M20 B.E. Chenhall et al.: Gneisses at Broken Hill, N.S.W.

The lower quartzofeldspathic gneiss at Broken Hill, New South Wales

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The intergrowth of calcic labradorite described by Phillips et al. (1977) occurs in rare specimens of the quartzofeldspathic gneisses that form elongate layers on the eastern side of the Broken Hill orebody. Diamond drill information and field extrapolation have suggested that some of the quartzofeldspathic rocks are related and they have been called the lower granite (-ic) or lower quartzofeldspathic gneiss (Carruthers and Pratten, 1961; Phillips and Stone, 1974; Johnson and Klingner, 1975). In particular, this pale grey, commonly garnet-free 'platy' or foliated gneiss, in which folia alternately rich in biotite and felsic minerals form the dominant structure, has been differentiated from the dark grey, potash-feldspar- and garnet-bearing Potosi gneiss (Vernon, 1969; Ransom, 1972, e.g. Table I, cols. 1 and 2)

Detailed work on the lower quartzofeldspathic gneiss has shown it to be variable (Table I, 3 to 11), although a division into two main groups is evident: one contains potash feldspar but is garnet-free (e.g. Table 1, 3-6), the other is without potash feldspar but locally holds small amounts of garnet (Table I, 7-11). The first group has been subdivided into two varieties on the basis of perthite morphology (Phillips and Stone, 1974; in Table I, 3 and 4 as opposed to 5 and 6). Overall it has a 'granitic' composition with high K_2O (and microperthite) and relatively high Na_2O to CaO (with oligoclase as the plagioclase). The second group, apart from the absence of potash feldspar, as an unusually high CaO content combined with high SiO_2. Mineralogically, most rocks in this division contain abundant quartz and relatively calcic plagioclase. Specimen 11, Table I, is particularly unusual as it appears to be an 'anorthositic gneiss' with the following mode: plagioclase 87.1% (vol.), muscovite 3.6, sphene 3.1, chlorite 2.5, clinozoisite and metamict allanite 2.0, quartz 0.9, opaques and apatite 0.8. Unfortunately, little information about the field relationships between these Ca-rich gneisses and the potash-feldspar-bearing gneisses has thus far been gleaned from drill cores.

The intergrowth of plagioclase described by Phillips et al. (1977) occurs in two of the specimens (9 and 10) listed in Table I. They have a similar chemistry and mode; their high CaO and SiO_2 content combined with low K_2O is particularly noticeable.

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TABLE 1. *Modes (% by volume), chemical analyses, C.I.P.W. norms and plagioclase compositions of quartzofeldspathic gneisses from Broken Hill*

	1	2	3	4	5	6	7	8	9	10	11
Modes											
Quartz	-	-	34.9	34.2	36.2	31.2	43.1	41.3	43.0	39.6	
Plagioclase	-	-	24.7	22.4	13.0	25.0	38.6	44.0	42.9	49.7	
Microperthite	-	-	31.5	32.6	37.0	26.2	-	-	-	-	see
Biotite	-	-	4.5	6.1	10.0	11.2	12.7	13.4	10.5	9.1	
Muscovite	-	-	4.4	4.7	1.8	5.3	5.6	0.4	1.8	0.2	text
Garnet	-	-	-	-	-	-	-	0.3	0.6	0.5	
Opaques	-	-	-	-	-	0.1	-	0.6	1.2	0.9	
Analyses											
SiO_2	66.26	65.80	73.94	73.41	73.08	72.50	71.36	70.71	70.87	70.54	45.83
TiO_2	0.75	0.79	0.14	0.15	0.39	0.31	0.48	0.54	0.51	0.50	0.91
Al_2O_3	16.39	15.85	13.41	13.60	13.45	13.44	14.23	14.65	14.68	15.84	32.75
Fe_2O_3	0.54	0.61	0.02	0.04	0.71	0.06	0.60	0.33	0.04	0.12	0.31
FeO	5.59	5.52	1.57	1.75	2.56	2.80	2.67	2.97	4.13	2.26	0.88
MnO	0.07	0.08	0.01	0.01	0.04	0.02	0.04	0.05	0.18	0.06	0.00
MgO	1.33	1.43	0.34	0.36	0.60	0.44	0.83	0.90	0.96	0.76	0.52
CaO	3.08	2.75	0.70	0.61	1.07	1.43	2.74	4.79	6.00	6.63	17.55
Na_2O	3.66	3.57	3.23	3.68	2.06	3.21	4.01	2.62	1.34	1.67	0.86
K_2O	3.12	3.30	5.20	5.42	4.86	4.56	1.96	1.19	0.89	0.68	0.41
H_2O+	0.40	0.48	0.86	0.63	0.50	0.91	0.91	0.53	0.41	0.66	0.31
H_2O-	0.08	0.13	0.16	0.05		0.06	0.05				
P_2O_5	0.27	0.24	0.20	0.20	0.15	0.16	0.16	0.15	0.15	0.19	0.22
Total	100.54	100.55	99.78	99.85	99.47	99.89	99.94	99.63	100.16	99.91	100.55
C.I.P.W. Norms											
Q	20.24	21.19	32.60	28.63	38.12	31.00	32.16	37.74	42.60	41.90	1.78
or	18.44	19.50	30.73	32.03	28.72	26.95	11.58	7.03	5.26	4.02	2.42
ab	30.97	30.21	27.33	31.14	17.43	27.16	33.93	22.17	11.34	14.13	7.28
an	13.52	12.08	2.17	1.72	4.33	6.05	12.55	22.78	28.79	31.65	84.31
C	2.04	1.98	1.68	1.05	3.22	1.01	0.92	0.70	0.87	0.76	-
di	-	-	-	-	-	-	-	-	-	-	1.03
hy	12.02	12.04	3.50	3.85	5.04	5.72	5.84	6.62	9.43	5.16	0.82
he	-	-	-	-	-	-	-	-	-	-	0.17
mt	0.78	0.88	0.03	0.06	1.03	0.07	0.72	0.48	0.06	0.17	0.20
il	1.42	1.50	0.27	0.28	0.74	0.59	0.91	1.03	0.97	0.95	1.73
ap	0.63	0.56	0.46	0.46	0.35	0.37	0.37	0.35	0.35	0.44	0.51
An/(Ab+An)	30.14	27.75	7.36	5.24	19.89	18.22	27.00	50.68	71.74	69.13	92.05
Plagioclase											
Optical An	41-2	38-40	15	15	23	23-5	28-9	54	about 65	67&03	about 95
Or	0.6	0.6	1.0	1.5	-	1.2	0.9	-	-		0.0
Probe Ab	61.9	62.1	87.8	83.5	-	75.6	70.1	-	-		6.4
An	37.5	37.3	11.2	15.0	-	23.2	29.0	-	-		93.6

1. and 2. Potosi gneiss (Phillips and Ransom, 1970). Rock nos. 7286 and 7288 respectively, Australian National University collections.

3. and 4. The lower K-feldspar-bearing gneisses (type with film and bead perthite (Phillips and Stone, 1974). Rock nos. 2931 and 2928 respectively, University of Wollongong collections.

5. and 6. The lower K-feldspar-bearing gneisses (type with film perthite (Phillips and Stone (1974)). Rock nos. 4119 and 2851 respectively, University of Wollongong collections.

7.8.9. and 10. The lower gneisses without K-feldspar but usually carrying minor garnet. Rock no. 10 is the type specimen in which the plagioclase has intergrowths of calcic labradorite. Rock nos. 2932, 4179, 4395 and 4420 respectively, University of Wollongong collections.

11. 'Anorthositic gneiss' included here with the lower gneisses. Rock no. 4208, University of Wollongong collections.
Analysts for whole rocks, S.E. Shaw and R. Flood (Macquarie University) (essentially by X.R.F.)
Microprobe analyses of plagioclase by R.F.Symes and J.C. Bevan, British Museum (Natural History).