Proceedings of a U.S. Geological Survey Workshop on Environmental Geochemistry

Edited by BRUCE R. DOE

U.S. GEOLOGICAL SURVEY CIRCULAR 1033

34. Geochemical Studies of Plants and Soils in the Beluga Coal Field, Alaska

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Evaluation of the geochemistry of undisturbed plants and soils is essential for objective predictions of the rehabilitation potential of an area to be disturbed by strip mining. These data also can be used after mining and rehabilitation to monitor geochemical changes in the landscape resulting from the rearrangement of rock strata and the disruption of soil development and of natural plant communities.

A predevelopmental geochemical survey was conducted for the Capps area of the Beluga coal field (fig. 34.1; table 34.1). Soil and plant collections were conducted according to an analysis-of-variance sampling design. This design allowed us to (1) determine the appropriate scale for geochemical mapping, (2) estimate the minimum number of samples necessary to prepare stable map patterns, and (3) establish geochemical baselines. The data were also used to examine the relations between soil geochemistry and plant uptake. Details of the methods used and results obtained are given in Severson and Gough (1983, 1984) and Gough and Severson (1983). A summary of these results is presented here.

Stable geochemical maps were prepared, on the basis of mean element content within a 1-km^2 cell, for pH and total levels of Al, Cu, Fe, Mg, P, Sr, and V and for diethylenetriamine pentaacetic acid- (DTPA-) extractable levels of Cu, Mn, P, and Zn in surface soil zones. Stable geochemical maps were also prepared for plant materials: willow (Al, As, B, Ca, Cu, Fe, K, La, Ni, P, S, and Sr) and

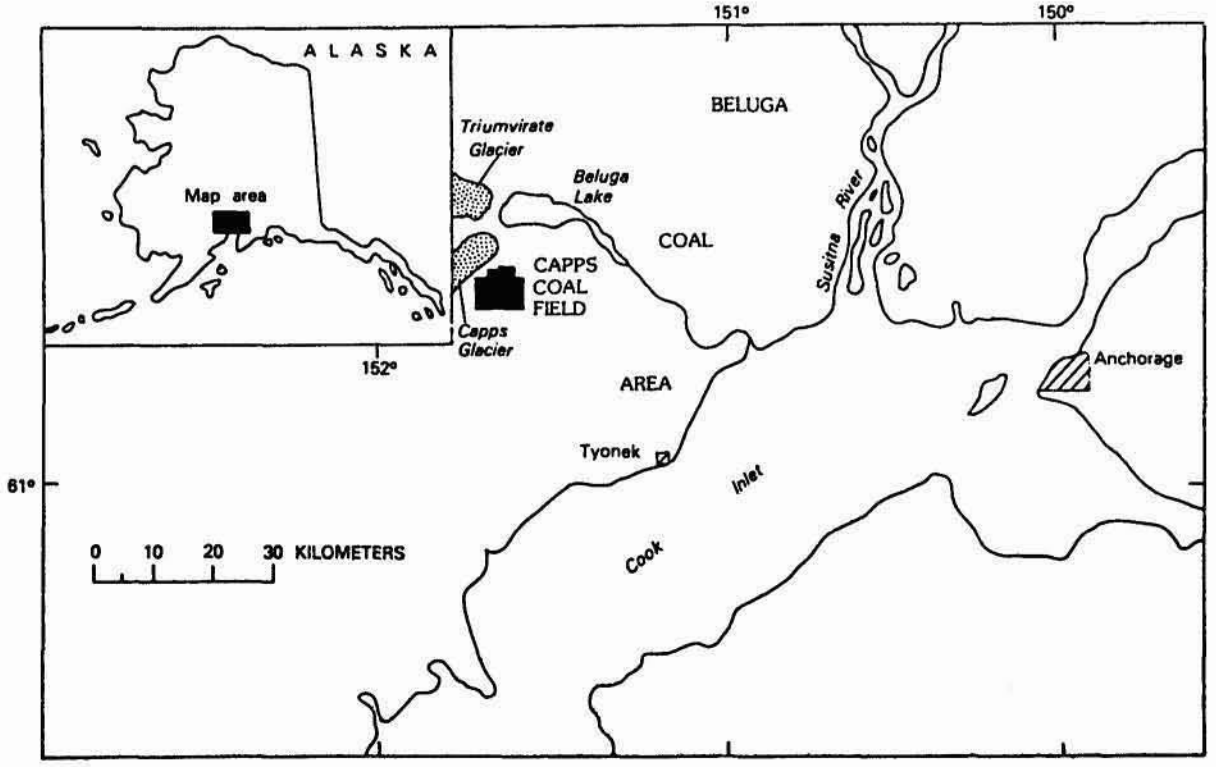

Figure 34.1. Location of the Capps coal field, Alaska.

Table 34.1. Observed range in concentration (in parts per million unless otherwise indicated) of six elements in samples of two soil zones and three plant species (dry weight basis) from the Capps coal field, Alaska

[*n*, number of samples]

Sample	Aluminum	Copper	Iron	Manganese	Phosphorus	Zinc
AB-DTPA[1] soil extract						
Upper zone (*n*=90)	19–240	1.9–9.3	160–560	3.8–64	6–60	0.5–8.2
Lower zone (*n*=90)	32–760	1.1–15	140–750	0.7–21	7–50	0.5–6.9
Total content in soil						
Upper zone (*n*=90)	7.2–10%	22–7	3.8–5.9%	860–1,300	70–110	61–98
Lower zone (*n*=90)	4.0–9.5%	11–120	1.3–18%	220–2,800	30–1,500	30–110
Calamagrostis canadensis (*n*=26)	<16–36	5–15	16–84	200–720	0.16–0.52%	29–72
Festuca altaica (*n*=64)	<16–400	3.1–13	16–260	170–690	0.19–0.45%	4.7–80
Salix pulchra (*n*=90)	16–220	2.1–12	16–130	52–340	0.072–0.33%	48–120

[1] AB-DTPA, ammonium bicarbonate-diethylenetriamine pentaacetic acid.

grass (As, B, Ba, Ca, Cu, Mg, Na, and S). The map patterns suggest relative independence of soil geochemistry to that of the plants; however, DTPA-extractable soil-element levels correspond better with plant chemistry than do total soil-element levels. Geochemical baseline data for soils and plants suggest that these compositions are not unusual when compared with geochemical baseline data from other natural areas.

Table 34.1 lists the observed range in concentration of six biologically important elements as determined in a soil extract, in a total digestion of soil, and in the dry material of three plant species. The extractable and total concentrations measured in the soil are assumed to represent physiologically acceptable ranges within which the normal growth of these three species takes place. These soil-concentration ranges, therefore, may be used in judging the feasibility of revegetating areas disturbed by mining and similar operations when native vegetation is to be used in site rehabilitation. The range of element concentrations in plant materials is also a measure of physiological tolerance. Additional work is needed, however, to determine if soil-extractable levels are a good measure of element availability for the uptake and translocation of these elements in these plants.

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