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Mantle deep carbon recycling by the Pacific plate subduction: evidence from mantle xenoliths in NE China

PENGTAO XU[1], JIE TANG[1], WENLIANG XU[1,2] AND FENG WANG[1]

[1]College of Earth Sciences, Jilin University

[2]Key Laboratory of Mineral Resources Evaluation in Northeast Asia, Ministry of Natural Resources

Presenting Author: 2372776744@qq.com

The mantle deep carbon recycling and its geodynamic effects have been the subject researched by earth science. NE Asia, as the key region affected by the Pacific plate subduction, is ideal site to study mantle deep carbon recycling and its geodynamic effects. The wehrlite and pyroxenite xenoliths occurred within the Cenozoic alkaline basalts from Yitong and Shulan areas, NE China, provide new insights into the mantle deep carbon recycling.

Mantle xenoliths in Shulan area comprise spinel lherzolite and wehrlite, as well as rare spinel harzburgite. High $Mg^{\#}$ (90-91) of olivine and orthopyroxene in harzburgites indicate they are residual phases after partial melting of mantle. According to geochemistry of clinopyroxenes, lherzolites can be divided into two groups. The clinopyroxenes in Group 1 are obviously enriched in LREE and Sr, and depleted in HREE and HFSE with high Ca/Al ratios and $^{87}Sr/^{86}Sr$ ratios (0.70345-0.70403), indicating that a carbonatite melt metasomatism happened after partial melting of lithospheric mantle, which is also supported by the fact that lherzolite was replaced by wehrlite. The clinopyroxenes in Group 2 are depleted in LREE and relatively enriched in HREE with insignificant Nb, Ta, Zr and Hf depletions, indicating that they are residual phases after partial melting and a silica-eriched metasomatism took place.

Mantle xenoliths in Yitong area comprise of peridotite, wehrlite, olivine-bearing clinopyroxenite, olivine-bearing orthopyroxenite, and websterite. The olivines in these xenoliths have low $Mg^{\#}$ values (78-86), indicating their cumulate origin. Based on the geochemistry of clinopyroxenes, pyroxenites can also be subdivided into two groups. The clinopyroxenes in Group 1 display convex-upward REE patterns and weak depletions in HFSE. The clinopyroxenes in Group 2 are enriched in LREE, and depleted in HREE and HFSE. Clinopyroxenes from two groups have relatively high $^{87}Sr/^{86}Sr$ ratios (0.70364-0.70488), and fall into the carbonate metasomatism area in the Ti/Eu-$(La/Yb)_N$ diagram.

Taken together, we conclude that carbonatite metasomatisms occurred in lithospheric mantle from Yitong and Shulan areas, NE China, implying occurrence of mantle deep carbon recycling related to the Pacific plate subduction beneath NE Asia.

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