Chemical and Spectral Characterization of Chromites from Sittampundi Anorthosite Complex, South India: Implications for Remote Observations of Spinels on Moon

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Introduction:

Planetary analogue study has drawn much attention in recent years. Understanding the chemical and spectral characteristics of terrestrial analogue rocks would help us make inferences on the history of formation and evolution of similar compositions on other planetary surfaces, particularly Moon. Spinel is a significant mineral detected on the lunar surface. The chemical composition of spinel can be used as a petrogenetic indicator [1, 2, 3]. In the present work, chemical and spectral characteristics of chromites from Sittampundi Anorthosite Complex have been studied. The changes in the spectral measurements in response to varying chemistry in the chromite samples have also been examined. This will enable a better identification and analysis of similar compositions on Moon detected through orbital remote sensing data. Chromites in the study area are found to be associated with anorthosites, meta-pyroxenites and amphibolites as layers and disseminations [4]. EPMA and XRD techniques were employed for chemical characterisation while spectral characteristics are analysed using Laser Raman and hyperspectral spectroscopy.

Results:

The chromite samples have moderate Cr_2O_3 contents and the individual grains are found to be chemically homogeneous.

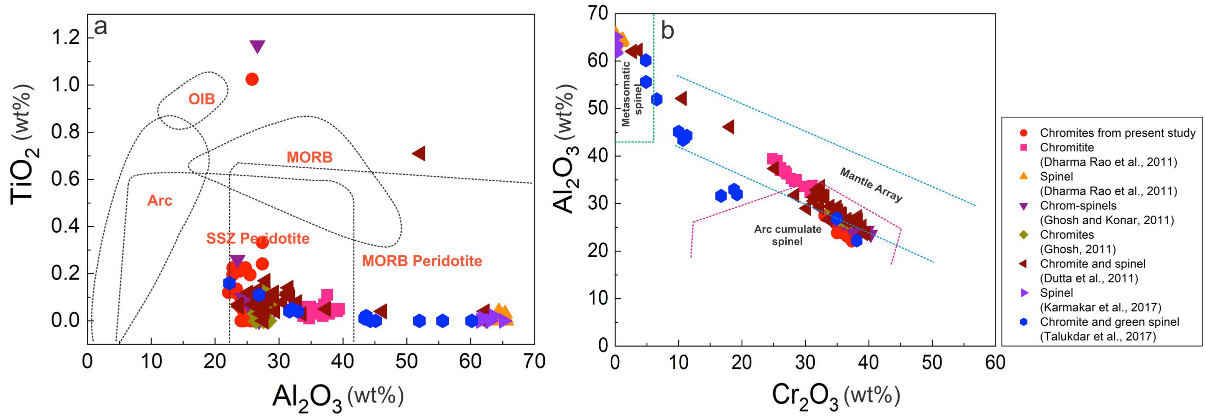

Figure 1. (a-b) Discrimination diagrams of the chromite samples

The X-ray Diffraction (XRD) analysis has yielded the characteristic chromite peaks with the highest intensity peak at around 36.15°. In micro-Raman analysis, the strong band for chromite have been observed at ~670 cm^{-1} (A_{1g}) and ~520 cm^{-1} ($F_{2g(2)}$). Weak peaks corresponding to E_g and F_{2g} can be observed at ~450 cm^{-1} and 600 cm^{-1} respectively. VNIR reflectance spectra of the chromite samples show a stronger and broader absorption band at 2 μm along with weak absorption features at 0.59μm and 0.94μm corresponding to the Cr^{3+} content. The band corresponding to the Cr^{2+} content at 1.2μm has also been observed. The shift in the band positions with variation in the Cr# has been shown in Tabel 1.

	Band positions (μm)										Oxides (wt %)			Cr# {Cr_2O_3/(Cr_2O_3+Al_2O_3)}
	0.49		0.59		0.94		1.3		2		Al_2O_3	Cr_2O_3	MgO	
	chip	powder	chip	powder	chip	powder	chip	powder	chip	powder				
SR6	0.475	0.5025	0.5741	0.5977	0.910	0.8764	1.25	1.2765	1.974	1.96	24.843	29.398	9.11	0.5004
SR10	0.51	0.5003	0.5982	0.5982	0.912	0.9015	1.27	1.2735	1.971	1.947	15.849	16.269	8.881	0.4110
SR14	0.5078	0.5033	0.59	0.5998	0.934	0.9133	-	1.2765	1.993	1.976	14.519	9.0666	13.53	0.2185
SR14l	0.5132	0.5033	0.5973	0.599	0.917	0.9008	1.27	1.273	1.996	1.976	13.594	16.55	18.59	0.3689
SR17	0.5114	0.5008	0.5963	0.5993	0.890	0.9096	1.27	1.278	1.938	1.957	13.144	4.938	25.00	0.2610

Table 1. Shows the relationship of absorption band positions with the Al_2O_3, Cr_2O_3, MgO, Cr# in the chromite samples.

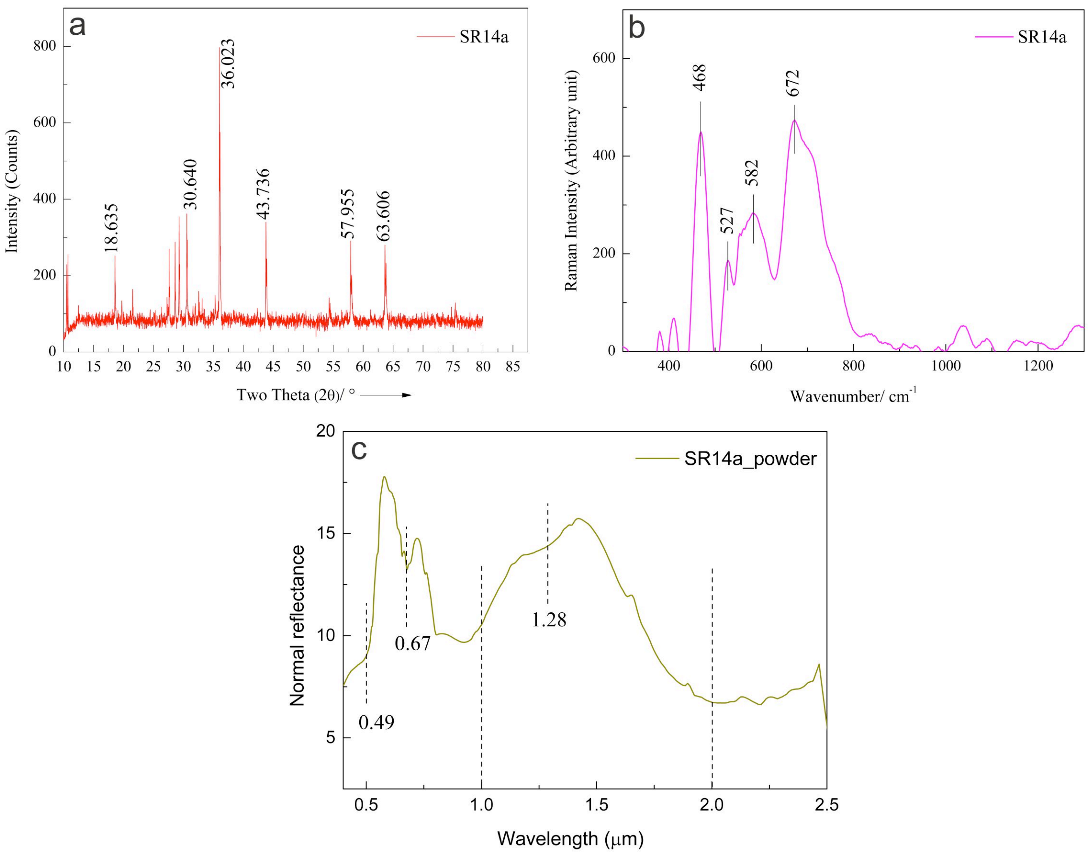

Figure 2. (a) XRD spectrum of the chromite sample (b) Laser Raman spectrum of the chromite (c) Reflectance spectrum of chromite.

Conclusion:

The chemically homogeneous chromite layers and disseminations associated with Sittampundi Anorthosite Complex show varying Cr_2O_3 contents. Unlike disseminated chromites, layered chromites are Cr_2O_3 rich (> 60 wt%). A large number of both primary and secondary silicate inclusions are found to be associated with the chromite grains. The strong diagnostic Raman peak obtained at around 680 cm^{-1} can be used to infer the chemical phases present in the samples. The hyperspectral data has been analysed to quantify the elemental abundance in the sample. The present study has important implication for the remote observation of spinels on Moon.

References:

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