Using monazite chemistry in exploration for iron oxide-copper-gold deposits

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Light rare earth elements (LREE) are commonly enriched within iron oxide-copper-gold (IOCG) deposits within the Gawler Craton, South Australia. The elevated LREE signature can be used as a geochemical vector towards potential IOCG mineralization. The LREEs are hosted within a number of phases including monazite, which is a resistate phase that can withstand processes of physical transport and weathering without significant chemical alteration.

In the northern Gawler Craton, LREE-enriched monazite is preserved within basement rocks within and proximal to the Prominent Hill IOCG deposit. These basement rocks have been physically transported and dispersed during Permian glacial activity subsequent to the mineralization event, and redeposited in the cover sequence as a glacial diamictite. Here we show that the monazite within the mineralized zone has a characteristic geochemical signature, and that this signature has been preserved within monazite grains preserved within mineralized and unmineralized clasts in the overlying glacial diamictite. The monazite is characteristically enriched in La and Ce, and depleted in Y and Th compared to the background monazite chemistry (e.g., shear zone-hosted and metamorphic monazite). A chemical criteria for exploration using monazite in the diamictite cover sequence is derived. Monazite chemistry showing concentrations of La + Ce > 63 wt% and Y and Th < 1 wt% is interpreted to represent monazite derived from mineralization, and is therefore compelling data. Concentrations of 57.5 wt% < La + Ce < 63 wt% are considered interesting, and compositions of La + Ca < 57.5 wt% are considered background. The scale of the footprint associated with dispersion of monazite preserving the geochemical signature characteristic of Prominent Hill-style IOCG mineralization is related to glacial processes and palaeotopography.

This chemical criteria is a useful vectoring tool towards Prominent Hill-style IOCG mineralization, however needs to be related back to the glacial processes that resulted in dispersion of the basement clasts that contain the monazite so that the true extent of the footprint and the vectoring direction can be resolved. This method may also be applicable to exploration for other IOCG deposits within the Gawler Craton and further afield.