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Discussion

Reply to Discussion of "Geology and diamond distribution of the 140/141 kimberlite, Fort à la Corne, central Saskatchewan, Canada" by A.K. Berryman, B.H. Scott Smith and B.C. Jellicoe (Lithos 76, 99–114) by B.A. Kjarsgaard, D.A. Leckie and J.P. Zonneveld

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1. Introduction

Kjarsgaard et al. (2007) suggest that their data do not support the two stage emplacement model proposed by Scott Smith et al. (1994, 1995, 1998). The results of the latter investigation are presented in detail by Scott Smith (in review). The work was undertaken on behalf of the joint venture partners at the time of the work (see Acknowledgements), with De Beers Canada Inc. being the most recent operator. This emplacement model for the Fort à la Corne (FALC) kimberlites is briefly summarised below followed by comments on Kjarsgaard et al. (2007) using the sub-headings of that paper (section 2 onwards).

A geological model for the FALC kimberlites is presented in Fig. 1. The volumetrically significant kimberlites in each body are proposed to be explosively excavated shallow bowl-shaped craters at least 200 m deep which were subsequently infilled by pyroclastic kimberlite. The kimberlite in most FALC drillcores can be sub-divided into two groups: (i) major continuous intersections of kimberlite (~65 to 275 m long) and (ii) volumetrically minor or thin intersections (<10 m thick) as shown in Table 1 and Fig. 1. The variable thicknesses of the major kimberlite intersections define a crater shape, the longer deeper examples occurring towards the centre of each body (Fig. 1). Dips of the observed kimberlite to country rock contacts of 0–60°, mainly ~30°, are consistent with the dips of 5 to 55° indicated by the modeled crater shapes. Minor kimberlites of differing age and contrasting petrography occur as thin conformable layers within the sediments, both above and below, the main crater infill (<141.3 m in Table 1a, >249 m in Table 1b respectively, illustrated in Fig. 1). Observed country rock to minor kimberlite contacts are commonly horizontal. The main difference in the interpretation to that proposed by Kjarsgaard et al. (2007) is that the major kimberlites represent excavated craters postdating most of the observed country rock

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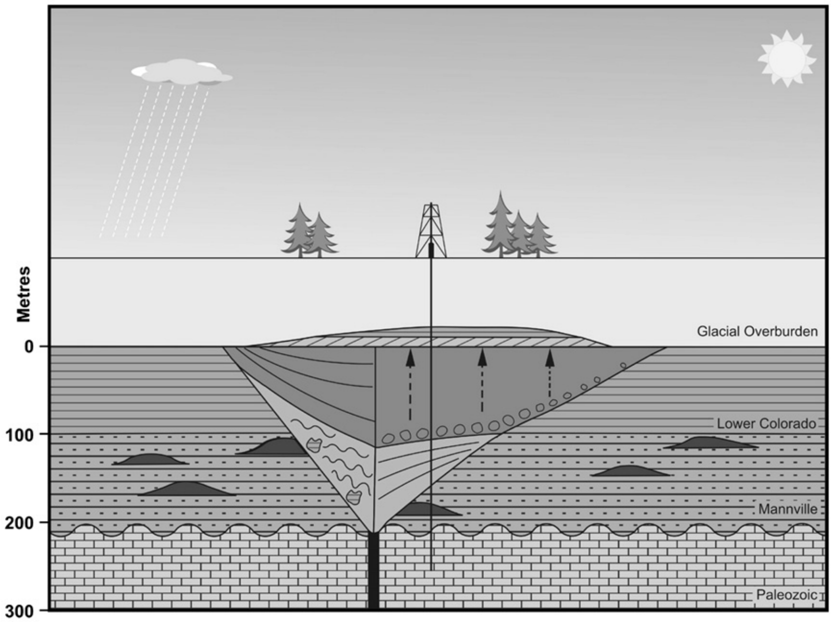

Fig. 1. Geological model for the FALC kimberlites (after Fig. 18g of Scott Smith in review). 0 metre is the present day sub-glacial bedrock surface (~100 m below the present day surface). The country rock sediments comprise Paleozoic carbonates (brick symbol), Cretaceous Mannville Group sediments (alternating solid and dashed lines; ~118–103 Ma.), Lower Colorado shales (solid lines; ~103–98.5 Ma.), glacial overburden (unornamented). The kimberlite in most FALC drillcores can be sub-divided into two groups (i) major and (ii) minor intersections. The major intersections (pale and medium grey) define crater- or bowl-shaped bodies. Two schematic examples of crater infill are shown to the left and right of the central vertical line. On the left, early crater infill comprises a kimberlite unit with disturbed bedding and subsided xenoliths of Lower Colorado sediments overlain by younger xenolith-poor bedded kimberlite. On the right, an early bedded kimberlite unit is overlain by a younger mega-graded bed with a basal breccia composed of kimberlite transported basement xenoliths (arrows indicate upward fining). The minor intersections (ii) are conformable within the underlying or overlying sediments. Below the crater, contrasting minor and laterally discontinuous kimberlites (dark grey) occur as thin conformable layers presumed to represent small volcanic cones in the country rock sediments. The uppermost positive relief material is an erosional remnant of the overlying cross stratified reworked kimberlite (oblique lines) and interbedded shale (horizontal lines). Kjarsgaard et al. (1995) and Leckie et al. (1997a) show that the shale overlying the body 169 kimberlite is Late Albian Westgate Formation, the end of which is proposed to be 98.9 Ma by Kjarsgaard et al. (2007).

sediments rather than volcanic cones contemporaneous with the deposition country rock sediments.

2. Geology and geological setting

The geology of the country rock and ages of the FALC kimberlites were not well known at the time of Scott Smith et al. (1994, 1995, 1998). The revised data for the Cretaceous sediments (e.g. Christopher, 2003) presented by Scott Smith (in review, summarised in caption to Fig. 1) are consistent with Fig. 1 of Kjarsgaard et al. (2007). With respect to the identification of the Pense Formation, only one of the drillcores examined by Scott Smith et al. (1994, 1995, 1998) recovered sediments at the appropriate stratigraphic level. In this drillcore, located near the edge of body 140/141, the Pense Formation was identified between 183.6 and 192.3 m from surface by Christopher (1993, as presented in Fig. 9 of Berryman et al., 2004, Fig. 2 of Scott Smith, in review; Christopher, 2003). An updated stratigraphic column (after Fig. 2 of Berryman et al., 2004) is presented in Fig. 2 of Lefebvre and Kurszlaukis (2006) which is consistent with that of Kjarsgaard et al. (2007). The new data show that Pense Formation is typically <10 m thick and that the base of the Lower Colorado occurs ~190 m from the present surface. The presence, absence or thickness of the Pense Formation is not critical to the crater model.

The current published radiometric ages for the main FALC kimberlites of ~94–103 Ma noted by Scott Smith (in review) are similar to Kjarsgaard et al. (2007). The ages of 104 and 105 Ma from Scott Smith et al. (1996) discussed by Kjarsgaard et al. (2007) are model Rb/Sr ages. Scott Smith et al. (1996) noted that applying a more typical initial ratio of 0.708 results in a recalculated age of 95 Ma which is more consistent with the other age available at that time of 98 Ma (Hegner et al., 1995 cited as in press by Scott Smith et al., 1996). The age of 108 Ma discussed by Kjarsgaard et al. (2007) is based on stratigraphic relations and