Evidence from pyroxenite xenoliths for subducted lower oceanic crust in subcontinental lithospheric mantle

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Pyroxenite xenoliths entrained in alkali basalts are mostly interpreted as high pressure cumulates from mantle-derived melts [1, 2]. However, the garnet pyroxenite xenoliths (websterites and clinopyroxenites) from Jiaohe, Northeast China may have an origin from subducted oceanic crust. Their bulk rock compositions are characterized by relatively high Al_2O_3 contents (12.2-17.4%) and high Mg# (up to 0.88), resembling those for olivine-bearing cumulative gabbros. A crustal origin for the Jiaohe pyroxenites from plagioclase-bearing protoliths is further supported by positive Eu and Sr anomalies in both whole rocks and in garnet and clinopyroxene, low HREE abundances in garnet and lower $\delta^{18}O$ (4.9-5.1‰) relative to typical mantle values (5.5‰). Moreover the Jiaohe pyroxenites display unusual O isotopic disequilibrium between co-existing minerals, with $\delta^{18}O$ in clinopyroxene (4.5-5.4‰) lower than, $\delta^{18}O$ in garnet (5.1-5.6‰) similar to, and $\delta^{18}O$ in spinel (~5.2‰) significantly higher than the average mantle values for corresponding minerals [3]. In particular, the observed O isotopic fractionation between garnet/spinel and clinopyroxene in the Jiaohe pyroxenites is similar to that of plagioclase/clinopyroxene pair in seawater-altered oceanic crust. This is attributable to metamorphic transformation from plagioclase to spinel then to garnet during subduction, in which garnet and/or spinel isotopically inherits that of plagioclase. This transformation is recorded as petrologic development of garnet at expense of spinel. Identification of remnants of subducted oceanic crust in the continental lithospheric mantle is important to understanding mantle heterogeneity and genesis of intraplate magmatism.

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Physicochemical condition of mineralization of the Xiaomiaoshan gold deposit, Anhui Province, China

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There are three types of fluid inclusions identified in the quartz veins sampled from the Xiaomiaoshan gold deposit, including vapor-rich, liquid-rich and daughter minerals-bearing fluid inclusions. The homogenization temperatures of these fluid inclusions ranges from 133 °C to 378 °C, the crest values are between 180 °C and 200 °C and between 220 °C and 260 °C respectively. The salinity is calculated and ranges from 0.2 wt%NaCl eq. to 44.6 wt%NaCl eq. with a crest value between 3 wt%NaCl eq. and 6 wt%NaCl eq.. Based on the Laser Raman analysis of the captured fluids, it is disclosed that the gas composition is mainly CO_2, H_2O vapor and a little amount of CH_4. The group analyses of the inclusions indicates that the liquid composition is mainly Na^+, K^+, Ca^{2+}, F^-, Cl^-, NO_3^- and SO_4^{2-}, while the gaseous compositons are mainly CO_2, N_2, H_2O, CH_4, C_2H_2 and C_2H_6. The K^+/Na^+ ratios are between 1.55 and 2.75, and F^-/Cl^- ratios are between 0.02 and 0.03. For hydrogen and oxygen isotopes, $\delta^{18}O_{H2O}$ of the fluid trapped in the quartz vein ranges from -2.31 ‰ to 2.36 ‰, and δD_{H2O} from -51.2 ‰ to -45.9 ‰. The characteristics of both isotopes show that the ore-forming fluid were mostly derived from the magma and mixed with the meteoric precipitation in late stage.

Based on the geological setting of the mineralization and the physichemical properties and isotopic geochemistry of the ore-forming fluid from the Xiaomiaoshan gold deposit, it is concluded that the faults in north-south direction were the route of gold activation, transportation and precipitation. When the fluid of high temperature and salinity mixed with the meteoric water along the faults, the oxygeon fugacity increased and the pH, temperature, salinity and pressure decreasing remarkably, which resulted in the disassociation of the gold complexes and caused the precipitation of gold.

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