

# Physical transport of nano-Au/TABS in mantle-derived magmas

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The role of nanomaterials (i.e., atomic clusters, nanomelts, nanoparticles) is being increasingly recognized in the literature as a key factor controlling metal transport and deposition in silicate melts. Here, we report results of micron to nanoscale observations on natural samples and experimental runs counterparts, specially designed to better define the role of gold nanomaterials in conjugated silicate-TABS (Te, As, Bi, Sb) melts, with special application to upper mantle conditions. Inspection of peridotite xenoliths and orogenic peridotites reveal that Au-rich nanomelts and nanoparticles are present in all rocks of the subcontinental lithospheric mantle (SCLM). Similarly, mantle-derived magmas such as OIB and rocks of the lamproite suite also contain nano-to-micron scale Au±TABS minerals included in minerals (i.e., silicates and sulfides) and quenched silicate melts (i.e., silicate glasses). Their specific location in the rock and intimate link with high temperature minerals suggest that Au-rich nanomelts and nanoparticles may form at high temperatures (> 900 °C) in both silicate and/or sulfide melts. Careful analyses of experimental runs applying a combination of micro- and nano-analytical techniques [i.e., field emission gun scanning electron microscopy (FEG-SEM) and electron probe microanalyzer (FEG-EPMA), focused ion beam (FIB) and high-Resolution transmission electron microscopy (HRTEM)] reveal features nearly identical to natural samples. Contrary to convention, we show that Au nanomaterials are high temperature phases that are immiscible to silicate and sulfide melts. We argue that Au nanomaterials may form in upper mantle prior to basaltic melts generation in mantle sources. During partial melting, melt segregation and extraction of mantle melts these Au nanomaterials may be collected and entrained in suspension, thus physically behaving incompatibly in the basaltic melts and their derivatives. Our new results offer a physical alternative to conventional chemical partitioning and provide a mechanism of Au partitioning, transport and deposition in silicate, sulfide and arsenide melts.