Airborne Geological and Geophysical Mineral Inventory **FY2001 Request: $250,000**
Reference No: 6852

AP/AL: Appropriation
Project Type: Planning
Category: Development
Location: Statewide
Contact: Nico Bus
House District: Statewide (HD 1-40)
Contact Phone: (907)465-2406
Estimated Project Dates: 07/01/2000 - 06/30/2002

Brief Summary and Statement of Need:
This project seeks to catalyze private-sector mineral development investment. The project delineates mineral zones on Alaska state lands that: 1) have major economic value; 2) can be developed in the short term to provide high quality jobs for Alaska; and 3) will provide economic diversification to help offset the loss of Prudhoe Bay oil revenue.

Funding:	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	Total
Gen Fund	$250,000	$500,000	$500,000	$500,000	$500,000	$500,000	$2,750,000
Total:	$250,000	$500,000	$500,000	$500,000	$500,000	$500,000	$2,750,000

☐ State Match Required ☐ One-Time Project ☑ Phased Project ☐ On-Going
0% = Minimum State Match % Required ☐ Amendment ☐ Mental Health Bill

Operating & Maintenance Costs:

	Amount	Staff
Project Development:	0	0
Ongoing Operating:	0	0
One-Time Startup:	0	
Totals:	0	0

Additional Information / Prior Funding History:
See detailed project description for additional information.

Project Description/Justification:
Description of Work to be done:
Contingent upon funding levels, DGGS proposes to conduct airborne geophysical surveys in FY01 in one to five areas in south-central, east-central, northwestern, or central Alaska. Candidate lands for this project have been identified on the basis of existing geologic knowledge, land ownership, and as response to solicitations for nominations from Alaska's mineral industry and Native regional corporations. The areas proposed for FY01 include: 1) Bonnifield district, central Alaska; 2) Paxson Region, south-central Alaska, 3) Northern Solomon district, Seward Peninsula; 4) Black Mountain/Southeast Pogo, east-central Alaska and 5) East Tanacross, east-central Alaska. These areas were chosen from a list of 51 candidate areas that have been identified by DGGS and nominated by knowledgeable Alaskan's for mineral surveys. To date geophysical surveys of the highest mineral potential tracts within 14 of the 51 candidate areas have been completed.

The Geophysical/Geological Mineral Inventory CIP project is designed to coordinate the generation of airborne geophysical data with ground-based geologic surveys. The geophysical data are of limited effectiveness unless good geologic maps are available to permit analysis and interpretation of the geophysics. If existing geologic data are inadequate, the required geological surveys are most effective when they follow generation of the final geophysical maps. Thus, unless good quality 1:63,360-scale geologic maps already exist, at least one additional year of ground-based field studies is needed to complete a project after an area has been surveyed with airborne geophysical sensors.

Cost of the surveys varies depending on each tract's size, location, and bid responses from geophysical services vendors. In the past, geophysical/geological surveys of single minimal but reasonably sized tracts have required about $400,000 to $500,000 in CIP funds, augmented by Federal Receipts and General Funds from the operating budget.

Products resulting from these surveys would include:
1. 1:63,360-scale aeromagnetic and airborne-electromagnetic maps
2. 1:63,360-scale bedrock and surficial geologic maps
3. 1:63,360-scale mineral occurrence maps
4. 1:63,360-scale land status map
5. Various other geological, geochemical, and geophysical data compilations.

Following is a more detailed description of the survey tracts being proposed for FY01.

Area 1: Bonnifield mining district, central Alaska
The Bonnifield district is located about 80 miles south of Fairbanks, Alaska. The district extends across the north flank of the Alaska Range for approximately 40 miles and is part of a larger mineral belt that extends into Canada. DGGS believes that geophysical data leading to a better understanding of the geologic framework hosting identified and potential ore deposits in the Bonnifield district will stimulate increased mineral exploration investment within this belt of rocks. Airborne geophysical surveys would provide valuable information to help decipher the distribution of the intrusive rocks, ore-bearing massive sulfide horizons, and fault structures believed to control the occurrence of mineralization within the Bonnifield district. The survey would also enable us to see beneath the younger Tertiary gravel that covers a significant part of the prospective bedrock in the district. Existing roads, infrastructure, and proximity to a power source at Healy would facilitate the mineral development of this area.

Approximately 80,000 oz of placer gold has been mined from the region since 1903; most of the placer gold has come from the western part of the district. Major lode prospects in the area include Liberty Bell gold deposit on the western end and the Dry Creek copper-lead-zinc-silver deposits on the eastern end of the proposed tract. Gold and base-metal (copper-lead-zinc) anomalies and mineral alteration zones are known throughout the proposed survey tract.

The varieties of metal associations in the district are poorly understood and point to multiple mineralization sources and types of deposits. Massive sulfide mineralization is known to occur with the mid-Paleozoic (320-400 million years old) Totatlanika Schist, near the contact between phyllitic felsic metavolcanic and metasedimentary rocks of the Mystic Creek member and the overlying carbonaceous phyllites of the Sheep Creek member. Shallow-dipping, large-scale faults are known to control massive sulfide mineralization. Alteration zones up to 2,000 ft wide have been identified along these faults. In addition geochemical and isotopic data indicative of pluton-related mineralization also are known within the proposed survey tract. Thus, both types of deposits may be present and commonly have distinctive geophysical signatures that can be matched to known deposits and used to identify new targets for advanced-stage exploration.

Area 2: Paxson Region, south-central Alaska
This region lies on the south flank of the Alaska Range, about 180 miles south of Fairbanks and 180 miles north of tidewater at Valdez. The area is near the intersection of the Richardson and Denali Highways and is crossed by the Richardson Highway.

Extensive faulting associated with the Denali fault has brought two different mineralized terranes in juxtaposition (1) Pennsylvanian-Permian volcanic arc rocks with massive sulfide occurrences of copper-lead-zinc, plus or minus gold and silver (Cu-Pb-Zn +/- Au, Ag) and (2) mafic-ultramafic rocks of Wrangellia terrane with copper-nickel-platinum group elements (Cu-Ni-PGE) potential. In addition, the faulting has created the plumbing for younger plutonic rocks with associated Cu-Au skarn and porphyry mineralization. Some believe that the plutonic rocks may also have played a role in mobilizing and concentrating the platinum group elements.

Most historic prospecting has concentrated on the mineralization associated with the porphyry, massive sulfide and skarn occurrences, while recent large-scale claim blocks have targeted the potential Cu-Ni-PGE resource where magmatic sulfides with significant platinum grades are reported. Within the last ten years, a metallogenic terrane of mafic and ultramafic rocks favorable for deposits of Ni-Cu-PGE, +/-Au has been identified to extend about 600 km along strike along the margin of "Wrangellia" south of the Denali fault from Alaska into northern British Columbia. The ultramafic rocks form sill-like intrusive centers thought to act as subvolcanic magma chambers that fed the thick, overlying basalts of the Nikolai Group. The portions of these intrusive complexes particularly favorable for deposits of Ni-Cu-PGE are believed to lie within this survey area, mostly covered by surficial deposits and vegetation.

Aeromagnetic surveys were flown of this area in the early 1970's, but we believe that modern, more closely spaced and

thus more detailed surveys will provide better control to more accurately determine faulting, mineral phases and alteration critical in defining the geology and locating the different types of mineralization. Coordinated "on-the-ground" field studies would be valuable in assessing the future platinum resources of the region. In addition, drill core from the mafic-ultramafic rocks that was given to the State by the private sector would play a critical role in this assessment. Although geochemical, isotopic and petrogenetic criteria have been established in the Canadian literature for the Cu-Ni-PGE deposits, these defining characteristic have not been applied using modern analytical techniques in the public literature to the Alaskan end of the trend.

Area 3: Northern Solomon District, Seward Peninsula
In 1993, DGGS conducted airborne-geophysical and ground-truth geological mineral surveys in the western half of the Nome mining district. The entire eastern half of the district also has high mineral potential but has not been geophysically or geologically inventoried. Our long-term objective is to acquire airborne geophysical and ground-truth geological data for the entire eastern Nome mining district. Because funding is often limited, however, we have subdivided the eastern Nome district into four potential survey tracts: northern Solomon, southern Solomon, Bluff, and Council.

The eastern Nome district encompasses the smaller Solomon, Bluff, and Council districts, which have collectively produced 5,921,000 ounces of gold (18 percent of total historical Alaskan output), from 1898-1995. The region is drained by Iron Creek, tributary to the Pilgrim and Kuzitrin Rivers. The proposed tracts contain a mixture of Native, state, and federal lands. The eastern Nome district is underlain by metamorphic rocks of the Nome Group which have been subdivided by DGGS and industry geologists during recent past geological and mineral surveys in the western Nome district. The Nome Group rocks contain several important mineral deposit types including low-sulfide gold quartz veins and zinc-silver-lead-gold massive sulfide deposits. Heavy mineral gold placer deposits have accounted for nearly all the past gold production. A combined airborne geophysical and geological ground-truth survey will allow industry to conduct more efficient detailed mineral exploration in the Nome area. If successful in catalyzing the development of a major year-round mining operation, the Alaska citizens living on the Seward Peninsula will have a significantly expanded opportunity for local employment.

Area 4: Black Mountain/Southeast Pogo, east-central Alaska
The Black Mountain/Southeast Pogo area is located approximately 50 miles northeast of Delta Junction. Access is by air or by boat up the Goodpaster River and the South Fork of the Goodpaster River from the Richardson Highway. The area is in the Goodpaster mining district, and has very little historical gold production. The private sector is very interested in this area for potential Pogo type deposits.

Regional geology of the Black Mountain/Southeast Pogo area consists of highly deformed, high-grade metamorphic rocks that were intruded by Cretaceous granodiorites about 92 million years ago. Elsewhere in the Yukon-Tanana terrane, granitoid rocks of this age are associated with gold mineralization.

Teck Resources Inc. and Sumitomo Corporation have announced a 1998 resource calculation at Pogo of 5.21 million ounces of gold with a grade of 0.52 ounces per ton. Mineralization is hosted in three large, tabular, gently dipping quartz bodies containing 3% sulfides, native bismuth, and native gold near a Tombstone suite granite body. Regional work has identified an 8 mile long trend of anomalous soil geochemistry extending from the Pogo deposit to the southeast. In the Black Mountain area several creeks contain placer gold and there are numerous lode gold prospects.

The geologic setting for mineral lode deposits is poorly known because of extensive vegetative cover. Airborne geophysical surveys would provide a way to map various lithologic units, especially distinguishing between plutonic rocks and the various schist and gneissic units, and regional structures. By completing an integrated geophysical-geologic mineral inventory program in the southeast Pogo area, extensions or new zones of Pogo-style mineralization may be identified.

Area 5: East Tanacross, east-central Alaska
The Tanacross quadrangle is located in east-central Alaska along the border with Canada, and it is transected by the Alaska and Taylor Highways. The east half of the Tanacross quadrangle contains numerous placer gold, lode gold, porphyry copper-molybdenum, and stratiform base metal prospects, and is part of a larger mineral belt that extends into Canada.

The regional geology of the area consists of Precambrian to Paleozoic amphibolite-grade schist and gneiss of the Yukon-Tanana terrain. The metamorphic units have been intruded by suites of plutonic rocks of Jurassic through Tertiary age.

Several porphyry copper-molybdenum prospects occur within the eastern Tanacross quadrangle, including the Taurus prospect. Preliminary reserves at the East Taurus prospect are estimated to be 23 million tonnes grading 0.3% copper and 0.039% molybdenum. There is also the potential for plutonic-related gold deposits similar to Pogo or Fort Knox, and for Tertiary epithermal-style gold mineralization. Locally the metamorphic rocks contain graphitic and quartz-mica schist units that host lead-zinc-copper mineralization, and these areas likely represent stratiform volcanogenic massive sulfide deposits.

The geologic setting for mineral lode deposits in the Tanacross quadrangle is poorly known because of extensive vegetation cover. Airborne geophysical surveys would provide a way to 1) map various lithologic units, especially distinguishing between plutonic rocks and the various metamorphic units, 2) identify conductive horizons favorable for hosting ore-bearing massive sulfide horizons, and 3) locate regional fault structures. At least two of the known porphyry copper prospects are spatially associated with magnetite, and an aeromagnetic survey may be useful for identification of additional magnetite-bearing plutons. By completing an integrated geophysical survey and geologic field mapping program in the Tanacross quadrangle, new zones of Pogo-style or Fort Knox-style gold, porphyry copper-molybdenum, and stratiform lead-zinc-copper-silver-gold mineralization may be identified.

Project Benefits:
Geologic resources comprise a major part of Alaska's economic assets. The location and magnitude of these resources are largely unknown, yet that knowledge is the key to orderly development of the state and to the maintenance of a stable economy. Experienced mineral exploration managers have characterized Alaska's present state of mineral development as analogous to that of the entire group of states west of the Rocky Mountains in the late 1800s. At that time a few major ore bodies had been found and prospectors had located hundreds of prospects but none of the scores of subsequent world-class mines had been discovered. Alaska is like that. We, however, have the opportunity, capital, and technology to expedite discovery if we so choose.

Alaskans cannot manage or develop assets that are unknown and unquantified. The present lack of geologic knowledge is a formidable impediment to long-range planning for both industry and the state. The lack of knowledge discourages private-sector investment in Alaska, and instead favors capital allocation to other areas of the world where comprehensive assessments exist or are being actively generated. Major mining companies rely on government-supplied exploration scale (1:63,360) geological, geophysical, and geochemical maps to design and implement their programs. They expect at least this level of effort from any government that seriously desires a mineral industry. Alaska is in competition with every other country, state, and province for investment dollars. Many of those competitors' lands have far less potential than Alaska, are just as remote, have been more explored, or exist in a much less stable political climate than Alaska. These competitors are more successful than Alaska in sustaining a robust mining industry because of their extensive geologic information base or because of the pace at which they are generating such a base of new information.

Applications of a thorough resource information base include:
1. Enhancing community and local government economies and revenue opportunities. Resource development in these areas can provide local sources of wages, tax revenue, and royalty income that are necessary for local infrastructure and essential services.
2. Stimulating private-sector exploration and competitive development of Alaska's mineral resources. The present lack of geologic resource knowledge is a formidable impediment to long-range planning for both industry and the state. The lack of resource knowledge discourages private-sector investment in Alaska, and instead favors capital allocation to other areas of the world where comprehensive assessments exist.
3. Marine terminal and transportation corridor development. Transportation infrastructure development always requires cost justification based on prior knowledge of resource availability indicating the likelihood of investment payback and geotechnical knowledge that ensures engineering feasibility.
4. Long-term decisions on management of state-interest lands. Products from this project allow the state to look beyond the short-term rise and fall of commodity markets in formulating mineral-resource policies and in responding to related issues, such as land trades, corridor development, area plans, etc.

Economic Development:
The Airborne Geophysical and Geological Mineral Inventory Project has been successful in catalyzing private sector investment and job generation at a level that far surpasses the cost of conducting the surveys. For the past six years there has been a sustained growth in the contribution of Alaska's mineral industry to the economy of the state. In 1993, a year prior to the state's first district-scale airborne geophysical/geological mineral inventory surveys, $30.3 million/year was spent on exploration in Alaska. By 1998 the amount spent on exploration had increased to $56.4 million/year. The

estimate for exploration expenditures in 1999 ($50.0 million) is similarly high. In 1993, the total value of the Alaska mineral industry was $506.7 million/year and in 1997, the total value of the Alaska mineral industry was $1,105.4 million/year in 1998. Additionally, although many small-scale placer operations have vanished, there is a net increase of 350 jobs in the mineral industry in the state since 1993 because of the increase in mineral exploration and active lode mining.

Finally, although mineral development is a high risk enterprise, there is a good probability that several of the prospects identified with the help of data generated by this project will become major mines and thus return the amount of the state's data generation investment a hundred fold. A similar investment in geologic knowledge in 1982 contributed to the ultimate development of the Fort Knox gold mine near Fairbanks. A recent study found that the Fort Knox Mine creates an annual total of $107 million in local purchases including $35 million directly, and creates 312 indirect jobs in the Fairbanks area. About $4.4 million of local property taxes are generated annually by the mine and its employees, and average residential electricity rates in the Fairbanks area have been reduced by about 7 percent by the mine. These economic benefits to Fairbanks and Alaska are projected to continue throughout the mine life of five to ten years.

Project Support:
Local communities, Native corporations, private resource industry, Alaska Minerals Commission, regional borough governments, Department of Commerce and Regional Affairs, and Department of Natural Resources support the project. Three surveys (western Nome District, Nyac, and parts of the Rampart/Manley District) were conducted in cooperation with the Bering Straits Native Corporation, Sitnasuak Village Corporation, Calista Native Corporation and Doyon Native Corporation, respectively. As owners of large tracts of land intermingled with state lands, they contributed various combinations of services, private geoscience data files, and funding to support the surveys.

Project Opposition: None known.

Alternative Approaches Considered:
1. Sole reliance on satellite or remote sensing imagery. This approach is rejected because of low resolution and because it cannot look beneath extensive ground cover such as tundra, forest, and soil types in Alaska, and also because it does not provide an unambiguous methodology for detecting subsurface mineralization.
2. Sole reliance on currently available data. Rejected because of general lack and quality of geologic data. Only 15 percent of Alaska has adequate geological mapping, and almost none of it has detailed geophysical surveys.
3. Sole reliance on ground-based field investigations. Rejected because of protracted time necessary for such an approach (decades) and because it provides no subsurface information.
4. Sole reliance on airborne geophysical methods. Rejected because geophysical anomalies alone cannot be interpreted without geological and geochemical control.
5. An integrated approach, utilizing regional geophysical and geochemical methods that define resource-rich regions, followed by detailed airborne geophysical surveys and ground-based geological/geochemical investigations of high priority areas. This approach allows the inventory to be completed in an acceptable time, to discriminate between barren and resource-rich anomalies, to identify specific commodities, and provide a quantified estimate of resource value and location.

Alternative Financing Considered:
1. Financing the project through voluntary consortia of private-sector firms. Rejected because of inherent conflict-of-interest concerns between the state, contributing firms, non-contributing firms, and the public at large; the timeliness of executing such a financing approach; and the lack of continuity inherent in such a funding mechanism.
2. Funding the project through the operating budget was considered and rejected because of the significant increase to the base budget.

Projected Revenue to the State:
Mining license tax, Corporate income tax, Local property taxes

Does this project leverage other funding for the state?
DGGS will designate a portion of these CIP funds as a state match for federal funds within the federal State Map National Cooperative Geologic Mapping Program. We also use general fund base-budget money to fund personnel who implement this project.

Project History:
Started in 1992, the project was originally designed to systematically acquire geophysical, and where necessary,

geological data for about 40 million acres of state-owned uplands having high perceived mineral potential. Funding restrictions have led to decreasing the annual scope of the project (table 1 below), but the purpose and goals have not changed. Candidate lands for this project have been identified on the basis of existing geologic knowledge, land ownership, and responses to solicitations for nominations from Alaska's mineral industry and Native regional corporations.

Table 1 below lists previous appropriations for the Airborne Geophysical and Geological Mineral Inventory program, by fiscal year and CIP amount appropriated.

FY93 $450,000
FY94 $750,000
FY95 $600,000
FY96 $200,000
FY97 $600,000
FY98 $500,000
FY99 $500,000
FY00 $400,000

Table 2 below shows the status of previous and current geophysical/geological survey areas. Preliminary products for ground-truth mapping for the geophysical surveys of the Upper Chulitna and Petersville regions were released in FY99. Final geologic maps should be released by January 2000. Ground-truth geologic mapping began in FY01 in the Iron Creek and Fortymile survey tracts, flown in FY98 and FY99.. Iron Creek is planned as a two year project in cooperation with the U.S. Geological Survey. Ground-truth work in the Fortymile tract is designed as a three year project. Publications from these areas will be produced yearly by the following summer to keep the public informed of the progress. Previously authorized CIP funds are designated to support these geological ground truth activities. Unless additional funds are appropriated to initiate new airborne-geophysical/geological mineral surveys elsewhere, no new high mineral potential tracts will be geophysically surveyed in FY01.

Table 2. Status of work on previous and current geophysical/geological survey areas:

Nome District western core area	494 sq. miles	Airborne geophysical mapping completed Ground-truth geological mapping completed
Nyac District core area	183 sq. miles	Airborne aeromagnetic mapping completed
Circle District core area	338 sq. miles	Airborne geophysical mapping completed Ground-truth geological mapping completed
Valdez Creek District	75 sq. miles	Airborne geophysical mapping completed
Fairbanks District	626 sq. miles	Airborne geophysical mapping completed Ground-truth geological mapping completed
Richardson District	137 sq. miles	Airborne geophysical mapping completed
Rampart/Manley-Tofty	1017 sq. miles	Airborne geophysical mapping completed Ground-truth geological mapping completed
Upper Chulitna District	364 sq. miles	Airborne geophysical mapping completed Ground-truth geological mapping completed FY99; Final summary/synthesis map to be completed in FY00)
Petersville-Collinsville District	415 sq. miles	Airborne geophysical mapping completed Ground-truth geological mapping completed FY99; Final summary/synthesis map to be completed in FY00)
Iron Creek District	689 sq. miles	Airborne geophysical mapping completed Ground-truth geological mapping (begin FY01, first of three years)
Ruby District	591 sq. miles	Airborne geophysical mapping completed Geological map completed
Fortymile District	1036 sq. miles	Airborne geophysical mapping completed Ground-truth geological mapping (begin FY01, first of three years)
Livengood District	229 sq. miles	Airborne geophysical mapping completed
Salcha River/North Pogo District	1032 sq. miles	Airborne geophysical mapping (will be completed in FY00)