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(Received: April 21, 1978)

Jour. Geological Society of India, Vol. 20. Mar. 1979, pp. 142 to 144

Spinel bronzite pyroxenites from Vemparala, Andhra Pradesh

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Abstract

Vemparala in northernmost Precambrian Nellore schist belt is made up of banded quartz-magnetite rocks, quartzites, pyroxene granulites, gabbros and granites. These were subjected to folding and refolding resulting in F_1, F_2, F_3 folds. Spinel-bronzite pyroxenites were structurally emplaced along the crests of F_2 folds and are the first known occurrences in Nellore Precambrian belt.

Introduction

The Precambrian quartz-magnetite rocks from Vemparala and surrounding regions were studied by Foote (1903), Krishnan (1964), and Sastry and Vaidyanadhan (1968). These rocks are confined to the northernmost Nellore Precambrian belt. The southern part is characterised by schists and gneisses and muscovite-bearing pegmatites. The quartz-magnetite rocks and associated pyroxene granulites and granitic gneisses are folded. Gabbros were occasionally found following the F_1 axial plane. They were refolded and resulted in NNW–SSE (F_2) and NNE–SSW (F_3) cross folds plunging NNW and NNE respectively. The F_2 cross folds are accompanied by spinel pyroxenite and granitic intrusions. The spinel pyroxenites occur at two places in Eddalakonda and these were earlier referred and indicated as hypersthene magnetites (Sastry and Vaidyanadhan, 1968, Fig. 3). The mineralogical and petrological data on spinel pyroxenites are presented.

Petrography and mineralogy

The spinel pyroxenites are very coarse and are composed of bronzite (80-85%), clinopyroxene (5-8%), spinel (4-6%), magnetite (2-4%) and amphibole and garnet

TABLE I. Chemical analyses of minerals from Vemparala spinel pyroxenite (No. 1)

	Bronzite	Augite	Spinel	Magnetite
SiO_2	51.59	49.72	0.40	—
Al_2O_3	4.64	5.04	65.50	0.20
TiO_2	0.14	0.71	1.50	1.95
Fe_2O_3	0.57	1.97	0.88	67.42
FeO	17.21	4.68	19.99	29.50
MgO	25.05	14.44	11.50	0.40
MnO	0.25	0.12	0.10	0.10
CaO	0.48	23.45	0.10	0.48
Na_2O	0.02	0.12	—	—
K_2O	0.02	0.10	—	—
H_2O+	0.05	0.02	—	—
H_2O-	0.04	—	—	—
Total	100.06	100.37	99.97	100.05
Trace elements in ppm:				
Ga	6	5	50	25
Cr	110	100	14000	9000
Li	5	4	—	tr.
Ni	600	650	7000	2500
Mo	3	—	—	6
Co	65	60	700	250
V	30	25	350	2500
Mn	2100	600	800	600

TABLE II. Chemical analyses of spinel bronzite pyroxenites from Vemparala, Nellore Precambrian belt

	1	2
SiO_2	47.22	47.61
Al_2O_3	9.02	10.86
Fe_2O_3	2.66	2.42
FeO	16.35	15.11
TiO_2	0.52	0.60
MgO	22.30	20.98
MnO	0.20	0.22
CaO	1.50	1.96
Na_2O	0.08	0.10
K_2O	tr.	tr.
H_2O+	0.08	0.10
H_2O-	—	—
Total	99.93	99.96
C.I.P.W. norm		
Ab	1	1
An	7	10
C	6	7
Hy	75	77
Ol	6	1
Mt	4	3
Il	1	1
Trace elements (in ppm)		
Ga	8	10
Cr	1000	1100
Li	10	15
Ni	1400	1350
Mo	tr.	tr.
Co	115	100
V	300	250
Mn	1900	1800
Sc	10	10
Y	< 5	< 5

1. Spinel bronzite pyroxenite in Eddalakonda. ¾ mile NE of Vemparala.
2. Spinel bronzite pyroxenite in Eddalakonda. 1 mile NE of Vemparala.

(3-5%). The bronzite is pleochroic from salmon pink to light green and has $2V_\alpha$ = 73-76°; $\gamma : Z = 0\text{-}5°$; R.I α = 1.686; γ = 1.700; and cell parameters – a = 18.300 Å, b = 8.860 Å, c = 5.195 Å, indicating a composition of about En_{70}. Chemical analysis confirms the optical inference. Clinopyroxene has 2V γ 60°, $\gamma : Z$ = 44°; R.I. α = 1.695, β = 1.710, γ = 1.719 and the analysis indicates the composition, Mg_{41} Fe_{11} Ca_{48} for the clinopyroxene. Spinel occurs along cleavages and grain

margins and also as interstitial grains often enclosing pyroxenes. The unit cell (a) 8.133 ± 0.002 Å and composition of green spinel indicate it to be a variety intermediate between pleonaste and hercynite. Magnetite is closely associated with spinel and encloses and replaces spinel suggesting a late paragenetic sequence. The chemical analyses of orthopyroxene, clinopyroxene, spinel and magnetite are given in Table I.

Origin

The chemical analyses of 2 spinel bronzite pyroxenites together with the C.I.P.W norms are given in Table II. The coexisting pyroxene phases normative molecules of hypersthene and olivine in spinel pyroxenites are considered to be indicative of tholeiitic magma composition (Deer *et al.*, 1963; Yoder & Tilley, 1962). The higher trace elemental concentrations—Cr, Ni, Co, Sc, V—in the pyroxenites and confinement of pyroxenites to the F_2 fold crests support igneous parentage. The trace elements in magnetite (Mn = 210, Cr = 25, V = 12, Co, Ni, Ga = < 10) from quartz-magnetite rocks on comparison with the magnetite from pyroxenite indicates a sedimentary environment for the former.

Acknowledgements: The authors thank Dr. Peter Zentai of Hungarian Geological Institute for help in trace element determination.

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(Received: May 3, 1978; Revised form accepted: July. 10, 1978)