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# Geochronology and Petrogenesis of Mesozoic Granitoids in the Geological Corridor of Western Liaoning Province, China

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## 1 Abstract

The geological corridor of Western Liaoning province is an area of length 100 km and width 20 km and located in the eastern segment of northern margin of North China Craton (NCC), with the wide distribution of Mesozoic granitic magmatism. It is the ideal area to study the granitic petrogenesis, the nature of magma source and the tectonic attribute. In this paper, we do the systematic researches about the petrology, geochronology, geochemistry and Zircon Hf isotopic of granitic rocks. Based on the mentioned above, we have built the geochronological framework and have discussed the petrogenesis, the nature of magma source and the tectonic setting of granitic rocks. And according to the information about the crust-mantle interaction recorded in granitic rocks and the regional data, we also discuss the relationship between Mesozoic granitic magma activities and lithosphere thinning, destruction of Craton mechanism in the eastern segment of northern margin of NCC.

The Mesozoic granitic magma activities in The geological corridor of Western Liaoning province are divided into four stages (Fig. 1): Late Triassic (230 Ma～228 Ma), early-middle Jurassic (194 Ma～169 Ma), Late Jurassic (161 Ma～155 Ma) and Early Cretaceous (139 Ma～121 Ma).

The late Triassic granitic rocks are composed of adamellite, monzogranite and diorite. The samples have high Sr, Cr, Ni content and low Yb, Y content, and the sample have high $Mg^{\#}$ and high ratio of Sr/Y and La/Yb. The characteristics of inhomogenous negative value of $\varepsilon_{Hf}(t)$ (-6.40～+0.19) in magmatic zircons and ancient crustal TDM2 values of 1.25 Ga～1.67 Ga(Fig. 2), indicate that the Triassic granitic rocks were formed in a post-collisional extensional tectonic setting after subduction of Paleo-Asian Ocean and the subduction of Yangtze Craton, and they are the product of partial melting of ancient lower crust under the condition of the mantle-derived magma underplating, and geochemical features of the high Sr and low Y are inherited from the source of magma which is also enriched in Sr and depleted in Y.

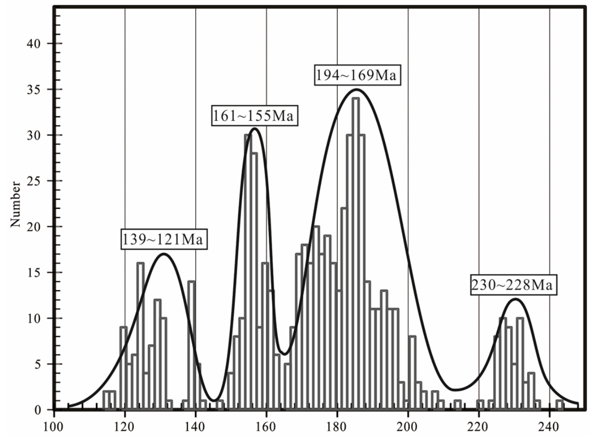


Fig. 1. Zircon U-Pb ages of Granitoids rock in The geological corridor of Western Liaoning province.

The geochemical features and assemblages of rocks formed during Jurassic-early Cretaceous are similar. The early-middle Jurassic granitic rocks are composed of syenogranite, monzogranite, quartz monzonite, granitic porphyry, granodiorite and quartz diorite. The late Jurassic granitic rocks are composed of monzogranite, granitic porphyry, and quartz diorite. The early Cretaceous granitic rocks are composed of monzogranite, quartz syenite, granitic porphyry, and quartz monzodiorite. The samples are characterized by the high $SiO_2$ content and total alkalis and are belonged to the high-K calc-alkaline series. And the characteristics of quasi-aluminous to weakly peraluminous (A/CNK＜1.1,

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A/NK＞1.0) and the negative relationship between $P_2O_5$ and $SiO_2$ are similar to the characteristics of I-type granite. The samples are enriched in LREE contents and K, Pb and depleted in Nb, Ta, Ti and P. The characteristics of assemblage and geochemical features indicate the Jurassic-Cretaceous granitic rocks formed in the setting of active continental margin related to the subduction.

The magmatic zircons of early-middle Jurassic granitic rocks have negative $\varepsilon_{Hf}(t)$ (-16.60～-4.15) and ancient crustal TDM2 values of 1.49 Ga～2.28 Ga which indicates the primary magma is from the partial melting of ancient middle-lower crust(Fig. 2). These rocks formed in the setting of active continental margin of subduction of Paleo-Pacific plate. The magma source of granitic rocks is from partial melting of the ancient lower-middle curst caused by the underplating of mantle magma, which formed in the condition of fluid derived from the dehydration of subducted slab affected on the lithosphere mantle.

The magmatic zircons of late Jurassic granitic rocks have negative $\varepsilon_{Hf}(t)$ (-26.24～-18.56) and ancient crustal TDM2 values of (2.39 Ga～2.87 Ga) which indicates the primary magma is from the partial melting of ancient upper-middle crust (Fig. 2). And these rocks may be formed in the setting of active continental margin of intense subduction of Paleo-Pacific plate. In the intense subduction, the mantle magma is formed in the interaction of fluid derived from the dehydration of subducted slab with the lithosphere mantle, then further underplated the ancient middle-upper crust and make the ancient middle-upper curst partial melting. In this setting, the late Jurassic rocks are distributed widely in eastern North China.

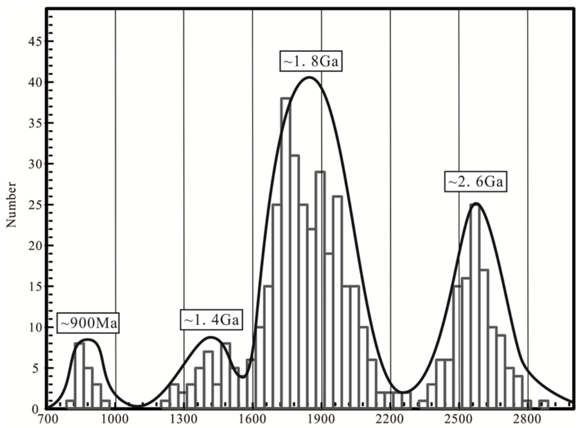


Fig. 2. Zircon Hf isotopic two-phase model age (TDM2) frequency diagram of Granitoids rock in The geological corridor of Western Liaoning province.

The samples in early Cretaceous have a wide range of values of Hf isotope: -24.92～-20.88 (139 Ma), -4.72～+6.22 (130 Ma), -17.30～-11.56 (125 Ma～121 Ma), and the characteristics of Hf isotope indicate the source of early Cretaceous magma (middle-upper crust, middle-lower crust or juvenile crust) is very complicated (Fig. 2). The early Cretaceous granitic rocks were formed in the lithosphere extensional environment when the Paleo-Pacific plate subducted/roll-backed quickly in the direction of NNW with high angle. The regional extension made the asthenosphere upwell and be unstable, and the magma of mantle was formed. Then wide mantle-crust interactions make the crust partial melt, as a result, the source of early Cretaceous igneous rocks which are distributed widely in eastern North China Craton.

The participation of depleted mantle components in the process of Late Triassic rock formation in western Liaoning area indicate the time of the lithosphere thinning in the eastern segment of northern margin of NCC begin from the late Triassic (～230 Ma). The double subduction of Paleo-Asian Ocean and Yangtze Craton in the early period is the reason of the lithosphere thinning. After the double subduction, the mantle-derived magma upwell and underplate the lithosphere mantle and lower crust in a post-collisional extensional tectonic setting. As a result, the lithosphere began to thin but the Craton destruction was not obviously in this period. The participation of depleted mantle components makes the continental crust slightly reforms and grows. The eastern segment of northern margin of NCC was in the setting of active continental margin in Jurassic, and the continuing dehydration and metasomatism of subduction slab changed the physical and chemical properties of the lithosphere mantle. The initial weak subduction in early-middle Jurassic makes the lithosphere become thin but no obvious destruction of Craton. And in this period, the continental crust reformed and grew slightly. As the subduction became stronger during late Jurassic, the thickness of lithosphere in eastern segment of northern margin of NCC become thinner and the destruction of Craton occurred locally and the continental crust reformed and grew to some extent. In early Cretaceous, the change of direction and angle of subduction of Paleo-Pacific led to the regional extension, which is the reason for massive mantle material upwelling and intense crust-mantle interaction. And the lithosphere thinning and destruction of Craton reached the peak. As a result, the effects of reconstruction and hyperplasia of continental crust are obviously. In our opinions, the underplating mechanism of mantle-derived magma occurred mainly in the initial stage (early Mesozoic) of lithosphere thinning, and the delamination of lithosphere mantle or lower crust coexisted while erosion action of mantle material occurred in the stage (late Mesozoic) of strong lithosphere thinning and destruction of Craton.

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