

Geology and Geochronology of the Mount Marion Lithium Pegmatite Deposit, Yilgarn Craton, Australia

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The Mount Marion lithium deposit is a globally significant hardrock lithium mine located in the Eastern Yilgarn Craton of Western Australia, a well-endowed region for lithium as well as gold and nickel. Although Mount Marion was discovered in 1913, it received relatively little attention nor research for almost a century. Over the last decade, multiple drilling campaigns have delineated a sizable resource of 66.1Mt @ 1.36% Li₂O and have helped greatly improve our understanding of the deposit.

Lithium mineralisation at Mount Marion is hosted in spodumene-bearing pegmatites that intrude the NW to NNW striking Archaean Saddle Hills Greenstone belt. The deposit is made up of around 100 pegmatite bodies across an ~8km trend. The pegmatites lie sub-parallel, trending roughly northeast and dip at ~10° - 30° to the northwest, as well as some less common steeper dyke-like orientations. Individual pegmatites vary significantly in size, from <2m up to 35m in thickness and up to ~1500m in strike length.

Pegmatite mineralogy is dominated by quartz-albite-spodumene-muscovite with minor garnet, microcline, apatite and tourmaline. Typical pegmatite accessory minerals such as columbite-tantalite and cassiterite are present, but relatively rare, and occur sporadically throughout the deposit.

New U-Pb geochronological studies of apatite from two samples have yielded Tera-Wasserburg lower intercept ages of 2617 ± 14 Ma (MSWD = 0.64, n = 54) and 2629 ± 34 Ma (MSWD = 0.48, n = 53), providing the first direct age constraint for the lithium-bearing pegmatites at Mount Marion. This age is consistent with other lithium-caesium-tantalum (LCT) pegmatites throughout the Yilgarn Craton. The pegmatite age is also coincident with widespread low-Ca granite emplacement, suggesting that the regional tectonic regime provided pressure-temperature conditions conducive to fractionated melt production and subsequent LCT pegmatite formation.