largely derived from hydrogen sulphide (H_2S)-rich conventional natural gas. Oil sands deposits also contain significant amounts of sulphur, which is either recovered during upgrading in the form of elemental sulphur or remains in the coke.

TITANIUM-ZIRCONIUM, vanadium and rare earth elements (REEs) occur naturally in small quantities in oil sands, but these minerals concentrate during the final stage of the oil sands bitumen extraction process. An industry project is currently conducting engineering design for the commercial implementation of proprietary technology to recover titanium and zirconium before they end in the oil sands froth treatment tailings. Vanadium occurs in high concentrations in oil sands coke and fly ash, both by-products of bitumen upgrading. REEs are concentrated in the tailings solvent recovery unit during oil sands processing.

URANIUM occurs extensively in the Athabasca Basin and Canadian Shield in several types of deposits related to granites, pegmatites, metamorphic rocks, and structures such as unconformities, shear zones and veins. The most explored occurrence is the Maybelle River project which intersected a high-grade uranium zone in a sandstone unit of the Late Paleoproterozoic Fair Point Formation along the Maybelle River Shear Zone and above the unconformity between the Athabasca Group and basement rocks. Since large mineable unconformity-related uranium deposits occur in the Athabasca Basin in Saskatchewan, it is expected that similar deposits may also occur on the Alberta side of the basin. Prospective areas for uranium are in the Late Paleoproterozoic–Early Mesoproterozoic Athabasca Group, particularly along shear zones, and in the Mesoarchean–Paleoproterozoic Canadian Shield. Uranium occurrences are also documented in Cretaceous sandstone units south and west of Lethbridge. Prospective areas are in the Upper Cretaceous St. Mary River and Willow Creek formations in southern Alberta.

ZINC-VANADIUM-NICKEL-RARE EARTH ELEMENTS occur in thin metalliferous horizons in laterally extensive organic-rich marine black shale. Other metals present include copper, cobalt, uranium, silver, and REEs. The Buckton near-surface deposit in the Upper Cretaceous Second White Specks Formation north of Fort McMurray, was evaluated for copper-zinc-nickel-cobalt sulphides, dry uranium oxide and REEs concentrate. Prospective areas for zinc, vanadium, nickel, REEs and other base metals are in the Lower Cretaceous Loon River Formation in the northwest, the Upper Cretaceous Second White Specks Formation in the northeast, the Jurassic Fernie Formation in the west, and the Devonian–Mississippian Exshaw Formation in the southwest.

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Map 590

Minerals of Alberta

Compiled by: G.P. Lopez, H.E. Budney, J.A. Weiss and J.G. Pawlowicz

Scale 1:1 250 000

25 0 25 50 75 100 kilometres
10 0 10 20 30 40 50 miles

Projection: 10 Degree Transverse Mercator
Datum: North American Datum, 1983

Alberta Energy Regulator

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