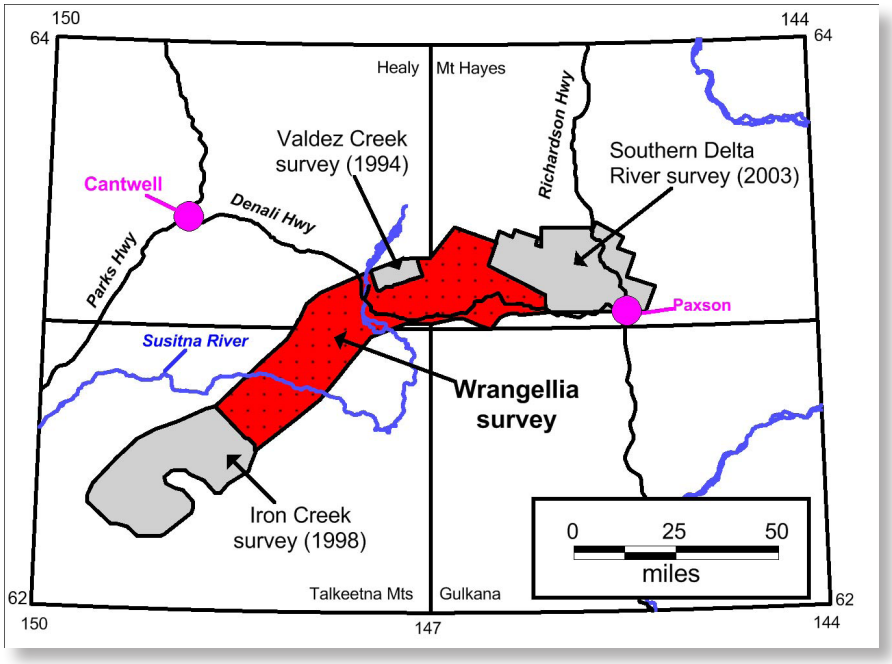
# AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: AIRBORNE GEOPHYSICAL SURVEY OF WRANGELLIA, SOUTH-CENTRAL ALASKA

The Alaska Division of Geological & Geophysical Surveys' (DGGS) Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is a multi-year investment to expand the knowledge base of Alaska's mineral resources and catalyze private-sector mineral development. The program seeks to delineate 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. Candidate lands for this project are identified on the basis of existing geologic knowledge, land ownership, and responses to solicitations for nominations from Alaska's geologic community. Products resulting from these surveys generally include: (1) 1:63,360-scale aeromagnetic and airborne-electromagnetic maps; (2) 1:63,360-scale geologic maps; and (3) various other geological, geochemical, and geophysical data compilations. As a result of this program, millions of dollars of venture capital have been spent in the local economies of the surveyed mining districts and adjacent areas in direct response to the new geologic knowledge provided by the surveys.

As part of the state-funded AGGMI program, the Strategic and Critical Minerals Assessment Project is geophysically surveying 1,400 square miles in the Talkeetna Mountains, Healy, and Mount Hayes quadrangles, termed the Wrangellia survey (see figure). The survey area lies 150 miles north–northeast of Anchorage, and encompasses portions of the Clearwater Mountains, the Talkeetna Mountains, and lowlands of the Susitna and Maclaren river valleys. The new survey is adjacent to three surveys previously released by DGGS. The area is composed mainly of State lands, with lesser areas of BLM-managed State selected land, and minor amounts of Native and Native selected land. Geophysical information being acquired for the Wrangellia survey includes aeromagnetic and electromagnetic data. Millrock Exploration Corporation is contributing additional, privately funded airborne geophysical data to be combined and published with the DGGS survey.




The majority of the Wrangellia survey area is underlain by upper Paleozoic to Late Triassic sedimentary and volcanic rocks of the Wrangellia terrane. These strata are intruded by Late Triassic gabbroic to ultramafic dikes and sills; similar intrusions are associated with nickel, copper, and platinum-group-element mineralization where they have been explored in the Paxson area and at the Wellgreen prospect in the Yukon Territory. The survey also covers the Butte Creek placer gold mining area, underlain by Kahiltna Assemblage sedimentary rocks and Cretaceous to Early Tertiary granitic intrusions.

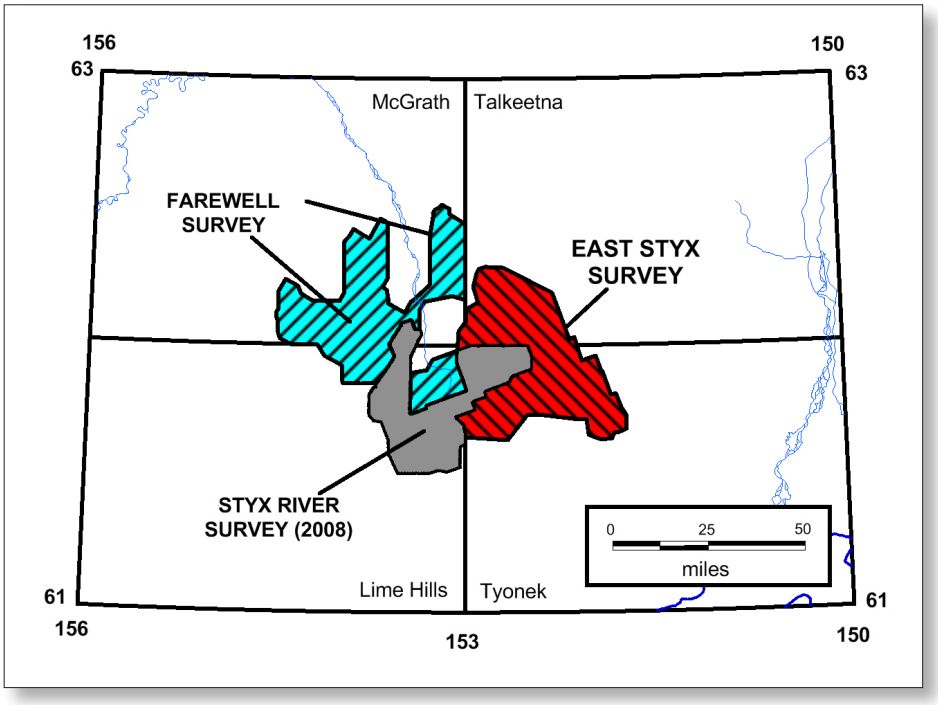
Airborne geophysical surveys enable users to delineate regional structures and identify metamorphic–stratigraphic lithologies and plutonic rock types on the basis of their geophysical characteristics. Follow-up geologic mapping tests geophysical anomalies and interpretations, and provides detailed documentation of the types, locations, and spatial distribution of metamorphic and plutonic rocks and structural features. By completing an integrated geophysical–geological mineral inventory study, new zones of mineralization may be identified and extrapolation of some of the information into surrounding areas may be appropriate.

Maps and digital data will be released as DGGS Geophysical Reports by February 2014. A second publication, containing a project report, interpretation, and electromagnetic anomalies, is expected to be released by summer 2014. DGGS believes these data will lead to a better understanding of the geologic framework of the area and will stimulate increased mineral exploration investment in the survey boundary and the surrounding area.

Contact: Laurel Burns, 907-451-5021, laurel.burns@alaska.gov

# AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: AIRBORNE GEOPHYSICAL SURVEY OF THE EAST STYX AREA, SOUTH-CENTRAL ALASKA

The Alaska Division of Geological & Geophysical Surveys' (DGGS) Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is a special multi-year investment to expand the knowledge base of Alaska's mineral resources and catalyze private-sector mineral development. The program seeks to delineate 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 Alaskans; and (3) will provide economic diversification to help offset the loss of Prudhoe Bay oil revenue. Candidate lands for this program are identified on the basis of existing geologic knowledge, land ownership, and responses to solicitations for nominations from Alaska's geologic community. Products resulting from this program generally include: (1) 1:63,360-scale aeromagnetic and airborne-electromagnetic maps; (2) 1:63,360-scale bedrock geologic maps; and (3) various other geological, geochemical, and geophysical data compilations. As a result of the AGGMI program, millions of dollars of venture capital have been spent in the local economies of the surveyed mining districts and adjacent areas in direct response to the new geologic knowledge provided by the surveys.




Through the state-funded AGGMI program, DGGS is geophysically surveying 1,052 square miles in the northwestern Tyonek, southwestern Talkeetna, and eastern Lime Hills quadrangles in 2013 and 2014 (see figure). The East Styx survey is centered about 95 miles northwest of Anchorage and is adjacent to the Styx River survey released in 2008. The East Styx area is State-owned land and is mostly in the Yentna mining district. Aeromagnetic, electromagnetic, and radiometric data are being acquired. These data will be released in 2014. A later publication will contain merged aeromagnetic and merged resistivity grids for the East Styx, Styx River, and Farewell surveys.

Reconnaissance geologic mapping suggests the area consists mainly of Juro–Cretaceous sedimentary rocks of the Kahiltna terrrane, mafic volcanic rocks of possible Talkeetna Formation (Jurassic), and numerous plutons of mafic to felsic composition of Cretaceous to Tertiary age. Tertiary coal-bearing sediments lie unconformably on the Juro–Cretaceous sedimentary rocks. Many prospects are present in the survey area and are thought to represent several different deposit types, including polymetallic veins, epithermal veins, and porphyry copper deposits. Many prospects are near the plutonic rocks. The structural history is complex and poorly understood.

Airborne geophysical surveys, in combination with detailed geologic mapping, provide a way to differentiate various rock units, especially distinguishing between granitic rocks and the various metamorphic rocks, and to delineate regional structures. By completing an integrated geophysical/geological mineral inventory study, new zones of mineralization may be identified, and extrapolation of some of the information into surrounding areas may be appropriate. DGGS believes that geophysical and geological data, which lead to a better understanding of the geologic framework hosting identified and potential ore deposits in these districts, will stimulate increased mineral exploration investment in these belts of rocks and the surrounding areas, and will provide information useful for state resource management and land-use planning.

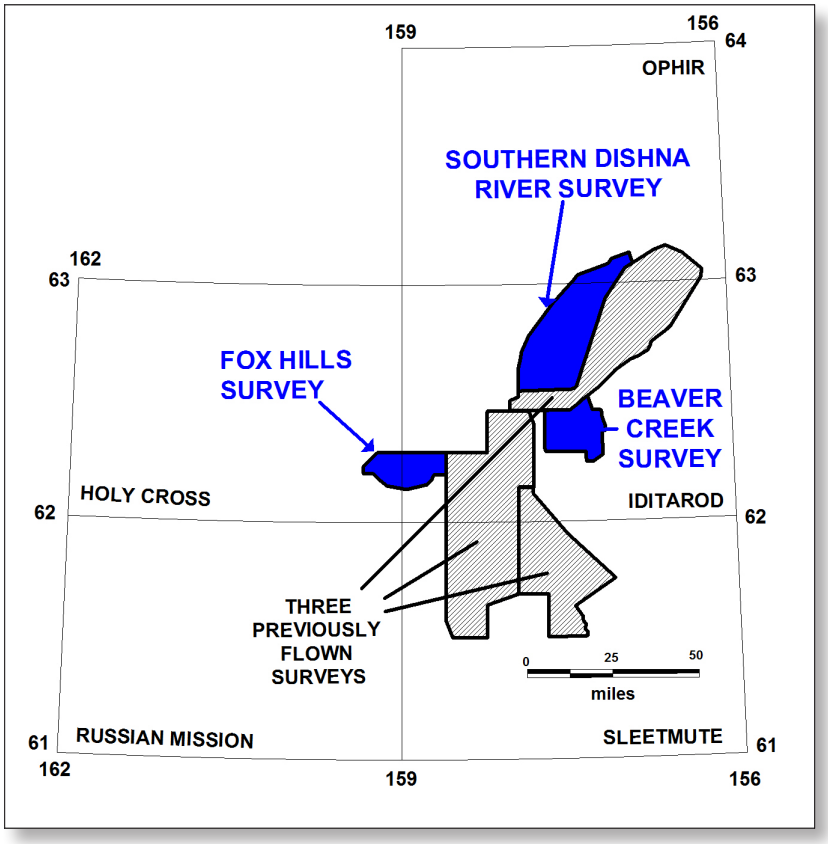
Contact: Laurel Burns, 907-451-5021, laurel.burns@alaska.gov

# AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: AIRBORNE GEOPHYSICAL SURVEYS OF SOUTHERN DISHNA RIVER, FOX HILLS, AND BEAVER CREEK AREAS, WESTERN ALASKA

The Alaska Division of Geological & Geophysical Surveys' (DGGS) Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is a multi-year investment to expand the knowledge base of Alaska's mineral resources and catalyze private-sector mineral development. The program seeks to delineate mineral zones on Alaska State-owned 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. Candidate lands for this project are identified on the basis of existing geologic knowledge, land ownership, and responses to solicitations for nominations from Alaska's geologic community. Products resulting from these surveys generally include: (1) 1:63,360-scale aeromagnetic and airborne-electromagnetic maps; (2) 1:63,360-scale geologic maps; and (3) various other geological, geochemical, and geophysical data compilations. As a result of this program, millions of dollars of venture capital have been spent in the local economies of the surveyed mining districts and adjacent areas in direct response to the new geologic knowledge provided by the surveys.

Through the State-funded AGGMI program, DGGS acquired airborne-geophysical data for three blocks in the Iditarod, Ophir, Sleetmute, and Holy Cross quadrangles in FY13 (see figure). The new blocks are adjacent to the previous Iditarod and Aniak surveys. The three areas of this survey total 1,029 square miles and are roughly centered on Flat, Alaska, about 85 miles southwest of McGrath and 275 miles west–northwest of Anchorage. Two-thirds of the area is State-owned land, and the remainder is Federal land. Most of the survey area is part of the Iditarod and Innoko mining districts, which have produced more than 2.3 million ounces of gold; only 3,000 ounces of this production has been from lode sources. The discovery of more than 33 million ounces of gold associated with a Late Cretaceous dike swarm at the Donlin gold deposit, south of the area in the western Sleetmute Quadrangle, has kept mineral exploration activity high in the region.

Like the Donlin gold area, most of the survey area is composed of the Upper Cretaceous Kuskokwim Group, a flysch sequence consisting of interbedded sandstone and shale. Most plutons have quartz-monzonitic to monzonitic compositions and are calc-alkaline. Mineralization is thought to be contemporaneous with plutonism at several localities in the region. Besides plutonic-related gold deposits, other lode potential in the survey area includes mesothermal and epithermal deposits that contain mercury, tungsten, silver, antimony, and tin.




Airborne geophysical surveys enable users to delineate regional structures, and identify metamorphic–stratigraphic lithologies and plutonic rock types on the basis of their geophysical characteristics. Follow-up geologic mapping tests geophysical anomalies and interpretations, and provides detailed documentation of the types, locations, and spatial distribution of metamorphic and plutonic rocks and structural features. By completing an integrated geophysical–geological mineral inventory study, new zones of mineralization may be identified, and extrapolation of some of the information into surrounding areas may be appropriate.

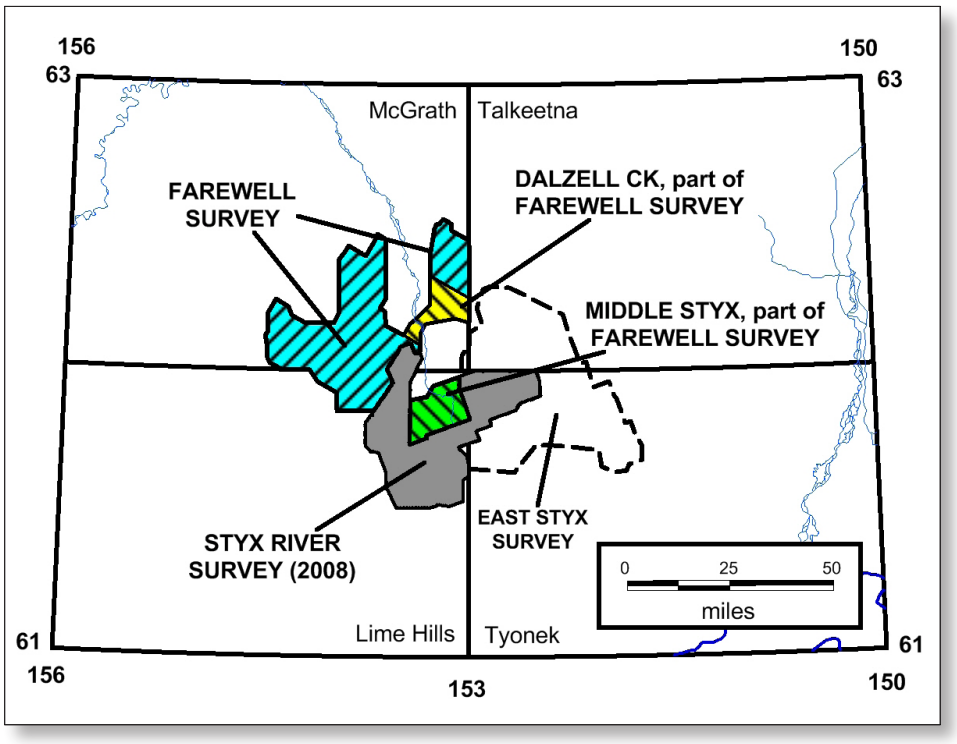
Geophysical information being acquired for these three areas includes aeromagnetic and electromagnetic data. Processed digital data and maps acquired for these three areas were released as DGGS Geophysical Reports in November 2013. A second publication, containing a project report, interpretation, and electromagnetic anomalies, will be released in mid- to late 2014. DGGS believes these data will lead to a better understanding of the geologic framework of the area and will stimulate increased mineral exploration investment within the survey boundary and the surrounding area.

Contact: Laurel Burns, 907-451-5021, laurel.burns@alaska.gov

# AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: AIRBORNE GEOPHYSICAL SURVEY OF THE FAREWELL AREA, SOUTH-CENTRAL ALASKA

The Alaska Division of Geological & Geophysical Surveys' (DGGS) Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is a special multi-year investment to expand the knowledge base of Alaska's mineral resources and catalyze private-sector mineral development. The program seeks to delineate 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 Alaskans; and (3) will provide economic diversification to help offset the loss of Prudhoe Bay oil revenue. Candidate lands for this program are identified on the basis of existing geologic knowledge, land ownership, and responses to solicitations for nominations from Alaska's geologic community. Products resulting from this program generally include: (1) 1:63,360-scale aeromagnetic and airborne-electromagnetic maps; (2) 1:63,360-scale bedrock geologic maps; and (3) various other geological, geochemical, and geophysical data compilations. As a result of the AGGMI program, millions of dollars of venture capital have been spent in the local economies of the surveyed mining districts and adjacent areas in direct response to the new geologic knowledge provided by the surveys.

As part of the state-funded AGGMI program, the Strategic and Critical Minerals Assessment project geophysically surveyed 1,092 square miles in the southeastern McGrath and northeastern Lime Hills quadrangles in 2012 and 2013 (see figure). The Farewell survey blocks, about 135 miles northwest of Anchorage, are in State-owned land except for almost 100 square miles of Native-owned land. Cook Inlet Region, Inc. (CIRI) contributed additional money for data acquisition over an extension of Native land immediately to the north of the planned survey area. These data will be included with the DGGS data. Most of the land is in the McGrath mining district, and about 18 square miles is in the Yentna mining district.




The Farewell survey is adjacent to the Styx River survey that was released in 2008. Aeromagnetic, electromagnetic, and radiometric data are being acquired. Two subsets of the Farewell survey, the Middle Styx and Dalzell Creek surveys, were released in fall 2013 and comprise about 240 square miles of data. The remaining areas of the Farewell survey were flown in summer of 2013. All data from 2013 will be merged with the Dalzell Creek data and are expected to be released in mid to late winter 2014.

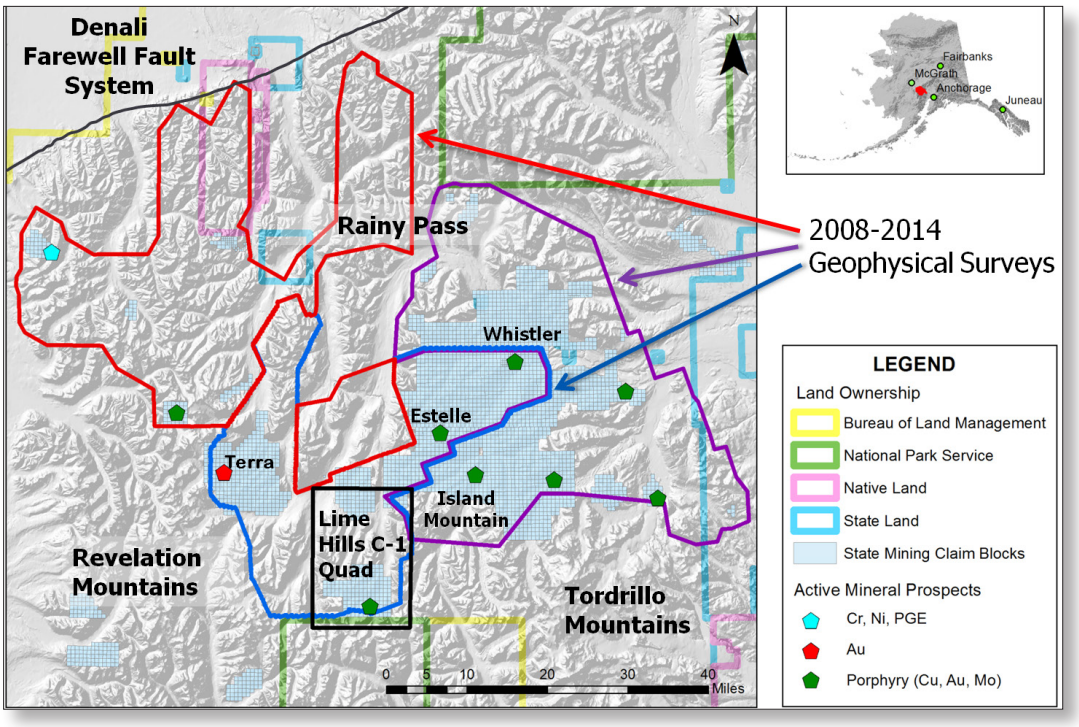
The Farewell geophysical survey area is just south of the Denali–Farewell fault system and is underlain by structurally deformed rocks of the Dillinger and Mystic subterranes. The region contains numerous Cretaceous- and Tertiary-age plutonic complexes, dike swarms, and volcanic fields, many of which are spatially and genetically associated with mineral occurrences. Most of the mineral prospects and occurrences are porphyry copper ± molybdenum ± gold deposits and polymetallic veins. Lead–zinc skarns, molybdenum-bearing quartz veins, sediment-hosted base-metal, platinum-group-element (PGE), and rare-earth-element (REE) deposit types are also present. The areas around Bowser Creek and the Chip–Loy and Robert's PGM prospects are currently being actively explored, as well as several other areas.

Airborne geophysical surveys, in combination with detailed geologic mapping, provide a way to differentiate various rock units and delineate regional structures. By completing an integrated geophysical–geological mineral inventory study, new zones of mineralization may be identified and extrapolation of some of the information into surrounding areas may be appropriate. DGGS believes that geophysical and geological data, which lead to a better understanding of the geologic framework hosting identified and potential ore deposits in these districts, will stimulate increased mineral exploration investment within these belts of rocks and the surrounding areas, and will provide information useful for state resource management and land-use planning.

Contact: Laurel Burns, 907-451-5021, laurel.burns@alaska.gov

## GEOLOGIC MAPPING IN THE STYX RIVER AREA, WESTERN ALASKA RANGE

The Alaska Division of Geological & Geophysical Surveys (DGGS) Mineral Resources section conducted four weeks of geologic mapping in the Styx River area of the Lime Hills C-1 Quadrangle (see figure) during summer 2013 as part of the State-funded Airborne Geophysical/Geological Mineral Inventory (AGGMI) program. DGGS geologists mapped with the benefit of airborne geophysical data from the 2008 Styx River survey, which aided geologic interpretations. Concurrent with this field program, two other airborne geophysical surveys were flown nearby: the Farewell survey (p. 44) and the East Styx area (p. 42). The DGGS map area is bounded by the high Tordrillo Mountains to the southeast, and is about 45 miles southwest of Denali National Park and Preserve.



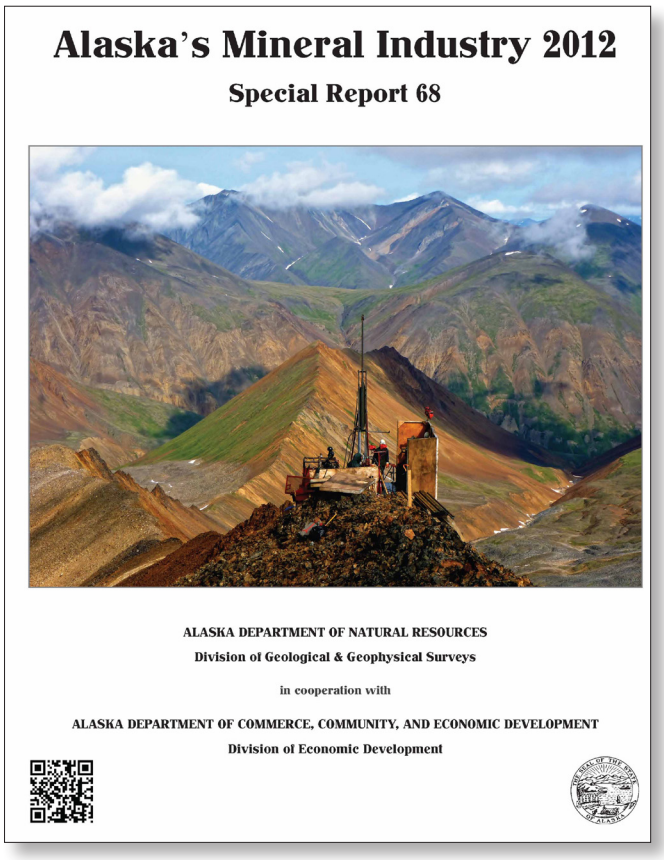

This is an area of interest for the State because of its mineral-resource potential, as evidenced by the many recent geophysical surveys and amount of active mineral exploration on State land. Millrock Resources, Inc., and Kiska Metals Corp. have large tracts of mining claims to the northeast of the study area. The claims are located in the mineralized Mount Estelle pluton and the Whistler and Island Mountain porphyry copper–gold–molybdenum systems. Northwest of the map area at the Terra prospect, Corvus Gold, Inc., and WestMountain Gold, Inc., are exploring and test-mining gold and polymetallic veins at the foot of the Revelation Mountains. There are also reduced intrusion-related gold, lead–zinc skarns, molybdenum-bearing quartz veins, sediment-hosted base metals, platinum-group-element, and rare-earth-element prospects in the region. The majority of these mineral occurrences are related to numerous Late Cretaceous- and Tertiary-age granite to gabbro intrusions and Tertiary volcanic rocks. Understanding the complex overlapping intrusive, volcanic, and tectonic history of the area is critical to determining the source and controls of mineralization. The detailed geologic mapping and research that DGGS conducts as part of the AGGMI program provides the basis for this understanding.

Prior to the geologic mapping by DGGS, the U.S. Geological Survey (USGS) published a 1:125,000-scale geologic map based on aerial photo interpretation and limited on-the-ground observations. The DGGS mapping team described and sampled bedrock, recorded the kinematics of structural features, and examined and sampled known and newly discovered mineral occurrences. Significant changes and refinements are being made to the existing map, including additional faults and dikes, revision of pluton boundaries, and subdivision of geologic units. These new observations and interpretations, supported by geochemical data, petrographic research, and new age determinations, will shed light on the intrusive, volcanic, and structural history of the area and will foster a better understanding of the ore deposits in the region. The DGGS team is also collaborating with the USGS Western Alaska Range Project (WARP) team, which is conducting two regional transects of the Alaska Range north and south of the Styx River project. Continued work on the Styx River project will result in a 1:63,360-scale geologic map, accompanying interpretive text, and supporting geochemical and geochronologic data releases. These products will be published on the DGGS website during 2014.

Contact: Karri Sicard, 907-451-5040, karri.sicard@alaska.gov

## ANNUAL ALASKA MINERAL INDUSTRY REPORT

The Department of Natural Resources' Division of Geological & Geophysical Surveys (DGGS), and the Division of Economic Development (DED) in the Department of Commerce, Community & Economic Development gather, verify, collate, and distribute statistics and summary observations about Alaska's mineral industry and release this information to the public in a timely manner in the form of an annual report. The report satisfies Alaska Statute § 27.05.060 stating, "The department [DNR] shall make an annual report to the governor on all essential matters with regard to mining in the state…" The purpose of this cooperative effort is to supply information to the mineral industry, provide the State and the public with valuable data pertaining to the health of Alaska's mineral industry, and foster a better understanding of the significance of the mineral industry to Alaska's private sector and government.




The annual Alaska mineral industry report is a key source of information about exploration, development, and production of Alaska's mineral resources. Statewide and international circulation of the report and its findings at professional mineral industry conventions and trade shows, at chambers of commerce and other organizations' meetings, and in professional journals informs the general public, local and international mineral industry, and local, State, federal, and international government agencies about current activities in Alaska's mineral industry. The report serves as a barometer for the mineral industry's status in any given year and provides unbiased, authoritative information compiled in a consistent format. Government personnel rely on the report as an essential tool for formulating public policy affecting resource and land management.

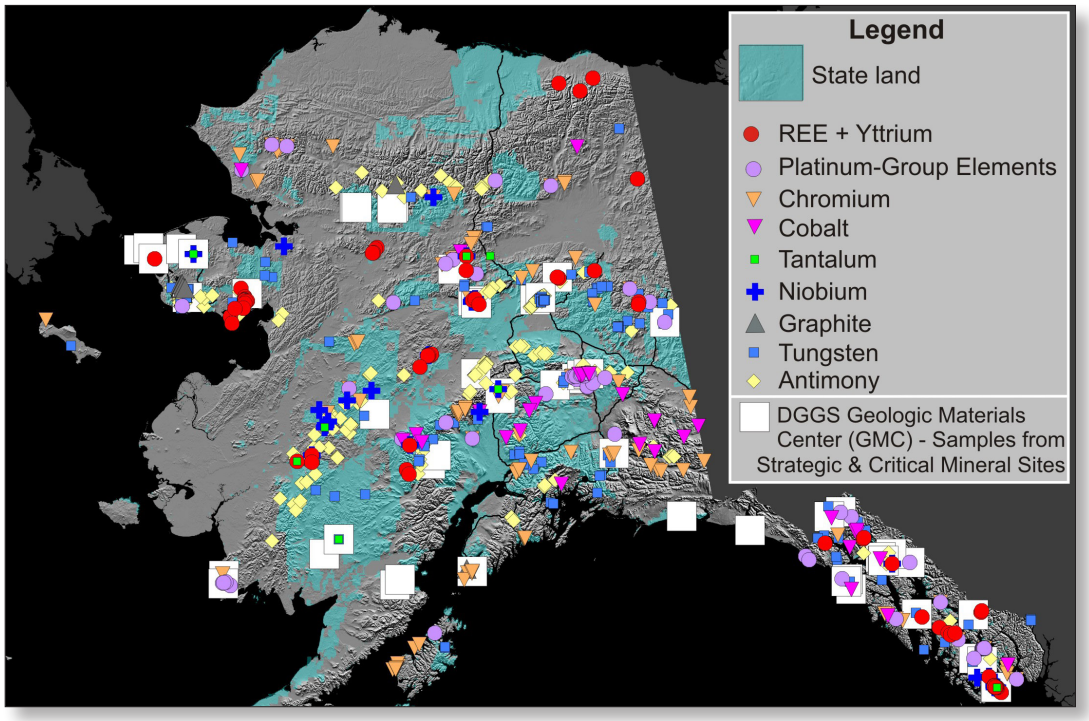
DGGS and DED are collaborating with the Department of Natural Resources' Division of Mining, Land & Water, Department of Labor & Workforce Development, and the Department of Revenue to streamline data collection and enhance reporting on Alaska's mineral industry. The agencies are working with industry representatives and the State Minerals Commission to develop a program that is comprehensive and statistically valid, minimizes redundant or archaic data collection methods, and keeps pace with evolving stakeholder needs. In the interim, DGGS and DED are committed to maintaining uninterrupted collection of mineral exploration, development, and production data. The 2012 Alaska mineral industry activity report, released in November 2013, summarizes information provided via questionnaires mailed by DGGS, phone interviews, press releases, and other information sources (see figure). The total reported value of Alaska's mineral industry remained strong in 2012, decreasing slightly to $4,113.6 million. Exploration expenditures for 2012 were at least $335.1 million, down about 8 percent from the 2011 value of $365.1 million. Development expenditures increased by almost 26 percent, to approximately $342.4 million, and mineral production value remained steady, decreasing a scant 2 percent to $3,436.1 million.

Contact: Larry Freeman, 907-451-5027, larry.freeman@alaska.gov

## STRATEGIC AND CRITICAL MINERALS ASSESSMENT PROJECT

Strategic and critical minerals (SCMs) are essential for our modern, technology-based society. For example, platinum-group elements (PGEs) are extensively used in electronics and in catalytic converters for vehicles. Rare-earth elements (REEs) are necessary for military and high-technology applications, as well as clean/renewable-energy technologies such as wind turbines, solar panels, and batteries for electric vehicles. REEs are used to convert heavy crude oil into gasoline, and to make small, permanent magnets that enable miniaturization of electronic components for devices such as cell phones. Current technology and system designs of U.S. defense systems depend heavily on REEs. In many cases there are no effective non-REE substitutes. The current U.S. Geological Survey (USGS) list of SCMs includes REEs, the PGEs, antimony, barium, chromium, cobalt, fluorine, gallium, graphite, indium, niobium, rhenium, tantalum, titanium, tungsten, and yttrium. The U.S. is more than 70 percent dependent on imports for 13 of these 16 elements and elemental groups, and 100 percent dependent on imports for seven. This leaves the U.S. vulnerable to disruptions in the SCM supply chain.

The Alaska Division of Geological & Geophysical Surveys (DGGS) Strategic and Critical Minerals Assessment project provides information necessary for comprehensively evaluating Alaska's statewide SCM potential. Many areas of Alaska are geologically favorable for hosting SCMs, but the lack of basic data hinders evaluation of Alaska's SCM potential. Alaska has hundreds of known SCM occurrences (see figure) and millions of acres of selected or conveyed lands with the potential to contain SCMs, but the mineral-resource potential of these occurrences and lands is poorly understood. There has been no modern, systematic resource evaluation for SCMs in Alaska. The DGGS Strategic and Critical Minerals Assessment project is specifically designed to address this data and knowledge gap. By assessing Alaska's potential for SCMs, the State of Alaska will benefit from expanded mineral-industry investment in exploration, development, and associated employment, better understand the natural resources of its lands for management purposes, and help meet the nation's need for domestic supplies of these critically important elements.




In 2011 DGGS initiated the Rare-Earth Elements and Strategic Minerals Assessment project, which primarily focused on REEs. In 2012 DGGS expanded the scope of work with the Strategic and Critical Minerals Assessment project, including selected additional elements. The goals of these State-funded Capital Improvement projects are to: (1) compile historical and industry-donated data in digital format; (2) obtain new field and analytical data critical for assessing Alaska's SCM potential; (3) evaluate the historical and new data to identify areas of Alaska with the highest SCM potential, as well as those needing additional geologic evaluation; (4) communicate the results of our work to the public; and (5) publish the data and results of our studies on the DGGS website (free access).

In 2013 DGGS contracted for a 1,400-square-mile SCM-related airborne geophysical survey covering part of the Wrangellia Terrane in south-central Alaska (see p. 41 for project description). DGGS also conducted a 2,600-square-mile field project throughout the Wrangellia Terrane to evaluate its SCM potential (see p. 48 for project description). Additionally, DGGS compiled more than 5,390 historical geochemical analyses in digital format for areas with SCM mineral potential throughout the state and, to date, have obtained new, modern geochemical analyses for more than 1,200 archived samples stored at the DGGS Geologic Materials Center. Additionally, DGGS started the process of obtaining new geochemical analyses from statewide historical samples from State land that are stored at the USGS Denver Federal Center warehouse. Publication of geochemical data is planned for 2014. In summer 2014 DGGS will conduct additional geologic fieldwork and mapping in the Wrangellia Terrane.

Contact: Melanie Werdon, 907-451-5082, melanie.werdon@alaska.gov

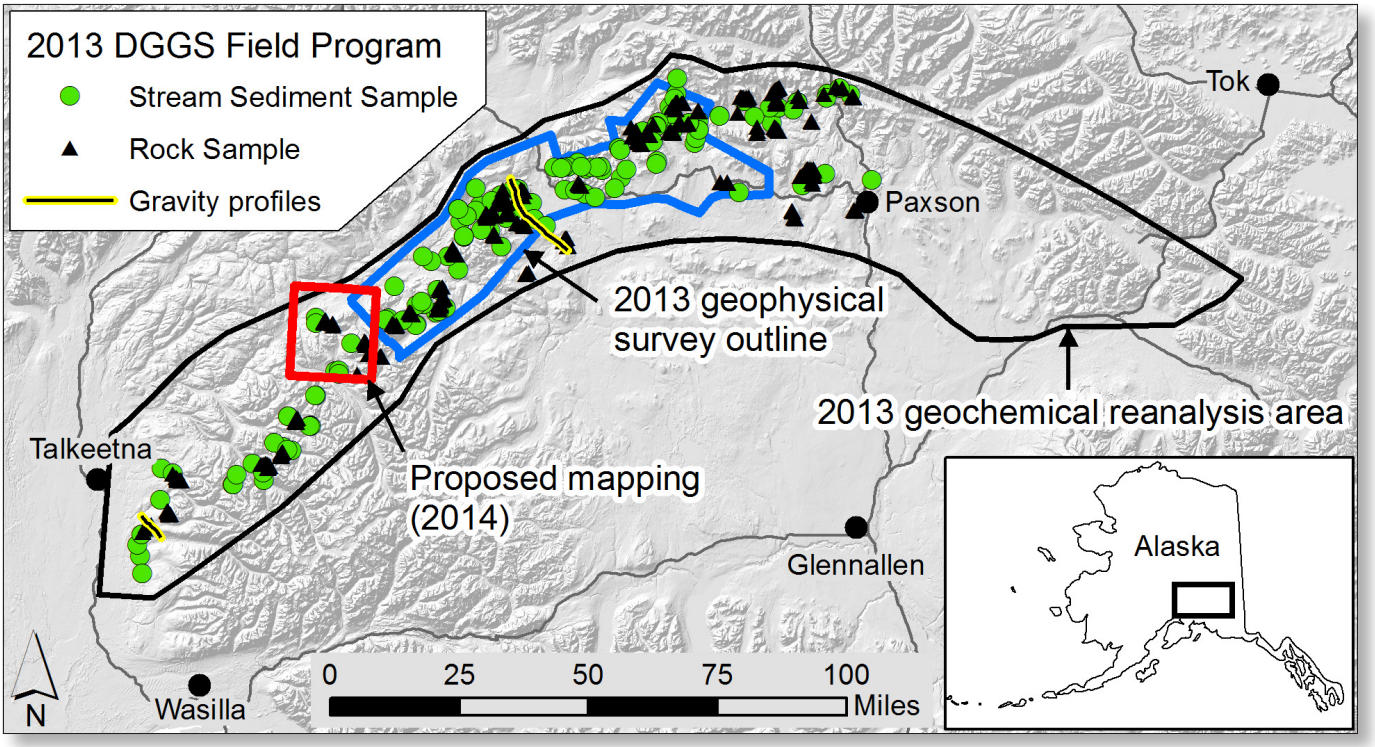
# STRATEGIC AND CRITICAL MINERALS ASSESSMENT IN THE WESTERN WRANGELLIA TERRANE

During 2013 the Alaska Division of Geological & Geophysical Surveys (DGGS) began a multi-year project to understand and improve the geologic framework of the western portion of the Wrangellia geologic belt, with particular emphasis on evaluating the potential of the area to host magmatic-type nickel, copper, and platinum-group-element (Ni–Cu–PGE) deposits. The project aims to encourage exploration and increase the likelihood of discovering mineralization similar to that at the Wellgreen deposit in Yukon Territory, which is hosted in the eastern portion of the targeted Wrangellia geologic belt. The project is funded as part of the Strategic and Critical Minerals Assessment program.

The Wrangellia project includes components of exploration geochemistry, geophysics, and targeted geologic mapping. Our initial three-week field reconnaissance program traversed an area of approximately 2,600 square miles in the eastern Alaska Range foothills and the Talkeetna Mountains between Paxson and Talkeetna (see figure). The DGGS field crew conducted stream-sediment sampling and geological traverses in areas of known or suspected Late Triassic mafic to ultramafic intrusions, the geologic features most likely to host Ni–Cu–PGE mineralization. The crew also conducted two gravity profiles, totaling 24 line-miles, to help resolve concealed magnetic anomalies. In partnership with the U.S. Geological Survey (USGS), DGGS will also be reanalyzing archived stream-sediment samples using modern, high-sensitivity methods for a broad spectrum of elements, including platinum and palladium. Finally, DGGS contracted for a 1,400-square-mile airborne magnetic and electromagnetic survey over prospective Ni–Cu–PGE areas in the northern Talkeetna Mountains.

Geologic work started with the compilation and digitization of published and unpublished detailed geologic mapping and focused on areas where mafic and ultramafic bodies were previously reported or were inferred from geophysical and geochemical surveys. DGGS geologists targeted traverses to validate, map, and sample these intrusions for major- and trace-element geochemistry, petrographic study, and radiometric dating. Additional traverses focused on resolving stratigraphic uncertainties using the distinctive trace-element geochemistry of the Late Triassic basalts as a marker. Preliminary results from this project have improved our understanding of the geology and metallogenesis of western Wrangellia; they will be published as a series of DGGS raw-data files and a final interpretive report once analyses are complete.

This investigation and previous work by DGGS and the USGS have shown that there are significant shortcomings in existing basic geologic mapping that hamper evaluation of PGE potential of the project area, particularly the southwestern portion. The DGGS Mineral Resources Section has applied for matching funds through the USGS STATEMAP program to complete a detailed geologic map in the Talkeetna Mountains C-4 Quadrangle during the 2014 field season.



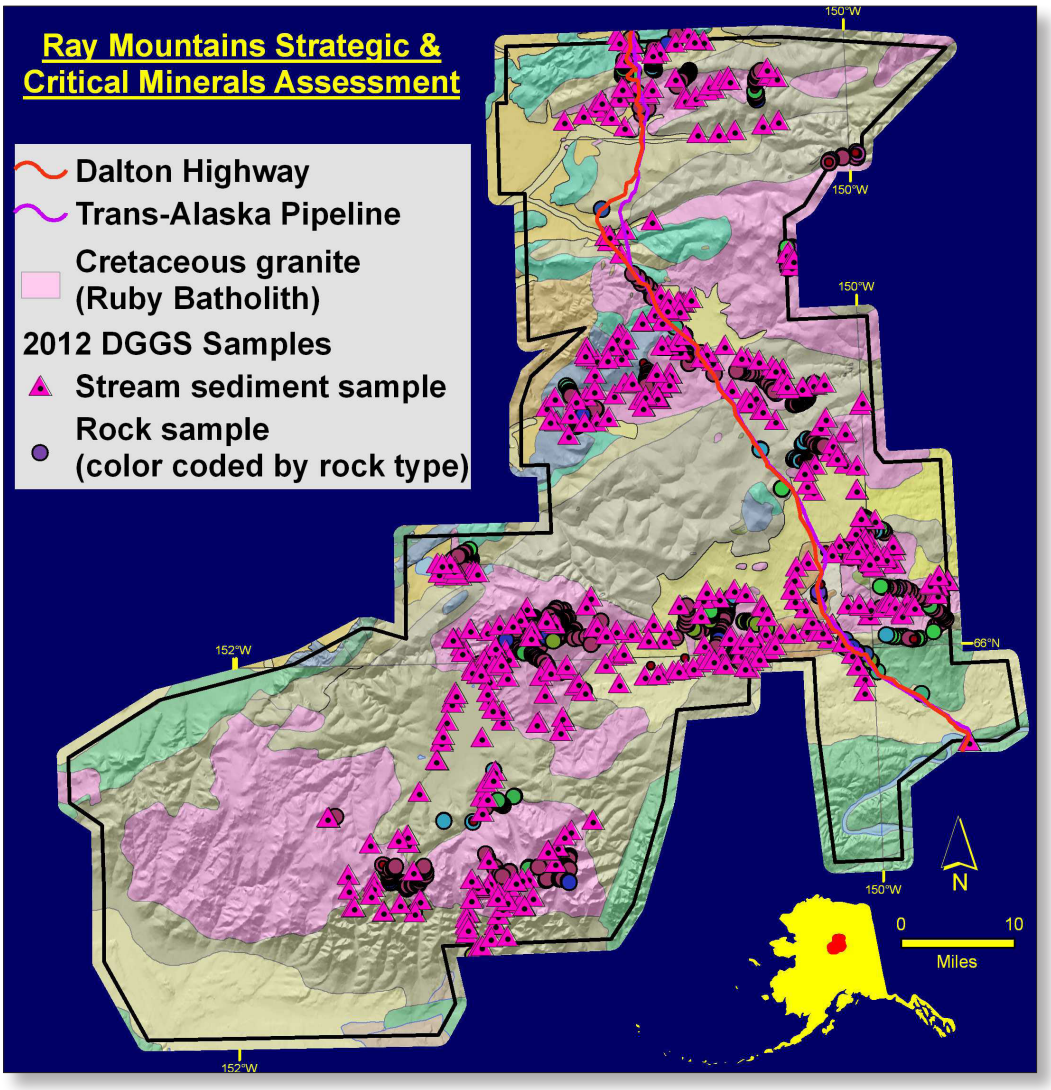

Contact: Evan Twelker, 907-451-5086, evan.twelker@alaska.gov

# STRATEGIC AND CRITICAL MINERALS ASSESSMENT IN THE RAY MOUNTAINS AREA, NORTH-CENTRAL ALASKA

During summer 2012 the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted fieldwork in the Ray Mountains area of north-central Alaska (see figure) as part of the DGGS Strategic and Critical Minerals Assessment project (p. 47). The Ray Mountains area has been recognized since the 1970s as having anomalously high values of uranium, thorium, tungsten, tin, and rare-earth elements (REEs). Recent private-sector work highlighted the potential for localized placer–REE concentrations associated with Cretaceous granite. Most of the land in this area is State selected or top filed under U.S. Public Land Order 5150, which closed a large area to mineral entry prior to finalizing the route of the Trans-Alaska Pipeline; the area is currently under U.S. Bureau of Land Management (BLM) jurisdiction. The DGGS field-based assessment in the Ray Mountains area builds on previous mineral-resource assessments conducted by the U.S. Geological Survey, U.S. Bureau of Mines, and BLM, and is enhanced by donations of proprietary data from private entities. Evaluation of all available geologic data will allow for science-based prioritization of the State-selected and top-filed lands based on their strategic and critical mineral-resource potential. Products will include interim data releases and a report of investigations that will be made available on the DGGS website in 2014.

The 3,500-square-mile Ray Mountains study area is 125 miles northwest of Fairbanks in the Ray Mountains and Hodzana Uplands. The area extends from east of the Trans-Alaska Pipeline and Dalton Highway southwest 73 miles to the Ray Mountains. DGGS geologists examined and geochemically sampled known and newly discovered lode and placer occurrences, mapped and sampled granitic rocks, and collected stream-sediment and pan-concentrate samples. The field work and ongoing geochemical, geochronologic, and petrographic studies will allow us to determine appropriate ore deposit models and assess the strategic and critical mineral-resource potential for lode and placer deposits.

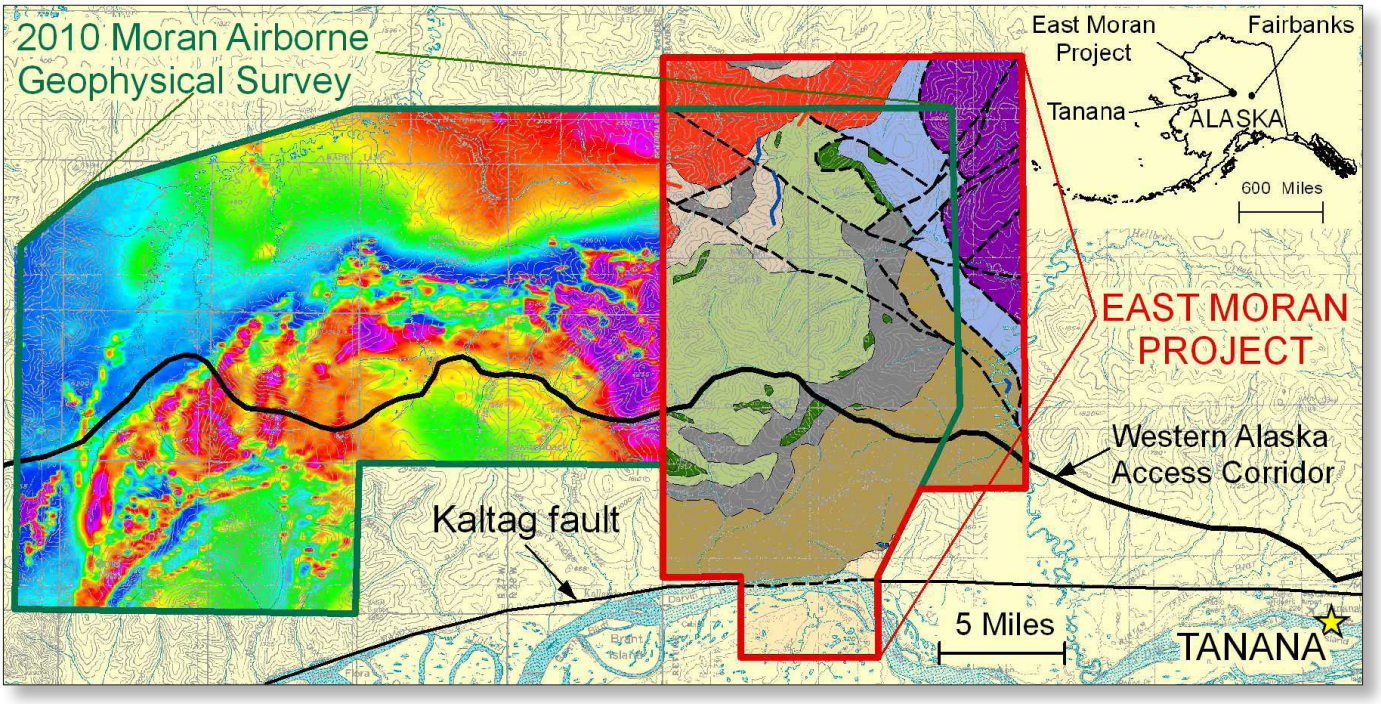
Initial results indicate the Cretaceous granites of the Ruby Batholith are variably enriched in REEs and that the REEs occur as widely disseminated accessory minerals. The accessory minerals are released as the granites are eroded, and are subsequently concentrated in ancient and modern river gravels. Further studies will include scientific interpretations of the granite source of the REE minerals, the concentration and type of REEs and other minerals contained in the ancient and modern gravels, and the extent of potentially economic concentrations of REEs and tin in the gravels. Land managers and policymakers will be able to use the results of this study to make informed and logical decisions on prioritization of State-selected lands for potential transfer to State ownership.




Contact: Larry Freeman, 907-451-5027, larry.freeman@alaska.gov

# GEOLOGIC MAPPING IN THE EASTERN MORAN AREA, TANANA AND MELOZITNA QUADRANGLES, ALASKA

Historical and active placer mines in the Melozitna mining district, which encompasses the Moran Dome area, have produced more than 12,000 ounces of gold and an undetermined amount of tin, yet little is understood about sources for the placer metals or the area's gold and polymetallic lode occurrences. To encourage renewed industry exploration for mineral deposits in this region, in 2010 the Alaska Division of Geological & Geophysical Surveys (DGGS) released the 653-square-mile Moran airborne-geophysical survey (see figure) as part of the State-funded Airborne Geophysical/Geological Mineral Inventory (AGGMI) program. The Moran survey area is 150 miles west of Fairbanks, on the north side of the Yukon River between the villages of Ruby and Tanana. The State's preferred Western Alaska Access Corridor transects the survey area. During summer 2011 DGGS geologically mapped 301 square miles in the eastern part of the Moran geophysical survey area, and conducted reconnaissance mapping in the western part. Geochemical data from the project were released in 2011, several public presentations were given at trade and professional meetings, and additional products, including geochronologic data and the final 1:63,360-scale geologic map, will be published in 2014. The products will foster a better understanding of the area's geology and mineral potential. This mapping project was funded primarily by State general funds, with supplemental funding from the federal STATEMAP program through the U.S. Geological Survey.



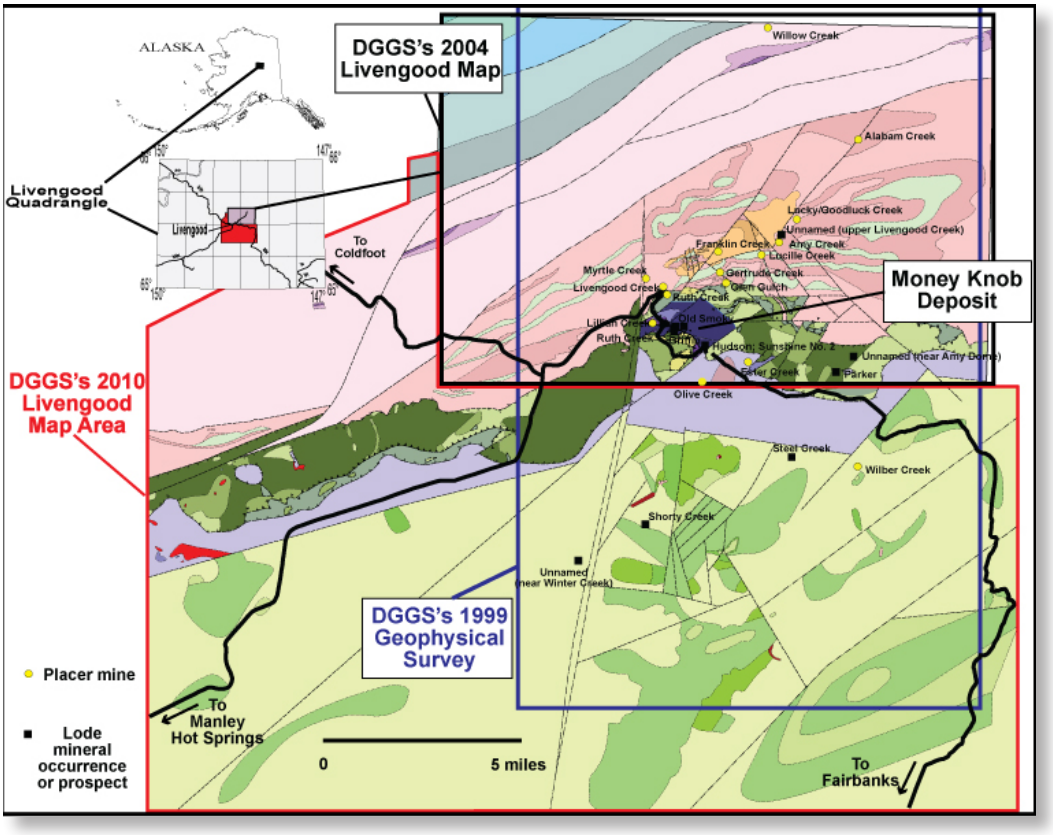

Prior to 2011, only reconnaissance-level, 1:250,000-scale geologic maps were available for the Moran area; DGGS's 2010 geophysical data indicate the geology is much more complex than shown on these maps. During 2011 fieldwork DGGS geologists field-checked airborne geophysical interpretations, identified the location, type, and character of bedrock and surficial-geologic units, examined and geochemically sampled known and newly discovered lode and placer occurrences, and determined the location and kinematics of structural features. This detailed geologic framework, supported with ongoing geochemical, geochronologic, and petrographic studies, will allow us to develop deposit models for the area's gold and polymetallic lode prospects and explain the distribution and metal content of local placer deposits. Regional geologic hazards are also of concern and potentially include the Kaltag fault, which crosses the southern edge of the map area. Part of the 2011 study includes evaluation of possible Holocene and Quaternary displacement history of the Kaltag fault and its associated seismic hazards between Tanana and Ruby.

The primary objective of the eastern Moran project is to map the geology in sufficient detail to inform State and local land-use decisions and to guide mineral industry exploration efforts. The timing of this project coincides with renewed mineral-industry interest in underexplored gold districts and in strategic and critical minerals. Because economic or infrastructure development could potentially conflict with other land uses, the availability of DGGS's detailed geologic, mineral-resource, and hazard assessments is important for long-range planning by State and local agencies that need to balance resource and infrastructure development with other land-management priorities.

Contact: Larry Freeman, 907-451-5027, larry.freeman@alaska.gov

# BEDROCK GEOLOGIC MAPPING IN THE TOLOVANA MINING DISTRICT, LIVENGOOD QUADRANGLE, ALASKA

Historic and active placer mines have produced more than 500,000 ounces of placer gold in the Livengood area. To encourage renewed industry exploration for mineral deposits in this region, and to provide geologic data for State and local land-use management, the Alaska Division of Geological & Geophysical Surveys (DGGS) has conducted a series of geophysical and geological investigations in the area. This work is part of the Airborne Geophysical/Geological Mineral Inventory (AGGMI) program, supported by State General Funds. DGGS released a 230-square-mile airborne-geophysical survey of the Livengood area in 1999. In 2004, DGGS published a geologic map and associated geologic report for an area that includes the northern portion of the 1999 geophysical survey (see figure). Subsequent mineral industry exploration in this map area resulted in the discovery of a large gold deposit at Money Knob, with an identified resource of 20.6 million ounces of gold. In 2010, DGGS conducted geologic mapping and sampling of the southern portion of the 1999 geophysical survey and surrounding area.




The purpose of DGGS's mapping is to provide geologic context for known lode and placer deposits and occurrences, and to evaluate the area's mineral-resource potential. The only known significant lode mineralization in the 2010 map area is 5.5 miles south of Money Knob at Shorty Creek, a prospect with elevated Ag–Bi–Sn and, locally, Au values in rock and soil samples. Felsic igneous rocks spatially associated with the Shorty Creek prospect are compositionally different and temporally about 25 million years younger than the Money Knob gold-related plutonic rocks; hence they represent two different types of mineralizing systems. Rocks of the Cascaden Ridge pluton, 8 miles southwest of Money Knob, are compositionally equivalent to Money Knob dikes and similarly intrude Devonian sedimentary and volcanic rocks that act as the host rock in the Money Knob system. The Money Knob prospect is currently being further delineated for possible development and production by International Tower Hill Mines.

Wilber Creek is the only creek in the 2010 map area with known placer gold production. Its gold compositions are similar to placer gold of the Livengood area, and the present stream morphology suggests the gold is derived from the 2010 map area. Magnetic anomalies in the 1999 geophysical survey indicate a potential igneous source for the Wilber Creek placer deposit. A group of felsic dikes of similar composition to the gold-related Money Knob rocks is found in the area and may be related to a potential lode source of the placer gold.

A geochemical report for the south Livengood area was published in 2010, and a 1:50,000-scale bedrock-geologic map and accompanying interpretive report for the entire Livengood study area will be published in 2014. This publication will summarize the collective findings of the DGGS 2004 and 2010 investigations, as well as incorporating industry data from the area around the Money Knob deposit. AngloGold Ashanti (2003–2006) and International Tower Hill Mines Ltd. (2006–present) have conducted detailed geologic mapping of Money Knob and surrounding area, and contributed to geologically subdividing the Paleozoic Amy Creek assemblage, the Cambrian ophiolite package, and the Devonian Cascaden Ridge unit. We also utilized the 2010–2011 DGGS LiDAR survey of the Trans-Alaska Pipeline corridor to identify faults in the map area.

Contact: Evan Twelker, 907-451-5086, evan.twelker@alaska.gov

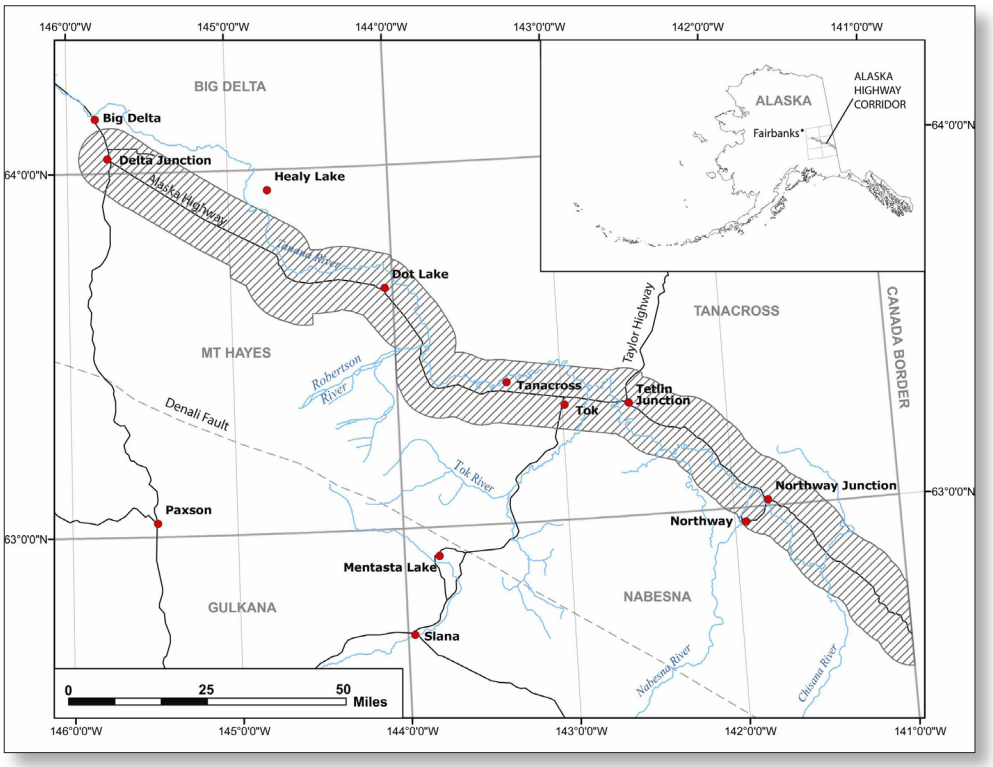
# BEDROCK GEOLOGY AND MINERAL RESOURCE ASSESSMENT ALONG THE ALASKA HIGHWAY CORRIDOR FROM DELTA JUNCTION TO THE CANADA BORDER

The Alaska Highway is the primary land transportation route to Interior Alaska from the contiguous United States and is likely to become the locus of increasing development, especially if a proposed natural gas pipeline or Alaska Railroad extension are constructed along this route. Despite its strategic location, relatively little geological and geotechnical work has been published relating to this corridor. The Alaska Division of Geological & Geophysical Surveys (DGGS) is engaged in a multi-year program, primarily supported by State Capital Improvement Project (CIP) funds, to develop a framework of geologic data between Delta Junction and the Canada border with which engineering, design, and resource decisions may be evaluated for future development in that area. In 2006, as the first phase of this project, DGGS collected, interpreted, and published airborne-geophysical data for a 16-mile-wide corridor centered on the Alaska Highway. In the second phase DGGS was charged with mapping the bedrock and surficial geology of the area and evaluating the geologic hazards and resources. The surficial-geology and geologic-hazards segments of the project are described separately (p. 59).

DGGS staff have completed the field data collection phase needed to assess the mineral resources of the area and create a 1:63,360-scale bedrock-geologic map. In 2006 and 2007, DGGS conducted geologic fieldwork between Delta Junction and Dot Lake, in 2008 between Dot Lake and Tetlin Junction, in 2009 between Tetlin Junction and the Canada border, and in 2010 along the entire length of the corridor from Delta Junction to the Canada border.

The bedrock maps incorporate interpretations of DGGS's airborne magnetic and resistivity data, field data, and various scientific analytical data. The geophysical data is particularly valuable for interpreting the geology in areas covered by surficial deposits or vegetation. Numerous plutonic rock suites were defined; these plutons intruded complexly deformed, amphibolite-facies metasedimentary and metaigneous rocks similar to those found elsewhere in the Yukon–Tanana Upland, as well as a suite of greenschist-facies metasedimentary rocks and metamorphosed mafic intrusions that correlate with similar units directly across the border in Canada. DGGS also determined the location and kinematics of many smaller-scale faults in the corridor that are related to the Denali fault system; these data will provide a better understanding of the history and potential impacts of the faults.

DGGS evaluated the mineral-resource potential of bedrock units by sampling and analyzing altered rocks to provide baseline geochemical data for use by State land-use planners and mineral exploration companies. Geochemical analyses, U-Pb, and $^{40}Ar/^{39}Ar$ age dates for samples collected during 2008–2010 fieldwork will be published in early 2014. Bedrock-geologic maps for the three segments of the proposed gas pipeline corridor will be published by the end of 2014.




Contact: Melanie Werdon, 907-451-5082, melanie.werdon@alaska.gov