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Gold Grains and X-ray Microscopes – A New Exploration Tool for Identifying Proximal and Distal Gold Deposits

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Gold grains dispersed in the secondary environment and their distinct micromorphology and compositional characteristics can be used as a powerful tool during exploration. Because of the malleable nature of gold, grains are susceptible to be affected by morphological reworking through transport in sediment. As such, morphology of gold grains can be used as a proxy for distance-to-source indicator. Furthermore, using the compositional characteristics of the gold grain, an assessment can be made on the deposit type as well as to residence time in the sediment. As such, detrital gold grains can be a powerful undercover exploration tool, especially but not exclusively in glaciated terrain, not only providing an indication of deposit type, but also on dispersion process and proximity of the primary deposit.

Typically, studies using gold grains as an exploration tool are carried out by binocular microscope, and morphology simply classified as "pristine", "modified" or "reshaped", based on mineralogist judgement [1]. Improvement to the method can be achieved using an SEM, for small grain detection as well as measuring morphological characteristics such as angularity, area, perimeter, length, breadth, aspect ratio and flatness index. However, these manual or automated measurements of complex 3D shapes are limited by 2D image analysis functions. As such, these are unable to fully quantify the morphological characteristics of the grains.

We here proposed an alternative of using X-ray Microscope technology to provide 3D measurements and imaging. The X-Ray microscope technology provides advantages over conventional Computed Tomography (CT) due to the two stage magnification capability providing a spatial resolution of <0.7 microns (<150 nm voxels). In addition, the advanced contrast capability enables increased mineral phase discrimination by employing a dual energy acquisition.

This paper outlines how the ZEISS Versa 510 X-ray Microscope was applied to gold exploration. The automated acquisition and minimal sample preparation allows for high sample throughput thus allowing the generation of a large volume of statistically valid data. In combination with the 3D projections and reconstruction, the XRM is able to achieve a spatial resolution of <0.7 microns thus providing detailed and accurate 3D measurements and textural analysis with no stereological bias.

The application of XRM for gold exploration is the latest in the growing number of geoscience applications utilizing XRM capabilities. Others include ore characterization and bulk mineralogy analysis, leaching studies, rapid liberation analysis and comminution studies.

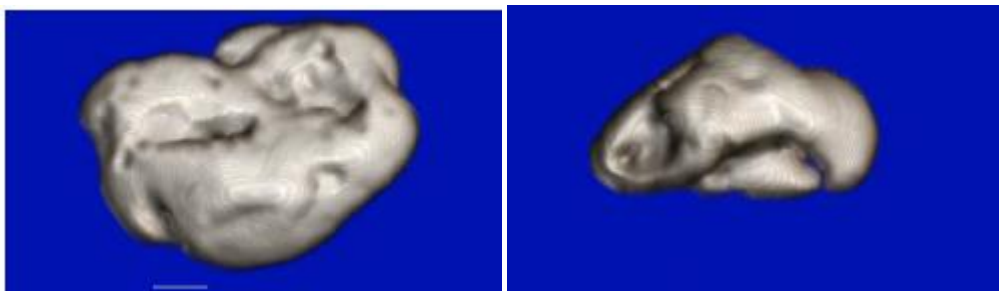

Figure 1: Gold grains, approximately 150 micrometers in diameter, as imaged by XRM.

[1] DiLabio R.N.W. 1982, GSC Paper 82-1b, p. 57-62