Large thermal events in Proterozoic mantle and carbonatite formation

D. KAVECSANSZKI[1]*, DR. K. R. MOORE[1] , PROF. F. WALL[1]

[1] Camborne School of Mines, Univ. of Exeter, Penryn,
TR109FE, UK
(*correspondence: dk287@exeter.ac.uk)

Model of Proterozoic silicocarbonatite magmatism

We use Davies' (1995) [1] model of the thermal evolution of the Earth's mantle and the experimental literature of melting in a carbonated mantle to investigate the relationship between the formation of Proterozoic mantle metasomes and the occurrence of the most economic carbonatite deposits. The temperature of the carbonate-mica-peridotite solidus was significantly lower than the geotherm during episodic intervals of large thermal events in the Proterozoic mantle. The implication is that underplating by voluminous magmas would either enrich metasomes in established Sub Continental Lithospheric Mantle (SCLM) or destroy metasomes by large fraction melting in new SCLM with higher heatflow. Between thermal peaks, the carbonate-mica-peridotite solidus largely coincided with the geotherm at P > 4 GPa, implying that the formation of small-fraction, volatile-rich metasomatising melts was common and widespread. Magmas with compositions between carbonatite and kimberlite would generate extensive metasomes in the Proterozoic SCLM that acted as reservoirs for post-Proterozoic magmatic events, or transported critical metals such as REE to the crust, where they were further concentrated in carbonatite by fractionation from silicocarbonatite parental magmas.

Application to carbonatite-hosted ore deposits

The largest carbonatite-related ore deposits are often Proterozoic: examples include Mountain Pass (USA), Mount Weld (Australia), Bayan Obo (China) (REE, Nb), and Phalaborwa (RSA) (Cu). Our model neatly explains the enriched nature of Proterozoic carbonatites, the location of the most critical-metal enriched Phanerozoic carbonatites in Proterozoic terranes and the association of carbonatites with ultramafic cumulates that fractionated from parental carbonate-rich magmas.

[1] Davies (1995) *Earth Planetary Letters* **136,** 363-379.