Solid Earth Discuss., 5, C1105–C1109, 2014
www.solid-earth-discuss.net/5/C1105/2014/

Solid Earth
Discussions
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Interactive comment on "The morphology and surface features of olivine in kimberlite lava: implications for ascent and emplacement mechanisms" *by* T. J. Jones et al.

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Received and published: 24 March 2014

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Dear Mike,

We are pleased that you have found our manuscript " The Morphology and Surface Features of Olivine in Kimberlite Lava: Implications for Ascent and Emplacement Mechanisms" suitable for publication in Solid Earth, pending substantial revision. We do believe that this work presents novel ideas; ideas we hope and suggest will interest a

wide range of Earth Scientists working on transport and eruption in volcanic systems and on kimberlite volcanism, in particular.

We have read carefully the comments, criticisms and suggestions resulting from external review of the manuscript and from you. We have found many of the comments to be valid, insightful and generally helpful. Therefore, using these comments we have revised the manuscript substantially with the goal of making this a high impact paper. The time invested by yourself and the two reviewers is highly appreciated and has proven extremely useful.

You will find in a separate document a detailed point-by-point description/discussion of the changes we have made or not made to the manuscript in response to the reviewers comments. Additionally, all grammatical miscues, errors in spelling, and editorial suggestions have been corrected within the final submitted manuscript. As reiterated by your letter, the review process identified three major issues and we summarize, here, how we have dealt with these issues:

1) Olivine compositions

Previously published studies that concentrated on petrology and geochemistry at the Igwisi Hills include detailed chemical analysis of olivine compositions. Both (Dawson, 1994) and (Reid et al., 1975) report the forsterite content of the olivine ellipsoids used in this study. They also provide analysis of core to rim compositional profiles for Fe, Ni, Ca and Mn. These chemical data are now integrated into the text and compared to more recent studies of olivine core-rim chemistry from other kimberlites. We have not performed our own EMP analyses because: i) the purpose of this paper is elucidate the textural properties of olvines in kimberlite (completely new work and ideas), and ii) there is already a plethora of EMP analyses of kimberlitic olivine in the literature (e.g. Arndt et al., 2006; Arndt et al., 2010; Brett et al., 2009; Kamenetsky et al., 2008; Moore, 2012) and, more importantly, new measured compositions of olivine edges will not constrain the physical processes we are introducing.

2) Lack of scholarship

We apologise for this lack of scholarship in our original submission. Our haste made for a less than perfect submission. We have now reviewed the literature fairly comprehensively and created and included a table which summarises the olivine literature with observations/interpretations pertinent to our study. This table now makes for a useful review of the current controversies and theories regarding kimberlitic ascent. Finally, we make references to how our abrasion ascent model can be used in conjunction with these, typically more petrographic studies.

3) Volume proportions of mantle material and olivine content in lava

Our original manuscript had a typo: we reported 46 vol. % olivine at the base of the lava flow when the number was actually 26 vol. %. This created part of the problem that Reviewer #1 raised. This has now been corrected (26%; (Brown et al., 2012). This solves many of the issues raised by Reviewer #1. Such a high concentration in this basal part of the flow studied is a manifestation of crystal settling during lava emplacement. This is now clearly outlined in the text.

Secondly, questions were raised about the composition of the mantle source. In the manuscript we describe kimberlite as sampling "mantle peridotite"; peridotite is a broad class of rock type that includes dunite (as proposed by (Arndt et al., 2010). Alternatively, published literature suggests that cratonic mantle lithosphere have olivine contents of >70% and orthopyroxene comprising the majority of the remaining proportion (Kopylova and Russell, 2000). The apparent absence of orthopyroxene can be simply explained by its instability in a kimberlitic melt, becoming assimilated during ascent (e.g. Russell et al., 2012).

Lastly, orthopyroxene, garnet and clinopyroxene are all, in fact, observed in minor abundances in the Igwisi Hills lavas as described by two previous petrographic and geochemical studies (Dawson, 1994; Reid et al., 1975). Our model only attempts to explain the physical processes which operate during kimberlite ascent of an olivine

xenocrystic cargo - we have no comment on the mineralogical diversity of the lithospheric mantle nor on the pre-kimberlite history of the mantle lithosphere (i.e. Arndt's de-fertilization hypothesis).

We have made substantial revision to the manuscript that was driven and aided by the thoughtful reviews we received. Now, we hope that this submission meets the criteria for publication in Solid Earth; if there is anything that needs our further attention please contact me at your earliest convenience.

Yours truly,

Thomas J Jones

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Please also note the supplement to this comment:
http://www.solid-earth-discuss.net/5/C1105/2014/sed-5-C1105-2014-supplement.pdf

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Interactive comment on Solid Earth Discuss., 5, 2283, 2013.