Gold Abundance of Japanese Plutonic Rocks:  
A Preliminary Result

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Yuko SAITO** and Yoshimitsu HIRAO**

Abstract: Eleven gabbroids and two granitoids were analyzed by NAA method. Magnetite-series gabbroids have  
generally higher values (range, 0.4-5.3 ppb Au; average, 1.8 ppb Au) than the ilmenite-series gabbroids (range 0.2-  
0.6 ppb Au; average, 0.4 ppb Au); the result consistent with that observed on granitoids (ISHIHARA, KIMURA , et al.,  
1985). The gold contents depend upon the bulk composition being low in the gabbroids and high in felsic granitoids:  
the average contents are 1.1 ppb Au in gabbro, 2.4 ppb Au in diorite-tonalite, 3.0 ppb Au in granodiorite and 3.8  
ppb Au in granite. Gold deposits tend to occur in the magnetite-series plutonic terranes, indicating a genetic relation-  
ship with the magmatism.

Introduction

Abundance of gold in fresh igneous rocks is  
very little known in Japanese Islands. Only a  
few analyses have been reported even on the  
standard rock samples prepared by the  
Geological Survey of Japan as follows (AYABE  
et al., 1980):

JA-1 Tholeiitic andesite: 0.09 ppb Au,  
Hakone, Manazuru
JB-1 Alkaline basalt: 0.85 ppb Au, Kitamatsuura, Sasebo
JB-2 Tholeiitic basalt: 7.2 ppb Au, Mihara-  
yama, Oshima.

We have examined by neutron activation  
method (NAA) twenty-four samples of repre-  
sentative granitoids from three magnetite-  
series and three •ilmenite-series granitic ter-  
rannes in the Japanese Islands (ISHIHARA,  
KIMURA et al., 1985). The results indicated that  
the magnetite-series granidoids contained  
more gold (average 4.3 ppb Au) than the il-  
menite-series ones (average 2.5 ppb Au),  
which was considered due to higher amount of  
magnetite in the former series than in the lat-  
ter series of granitoids. The second contribu-  
tion was that the gold content increased with  
the increasing of silica content within the  
range of 61-76 percent. This conclusion is  
different from that drawn by GOTTFRIED et al.  
(1972) who suggested a decreasing tendency of  
gold content from gabbroid to felsic granitoid  
in the major batholiths of western United  
States of America.

In this paper, we examined eleven gabbroids  
from major granitic terranes and two  
granitoids from the Hidaka ilmenite-series  
belt by the method described by SAITO et al.  
(1984). In combining the previous and the pre-  
sent data together, gold abundance of the  
Japanese plutonic rocks will be summarized in  
this short communication.

Samples

Major plutonic belts of the Japanese Islands  
are illustrated with their ages in Figure 1. The  
studied gabbroids occur generally as  
xenolithic bodies, several to 10 km in  
diameter, in granitic batholiths. They are in-  
truded by granitoids of similar ages; thus are  
earlier intrusions in the plutonic sequences  
and their margins are often assimilated by the  
surrounding granitoids. The analyzed samples  
were taken from the core portion in each
body, which has least heat effect of the later granitic intrusions.

Quartz diorite (75KO32) from Yamanashi, on the contrary, is the latest intrusion in the Kofu batholith. Gabbroids from Kumohara of the Sanin Belt and Hidaka belt of Hokkaido are also independent intrusion from the nearby granitic bodies.

Analytical Results

The analytical results are listed with some other related components in Table 1. Magnetite-series gabbroids range from 0.4 to 5.3 ppb Au and the average is 1.8 ppb Au. Ilmenite-series gabbroids, on the other hand, are always low as 0.2–0.6 ppb Au and are averaged as 0.4 ppb Au. Thus the results are consistent with the previous ones on the granitoids that the magnetite-series contains more gold than the ilmenite-series.

Two granitoids from the Hidaka ilmenite-series belt which was not examined in the previous study has very low contents of 0.2 and 0.4 ppb Au. The contents are much lower than those (1.2–4.8 ppb Au) of the Outer Zone granitoids of Southwest Japan, which occur in the same fore-arc tectonic setting.

Gold vs. Silica Contents

The gold contents are plotted against silica contents in Figure 2. The gold contents increase generally with the increasing of silica contents in the magnetite-series Sanin, Kitakami and Green Tuff Belts, and the ilmenite-series Sanyo Belt and Outer Zone of Southwest Japan and slightly in the ilmenite-series Ryoke Belt. The gold contents are consistently low in the ilmenite-series Hidaka Belt.

Average gold contents of the studied plu-
Gold abundance of Japanese plutonic rocks

Table 1 Gold content and selected other components of representative gabbroids from Japan

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Locality</th>
<th>Rock Type</th>
<th>SiO₂ (%)</th>
<th>Au (ppb)</th>
<th>Cu (ppm)</th>
<th>S (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SANTIN</td>
<td>(Magnetite series)</td>
<td>Pyroxene-hornblende gabbro</td>
<td>46.8</td>
<td>5.3±0.7</td>
<td>180</td>
<td>670</td>
</tr>
<tr>
<td>HH239</td>
<td>Neu, Tottori</td>
<td>Pyroxene-hornblende-biotite gabbro</td>
<td>47.3</td>
<td>1.0±0.3</td>
<td>92</td>
<td>5100</td>
</tr>
<tr>
<td>651120</td>
<td>Zakka, Shimane</td>
<td>Hornblende quartz gabbro</td>
<td>51.7</td>
<td>0.6±0.4</td>
<td>32</td>
<td>1070</td>
</tr>
<tr>
<td>73M23</td>
<td>Kumohara, Kyoto</td>
<td>Pyroxene-hornblende-biotite quartz gabbro</td>
<td>54.0</td>
<td>1.7±0.2</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>GREEN TUFF</td>
<td>(Magnetite series)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75K032</td>
<td>Tokuwa, Yamanshi</td>
<td>Hornblende-biotite quartz diorite</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Constitutive rocks are calculated in four composition-al divisions of gabbro, diorite-tonalite, granodiorite and granite in Table 2. The contents become higher in the felsic plutonic rocks as 1.1, 2.4, 3.0 and 3.8 ppb Au, respectively, although the more mafic in composition, the richer in gold in those of western United States (GOTTFRIED et al., 1972).

Relationship to Gold Deposits

Almost all the economically significant gold deposits of Japan occur in magnetite-series igneous terranes (ISHIHARA, 1978). The gold mineralization is outstanding in the inner side of the Japanese Islands related to the late Mesozoic-Cenozoic plutonic rocks of Japan and western U.S.A.

Table 2 Comparison of gold abundance in ppb of Mesozoic-Cenozoic plutonic rocks of Japan and western U.S.A.

<table>
<thead>
<tr>
<th>Rock Type</th>
<th>Japan</th>
<th>Western U.S.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range (n)</td>
<td>Average</td>
</tr>
<tr>
<td>Gabbroids</td>
<td>0.2-5.3(10)</td>
<td>1.1</td>
</tr>
<tr>
<td>Diorite-tonalite</td>
<td>0.4-5.8(4)</td>
<td>2.4</td>
</tr>
<tr>
<td>Granodiorite</td>
<td>0.2-6.1(13)</td>
<td>3.0</td>
</tr>
<tr>
<td>Granite</td>
<td>0.4-7.1(10)</td>
<td>3.8</td>
</tr>
</tbody>
</table>

The Japanese data taken from this study and also ISHIHARA, KIMURA et al. (1985) and the U.S.A. data from GOTTFRIED et al. (1972).

Cenozoic Green Tuff igneous activity in Northeast Japan and similar magmatism in...
Kyushu Island. These terranes are too young to expose plutonic rocks in batholithic dimensions, except for the Fossa Magna region. The gold mineralization appears to be genetically connected with the subvolcanic (ISHIHARA et al., 1986), hence ultimately plutonic activities of these terranes.

In the Kitakami Mountains, many gold-scheelite type deposits are distributed close to the Cretaceous plutonic bodies. Gold deposits are poorly seen in the magnetite-series Sanin Belt where high level parts of the granitoids have been eroded out. In the ilmenite-series terranes, some gold occurs in ore deposits of volcano-plutonic terranes of the late Cretaceous Sanyo Belt and Miocene Outer Zone of Southwest Japan. However, none of gold deposits has been known in the Cretaceous Ryoke Belt and Tertiary Hidaka Belt, where the trace amount of gold is minimum.

These observations would indicate the relationship between the trace amount of gold in magmatic rocks and gold mineralization. Like the case of tin mineralization (ISHIHARA, 1978), felsic magma which is capable to form gold deposits would have higher concentration of gold in both their magmatic and deuteric processes than those unrelated to the mineralization.

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**References**


