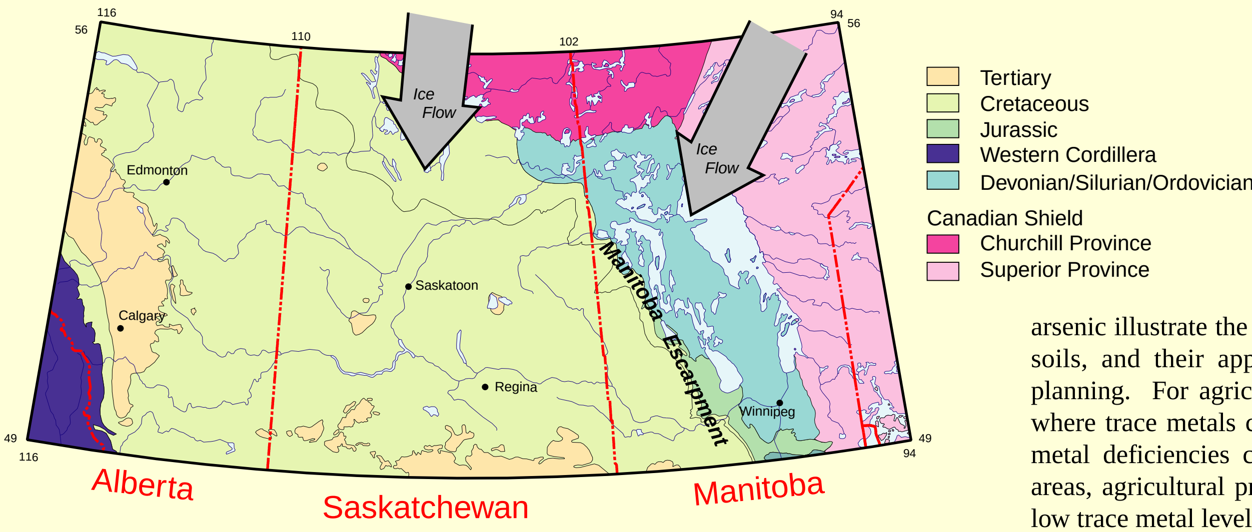
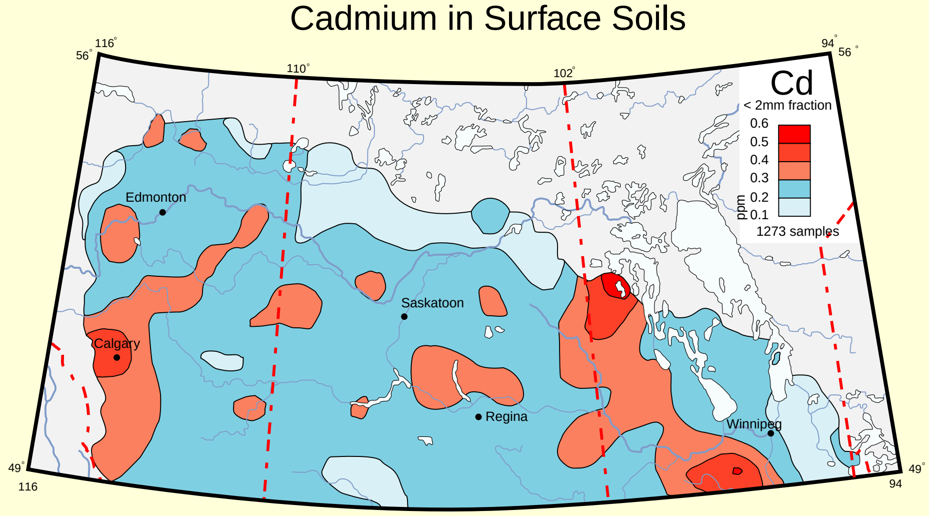
Prairie Soil Geochemistry

Bedrock Geology and Summary Ice Flow Direction



Geochemical maps portray natural background variations in soil composition, reflecting the combined effects of bedrock type, glaciation, weathering, and soil forming processes. Maps for individual elements can be unique due to different geochemical properties and different mineral and bedrock associations. For the Prairies, geochemical maps of the trace metals cadmium and arsenic illustrate the effects of those controls on trace metal concentrations in soils, and their application to environmental geochemistry and land use planning. For agriculture, geochemical maps can be used to identify areas where trace metals can enter cereal crop or cattle feed, or areas where trace metal deficiencies could affect crop growth or livestock health. In these areas, agricultural practices that minimize the impact of abnormally high or low trace metal levels can be selected.

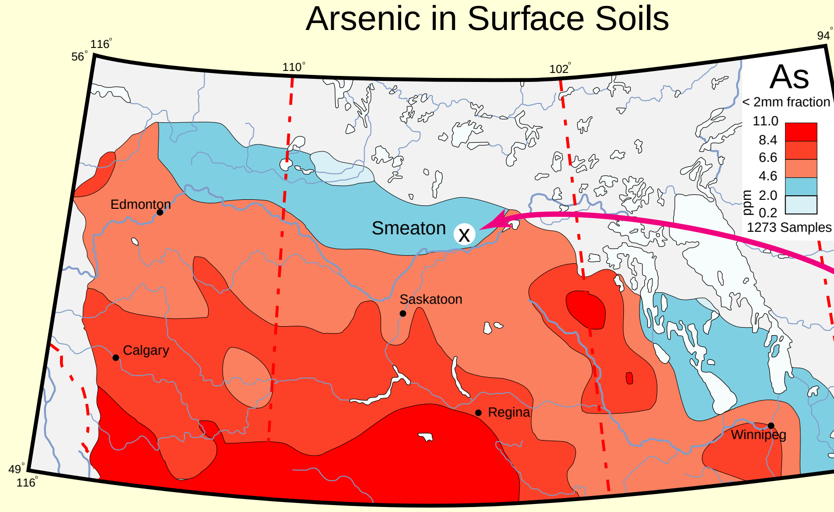
Cadmium in Surface Soils

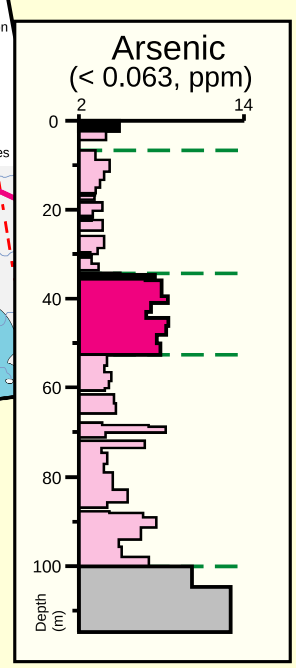


Cadmium in Surface Soils

Along the northern margin of the Prairies in north-central Saskatchewan and eastern and central Manitoba, low cadmium concentrations reflect the southward glacial transport of Shield bedrock debris impoverished in cadmium. In soils, the glacially transported debris masks the expression of the underlying bedrock. In contrast, high cadmium concentrations, across southwestern Manitoba, reflect the incorporation of shale bedrock (naturally enriched in cadmium) derived from the Manitoba Escarpment into the glacial debris (till) on which the soils developed. Due to glacial transport, the distribution of shale debris across the land surface is more extensive than the bedrock source.

Arsenic in Surface Soils





Arsenic in Surface Soils

Similar to cadmium, low concentrations of arsenic in soils along the northern prairie margin reflect southward glacial transport of arsenic-poor glacial debris from Shield bedrock. In contrast, increased concentrations of arsenic in the southern and southwestern Prairies reflect regional differences in moisture and soil forming processes. There, arsenic dissolved in groundwater during wet periods is fixed with iron in an immobile form during dry summer conditions, leading to an increase in arsenic concentrations at the surface.

Beneath the surface, vertical geochemical profiles through glacial deposits reflect changes in ice flow direction during glaciation and differences in the composition of bedrock eroded and transported by the ice. This is illustrated by geochemical analysis of drill core from a hole at Smeaton in north-central Saskatchewan. In the Smeaton drill core, high arsenic concentrations are associated with shale-rich sediment transported by westward flowing ice from the Manitoba Escarpment during an early phase of glaciation. These older arsenic-bearing glacial deposits have been buried under sediments depleted in arsenic and rich in Shield debris transported by younger southward-flowing ice. Through poor land use practices, such potentially hazardous, buried materials could become mobilized and increase surface arsenic values in an area otherwise depleted in arsenic.