

**DIAMONDS AND MANTLE XENOLITHS IN KIMBERLITES FROM THE
NORTH CHINA CRATON AND THE CANADIAN NORTHWEST
TERRITORIES**

by

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Dedicated to
my families, in China and here in the United States, especially to my wife Qinglan Liu and
children Sijia and Sihua.

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ABSTRACT

This dissertation focuses on mantle compositions and processes. Mineral inclusions in diamonds from the Liaoning kimberlites, China belong mainly to a harzburgitic assemblage. The diamonds crystallized at depths of 140 to 200 km. Mineral inclusions in chromites from the same locality include silicates, carbonates, hydrous silicates and sulfides. Composite inclusions of carbonates+silicates in chromites might represent entrapped and crystallized kimberlitic magma. A garnet-olivine-chromite assemblage indicates that the depth where chromites formed is ~140 km. Similarities and differences between the inclusion assemblages in diamonds and in chromites suggest that minerals in diamonds and in chromites came from different depths, and that most mineral inclusions in chromites were probably trapped during the stage of the formation of kimberlite.

Mantle xenoliths from the Nikos kimberlites, Somerset Island, and the Zulu kimberlites, Brodeur Peninsula, Baffin Island, Canada are mainly coarse, protogranular, low-temperature lherzolites. High-temperature xenoliths, which are common in the Kaapvaal and Siberian cratons, were not found at Nikos. Garnet-spinel lherzolite xenoliths are common at Nikos. The calculated pressures and temperatures follow a continental geotherm. The f_{O_2} from olivine-orthopyroxene-spinel is from 1.3 log units above to 0.6 log units below EMOD (enstatite-magnesite-olivine-diamond), suggesting that diamond may or may not be stable relative to carbonates.

A MORID vein (mica-orthopyroxene-rutile-ilmenite-diopside±chromite) in a garnet-spinel lherzolite is characterized by high K, Fe, Ti and OH components. A method (referred to as RI) is developed to calculate oxygen fugacity from rutile-ilmenite for a MORID or similar suite with the reaction $2Fe_2O_3$ (in ilmenite) + $4TiO_2$ (rutile) = $4FeTiO_3$ (in ilmenite) + O_2 . The RI is applicable to many rutile-ilmenite-bearing assemblages.