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Thermal structure beneath Northeast China recorded in mantle xenoliths

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Back-arc areas have not attracted many researchers studying magmatism or heat flux. In Northeast China, however, there exists Cenozoic volcanism. If a long-term or a large-scale magmatism exists in such back-arc areas, both global heat flux and material circulation system in the Earth should be reconsidered with their effects. Such a significant magmatic activity can cause thermal disturbance in the lithosphere. We therefore studied lithospheric thermal structure in the area.

We estimated thermal structure using equilibrium temperatures and pressures recorded in mantle-derived peridotite (or spinel-lherzolite) xenoliths sampled in the Liaoning Kuandian volcanic field, Northeast China. Determination of residual density of CO_2 fluid inclusions in the xenoliths allowed us to estimate equilibrium pressures of spinel lherzolites, to which no petrological geobarometer have been applied before. Equilibrium temperatures and original depths obtained from five xenoliths are about 1000 degree Celsius and 30-40 km, respectively. This temperature and pressure conditions correspond to 110 - 140 mW/m^2 in heat flow. In contrast, Huang and Xu (2010, Journal of Earth Science) reported the heat flow of the area to be about 70 mW/m^2, based on P-T estimates using garnet pyroxenites whose original depths are 50 - 60 km. We suggest the higher heat flow in the shallow lithospheric mantle. This requires the existence of a high temperature area near the Moho discontinuity, suggesting a long-term magma activity in the uppermost mantle beneath the area. If such a long-existing magmatic activity is common in the back-arc areas, the areas have significant influences on global heat balance and thermal history.

Keywords: back-arc, geotherm, heat flow, Northeast China, mantle xenolith, fluid inclusion