Phosphates from of the Martian meteorites: A cathodoluminescence spectroscopical overview

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Introduction

The purpose of this study is to identify and microcharacterize the phosphates in Martian meteorites.

Samples and Experimental Procedures

Standard polished geological thin sections were prepared from the Nakhla, ALH84001 and Y-000593 nakhlites for WDS analysis and CL spectral investigation. Details on the CL equipments, methods, sample preparation and samples can be found in [1-3].

Discussion of results

Various phosphates such as β-Ca-phosphate (ALH84001), chloroapatite (Nakhla) and apatite (Y-000593-nakhlite) have been identified in these samples (Fig. 1), indicating the mineralogical information on the fluid-rock-atmospheric interactions in the Martian environment s.

Sample	CL spectra (nm)	Phosphate	Ref.
ALH84001 (#3734,373 83739 fragm.)	350: Ce, La 478: Ce, La 578: Dy 600: Sm 648: Sm 780: Nd	β-Ca-phosphate	[1]
Nakhla	514:Al, REE	Chloroapatite	[2]
Y-000593 (nakhlite)	578: Dy 598: Sm 650: Sm	Apatite	[3]

Table 1: CL properties of three Martian meteorites.

References

[1] Protheroe W.J. and Stirling J.A.R. (2000), *LPSC* **XXXI** #2021
[2] Protheroe W.J., Venance K. and Stirling J.A.R. (2001), *LPSC* **XXXII** #1642
[3] Matsuda N., Gucsik A., Nishido H., Ninagawa K., Okumura T. and Kayama M. (2007) *LPSC* **XXXVIII** #1061.

Micro-Raman spectroscopy and optical reflectance studies of coals with different rank

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Powerfull techniques for studying changes in the structure of organic matter during coalification and graphitisation processes include micro-Raman spectroscopy and optical reflectance.

Since coal is a heterogeneous rock with different maceral composition, the coalification studies should include the properties of each individualized component and not the average samples. Therefore, micro-Raman spectroscopy and optical reflectance analysis were performed on collotelinite and fusinite macerals from a set of coals with increasing rank.

The Raman analysis indicates the presence of bands at 1580 cm^{-1} (G), 1470 cm^{-1}, 1350 cm^{-1} (D1) and 1170 cm^{-1} on the first-order Raman spectrum on both macerals from the different coal samples. From table 1 several differences between both macerals can be observed, lower values of $FWHM_G$ and higher values of reflectance, ν_G and D1/G were obtained on fusinite in all samples with the exception of sample 3153 (anthracite). With increasing reflectance a narrowing of the G band and its shift toward higher wavenumbers occur on both macerals. However the D1/G intensity area show a slight decrease on collotelinite (except for sample 3153) and a rather constant values on fusinite. The results show that within the same coal sample the Raman parameters and reflectance in collotelinite and fusinite are different and their evolution with increasing of coal rank is also different.

Table 1: Raman parameters and reflectance of collotelinite and fusinite macerals from a set of coals of increasing rank.

	Collotelinite				Fusinite			
Sample	Ro	ν_G	$FWHM_G$	D1/G	Ro	ν_G	$FWHM_G$	D1/G
3157	0.50	1591	59	2.1	5.15	1591	54	3.2
3158	0.63	1591	67	1.2	4.27	1594	53	3.7
3159	0.78	1591	57	1.8	4.51	1591	56	3.5
3155	0.90	1588	59	2.0	3.81	1592	48	3.4
3156	1.14	1589	54	1.9	4.28	1594	45	3.7
3152	1.41	1588	55	1.8	4.63	1596	48	2.9
3160	1.96	1591	46	1.7	5.05	1592	44	2.8
3153	4.28	1596	34	2.5	6.11	1594	42	3.3

ν_G: G band wavenumber; $FWHM_G$: full width at half maximum of G band; D1/G: intensity area ratio; all are mean values; Ro: mean random reflectance.

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