Paper Number: 4081

Kyanite-bearing eclogite xenoliths from the Udachnaya kimberlites, Siberia

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Xenoliths brought up by kimberlite magmas are unique samples of the otherwise inaccessible lithospheric mantle. Eclogite xenoliths are found throughout most cratons and show a range of mineralogical and chemical compositions that can be used to better understand craton formation.

The kyanite – bearing eclogites are more REE – depleted than bimineralic eclogites, for both types I and II. Both omphacite and garnet typically show positive Eu anomalies, like those from the Slave, Kaapvaal and Dharwar cratons. The positive Eu and sometimes Sr anomalies are interpreted as "ghost plagioclase" signatures implying a plagioclase – rich protolith in accordance with the subduction-related origin of mantle eclogites.

Kyanite – bearing eclogites often belong to the pristine type IIB. These samples offer the most accurate information about mantle eclogites' protoliths as their composition has not undergone metasomatic enrichments by carbonaceous/kimberlitic fluids. This is proven by both chemical composition (major and trace elements) and age (older than the kimberlite eruption). A particular characteristic of kyanite – bearing eclogites is the positive Eu and Sr anomalies, "the ghost plagioclase signature". Taking into account that this signature is preserved in non-metasomatised samples, it is safe to say that the Eu and Sr anomalies are not related to metasomatism, but were preserved from the protolith. The same compositions and textures are also seen in kyanite-eclogites from several cratons, which we see as a strong argument for a subduction-like formation mechanism related to craton accretion.

References:

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