ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
IN COOPERATION WITH ARCO ALASKA, INC., AND DOYON, LIMITED

REPORT OF INVESTIGATIONS 96-6a
Van Kooten and others (1997), sheet 3 of 3

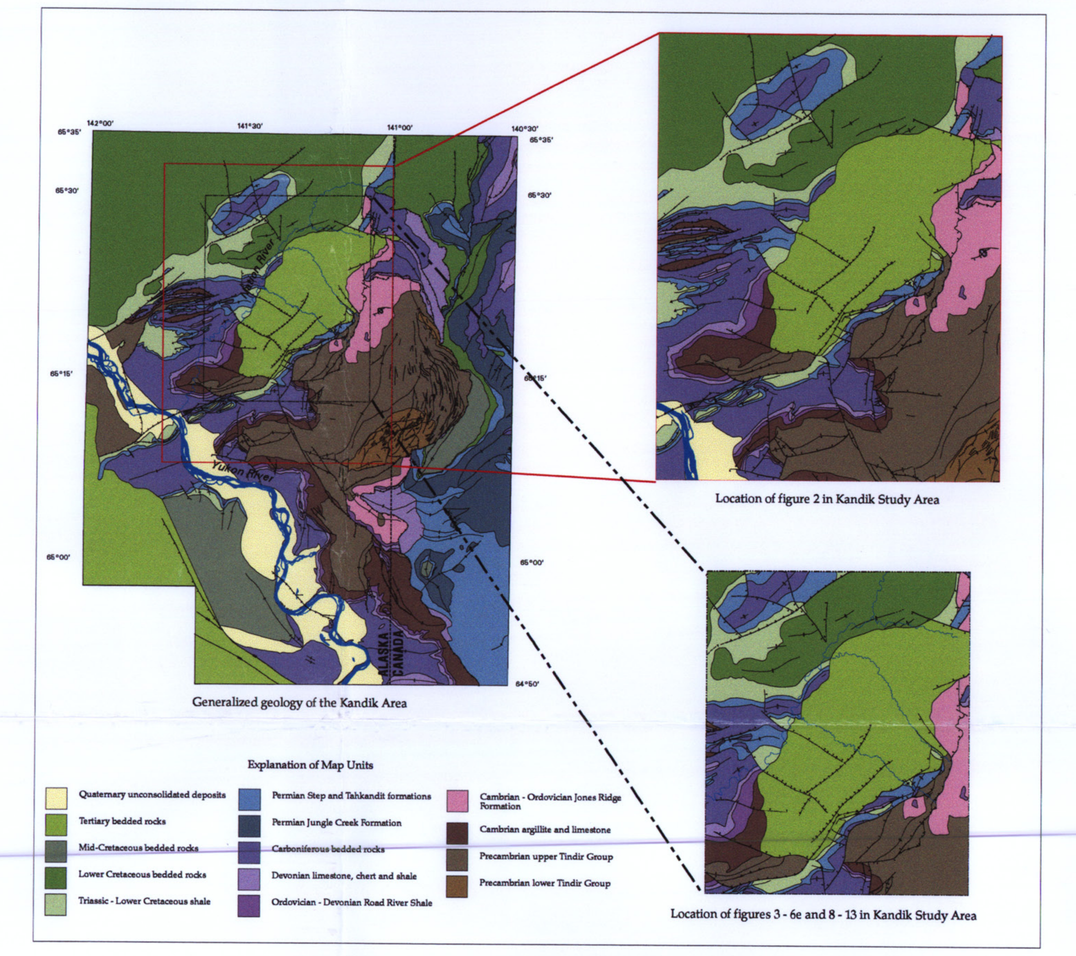

Figure 1. Location Map for Geochemistry Figures

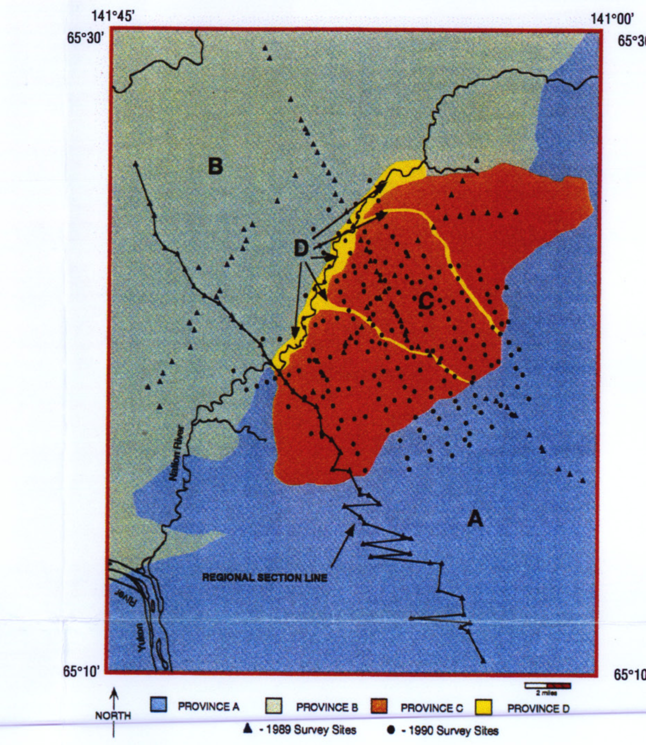

Figure 2. Regional Geochemistry Provinces - Eagle/Kandik

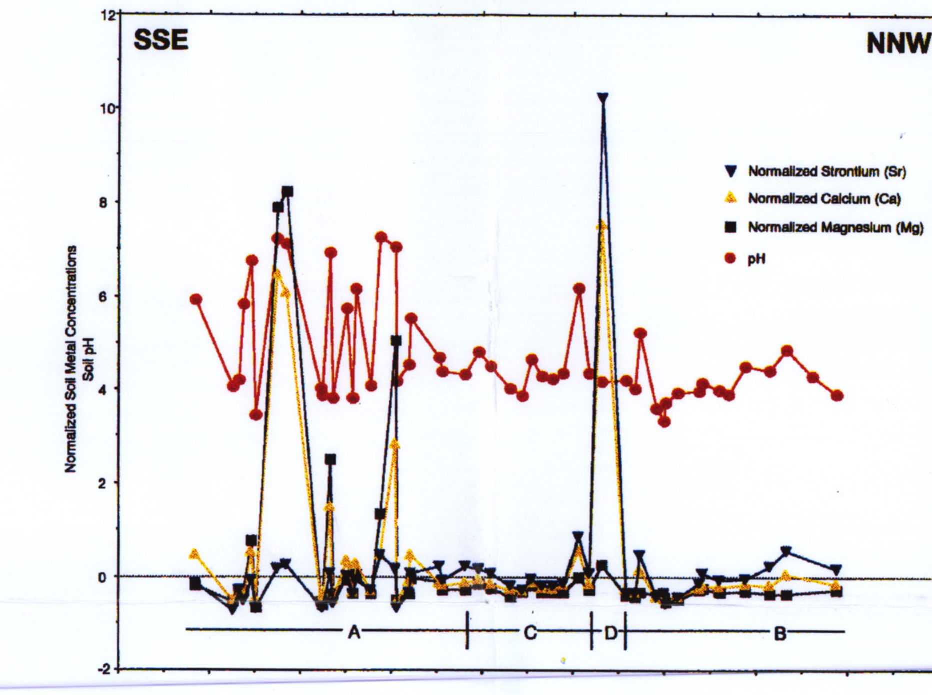

Figure 3. Regional Section Line - Soil Alkaline Earth Metals and Soil pH.

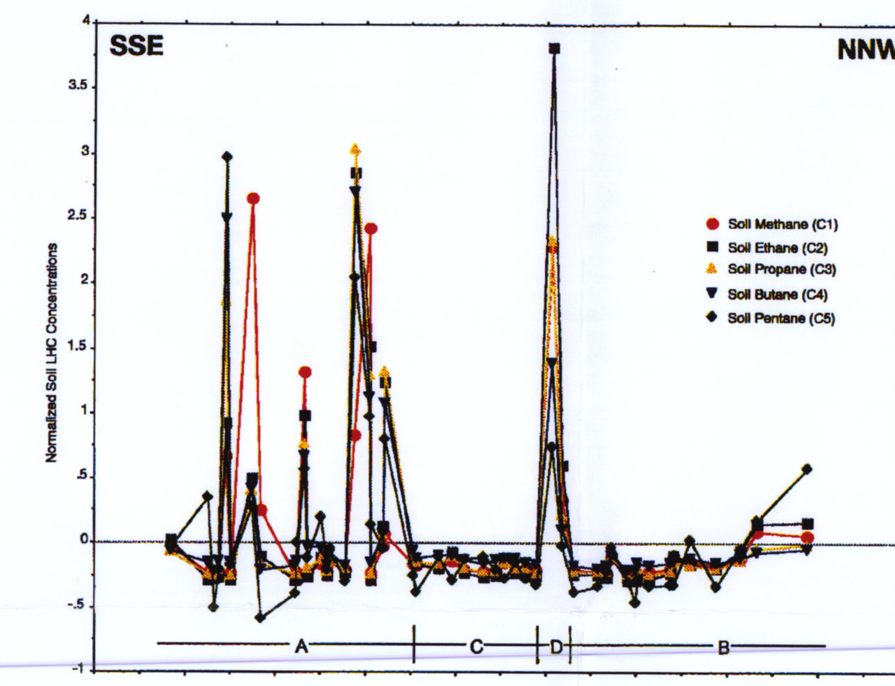

Figure 4. Regional Section Line - Soil Light Hydrocarbons (C1-C5).

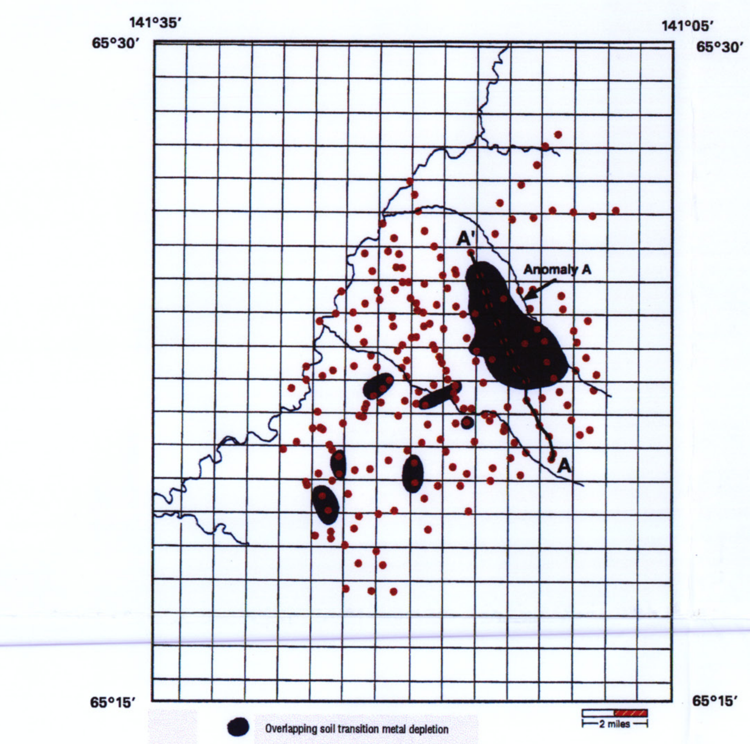

Figure 5. Soil Transition Metal Depletion Anomaly Map (Fe,Mn,Ni,Co,Cr).

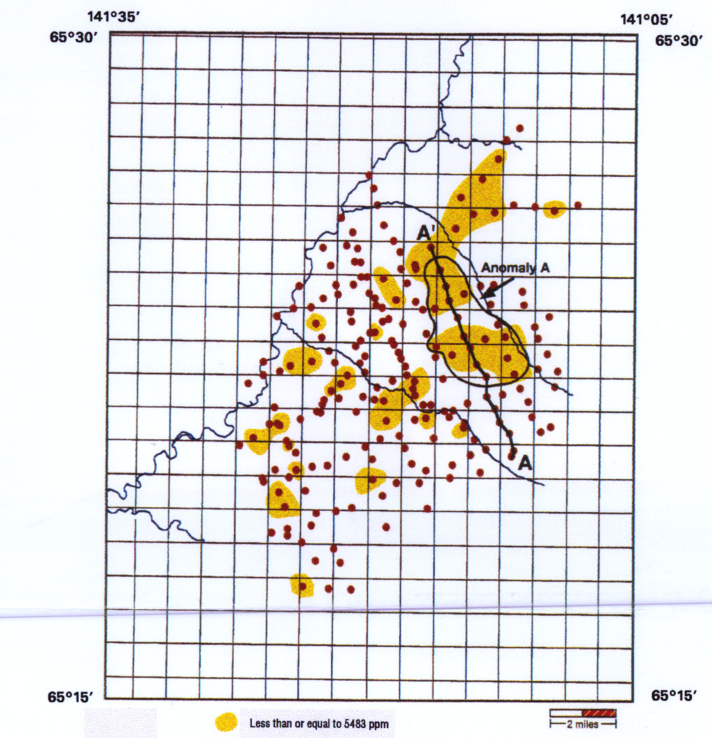

Figure 6a. Soil Iron (Fe) Depletion Map.

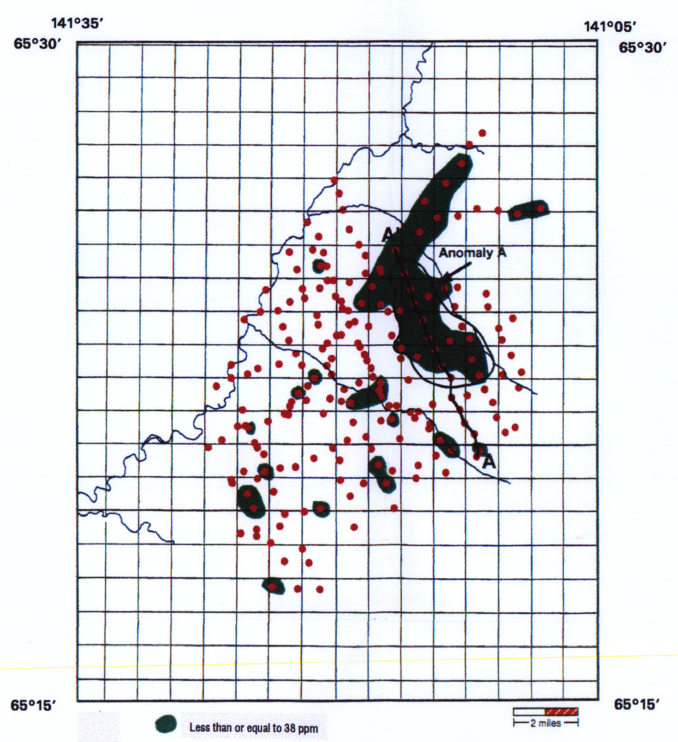

Figure 6b. Soil Manganese (Mn) Depletion Map.

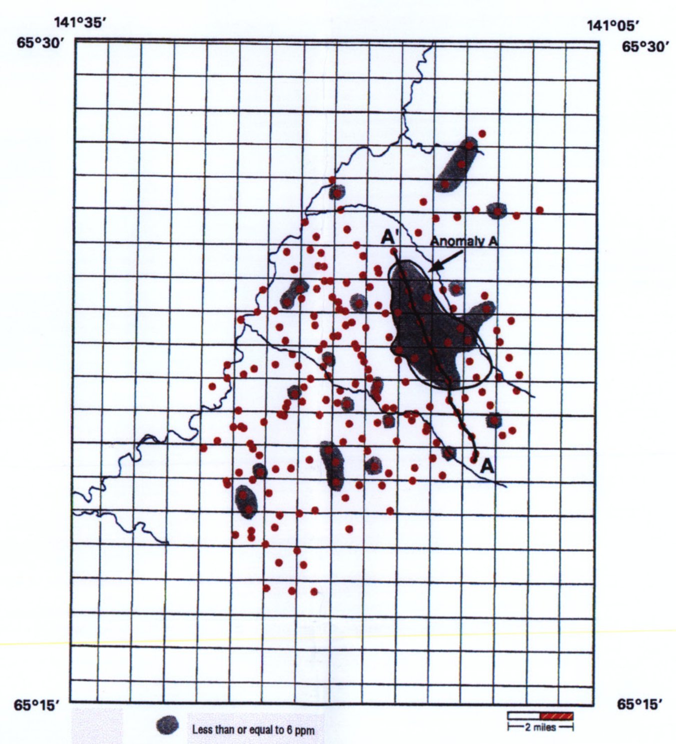

Figure 6c. Soil Nickel (Ni) Depletion Map.

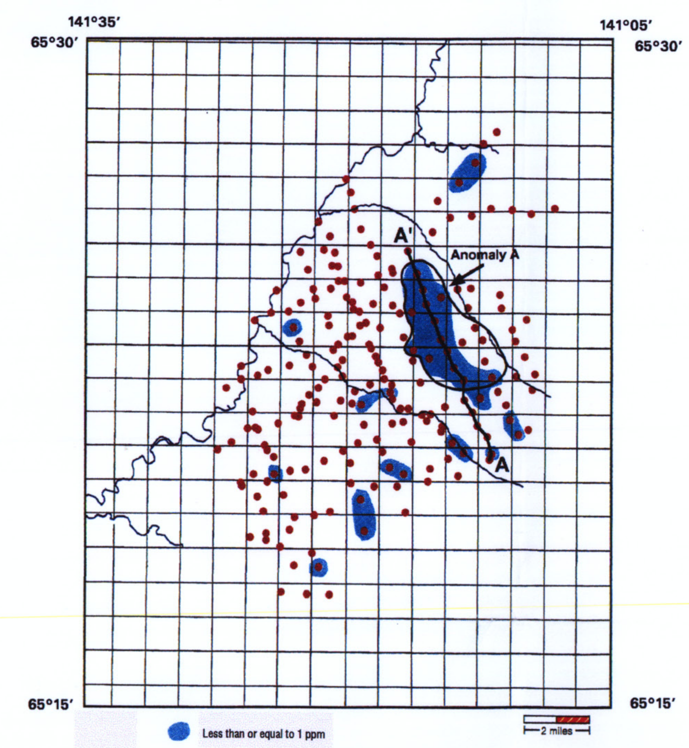

Figure 6d. Soil Cobalt (Co) Depletion Map.

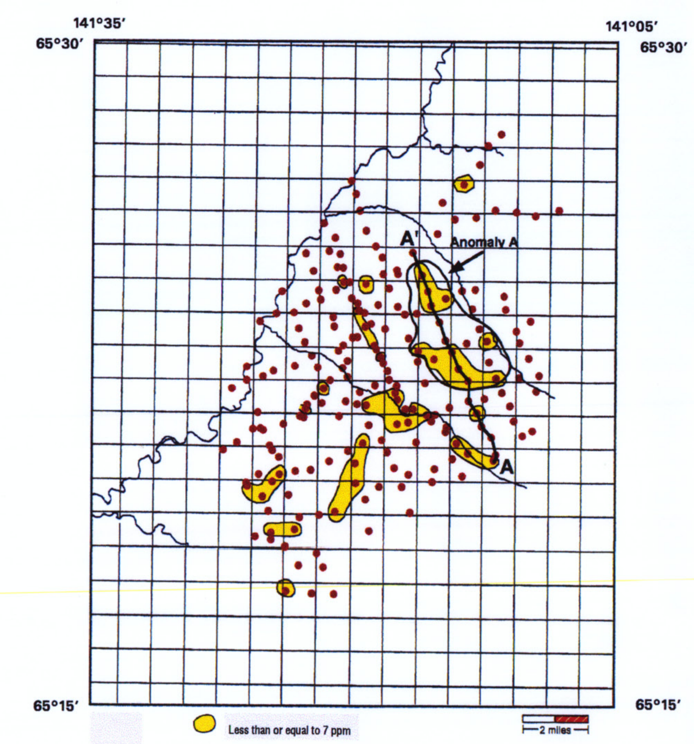

Figure 6e. Soil Chromium (Cr) Depletion Map.

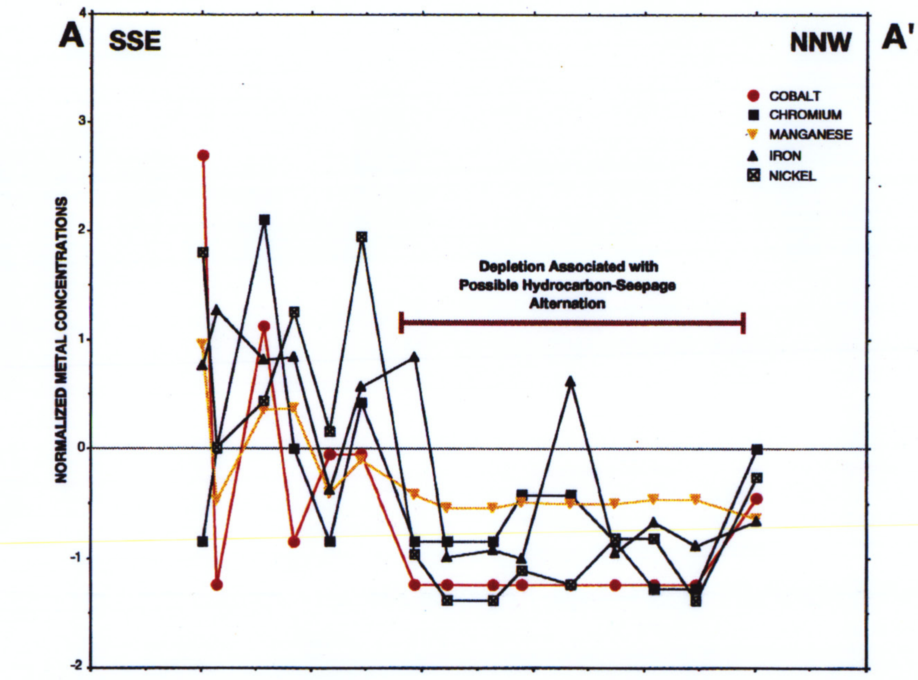

Figure 7. A-A' section line through Anomaly A showing transition metal depletions.

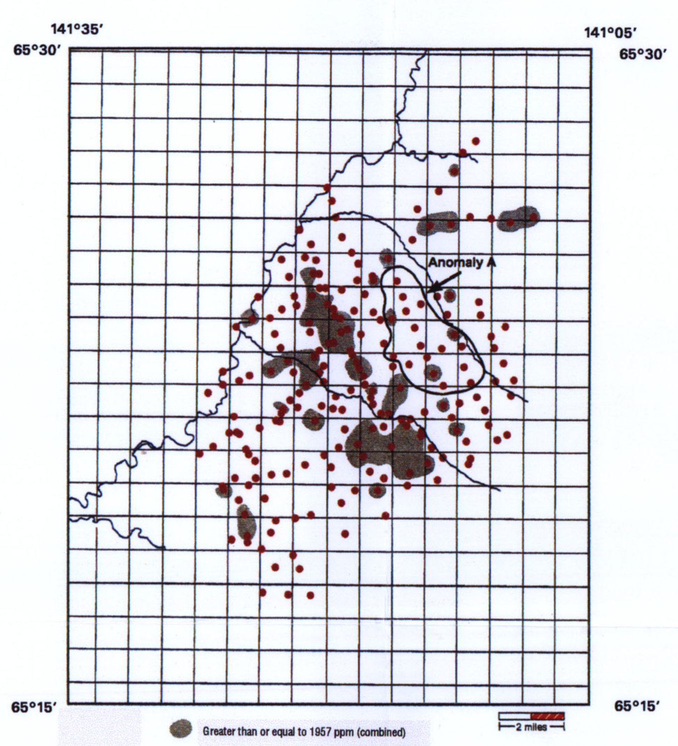

Figure 8. Plant FeVTi Stack Enrichment Map.

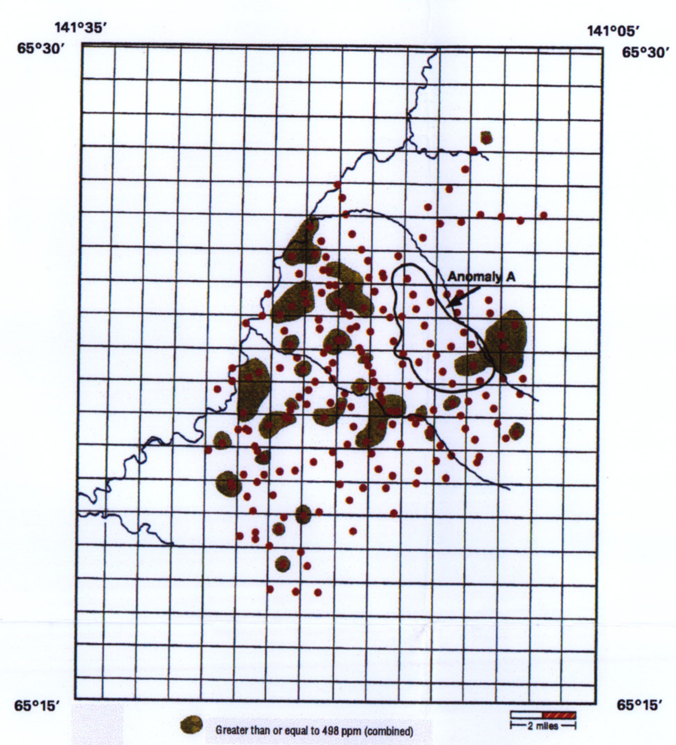

Figure 9. Humus MnCo Stack Enrichment Map.

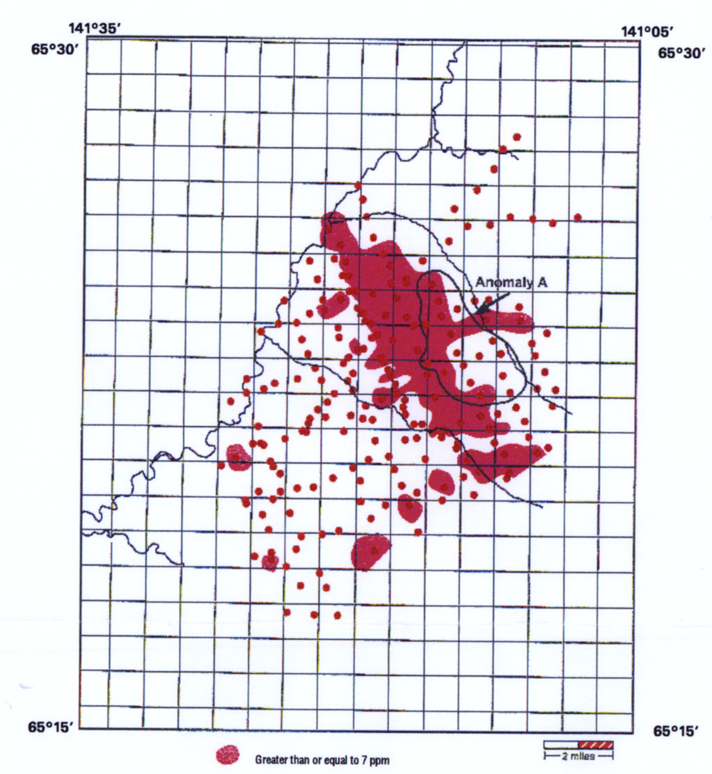

Figure 10. Plant Cobalt (Co) Enrichment Map.

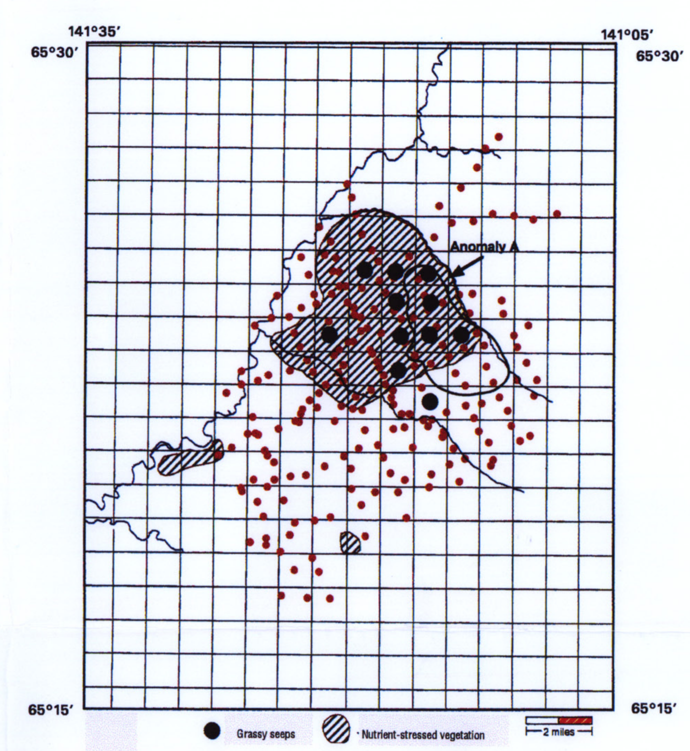

Figure 11. Biogeochemistry Anomaly Map.

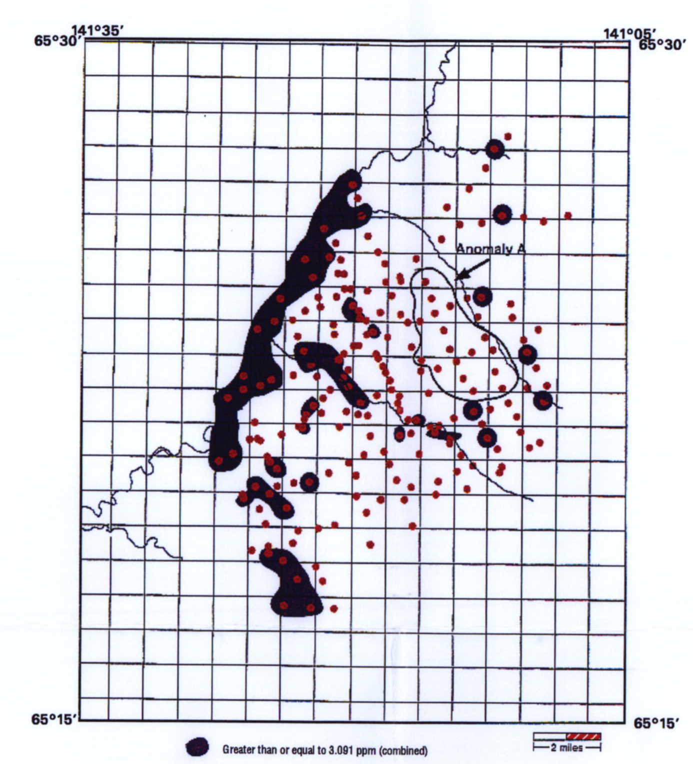

Figure 12. Soil Total LHC (Light Hydrocarbon Content: C1+...+C5) Enrichment Map.

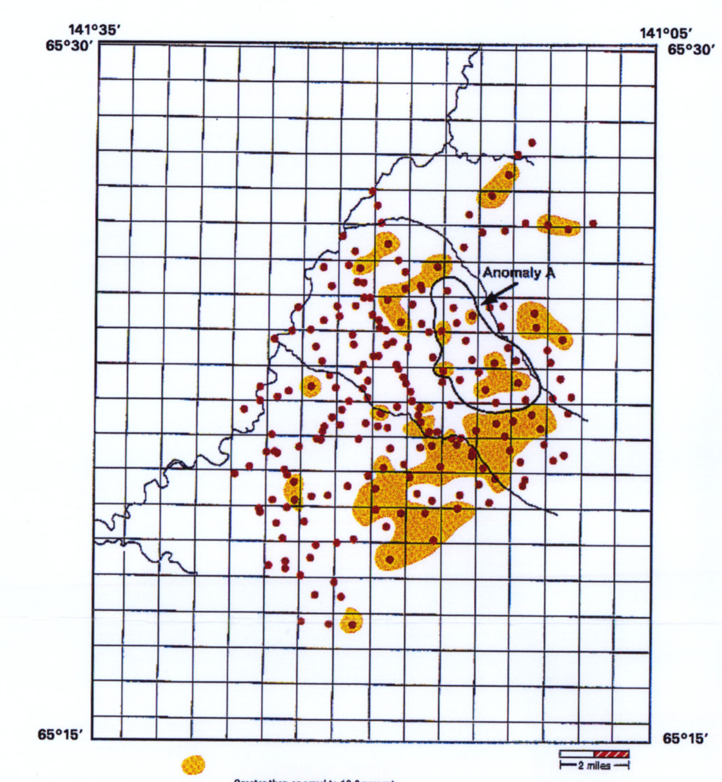

Figure 13. Soil LHC Wetness (Light Hydrocarbon Content: C2+...+C5/C1+...+C5) Percentage Map.

DISCUSSION

by Charles T. Roberts

Surface geochemical techniques are based on the premise that hydrocarbons migrate upwards from the subsurface and are adsorbed by near surface sediments. Direct detection techniques attempt to locate and measure hydrocarbons in surface samples. Indirect detection techniques focus on geochemical anomalies presumably related to the presence of hydrocarbons. In near surface sediments, hydrocarbons are metabolized by microbes, which may decrease Eh and increase pH in pore waters and cause mineralogical alterations of the sediment. Mobilization and translocation of transition metals may occur and precipitation of minerals, such as carbonate, may result. These altered areas can be identified in soil, and metal anomalies may be reflected in plants.

Figures 1-13 show geochemical results from analyses of soils, humus, and plants. 130 sites were sampled in the summer of 1989 and 211 sites were sampled in the summer of 1990. The 1989 samples were collected along traverses, while the 1990 samples were collected, where possible, on an approximate 1-mile grid. The original analytical data are not available, but summaries of the data are shown in Figures 1-13. A homogenized reference sample was submitted every tenth sample to evaluate reproducibility and batch error. In addition, duplicate samples were taken at every tenth site to monitor sampling error and local geochemical variability. Areas of metal depletion in Figures 1-13 are defined as the lowest 25 percentile of the population. Anomaly A is an area characterized by intense metal depletion.

SOILS

Samples were stored at field-moisture content until the completion of the survey when they were air dried and sieved to <2 mm for analyses. The ARCO Research Facility in Plano, Texas, performed analyses of acid-extractable hydrocarbon content and Eh/pH response. Hydrocarbon values are expressed as microliters of hydrocarbon gas per liter of headspace gas. Values were obtained by overnight soaking of the headspace-purged sample in a 0.04 HCl solution. Units of the Eh measurement are expressed as mV compared with the Ag/AgCl reference electrode. Weak-acid extractable metals were analyzed by X-Ray Assay Laboratories of Toronto, Canada. The weak-acid metal analyses were obtained by extracting 0.1g of soil in 1 percent HCl for 5 hours at 60°C. An acidic ionization suppressant (LiNO3) was added to the suspension and the analyses were performed using direct current plasma (DCP) spectrometry.

PLANTS

Black spruce plant material from the last 1-2 years of growth was collected with a hand pruner from plants growing within an approximately 30-foot circle at the sample site. In the lab, samples were washed, rinsed, and ashed at 500°C for 24 hours. The ash samples were sent to X-Ray Assay Laboratories of Toronto, Canada, for aqua-regia digestion and DCP analysis.

HUMUS

A plug of humus was collected with a posthole digger from the uppermost portion of the soil profile. Samples were analyzed similarly to the plant samples.

RESULTS

The study area was divided into four provinces. The criteria for dividing the study area into these provinces was based on geologic, physiographic, and geochemical parameters.

Province A is an upland area bordering the Nation River basin to the southeast. Province A contains highly variable rock lithology of PreCambrian through Mesozoic age, including dolomite, limestone, redbeds, basalt, and organic-rich shale and chert. The diversity in rock type is responsible for high geochemical variablility. Areas of high alkaline earth elements (Ca, Mg, Sr) correspond to carbonate outcroppings. Generally, the alkaline conditions are consistent with an overall higher soil pH of approximately 6.0 and low metal solubility and uptake by plants and resulting humus. Soil light hydrocarbon concentrations (LHCs) are generally high and show some of the highest concentrations of the study.

Province B is a broad upland area northwest of the Nation River basin. It is highly dissected and weathered with complex geology ranging from Devonian to Cretaceous in age. Lithologies include sandstone, quartzite, mudstone, argillite, organic-rich shale, conglomerate, and minor carbonate. The geochemistry of province B is dominated by the acid environment of weathering clastic sediments. Alkaline earth metals (Ca, Mg, Sr) are low and iron (Fe) is moderately high; concentrations consistent with the geology and low soil pH of about 4.5. Soil LHCs are virtually nonexistent in Province B. Humus and plant metal concentrations are variable and may reflect variable lithology.

Province C is the Nation River basin with Tertiary to Cretaceous alluvial, fluvial, and lacustrine sediments. The clastic rocks consist of conglomerate, sandstone, mudstone, claystone, and minor lignite. The soil pH is extremely acidic at approximately 4.0 and soil LHCs may be related to hydrocarbon migration within the basin. Metal contents of plants and humus are extremely variable, but form consistent enrichment and depletion patterns.

Province D is the recent alluvial drainage within the Nation River basin and along adjoining streams. The sediments include streambed alluvium and sediments on low-lying terraces. The sediments are typically high in alkaline earth metals (Ca,Mg,Sr), soil pH, transition elements, and soil LHCs, possibly reflecting the geochemistry of eroding rock types. Plant and humus metals are highly variable.?

GEOLOGIC INVESTIGATIONS OF THE KANDIK AREA, ALASKA AND ADJACENT YUKON TERRITORY, CANADA

by

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1997

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Division of Geological and Geophysical Surveys
Geologic Data Modeling System

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