Separation of the valency states of some elements on paper impregnated with zirconium phosphate

The application of paper chromatography has been extended during recent years by using papers impregnated with both organic and inorganic exchangers. ALBERTI AND GRASSINI[1] have shown that filter papers impregnated with zirconium phosphate can be successfully employed for the chromatographic separation of numerous cations. The advantage of chromatography with such papers lies in the fact that pure aqueous solutions containing different inorganic solutes can replace the organic mixtures normally used in conventional chromatography.

The paper chromatographic separations of elements in different valency states using organic solvent systems have been reported by various workers[2–6]. We have now found that strips impregnated with zirconium phosphate can be successfully used with aqueous solutions as eluents or for the rapid separation and detection of several elements in different valency states when present in admixture with each other.

TABLE I

Valency states of the elements	*Composition of the eluent*	R_F *values*
Fe(II) and Fe(III)	0.5 *N* H_2SO_4	Fe(II) = 0.84 Fe(III) = 0.0
U(IV) and U(VI)	3.0 *N* HCl	U(IV) = 0.0 U(VI) = 0.72
U(IV) and U(VI)	3.0 *N* H_2SO_4	U(IV) = 0.22 U(VI) = 0.68
U(IV) and U(VI)	3.0 *N* HNO_3	U(IV) = 0.03 U(VI) = 0.54
Ce(III) and Ce(IV)	1.0 *N* H_2SO_4	Ce(III) = 0.64 Ce(IV) = 0.06
Ce(III) and Ce(IV)	1.0 *N* HCl	Ce(III) = 0.68 Ce(IV) = 0.0
Cr(III) and Cr(VI)	Saturated solution of Na_2SO_4	Cr(III) = 0.84 Cr(VI) = 0.3
As(III) and As(V)	1.0 *N* HCl	As(III) = 0.66 As(V) = 0.14
As(III) and As(V)	1.0 *N* HNO_3	As(III) = 0.70 As(V) = 0.06
V(IV) and V(V)	Na_2HPO_4–citric acid buffer pH 7	V(IV) = 0.06 V(V) = 0.83 (slight tailing)
Mo(V) and Mo(VI)	4 *N* HCl	Mo(V) = 0.63 Mo(VI) = 0.35
Hg(I) and Hg(II)	0.1 *N* HNO_3	Hg(I) = 0.0 Hg(II) = 0.69

Experimental

Strips (4 cm × 25 cm) of Whatman No. 1 chromatography grade filter papers were drawn at a uniform rate through a 10 % solution of zirconium oxychloride in 4 *N* HCl

and then hung up to dry. The strips were then passed through a solution of 12% phosphoric acid in 4 *N* HCl and dried at room temperature. Then they were washed with distilled water until free from acid (pH = 4). For further activation, the strips were slowly passed through a 1:3 phosphoric acid solution (containing HCl) at 50°. After drying at room temperature they were again washed with distilled water until free from acid (pH = 4). The strips prepared in this way were used for the separations. Usual methods were employed for the detection of the spots.

In Table I the R_F values of various elements in different valency states are given.

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Structure and chromatographic properties of carbohydrates

II. The liquid–liquid partition mobilities of aldono-γ-lactones*

It is a simple matter to resolve isomeric carbohydrate substances by partition chromatographic means and so the mobilities of compounds depend not only upon fundamental features of the molecules, *e.g.* molecular weight and "hydrophilic nature" (as determined by the number of unsubstituted hydroxyl groupings present), but upon subtler factors related to configuration and conformation. Little attention has been paid to the correlation of structure with chromatographic properties or to the study of the detailed physical phenomena upon which the mobilities depend. Some interrelationships between the disposition of the hydroxyl groupings on pyranose sugars and their chromatographic behaviour have, however, been noted[2], and these have lately been reinterpreted in conformational terms[3]. Thus, free sugars which can assume chair conformations having few axial hydroxyls are less mobile than those which have several. We now note some correlations in the γ-lactone series.

All the measurements (see Table I) were made on Whatman No. 1 papers developed with butan-1-ol–ethanol–water (4:1:5). The members of each group were run together at 25° on one paper and the mobilities quoted in the table are relative to the fastest in each series.

From erythrono- and threono-γ-lactones it is seen that a C_2–C_3 *cis*-diol reduces mobility relative to a *trans*-diol. The pentono-γ-lactones show that the isomer (*lyxo*-) with the configuration which has three hydrophilic groupings on one side of the ring

*. For Part I, see ref. [1].