Melt-Melt Immiscibility as a Key Mechanism for Spodumene-Quartz Mineralisation in Pegmatites, Insights on a Novel Concept from Andover, Western Australia

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Since discovery of the spodumene-bearing pegmatites hosted in the Andover Intrusion ~5km SE of Roebourne, Azure Minerals has compiled a world-class geochemical, structural, geological (lithological, mineralogical, textural) and spectral dataset. This dataset provides a robust framework for detailed characterisation of the Andover pegmatite swarm and offers key insights into the spatial and temporal evolution of this lithium-mineralised system and points towards a unique origin story.

An anatectic origin (as originally proposed by Stewart, 1978) for the Andover pegmatites is proposed, aligning with a recent notable shift in published literature (e.g. Koopmans et al., 2023). The lithium-enriched pegmatitic melt was structurally emplaced within the Andover Mafic-Ultramafic complex. The pegmatite underwent a significant degree of fractionation within the structural network during emplacement, preserved as systematic variations in whole rock geochemistry within the pegmatite swarm. This open system behaviour facilitates a more extreme degree of fractionation to a pure spodumene-quartz melt, and in much higher volumes than would be plausible with closed system fractionation.

Andover provides compelling evidence for the role of melt–melt immiscibility as a critical ore-forming process - a mechanism that has not received any attention in the context of lithium pegmatites to date. This mechanism facilitates the crystallisation of high quality spodumene, high in lithium content and low in deleterious elements such as iron.

This revised genetic framework has wide-ranging implications from deposit-scale resource modelling and geometallurgical domain definition, through to regional exploration strategies targeting lithium pegmatites within the northwest Pilbara Craton and analogous geological settings globally. The recognition of high-quality immiscibility-driven spodumene mineralisation opens new conceptual frontiers in lithium pegmatite ore forming systems.