From Rocks Underfoot to Map in Hand: The DGGS Mapping Process in Alaska's Mineral-Rich Lands

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Over the past 6 years, geologists in the Alaska Department of Natural Resources, Division of Geological & Geophysical Survey Mineral Section (DGGS), with Rainer Newberry from the Department of Geology & Geophysics, University of Alaska Fairbanks, have devised a field bedrock mapping methodology during mapping studies in Interior Alaska. Surficial deposits and vegetation impede bedrock geologic mapping over much of Interior Alaska. An integrated program of airborne geophysics, geological and geochemical methods has been developed and refined that lead to highly detailed 1:50,000 and 1:63,360 scale geologic maps.

Airborne geophysical data collected prior to fieldwork helps define the geologic mapping area. Geophysical surveys and geologic maps are part of the Alaska Airborne Geophysical /Geological Mineral Inventory Program, a special multi-year investment by the State of Alaska to expand Alaska's geologic and mineral resources knowledge base, catalyze future private-sector mineral exploration and development, and guide state planning. Geophysical surveys (generally magnetic, electromagnetic, and VLF data) are selected for areas of high mineral potential, as well as a range of geologic features, terranes, or other criteria. Geophysical data is used for predictive modeling prior to fieldwork and the data and derivative models are used for planning field traverses. Prior to fieldwork, geophysical data are used to identify locations of inferred faults, potential unit boundary locations, and to identify unusual locations of anomalies for follow-up investigation in the field.

Field observations are the key elements for DGGS geologic maps. Field notes and rock samples are collected at thousands of stations (locations) throughout a project area. Our methods are team oriented. Mapping traverses are planned so that all team geologists work throughout the map area to avoid "border faults" between portions of map areas and to gain collective knowledge that builds on each geologist's observations. Daily discussions between all field members are key to this team approach. Location data are downloaded from Garmin 12XL GPS units into a Microsoft Access database. A student intern manually enters field notes into the database. Spatial data attributes are either queried directly from the database or attached to the objects using MapInfo Professional 6.5 or ArcEdit 8.0.2. Geologic data used in the project compilation are field maps and notes from a project as well as data from other sources.

Whole rock analysis, petrography and modal analyses on thin sections, and modal analysis of stained rock slabs are used to classify rocks according to established petrologic nomenclature. Analytical data is used to determine permissible protoliths for metamorphic rocks, and to assign root names and trace-element-indicated tectonic settings to igneous and metamorphosed igneous rocks. This data is used to define map unit boundaries and is incorporated into unit descriptions. Geochronological data is obtained by $^{40}Ar/^{39}Ar$ and U-Pb methods to determine the age of geologic units and mineralization in the map area.

A set of four geologic maps is produced digitally using GIS software, including bedrock geology, surficial geology, engineering-materials, and comprehensive geologic maps. Maps and data can be purchased at DGGS or viewed and downloaded for free from the DGGS web site.