Sm-Nd and Sr isotope systematics of Western Abitibi scheelites and andradite garnets, implications for gold mineralization

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Gold mineralization at the Timmins West Mine (TWM) complex is largely associated with ultramafic and syenitic intrusions of the Bristol Alkaline Intrusive Complex and areas of intense alteration and high strain zones [1]. Most of the geochronological studies of the area have been based on U-Pb systematics in zircon, sphene, or garnet [2]. To bring new constraints on the origin and history of gold formation at TWM, we investigated two mineral phases: (i) scheelite, which is found in contact with gold in quartz-rich veins within syenite, and (ii) garnet, which is found in albititic dykes that are cut by gold mineralization veins within pyroxenite. We find that scheelites are not zoned, with average [Sm] of 145 ppm, Sm_N/La_N of 20, Sm_N/Lu_N of 40, and no Eu anomaly (by LA-ICPMS). Sm-Nd isotopic analyses of 15 scheelites yield an internal mineral isochron with an age of 2587 ± 49 Ma (MSWD = 2.5; by MC-ICPMS). The initial Nd and Sr isotopic compositions of scheelites have well-constrained εNd_i of 1.0 ± 0.1 (2SD), while $^{87}Sr/^{86}Sr_i$ are more heterogeneous with εSr_i of -0.1 ± 4.0 (2SD) but do not correlate with Nd compositions. The garnet is on average $Adr_{73}Grs_{24}Prp_2Sps_1$ (by EMPA) with up to 0.23 wt% H_2O (by FTIR), and average [Sm] of 570 ppm, Sm_N/La_N of 10, Sm_N/Lu_N of 10, and no Eu anomaly. Two individual micro-drilled garnets provide Sm-Nd isochron ages at 2634 ± 56 Ma for garnets with εNd_i of +2.2, and 2647 ± 20 Ma when including vein materials. These ages, although less precise, are distinctly much younger than the U-Pb garnet and titanite age of the Bristol Township lamprophyre (2687 ± 3 Ma) [3]. The εNd_i are in agreement with the composition of the Abitibi Archean mantle (+2.5) [4]. Our results suggest that two late hydrothermal events, post-dating host intrusions by at least 40 Ma, were associated with gold formation at TWM.

[1] MacDonald et al., 2018. CJES, 999, 1. [2] Ayer, 2005. OGS report. [3] Barrie, 1990. CJES, 27, 1451. [4] Vervoort et al., 1994. EPSL, 128, 215.