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Temporal Constraints on Auriferous Fluid Activity along the Destor-Porcupine Fault Zone, Southern Abitibi Greenstone Belt, Canada

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The Abitibi Greenstone Belt in the southern Superior Province is one of the most globally prolific Archean orogenic gold provinces. In its southern part, gold mineralization is spatially associated with two major crustal-scale fault systems: the Larder Lake-Cadillac Fault Zone (LLCFZ) to the south and the Destor-Porcupine Fault Zone (DPFZ) to the north. These mineral systems developed during successive shortening events (i.e., D1-D5). Whilst the timing of gold mineralization along the easternmost segment of the LLCFZ is relatively well constrained, the temporal evolution of auriferous events along the DPFZ remains poorly resolved. This study provides new geochronologic constraints on gold mineralization along the DPFZ based on in situ U-Pb dating of hydrothermal xenotime and monazite from gold-bearing shear and crustiform quartz veins and alteration assemblages, and Re-Os molybdenite model ages from crustiform-banded quartz veins. U-Pb monazite ages from shear quartz veins at the Whiskey Jack deposit of 2686 Ma overlap with pre-D3 events. Coeval U-Pb xenotime ages of 2685 Ma at the Duparquet deposit together with a Re-Os molybdenite model age of 2670 Ma from the Gibson deposit, from crustiform-banded veins indicate that mineralization occurred during a transition from late D1-D2-shortening to extension. Younger xenotime and monazite ages from major deposits (e.g., McIntyre, Hollinger, Bell Creek, Pamour, Stock, Black Fox, and Holloway) cluster between ~2660 and 2620 Ma. These ages also overlap with previously reported U-Pb monazite ages from the Dome mine and U-Pb hydrothermal zircon rims from the Hoyle Pond mine. Collectively, the datasets suggest that the main gold mineralization event was associated mainly with D3-shortening and subsequent transpressional deformation, with possible Au remobilization. Within this framework, although the geochronological data presented here are under interpretation, gold mineralization along the DPFZ appears temporally distributed, with D3-shortening representing the dominant mineralization interval.