STATE OF ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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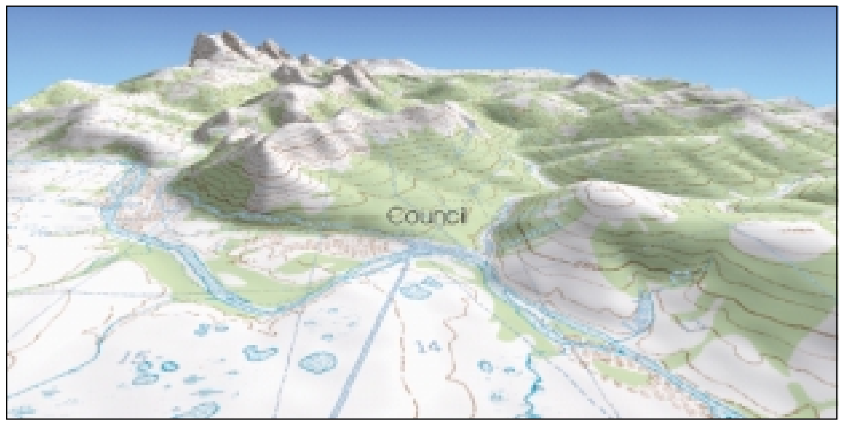
NOTE: THE MARCH 2004 NEWSLETTER WAS INCORRECTLY LABELED AS VOL. 6, NO. 1; IT SHOULD HAVE READ VOL. 7, NO. 1.

APPLICATION OF REMOTE-SENSING IMAGERY AND 3-D VISUALIZATION IN THE COUNCIL MINING DISTRICT, SEWARD PENINSULA

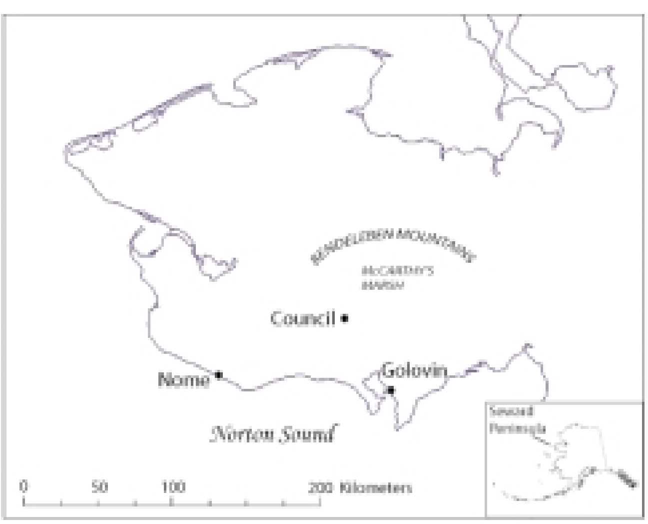
DeAnne S.P. Stevens

SUMMARY

The Alaska Division of Geological & Geophysical Surveys (DGGS) is engaged in a NASA-funded project to help facilitate the economic viability of rural communities through increased placer mining opportunities. The project will apply remote-sensing imagery, multi-resolution digital elevation models (DEMs), and high-altitude color-infrared photography in conjunction with knowledge of geomorphology, surficial deposits, and bedrock geology, to evaluate the placer gold potential of part of the Council placer mining district on the Seward Peninsula, northwestern Alaska. Additionally, as part of our commitment to the rural people of the Seward Peninsula, we have presented a series of educational workshops in Nome to teach interested members of the communities impacted by this research how to understand, interpret, and apply the map and GIS products that will be generated by the study.



Virtual three-dimensional landscape model of the Council area generated by draping digital topographic map over inSAR-derived DEM with 4X vertical exaggeration. View is to north. Landscape models can help users learn to interpret topographic maps and visualize the geography of an area.



Map of Seward Peninsula.

BACKGROUND

In March 2000, regional and village Native Alaskan leaders met in Kotzebue, northwestern Alaska, to discuss avenues for preserving the indigenous cultures of Alaska and increasing the quality of life for their communities. The Arctic Economic Development Summit determined that new economic development in rural Alaska results in higher employment; greater access to health care, water, sewer and transportation; and a tax base or payments that can support schools and needed social services. Further, they asserted that development projects ultimately provide greater self-sufficiency and determination over the future for the Native communities. Historically, small-scale placer gold mines have been readily available as a means of generating income in rural areas. Between 1992 and 2001, however, 780 of a total 1,251 placer mining jobs had been lost statewide. Most of these jobs were located in rural Alaska and provided well paying seasonal employment to local residents. Part of the reason for the decline is that most placer districts are perceived as mined out. Preliminary examination of aerial photographs, however, suggested that untapped placer re-

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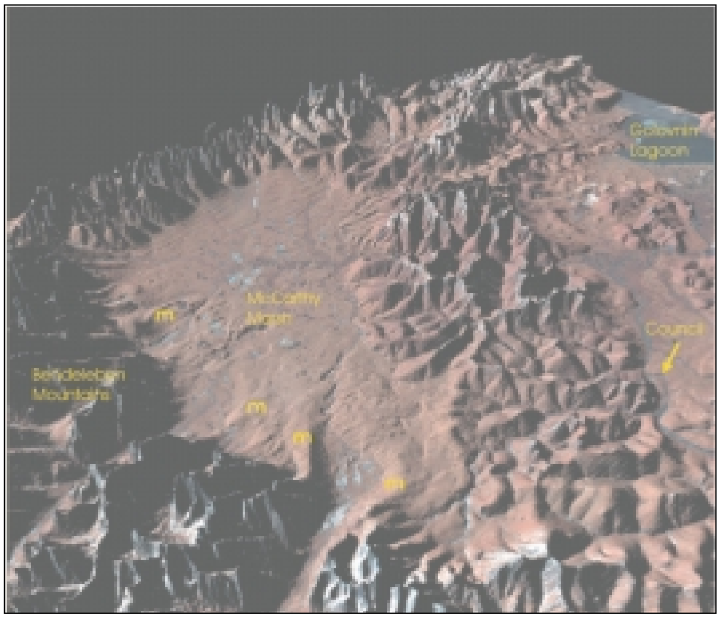


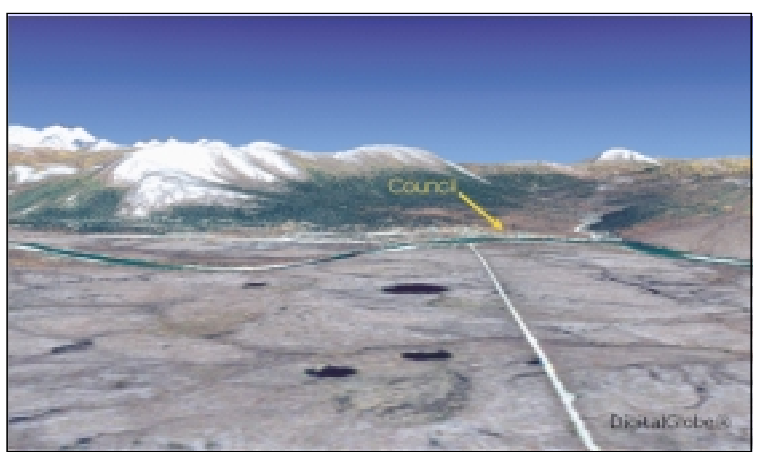
Virtual three-dimensional landscape model of the Council area generated by draping Landsat-7 ETM+ imagery (bands 2–3–4 displayed as blue–green–red) over NED-derived DEM with 8X vertical exaggeration. The extreme vertical exaggeration and low sun angle combine to enhance the surface expression of the moraines fronting the Bendeleben Mountains (indicated by "m"). View is to southeast.

serves might still be present. Alaska's Senator Ted Stevens, working with NASA, obtained congressional funding to address projects in Alaska that might benefit from remote-sensing technology. Remote sensing involves analyzing and extracting useful information from images taken from aircraft and spacecraft, including aerial photography and satellite imagery. The DGGS project discussed here is one of eight statewide selected for funding.

Project Strategy

Our strategy to identify potential untapped placer resources is based on what we know about placer deposits. Placers are generally water-laid deposits, usually gravel, that are enriched in valuable minerals (gold, platinum, and diamonds are the most familiar commodities), and are formed when the original lode deposit (rock) is gradually broken apart by erosion (physical and chemical processes) and the resulting material is transported into streams where water has a tendency to remove less-dense components and leave denser material behind. Over time, the stream bottom may develop sufficiently high concentrations of the dense commodities to be economically valuable. It is clear, then, that geomorphology is key to locating placers: Landforms are geologic indicators of past stream activity and thus of placer potential. The targets of our search in the Council area include stream terraces, buried and abandoned paleochannels, and some classes of glacial deposits, all within the context of a geologic framework where they occur in association with known placers and/or have ancestral headwaters in known gold-bearing rocks. Such landforms and their age relationships are often subtle and require accurate topographic control to either recognize or correctly spatially relate to one another. Because of this, DGGS is particularly interested in developing the in-house capability to perform image draping and generate three-dimensional block diagrams that promise to be especially useful in visualizing the data in a topographic context that permits discernment of subtle landforms.

The project is being implemented in two phases: Phase I, regional evaluation using lower-resolution data; and Phase II, detailed evaluation using higher-resolution data. Additionally, high-altitude color-infrared aerial photographs are being used to cross-check satellite imagery classifications, produce tradi-



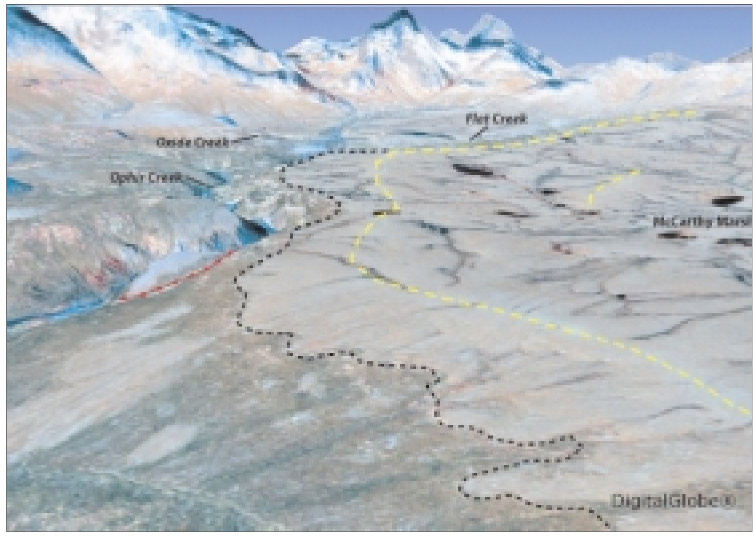
Virtual three-dimensional landscape model of the Council area generated by draping QuickBird multispectral imagery (bands 1–2–3 displayed as blue–green–red) over inSAR-derived DEM with 3X vertical exaggeration. This satellite image was collected in September 2003, and the bright colors on the hills are fall vegetation. Bedrock is principally marble, which appears white in this image, as does the Nome–Council road seen in the foreground. View is to north.

tional photointerpreted geologic maps, and to generate geographically corrected orthophoto base maps that will be useful for many other applications in the Council area.

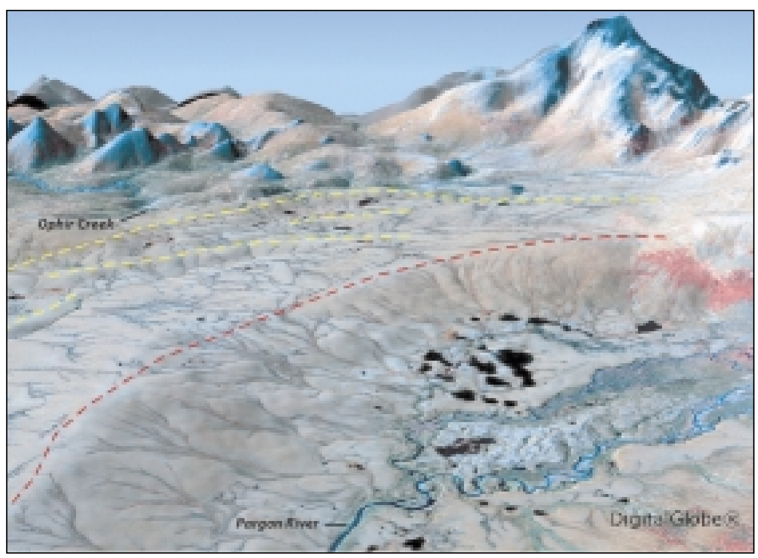
Results

Phase I of the project involves regional landform analysis using Landsat-7 ETM+ imagery and a digital elevation model (DEM) from the USGS National Elevation Database (NED). DEMs are digital datasets in which each geospatially located cell (analogous to a pixel) is assigned a value corresponding to its elevation. Landsat-7 ETM+ imagery has a spatial resolution of 30 m for its six-band multispectral data, and the NED DEM has a 60-m cell resolution in the study area. In addition to virtual three-dimensional image drapes, we are evaluating the utility of the imagery in distinguishing key geomorphic features by applying remote-sensing analysis techniques that include edge detection, principal component analysis, and supervised and unsupervised classification. While we are able to distinguish many key geomorphic features at this level, critical distinctions cannot yet be made regarding some important groups of glacial deposits. Distinguishing between different ages of glacial deposits should theoretically be possible because the different-aged surfaces should be characterized by different vegetation and surface expression, especially roughness. Older surfaces would have experienced more post-depositional smoothing due to periglacial processes such as solifluction. However, the scale of the Phase I data is proving too coarse to distinguish anything but the largest features. Nevertheless, combining spectral, geologic, and topographic data to generate virtual 3-D landscape models at this scale shows great potential as a powerful analytical tool on a regional level, as well as being an instantly intuitive means of portraying the data relationships to the general public.

QuickBird imagery, with a resolution of 2.4 m for its four-band multispectral data, was selected for Phase II detailed analysis. The Phase II evaluation uses DEMs with 30-m cell resolution that were generated by the Alaska SAR Facility (ASF) from ERS-derived Tandem Mission radar data processed using interferometric SAR (inSAR) methods. As in Phase I, we are generating virtual three-dimensional image drapes as well as evaluating the imagery using edge detection, principal component analysis, and supervised and unsupervised classification. Possible additional future investigations may include applying roughness algorithms and slope analysis using the inSAR DEMs in an attempt to differentiate between degrees of smoothing on surfaces of different ages. Again, the most useful analytical tools for the project to date are the virtual 3-D image models,



Virtual three-dimensional landscape model of upper Ophir Creek generated by draping QuickBird multispectral imagery (bands 1–2–4 displayed as blue–green–red) over inSAR-derived DEM with 3X vertical exaggeration. Dashed yellow lines are moraine crests of the pre-Wisconsin Sinuk Glaciation, black dashed line is limit of preserved Sinuk-age moraine deposits, and red arrows show abandoned paleochannel incised by Ophir Creek. View is to northwest. In pre-glacial times upper Ophir Creek, Oxide Creek, and Flat Creek probably drained to the east across what is now McCarthy Marsh. Advancing glaciers pushed the streams southwestward and eventually completely diverted them to their modern southern flow.



Virtual three-dimensional landscape model of Pargon River - upper Ophir Creek area generated by draping QuickBird multispectral imagery (bands 1–2–4 displayed as blue–green–red) over inSAR-derived DEM with 3X vertical exaggeration. Dashed yellow lines are moraine crests of the pre-Wisconsin Sinuk Glaciation, dashed red line is moraine crest of pre-Wisconsin Nome River Glaciation. View is to west–southwest. Glaciers in the Bendeleben Mountains carved Pargon River valley and advanced across McCarthy Marsh, filling the basin with glacial sediments and changing the courses of streams like Ophir Creek.

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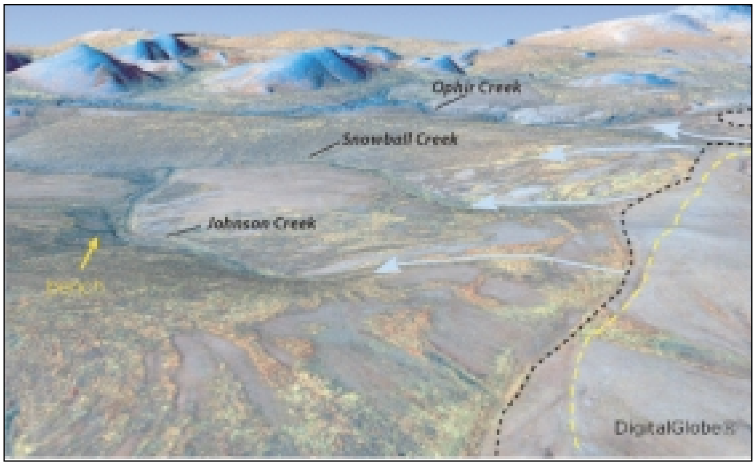

Virtual three-dimensional landscape model of upper Ophir Creek generated by draping QuickBird multispectral imagery (bands 1–2–4 displayed as blue–green–red) over inSAR-derived DEM with 3X vertical exaggeration. This satellite image was collected in September 2003, and the bright colors on the hills are fall vegetation. Bedrock is principally marble and schist, which appear blue in this image. Dashed yellow line is moraine crest of the pre-Wisconsin Sinuk Glaciation, black dashed line is limit of preserved Sinuk-age moraine deposits, and blue arrows show proglacial meltwater drainages feeding into the heads of Johnson and Snowball creeks. View is to west. Glaciers originating in the Bendeleben Mountains advanced across McCarthy Marsh and overtopped ridges at the heads of modern Johnson and Snowball creeks. Large volumes of proglacial meltwater flowed into these valleys, draining southward and carving subdued, elevated bedrock benches like the one marked.

which allow us to analyze the landscape using a powerful combination of manipulation of multi-band spectral data over three-dimensional topography that can be enhanced by user-controlled vertical exaggeration, sun angles, and viewing geometry. The geospatial relationships between landscape and geology are apparent to professional and layperson alike.

It is clear that the new remote-sensing technologies will be extremely useful in future geologic investigations, but they are best used *in conjunction with* traditional air photo based methods, not *instead of* them. Ground truthing is a critical requirement, as it is in all image-based (e.g., air photo) analyses, and the new technologies require high-end computers and expensive software in order to be utilized effectively. DGGS remains committed to using these tools to better serve the needs of communities throughout Alaska. Upon completion of this project, we will employ remote-sensing technology in engineering-geology assessments of flood-plain hazards, transportation corridor analysis, re-assessment of mining potential in historical placer districts throughout the state, and in conducting construction-material inventories. Many additional applications will likely become apparent over time.

Products

Products from this study will consist of detailed geologic maps of unconsolidated Quaternary sedimentary deposits in the Council area and appropriate cross-sections and three-dimensional landform models. The maps and models will display the spatial relationships between deposits that are fundamental to understanding the Quaternary geologic history of the mining district and identifying the most probable location and extent of currently undiscovered placer gold-bearing deposits. All map products will be produced in conformance with NGDC standards, will be in ESRI ArcGIS format, and available for viewing and download on the DGGS Web site. Anticipated release date is spring 2005. In addition to the educational workshops that have already been held in Nome in 2002 and 2003, a final workshop is scheduled for summer 2005 that will focus on interpreting and using the completed map and GIS products generated for the Council mining district.

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Dear Readers:

This issue of GeoSurvey News highlights the use of modern remote-sensing technology as part of a multi-disciplinary approach to addressing practical problems in landform analysis and geologic mapping. We are excited about the potential outcome of this project for helping to identify possible untapped placer-mineral resources on Seward Peninsula and look forward to applying the technology to many other practical geologic-resource and hazards problems around Alaska.

When you call or visit our office you will have an opportunity to meet Sean Willison, who has taken the position of Natural Resource Technician, replacing Dawn Roberts at the front desk. After three years of productive service to DGGS managing the geology library and cheerfully responding to public inquiries, Dawn was accepted to a master's degree program in museology at the University of Washington. We congratulate Dawn and wish her the best in her graduate studies. Sean comes to us with an academic background and work experience in natural resource management, now completing course work for a bachelor's degree in NRM at UAF. We welcome him into his new position at DGGS.

Last but not least, Gail Davidson retired at the end of August after 25 years of service with DGGS. For the past several years, in her position as chief of the Geologic Communications section, Gail oversaw the entire range of internal and external communications processes in the division, including map & report production, public information, Web site development, geographic information system (GIS), microcomputers, and network services. We congratulate Gail for her many lasting contributions to DGGS and wish her the very best in her new endeavors. Long-time DGGS employee Paula Davis is now serving as acting chief of GeoComm.

Sincerely,

Rodney A Combellick

Rod Combellick,
Acting Director

GLACIAL GRAFFITI

NEW PUBLICATIONS

GEOPHYSICAL MAPS & REPORTS

GPR 2004_1. Selected plot files of the airborne geophysical survey data of the Fairbanks and Richardson areas, interior Alaska. **1 CD-ROM**. Contains the **12 maps** listed below as GPR2004_1_xy in both HPGL/2 format and postscript printer format. **Software is needed** with **ability to plot HPGL2 files for an HP Design Jet 5000 series plotter** or **postscript files designed for an HP Design Jet Designjet 2500 using Postscript 3 printer driver v5.0**. The postscript files **should plot on all Hewlett Packard plotters that can interpret Postscript 3 files.** $10.

GPR 2004_1_1a. Total magnetic field of the Fairbanks mining district, interior Alaska, 2 sheets, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2004_1_1b. Total magnetic field of the Fairbanks mining district, interior Alaska, 2 sheets, **scale 1:63,360. Magnetic contours and section lines included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2004_1_2a. 7200 Hz coplanar resistivity of the Fairbanks mining district, interior Alaska, 2 sheets, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2004_1_2b. 7200 Hz coplanar resistivity of the Fairbanks mining district, interior Alaska, 2 sheets, **scale 1:63,360. Resistivity contours and section lines included**. **Full-color plot** from electronic file, 600 dpi. $26.

GPR 2004_1_3a. 900 Hz coplanar resistivity of the Fairbanks mining district, interior Alaska, 2 sheets, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $26.

GPR 2004_1_3b. 900 Hz coplanar resistivity of the Fairbanks mining district, interior Alaska, 2 sheets, **scale 1:63,360. Resistivity contours and section lines included**. **Full-color plot** from electronic file, 600 dpi. $26.

GPR 2004_1_4a. Total magnetic field of the Richardson mining district, interior Alaska, 1 sheet, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $13.

GPR 2004_1_4b. Total magnetic field of the Richardson mining district, interior Alaska, 1 sheet, **scale 1:63,360. Magnetic contours and section lines included. Full-color plot** from electronic file, 600 dpi. $13.

GPR 2004_1_5a. 7200 Hz coplanar resistivity of the Richardson mining district, interior Alaska, 1 sheet, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $13.

GPR 2004_1_5b. 7200 Hz coplanar resistivity of the Richardson mining district, interior Alaska, 1 sheet, **scale 1:63,360. Resistivity contours and section lines included**. **Full-color plot** from electronic file, 600 dpi. $13.

GPR 2004_1_6a. 900 Hz coplanar resistivity of the Richardson mining district, interior Alaska, 1 sheet, **scale 1:63,360. Topography included. Full-color plot** from electronic file, 600 dpi. $13.

GPR 2004_1_6b. 900 Hz coplanar resistivity of the Richardson mining district, interior Alaska, 1 sheet, **scale 1:63,360. Resistivity contours and section lines included**. **Full-color plot** from electronic file, 600 dpi. $13.

GPR 2004_2. Line, gridded, and vector data of airborne geophysical survey data for the Fairbanks and Richardson mining districts, interior Alaska. **1 CD-ROM set. Line data in ASCII format; gridded data in Geosoft format; vector files in Autocad 13 dxf files.** $20.

GPR 2004_3. Line, gridded, and vector data, and selected plot files of the airborne geophysical survey data of the Valdez Creek mining district, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp**. 1 CD-ROM**. **Line data in ASCII format; gridded data in Geosoft format and ER Mapper; vector files in Autocad 13 dxf files. 12 maps** listed below as GPR2004_3_xy are included as **plot files for** in both HPGL/2 format and postscript printer format. **Software is needed** with **ability to plot HPGL2 files for an HP Design Jet 5000/5500 series plotter** or **postscript files designed for an HP Design Jet Designjet 5000/5500 using Postscript 3 printer driver v5.0**. The postscript files should plot on all Hewlett Packard plotters that can interpret Postscript 3 files. *Supercedes PDF 94-15 and PDF 94-35.* $10.

GPR 2004_3_1a. Total magnetic field of the Valdez Creek mining district, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full-color map; topography included.** *Supercedes RI 94-18; see also GPR 2004_3_1b.* $13.

GPR 2004_3_1b. Total magnetic field of the Valdez Creek mining district, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full-color map; magnetic contours and section lines included.** *.Supercedes RI 94-18; see also GPR 2004_3_1a.* $13.

GPR 2004_3_2a. 7200 Hz coplanar resistivity of the Valdez Creek mining district, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full-color map; topography included.** *Supercedes RI 94-20; see also GPR 2004_3_2b.* $13.

GPR 2004_3_2b. 7200 Hz coplanar resistivity of Valdez Creek mining district, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full-color map; resistivity contours and section lines included**. *Supercedes RI 94-20; see also GPR 2004_3_2a.* $13.

GPR 2004_3_3a. 900 Hz coplanar resistivity of the Valdez Creek mining district, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full-color map; topography included.** *Supercedes RI 94-21; see also GPR 2004_3_2b.* $13.

GPR 2004_3_3b. 900 Hz coplanar resistivity of the Valdez Creek mining district, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full-color map; resistivity contours and section lines included**. *Supercedes RI 94-21; see also GPR 2004_3_2a.* $13.

GPR 2004_4. Line, gridded, and vector data, and selected plot files from the **aeromagnetic** survey of the **Nyac mining district**, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp**. 1 CD-ROM**. Line data in ASCII format; gridded data in Geosoft format; vector files in Autocad 13 dxf files. **2 maps** listed below as GPR2004_4_1a and 1b are included as **plot files for** in both HPGL/2 format and postscript printer format. Software is needed with ability to plot HPGL2 files for an HP Design Jet 5000/5500 series plotter or postscript files designed for an HP Design Jet Designjet 5000/5500 using Postscript 3 printer driver v5.0. The postscript files should plot on all Hewlett Packard plotters that can interpret Postscript 3 files. *Supercedes PDF 94-15 and PDF 94-34.* $10.

GPR 2004_4_1a. Total magnetic field of the Nyac mining district, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full color map; topography included.** *See also GPR 2004_4_1b.* $13.

GPR 2004_4_1b. Total magnetic field of the Nyac mining district, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full color map; magnetic contours and section lines included.** *See also GPR 2004_4_1a.* $13.

GPR 2004_5. Line, gridded, and vector data, and selected plot files of the airborne geophysical survey data of the **Circle** mining district, central Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, **1 CD-ROM**. **Contractor's report, previously released as PDF 94-36, is also included.** Line data in ASCII format; gridded data in Geosoft and ER Mapper format; vector files in Autocad 13 dxf files. 6 maps listed below as GPR 2004_5_1a through 3b are included as plot files for in both HPGL/2 format and postscript printer format. Software is needed with ability to plot HPGL2 files for an HP Design Jet 5000/5500 series plotter or postscript files designed for an HP Design Jet Designjet 5000/5500 using Postscript 3 printer driver v5.0. The postscript files should plot on all Hewlett Packard plotters that can interpret Postscript 3 files. *Supercedes PDF 94-15 and PDF 94-33.* $10.

GPR 2004_5_1a. Total magnetic field of the **Circle** mining district, interior Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full color map; topography included.** *Supercedes RI 94-14; see also GPR 2004_5_1b* $13.

GPR 2004_5_1b. Total magnetic field of the **Circle** mining district, interior Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full color map; magnetic contours and section lines included.** *Supercedes RI 94-14; see also GPR 2004_5_1a.* $13.

GPR 2004_5_1c. Color shadow total magnetic field of the **Circle** mining district, interior Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full color map; section lines included.** *Supercedes RI 94-15.* $13.

GPR 2004_5_2a. 7200 Hz coplanar apparent resistivity of the **Circle** mining district, interior Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full color map; topography included.** *Supercedes RI 94-16; see also GPR 2004_5_2b.* $13.

GPR 2004_5_2b. 7200 Hz coplanar apparent resistivity of the **Circle** mining district, interior Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full color map; resistivity contours and section lines included.** *Supercedes RI 94-16; see also GPR 2004_5_2a.* $13.

GPR 2004_5_3a. 900 Hz coplanar apparent resistivity of the **Circle** mining district, interior Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full color map; topography included.** *Supercedes RI 94-17; see also GPR 2004_5_3b.* $13.

GPR 2004_5_3b. 900 Hz coplanar apparent resistivity of the **Circle** mining district, interior Alaska, by L.E. Burns, Fugro Airborne Surveys Corp., and Stevens Exploration Management Corp., 2004, 1 sheet, scale 1:63,360. **Full color map; Resistivity contours and section lines included.** *Supercedes RI 94-17; see also GPR 2004_5_3a.* $13.

Now Available: Updated map and digital data formats for Valdez Creek, Circle, and Nyac mining districts 1994 airborne geophysical data. Main products are color geophysical maps with topography and plot files of these maps. The 1994 digital data are also re-released on a CD-ROM, which contains additional vector files such as data contour files, EM anomalies (Valdez Creek and Cirlce only), flight lines, and interpretation overlays that were not available in 1994.

MISCELLANEOUS PUBLICATIONS

MP 45-122. Survey of geology, geologic materials, and geologic hazards in proposed access corridors in the *(see list below)* Quadrangle, Alaska

MP 45. Ambler River, 5 sheets. $65.
MP 46. Anchorage, 5 sheets. $65.
MP 47. Baird Mountains, 4 sheets. $53.
MP 48. Barrow, 5 sheets. $65.
MP 49. Barter Island, 5 sheets. $65.
MP 50. Beechey Point, 5 sheets. $65.
MP 51. Bendeleben Mountains, 5 sheets. $65.
MP 52. Bering Glacier, 5 sheets. $65.
MP 53. Bethel, 5 sheets. $65.
MP 54. Bettles, 5 sheets. $65.
MP 55. Black River, 5 sheets. $65.
MP 56. Bradfield Canal, 5 sheets. $65.
MP 57. Candle, 5 sheets. $65.
MP 58. Chandalar, 5 sheets. $65.
MP 59. Chandler Lake, 5 sheets. $65.
MP 60. Charley River, 5 sheets. $65.
MP 61. Chignik Point, 5 sheets. $65.
MP 62. Circle, 5 sheets. $65.
MP 63. Cold Bay, 5 sheets. $65.
MP 64. Cordova, 5 sheets. $65.
MP 65. DeLong Mountains, 5 sheets. $65.
MP 66. Demarcation Point, 5 sheets. $65.
MP 67. Dillingham, 4 sheets. $52.
MP 68. Eagle, 5 sheets. $65.
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MP 72. Healy, 5 sheets. $65.
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MP 76. Iditarod, 4 sheets. $52.
MP 77. Ikpikpuk, 5 sheets. $65.
MP 78. Iliamna, 5 sheets. $65.
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MP 80. Kantishna River, 5 sheets. $65.
MP 81. Karluk, 5 sheets. $65.
MP 82. Kateel River, 5 sheets. $65.
MP 83. Killik River, 5 sheets. $65.
MP 84. Lake Clark, 4 sheets. $52.
MP 85. Lime Hills, 4 sheets. $52.
MP 86. Livengood, 5 sheets. $65
MP 87. Lookout Ridge, 5 sheets. $65
MP 88. McGrath, 5 sheets. $65.

MP 89. Meade River, 5 sheets. $65.
MP 90. Medfra, 5 sheets. $65.
MP 91. Melozitna, 5 sheets. $65.
MP 92. Misheguk Mountain, 5 sheets. $65.
MP 93. Mount Katmai, 5 sheets. $65.
MP 94. Mount McKinley, 5 sheets. $65.
MP 95. Mount Michelson, 5 sheets. $65.
MP 96. Naknek, 4 sheets. $52.
MP 97. Noatak, 4 sheets. $52.
MP 98. Norton Bay, 5 sheets. $65.
MP 99. Nulato, 5 sheets. $65.
MP 100. Ophir, 5 sheets. $65.
MP 101. Petersburg, 5 sheets. $65.
MP 102. Philip Smith Mountains, 5 sheets. $65.
MP 103. Port Moller, 5 sheets. $65.
MP 104. Ruby, 4 sheets. $52.
MP 105. Russian Mission, 5 sheets. $65.
MP 106. Sagavanirktok, 4 sheets. $52.
MP 107. Selawik, 5 sheets. $65.
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