

Formation of cratonic subcontinental lithospheric mantle from hybrid plume sources

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Peridotitic sulfide inclusions in diamonds from the central Slave craton constrain the age and origin of their subcontinental lithospheric mantle (SCLM) source. In the Re-Os isochron diagram, sulfides form two ca 3.4 Ga age arrays with variably elevated initial ¹⁸⁷Os/¹⁸⁸Os indicative of enriched sources. Archean to recent plume-derived melts carry a subducted crust (eclogite) signature [1], and some cratonic mantle lithosphere may have been generated in plumes by extraction of komatiitic liquids [2]. We explain our data by melting in a hybrid mantle plume that contains domains of recycled eclogite [1] and/or (?plume-initiated) subduction of proximal evolved lithospheric material [3].

In upwelling hybrid mantle, eclogite will melt first. Melts will react with olivine in surrounding peridotites to form orthopyroxene (opx), convert peridotite to pyroxenite [1] and confer their crustal isotope signatures. Upon further decompression, pyroxenitic melts [1] pervade the near-solidus mantle, helping local isotopic homogenization and adding aluminous opx. The subsequent partial melting of this opx-(Al- and Si-) enriched source generated komatiites and complementary ultradepleted cratonic mantle residues.

Subduction still is needed to explain many cratonic features. Nonetheless, this model satisfies several key observations: (1) suprachondritic initial ¹⁸⁷Os/¹⁸⁸Os in subsets of lithospheric mantle samples and in some coeval Archaean komatiites; (2) variable aluminous opx enrichment and (3) high Mg# combined with high opx content in cratonic SCLM [2] due to higher melt productivity of an Al- and Si-richer source [4], in addition to higher Archean temperatures. The model also alleviates a mass balance problem [2, 4] because it predicts a hybrid mantle source with variably higher SiO₂ than pyrolite, and contrary to a primitive mantle source is able to reconcile compositions of komatiites and complementary cratonic mantle residues.

[1] Sobolev *et al.* (2007) *Science* **316**, 412–417. [2] Herzberg (1993) *Earth Planet. Sci. Lett.* **120**, 13–29. [3] Burov & Cloetingh (2010) *GRL* **37**, L03309. [4] Francis (2003) *Lithos* **71**, 135–152.

Characterization of nanoparticle, size, shape, morphology, oxidation state and crystallinity: A multi-method approach

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Nanoparticle size has been recognized as the most important factor determining the behavior of nanoparticles (NPs), although other properties such as shape, morphology, oxidation state, crystallinity and structural defects might play a significant role. This presentation will discuss the characterization of these properties in nano- and micron- sized particles of cerium oxide). Emphases will be paid to size measurement by different techniques, including high resolution-transmission electron microscopy (HR-TEM), dynamic light scattering (DLS), atomic force microscopy (AFM), X-ray diffraction (XRD) and BET. In addition, shape, morphology, crystallinity and structural defect analysis was performed by HR-TEM, AFM and scanning electron microscopy (SEM). Oxidation state analysis was performed by electron energy loss spectroscopy coupled to TEM.

Results suggest that combination of several techniques is vital to understand the properties and behavior of NPs, and a good understanding of the physical principles of the characterization method is a key to interpret and compare the results. Sizes measured by HR-TEM, AFM, XRD and BET were comparable, though DLS showed larger sizes. While TEM and AFM allow single particle and aggregate sizing, XRD and BET measure the size of the single crystals and do not account for particle aggregation. However, DLS is biased toward large size due to the 6th order-dependence of scattered intensity on particle size. HR-TEM allows observation of the lattice image of single particles, and therefore, crystal structure determination, as well as the terminating atomic planes, particle shape and structural defects. However, the high resolution capability of TEM is limited by particle thickness, which limits the utility of HR-TEM to small particles (<15-25 nm) and is ideal for NP analysis. For larger particles, XRD is the technique of choice for crystal structure determination and AFM and/or SEM for shape determination.