

Genetic Framework for the Classification and Distribution of Archean Rare Metal Pegmatites in the North Pilbara Craton, Western Australia

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Abstract

The Pilbara pegmatite province in the Archean North Pilbara Craton contains at least 120 pegmatite deposits in over 27 pegmatite groups and fields, including the giant Mount Cassiterite tantalum orebody in the Wodgina pegmatite district. Generally, rare metal pegmatites in the province are hosted by mafic-ultramafic volcanic-dominated supracrustal sequences of predominantly greenschist facies, adjacent to, and rarely within, domal multiphase granitoid-gneiss complexes. The most fractionated pegmatites are hosted by tongues or inliers of greenstone belts protruding into or within the larger granitoid complexes. Most of these are within two of the six tectonostratigraphic domains of the East Pilbara granite-greenstone terrane of the North Pilbara Craton. They tend to be clustered along and within 5 km (at surface) of major faults and craton-scale lineaments that coincide with or are parallel to domain boundaries. All of the major tantalum deposits (Wodgina, Mount Cassiterite, Tabba Tabba, Strelley, Pilgangoora) are along a north-northeast-trending corridor that is within one tectonostratigraphic domain. Most rare element pegmatites are within 5 km (at surface) of their apparent parent pluton, and all are within 10 km where the pluton has been identified. Although granitic rocks of the North Pilbara Craton were emplaced over an 800 m.y. period (3600–2800 Ma), rare element class pegmatites can be tied to a number of post-tectonic plutons of a younger granite suite that were emplaced into most of the granitoid complexes and adjacent greenstone belts at 2890 to 2830 Ma. Subtle differences in the composition of these granites that have given rise to different petrogenetic pegmatite suites can be identified in processed radiometric data from airborne surveys. These parental younger granites are enriched in lithophile and volatile elements and have a highly fractionated character that permitted formation of significant pegmatite mineralization. They represent the culmination of the crustal evolution of the North Pilbara Craton and the onset of cratonization, as part of a global appearance of rare metal pegmatite mineralization post-3 Ga.