There is an indication of general increase of concentration of minor elements with increasing ash.

The high concentration of the minor elements in coal is now commonly believed to be the retention of these as insoluble metal-organic complexes with the leaching out by water of the normal inorganic matter. The results in Table I are marked by the enrichment of the elements like Ge. Ga. V. Ni. and Co. which occupy higher positions in the organic affinity series established by Zubovic and others (1961). The concentration of these elements in coal bands with many thin clay partings suggests submergence under aqueous waters rich in these elements. Major part of the high concentration of Mn in seam No. III may be of detrital origin, derived from the metamorphic subprovenance south of the area.

The study of concentration of germanium in different fractions of coal is under study, the results of which will be published in due course.

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COEXISTING PYROXENES AND ISOGRADIC ZONATION OF GRANULITE FACIES WITH REFERENCE TO THE INDIAN CHARNOCKITES

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Introduction: Binns (1962) sud-divided the hornblende-pyroxene granulite zone of New South Wales, Broken Hill district into three isograds A, B and C plotting β of clinopyroxene against γ of coexisting orthopyroxene. The isograd A marks the lower grade and B and C the progressively higher grade granulites. The object of the present study is to appreciate the isogradic zonations, if any, of Indian charnockites using the method of Binns.

Data processing: Unfortunately the measured refractive index data are not available for most of the analysed coexisting pyroxenes from the Indian charno-

TABLE I

COMPUTED REFRACTIVE INDICES OF PAIRED PYROXENES FROM CHARNOCKITIC ROCKS OF INDIA AND HORNBLENDE-PYROXENE GRANULITES OF BROKEN HILL

Ref. No.	Specimen No.	Clino-pyroxene β	Ortho-pyroxene γ	Area	Source
B 1	84319	1.701	1.737	Broken Hill	Binns, 1962
B 2	84320	1.705	1.744	,,	,,
B 3	84321	1.716	1.757	,,	,,
B 4	84322	1.697	1.723	,,	,,
B 5	84323	1.709	1.744	,,	,,
B 6	84324	1.697	1.723	,,	,,
B 7	84325	1.697	1.727	,,	,,
1	120	1.699	1.732	Garbham	Bhattacharyya, 1969
2	529	1.697	1.729	,,	,,
3	JJ 15	1.688	1.708	Salur-Bobbili	Naidu & Rao, 1967
4	JJ 118	1.691	1.713	,,	,,
5	JJ 140	1.690	1.715	,,	,,
6	JJ 157a	1.689	1.711	,,	,,
7	3709	1.686	1.697	Madras	Howie, 1955
8	4645	1.685	1.698	,,	,,
9	2270	1.692	1 713	,,	,,
10	2941	1.697	1.722	,,	,,
11	4642A	1.705	1.736	,,	,,
12	115	1.710	1.743	,,	,,
13	Ch 114	1.689	1.716	,,	Subramaniam, 1962
14	Ch 132	1.702	1.733	,,	,,
15	Ch 199	1.701	1.735	,,	,,
16	Ch 207	1.703	1.739	,,	,,
17	323	1.682	1.689	Kondapalli	Leelanandam, 1967
18	D 14	1.690	1.710	,,	,,
19	28	1.693	1.719	,,	,,
20	61	1.692	1.717	,,	,,
21	G 17	1.695	1.720	,,	,,
22	474	1.695	1.720	,,	,,
23	A 18	1.695	1.729	,,	,,
24	62	1.696	1.725	,,	,,
25	3 C	1.695	1.717	Saltora	Sen & Rege, 1966
26	124	1.696	1.728	,,	,,
27	10	1.698	1.729	,,	,,
28	213	1.691	1.713	,,	,,

ckites considered in this paper. Therefore, the refractive index β of analysed clinopyroxene has been found out by plotting Ca – Mg – ΣFe in Hess's diagram (Hess, 1949, p. 634). Similarly, γ of orthopyroxene has been derived from the plot of 100 Mg/ (Mg + Fe^{2+} + Fe^{3+} + Mn) in the diagram given by Deer et al (1965, p. 112). The results are shown in Table I. Since the isograds of Broken Hill were obtained from the plots of measured refractive indices of paired pyroxenes, one is likely to be in serious error to use the diagram by plotting the computed refractive indices. To maintain the uniformity, therefore, refractive indices of clinopyroxene and orthopyroxene of Broken Hill also were computed, as above, from their chemical analyses and were first plotted in Fig. 1. Two isograds A and B could be drawn through the Broken Hill plots.

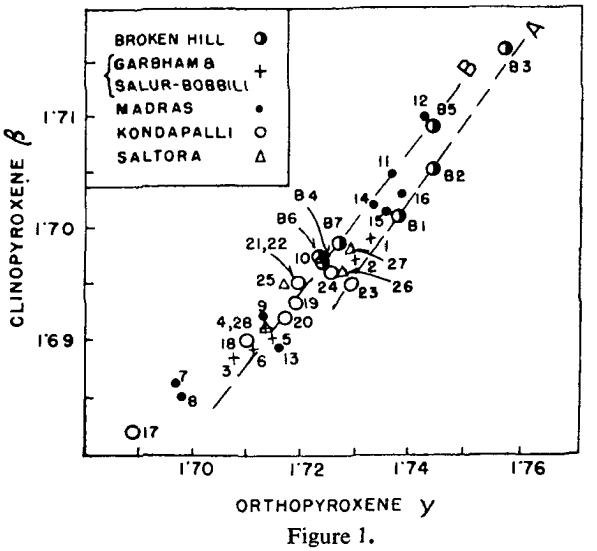

Figure 1.

Discussion and conclusion: Fig. 1, due to the use of computed refractive indices, differs from that given by Binns (op. cit.) in two respects. Firstly, the isograds B and C of Binns condense to a single isograd, here marked as B. Secondly, the positions of the lines representing isograds of Binns have slightly shifted here.

The Indian charnockites, as seen from Fig. 1, correspond well with the isograd B and less commonly with A. A few plots from almost all the localities of Indian charnockites lie in between the isograds A and B. Despite the analytical and computational errors, this can be explained by assuming the fluctuations of P–T condition in the granulite facies of the individual localities.

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