Geochemistry of Granitoid Rocks and Crustal Evolution, Zhejiang Province, China—Ⅱ. Proterozoic Granitoid Rocks *

**WANG YIXIAN (王一先), ZHAO ZHENHUA (赵振华), BAO ZHIWEI (包志伟), AND LI XIANHUA (李献华)**

*(Guangzhou Institute of Geology, Chinese Academy of Sciences, Guangzhou, 510640)*

**Abstract:** Proterozoic granitoid rocks in Zhejiang Province were formed in the Shengongian period (1.8–1.9 Ga) and the Late Jinningian period (0.6–0.9 Ga), respectively. Petrogenetic problems are discussed based on chemical (major, trace elements and REEs) and Nd-Sr isotopic compositions. The Shengongian granites resulted from partial melting of the Badu Group and the Late Jinningian granites are of mafic derivation with or without contamination of crustal material. The crust in Zhejiang had undergone three major periods of growth during 2.6–2.7 Ga, 0.8–1.1 Ga and 0.10–0.12 Ga after it was generated in Archean time. Compositional fractionation in the process of crust evolution is not evident. The presence of Late Jinningian granites of mantle- and mantle-crust-derivation along the Jiangshan-Shaoxing Fault is indicative of crust subduction at that time.

**Key words:** Proterozoic granitoid rock; major element; trace element; REE; isotope; crustal evolution

Petrochemistry of the Proterozoic Granitoid Rocks

**The Shengongian granites**

Granites of the Shengongian period are distributed around Longquan and Suichang in Zhejiang Province. The Dazhe tonalite in Suichang has a zircon U-Pb concordia age of 1800 ± 44 Ma (2σ and hereafter, Table 1) and a Pb-Pb isochron age of 1810 ± 21 Ma (Fig. 1). The available U-Pb ages for the Longquan mass are 1878 Ma (the Danzhu tonalite, Hu Xiongjian et

<table>
<thead>
<tr>
<th>Sequence No.</th>
<th>Sample description</th>
<th>Concentration ((\times 10^{-6}))</th>
<th>Isotopic ratio</th>
<th>Apparent age (Ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>U</td>
<td>Pb</td>
<td>(^{206})Pb</td>
</tr>
<tr>
<td>1</td>
<td>&lt;100 mesh, short-prismatic</td>
<td>145.94</td>
<td>58.60</td>
<td>353.0</td>
</tr>
<tr>
<td>2</td>
<td>&gt;100 mesh, tabular</td>
<td>141.19</td>
<td>55.13</td>
<td>358.5</td>
</tr>
<tr>
<td>3</td>
<td>&lt;100 mesh, long-prismatic</td>
<td>162.87</td>
<td>65.26</td>
<td>1339</td>
</tr>
<tr>
<td>4</td>
<td>&gt;100 mesh, long-prismatic, euhedral</td>
<td>142.48</td>
<td>54.63</td>
<td>896.1</td>
</tr>
</tbody>
</table>

Pb-Pb isochron age: 1810 ± 21 Ma, concordia age: 1800 ± 44 Ma

**Note:** Analyzed at the Guangzhou Institute of Geology, Chinese Academy of Sciences, with the precision being 0.02% - 0.04%.

ISSN 1000-9462

* This project was finanally supported by both the National Natural Science Foundation of China (No. 9490011) and the Zhongguancun Test Center.
al., 1991), 1889 Ma (the Quankengyan monzonitic granite, Hu Xiongqian et al., 1992), 1975 ± 80 Ma (the Xiaji monzonitic granite) and 1870 ± 36 Ma (the Lizhuang monzonitic granite, Gan Xiaochun et al., 1995).

The Shengongian granitoid rocks have a considerable range in major element composition (Table 2), and can be classified as tonalite, granodiorite, monzonitic granite and alkali-granite according to the Streckeien's scheme. Transitional elements (V, Cr and Co) are enriched by a factor of 1 − 3 over normal granites. On the other hand, the concentrations of incompatible elements are low and Rb, Ba and Nb are close to or lower than the average abundances in the granites (Table 3). The REE distribution patterns are characterized by right-inclined straight lines with highly variable LREE/HREE and δEu (Table 4).

Fig. 1. Zircon Pb-Pb isochron of the Dazhe tonalite. Pb-Pb isochron age: (1810 ± 21) Ma.

Fig. 2. The REE distribution patterns in the Proterozoic granitoid rocks, Zhejiang. (a) Shengongian granites; (b) Late Jinningian intermediate-acid rocks.

Intermediate-acid rocks of the Jinningian period

Intermediate-acid intrusions of the Late Jinningian period are distributed along the Jiangshan-Shaolong Fault and in the border area between Zhejiang and Anhui. In Xiqiu, Taohong and Daolinshan they intruded into the Shuangxiwu Group. In Huangshan and Dachengwu they intruded into the Chencai Group. Among the other rock bodies, the Luojia mass is found intruding into the Badu Group, and the Lianhuashan mass into the late Proterozoic Jingtang Formation and is transitional to granite porphyry and rhyolite. The Xiqiu quartz diorite has a whole-rock Rb-Sr isochron age of 852.6 ± 17.8 Ma (Qi Qu et al., 1986). The K-Ar age of