PETROCHEMICAL BEHAVIOUR OF AN ACIDIC–BASIC CONTACT ZONE

RANADHIR MUKHOPADHYAY
Department of Geology, Calcutta University,
Calcutta 700 019, India
Present address: National Institute of Oceanography, Dona Paula, Goa 403 004, India

The study area is about 30 km south of Purulia, West Bengal and represents the northeastern extension of the Archaean plateau of Chotanagpur granite gneiss\(^1,2\). Rocks in this area comprise mica schist, amphibolites, different types of granitoid rocks, migmatites and intrusive dolerites\(^3\). These intrusives are considered to be a part of Newer Dolerites of Singhbhum and range in age between 1100 and 950 m.y.\(^4\) The thermal history of these intrusives is complicated. The intrusives have undergone metamorphism in some places. Petrochemical changes in the characters of the country rock as well as those of the contact zone due to dolerite intrusion have been studied and presented here.

The area is flat, with gentle undulations. The host rock of the area, tonalite gneiss, is overlain unconformably by the Gondwana sediments\(^5\), and grades imperceptibly into granodiorites and quartz–diorite towards north and south respectively (figure 1). Two phases of structural deformations are distinct. The first phase has isoclinal folded the country rock with an east–west trending axial plane. A second episode of folding produced minor open folds on the foliation plane, with axes plunging at 45° towards 305°.

Tonalite consists of plagioclase, microcline, quartz, biotite, hornblende, sphenite, epidote, allanite, apatite, opaques and muscovite. The plagioclase feldspar appears to be of two generations: the younger generation ones are generally fresh, subhedral and vary in composition from An 27 to An 42 (andesine), whereas the early generation plagioclase (more calcic, An 30 to An 51) are commonly unwinned, small-sized, anhedral and slightly altered. Albite rim along the contact of plagioclase and microcline and allanite at the core of epidote are present. Biotite was in some places found to have replaced hornblende, as evidenced by the concomitant development of other minerals such as sphenite, epidote, apatite and quartz.

The central part of the intrusive sill is medium-

---

Figure 1. Geological map of the study area. + +, Tonalite gneiss; • • •, granodiorite; \||\, mica schist; ← ← ←, quartz diorite; Δ Δ, amphibolites; ← dolerite.
grained, and has cloudy and twinned plagioclase (An 63), and shows typical intergranular and ophitic texture. Fine, equant hornblende grains are found coronated along their outer periphery, by pyroxene and almandine garnet, in that order (figure 2).

Rocks along the contact zone are fine-grained and show evidence of intense crushing. Occurrence of crushed pyroxene (augite) within the bent polygonized plagioclase can be interpreted to have been mechanically derived from the peripheral crushed pyroxene granules during deformation. Scapolite might have been formed due to the alteration of plagioclase feldspar under a condition of shearing and temperature difference.

Chemical analyses show (table 1) a decrease in SiO₂, TiO₂, Fe₂O₃, FeO, K₂O and P₂O₅, and an increase in Al₂O₃, MnO, CaO and Na₂O in rocks from the contact zone compared to tonalite gneiss, indicating basification of the acid country rock as a result of intrusion. Release of Na, Ca and Mg from the dolerite body possibly facilitated the formation of more hornblende and augite in the contact zone. Corona structure (figure 2), formed by reaction between already crystallized phenocryst and intrusive dolerite melt; high content of SiO₂, TiO₂, FeO, P₂O₅ and K₂O in tonalite; and similar type of enrichment of SiO₂, MgO and CaO in dolerite of the study area compared to their average compositions⁶ (table 1) indicate thermochemical mobilization of elements across the contact zone.

The temperature of metamorphism (amphibolite facies) must have been appreciably high, as indicated by the presence of higher amount of garnet and its coexistence with hornblende⁷, and preservation of relict minerals and texture⁵. However, the younger metadolerites experienced comparatively short-duration metamorphism, which

<table>
<thead>
<tr>
<th>Oxides</th>
<th>A</th>
<th>B</th>
<th>Bl</th>
<th>C</th>
<th>D</th>
<th>Di</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>68.29</td>
<td>66.94</td>
<td>61.52</td>
<td>53.07</td>
<td>51.81</td>
<td>50.18</td>
</tr>
<tr>
<td>TiO₂</td>
<td>0.42</td>
<td>1.53</td>
<td>0.73</td>
<td>0.42</td>
<td>0.36</td>
<td>1.14</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>15.81</td>
<td>13.72</td>
<td>16.48</td>
<td>13.76</td>
<td>15.14</td>
<td>15.26</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.64</td>
<td>1.51</td>
<td>1.83</td>
<td>1.31</td>
<td>1.26</td>
<td>2.86</td>
</tr>
<tr>
<td>FeO</td>
<td>2.30</td>
<td>4.05</td>
<td>3.82</td>
<td>3.46</td>
<td>4.89</td>
<td>8.05</td>
</tr>
<tr>
<td>MnO</td>
<td>0.03</td>
<td>0.04</td>
<td>0.08</td>
<td>0.10</td>
<td>0.19</td>
<td>0.19</td>
</tr>
<tr>
<td>MgO</td>
<td>0.99</td>
<td>2.65</td>
<td>2.80</td>
<td>9.37</td>
<td>8.81</td>
<td>6.78</td>
</tr>
<tr>
<td>CaO</td>
<td>4.34</td>
<td>4.21</td>
<td>5.42</td>
<td>15.89</td>
<td>14.97</td>
<td>9.24</td>
</tr>
<tr>
<td>Na₂O</td>
<td>4.35</td>
<td>2.18</td>
<td>3.63</td>
<td>2.29</td>
<td>2.26</td>
<td>2.56</td>
</tr>
<tr>
<td>K₂O</td>
<td>1.97</td>
<td>2.46</td>
<td>2.07</td>
<td>0.26</td>
<td>0.24</td>
<td>1.04</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>0.28</td>
<td>0.25</td>
<td>0.03</td>
<td>0.03</td>
<td>0.27</td>
<td></td>
</tr>
</tbody>
</table>


commenced at the peak of the regional metamorphic episode.

The author thanks Dr C. Bhattacharyya, Calcutta University, for guidance.

24 October 1988; Revised 16 January 1989


Figure 2. Corona structure with garnet rim enclosing the granular pyroxene grains (crossed × 40).

---

AN EMPIRICAL MODIFICATION TO HIGA'S EQUATION FOR THE EVALUATION OF DIPOLE MOMENT OF A POLAR SUBSTANCE IN A NON-POLAR SOLVENT

M. B. R. MURTHY and R. L. PATIL*
S. D. M. College of Engineering and Technology,
Dharwad 580 002, India
*Physics Department, Karnataka University,
Dharwad 580 003, India

Several methods are available¹–⁶ for the evaluation of dipole moment of a polar molecule in a non-polar

*For correspondence