Structural controls and deformation history of the orogenic Island Gold deposit, Michipicoten greenstone belt, Wawa, Ontario

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The Island Gold mine is a currently producing, high-grade orogenic gold deposit in northern Ontario. It is hosted by the Goudreau Lake Deformation Zone (GLDZ), which transects the Michipicoten greenstone belt in the Wawa subprovince. The Island Gold mine has been in production for over ten years and mineralization is still open laterally and at depth. An improved understanding of the deposit and its tectonic setting is, however, necessary to optimize exploration at the mine and elsewhere in the district. This structural study aims to determine the controls on mineralization and the deformation history of the deposit and surrounding area. D¹ structures in the study area consist of regional- and camp-scale F¹ folds that are associated with a penetrative, axial-planar S¹ foliation and L¹ stretching lineation. The study area is located along the northern limb of such a regional F¹ fold and contains a parasitic, large-scale s-fold. The S¹ foliation is subvertical and strikes ~N070°, at an acute angle to steeply north-dipping stratigraphy in the study area. The stretching lineation L¹ is developed on the S¹ foliation surface and plunges steeply to the northeast. The GLDZ formed during D¹ deformation and is centered along a major lithologic contact. D² structures consist of camp- and outcrop-scale F² folding, S² foliation, and brittle reverse faults. F² folding overprints the S¹ foliation and consists of open to tightly folded, shallowly-plunging z-folds. The S² foliation dips steeply to the north and consists of transposed S¹ foliation. Brittle reverse faults dip moderately to the south and cross-cut the S¹ foliation. The Island Gold deposit forms a mineralized corridor within the southern GLDZ, south of the north-dipping, trondhjemitic Webb Lake Stock. The main deposit is hosted in intermediate fine-grained volcaniclastic rocks and consists of subparallel ore zones of predominantly smoky grey, laminated V¹ quartz veins and sub-parallel V² crack-seal veinlets within a silicic and sericitic alteration package. The ore zones strike ~N070° with an average dip of 80° to the south. Barren V³ quartz-carbonate extensional veins cross-cut V¹ ore veins and often appear as “boudin necks” in drift faces. During D¹ deformation, V¹ and V² ore veins were emplaced sub-parallel to the S¹ foliation in a strain shadow created by the Webb Lake Stock. The ore zones were folded and sheared into the current form during subsequent D² deformation. V³ veins were also emplaced during D² in areas of high competency contrast.