Acta Geologica Sinica (English Edition), 2019, 93(supp.2): 45–46

Petrogenesis of the Triassic Intrusive Rocks in the Liaodong Peninsular, NE China: Constraints from Geochronology and Geochemistry

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Citation: Quan et al., 2019. Petrogenesis of the Triassic Intrusive Rocks in the Liaodong Peninsular, NE China: Constraints from Geochronology and Geochemistry. *Acta Geologica Sinica* (English Edition), 93(supp.2): 45–46.

Abstract: This paper carries out new whole-rock Major and trace elements, Sr-Nd isotopic, zircon U-Pb and Hf-O isotopic data for Late Triassic intrusive rocks of the Yinjian (YJ) syenite, Laojiandingzi (LJDZ) hornblende gabbro, Shuangdinggou (SDG) monzogranite and lamprophyre and Xiongdishan (XDS) syenogranite (Fig. 1), hornblende diorite and hornblende gabbro in the Liaodong Peninsular, NE China, aiming to constrain their petrogenesis and beginning age of lithospheric thinning of the northeastern North China Craton (NCC). New zircon laser-ablation inductivity coupled plasma mass spectrometry (LA–ICP –MS) U–Pb data indicate that the mafic rocks were emplaced during the Late Triassic (220 ~ 215 Ma), the alkaline rocks were emplaced during the Late Triassic (219 Ma), the granitic rocks were emplaced during the Late Triassic (219 ~ 211 Ma). The mafic rocks show relatively low SiO_2 (48.67 ~ 59.57 wt.%) and high MgO (2.62 ~ 7.31 wt.%) concentrations, with relatively high $\varepsilon_{Hf}(t)$ (-15.5 ~ 1.50) and $\delta^{18}O$ (7.06 ~ 7.82 ‰), indicating they were formed by the partial melting of lithospheric mantle with different extent involvement of continental crust materials. The alkaline rocks display intermediate SiO_2 (63.33 ~ 65.55 wt.%), high Na_2O+K_2O contents (12.22 ~ 13.22 wt.%) and low MgO (0.12 ~ 0.28 wt.%) concentrations. They show intermediate $(^{87}Sr/^{86}Sr)_i$ (0.7064 ~ 0.7073), $\varepsilon_{Nd}(t)$ (-14.53 ~ -14.79), $\varepsilon_{Hf}(t)$ value (-5.70 ~ -11.7) values and relatively low $\delta^{18}O$ value (5.49 ~ 6.37) values, together with their whole-rock geochemical characteristics, indicating they were originated from the partial melting of enriched lithospheric mantle metasomatized by melt melted by lower crustal material accompanied by the strongly fractional crystallization. In contrast, the granitic rocks possess relatively high SiO_2 (69.07 ~ 78.01 wt.%), Na_2O+K_2O (7.96 ~ 9.28 wt.%) and low MgO (0.11 ~ 0.89 wt.%) contents. They show two different kinds of isotopic data: the monzogranites relatively high $(^{87}Sr/^{86}Sr)_i$ (0.7085 ~ 0.7087), relatively low $\varepsilon_{Nd}(t)$ (-16.81 to -17.02), $\varepsilon_{Nd}(t)$ (-8.14 ~ -8.98), $\varepsilon_{Hf}(t)$ (-17.9 ~ -14.4), relatively high T_{DM2} model ages of 2165 ~ 2385 Ma and intermediate $\delta^{18}O$ (6.10 ~ 6.95 ‰) values; the syenogranites

Fig. 1. Representative field photographs of Late Triassic rocks within the Liaodong Peninsular.

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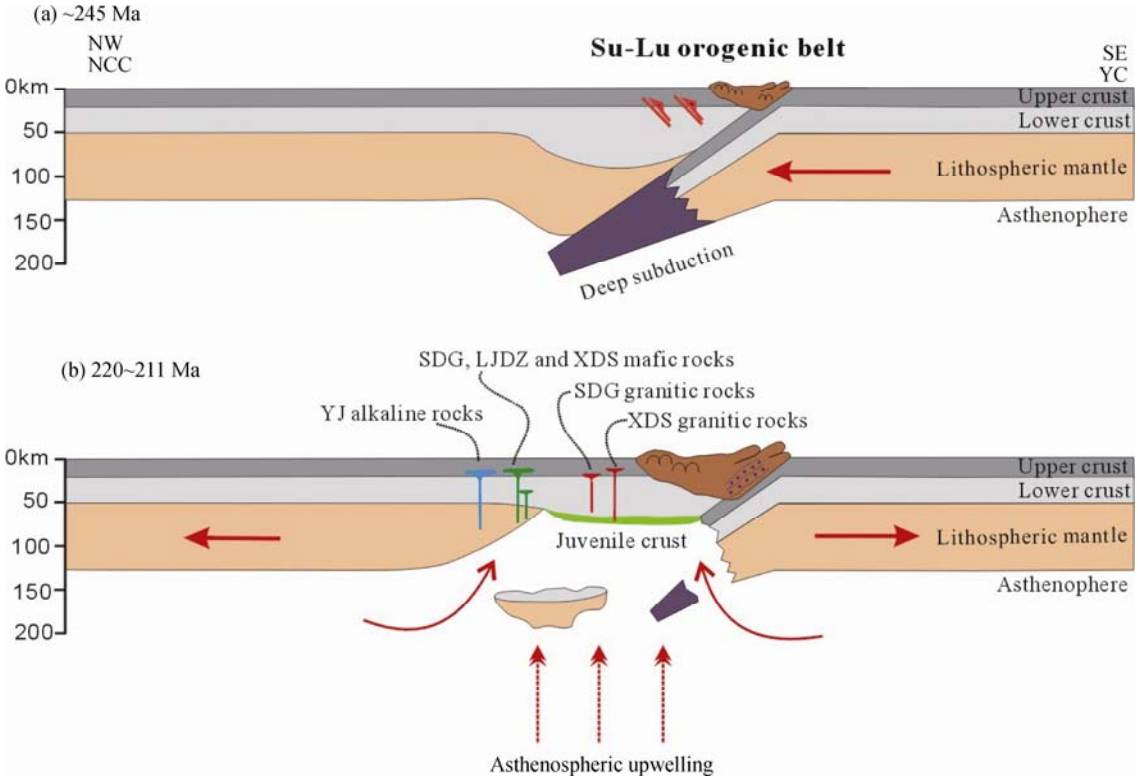

Fig. 2. Schematic illustration showing the collision and exhumation of the North China Craton (NCC) and Yangtze Craton (YC), accompanied by melting of upwelling asthenosphere and delamination of lithosphere.

have relatively high $\varepsilon_{Nd}(t)$ (-8.14 ~ -8.98), $\varepsilon_{Hf}(t)$ (-3.40 to +1.20) values, relatively low T_{DM2} model ages of 1180 ~ 1405 Ma and relatively low $\delta^{18}O$ (5.52 ~ 7.29 ‰) values, indicating that the monzogranites were derived from partial melting of ancient lower crust with relatively high extent contamination of mantle derived materials and syenogranites were derived from partial melting of juvenile lower crust. According to zircon U-Pb ages, geochemical data, Sr-Nd-Hf-O isotopic data and regional investigations, we conclude that the generation of the late Triassic intrusive rocks in the Liaodong Peninsular were most likely related to the collision between NCC and Yangtze Craton and the first exhumation of the subducted slab (Fig. 2). In addition, the collision is the inducing factor for the lithospheric thinning of the northeastern NCC and that the lithospheric thinning began at Late Triassic.

Key words: Petrogenesis, Lithospheric thinning, Continental collision, Late Triassic, North China Craton

Acknowledgements: This work was financially supported by the National Key R&D Program of China (2016YFC0600103), the Natural Science Foundation of China (41722204), and the research grant of State Key Laboratory of Isotope Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences (SKLaBIG-KF-18-06), the basic Scientific Research Foundation of Central Universities of China (Jilin University).

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