



## Geology of the K6-252 Complex, Alberta

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### Introduction

The Buffalo Head Hills (BHH) kimberlites comprise the third largest district of diamond-bearing kimberlites in Canada, with 41 kimberlites distributed over 6,000km<sup>2</sup>, of which 27 are diamondiferous. Discovery has been largely through drilling of magnetic targets, and extensive erosion prior to burial under thick glacial made it difficult to correctly model their geology. In 2010 the BHH Joint Venture consisting of Canterra Minerals Corp., Shore Gold Inc. and Encana Corp. undertook systematic grid drilling and detailed logging with emphasis on the modal abundance of macrocrysts, lapilli, xenoliths and matrix. This led to the modeling of several of the kimberlites as larger kimberlite complexes. The most conclusive modeling is for the K6 and K252 kimberlites, hereafter referred to as the K6-252 kimberlite complex.

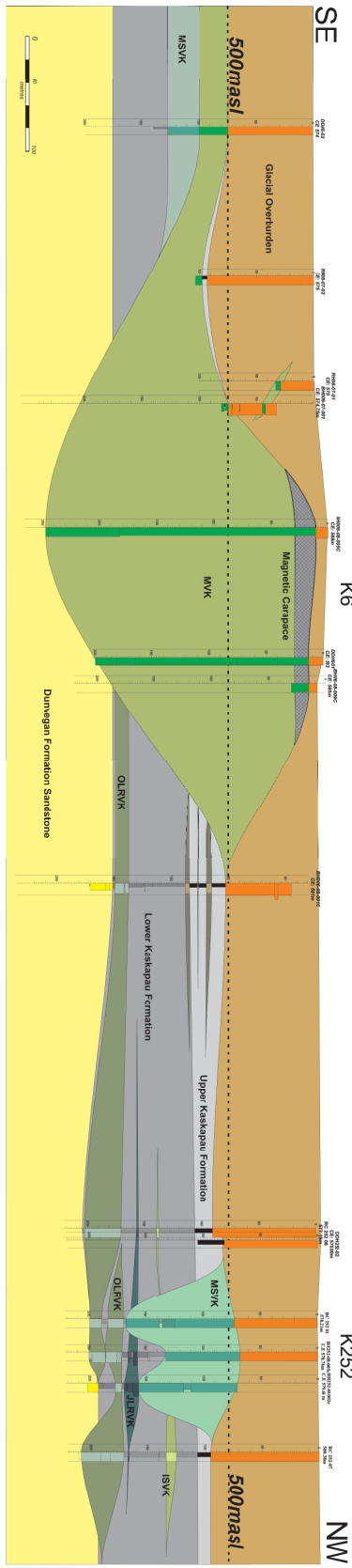
### Geological Setting

The BHH kimberlites are emplaced through the ~2.31.9Ga Buffalo Head Terrane that is notably younger than >2.5Ga lithosphere that hosts diamondiferous kimberlites worldwide. This atypical setting is expressed in mantle indicator chemistry with a near-absence of G10 pyrope. For pyrope as well as the other indicators, neither composition nor abundance correlates with diamond content (Hood and McCandless, 2004). Two kimberlite age groups are present; the ~85Ma Group and the ~60Ma Group. The 85Ma kimberlites were emplaced coevally with deposition of the late Cretaceous Dunvegan and Kaskapau Formations, and then partially eroded in the Tertiary and buried under Quaternary glacial cover.

### The K6-252 Complex

At K6 there are two depositional centers (vents) identified by gravity, with the northern vent forming a topographic high. The K252 kimberlite is 300 meters northwest of K6 with a single vent buried under 50 meters of glacial cover (Figure 1). Connecting the two vents is the earliest interbedded unit, an olivine-rich volcanoclastic kimberlite (OLRVK) whose upper contact occurs at the contact of the Dunvegan and Kaskapau Formations. Juvenile lapilli-rich VK (JLRVK) kimberlite rests stratigraphically above the OLRVK and within the Kaskapau Formation. Both units increase in thickness toward K252 and appear to be apron deposits of K252, similar to those observed at some FALC kimberlites (Zonneveld et al., 2004). Both the main vent facies at K6 (MVK) and the matrix-supported vent facies at K252 (MSVK) rest unconformably on the upper Kaskapau Formation and cross-cut the lower marine strata. The MVK at K6 is distinguished by abundant crystalline basement xenoliths, which are relatively rare in the MSVK at K252. When projected at 1:1 scale and correlated to a single datum, the interbedded units stratigraphically align, further supporting the interpretation of K6-252 as a single kimberlite complex (Figure 1).

Subsequent to emplacement in the Cretaceous, the K6-252 complex (and several other BHH complexes) were exposed to weathering and erosion in the Tertiary. Weathering in the Tertiary is believed to have formed a carapace of magnetic minerals near the top of each vent, which was later removed from K252 by glacial erosion in the Quaternary. This model explains why K6 has a strong magnetic signature, whereas K252 is magnetically-transparent and identified as an EM-anomaly prior to drilling (Skelton et al., 2003).



**Figure 1.** Longitudinal fence diagram for K6-252 referenced to 500masl (dashed line). See text for discussion.

## **Diamond Characteristics**

Diamonds from the K6-252 complex are dominantly tetrahedra, which is typical for the BHH kimberlites (Banas et al., 2007). The K252 vent has the highest diamond content in the BHH at 0.55 carats per tonne (cpt) from 28 tonnes, with grades approaching 1cpt from some interbedded units. Though lower in grade at 0.07cpt (from 232 tonnes), K6 has the largest diamonds reported from the BHH including a 1.77ct colorless and a 0.77ct fancy yellow diamond. Along with the 1.77 carat diamond, three diamonds exceeding one carat and of similar quality were recovered from a ~16 carat sample, suggesting a coarse diamond distribution for this part of the complex (Canterra, 2016).

## **Conclusions**

Systematic drilling and detailed logging of the K6-252 kimberlite complex indicates that it is a multiple eruptive kimberlite with kimberlite units defining both within-vent as well as interbedded lithologies. The complex was emplaced during deposition of late Cretaceous sedimentary rocks in a marine setting. Neither the geology nor the diamond characteristics of K6-252 complex are likely to be unique, and the application of these latest findings could have significant implications for the future exploration and economics of other BHH kimberlites.

## **References**

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