Mat-Su Borough
Mineral Resources Assessment Study

Technical Report

By

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February, 2003

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This report on the Mineral Resources of the Matanuska-Susitna Borough (MSB) accompanies an ArcGIS Project, also prepared for the MSB by T. Crafford & Associates (TCA). This text provides additional information and discussion about the layers in the ArcGIS Project and is intended not as a stand alone document, but as a companion to the ArcGIS Project. In the following text, the names of the layers in the ArcGIS Project appear in italicized bold text as follows, ***ArcGIS Layer.***

INTRODUCTION

This *Technical Report* is one of three parts that collectively constitute T. Crafford & Associates' (TCA's) *Mat-Su Borough Mineral Resources Assessment Study.* The other two parts are the *ArcGIS Project* and the *ArcGIS Project Summary Document* (Note: the *ArcGIS Project* is provided as both an ArcView 3.2 project and an ArcGIS 8.2 project). The Study focuses on the mineral assets of the Matanuska-Susitna Borough (MSB) that 1) are most likely to be developed in the near future, 2) are on or near Borough lands, and 3) are near the existing transportation infrastructure in the Borough. Additionally, this report provides a more general overview of potential minerals related projects throughout the Borough. Previous studies on the mineral resources of the Mat-Su Borough were conducted by (Renshaw, 1979, 1980) and (Renshaw, 1982).

The following text is subdivided into sections on Metallic Resources; Non-Metallic/Non-Energy Resources; and Energy Resources. In each of the sections the relevant layers in the *ArcGIS Project* are discussed. Additional text is provided on specific mineral properties and topics. The *ArcGIS Project* includes many layers that are not specific to minerals resources (e.g., land status, roads, hydrology, topography, etc.). Those layers are not discussed here but are addressed in the *ArcGIS Project Summary Document* which lists and briefly discusses each layer in the *ArcGIS Project.*

METALLIC RESOURCES

While there are many metallic mineral occurrences, prospects and past-producing mines in the MSB, the only current production comes from a very few small- to modest-sized placer gold mines. There are no currently producing hard rock metal mines, nor are there any hard rock

properties in the advanced stages of development or permitting that might be expected to achieve production in the next few years. However, there are extensively explored or previously developed hard rock and placer properties that might attract strong attention if metal prices, especially gold, remain elevated for an appreciable length of time. These include:

- Placer deposits in the Petersville area; There were only one or two small placer operations in this area in 2002 (Kerwin Krause, ADNR, 2002, Personal Communication), but the area contains numerous properties that might be reactivated if gold prices remain high
- The Golden Zone and nearby prospects in the western part of the Healy quad northwest of the 'Colorado' station on the Alaska Railroad
- The Independence Mine and other gold prospects/properties in the Willow Creek Mining District in the vicinity of Hatcher Pass
- Placer and hard rock gold properties in the Valdez Creek area near the Denali Highway in the southeastern part of the Healy quad
- The Denali (Caribou Dome) copper prospect and other hard rock copper prospects in the Clearwater Mountains in southeastern Healy quad
- Hard rock base and precious metal prospects in the Iron Creek area in the southwest-central part of the Talkeetna Mountains quad
- The base and precious metal Sheep Mountain prospect just north of the Glenn Highway in the northeastern part of the Anchorage quad

In addition, there is a lot of interest currently in platinum group metals (PGM's) outside of the Borough in the Tangle Lakes – Fish Lake area north of the Denali Highway, west of Paxson. The mafic and ultramafic ('mafic' means rich in magnesium and iron) rocks associated with PGM mineralization in this area extend to the west into the Mat-Su Borough in the Mount Hayes and Healy quads. There is a strong probability that these rocks (Trn and Trnm in the ***General Geology, 1:250,000*** layer in the *ArcGIS Project*) will receive strong exploration attention if additional discoveries are made in the Tangle Lakes – Fish Lake area.

Locations and information on the aforementioned prospects/properties are available in the ***Metallic Mineral Resources*** layer of the *ArcGIS Project.* This layer consists of the Alaska Resource Data Files (ARDF's) for the portions of the Healy, Talkeetna Mountains, Gulkana, Talkeetna, Tyonek and Anchorage 1:250,000 scale quadrangles within the Borough. The ARDF files are databases of mostly metallic mineral Occurrences (small circles), Prospects (small squares), and past or present Mines (large squares) compiled on a quadrangle by quadrangle basis by/for the U. S. Geological Survey (USGS). A very few of the ARDF locations are notable non-metallic industrial mineral sites, like zeolites, pumice, etc.

The ARDF databases are a relatively recent effort by the USGS and the files included in the *ArcGIS Project* range in age from 1998 to 2003. Note that because the ARDF files for the Mount McKinley, Mount Hayes and Valdez quads are still in review and have not yet been released to the public, they have not been included in the *ArcGIS Project.* Only small portions of the Mount McKinley and Mount Hayes quads and a very small part of portion of the Valdez quad lie within the Borough. TCA does not know of any advanced projects within the Borough in these three quads. There are, however, mining claims in the Mount Hayes quad within the

Borough and, as stated above, the mafic and ultramafic rocks in this area are likely to see some exploration attention for PGM's. ARDF files can be obtained on-line from the USGS at http://ardf.wr.usgs.gov/ (USGS, 2003) as either .pdf reports or digital data. The tabular information that accompanies this layer in the *ArcGIS Project* contains some very lengthy text fields which are difficult to read from within ArcGIS. The reader may wish to refer to Appendix A on the accompanying CD, which presents all of the ARDF records for the Mat-Su Borough as both a Microsoft Excel spreadsheet and a PDF file (AppendixA_ARDF.xls or AppendixA_ARDF.pdf.

Mineral prospects are generally not isolated occurrences and more commonly occur in clusters or in districts, as the ***Metallic Mineral Resources*** layer clearly illustrates. There are substantial groupings of ARDF sites in the Willow Creek area (northwest part of Anchorage quad); Petersville area (central Talkeetna quad); the Chulitna Mineral Belt (southwest corner, Healy quad); the Clearwater Mountains, including Valdez Creek (southeast corner, Healy quad); and, to a lesser degree, in the Nelchina area (southeast part of Talkeetna Mts. quad and northeast part of Anchorage quad).

The ***Placer Gold Mining Districts*** layer in the *ArcGIS Project* is from ADGGS and shows the boundaries and names of placer mining districts. Some of these districts do not appear to be very straight forward but, in general, they show the major placer mining areas. Two of the Mining Districts in the Borough, the Yentna and Valdez Creek Districts, are "organized" and have elected officers. The presidents of these Districts serve as the contact individuals for the placer miners in their districts. They are the logical first contacts re: issues/activities that might affect the local placer and hard rock miners. The 2003 presidents (which are tracked by the Alaska Miners Association in Anchorage, Steve Borell - Executive Director, 907-563-9229) are:

Valdez Creek Mining District
Kevin Thompson, President
P.O. Box 875534
Wasilla, AK 99687-5534
(907) 733-2351

Yentna Mining District
Carol Young, President
P.O. Box 211
Talkeetna, AK 99676
(907) 733-2351

The ***State Mining Claims as of October 2002*** and ***Federal Mining Claims as of October 2002*** layers in the *ArcGIS Project* show state and federal mining claims, respectively, as of October, 2002. There are more state than federal mining claims, primarily because there are more state than federal lands in the Borough. Also, the state preferentially selected lands for their mineral potential. Note, however, that there are instances where federal mining claims are shown in areas of state lands (e.g., in the Petersville area). This is because the federal claims were located prior to state selection of the land, and the claim owners have not chosen to relocate the federal claims as state claims. This has often been the case with federal mining claims, because of various differences between state and federal claim mining laws and the cost of relocating claims.

For about the last 10 years the state of Alaska has been funding a program of airborne geophysical mapping that is used to better define areas of mineral potential. These geophysical surveys are flown by a helicopter towing sensors that measure parameters like magnetism and resistivity that can help to define ore bodies or mineralized areas. The ***State Geophysical Areas Completed*** layer in the *ArcGIS Project* shows the areas within the Borough that have been flown under this program. The survey areas are selected by the Alaska Division of Geological and Geophysical Surveys, with input from private industry, and are focused on non-federal lands with reasonable access. Accordingly, they define areas judged by professionals to have significant potential for the development of bedrock hosted metallic minerals.

Four (the Petersville, Iron Creek, Chulitna-Broad Pass, and Valdez Creek surveys) of the 17 state-funded airborne surveys flown to date have been largely or wholly in the Mat-Su Borough. A small portion of a fifth survey, the Delta River survey, laps into the northeast corner of the Borough. Figure 1 shows the locations of all of the completed airborne geophysical surveys as well as the sites of areas nominated for future surveys. Seven of the 36 candidate areas nominated for future surveys (triangles 27 through 33) are within the Mat-Su Borough. The final selection of survey areas can certainly be influenced via the political process and some local governments (Wrangell, Ketchikan) and the Mental Health Trust have provided support that has helped to attract geophysical surveys to their areas.

NON-METALLIC/NON-ENERGY RESOURCES

SAND & GRAVEL

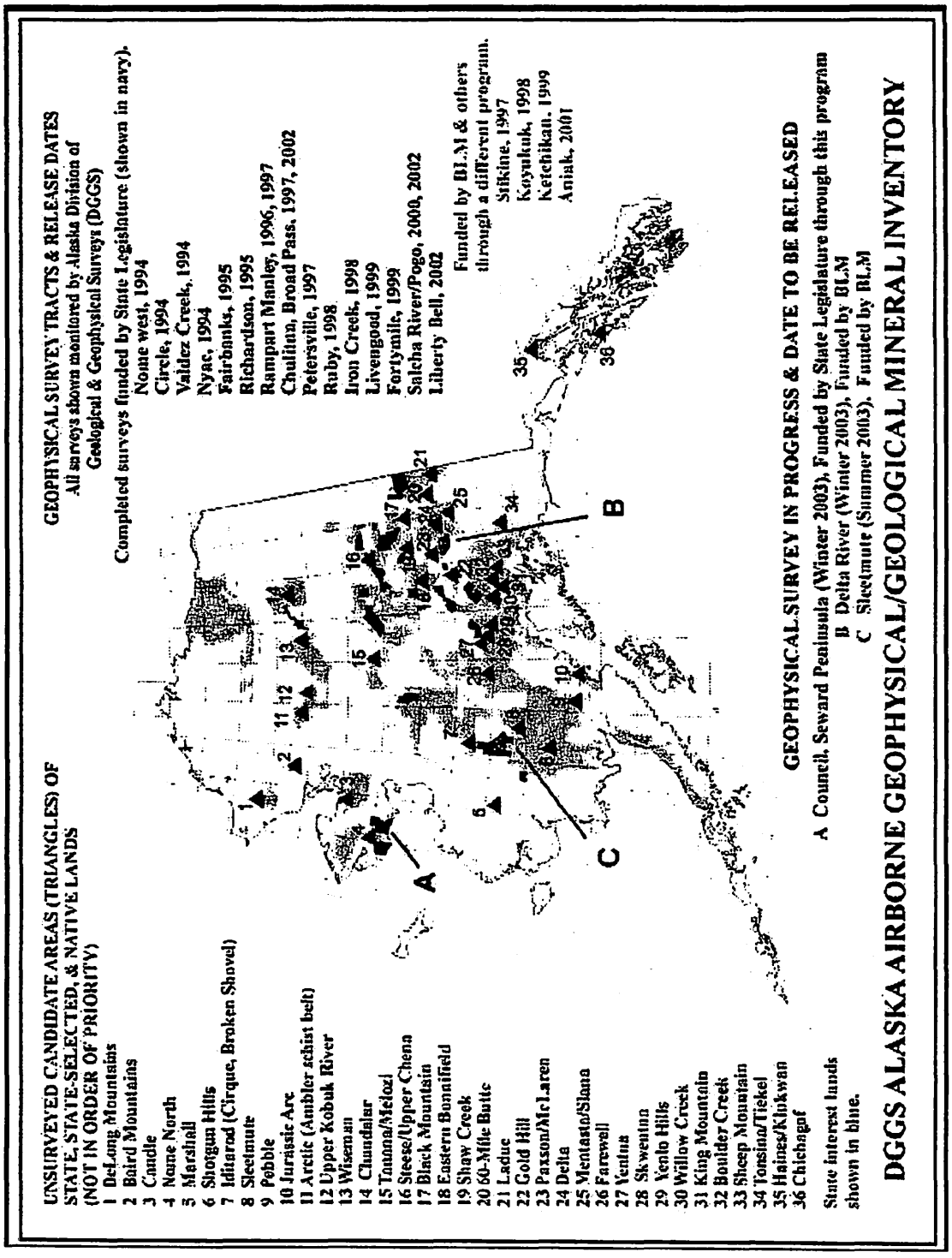
The most significant sand & gravel resources in the Borough owe their existence to the last major phase of glaciation to cover southcentral Alaska (Naptowne). During the Naptowne glaciation, which ended about 12,000 years ago (Reger, 1983) glaciers from the Matanuska and Knik valleys, as well as other glaciers from smaller valleys draining the Talkeetna and Chugach Mountains, coalesced in the Mat-Su Valley and covered most of the lowlands. Because the glaciers ground up and delivered the sand and gravel from the surrounding highlands, the extent of the Naptowne glaciation largely controls the distribution of sand and gravel deposits that exist today.

The major glaciers of the Naptowne glaciation spread to the west out of the Knik and Matanuska Valleys. Their maximum advance is marked by a discontinuous line of terminal moraines that extends in a scalloped pattern from near Willow on the north to the Point MacKenzie port site on the south. These end moraines are ridges of mixed silt, sand, and gravel that were plowed-up by the active glaciers at their toes.

As a result, a mantle of glacially derived sand and gravel today covers nearly all of the Mat-Su Valley lowlands east of the aforementioned irregular line of terminal moraines between Willow and Port MacKenzie. This mantle actually extends somewhat farther to the west, where streams have deposited outwash gravels from the glaciers and their associated moraines. Within the area of the sand and gravel mantle there are zones of cleaner, higher quality sand and gravel deposits where running water removed the fines (clay & silt) from the coarser, more valuable fractions (sand & gravel). This water was supplied largely by glacial meltwater flowing over, through, around, and under the stagnant and/or retreating ice during the waning stages of Naptowne glaciation. The moraines are likely to host only moderate to poor quality sand and gravel

deposits because, owing to their elevation, they were not cleansed of their silt by the rapidly flowing meltwaters.

Figure 1 ADGGS Airborne Geophysical Survey Tracts(ADGGS)



The ***Non-Metal Mineral Resources*** layer in the *ArcGIS Project* shows sand and gravel sites along with sites for a variety of other commodities. This layer was obtained from the EPA and its listing of sand and gravel sites is very incomplete. The most recent 1:63,360 and 1:25,000 USGS topographic maps are a good resource for locating current and historic sand and gravel pits. Additionally, the satellite imagery recently obtained by the MSB should provide good coverage of current and recently historic sand and gravel pits. It's also worth noting that Usibelli Coal Mine, Inc., owner of the Wishbone Hill Coal Project near Sutton, is examining the potential for producing sand and gravel from the overburden that would have to be mined to access the coal (see the Wishbone Hill Coal Project description on page 13).

The ***Geologic Materials of Studied Areas*** layer in the ArcGIS project is TCA's compilation and interpretation of published state and federal surficial geology and geologic materials maps. Unfortunately, these maps constitute an incomplete coverage of the Borough that extends, with one gap, from Talkeetna to Point MacKenzie and eastwards to the Glenn-Parks Highway intersection. It is based solely on published mapping and has not been field checked by TCA. The legend for this layer shows areas that TCA has interpreted to have good, moderate, and low potential for sand and gravel resources. Additionally, the legend includes categories for other material types, most notably peat.

Two 'derivative' layers, ***Good Sand and Gravel Potential*** and ***Good Sand and Gravel Potential-Borough Land***, are also included in the *ArcGIS project*. The first of these layers shows areas of Good Sand and Gravel potential within one mile of roads or the Alaska Railroad. The second layer shows only Borough lands with Good Sand and Gravel potential within one mile of roads or the Alaska Railroad.

The extent and intensity of the glaciation and the re-working by meltwaters of the glacial sediments in the Mat-Su Valley area produced large, good quality sand and gravel deposits that have long been the major source of construction materials for the Anchorage area. For low unit value commodities like sand and gravel, the economics are controlled largely by the cost of transportation, i.e., the commodity must either be close to its market or there must be a reasonably inexpensive means of transportation to get the commodity to market. The sand and gravel operations straddling the Glenn Highway between Echo Lake and McLeod Lake are not there solely because of the presence of sand and gravel resources of adequate size and quality. They are located there also because of their proximity to the (relatively) cheap transportation afforded by the Alaska Railroad.

An additional consideration is the combined cycle time for roundtrip rail travel and loading/unloading of aggregate. Anchorage Sand & Gravel (AS&G) receives two unit trains per day during the summer season. In order to maintain this schedule, which allows for the regular and efficient scheduling of personnel, the cycle time can be no longer than 12 hours. Practically speaking, it needs to be nearer to 11 hours to provide adequate leeway for contingencies. AS&G is currently able to maintain this schedule, but significantly greater haulage distances would need to be offset by higher transit speeds and/or reductions in loading/unloading time. Load/unload times could be reduced by employing fewer rail cars, but with a resultant loss in efficiency (Dale Morman, President, AS&G, 2003, Personal Communication,). On-going improvements to the railroad tracks between Anchorage and Wasilla will also reduce cycle times, allowing Anchorage sand and gravel operations to look farther away.

AS&G also foresees a decline in the Anchorage demand for aggregate for new construction. They note that the undeveloped acreage in the Anchorage bowl is limited and that future construction is likely to move towards the redevelopment of existing developed sites, with a consequent reduction in the demand for aggregate as fill. As an example, AS&G cites the new Best Buy store in the Dimond Mall which, rather than clearing new ground, re-developed an existing building.

The greatest future markets for aggregate are probably within the Mat-Su Borough itself, primarily along the main transportation corridors, in the current areas of high growth and, if and when a bridge is built across the mouth of Knik Arm, near Point MacKenzie.

It is also important to understand that sand and gravel pits do not last forever. Well designed post-mining reclamation can produce attractive land that is well-suited for subdivisions or parks, as well as lakes and ponds for recreation. In Fairbanks, at least one sand and gravel pit on the south side of town has been re-developed as a real estate subdivision, with the flooded pit now a recreational lake. A proper sand and gravel operation will have a reclamation plan in place prior to the onset of mining and, on public lands, commercially reasonable financial guarantees should be in place to ensure completion of reclamation.

LIMESTONE, QUARRY ROCK AND DIAMONDS

These commodities are addressed in the ***NonMetal Mineral Resources*** layer in the *ArcGIS Project*. Originally created by the EPA, this layer included locations for coal, sand and gravel, gypsum and stone. Based upon its geological knowledge of the Mat-Su Borough, TCA has added sites and commodities (limestone and diamonds) to this layer.

Limestone

Limestone has a wide variety of industrial and agricultural applications. These include use as a non-abrasive aggregate; an essential ingredient in cement and concrete; and as a reagent used to raise pH in chemical processes and agriculture. The new combustion technology employed at the Healy Clean Coal Project (HCCP) power plant injects powdered limestone into the burners to control air emissions, and the Fort Knox Gold Mine north of Fairbanks uses lime, made by roasting limestone, to maintain high pH in its gold recovery circuit.

The ***NonMetal Mineral Resources*** layer in the *ArcGIS Project* shows three limestone sites along the Kings River on the north side of the Matanuska River near Chickaloon. The two more northerly of sites are on the west side of the Kings River and are controlled by CIRI. The other site is on the east side of the Kings River and is controlled by the Alaska Mental Health Trust. These sites were studied by Kaiser Permanente in 1960 and were judged to be of a quality suitable for the manufacture of Portland cement (Jasper and Mihelich, 1961). A pioneer road, the 'Permanente Road' was installed when these properties were being evaluated. Today, this road, best suited for 4 wheelers and serious off-road vehicles, provides access for hunters and recreationists up the Kings River valley.

Since limestone is a low unit value commodity, the development of these limestone resources is largely dependent on a local market. The aforementioned Fort Knox Mine and HCCP (if the HCCP resumes operations with the same technology) are possible markets, but may be too small to justify the development of these limestone occurrences. Hobbs Industries, which holds coal leases on the nearby inoperative Castle Mountain coal mine, has been seeking to negotiate a

lease with the Alaska Mental Health Trust on the southerly limestone occurrence on the east side of Kings River. Hobbs' idea is to process the limestone using Castle Mountain coal to produce clinker (a chunk-like precursor or 'raw' form of Portland cement) that could be milled in Anchorage Sand and Gravel's ball mill in Anchorage to produce Portland cement. Anchorage Sand and Gravel currently imports (from Seattle?) its Portland cement through the Port of Anchorage. The marketability of clinker from Kings River limestone would clearly depend on the cost of its production and transportation relative to that of imported Portland cement.

Quarry Rock

The term 'quarry rock' here refers to bedrock sources of durable rock that can be used for a variety of applications, including but not limited to aggregate, railroad ballast, armor stone, and rip rap. As used here, 'quarry rock' does not refer to ornamental or monument types of stone. Unlike a sand and gravel pit which can simply be dug using heavy equipment, quarry rock ordinarily must be drilled, and blasted. There are few sources of high quality, durable quarry rock in southcentral Alaska and one of the best, the Eklutna quarry, has recently been shut down due to opposition from the local community.

Quarry rock sites are shown in the ***NonMetal Mineral Resources*** layer in the *ArcGIS Project*. The original layer is from the EPA and included only two 'stone' sites, the 'Comsat Quarry' along the Comsat Road just southeast of Talkeetna and the 'Jack Quarry' along the Matanuska Highway east of Caribou Creek. TCA is unfamiliar with both of these sites. The Comsat Quarry plots within an area mapped as overburden (Qs or Quaternary sediments) in the ***General Geology, 1:250,000*** layer, i.e., an area where no bedrock outcrops at the surface. However, bedrock may have been present beneath a thin mantle of overburden or there may be an outcrop too small to show at the scale of the mapping in the *ArcGIS Project*. In either case, the rock would probably be granite since the closest bedrock outcrops are a sizable granitic knoll a little over a mile to the southeast. The Jack Quarry plots adjacent to an area mapped as Thf (hypabyssal felsic and intermediate intrusion, probably an aplite, i.e., a fairly fine-grained intrusion with a composition similar to granite). Rocks of this type in the Matanuska Valley are known to be hard and durable and this may be a source of good material.

TCA has added several Quarry rock sites to this layer. Those sites include:

- A site on the Glenn Highway about 2 miles west of Chickaloon in the SE corner of Sec 35, T20N, R5E. This site is in the right-of-way of the Glenn Highway and DOT has used it to extract rip rap for the nearby armoring project where the Glenn Highway is immediately adjacent to the Matanuska River. The rock here is mapped on the ***General Geology, 1:250,000*** layer as Thm (hypabyssal mafic intrusion), a rock type related to the Thf unit (see Jack Quarry, above) that should also be hard, durable material. Other areas where the Thm and Thf units are mapped along the Matanuska Valley are likely sources of durable quarry rock.
- An approximately located site south of the Knik River adjacent to the Old Glenn Highway immediately south of the old Knik River Bridge. The area here is mapped as Kmk which is a mélange. Mélanges are chaotic assemblages composed of large blocks of different types of rocks. The rock here must be fairly durable, as DOTPF used material from this site to construct the groins along the south side of the Matanuska River near Bodenburg Butte. Here again, DOTPF probably mined the material from within the highway right-of-way.

- A site at Burnt Butte, about 2.5 miles northeast of Bodenburg Butte near Jim Lake. Burnt Butte is the easternmost of 3 knobs that includes Bodenburg Butte at the southwest end and a low unnamed knob approximately midway between the Burnt and Bodenburg Buttes. The ***General Geology, 1:250,000*** layer shows Burnt Butte, the unnamed knob, and the southern half of Bodenburg Butte to be Jmu, a unit consisting of Jurassic intrusions of intermediate to ultramafic composition. CIRI owns land at Burnt Butte and evaluated it as a source of durable aggregate when the Eklutna Quarry was closing. Preliminary indications were that it was a good material of similar character and composition to that at Eklutna. The geologic mapping suggests that all three knobs probably are likely sources of durable rock.

TCA has not reconnoitered the Mat-Su Borough for potential hard rock quarry sites, but the ***General Geology, 1:250,000*** layer in *ArcGIS Project* provides some direction on where to look. Granitic rocks are generally good candidates for hard, durable quarry rock. The ***General Geology, 1:250,000*** layer shows granitic rocks that outcrop at a variety of locations along the Alaska Railroad and along the east side of the Parks Highway from Willow to the northern edge of the Borough. Other large masses of granitic rock on the west side of the Talkeetna Mountains north of the Hatcher Pass Road are shown in red and orange. Finally, on the east side of Government Peak where the Palmer-Fishhook Road enters the mountains, there is an area of hornfels mapped as PPast. Hornfels is a 'baked' sedimentary rock that occurs near igneous intrusions and is noted for its hardness.

Diamonds

One diamond site is shown near Shulin Lake, about 20 miles southwest of Trapper Creek, in the ***NonMetal Mineral Resources*** layer in the *ArcGIS Project*. The Shulin Lake Property is controlled by Golconda Minerals, Shear Minerals (Shear) and Shulin Lake Mining Inc. and consists of 54 State mining claims and 99 State prospecting sites covering 12,600 acres according to Shear's website (Shear Minerals, 2002). This large package of claims and prospect sites is readily visible on the ***State Mining Claims as of Oct. 2002*** layer in the *ArcGIS Project*. Diamond exploration has been conducted within the project area at least since 2000. Diamond indicator minerals have been found and exploration drilling is reported to have returned 1 macrodiamond and 15 microdiamonds. If so, this is the first discovery of diamonds in bedrock in Alaska.

The companies believe they have discovered a kimberlitic or lamproitic volcanic pipe. Similar pipes host diamonds elsewhere in the world. To date, natural diamonds have been reported only from a single 10 kg (approx. 22 lb) sample and much more exploration is needed to thoroughly evaluate the property.

ENERGY RESOURCES - COAL AND COALBED METHANE

Most of the lowlands in the Matanuska and Susitna Valleys are filled with non-marine sediments that were deposited during the Tertiary period in a trough which extends the length of Cook Inlet and beyond. These sediments, which are over 25,000 feet thick, host oil, gas, coal and coalbed methane resources. The better coal resources in the Cook Inlet basin are hosted in some of the older, deeper strata which, due to uplift along the basin margins, are present at or near the surface in the Matanuska and Susitna River valleys where they are accessible by surface and underground mining as well as coalbed methane drilling (Stricker, 1991; Swenson, 2001).

This section on Coal and Coalbed Methane is sub-divided into two parts. The first discusses coal and the second addresses coalbed methane, a new and particularly exciting resource development opportunity of potentially large economic importance to the Mat-Su Borough.

COAL

The ***Coal Fields*** layer in the *ArcGIS project* shows area where coal is known to exist reasonably near the surface. It includes 6 coal fields (Matanuska, Susitna, Beluga, Yentna, Broad Pass and Copper River) within the Mat-Su Borough (--, 1998; Merritt and Hawley, 1986; Stricker, 1991). The first 4 are contained within the Cook Inlet-Susitna Province, which covers essentially all of the Cook Inlet and Mat-Su Valley lowlands, where coal, oil, and gas drilling has shown voluminous quantities of coal to exist at depth. The Broad Pass and Copper Valley fields are of similar age to the other fields but are generally considered as 'lesser' fields, although some coal mining did occur in the Broad Pass field at the Dunkle Mine. Both the Broad Pass and Copper Valley fields have received little exploration interest in recent years and are unlikely to see commercial scale development in the near future.

There is currently no commercial scale coal mining in the Mat-Su Borough although coal mining previously occurred at a small surface pit near Houston and at various sites in the Matanuska Valley. These former coal mines are shown as colored circles in the ***Non-Metallic Mineral Resources*** layer in the *ArcGIS project*. The Matanuska Valley coals are older (lower in the stratigraphic section) and structurally more complex (more faulted and/or folded) than other coals in the Cook Inlet-Susitna Province. Their rank generally increases up valley to the east, reaching anthracite rank in the appropriately named Anthracite Ridge area up-valley from Chickaloon. While there are coal showings along much of the Matanuska Valley, the major production has come from the Wishbone Hill District near Sutton where some 7 million tons of bituminous coal were mined prior to 1968 (Barnes and Payne, 1956; Merritt and Hawley, 1986).

The ***Coal Leases, Oct. 2002*** layer in the *ArcGIS project* shows the active state coal leases within the Mat-Su Borough. These are, therefore, the areas where future coal production is most likely to occur. The only active coal leases shown in the information provided by ADNR are located in the aforementioned Wishbone Hill District and at the Castle Mountain Mine near Chickaloon. Three groups are involved with these coal leases, two in the Wishbone District and one at the Castle Mountain Mine. Status summaries based on discussions with these three groups are provided in the following sub-section.

Wishbone Hill Project

The following description of the Wishbone Hill project, located at the western end of the Wishbone Hill District, was provided by Usibelli Coal Mine, Inc., owner of the Wishbone Hill Coal Project.

Wishbone Hill is a mineral resource development project that is solely owned by Usibelli Coal Mine, Inc. (UCM). The project is situated approximately 8 miles north of Palmer, Alaska between the Matanuska River system and the foothills of the Talkeetna Mountains. The Glenn Highway, a major road within south central Alaska, passes approximately 2-3 miles south of the project area. A 12 mile section of the highway, which extends from the project area to a point south of Palmer, was

Detailed environmental studies and regulatory evaluations have been completed for the Wishbone Hill project. All permits and regulatory approvals required for initial start-up of mining operations are currently in-place. The legal documents required for right of entry to both the surface and mineral estates within the project area have also been secured and continue to be maintained by UCM.

Jonesville Project

The Jonesville project seeks to redevelop the Evan-Jones underground coal mine and to recover and reprocess coal fines left behind by the former mining operations. Although legal disputes over the property had prompted the Mental Health Trust Land Office (MHTLO), owner of the bulk of the project area, to issue a notice of intent to terminate its lease(s), recent progress towards resolving those disputes has stayed lease termination by the MHTLO (Mike Franger, MHTLO, 2002, Personal Communication).

A new investment group that includes 2 related companies, United Energy Group and Environmental Energy Services Corporation (UEG/EESC) of Boise, Idaho, is apparently on the verge of obtaining a controlling interest from the previous lease holders. Technical consultants for UEG/EESC reported that plans call for recovering the 1 to 3 million tons of coal fines (fine grained coal left over from the previous mining) that were left on the surface at the site. The actual amount of coal fines on-site is not well established and some have burned or oxidized in situ. Reprocessing of the coal fines would be conducted on site and would employ a proprietary technology from the University of Alberta. The reprocessed products could be coal pellets, cubes, briquettes, logs, etc., depending on the market. Personnel requirements are estimated at 20 people for the coal fines recovery phase and 30 for the reprocessing phase. Proceeds from the recovery and reprocessing of the coal fines could be used to fund development of the underground Evan-Jones coal resources (Roger Kolb, Consultant to United Energy Group, 2003, Personal Communication).

Dan Renshaw, a consultant on the Jonesville Project, mentioned that if an all-Alaska natural gas pipeline from the North Slope to Valdez is built, as Ballot Measure #3 passed in November, 2002 seeks to mandate, that coal might be an alternative source for the energy required to liquefy the natural gas. Estimates have been made that 33-40% of the North Slope natural gas would be consumed as energy needed to fuel the liquefaction process. Dan felt that coal shipped from either Whittier or Port MacKenzie might be a viable alternative for powering the process, thereby extending the natural gas resource. However, Pacific Rim liquefied natural gas resources are currently plentiful and North Slope liquefied gas will face stiff competition in that market, regardless of the energy source for liquefaction.

Castle Mountain Mine

Randy Hobbs, holder of 2 coal leases totaling about 180 acres at the site of the historic Castle Mountain Mine, provided the following information (2002, Personal Communication). The property is located on the north side of the Matanuska River, west of Chickaloon and just east of the Kings River. Mr. Hobbs says that the property contains approximately 1 million tons of coal, but that about 250,000 tons

upgraded in 1992 to accommodate resource development in this area. The Alaska Railroad also maintains a spur which extends approximately 7 miles from their mainline to the town of Palmer. Although the rail bed corridor continues to the north beyond Palmer, the Alaska Railroad no longer maintains a rail system in this area. Reestablishment of the rail system, on the 6 mile segment of corridor immediately north of Palmer, would provide the additional infrastructure needed to effectively transport resource products from the Wishbone Hill project and surrounding areas.

The Wishbone Hill project includes eight (8) State of Alaska Coal leases and two (2) private coal leases from Cook Inlet Region, Inc. (CIRI). These lease holdings are situated in the Wishbone Hill Coal District of the Matanuska Coal Field and encompass approximately 8,140 acres of land. Of the four districts that comprise the Matanuska Coal Field, the Wishbone Hill District has the greatest coal development potential because of its relatively simple structure, excellent quality characteristics, close proximity to existing infrastructure, and ability to be extracted using surface mining techniques. All of the leases contain deposits of glacial gravel that lie above the coal.

To date, exploration programs, geologic modeling, mine planning, and engineering design have focused on the western portion of the lease holdings and a small block in the eastern section of coal lease area. These programs not only defined the quantity and quality of mineable coal reserves but also quantified the volume of glacial gravel that lies above the coal deposits. Just within the relatively small portion of the total coal lease area that has been evaluated to date, approximately 30,000,000 bank cubic yards of glacial gravel have been located and defined. Based on geologic mapping and preliminary evaluations, there are substantially larger quantities of glacial gravel not only within the coal leases but also immediately adjacent to the existing coal lease area. In particular, the adjacent area immediately south of the western portion of the coal lease area has the potential to yield major quantities of gravel suitable for construction materials. This area has the added advantage of being located in close proximity to not only the Glenn Highway but also the existing rail bed corridor that could be easily upgraded to support a rail line.

Mineable (run-of-mine) coal reserves within the Wishbone Hill project area have been defined through geologic modeling and are estimated at 25,226,000 metric tons. The coals are considered bituminous in rank and have highly variable amounts of parting material that grades into and out of boney coals and shales. Run-of-mine quality typically averages 2.5% moisture, 40% ash, 0.3% sulfur, and 8,200 BTU/lb (4,560 Kcal/Kg). Quality on run-of-mine coal washed to a 9% ash content, averages 5.0% moisture, 0.4% sulfur, and 12,200 BTU/lb. (6,780 Kcal/Kg).

Because of the excellent quality characteristics of the washed product, Wishbone Hill coal is very well suited for the international steaming coal market. On the domestic level, Wishbone Hill coal could be ideally used to fire a power plant situated near the reserve area. The gravel deposits that overly the coal could be used as well to meet the ongoing demand for construction materials in the Anchorage and Matanuska Valley areas.

are present at a 'reasonable strip ratio' (Strip ratio refers to the ratio of mined waste rock to mined coal. It applies to surface mining, where the amount of waste rock that must be removed to access the coal is often several times the amount of coal.). He further noted that Castle Mountain coal is of coking quality and that on an 'as received' basis contains slightly less than 13,000 BTU/lb, 0.5% Sulfur, and <5% moisture. The road to Castle Mountain Mine was recently upgraded under an RS-2477 Right Of Way with MSB approval. Mr. Hobbs also stated that DNR has approved a permit for production of 25,000 tons/year from the Castle Mountain Mine, upon receipt of the final bond payment.

Mr. Hobbs has investigated various marketing/development options for the Castle Mountain Mine. He believes that a market exists for 5,000 to 10,000 tons of coal/year sold into the Mat-Su Borough. He has also investigated the use of Castle Mountain coal as a filter media and has contacted the Mental Health Trust Land Office about obtaining a lease to develop limestone resources on Trust land about 1.5 miles north of the Castle Mountain Mine. The idea is to use Castle Mountain coal to fuel a plant that would make clinker using the nearby limestone. When ground to a fine powder, clinker becomes cement used to make concrete. ,Anchorage Sand & Gravel has a ball mill in Anchorage that could be used to grind the clinker into cement.

Additional Comments re: Coal

The Matanuska Valley coal resources are small to moderate in size. Their development is probably dependent on the definition/development of markets where these coals can compete against other Pacific Rim coals which are produced very cheaply on very large scales. The most likely markets are local ones, where Matanuska Valley coals would enjoy a transportation cost advantage. Probably the most likely scenarios would be the development of a near by coal-fired electrical power plant, much like the situation at Usibelli Coal Mining, Inc's. operations at Healy. The development of a coal-fired power plant is probably dependent on the availability (i.e., price) of natural gas in the Cook Inlet area which will be influenced by a complicated combination of factors that includes the level of success in defining additional Cook Inlet gas reserves (including coalbed methane discussed below) and the timing and route(s) of a North Slope gas pipeline(s).

COALBED METHANE

General

The distinction between coalbed methane (CBM) and shallow (low pressure) conventional gas may not always be clear. Technically, CBM is stored on the internal surfaces of organic matter in coalbeds, whereas conventional gas is contained in a reservoir rock, like sandstone. From a regulatory viewpoint, the distinction that needs to be made is between deep (high pressure) and shallow (low pressure) gas because the production technologies, environmental hazards, and economics are very different. Alaska has recently instituted a new system of regulations for shallow gas under the Alaska Shallow Natural Gas Leasing Program.

Traditionally, CBM has been considered a hazardous nuisance at coal mines where it was known to cause explosions and fires. However, in recent years CBM has been recognized as a recoverable energy resource. It is now being economically extracted in many lower-48 coal

fields like the Black Warrior Basin in Alabama, the San Juan Basin in Colorado, and the Powder River Basin in Wyoming. Some 669 trillion cubic feet (TCF) of coalbed methane have been estimated to exist in lower-48 coal fields. More than 1/3rd of that amount, 245 TCF, has been estimated by the U.S. Geological Survey (USGS) to be in place in Cook Inlet (Seamount and Downey, 2000) (NOTE: These are "Gas In Place" (GIP) amounts and actual recoverable gas reserves will be much less.).

Because of its large internal surface area, coal stores 6 to 7 times more gas than the equivalent rock volume of a conventional sandstone gas reservoir. CBM content generally increases with coal rank, with depth of burial of the coalbed, and with reservoir pressure. However, technical challenges increase with depth and below about 5,000 or 6,000 feet beneath the surface, CBM extraction becomes generally uneconomic. These factors combine to create a 'depth window' starting at about 500-1,000 feet below the surface and extending to about 5,000-6,000 feet below the surface, within which CBM development is most likely to occur.

Unlike conventional natural gas occurrences where the gas is under high pressure and will naturally flow at a high rate through a drill hole to the surface, methane-bearing coalbeds will only slowly release their gas. In order to stimulate gas production, coalbeds typically are first de-watered, which reduces the confining pressure and allows the methane to escape (desorp) from the coal. Additionally, the methane-bearing coalbeds are generally hydraulically fractured or "fraced" to further enhance flow rates. Fluids and "frac sand" are pumped at high pressure down the drill holes and induce fracturing of the coalbeds. The "frac sand" grains migrate into the fractures that are created and hold them open, allowing the methane to more readily escape.

Since CBM wells produce gas at low pressures with corresponding low flow rates, numerous wells are required to generate economic quantities of gas. The spacing of the CBM wells, which depends on many factors including geology, methane contents, depth to coal seams, ground water recharge rates, etc., is best determined by first drilling small sets of pilot wells and testing their performance. The spacing of CBM wells is likely to be on the order of 1 well for every 40 to 80 acres (Dave Lappi, Lapp Resources, 2002, Personal Communication).

The major environmental issues associated with CBM production relate to water. Large volumes of water may be produced during the initial de-watering and significant volumes may also be generated during gas production. This water, which is often saline or brackish, must be disposed of in a manner that does not negatively impact surface or aquifer water qualities. There are various means of disposing of the produced water, but probably the most common means and the one currently being employed in the Mat-Su Valley, is reinjection. The brackish water produced from the current pilot CBM wells in the Mat-Su Valley is being reinjected in a well off of Vine Road at a depth below fresh ground water where the in situ water quality essentially matches that of the reinjected water.

Alaska's Shallow Natural Gas Leasing Program

Out of recognition that CBM and other shallow natural gas deposits constituted potentially economic deposits which were 'over-regulated' by conventional oil and gas leasing regulations, legislation creating a Shallow Natural Gas Leasing Program (SNGLP) was passed and signed into law in 1996 (Bates, 2000). Enabling regulations were approved in 1998 and statutory amendments to the program were enacted in 2002.

Today, the state's SNGLP provides for non-competitive leases for shallow natural gas (including coalbed methane). An SNG lease grants rights to gas where at least some portion of the gas field being developed is within 3,000 feet of the surface. SNG lessees do not have rights to gas contained in fields where no portion of that field is within 3,000 feet of the surface and do not have rights to produce oil. If an operator encounters oil during exploration, the Alaska Oil and Gas Commission must be promptly notified and operations must cease until all regulations pertaining to conventional oil and gas exploration are met.

There is a $5,000 application fee for each SNG lease and the annual rent is $1.00/acre. Individual SNG leases may not exceed 5,760 acres and the aggregate acreage held by a lessee may not exceed 138,240 acres. SNG leases have a three (3) year term and are automatically extended while in production or while diligent exploration and development is occurring. Additionally, a SNG lessee may apply to the director once only for a lease extension of up to 3 years.

Bonds are required of a lease applicant, but no additional bond is required if an applicant has already posted a bond covering statewide oil and gas leasing activities in an amount of at least $500,000. The royalty rate for SNG is 6.25% unless the gas produced from the SNG lease is in direct competition with (conventional) gas on which the royalty rate is 12.5%.

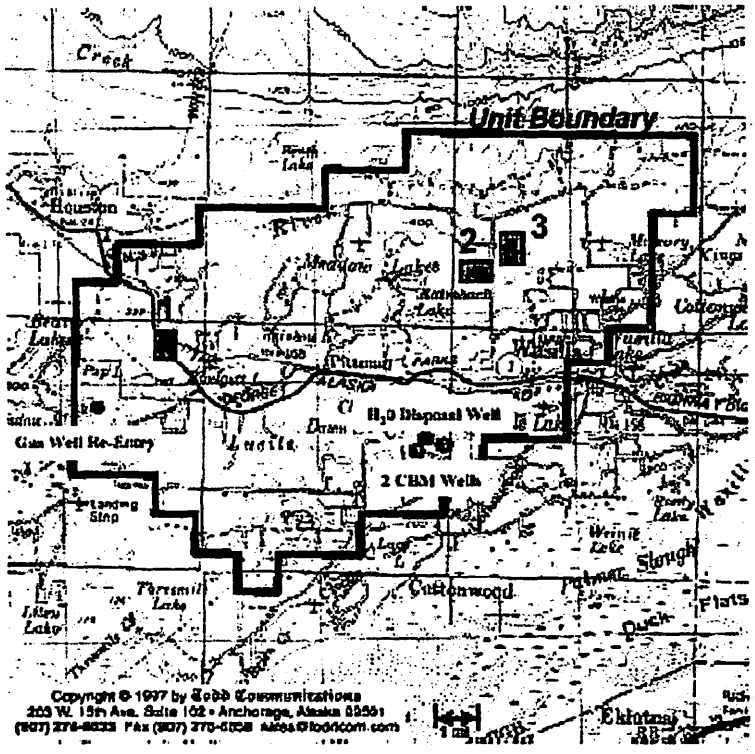
CBM in the Mat-Su Borough

In 1994, the Alaska Division of Oil and Gas (ADOG) drilled the state's first coalbed methane test well near the intersection of Spruce and Church roads (see ***Oil Wells, November 2002*** layer in the *ArcGIS Project*). The well (AK-94CBM-1) was drilled to a total depth of 1,245 feet, continuously coring the Tertiary-age Tyonek Formation from 354 feet to total depth. Eighteen seams of high volatile C bituminous coal were encountered, with the thickest being 6.5 feet and a net coal thickness of 41 feet. Thirteen of these seams were sampled for gas content. Evaluation of these samples showed that gas content and coal maturity generally increased with depth and suggested promising CBM potential (Flores et al., 1998; Seamount et al., 1997; Smith, 1995).

Prior to ADOG's test well, Unocal and Marathon had been investigating the shallow gas potential of the Mat-Su Valley. Unocal defined what is now known as the Pioneer Unit and explored it in partnership with Ocean Energy in 1999-2000. In April, 2001, the 72,000 acre Pioneer Unit (Figure 2 and ***Cook Inlet Basin Oil and Gas Units*** layer in the *ArcGIS Project*) was purchased by Evergreen Resources Alaska, a wholly owned subsidiary of Evergreen Resources, Inc. (Evergreen) of Denver, CO, a company that has substantial experience in the development of CBM (Seamount and Downey, 2000). Note that the Pioneer Unit, which predates the SNGLP, has been permitted under the state's conventional oil and gas leasing regulations, not under the SNGLP regulations. Note also that the Division of Oil and Gas has not yet produced a digital file of the boundaries of the Pioneer Unit. According to the Division, there are still problems with the legal description of the unit. Evergreen would have to resolve those problems before the unit could go into production. The unit outline in the ***Cook Inlet Basin Oil and Gas Units*** layer in the *ArcGIS Project* was provided by Evergreen and was added to the boundaries of the other units that were provided by the Division of Oil and Gas.

The Pioneer Unit, which has a northeast-southwest long axis, is essentially bounded on its northwest and southeast sides by two faults, the Castle Mountain Fault and the Cottonwood Creek Fault, respectively (Figure 3). Because the sedimentary rocks between these two faults have been down-dropped (Figure 4, cross section A-A'), a thicker section of the coal-bearing

Figure 2 Boundaries of Pioneer Unit, including locations of proposed pilot project areas (1, 2 & 3), and water disposal (reinjection) well (Tanigawa, 2002).



Tyonek Formation has been preserved. The coal-bearing Tyonek Formation sediments quickly thin against the Talkeetna Mountains to the northeast and gradually thicken to the southwest (Figure 4, cross section B-B') (Seamount et al., 1997, 2001; Seamount and Downey, 2000). Evergreen feels it has the greatest CBM development potential in the Mat-Su Valley because: 1) CBM contents of the coalbeds as determined by the 1994 State of Alaska test hole and subsequent drilling, 2) the thickness of the coal-bearing sediments within the 'depth window', and 3) its proximity to transportation infrastructure and to market (J. Tanigawa, Evergreen Resources Alaska Corp., 2002, Personal Communication). In December, 2002 Evergreen completed the drilling of 8 holes designed to test two pilot areas Pioneer Unit. The two areas are immediately south of Loon Lake about 1.5 miles northwest of the Parks Highway–Big Lake Turnoff intersection and near the intersection of Church and Pittman roads.

While the Pioneer Unit clearly has some of the highest CBM potential in the Mat-Su Borough, there is also substantial potential for CBM development elsewhere. CBM potential exists in the Mat-Su lowlands wherever the coal-bearing Tyonek Formation is of sufficient thickness and in the vicinity of the historic coal producing areas in the Matanuska Valley. Under the SNGLP, various parties have applied for non-competitive leases. However, because of on-going litigation re: over-lapping lease applications, leases have not yet been issued in the Cook Inlet area (Pirtle Bates, ADOG, 2003, Personal Communication). The ***Shallow Natural Gas Lease Applications, 2002*** layer in the *ArcGIS Project* depicts those sections on which SNGLP lease applications have been filed. This layer should provide a reasonably good approximation of the

Figure 3 Pioneer Unit geology: The outline of the Pioneer Unit is shown by the dashed red line. The traces of the Castle Mountain (NW) and the Cottonwood Creek (SE) Faults are also shown. The crest of the Pittman Anticline is shown by the blue arrow (Seamount et al., 2001).

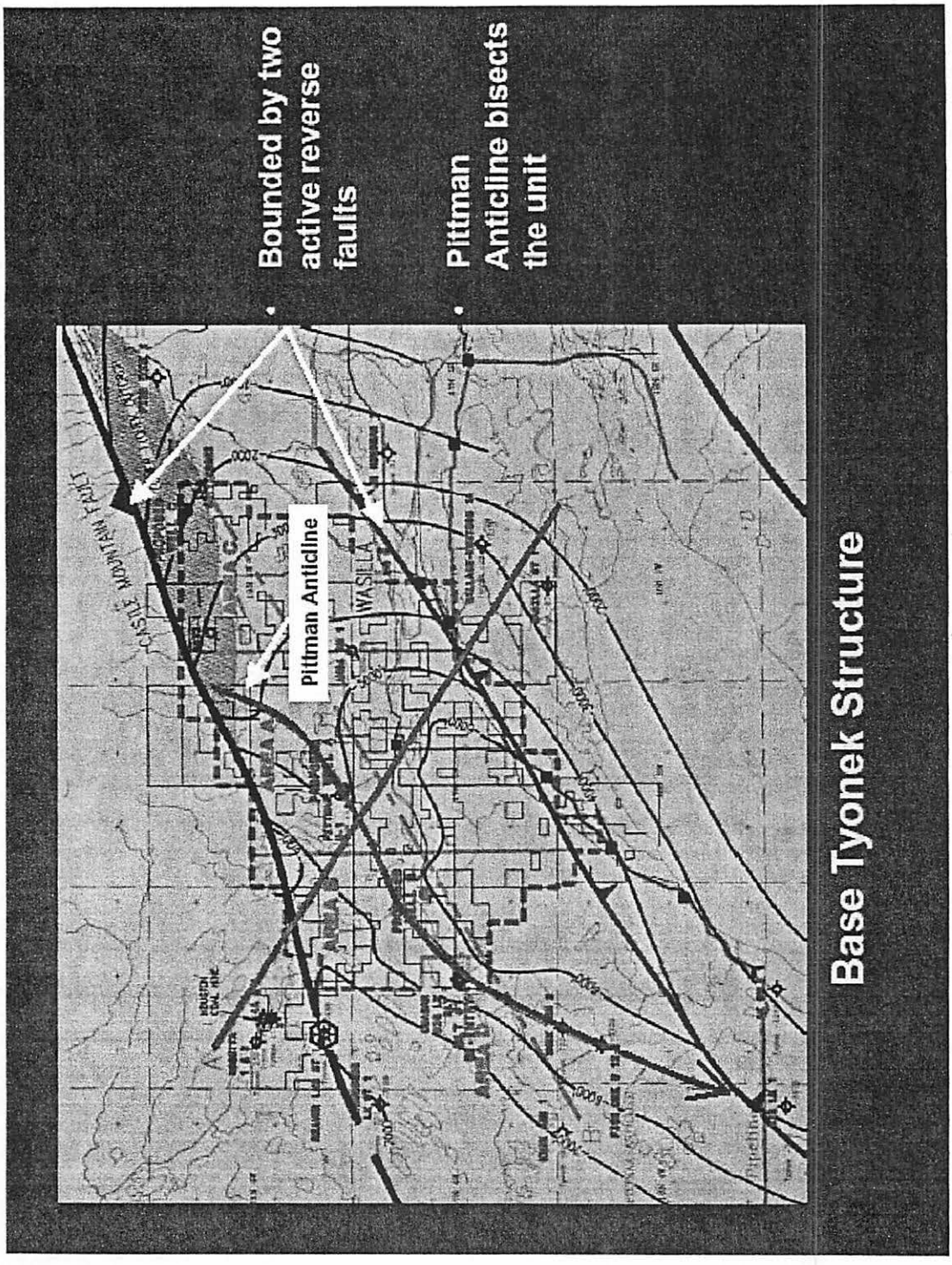
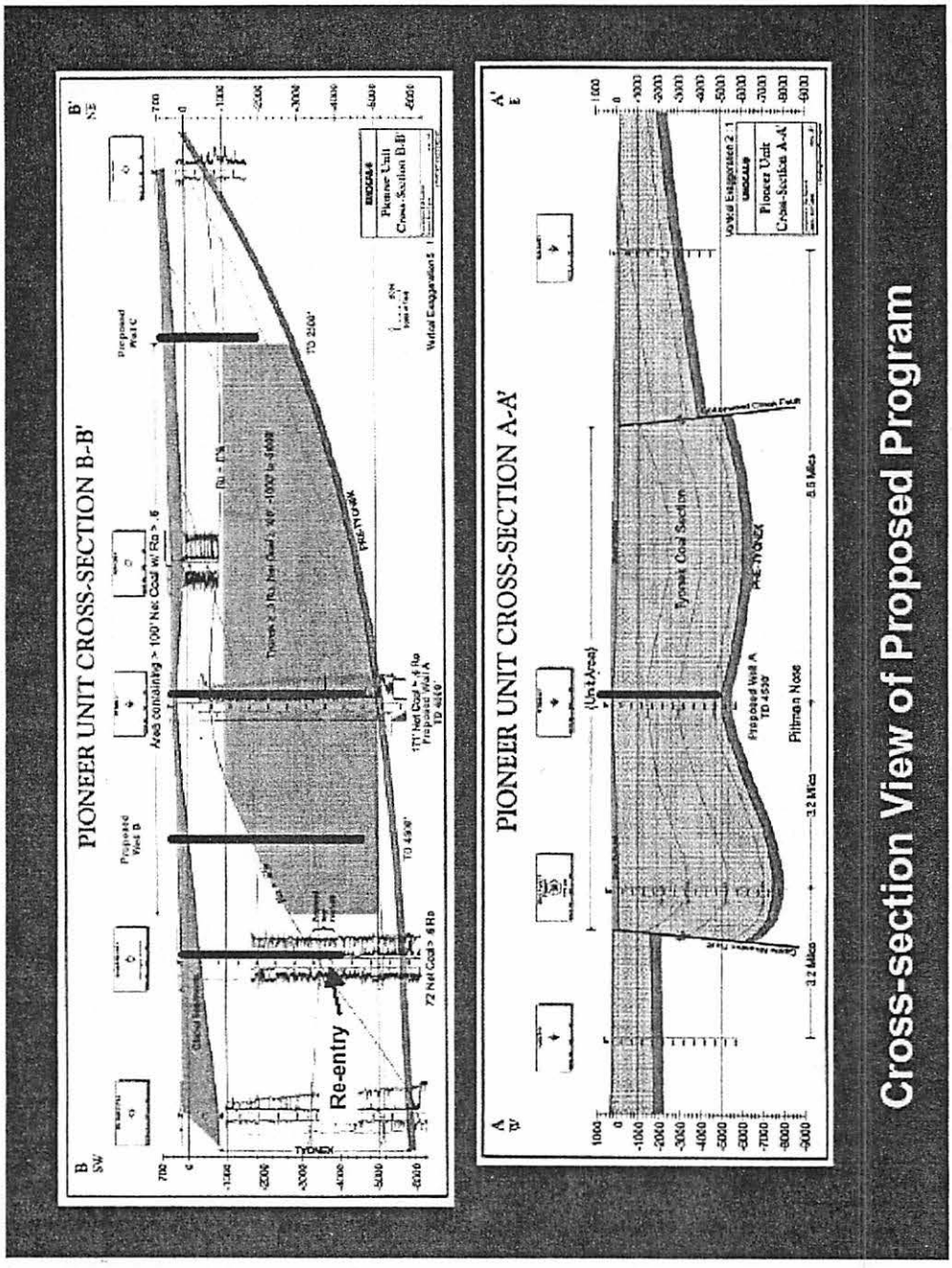


Figure 4 Pioneer Unit Cross Sections: Section A-A' looks to the northeast and is along the trace of the bold red line in Figure 3. It shows the greater thickness of the coal-bearing Tyonek Formation in the down-dropped block between the Castle Mountain and Cottonwood Creek Faults. Note also the arch-like Pittman anticline, which may serve as a trap for conventional (sandstone-hosted) gas. Section B-B' looks to the northwest and is along the trace of the dashed green line in Figure 3. It shows how the coal-bearing Tyonek sediments thin to the northeast, against the Talkeetna Mountains (Seamount et al., 2001).



other areas in the Mat-Su Borough, outside of the Pioneer Unit, which have significant CBM potential. Note that the Yentna and Beluga coal fields (see ***Coal Fields*** layer in the *ArcGIS Project*) may also contain substantial quantities of coalbed methane, but are less likely to be developed due to their remoteness. The Broad Pass coal field along the Parks Highway in the northern part of the Borough is less likely to contain commercial quantities of coalbed methane because the rank of its coal is relatively low.

Coalbed methane exploration and testing in the Mat-Su Borough is still in its infancy and there are still regulatory and economic hurdles to surmount. However, it is an exciting new potential energy source that may extend Cook Inlet gas reserves, and could provide many good-paying jobs in the Mat-Su Borough.

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