



The occurrence of magnesioferrite-rich spinel xenocrysts in the Mesozoic Jianguo andesite (W-Liaoning Province, NE China): implications for the oxidation state of the upper mantle underneath the North China Craton

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Magnesioferrite-rich spinels were found in the Cretaceous Jianguo trachyandesite in northeastern China. The trachyandesite is comprised of augite, plagioclase, K-feldspar, spinel, phlogopite, pseudomorphs of chrysotile/antigorite/chlorite, apatite and zircon. Texturally, four stages of spinel growth are observed: magnesioferrite-rich spinel I occurs within chrysotile/antigorite/chlorite pseudomorphs after olivine and/or orthopyroxene and magnesioferrite-rich spinel II occurs as xenocrysts in the trachyandesite. Magnetite-rich spinel III occurs either as rims around spinel II or as distinct magnetite grains. Spinel IV occurs within the pseudomorphs, as a worm-like magnetite-rich spinel. Spinel I contains 51 to 82 mol. % magnesioferrite, spinel II contains a magnesioferrite component ranging from 60 to 79 mol.%. Two-feldspar thermometry yields temperatures of 880 – 1000°C for the formation of the trachyandesite matrix assemblage. $T - fO_2$ model phase relations indicate that magnesioferrite-rich spinel I is stable at high T and high fO_2 . Spinel II xenocrysts, enriched in magnesio-

ferrite component, formed either due to a change in mineral assemblage, or decreasing T and increasing fO_2 . Subsequently, reduction leads to the formation of magnetite-rich spinel III. Spinel IV forms during subsolidus late-stage alteration of olivine. Thus the presence of magnesioferrite-rich spinels I and II in the trachyandesites indicates 1.) possibly high fO_2 conditions in the upper mantle source rocks thus could have formed in an oxidized, metasomatized, upper mantle or 2.) they formed from interactions between a highly oxidized magma and upper mantle rocks during the ascent of the trachyandesites. These data are in accordance with geochemical investigations, which indicate that Jianguo andesites were generated in the asthenosphere accompanied by combined assimilation and fractional crystallization. Thus the presence of magnesioferrite-rich spinels I and II in the andesites indicates high fO_2 in the upper mantle source rocks and is in accordance with the presence of a stagnant slab beneath the continental crust of the North China Craton (NCC), whose generation of melts results a high oxidation state in the mantle wedge above this paleosubduction zone.