

Evidence for Subaerial Hydrothermal Activity in the Neoproterozoic Abitibi Greenstone Belt, Canada

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The Timiskaming assemblage of the Neoproterozoic Abitibi greenstone belt is a late orogenic volcano-sedimentary succession formed between <2,679 and 2,669 Ma. It is exposed primarily along the crustal-scale Porcupine-Destor and Larder Lake-Cadillac fault zones and contains significant accumulations of alluvial and fluvial conglomerates. Quartz clasts represent minor, albeit conspicuous, components of these polymict conglomerates. To provide constraints on the origin of the quartz clasts, texturally diverse clasts were sampled from Timiskaming assemblage conglomerates in the Timmins-Porcupine, Kirkland Lake, Duparquet, and Rouyn-Noranda mining camps of Ontario and Quebec. The sampled clasts range from massive milky-white to purple quartz. Microscopic investigations indicate that the quartz in these clasts has typically been affected by extensive recrystallization. In many cases, the clasts consist of polycrystalline quartz exhibiting irregular grains. Individual quartz grains are characteristically crosscut by myriads of wispy trails of secondary fluid inclusions, many of which exhibit double-bubbles. These inclusion trails are interpreted to have formed as a result of the post-depositional metamorphic overprint of the quartz clasts. However, some clasts contain prismatic quartz crystals that have not been entirely recrystallized. These prismatic quartz crystals are intergrown with crustiform quartz, show blue to yellow cathodoluminescence colors, and contain low-temperature primary fluid inclusions. These properties are consistent with the quartz being derived from shallow subaerial hydrothermal vein quartz, not unlike quartz in epithermal deposits or shallow orogenic deposits. Such near surface hydrothermal activity must have been broadly contemporaneous with deposition of the Timiskaming assemblage. Shallow subaerial hydrothermal systems have not previously been documented in the Abitibi greenstone belt, let alone at the time of Timiskaming deposition. Given that hydrothermal vein quartz was sampled from conglomerate outcrops at different stratigraphic positions throughout the southern Abitibi greenstone belt, such deposits must have been widespread during deposition of the Timiskaming assemblage. This finding has important implications for metallogenic models of the Neoproterozoic Abitibi greenstone belt. Future exploration should not exclude the possibility of epithermal deposits, shallow orogenic deposits, or paleoplacer deposits.