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The Role of Deep-Seated and Multiple Structural Controls on the Emplacement of High Concentration of Monazite, Alces Lake Property, Northern Saskatchewan, Canada

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Summary

The Alces Lake Property, northern Saskatchewan, Canada, is an emerging world-class high-grade rare earth element ("REE") deposit (Figure 1a, 1b, 1c) within a deep-seated shear zone/fault corridor; endowed with critical REEs required for the permanent magnet industry. The property hosts some of the highest REE grades ever discovered in the world, and certainly the highest grades ever reported in Canada. Surface channel samples and diamond drill hole results have identified total rare earth oxide ("TREO") concentrations exceeding 20 wt% TREO in multiple zones at or near surface, including maximum concentrations of up to 54 wt% TREO. The United States and Canada have recently signed a Memo of Understanding (MOU) on the collaboration of critical minerals, which includes securing the supply chain of REE resources. Mineralization at Alces Lake has the potential to contribute to this North American supply chain.

Theory / Method / Workflow

Since 2017, three summer field programs have been completed which have included; an airborne magnetics, EM and radiometric geophysical survey, ground radiometric prospecting, outcrop mapping, excavating overburden materials to expose surface mineralization, detailed channel sampling of the surface zones, and diamond drilling. More than 15 REE bearing surface zones, as well as numerous sub-surface zones have been identified within an area measuring less than 500 m x 500 m. A new discovery (2019) was made 1.8 km west of the main working area and suggests the mineralization trend is far more robust and widespread than the current work has identified.

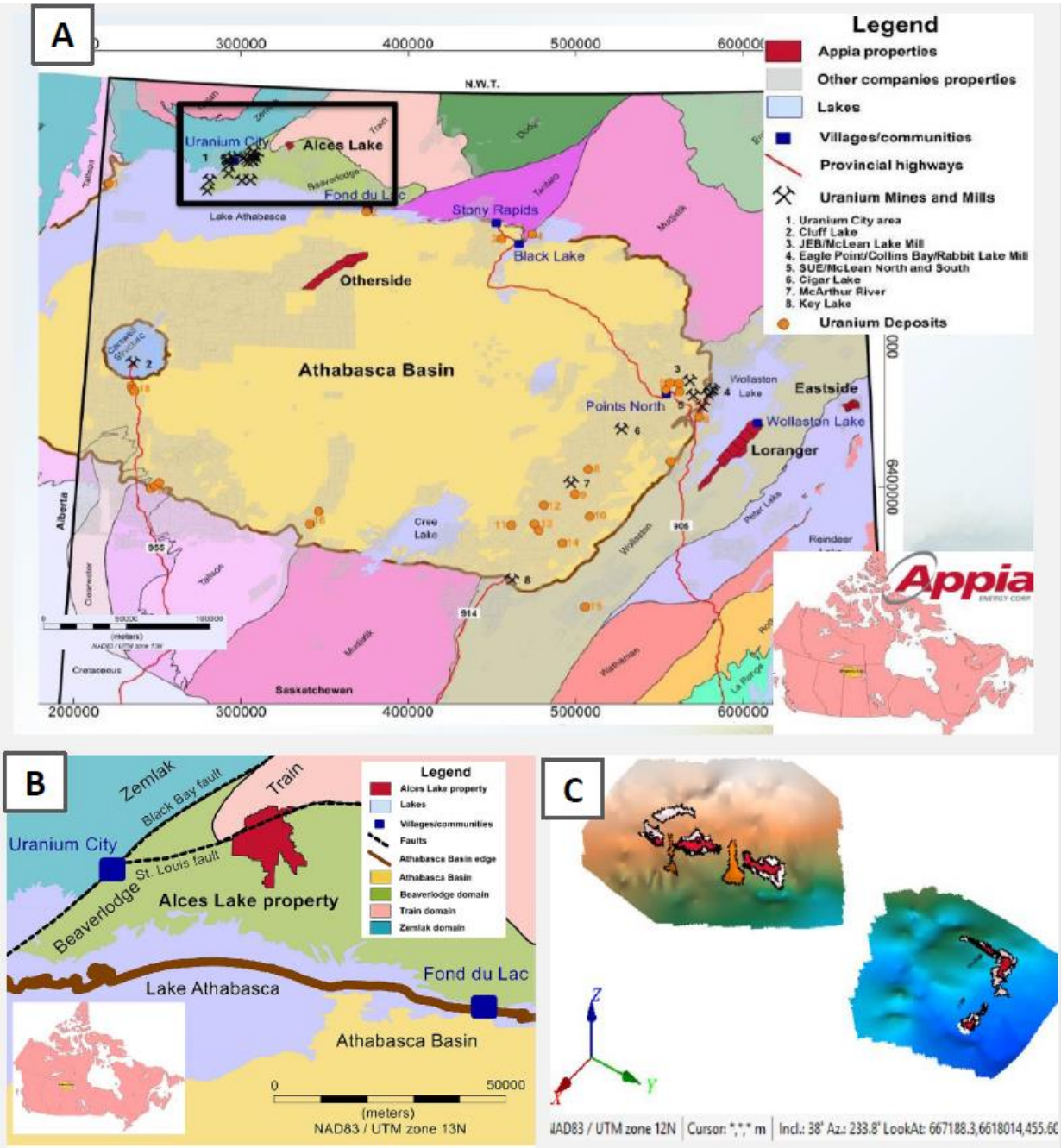

Figure 1: a),b) Regional geology and location of Alces Lake property; c) screen capture of 3D Geosoft model.

Results, Observations, Conclusions

The REEs are completely hosted within monazite; a red-colored, REE-rich phosphate which has a proven and successful economic and commercially viable extractability. Monazite at Alces Lake is coarse-grained, on average ranging from 0.5 to 3.0 mm across its widest axis.

Monazite tends to form as isolated grains, banded, or as clustered masses comprised of up to 85% monazite. Previous studies of Alces Lake monazite have suggested a crystallization date of 1927.1 +/- 1.2 Ma, which puts its formation within the latest stages of the Taltson-Thelon Orogeny. Petrographic studies have revealed euhedral to round monazite grains, suggesting undisturbed crystalline growth for the former and a “physically-active lifestyle” for the latter.

The world-class REE mineralization at Alces Lake is hosted within polyphase anatectic pods comprised of massive braided biotite schist and quartzo-feldspathic pegmatite augen. Monazite appears to be equally distributed within schist and pegmatite. The anatectic mineralization system occurs cross-cutting previously solidified gneissic material, confirming the crystallization age dates and late orogenic development. Rocks within the Alces Lake property have been subjected to upper amphibolite to granulite facies metamorphism and have undergone 2 to 3, possibly 4 phases of folding and deformation, depending on the age of the rocks.

The entire geological suite at Alces Lake is part of a regional re-folded synformal anticline with the eastern limb of the anticline hosting the majority of known REE zones. The eastern fold limb itself is a 40 km long, NW-trending shear zone/fault corridor with deep-seated structural crustal roots. Late-stage EW-trending faults cross-cut this NW-oriented shear zone/fault corridor.

Outcrop-scale folds and multiple structural systems have been shown to influence the deposition of monazite. Late brittle re-activated structures in the area cross-cut the regional fabric and offset the monazite mineralization, further providing relative timing of the anatectic mineralization system emplacement within the structural sequence of events.

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