



Plume-related alkaline and carbonatite magmatism in the Earth,s history. Link to carbonatized and metasomatized mantle.

Liya Kogarko

Vernadsky Institute of Geochemistry Moscow, Russian Federation (kogarko@geokhi.ru)

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Kogarko L.N.

Vernadsky Institute of Geochemistry and Analytical chemistry RAS,kogarko@geokhi.ru

Alkaline and carbonatitic magmatism have occurred since 2.5–2.9 Ga and the abundance of alkaline rocks and carbonatites has continuously increased throughout the Earth’s history. For example, the total volume of young platonolites in Kenya exceeds 50 000 km³ which is much larger than the volume of alkaline rocks of all other geologic epochs. Alkaline rocks appeared on the Earth with changes in the geodynamic regime of our planet, i.e. when plate tectonics sharply activated. The appearance of alkaline rocks at the Archean-Proterozoic boundary coincides with several global geological events, and this boundary became an important benchmark in the Earth history. One of the most important events at the Archean–Proterozoic boundary was the occurrence of an oxygen-containing atmosphere (Big Oxidation Event) and as a consequence, subduction of already significantly oxidized oceanic crust with elevated contents of volatiles (generally water and CO₂), resulting in partial melting of subduction plate and mantle wedge. The active interaction between the oceanic crust and mantle facilitated not only an increase in the contents of volatiles in the mantle, which had lost these components in the course of high-temperature accretion during the early evolutionary stages of the Earth, but also resulted in oxidation of mantle fluid. Experimental data show that oxidized aqueous-carbonate fluid can contain at high pressure a few percent of alkali-rich silicates and lithophile elements. Strong enrichment of alkaline magmas in rare lithophile elements and depletion with respect to radiogenic isotopes can be accounted for the metasomatic influx of these elements into zones of magma generation. Our study of some oceanic islands and East Antarctic mantle nodules showed the strong enrichment of carbonatized samples in rare elements.

Isotopic signature of super-large critical metal deposits of Kola demonstrated important role of plume activity and accompanied carbonate mantle metasomatism of mantle source in their origin.