Extraction Chromatographic Separation of Gold Using Bis(2-ethylhexyl)phosphoric Acid as an Extractant

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Bis(2-ethylhexyl)phosphoric acid (HDEHP), a liquid cation exchanger coated on silica gel from benzene quantitatively extracts gold from 7-8 M HCl and is stripped off with 2 M HCl. Gold in synthetic mixtures containing other metal ions such as Cu(II), Ni(II), Mn(II), Pb(IV), Pt(IV) and Pd(II) in the ratios actually present in various gold alloys has been successfully separated employing HDEHP.

Purified silica gel (60-120 mesh, BDH) was rendered hydrophobic by procedure described earlier. It was then coated with HDEHP taken in benzene. The excess benzene was removed by centrifugation at 2500 rpm using a Remi model T 8C centrifuge. This gel was used for carrying out column extraction studies as well as for reverse phase extraction chromatographic separation work.

General procedure

A slurry of silica gel coated with HDEHP was transferred to a chromatographic column and the height of the bed was maintained at 8 cm. It was washed with 2-8 M hydrochloric acid (10-15 ml) as the case may be. An aliquot of solution containing 40 μg gold/ml was rendered acidic (8 M) by adding hydrochloric acid. It was passed through the pretreated column at a flow rate of 1 ml/min. After extraction, gold was stripped with 2 M hydrochloric acid. Twenty fractions (each of 2 ml) were collected and gold from each fraction was determined spectrophotometrically as the gold-rhodamine complex in benzene at 565 nm.

It was found that gold is quantitatively extracted from 7-8 M hydrochloric acid. The gold thus extracted had a breakthrough volume above 60 ml and 90 ml at 7 M and 8 M hydrochloric acid, respectively. Therefore at 7-8 M hydrochloric acid, the extraction behaviour of other metal ions were studied. It was noted that except iron and uranium all other metal ions were not retained by the column under the conditions employed for the extraction of gold and they were all quantitatively recovered from within the initial fractions (1-8) of 2 ml each. Gold which was retained in the column was finally stripped with 2 M hydrochloric acid. Thus from 7-8 M hydrochloric acid gold was separated from other metal ions except iron and uranium.

It was observed that the optimum conditions for batch extraction of gold were not same as those for extraction chromatography. This is the case with many metal ions studied. The ions such as copper (0.01 M), nickel (not extracted), manganese (pH 4.0), lead (0.01 M), platinum and palladium (not extracted), silver (0.1 M), cadmium (0.03 M) and antimony (0.1 M) were extracted at different acidities of hydrochloric acid hence they passed through the column in 7 M hydrochloric acid medium facilitating separation of gold from binary mixtures.

It was possible to separate gold from binary mixtures containing copper and gold or tellurium and...
gold. In these cases, copper and tellurium were not retained by the column and could be quantitatively eluted with about 15 ml of 7 M hydrochloric acid. Finally gold was recovered with 2 M hydrochloric acid.

The separation of gold from binary mixtures containing platinum/palladium/ruthenium was also achieved on the pretreated column. Platinum, palladium or ruthenium were eluted with 7 M hydrochloric acid while gold was removed as usual with 2 M hydrochloric acid (Fig. 1).

The proposed method is simple, rapid, selective and permits separation of gold from commonly associated elements such as copper, tellurium, platinum, palladium, etc. The overall time required for extraction and separation does not exceed 2 hr. The method is reproducible with an accuracy of ± 1.0%.

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References
1 Braun T & Gersini G, Extraction chromatography (Elsevier, Amsterdam), 1975.
2 Preszlakowski B K, Kalym A V & Mikhalka I, Radiokhimija, 6 (1964) 111; Chem Abstr, 64 (1966) 391A.
5 Blouri J & Revel G, J radioanal Chem, 10 (1972) 121.
8 Fidelis I, Gwoz'dz R & Siekierski S, Nucleonika, 8 (1969) 327; Chem Abstr, 75 (1971) 144310X.
10 Pohlandt Chr & Steele T W, Talanta, 19 (1972) 839.