Preserved quartz inclusions from eclogite xenoliths record past subduction in Siberian craton

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Investigation of mantle xenoliths can provide information on the architecture and evolution of subcontinental lithospheric mantle through time. These reconstructions rely also on correct estimates of the pressures and temperatures (P-T) experienced by mantle rocks over time. Unlike chemical geothermobarometers conventionally used in petrology, elastic geobarometry does not rely on chemical equilibrium between minerals, so it has the potential to provide information on over-stepping of reaction boundaries and to identify other examples of non-equilibrium behaviour in rocks. Here we introduce a method that exploits the elastic anisotropy of minerals to determine the unique P and T of equilibration from a measurements of single mineral inclusions trapped in a crystal host from an eclogite xenolith. We apply it to perfectly preserved quartz inclusions in garnet from eclogite xenoliths in kimberlites. Our results indicate that quartz inclusions trapped in garnet at 3GPa and 800°C can be preserved when the rock reaches the stability field of coesite (high pressure and temperature polymorph of quartz). This supports a metamorphic origin for these xenoliths and suggests a mechanism of craton accretion from subducted crustal slab. Furthermore, we show that interpreting P and T conditions reached by a rock from the simple phase identification of key inclusion minerals can be misleading.

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