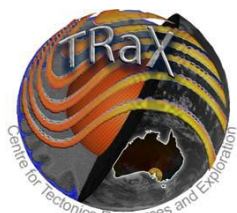

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ENVIRONMENTAL SCIENCES

Mineralogy and Petrography of Rare Earth Element (REE) mineralisation, Browns Ranges, W.A.

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ABSTRACT

Northern Minerals' current Browns Range exploration project is situated within the Gordon Downs Region, W.A. This area is remote and relatively unstudied, with only a few regional mapping studies and old exploration reports available. The area is currently being explored for REE mineralisation. Identified REE-prospects contain xenotime-dominant mineralisation hosted within Lower Proterozoic Arkoses and Archean metasediments (Browns Range Metamorphics). Detailed ore mineralogical, petrographic and mineral-chemical investigation of samples from the six currently-known prospects within the exploration area give insights into the mineralogical distribution of REE and provide evidence for the genetic evolution of the Browns Range REE mineralisation via a succession of hydrothermal processes.

Two main REE-bearing minerals are identified: xenotime [(Y,REE)PO₄], HREE selective; and florencite [(REEAl₃(PO₄)₂(OH)₆], LREE selective. Two distinct generations of xenotime are recognised. EPMA and LA-ICP-MS analysis provide a large chemical data set for both xenotime and florencite allowing comparison with other localities worldwide. Xenotime contains Dy (up to 6.5 wt%), Er (up to 4.35 wt%), Gd (up to 7.56 wt%), Yb (up to 4.65 wt%) and Y (up to 43.3 wt%).

Xenotime composition is shown to be consistent across all prospects and xenotime generations.

Florencite is commonly zoned and contains Ce (up to 11.54 wt%), Nd (up to 10.05 wt%) and La (up to 5.40 wt%) and is also notably enriched in Sr (up to 11.63 wt%) and Ca. Subordinate zircon is also enriched in REE (up to 13 wt% Σ REE) and is the principal host of Sc (up to 0.8 wt%).

Early xenotime occurs as coarse euhedral grains which underwent surface etching, fracturing, partial breakdown and replacement by florencite. Second generation xenotime occurs as abundant small blades commonly associated with needles of hematite. Florencite occurs as replacement of xenotime and as overgrowths on detrital feldspar in the arkose, giving a

characteristic skeletal replacement texture. The preliminary genetic model involves percolation of a reduced, acidic, volatile-rich, granite-derived hydrothermal fluid through porous arkose units. The presence of late hematite suggests that mixing with meteoric water and subsequent oxidation may have played a role in the later stages of deposit evolution. Field observations suggest that faults acted as fluid conduits and that brecciation, possibly associated with release of volatiles from the fluid, occurred along these faults.

As well as providing a characterisation of the Browns Range deposits, the data generated provided valuable data, largely unavailable elsewhere, on chemical compositional trends in hydrothermal xenotime and coexisting minerals. Given the current surge in REE exploration, this data will assist in the development of exploration models for comparable terranes.

Keywords: Xenotime; florencite; hydrothermal; Browns Range; replacement; REE geochemistry