Differentiating source geochemical contributions in glacial tills in local (deposit-scale) surveys

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Geochemical signatures in local (deposit) scale glacial till surveys can be better understood by first examining possible bedrock sources for elemental enrichment and accounting for pre-glacial weathering (mechanical and chemical) of bedrock. Factors such as bedrock competency and tectonic deformation determine which source rocks are weathered, and thus the abundance of certain elements in the clay and silt (<0.063 mm) fraction of till. Pre-glacial chemical concentration can occur when meteoritic processes interact with minerals, resulting in the preferential dissolution and precipitation of elements.

Glacial dispersal patterns from the Mount Fronsac North Pb-Zn-Ag deposit in northern New Brunswick were studied in terms of bedrock environment, pre-glacial bedrock alteration and subsequent glacial transport history. The clay and silt fraction of 236 glacial till samples collected over the deposit were analyzed for 53 elements, using aqua regia digestion and ICP-MS/OES analysis. Results from a 2 km, 25 m-spaced self-potential (SP) transect are also analyzed in the context of the geochemical element profiles. The results of a select suite of elements in the till were compared to geochemical concentrations in unweathered and weathered (mineralized gossan) bedrock, using tin (Sn) as an immobile element, to determine the source and path of element migration from bedrock to till. Elemental abundances were examined with respect to their inter-correlation, bedrock topography and the mechanical characteristics of the underlying bedrock units.

Enrichment of Pb, Bi, Hg, Cu, As, Mo, and Sb was observed in gossan relative to bedrock whereas enrichment of Co, Zn, Sr, Au, Cd, Ba, Hg, and Se was observed in till relative both to bedrock and to mineralized gossan. Dispersal patterns indicate two main glacial transport directions, with possible preconcentration of material at the base of a topographic low directly north of the outcropping deposit by colluvial (slopefall) processes. Enrichment of Cu, As, Mo, Sb, Pb, Bi, and Hg in the gossan is believed to be due to the chemical nature of the gossan, with anionic complexes adhering to mineralogically immature goethite, and formation of sulfosalts under low pH conditions. Additions of Co, Ba, and some Au are thought to originate from surrounding units, i.e., not from the mineralized zone, based on the dispersal patterns and the nature of the bedrock units. Anomalous element dispersal shows an offset pattern reflecting an earlier E to W large-scale glacial transport event, followed by a smaller SW to NE local glacial event. Dispersal patterns of Zn, Cd, and Hg in till are thought to be caused by initial alteration processes, and further enhanced by meteoritic and electrochemical processes in areas of increased porosity. Results of the SP survey support this interpretation as the profile appears as a classic double-peaked anomaly occurring on the boundaries of the deposit, with a trough above it. Thus, elements such as Zn, Cd, and Hg maybe more effective in delineating the extent of this type of deposit in situ, as the distribution of higher concentrations of these elements seems to be

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independent of large-scale mechanical processes and may reflect the electrochemical interaction of the mineralized body with the surrounding environment.

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