Kimberlites: A peep into the Earth’s mantle

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Distribution of kimberlites worldwide
Importance of Kimberlites

They are the only primary sources of diamonds and exotic mantle material in the form of nodules which are the most informative messengers from Earth’s mantle.
Mantle rocks

**Peridotite** - olivine, enstatite, garnet, and clinopyroxene.

**Eclogite** - garnet and clinopyroxene.
Pyroxene enters the garnet structure at high pressure.

C conc. in mantle

100 ppm

1000-3700 ppm

A 400-micron wide ferropericlase inclusion
Utility of kimberlites

- Composition of the deep mantle
- Date the deep mantle perturbation events
Several natural radioisotopes have half lives suitable for geochronology

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Decay Product</th>
<th>Half-life</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{40}\text{K}$</td>
<td>$^{40}\text{Ar}$ (and $^{40}\text{Ca}$)</td>
<td>1.25 Ga</td>
</tr>
<tr>
<td>$^{87}\text{Rb}$</td>
<td>$^{87}\text{Sr}$</td>
<td>48.8 Ga</td>
</tr>
<tr>
<td>$^{238}\text{U}$</td>
<td>$^{206}\text{Pb}$</td>
<td>4.47 Ga</td>
</tr>
<tr>
<td>$^{235}\text{U}$</td>
<td>$^{207}\text{Pb}$</td>
<td>704 Ma</td>
</tr>
<tr>
<td>$^{147}\text{Sm}$</td>
<td>$^{143}\text{Nd}$</td>
<td>106 Ga</td>
</tr>
</tbody>
</table>
Historically famous diamonds

- Great Mogul – 900 cts.
- Koh-i-Nor – 793 cts.
- Nizam – 440 cts.
- Regent – 410 cts.
- Orloff – 195 cts.
- Darya-i-Noor – 186 cts.
- Hope – 112 cts.
- Shah – 95 cts.
Present day

Equator

1100 Ma
Reconstruction at 1100 Ma
Relative probability

Age in Ma

Alkaline rocks

1160 Ma
Umkondo igneous province
1102 – 1112 Ma

Hanson et al. 2004. Science
Warakurna large igneous province
Age: 1076 Ma
Thank Q