Geochemistry and metasomatic processes of spinel peridotite suite from mantle wedge of subduction zone, Western Tianshan

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Spinel peridotite and olivine amphibolite of the Western Tianshan orogenic belt are enclosed in micaschist and derive from an orogenic wedge environment, showing evidence of melt extraction and metasomatic enrichment and documenting a complex history of the shallow mantle. Al–spinel is closely intergrown with secondary hornblende, diopside and serpentine, indicating that it grows at the expense of former Cr-spinel. Compositions of orthopyroxene, olivine and spinel indicate equilibration within the spinel–peridotite facies of the upper mantle, at depths about 45–65 km and temperatures around 676–735 °C.

High Cr/Al ratio of relict primary spinel and no detected primary clinopyroxene indicate that the ultramafite of the Western Tianshan represents a high degree melting and highly depleted residual mantle. The spinel peridotites derive from a depleted mantle that became enriched in some large ion lithophile element (LILE) and light rare earth element (LREE). Whole-rock trace element patterns from the most spinel peridotite suite show distinct negative anomalies for Nd, Ti and positive anomalies for Pb and Sr. Early amphiboles generated in the mantle wedge above subduction zones are depleted in heavy rare earth element (HREE) with subchondritic Ti/Nb and Zr/Nb ratios, whiles late developed amphiboles are even more depleted in HREE, showing heavily effected by subduction-related fluid. The changing pattern of early edenite to late hornblende in peridotites and amphibolites indicate that the mantle rocks took place within the mantle wedge where a suprasubduction metasomatic event overprinted a probably early mantle metasomatic episode.

Geochemical characteristics of minerals and rocks indicate that the ultramafic rocks from subduction mantle wedge in the western Tianshan represent an island arc environment.

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Atmospheric aerosol as the source of nitrate deposits in Turpan-Hami Basin, China: Evidence from oxygen and nitrogen isotopic compositions

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The Turpan-Hami Basin, which located in eastern Xinjiang, China, is a closed inland basin and one of the driest regions on the Earth. Recently, a super-scale nitrate ore field was found in this basin. The total amount of nitrate resources in Turpan-Hami Basin is about 2.5 billion tons, as much as the amount in Atacama Desert of Chile. The Turpan-Hami nitrate deposits can be mainly divided into two types: (1) Quaternary alluvial-pluvial sediment fissures-filling sodium nitrate deposits, (2) Modern saline type niter deposit.

The N and O isotopic compositions are different in the two types of nitrate deposits. The $\delta^{15}N_{Air}$ values of sodium nitrate vary from 0.7‰ to 6.0‰, which are similar to atmospheric NO_3^-; The $\delta^{18}O_{V\text{-}SMOW}$ values are very high, range from 34.4‰ to 45.0‰, which are different from microbial nitrification nitrate, and similar to atmospheric NO_3^-; The $\Delta^{17}O$ values range from 12.20‰ to 20.70‰, mass-independent fractionation (MIF) of oxygen isotope is obviously. With these proofs of oxygen and nitrogen isotopic compositions of nitrate, we can conclude that sodium nitrate deposits in Turpan-Hami Basin were products of long term atmospheric deposition of nitrate aerosol particles, which produced by photochemical reactions. The niter deposits character with high $\delta^{15}N_{Air}$ (15.0‰ ~ 27.6‰), low $\delta^{18}O_{V\text{-}SMOW}$ (30.2‰ ~ 36.3‰) and $\Delta^{17}O$ (3.93‰ ~ 12.39‰) values.

The sodium nitrate and niter deposits in Turpan-Hami Basin are from the same source, and niter deposits experienced strong microbial denitrification during the formation.