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THE GLADSTONE–DALE CONSTANT $k(UO_3)$ FOR URANYL PHOSPHATES AND ARSENATES

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ABSTRACT

The best value for the Gladstone–Dale constant $k(UO_3)$ for uranyl phosphates and arsenates is approximately 0.134; this value was calculated from the data for 12 well-defined compounds.

Keywords: Gladstone–Dale relationship, UO_3, phosphates, arsenates, compatibility.

SOMMAIRE

Pour les phosphates et arséniates d'uranyle, la meilleure valeur de la constante $k(UO_3)$ de Gladstone–Dale est aux alentours de 0.134; cette valeur a été calculée à partir des données provenant de 12 composés bien définis.

Mots-clés: relation de Gladstone–Dale, UO_3, phosphates, arséniates, compatibilité.

In the definition of new minerals, the value of the "compatibility index" (Mandarino 1981) represents an important criterion for checking the internal consistency of some of the data. The method is based upon a comparison of two quantities: K_P and K_C. The first is calculated from physical data: $K_P = (\bar{n}-1)/D$, where $\bar{n}$ is the mean index of refraction and D is the density. The second is calculated from the chemical composition: $K_C = \Sigma k_i p_i$, where p_i represents the weight fraction of a constituent, and k_i, the corresponding Gladstone–Dale constant.

The k values were calculated mainly by Larsen (1921) and by Mandarino (1976, 1981) and may vary with the kind of compound (silicate, phosphate, sulfate, *etc.*). In the case of uranyl compounds, the value of the constant k for UO_3 of Mandarino (0.118) is very different from that of Larsen (0.134).

In Table 1, we have selected 12 compounds for which the indices of refraction, the chemical compositions and crystal structures are particularly well defined. In each case, we have verified that the measured density is near the calculated density D_X and used the latter (which is generally more precise) in the calculation of $k(UO_3)$:

$$k(UO_3) = (\frac{\bar{n}-1}{D_X} - \Sigma k_i p_i)/p(UO_3)$$

where k_i are the values proposed by Mandarino (1981). Of course, $\Sigma k_i p_i$ does not include UO_3. An examination of Table 1 shows that Larsen's constant is better for uranyl phosphates and arsenates. As the mean value of $k(UO_3)$, 0.133, is not significantly different from Larsen's value (0.134), it is suggested that Larsen's value be applied.

The mean values of the twelve compatibility indices using 0.134 for $k(UO_3)$ is 0.026 (in the "excellent" category), whereas it is only 0.061 (in the "fair" category) for $k(UO_3) = 0.118$.

TABLE 1. VALUES OF $k(UO_3)$ CALCULATED FROM DENSITY D_X, MEAN INDEX OF REFRACTION $\bar{n}$, CHEMICAL COMPOSITION, AND OTHER GLADSTONE-DALE CONSTANTS k*

	D_X	$\bar{n}$	$k(UO_3)$	Refer.
Hügelite				
$3UO_3.2PbO.As_2O_5.5H_2O$	5.80	1.907	0.148	*a*
Dumontite				
$3UO_3.2PbO.P_2O_5.5H_2O$	5.66	1.87	0.140	*b,c*
Phurcalite				
$3UO_3.2CaO.P_2O_5.6H_2O$	4.26	1.723	0.141	*d*
Althupite				
$7UO_3.0.5Al_2O_3.ThO_2.2P_2O_5.17.5H_2O$	3.98	1.649	0.131	*e*
Upalite				
$3UO_3.0.5Al_2O_3.P_2O_5.7.5H_2O$	3.94	1.664	0.137	*f,g*
Metatorbernite				
$2UO_3.CuO.P_2O_5.8H_2O$	3.70	1.624	0.123	*h,i*
Abernathyite				
$2UO_3.K_2O.As_2O_5.6H_2O$	3.57	1.595	0.132	*j*
Synthetic compound				
$3UO_3.P_2O_5.5H_2O$	3.53	1.577	0.141	*k*
Phuralumite				
$3UO_3.Al_2O_3.P_2O_5.13H_2O$	3.52	1.613	0.123	*g,l*
Synthetic compound				
$4UO_3.K_2O.2As_2O_5.15H_2O$	3.52	1.598	0.131	*j*
Synthetic compound				
$2UO_3.(NH_4)_2O.As_2O_5.6H_2O$	3.43	1.608	0.124	*j*
Threadgoldite				
$4UO_3.Al_2O_3.2P_2O_5.17H_2O$	3.32	1.581	0.126	*m*
		Mean	0.133	

References: *a* Walenta (1979), *b* Piret & Piret-Meunier (1988), *c* Thoreau *et al.* (1958), *d* Deliens & Piret (1978), *e* Piret & Deliens (1987), *f* Piret & Declercq (1983), *g* Deliens & Piret (1979a), *h* Ross *et al.* (1964), *i* Hallimond (1920), *j* Ross & Evans (1964), *k* Sidorenko *et al.* (1975), *l* Piret *et al.* (1979), *m* Deliens & Piret (1979b). * Taken from Mandarino (1976). The mean value of $k(UO_3)$ is 0.133.

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