Petrogenesis and significance of the Mesozoic North Taihang complex: Major and trace element evidence

CHEN Bin (陈斌)1,2, ZHAI Mingguo (翟明国)2 & SHAO Ji’an (邵济安)1

1. Key Laboratory of Orogenic Belts and Crustal Evolution, Department of Geology, Peking University, Beijing 100871, China;
2. Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China
Correspondence should be addressed to Chen Bin (email: bchen@geoms.goo.pku.edu.cn)

Received July 31, 2002

Abstract The Mesozoic North Taihang complex consists mainly of intermediate rocks and leucogranites as well as minor, synplutonic enriched-mantle derived mafic rocks. The intermediate rocks show high-K calc-alkaline affinity, and high Sr (and Ba) and La/Yb ratios with negligible Eu anomalies, but are low in Y; these signatures are shared by the mafic rocks. The intermediate rocks were probably produced by magma mixing between the evolved enriched-mantle derived mafic magma and a crustal granitic magma, followed by fractional crystallization. The leucogranites show high SiO2 and low ferromagnesian contents; they probably represent residual melts produced from fractional crystallization of the intermediate rocks. Therefore, the North Taihang complex represents significant addition of juvenile crust in the Mesozoic. Mobilized by an upwelling asthenosphere, enriched portions of subcontinental lithospheric mantle experienced partial melting and were consumed significantly, resulting in the intensive magmatism within the North China Craton (NCC). This process is possibly an important mechanism responsible for the lithosphere thinning beneath the NCC. Although the Taihang (and the whole eastern China) granites display rare earth patterns similar to adakites, they appear to have no genetic link with the latter. The model of “eastern plateau” proposed by some authors is not supported by our new data for the Taihang rocks.

Keywords: Taihang, Mesozoic complex, geochemistry, lithosphere thinning.

DOI: 10.1360/02yd0447

The intensive Mesozoic magmatism in the North China Craton (NCC) has drawn great attention for its particular geochemical signatures (e.g. high-K), petrogenesis and tectonic setting. The North Taihang complex represents the westernmost magmatic belt of the NCC. Previous studies for the Taihang rocks were confined to petrology[1,2], and research of geochemistry for these rocks is limited, which prevents comprehensive understanding to how they were produced. The Taihang magmatism has high-K calc-alkaline affinity that is shared by magmatism in other parts of the NCC[3-5]. This signature is interpreted by many workers as being related to intra-continental extension[6-9], although others related it to subduction of the Pacific plate beneath the eastern China block in Mesozoic times. More recently, the Mesozoic granites of the NCC (including those of Taihang) were considered adakites, produced by melting of mafic lower crust under conditions of thickened continental crust[10,11]. Apparently, the origin of the Taihang (and the whole NCC) igne-
ous rocks is still a debatable issue. We report in this paper new geochemical data for the Taihang rocks, aiming at investigating their origin, tectonic setting and implications for the Mesozoic magmatism of the whole NCC as well.

1 Regional geology and petrological descriptions

The north Taihang complex contains mainly Wang’an and Dahrenan plutons which were emplaced into the Precambrian rocks (fig. 1). Broadly, the Taihang rocks fall into three categories: mafic rocks, intermediate rocks and leucogranites. The mafic rocks, mostly gabbroic diorites and diorites in composition, are minor, with predominant plagioclase, pyroxene and hornblende, and minor olivine. The middle- to coarse-grained intermediate rocks predominate the Taihang complex, including quartz diorite, granodiorite, quartz monzonite, monzogranite and hornblende syenite. They are characterized by the presence of mafic enclaves and hornblende, and porphyritic plagioclase and K-feldspar as well. The leucogranites are subordinate but widespread (fig. 1), and the cross-cut relationship indicates that they are the youngest of the Taihang complex. The leucogranites are chemically homogeneous (mainly granites and K-feldspar granites), and are distinguished from the intermediates by the absence of mafic enclave and hornblende. Mafic enclaves are centimeters to tens of centimeters in size, fine-grained (occasionally porphyritic), and show lobate to cuspat e contacts against the host rocks. These pieces of evidence suggest that mixing between mafic and felsic magmas may have been important during the genesis of the Taihang rocks. This paper is further to the above petrological research, carrying out elemental geochemistry to study the petrogenesis and implications of the Taihang complex.

2 Analytical methods and sampling

Sampling covers all rock types (see fig. 1 for localities). Chemical analyses were done in the