

# U-Pb Chemical and Isotopic Ages, and Associated REE Patterns of the Hook Lake Showing, Way Lake Project, Northern Saskatchewan

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## Summary

Located just outside of the Athabasca Basin, the Hook Lake shear-hosted uraniumiferous veins are one example of igneous-hosted uranium occurrences in the Wollaston Domain of northern Saskatchewan. The chemistry, isotopic ages and rare earth element patterns for the two zones of the studied uranium oxides confirm the Hudsonian origin of this uranium occurrence.

## Introduction

The Hook Lake uranium showing is located in northern Saskatchewan on the Way Lake Property, owned by JNR Resources Inc., and located approximately 55 km east of the Key Lake uranium mine (Fig. 1). This showing contains significant uranium mineralization accompanied by rare earth element (REE) and pathfinder element enrichment, and is the main focus of this research. The purpose of this study is to determine the chemical and isotopic ages of the uranium and associated mineralization at Hook Lake in order to further the understanding of this type of mineralization and its relationship to the high-grade unconformity-type uranium deposits of the Athabasca Basin.

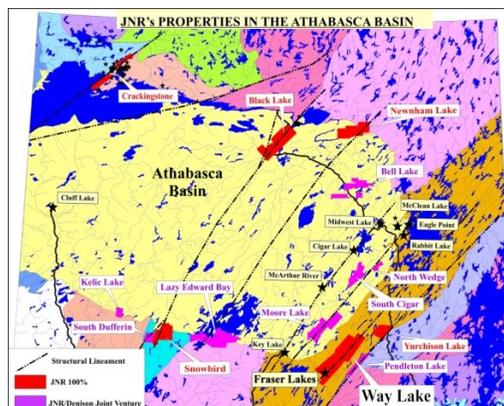


Fig. 1. Geological subdivisions of northern Saskatchewan, with the location of important uranium deposits, and JNR Resources Inc. properties, including Way Lake (JNR Resources Inc. 2009),

## Local Geology

The Way Lake uranium property is underlain by a steeply-dipping, northeast-trending, highly folded sequence of intercalated Paleoproterozoic Wollaston Group metasediments and underlying Archean orthogneisses of the eastern Wollaston Domain (Annesley et al., 2005, 2009). High-grade uranium mineralization was obtained in 2006 from a previously identified massive pitchblende vein, now called the Hook Lake showing. Two grab samples yielded 40.1% and 48% U<sub>3</sub>O<sub>8</sub> with significant lead, rare earth element, and thorium enrichment, and anomalous boron, cobalt, and vanadium. The showing occurs in a dilational jog within a south-southwest trending ductile-brittle shear zone hosted by felsic to intermediate intrusive rocks. The Hook Lake U mineralization is cross-cut by a number of NE- and NW- trending brittle faults, which could have provided dilation zones for fluid flow at the now eroded Athabasca/basement unconformity (~ 200 - 250m above the present-day outcrop surfaces), similar to the recently reported Fraser Lakes uranium and thorium mineralization (Annesley et al., 2009; JNR Resources Inc., 2009). The basement-hosted high-grade mineralization at Hook Lake has structural similarities to Athabasca basement-hosted uranium deposits, such as Eagle Point and Millennium.

## Description and chemical composition of the uranium oxides

Two distinct generations of uranium oxides were observed in the thin section: the white zone (WZ) and the grey zone (GZ). These two zones are optically and chemically different. According to the paragenetic links, the white zone can be considered as the primary crystallized zone in the Way Lake mineralization. This zone is homogeneous, without alteration features and is rarely longer than 500 µm. The grey zone, which represents the main part of the mineralization, is more contrasted than the white zone with various grey shades. These shades, usually associated to microfractured areas, can be linked to secondary alterations posterior to the crystallisation of the uranium oxides. The white zone and the grey zone are chemically distinguishable by their lead (18-21.5% PbO for WZ, 14.2-21% PbO for GZ), calcium (0.6-2.6% CaO for WZ, 1.7-4.4% CaO for GZ), and silica contents, for example.

## U/Pb ionic ages

Several homogeneous and weakly altered zones were selected and analysed by ionic microprobe Ims-3f (CRPG laboratory, France) to obtain the U/Pb isotopic dating of each zone of the Way Lake mineralization (Fig. 3).

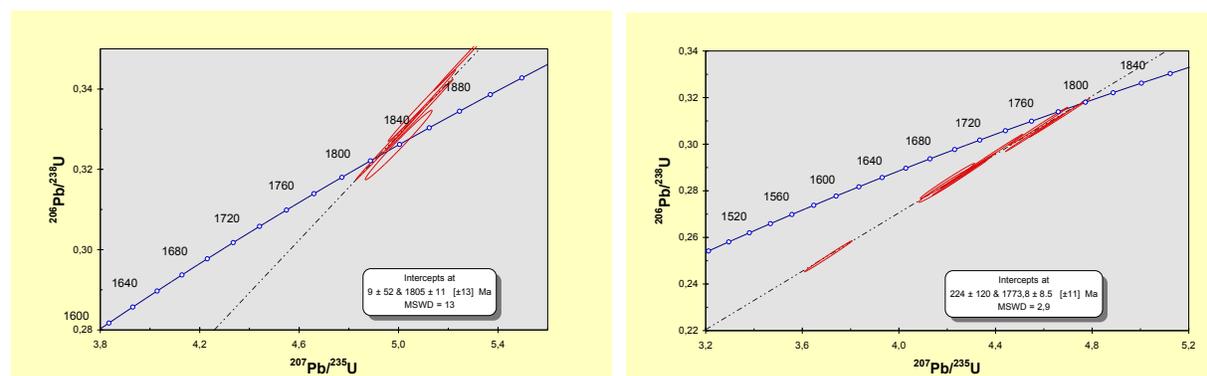


Fig. 3. U/Pb ionic ages for the WZ (left) and GZ (right) of the Way Lake mineralization

The white zone of the Way Lake mineralization preserve one generation of uranium oxide with an isotopic age at  $1805 \pm 11$  Ma [MSWD=13]. The U/Pb isotopic ratios obtained for all analytical points are strongly concordant, indicating the lack of lead loss (i.e. alteration episode) after the crystallisation of the uranium oxides. This is confirmed by the lower intercept close to the origin.

The grey zone of the Way Lake mineralization presents one generation of uranium oxide with an isotopic age at  $1774 \pm 9$  Ma [MSWD=2.9]. The U/Pb isotopic ratios obtained for all analytical points are concordant, indicating a very small lead loss (i.e. alteration episode) after the crystallisation of the uranium oxides. The small lead loss is confirmed by the lower intercept distinct from the origin ( $224 \pm 120$  Ma). This lower intercept could be associated to a main late alteration episode favourable to the creation of the different observed shapes for the GZ.

### REE patterns of the uranium oxides

The uranium oxides dated by U/Pb isotopic method were also analyzed by ion microprobe Lms-3f (CRPG laboratory, France) to determine the REE patterns of each uranium oxide generation (methodology in Bonhoure et al., 2007). The WZ and the GZ are characterized by similar chondrite-normalized REE patterns with enrichment of the light REE and a quite constant concentration of the intermediary to heavy REE. The same pattern for the zones indicates that the conditions of crystallization were identical for the two uranium oxides generations. A comparison with unconformity-related uranium oxides from the Athabasca Basin shows that the two main types of mineralization associated to Athabasca Basin (unconformity-related and Hook Lake) have totally different REE patterns. The conditions of crystallization are therefore distinct and this is confirmed by the U/Pb isotopic ages.

### Conclusions

The white and grey zones of the Hook Lake occurrence correspond to two distinct uranium deposition events. The Way Lake mineralization, formed as a result of two main uranium oxide deposition events ( $1805 \pm 11$  Ma and  $1774 \pm 9$  Ma), is a Hudsonian uranium mineralization clearly distinct (i.e. by age and chemical composition) from the Athabasca Basin unconformity-related uranium mineralization. Indeed, the U/Pb isotopic ages for unconformity-type deposits are younger than 1590 Ma (Alexandre et al., 2009) and this limit is 200 Ma younger than the U/Pb isotopic ages obtained in this study for the Hook Lake mineralization. At the present time, we cannot conclude if the grey zone uranium oxides formed as a result of white zone alteration (i.e. a continuum) or if it is a totally disconnected mineralized event.

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