PETROCHEMICAL BEHAVIOUR OF AN ACIDIC–BASIC CONTACT ZONE

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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 isoclinally 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, sphene, 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 untwinned, 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 sphene, epidote, apatite and quartz.

The central part of the intrusive sill is medium-

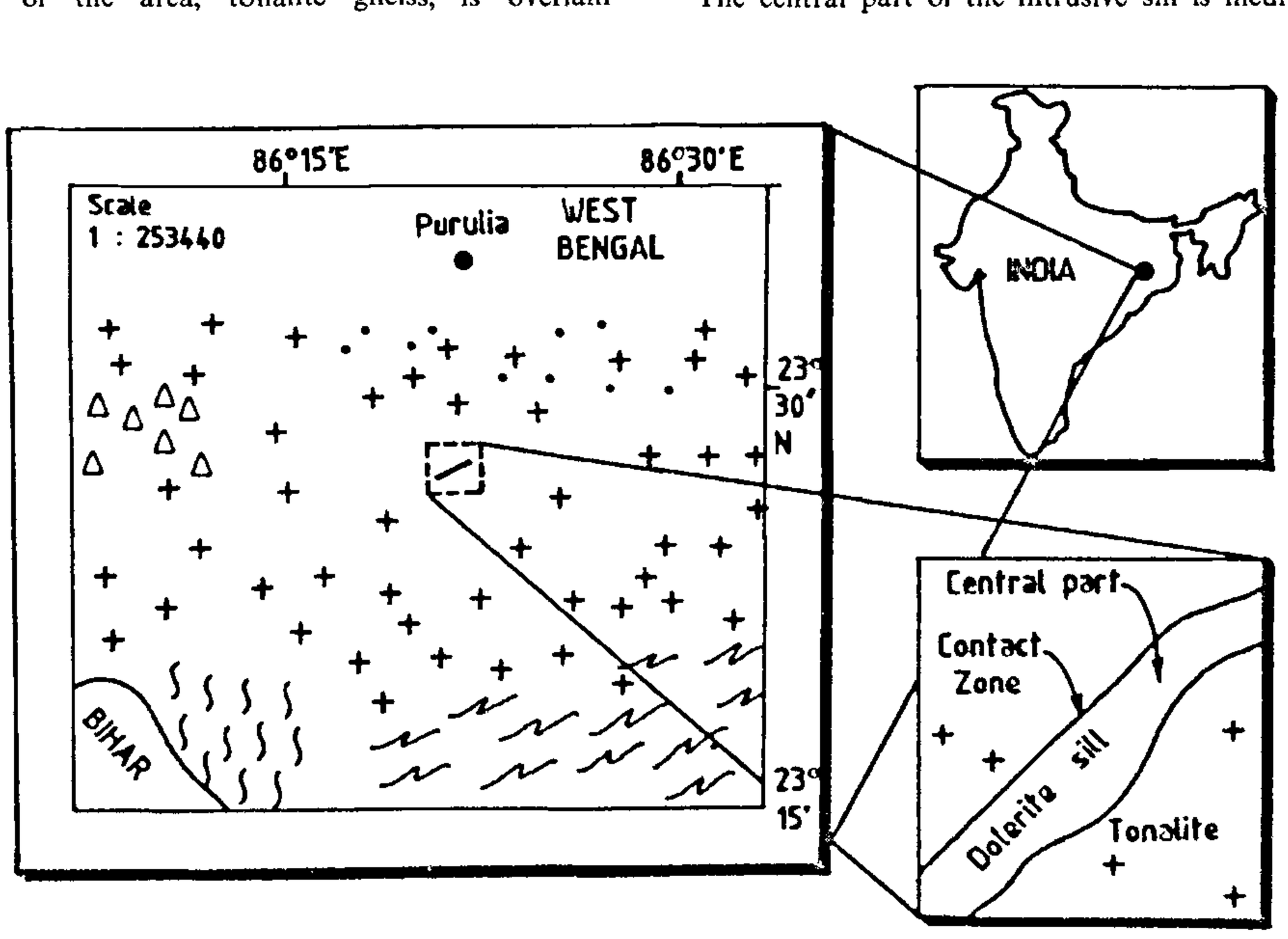

Figure 1. Geological map of the study area. + +, Tonalite gneiss; ••, granodiorite; \\, mica schist; ~ ~, quartz diorite; △ △, amphibolites; ⌐ dolerite.

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 SiO_2, TiO_2, Fe_2O_3, FeO, K_2O and P_2O_5, and an increase in Al_2O_3, MnO, CaO and Na_2O in rocks from the contact zone compared to tonalite gneiss, indicating basification of the acidic 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 SiO_2, TiO_2, FeO, P_2O_5 and K_2O in tonalite; and similar type of enrichment of SiO_2, MgO and CaO in dolerite of the study area compared to their average compositions[6] (table 1) indicate thermochemical mobilization of elements across the contact zone.

The temperature of metamorphism (almandine-amphibolite facies) must have been appreciably high, as indicated by the presence of higher amount of garnet and its coexistence with hornblende[7], and preservation of relict minerals and texture[3]. However, the younger metadolerites experienced comparatively short-duration metamorphism, which commenced at the peak of the regional metamorphic episode.

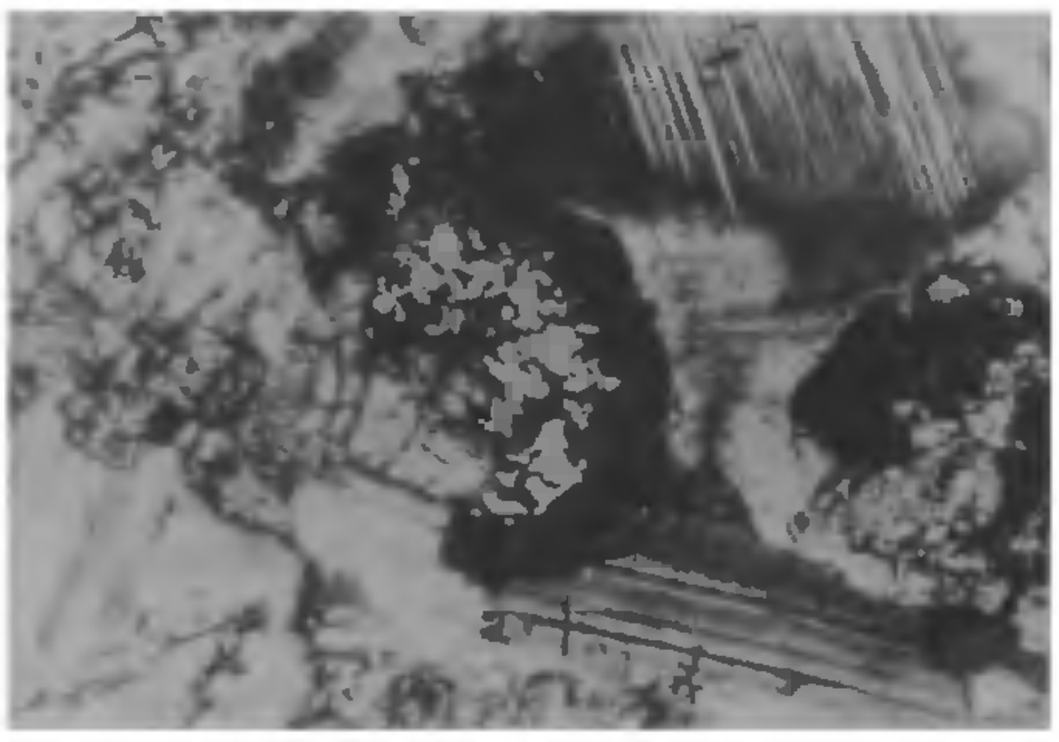

Figure 2. Corona structure with garnet rim enclosing the granular pyroxene grains (crossed × 40).

Table 1 *Chemical analyses of some major elements (wt %)*

Oxides	A	B	Bl	C	D	Dl
SiO_2	68.29	66.94	61.52	53 07	51.81	50 18
TiO_2	0 42	1.53	0.73	0.42	0.36	1.14
Al_2O_3	15.81	13.72	16.48	13.76	15.14	15.26
Fe_2O_3	0 64	1 51	1 83	1.31	1.26	2.86
FeO	2.30	4 05	3.82	3.46	4.89	8.05
MnO	0 03	0.04	0.08	0.10	0.19	0.19
MgO	0.99	2.65	2.80	9 37	8.81	6.78
CaO	4.34	4.21	5 42	15.89	14.97	9 24
Na_2O	4.35	2.18	3 63	2.29	2.26	2.56
K_2O	1.97	2.46	2.07	0.26	0.24	1.04
P_2O_5	—	0.28	0.25	0.03	0 03	0.27

A, Granodiorite; average of 3 samples. B, Tonalite gneiss; average of 6 samples. Bl, Average composition of tonalite, (Cox *et al.*[6]). C, Contact zone; average of 5 samples. D, Central part of the sill; average of 4 samples. Dl, Average composition of dolerite, (Cox *et al.*[6]).

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

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SEVERAL methods are available[1–6] for the evaluation of dipole moment of a polar molecule in a non-polar

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