# Relative roles of cratonic lithosphere and asthenosphere in controlling kimberlitic magma compositions: Sr-Nd-Hf isotope evidence from the Greenland-Labrador diamond province

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The origin of kimberlite magma has probably invoked more mantle reservoirs than any other magma type, with options varying from ancient subducted oceanic crust trapped in the mantle transition zone, the asthenosphere, and/or metasomatized mantle lithosphere. Little attention has been given to interactions between melts derived from these different mantle reservoirs and their relative roles in forming kimberlites and related rocks. A wide compositional spectrum of 600-550 Ma old diamondiferous kimberlitic magmas ranging from potassic-silicate (lamproitic) through carbonated potassic-silicate (aillikitic) to carbonatitic intrudes the North Atlantic craton in Greenland and Labrador. We present new elemental and Sr-Nd-Hf isotope data for extremely carbonate-rich kimberlitic dykes (up to 20 wt% $CO_2$) from Sarfartoq and Majuagaa in West Greenland. We contrast their compositions with carbonated potassic-silicate magmas that formed beneath northern Labrador [1] to examine the contributions from different mantle reservoirs.

The most isotopically enriched compositions are confined to carbonate-poor, strongly potassic melts from Labrador (0.7070 $^{87}Sr/^{86}Sr$, -5 εNd, -6 εHf), contrasting with depleted compositions in carbonate-rich samples across the region (0.7025 $^{87}Sr/^{86}Sr$, +4 εNd, +4 εHf). This suggests that a common asthenosphere-derived carbonated ultramafic silicate melt component was present throughout the North Atlantic craton base at 600-550 Ma and variably interacted with old phlogopite-bearing metasomes, giving rise to hybrid carbonated potassic-silicate magmas that approach lamproitic compositions. This case from the Greenland-Labrador diamond province lends support to the importance of cratonic mantle lithosphere in excerting a major control on kimberlitic magma compositions. The long-term metasomatic memory of this reservoir adds special chemical flavours to global convective upper mantle derived kimberlitic magmatism.

[1] Tappe *et al*. (2007) Geochim. Cosmochim. Acta **72**, 3258–3286.

# Early geodynamo history preserved in single silicate crystals

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The onset and nature of the geomagnetic field is important for understanding the evolution of the core, atmosphere and life. We have developed a new approach for retrieving this history using single silicate crystals carrying minute magnetic inclusions [1].

Quartz and feldspar from 3.2 Ga Kaapvaal craton plutons yield intensities within 50% of the modern value [2]. Quartz from 3.4 to 3.45 Ga dacites record a field ~30-50% weaker than present-day [3]. These data, with solar wind estimates, suggest magnetopause standoff distances similar to those seen during recent coronal mass ejections. Heating and volatile loss from the exosphere is implied, affecting long-term atmospheric composition. Tests for an even older Paleoarchean-Hadean geodynamo (Figure 1), using quartz and zircon crystals with magnetic inclusions will be discussed.

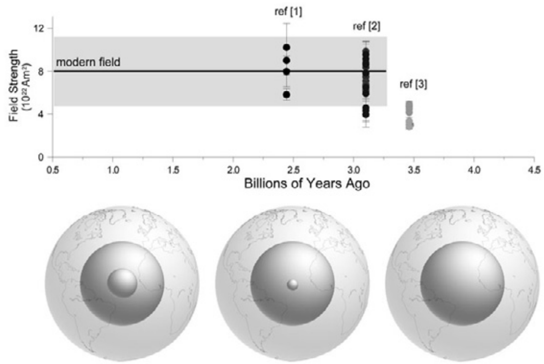


**Figure 1:** Early Earth paleointensity using single silicate crystals.

[1] Tarduno *et al*. (2006) *Rev. Geophys.* **44**, RG1002. [2] Tarduno *et al*. (2007) *Nature* **446**, 657–660. [3] Tarduno *et al*. (2010) *Science*, in press.