Caught in the act: Incipient metal extraction during melting of metasomatically oxidised mantle

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We have examined mantle xenoliths from Victoria (Australia) where melt generated by the breakdown of metasomatic phlogopite and hornblende is preserved as glass due to rapid volcanic extraction. In some xenoliths, oxidised glass with fO_2 of 1.2 to 1.8 log units above the fayalite-magnetite-quartz buffer (FMQ; determined by synchrotron XANES), contains an exceptionally high abundance of quenched sulfide droplets, whereas more reduced glass (fO_2 < FMQ) from other xenoliths has low sulfide content. Textural evidence shows that the oxidised melt was able to dissolve interstitial sulfides whilst percolating along grain boundaries, collecting sulfur and chalcophile elements. Oxidative metasomatism at this locality, which proceeded via subduction-related processes hundreds of millions of years prior to the volcanic event, eventually led to inheritence of elevated oxidation state and thereby, enhanced metallogenic fertility, in the newly generated basaltic magmas. These rocks thus represent a frozen snapshot of melting of the type mantle source region that can produce post-subduction arc-hosted ore deposits. Our finding proves, counter to some previous arguments, that oxidised, metal and sulfur-rich magmas are generated by melting of mantle modified by oxidative fluids derived from a subducting slab, providing the missing link in understanding the genesis of some of our most important ore deposits.