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Coexisting pyroxenes from spinel pyroxenites from the Eastern Ghats of Andhra Pradesh, India

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SYNOPSIS

ANALYSES are given of four pairs of coexisting pyroxenes; their K_p ranges from 1.282 to 1.369, suggesting equilibration temperatures as high as 1200 °C and pressures of the order of 8 to 9 kb.

COEXISTING PYROXENES FROM SPINEL PYROXENITES FROM THE EASTERN GHATS OF ANDHRA PRADESH, INDIA

The Eastern Ghats of Andhra Pradesh, India, comprise Khondalites (garnet-sillimanite-graphite - biotite gneisses, quartzites, calc-granulites, limestones); charnockites (orthopyroxene granitic rocks of tonalitic and granodioritic composition); and pyroxene-hornblende granulites (gabbroic and noritic composition). Charnockites occur as circular domes in Kondapalli (Krishna district), Kasipatnam (Visakhapatnam district) and also as stocks along the cores and axes of overturned isoclinal cynclinal folds (F_1) at Visakhapatnam. Pyroxene granulite sills and dykes are more associated with charnockites rather than khondalites. The pyroxene granulites contain coexisting ortho-and clino-pyroxenes and basic plagioclase. The distribution coefficient $K_p = \frac{(Fe^{2+}/Mg)\ opx}{(Fe^{2+}/Mg)\ cpx}$ values (Barthlomé, 1962) for coexisting pyroxenes in rocks for Kondapalli (Leelanandam, 1967), Visakhapatnam (Sriramadas et al., 1969; Rao et al., 1969), Madras (Howie, 1955) and Sri Lanka (Jayawardena and Carlswell, 1976), suggest equilibration temperatures in the range 700 ± 50°C. The mineral assemblage of the Eastern Ghat rocks fall into the intermediate - pressure granulite field of Green and Ringwood (1967), indicating formation at 5 to 7.5 Kb, roughly corresponding to crustal depth of 20 km.

Contrary to the coexisting pyroxenes from pyroxene granulites, spinel pyroxenites in the Eastern Ghats, India, have indicated lower K_p values (Table 1) corresponding to igneous temperatures in the range 1150 - 1250°C. The spinel pyroxenites are coarse grained and essentially made of orthopyroxenes with uncommon fine exsolution lamellae while clinopyroxene and spinel are accessories and pargasite is also often present (Rao, 1978a). The spinel pyroxenites occur as sills and dykes in khondalites, charnockites and pyroxene granulites often occuring in F_2 fold hinges. Chromite pyroxenites are observed in serpentine-carbonate rocks (Rao, 1978b) as nodules. Sapphirine development in parts of the Eastern Ghats suggests contamination of spinel pyroxenite magma with sillimanite gneisses and schists (Walker and Collins, 1908). The coexisting aluminous orthopyroxene, aluminous clinopyroxene and spinel is suggestive of high pressures and temperatures (Kushiro and Yoder, 1966). The following experimental reaction of Kushiro and Yoder (1966) can be generalized to account for the aluminous nature of the pyroxenes:

Olv + An = Al Opx + Al Cpx + spinel

The results of Kushiro and Yoder (1966), Irving and Green (1970), Ito and Kennedy (1971) and Green and Ringwood (1972) indicate a pressure range of 6 - 10 Kb and temperatures between 900 - 1300°C. The exsolution lamellae and K_p values of coexisting pyroxenes from spinel pyroxenites in the Eastern Ghats suggests the equilibration temperature as high as 1200°C. At such temperatures the pressure is on the order of 8 - 9 Kb.

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TABLE 1

Chemical analyses of coexisting pyroxenes from spinel pyroxenites from the Eastern Ghats, India.

	1		2		3		4	
	OPX	CPX	OPX	CPX	OPX	CPX	OPX	CPX
SiO_2	50.70	51.74	53.34	51.16	52.40	50.95	50.88	51.05
TiO_2	0.32	0.44	0.74	0.96	0.62	0.37	0.35	0.50
Al_2O_3	5.41	3.46	3.07	3.22	4.18	5.57	5.20	4.15
Fe_2O_3	1.86	1.51	2.69	1.54	2.58	1.69	1.85	1.60
FeO	15.34	6.66	10.58	4.80	10.64	4.50	15.30	6.28
MnO	0.62	0.14	0.42	0.14	0.50	0.20	0.60	0.16
MgO	24.98	13.91	28.02	16.42	27.99	15.80	25.10	14.04
CaO	0.48	21.64	0.79	20.95	0.59	20.82	0.50	21.59
Na_2O	0.14	0.58	tr.	0.64	0.17	0.30	0.12	0.49
K_2O	0.02	0.01	tr.	0.05	0.05	0.10	0.03	0.02
H_2O^+	0.07	0.15	0.28	0.12	0.15	0.10	0.06	0.18
H_2O^-	0.02	0.04	0.08	0.04	0.06	0.02	0.02	0.04
Total	99.95	100.28	100.01	100.04	99.94	100.32	100.01	100.10
	Number of ions on the basis of 6(O)							
Si	1.846	1.915	1.898	1.883	1.875	1.860	1.849	1.910
Al	0.154	0.085	0.102	0.117	0.125	0.140	0.151	0.090
Al	0.078	0.065	0.026	0.022	0.050	0.098	0.071	0.092
Ti	0.009	0.012	0.026	0.027	0.009	0.010	0.009	0.014
Fe^{3+}	0.051	0.042	0.072	0.042	0.069	0.041	0.050	0.045
Fe^{2+}	0.467	0.206	0.314	0.147	0.317	0.137	0.463	0.195
Mn	0.019	0.005	0.013	0.004	0.015	0.006	0.018	0.005
Mg	1.356	0.767	1.486	0.907	1.502	0.865	1.368	0.769
Ca	0.018	0.858	0.030	0.826	0.023	0.814	0.019	0.865
Na	0.009	0.042	-	0.045	0.012	0.021	0.001	0.035
K	0.001	-	-	0.002	0.002	0.004	0.001	0.001
Z	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
XY	2.008	1.997	1.967	2.022	1.999	1.996	2.000	2.041
$K_p = \frac{(Fe^{2+}/Mg)OPX}{(Fe^{2+}/Mg)CPX}$	1.282		1.303		1.332		1.369	

1. Spinel pyroxenite from Kondapalli Seshadripuram hill range, Krishna district. 2. Chromite pyroxenite from Gangineni, near Kondapalli, Krishna district. 3. Spinel pyroxenite from Kasipatnam, Visakhapatnam district. 4. Spinel pyroxenite from Air Port hill, Visakhapatnam.