

IR SPECTROSCOPIC CHARACTERS OF GARNETS AND SPINELS – A POTENTIAL DISCRIMINATIVE TOOL FOR DIAMOND EXPLORATION.

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Garnet and chromite are two important indicator minerals for diamond exploration. Most reported studies were focused on their compositional characters [1, 2, 3, 4, 5, 6, 7, 8] over the years. Although the structural refinement analysis [9, 10, 11], and spectroscopic studies [12, 13, 14] of garnet and spinel have been done in detail, but there is no one using the structural characters of garnet and chromite to discriminate primary diamond sources so far.

In recent years, the structure and spectroscopic features of above two minerals have been studied by the authors [15, 16, 17 for garnet and 18, 19 for chromite]. It has been discovered that there are some peculiar garnets and chromites to diamondiferous kimberlitic rocks. An IR microanalysis method has been established [18]. In order to contrast the spectroscopic character with its chemical composition of these two minerals because the IR spectroscopic and compositional information could be obtained from the same grain.

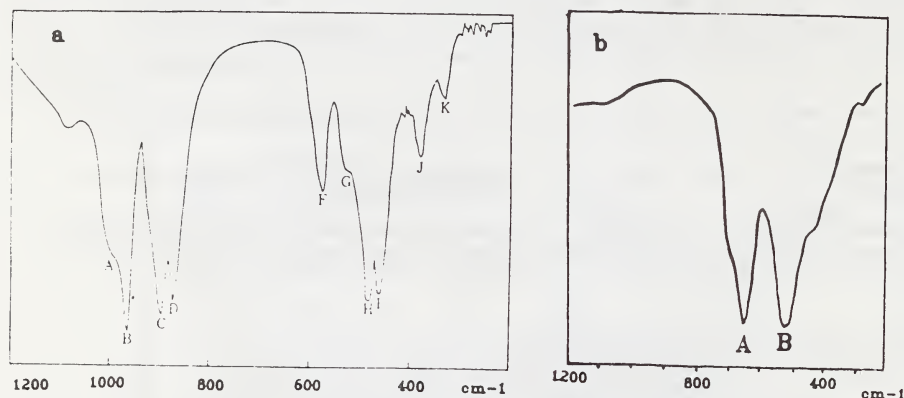


Fig. 1 IR spectra of Garnet(a) and chromite(b)

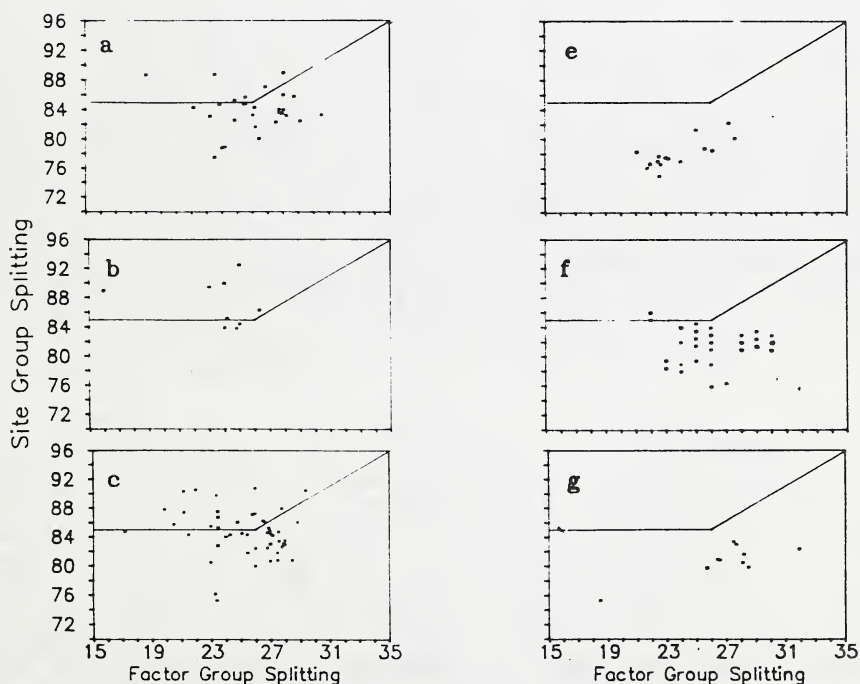
Figure 1a is a typical IR spectrum of garnet. The frequency differences of band positions ($\nu_C - \nu_D$) and $\nu_B - (\nu_C + \nu_D) / 2$ are assigned factor group splitting and site group splitting respectively. These two spectral characters are concerned with the substitution of ions Al^{3+} , Cr^{3+} and Fe^{3+} in octahedron, and Mg^{2+} , Fe^{2+} and Ca^{2+} in dodecahedron. The X-Y diagram drawn by using factor group splitting (ordinate) and site group splitting (abscissa) shows that more than 15% garnets of each diamondiferous kimberlite body with site group splitting larger than $85cm^{-1}$ because they have subcalcium in dodecahedron and smaller factor group splitting because of their rich chromium contents in octahedron (Fig. 2a-d). However, in all non-diamondiferous rocks, there are no garnet with the above characters (Fig. 2e-h).

IR spectra of most chromites show two strong bands (Fig. 1b). The shift of high-frequency band A is concerned with the distortion of octahedron which is mainly caused by the substitution of Al^{3+} , Cr^{3+} and Fe^{3+} . Another X-Y diagram drawn by using the positions of band A (abscissa) and band B (ordinate) shows that most chromites from diamondiferous kimberlitic rocks are located at the range of $635-625cm^{-1}$ for band A, and $505-495cm^{-1}$ for band B (Fig. 3a-c,h), but those from barren rocks are normally located out of this range (Fig. 3d,e-g).

Part of this work is supported by the Department of Geology, U.W.A. and CRA Exploration Pty Limited. Many thanks to Prof. P.G. Harris, Dr. W.J. Chang, Prof. N.M.S. Rock and Dr. C. Smith.

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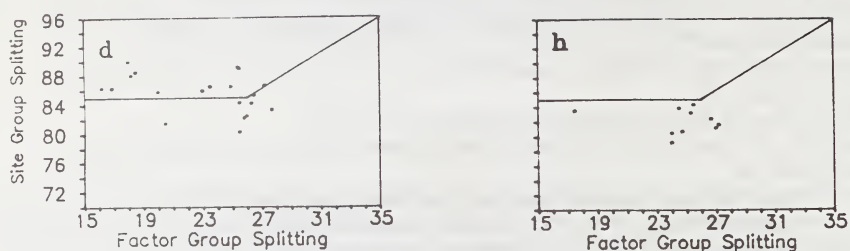


Fig. 2 Factor group splitting vs size group splitting of garnet Diamondiferous kimberlites (a-Liaoning 50, b-Liaoning 42, 3-Shengli 1 and 4-Hongqi 1), Barren kimberlites (c-Shangyu, f-Liuling), Basalt (g-Kuandian), Barren lamproite (h-Jingshan)

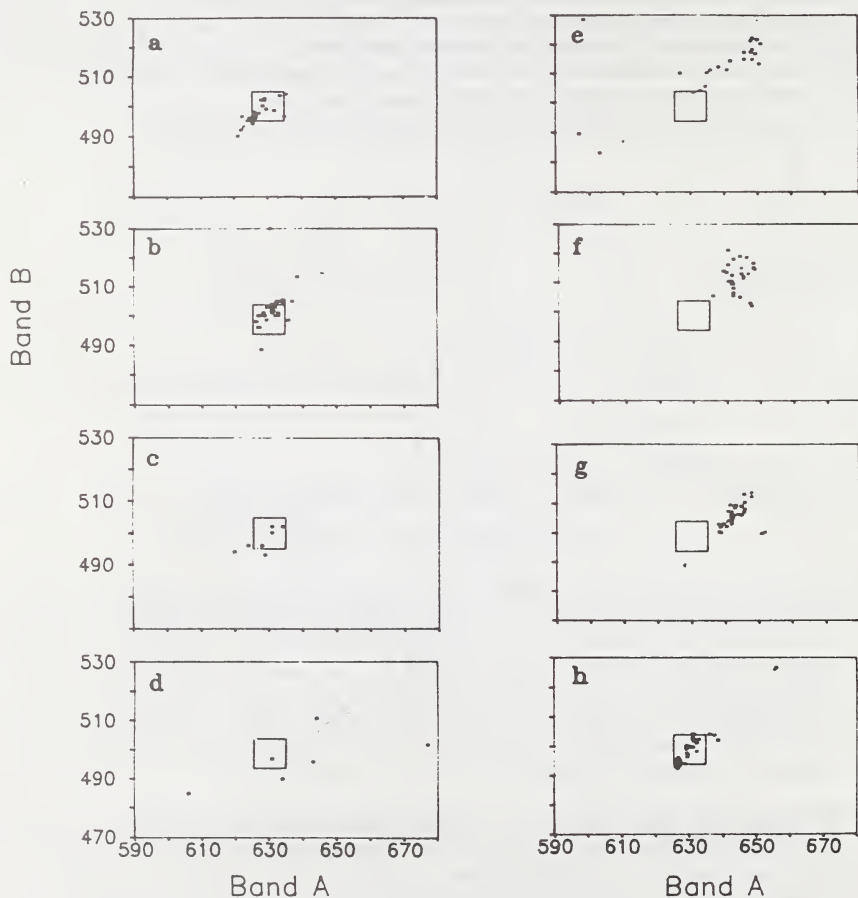


Fig. 3 Relationship of IR band A vs band B of chromite Diamondiferous Kimberlites (a-Shengli 1, b-Liaoning 50, c-Koffiefontein) and lamproite (h-Ellendale 4), Barren kimberlite (d-Rietfontein, e-Shexian), Related rocks (f-Anomaly 19 N.S.W., g-Narracoota Acid volcanics, W.A.)