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Distribution and Character of Gold in Weathered Till in the Flin Flon Greenstone Belt, Saskatchewan

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Gold concentrations in glacially derived sediments, primarily till, are affected by many factors in addition to those associated with the presence or absence of mineralization. These factors are interrelated and pertain primarily to the accuracy of both field and laboratory methods used for till sampling and determining gold content, respectively. They include:

1. the degree of alteration of the till,
2. the analytical technique(s) employed,
3. the sample size,
4. the size range of gold in till,
5. the form of gold within the primary deposit,
6. the distribution and extent of drift cover, and
7. the Quaternary history of the area (Lakin *et al.*, 1974; Nichol *et al.*, 1992; among others).

Because each mineralized region is unique, exploration strategies must be developed that are specific to the particular area and/or deposit. The main objective of this study is to determine the factors affecting gold distribution in the Flin Flon greenstone belt, northern Saskatchewan, by examining the distribution of both visible gold grains and gold determined by geochemical analysis of the finer grained fractions of till. The size and morphology of gold grains are characterized, using both a binocular and scanning electron (SEM) microscope, on a regional and property scale in order to evaluate the significance of these physical attributes to drift prospecting in the area.

The distribution of gold in till in the Amisk Lake–Annabel Lake area of the Flin Flon greenstone belt results from a combination of glacial transport and post-glacial weathering processes. Based on the results of previous work in the area (Campbell, 1988) and similar studies to the west in the shield terrane of Saskatchewan (Schreiner, 1986), the <0.063 mm fraction of till was analysed geochemically on a regional basis. Elevated gold values occur primarily in areas of known gold mineralization. The association between high gold concentrations in till and gold mineralization indicates glacial dispersal and suggests that the analytical technique employed serves as an effective means of prospecting in the area. Gold grains extracted from regional till samples (approximately 10 kg) are predominately <0.063 mm diameter and exhibit modified (60%) and pristine (27%) morphologies under SEM examination, based on the classification of DiLabio (1990). On a regional basis, the highest numbers of gold grains in till also coincide with areas of known gold mineralization, however, on a site to site basis, discrepancies are present between the number of visible gold grains and gold concentrations in the <0.063 mm fraction of till. This lack of correlation may be attributed to sample inhomogeneity resulting from the presence of one or several large grains in a subsample (the "nugget" effect) or to an abundance of very fine (invisible) gold. The difficulties inherent in gold analyses resulting from these factors may result in undetected or falsely represented gold anomalies at specific sites.

In a detailed study conducted down-ice from a known gold occurrence, average gold concentrations are anomalous for the region. The distribution of gold determined by geochemical analysis of weathered till (<0.063 mm fraction) collected at 10 cm intervals from nine pits dug to bedrock (0.5 to 1.2 m deep) indicates considerable vertical variation, with concentrations ranging from below detection limit to highly anomalous values, and no recognizable vertical distribution pattern. The size and morphology of gold grains in till collected near the base of the pits are similar to those observed in the regional study, however, the relative proportion of pristine grains increases (63%) and modified grains decreases (35%). The pristine grains exhibit features observed in gold associated with pyrite and quartz in the sampled mineralized zone. The presence, in till, of gold grains with similar morphological features to those found in the deposit suggests that these grains may have been released from sulphide minerals through post-glacial weathering processes. This observation questions the validity of using gold grain morphology in weathered till as an indication of glacial transport distance, since the grains may have been transported with sulphide minerals and released subsequent to deposition. When gold mineralization is associated with sulphide minerals, the strongest indication of closeness to the deposit is the number of gold grains present in oxidized till, as opposed to the morphology of the grains. Comparison of the results of gold grain counts in the regional and detailed study indicates that the abundance of grains in till is a reflection of mineralization, regardless of any secondary processes affecting the sample medium.

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