ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
FY2015 Project Description

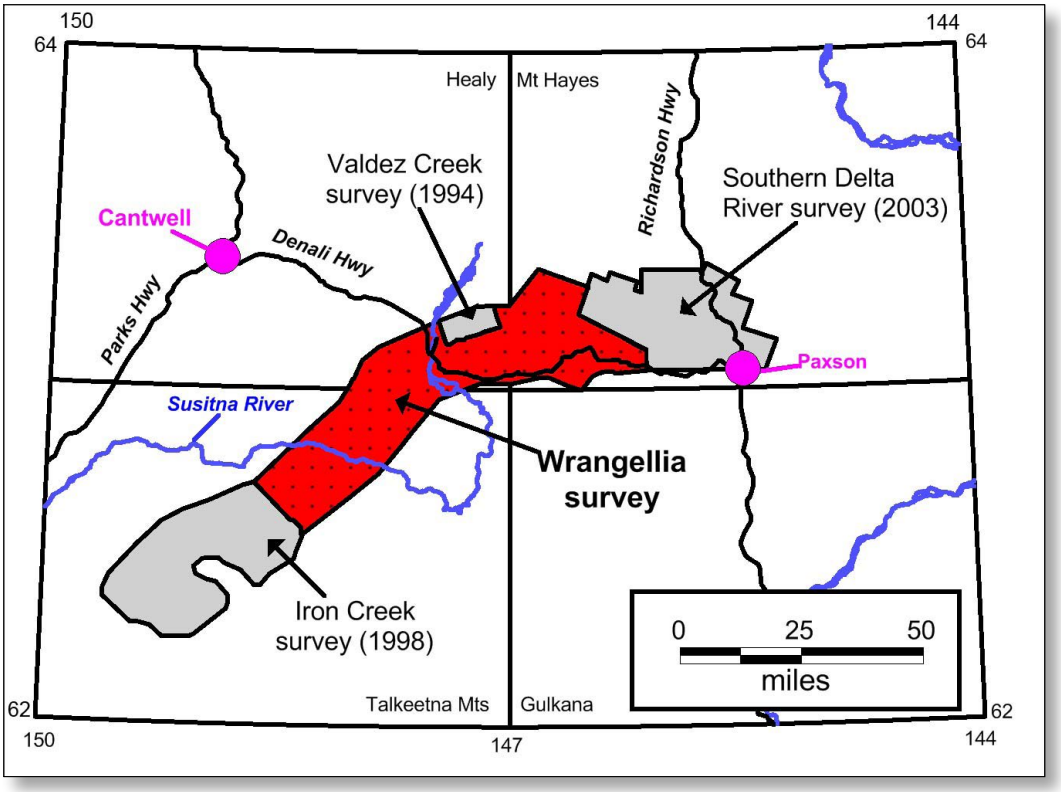
AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: AIRBORNE GEOPHYSICAL SURVEY OF WRANGELLIA, SOUTH-CENTRAL ALASKA

The goal of the Alaska Division of Geological & Geophysical Surveys' (DGGS) Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is to enhance the understanding 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 nominations from Alaska's geologic community. Products resulting from this program generally include aeromagnetic, airborne-electromagnetic, and geologic maps as well as other geological, geochemical, and geophysical data compilations. The AGGMI program and resulting new geologic knowledge are recognized world-wide and have encouraged millions of dollars of venture capital expenditures in the local economies of the surveyed mining districts. These venture capital expenditures have led to discovery and delineation of new mineral resources.

As part of the State-funded AGGMI program, the Strategic and Critical Minerals Assessment Project is geophysically surveying 1,322 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 and is composed mainly of State lands, with lesser areas of U.S. Bureau of Land Management-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 contributed additional, privately-funded airborne geophysical data for the area that will be included in DGGS's published survey.

The majority of the Wrangellia survey area is underlain by late 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 were released as DGGS Geophysical Reports in January 2014. A second publication, containing a project report, interpretation, and electromagnetic anomalies, is expected to be released in 2015. 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.

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ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
FY2015 Project Description

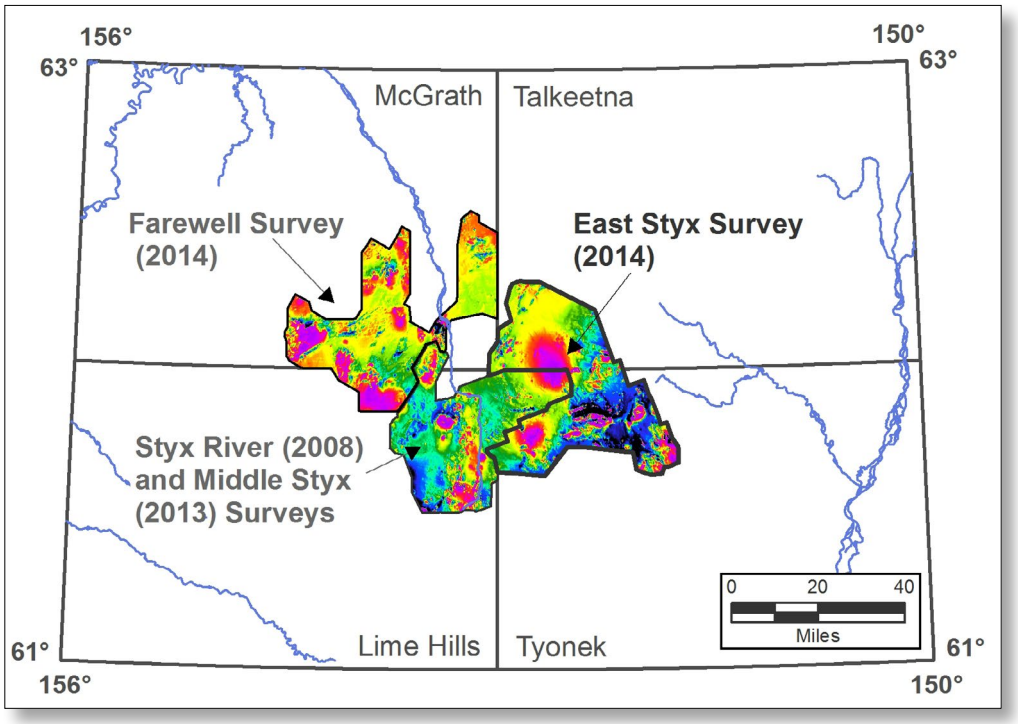
AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: AIRBORNE GEOPHYSICAL SURVEY OF THE EAST STYX AREA, SOUTH-CENTRAL ALASKA

The goal of the Alaska Division of Geological & Geophysical Surveys' (DGGS) Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is to enhance the understanding 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 nominations from Alaska's geologic community. Products resulting from this program generally include aeromagnetic, airborne-electromagnetic, and geologic maps as well as other geological, geochemical, and geophysical data compilations. The AGGMI program and resulting new geologic knowledge are recognized world-wide and have encouraged millions of dollars of venture capital expenditures in the local economies of the surveyed mining districts. These venture capital expenditures have led to discovery and delineation of new mineral resources.

Through the state-funded AGGMI program, DGGS geophysically surveyed 1,060 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 were acquired, and the data were released in November 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 that may be 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.



Merged aeromagnetic data for the East Styx, Styx River, Middle Styx, and Farewell surveys. Merged grids will be released this fiscal year.

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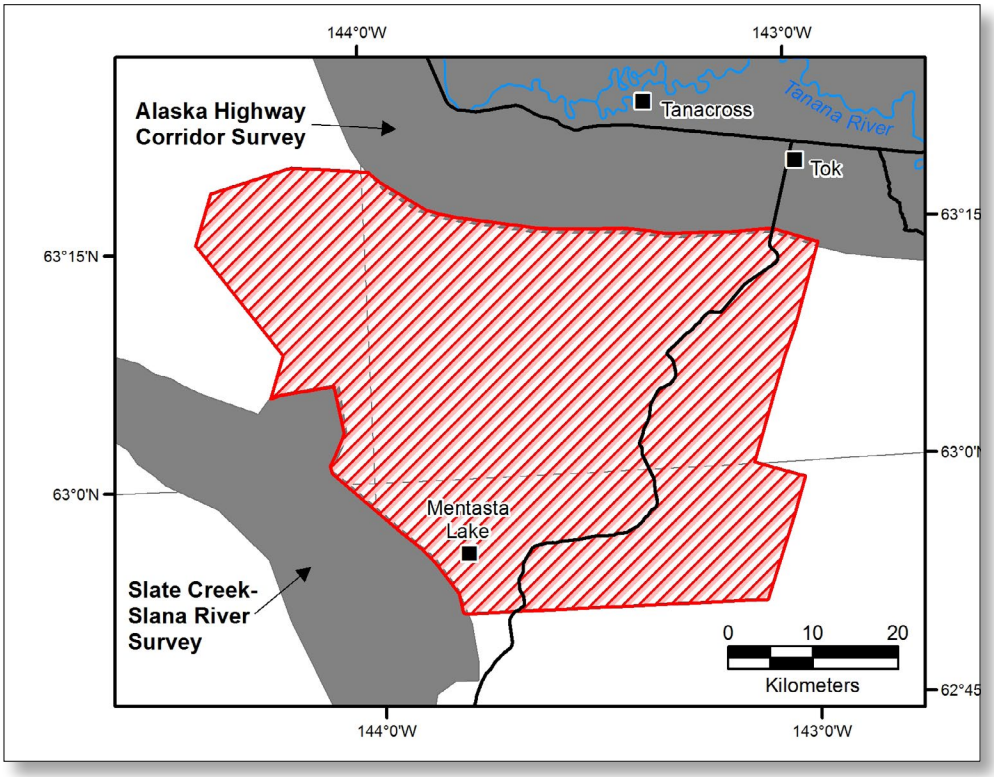
ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
FY2015 Project Description

AIRBORNE GEOPHYSICAL/GEOLOGICAL MINERAL INVENTORY PROGRAM: AIRBORNE GEOPHYSICAL SURVEY OF THE TOK AREA, EASTERN INTERIOR ALASKA

The goal of the Alaska Division of Geological & Geophysical Surveys' (DGGS) Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is to enhance the understanding 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 nominations from Alaska's geologic community. Products resulting from this program generally include aeromagnetic, airborne-electromagnetic, and geologic maps as well as other geological, geochemical, and geophysical data compilations. The AGGMI program and resulting new geologic knowledge are recognized world-wide and have encouraged millions of dollars of venture capital expenditures in the local economies of the surveyed mining districts. These venture capital expenditures have led to discovery and delineation of new mineral resources.

Through the State-funded AGGMI program, DGGS is geophysically surveying 989 square miles in an area centered roughly 35 miles west–southwest of Tok in the Mt. Hayes, Tanacross, Gulkana, and Nabesna quadrangles (see figure). Most of the area surveyed is in the Tok mining district; a minor portion is in the Chistochina district. The Tok survey area is bordered by two previous airborne-geophysical surveys: the 2006 Alaska Highway Corridor, and 2008 Slate Creek–Slana River surveys. The area is a mixture of State-owned and -selected land, Native-owned land, and Federally-owned land. Data will be released during spring 2015 as line, grid, and vector data as well as in map form.

The survey area contains numerous copper, gold, and gold–silver–copper prospects identified in the Alaska Resource Data Files (http://ardf.wr.usgs.gov/). The western part of the survey area covers several important volcanogenic massive sulfide (VMS) deposits with significant drill-identified polymetallic resources known collectively as the Delta Mineral Belt. Immediately northeast of the survey area recent exploration has discovered a large pyrrhotite-bearing gold–copper skarn deposit that is likely related to a concealed porphyry copper system. A lack of identified prospects in the eastern and central parts of the airborne geophysical survey area corresponds with a gap in detailed public-domain geologic data; regional geologic trends suggest that the mineralized host rocks should be present throughout the survey area. The survey data will increase the geologic understanding of the area and provide a framework for further mineral exploration. The new information is intended to catalyze new private-sector exploration, discovery and, ultimately, development and production. In addition the geophysical survey covers the eastern end of the identified rupture zone of the 2002 magnitude 7.9 earthquake on the Denali fault, and is being used to help understand the effects of future faults on the transportation corridor that passes through the area.



Tok survey location map with survey boundary (red line), prior surveys (grey polygons), towns (black squares), major highways (black), and rivers (blue).

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ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
FY2015 Project Description

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

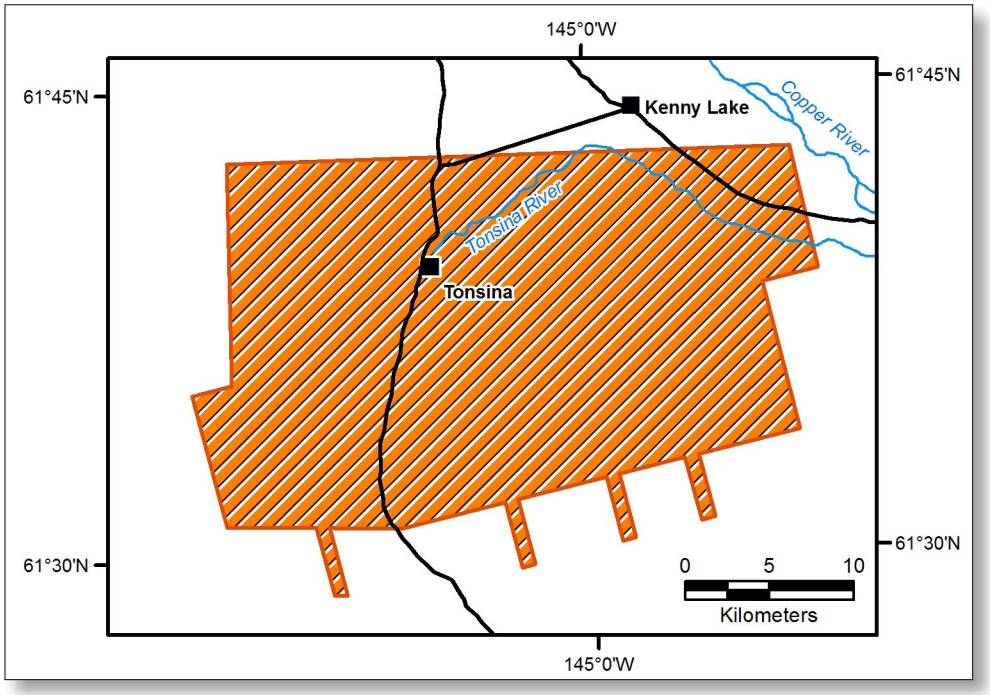
The goal of the Alaska Division of Geological & Geophysical Surveys' (DGGS) Airborne Geophysical/Geological Mineral Inventory (AGGMI) program is to enhance the understanding of Alaska's mineral resources and catalyze private-sector mineral development. The program seeks to delineate mineral zones on 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 nominations from Alaska's geologic community. Products resulting from this program generally include aeromagnetic, airborne-electromagnetic, and geologic maps as well as other geological, geochemical, and geophysical data compilations. The AGGMI program and resulting new geologic knowledge are recognized world-wide and have encouraged millions of dollars of venture capital expenditures in the local economies of the surveyed mining districts. These venture capital expenditures have led to discovery and delineation of new mineral resources.

Through the State-funded AGGMI's Strategic and Critical Minerals program, DGGS geophysically surveyed 266 square miles in the Tonsina area, about 56 miles northeast of Valdez and 37 miles south of Glennallen (see figure). The survey area crosses the Richardson Highway and encompasses portions of the Chugach Mountains and lowlands of the Copper River basin in the Valdez Quadrangle, and includes part of the Nelchina mining district. Land status includes State-owned and -selected with lesser amounts of Native-owned and –selected, as well as lands managed by the U.S. Bureau of Land Management. To support interpretations of the geophysical data, DGGS geologists collected a suite of outcrop and hand samples; the samples are well distributed in the survey area and represent most lithologies present. The airborne geophysical data, including gridded data, line data, and maps, will be published in January 2015. It is expected that these products will have wide distribution.

The Tonsina geophysical survey area is transected by the west–northwest-trending Border Ranges fault that juxtaposes the Pennisular terrane, which includes Nelchina River Gabbronorite (NRG) and Tonsina mafic–ultramafic complex, on the north against metasedimentary and metavolcanic rocks of the Cretaceous Chugach terrane to the south. Based on the regional aeromagnetic signature and sparse outcrop, gabbroic rocks of the NRG are present in the northern and northwestern part of the survey area. The Tonsina ultramafic complex, in the central and northeastern parts of the survey area, is even more magnetic than the gabbronorite, and is locally a granulitic gabbronorite. The NRG has been interpreted as part of the Jurassic Talkeetna island arc with the Tonsina complex representing part of the associated mantle. The Chugach terrane in the survey area consists of typically nonmagnetic, metamorphosed rocks of an accretionary wedge.

Approximately 65 percent of the survey area is covered by unconsolidated Quaternary deposits. Mineral occurrences in the survey area include: ultramafic rocks with associated platinum-group elements (PGE), chromite, and nickel–copper sulfides in ultramafic and mafic rocks; metamorphic-related Late Cretaceous to Tertiary age, low-sulfide, gold-bearing quartz veins in the Chugach terrane; and placer gold with minor scheelite in Holocene alluvial gravels.

The new airborne geophysical data will better define the extent and location of the PGE-bearing ultramafic rocks in areas lacking outcrop, increase the structural knowledge of the area, and improve the geologic mapping. The new information is designed to catalyze new private-sector exploration, discovery and, ultimately, development and production in the region.



Tonsina survey location map with survey boundary (orange line), towns (black squares), major highways (black), and major rivers (blue).

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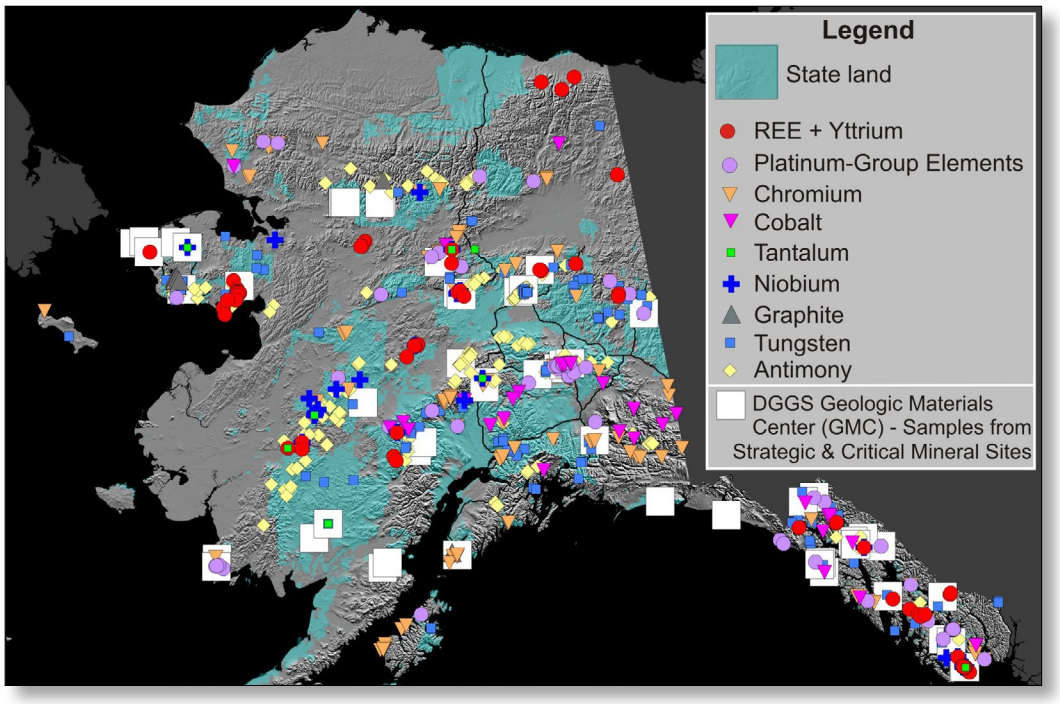
ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
FY2015 Project Description

STRATEGIC AND CRITICAL MINERALS ASSESSMENT PROJECT

Strategic and critical minerals (SCMs) are essential for our modern, technology-based society. 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 rely heavily on REEs. In many cases there are no effective non-REE substitutes. The current U.S. Geological Survey 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 to comprehensively evaluate Alaska's statewide SCM potential. Many areas of Alaska are geologically favorable for hosting SCMs, but the lack of basic geologic data hinders evaluation of their potential. Alaska has hundreds of known SCM occurrences (see figure) and millions of acres of selected or conveyed lands could 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 (http://www.dggs.alaska.gov).

In 2014 DGGS contracted for two SCM-related airborne geophysical surveys: the 266-square-mile Tonsina Survey in south-central Alaska (see project description) and the 989-square-mile Tok Survey in east-central Alaska (see project description). DGGS also conducted a 450-square-mile mapping project in the western Wrangellia Terrane to evaluate its SCM potential (see project description). Additionally, DGGS has compiled more than 29,039 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. DGGS also obtained 1,682 new geochemical analyses for statewide historical samples from State land that are stored at the USGS National Geochemical Sample Archive. Publication of additional geochemical data is planned for 2015. In summer 2015, DGGS will conduct geologic fieldwork and mapping in additional areas with SCM potential.

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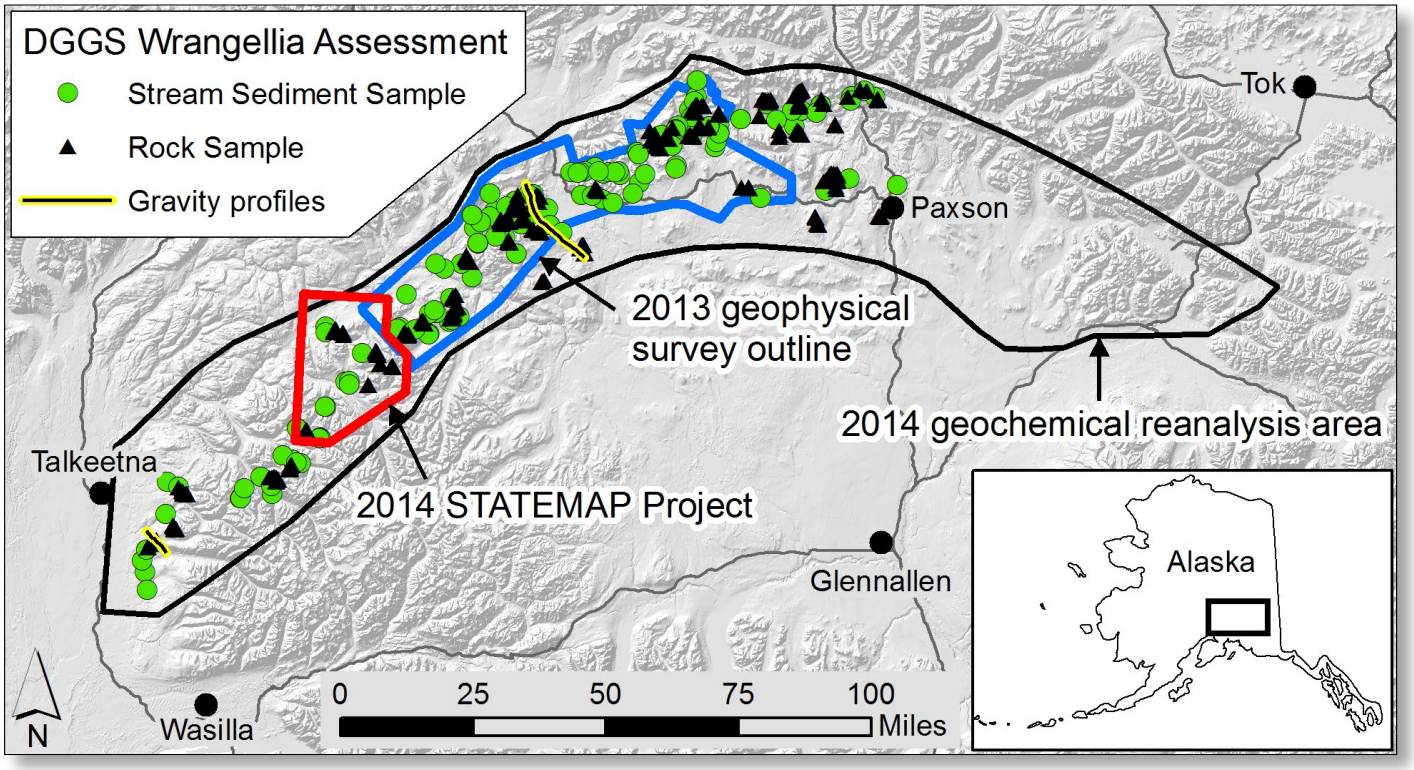
STRATEGIC AND CRITICAL MINERALS ASSESSMENT IN THE WESTERN WRANGELLIA TERRANE, SOUTH-CENTRAL ALASKA

During 2014 the Alaska Division of Geological & Geophysical Surveys (DGGS) continued 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* project.

The Wrangellia project includes components of exploration geochemistry, geophysics, and targeted geologic mapping. Our initial three-week 2013 field reconnaissance program encompassed 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 reanalyzed more than 1,600 archived stream-sediment samples using modern, high-sensitivity analytical methods (see project overview). DGGS also contracted a 1,400-square-mile airborne magnetic and electromagnetic survey over prospective Ni–Cu–PGE areas in the northern Talkeetna Mountains (see project description). Finally, in 2014 the DGGS Mineral Resources Section completed 450 square miles of geologic mapping in the Talkeetna Mountains (see project description) as part of the USGS STATEMAP program.

These investigations have filled significant gaps in the geologic knowledge base and allowed for a more accurate assessment of the mineral potential of the project area. Notable results thus far include the mapping, geochemical characterization, petrologic study, and radiometric dating of a PGE-prospective Late Triassic mafic to ultramafic intrusion; major revisions to the distribution of Late Triassic volcanic rocks; and the mapping of a series of previously unrecognized northeasterly-trending faults in the Talkeetna Mountains.

Wrangellia-related work resulted in five raw-data file publications and four public presentations during 2014; additional reports are in progress. These data will be synthesized in a final Report of Investigations focusing on the geology and PGE mineral potential of the project area.

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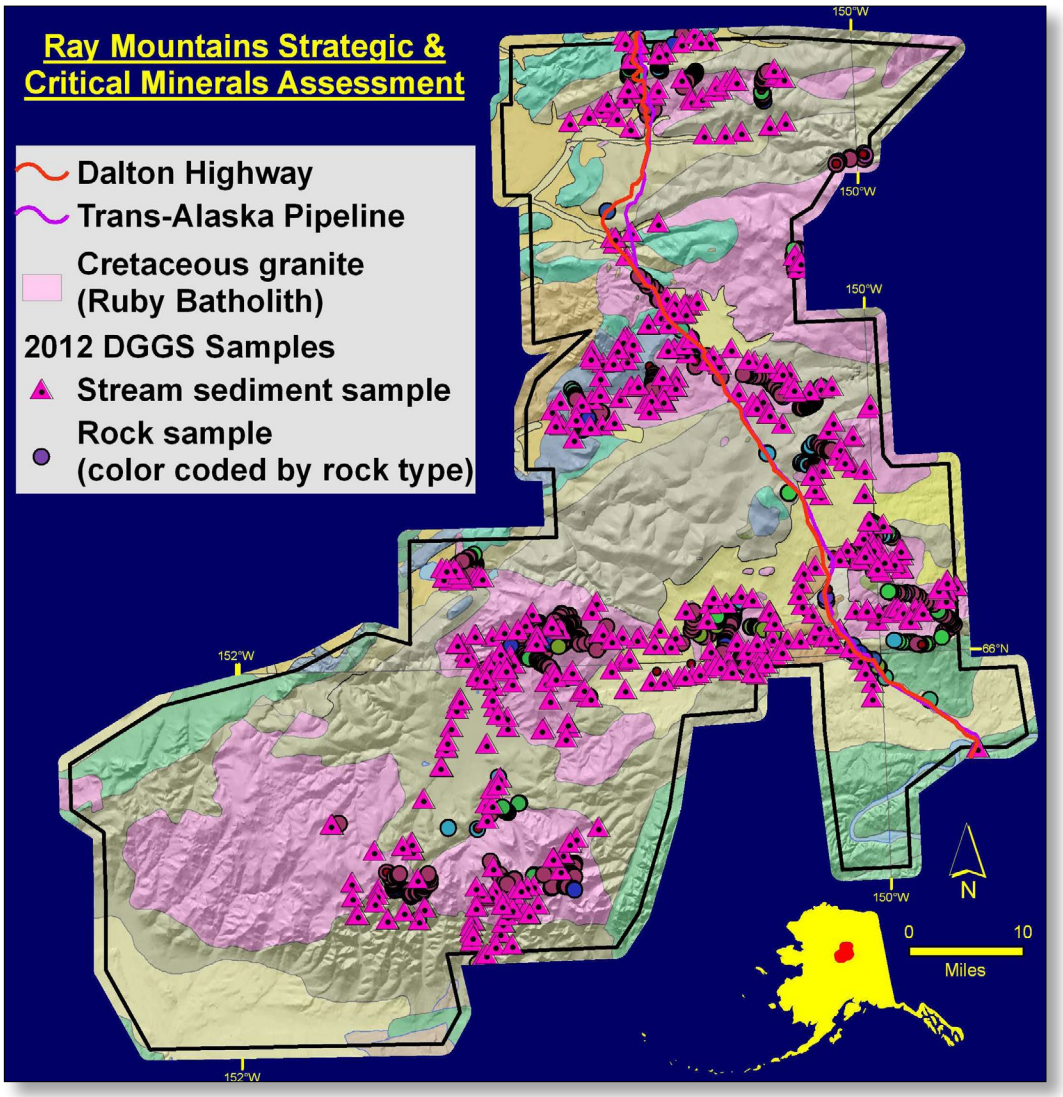
STRATEGIC AND CRITICAL MINERALS ASSESSMENT IN THE RAY MOUNTAINS AREA, NORTH-CENTRAL ALASKA



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. This 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 allows for science-based prioritization of the State-selected and top-filed lands based on their strategic and critical mineral-resource potential. Reports including $^{40}Ar/^{39}Ar$ data were released in 2014. Additional data, interpretations, and a report of investigations will be completed and made available on the DGGS website in 2015.

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. The alluvial REE resource of the area is being explored by Ucore Rare Metals.

Initial results indicate that the Cretaceous granites of the Ruby Batholith are variably enriched in REEs, which 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 are using preliminary results of this study to make informed and logical decisions on prioritization of State-selected lands for potential transfer to State ownership.

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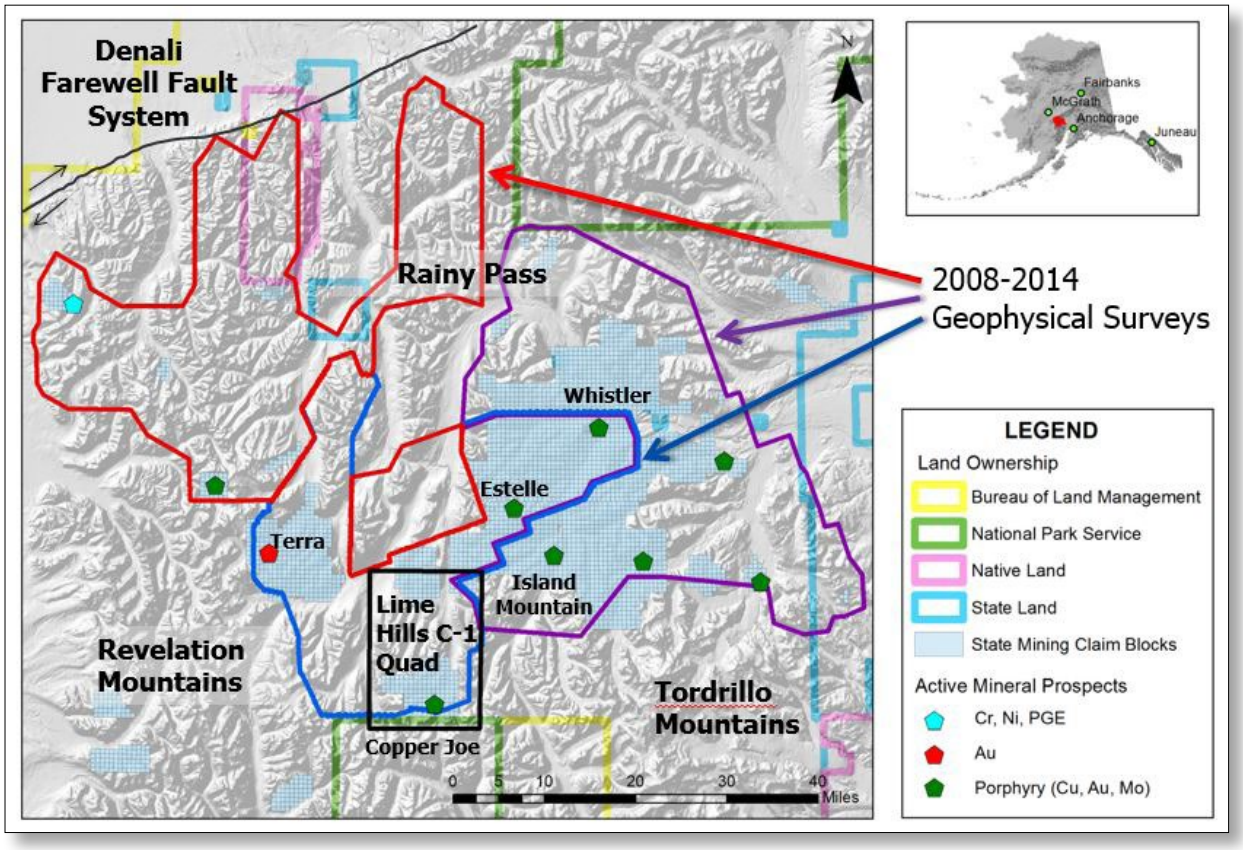
ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
FY2015 Project Description

GEOLOGIC MAPPING AND NEW GEOLOGIC DATES IN THE STYX RIVER AREA, LIME HILLS C-1 QUADRANGLE, WESTERN ALASKA RANGE

The Division of Geological & Geophysical Surveys Mineral Resources Section conducted field investigations for the Styx River Project in the Lime Hills C-1 Quadrangle during 2013 as part of the State-funded Airborne Geophysical/Geological Mineral Inventory (AGGMI) program. DGGS geologists' observations and mapping were aided by airborne geophysical data from the 2008 Styx River survey. During their time in the field, two other surveys were flown nearby: Farewell and East Styx. These results were just released in July and November 2014; the Dalzell Creek and Middle Styx Surveys were released October 2013. The DGGS geologic map area is in the southern part of the geophysical surveys.



As is evident from the numerous mining claims coinciding with the recent DGGS geophysical surveys, this is an area of significant mineral-resource potential on State-owned land. Millrock Resources and Kiska Metals have large mining claims to the northeast of the Lime Hills C-1 Quadrangle in the Mount Estelle pluton and at the Whistler porphyry copper–gold–molybdenum system. To the northwest of the map area, WestMountain Gold is exploring gold and polymetallic veins at the base of the Revelation Mountains. The area also hosts reduced intrusion-related gold, lead–zinc skarns, molybdenum-bearing quartz veins, sediment-hosted base metals, platinum-group elements, and rare-earth elements. The majority of these mineral occurrences are related to numerous Late Cretaceous and Tertiary age intrusive complexes, dikes, and volcanic rocks.

New $^{40}Ar/^{39}Ar$ radiometric ages of selected igneous and mineralized rocks from the map area released in 2014, along with previously published and other unpublished data, indicate that the large Mount Estelle plutonic complex, host to numerous copper, molybdenum, and gold prospects, has crystallization ages ranging from 63 to 70 million years old, a much longer timespan than previously thought. Alteration closely associated with porphyry copper–molybdenum-style mineralization at the Copper Joe prospect, 10 miles south of the Mount Estelle Pluton, ranges from 10 to 11 million years old. The Copper Joe prospect comprises an altered area approximately 2 miles in diameter that is visible in the DGGS airborne geophysical data. The new Copper Joe age is much younger than any mineralization previously recognized in the region and potentially opens new targets for exploration of copper–molybdenum deposits in this part of the state.

The new map for the Lime Hills C-1 Quadrangle will be released in 2015. Significant improvements include further subdivision of map units from previous mapping and refinement of the plutonic and volcanic history. This work will result in a 1:63,360-scale geologic map and supporting interpretive text that will foster a better understanding of the geology and mineral potential of the area.

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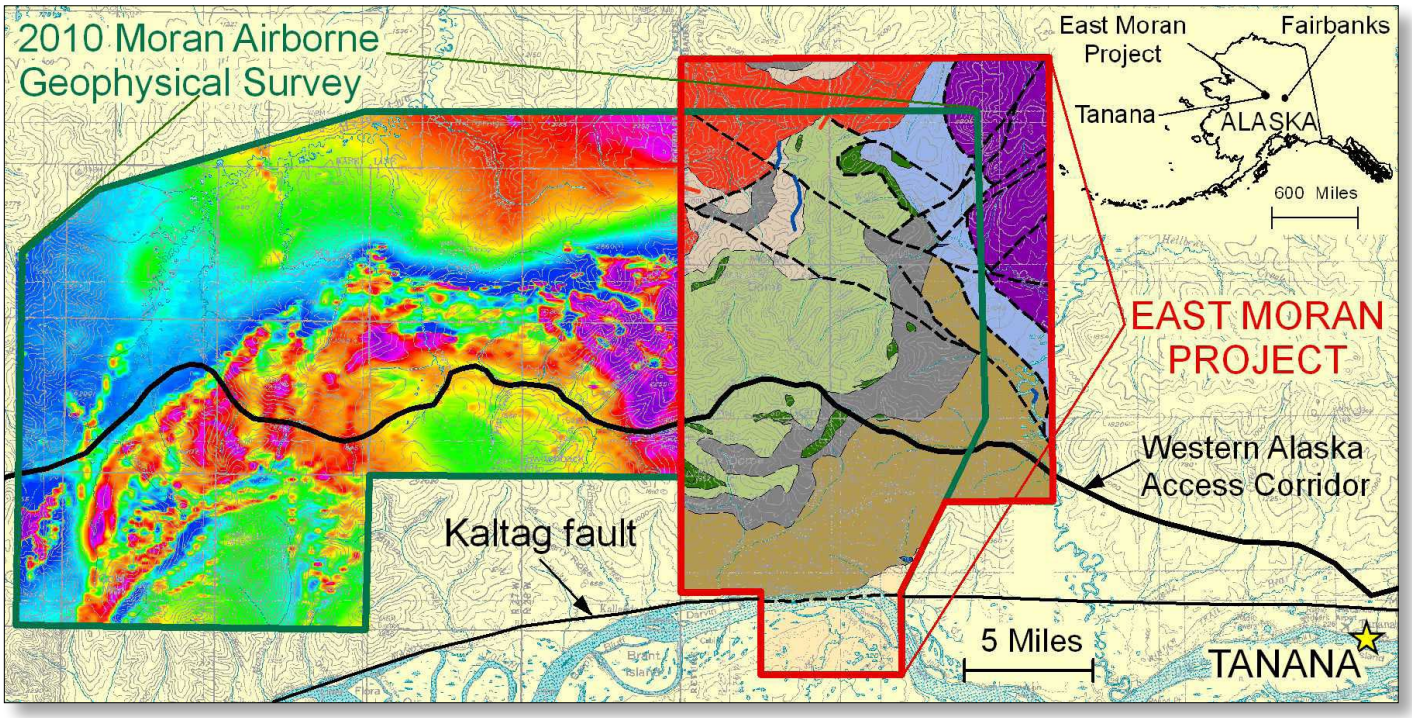
GEOLOGIC MAPPING IN THE EASTERN MORAN AREA, TANANA AND MELOZITNA QUADRANGLES, ALASKA

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 in 2012 and 2014, and additional products, including geochronologic data and the final 1:63,360-scale geologic map, will be published in 2015. 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 far 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 stimulate 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.

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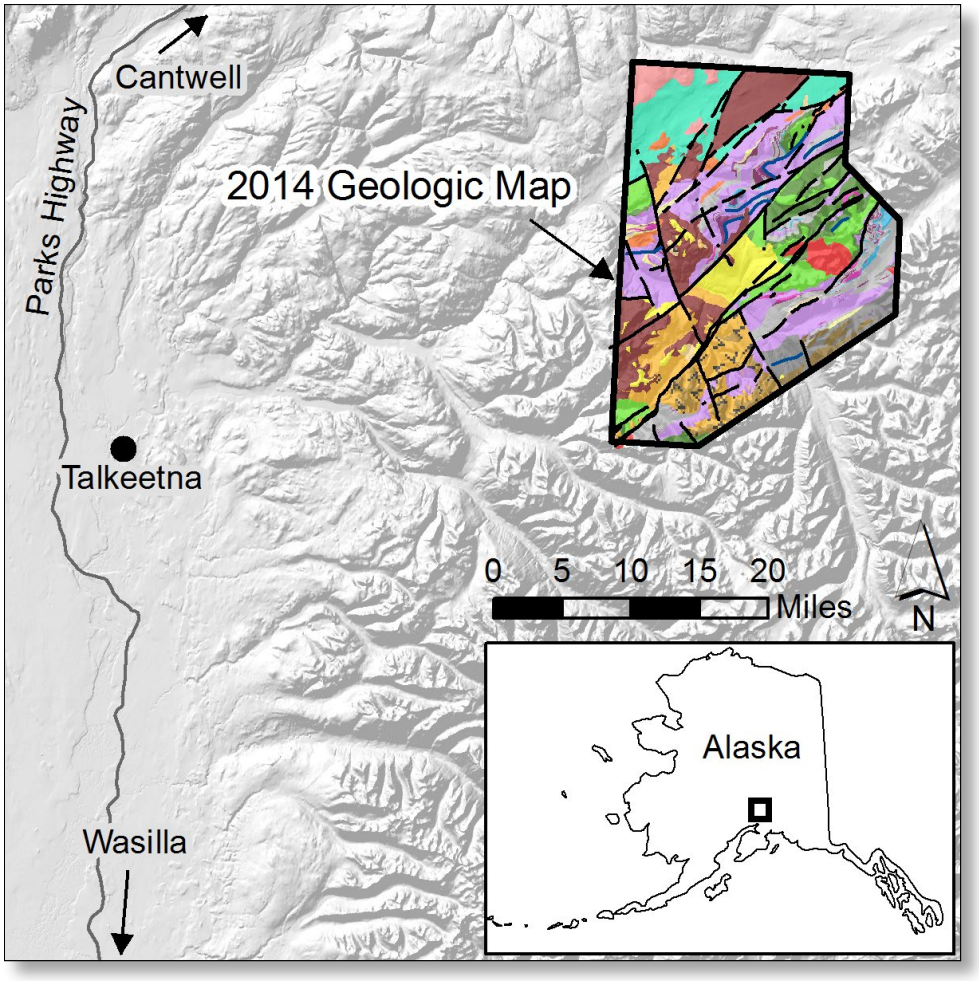
ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
FY2015 Project Description

GEOLOGIC MAPPING IN THE TALKEETNA MOUNTAINS, SOUTH-CENTRAL ALASKA

The Division of Geological & Geophysical Surveys' (DGGS) Minerals Resources section completed 450 square miles of bedrock and surficial-geologic mapping in the Talkeetna Mountains Quadrangle during 2014 (see figure). This work is part of a multi-year effort to improve the geologic understanding of the Wrangellia geologic terrane, a belt of rocks that hosts a significant deposit of the strategic and critical platinum-group elements (PGEs), nickel, copper, and cobalt in the Yukon Territory but is poorly understood where it occurs in the Talkeetna Mountains of Alaska. This work is jointly funded through the State's *Strategic and Critical Minerals Assessment* project (see project description) and the U.S. Geological Survey's STATEMAP Program.

DGGS mapping shows that the study area contains a broad section of the Wrangellia stratigraphy, including the Late Triassic gabbros, which are regionally prospective for PGE mineralization. The oldest rocks in the area are volcanic rocks, overlain by sandstone, siltstone, chert, and Permian limestone. These sedimentary units host numerous sills of Late Triassic gabbro, ranging from <1 meter to several hundred meters thick. The extrusive equivalents of these sills are the >1-kilometer-thick Nikolai Greenstone, which outcrops across the center of the map area.



Along the southern boundary of the map area, the Wrangellia stratigraphy is cut by Jurassic granodiorite plutons of the Talkeetna Arc. At the northern edge of the map Wrangellia rocks are fault-juxtaposed against Jurassic to Cretaceous flysch, and both are intruded by plutons of mid-Cretaceous to Paleogene age. A series of Paleogene subaerial arc volcanic rocks varying continuously from basalt to rhyolite in composition unconformably overlie the Mesozoic and Paleozoic rocks in the southern portion of the map.

The entire area is cut by a series of prominent northeasterly-striking faults, including the range-front fault that separates mountainous Wrangellia from the Fog Lakes lowland and Kahiltna flysch. Where these structures are exposed, they have normal-oblique kinematic indicators consistent with evolution in a complex strike-slip tectonic setting.

Geochemical results show a diverse array of mostly structurally controlled mineralization associated with the prominent northeast-striking fault systems. These quartz and sulfide veins and breccias have widely varying metal associations, including copper, silver, gold, and molybdenum.

The surficial-geology mapping component utilized fieldwork and remotely-sensed data, including aerial photographs and IfSAR. The surficial geologist visited numerous exposures and evaluated several soil pits, identified potential sand and gravel resources, mapped areas of slope instability, and refined previously mapped contacts of glacial drift units.

Products of this work will include a 1:50,000-scale comprehensive geologic map and accompanying report, as well as interim supporting geochemical and geochronological data reports.

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ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
FY2015 Project Description

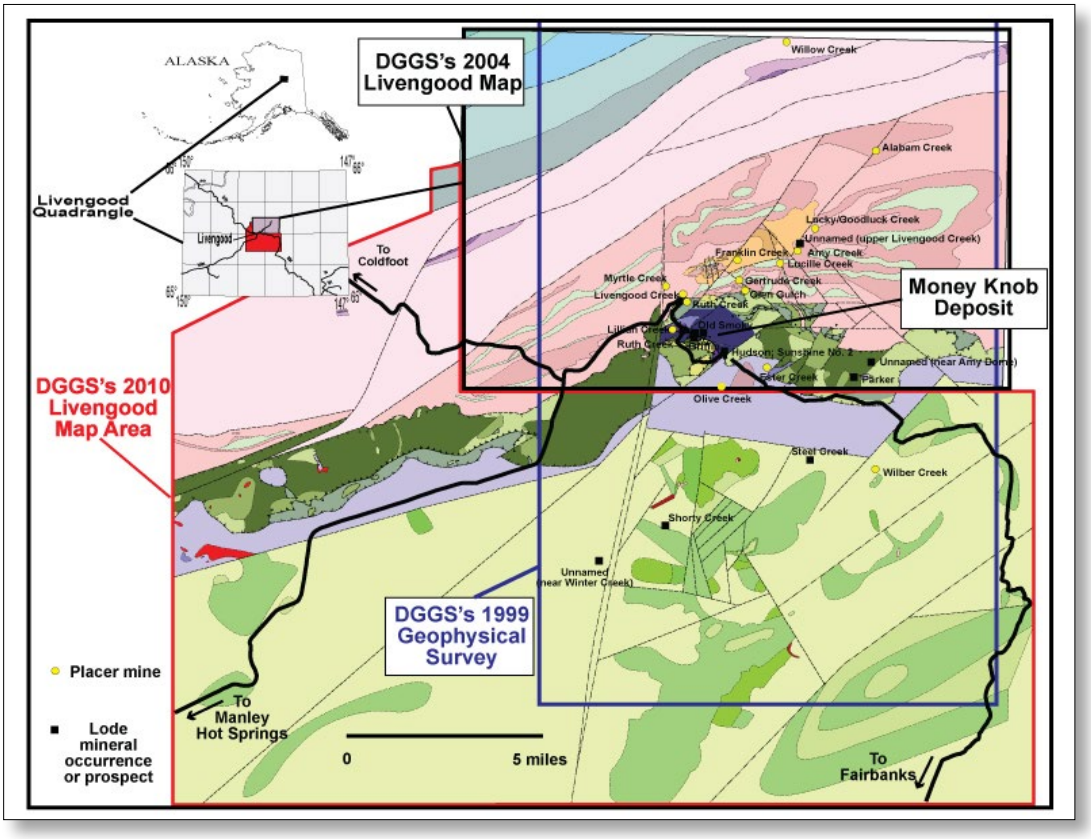
BEDROCK GEOLOGIC MAPPING IN THE TOLOVANA MINING DISTRICT, LIVENGOOD QUADRANGLE, ALASKA

Historic and active placer mines 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 report for an area that includes the northern portion of the 1999 geophysical survey (see figure). Subsequent mineral industry exploration in this 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, a Cu–Au–Mo porphyry signature, and, locally, Au values in rock and soil samples. Felsic igneous rocks spatially associated with the Shorty Creek prospect are compositionally different and 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 alkalic Cascaden Ridge pluton, 8 miles southwest of Money Knob, intrude Devonian sedimentary and volcanic rocks that also act as the host rock in the Money Knob system. The Money Knob prospect is currently being evaluated for possible development and production by International Tower Hill Mines, and the Shorty Creek deposit is being explored by Freegold Ventures.

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 similar in 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 comprehensive geologic map and accompanying interpretive report for the entire Livengood study area will be published in 2015. This publication will summarize the collective findings of the DGGS 2004 and 2010 investigations, and will incorporate 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 the 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.



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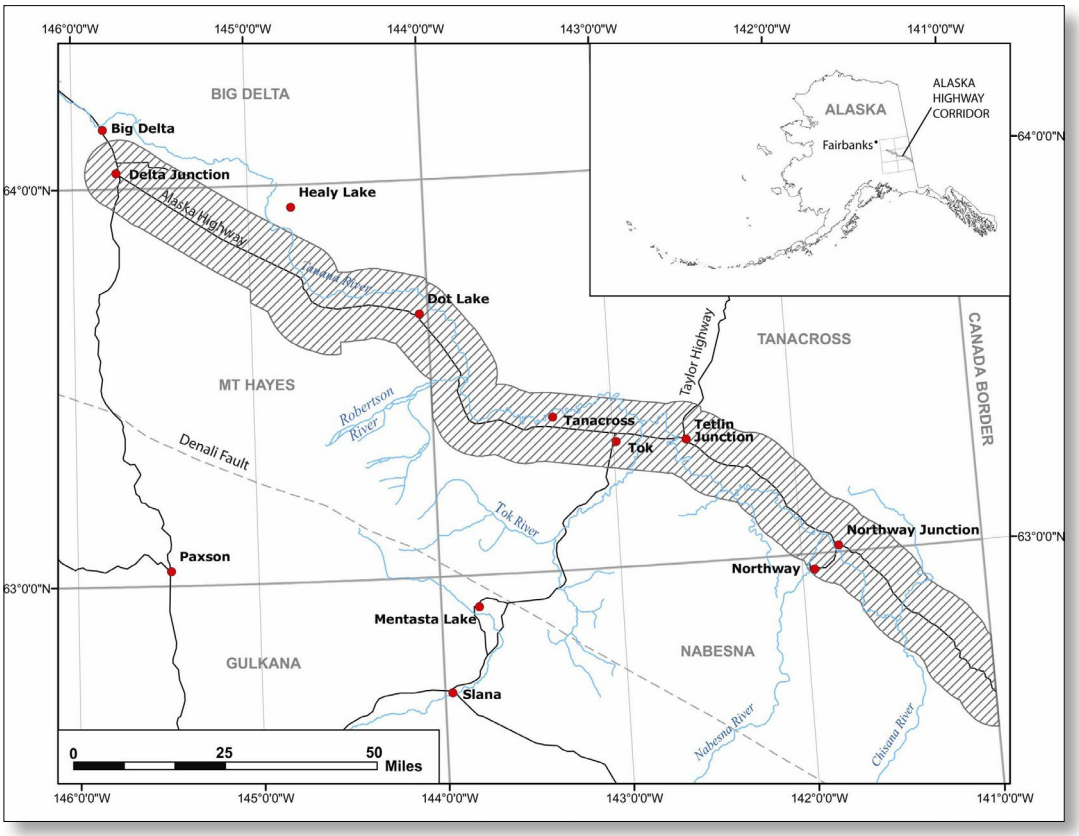
ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
FY2015 Project Description

BEDROCK GEOLOGY AND MINERAL-RESOURCE ASSESSMENT ALONG INFRASTRUCTURE CORRIDORS BETWEEN DELTA JUNCTION AND THE CANADIAN 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. Relatively little geological and geotechnical work has been published relating to this strategically located 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-geologic and geologic-hazards components of the project are described separately.



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 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 intrude 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 on any future infrastructure.

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, apatite fission-track data, and U-Pb and $^{40}Ar/^{39}Ar$ age dates were published in 2014. Bedrock-geologic maps for the three segments of the proposed gas pipeline corridor will be published by the end of 2015.

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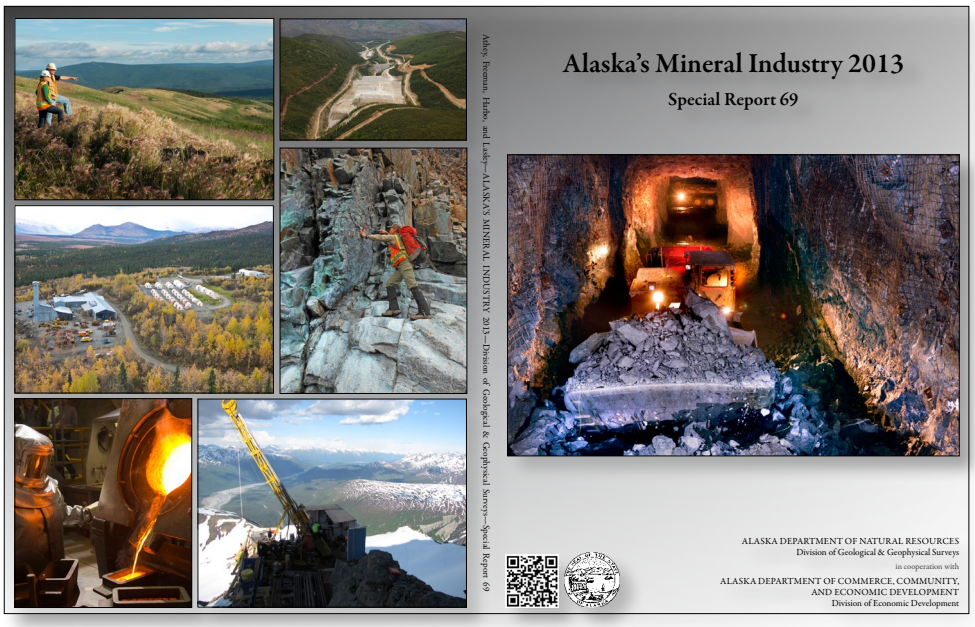
ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
FY2015 Project Description

ANNUAL ALASKA MINERAL INDUSTRY REPORT

The Alaska 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 distrib¬ute 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. Staff from DGGS and DED spend a significant amount of effort gathering data through the year from sources such as press releases and corporate annual and financial reports, responses to questionnaires sent to mining entities, and permitting paperwork, as well as through phone interviews with individuals. Other data is gathered from State of Alaska agencies including the Department of Revenue, Department of Labor and Workforce Development, and other divisions of the Department of Natural Resources. 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 coop¬erative 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 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, the 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 continuing to work with industry representatives and the Alaska 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 2013 Alaska mineral industry activity report, released in November 2014, 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 2013, decreasing less than 4 percent to $3,953,000,000, despite declines in metal prices and worldwide mineral investment. Exploration expenditures for 2013 were at least $175,500,000, down about 48 percent from the 2012 reported value of $335,100,000. The drop in exploration expenditures reflects a worldwide decrease in exploration expenditures as well as the transition of the Donlin Gold project from exploration to development. Statewide development expenditures increased by nearly 5 percent, to approximately $358,800,000, and mineral production value remained steady, decreasing less than 1 percent to $3,418,700,000. Alaska gold production exceeded 1 million ounces in 2013, a milestone only achieved once before—in 1906.



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