Structural and geometrical analysis of saddle reef folds at the mesothermal gold deposit, Port Dufferin, Halifax County, Nova Scotia: implications for future exploration and resource assessment

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The Port Dufferin gold deposit contains high-grade, low tonnage, nugget gold-bearing quartz-pyrite-arsenopyrite vein mineralization within a complex structural setting. Veins occur in a series of ten stacked saddle reefs along a parasitic anticline adjacent to (immediately south of) the regional Crown Pillar Anticline. Host rocks consist predominantly of massive greywacke interbedded with thinner, laminated argillite of the Goldenville Group, Meguma Supergroup. Strong fracture and slaty cleavages occur in these units, and exhibit a radiating fan pattern. Muscovite, chlorite, calcite and ankerite alteration occurs disseminated within the host rocks adjacent to the veins and along fracture cleavage within the greywacke. The saddle reefs are restricted to the argillite horizons, and filled open spaces that formed as a consequence of the different rheological behaviour of the slate and greywacke during folding.

Geometrical analysis of the form of the folds in both the greywacke and slate beds was undertaken to assess the differences in how the slate and greywacke deformed during compression on several cross sections. Polynomial regressions were fit through the locations of diamond drill core intersections of the various correlatable bed contacts to obtain best-fit macroscopic models of the fold forms. Both intersection and dip constraints were used in the regressions, and produced reasonable and consistent fold geometries. Bulk parameters describing the overall geometry of each fold surface (amplitude, wavelength, tightness, sharpness, inclination and asymmetry) were compared and exhibit consistent trends with depth. Isogon and quantitative analysis of fold limb thicknesses were also undertaken to investigate variations in fold form with depth. These results document changes in fold geometry with depth and should provide substantial guidance in future drilling programs.

Using these macroscopic fold models, distances between the fold hinges and each associated vein intersection were computed. This allows comparison of gold grade and vein thickness with distance from the fold hinge, and provides a quantitative model for proper interpolation and extrapolation of gold grade and vein thickness on each cross-section investigated. This will undoubtedly assist future geostatistical reserve estimation efforts by reducing the uncertainty created by the nugget effect.

Atlantic Geology, March 2000, Volume 36, Number 1