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ION-EXCHANGE BEHAVIOR OF MENDELEVIUM

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During the course of experimentation to produce new isotopes of mendelevium (element 101), the elution position of this element from cation-exchange resin columns was determined relative to the elution peaks of actinide and lanthanide elements. Mendelevium-256 was prepared by a recoil technique similar to that reported in the discovery of element 101.1

An einsteinium-253 target (containing $2 \times 10^{11}$ atoms electroplated on a 0.07-cm$^2$ area) was bombarded with 29-Mev helium ions in the 60-inch cyclotron at the Crocker Radiation Laboratory and the transmuted recoil nuclei were caught on a 0.1-mil-thick gold "catcher" foil placed adjacent to the target. With beam intensities of 2.5 microamperes, as many as one hundred atoms of Mv$^{256}$ could be produced per experiment.

At the end of bombardment, the gold foil was quickly dissolved in aqua regia containing actinide and lanthanide tracers to serve for internal calibration of the resin columns. The active fraction was separated from the gold by sorbing the latter on a Dowex A-1x10 anion resin column from a 2 M HCl solution. The drops containing the actinide fraction were evaporated to dryness; the residue was dissolved in 0.05 M HCl and transferred to a 5 cm x 2 mm Dowex-50x12 cation resin column. After washing with two drops of water, the activities were eluted in sequence with 0.23 M ammonium $\alpha$-hydroxy isobutyrate solution (pH = 4.62) at 87°C. The eluant was caught on platinum counting discs (one drop per plate per minute, 13 microliters per drop), evaporated to dryness, and the plates were flamed and then counted individually for fission, alpha, and beta activity. A typical elution curve is shown in Fig. 1.

The fission activity in the fermium fraction decayed with the 160-min half-life characteristic of Fm$^{256}$.

* On leave from J.E.N.E.R., Norway.
In the mendelevium fraction, \( \text{Mv}^{256} \) was identified by observation of its electron-capture-decay daughter, \( \text{Fm}^{256} \), as follows. The mendelevium fraction was passed through a second cation resin column, thus separating it into new mendelevium and fermium components. The new fermium fraction decayed by fission with a half-life of 160 min, and fission activity was observed to grow into the new mendelevium fraction. It was concluded that during the time between column separations, \( \text{Mv}^{256} \) decayed by orbital electron capture to its daughter \( \text{Fm}^{256} \).

To facilitate comparison, the elution positions are discussed in terms of the separation factor, \( S \), relative to curium,

\[
S = \frac{V_x - C}{V_{\text{cm}} - C},
\]

where \( V_x \) is the volume eluted when the concentration of \( x \) in the eluate is greatest, \( V_{\text{cm}} \) is the volume eluted when the concentration of \( \text{Cm} \) in the eluate is a maximum, and \( C \) is the free column volume.

In Table I are listed the measured separation factors\(^3\)\(^4\)\(^5\) of the lanthanide and actinide elements, relative to curium.

In Fig. 2, a plot of the separation factor vs the atomic number \( Z \), it may be noted that the separation factor of 0.050±0.005 for mendelevium corresponds to that expected for ekathulium, supporting again the actinide hypothesis. The actinide line may be extrapolated to predict a separation factor of 0.036±0.008 for element 102.

The authors wish to acknowledge with gratitude the tireless efforts during these experiments of the operating crew of the Crocker Laboratory 60-inch cyclotron, and are indebted to Thomas C. Parsons and Francis McCarthy for their aid during the early phase of these experiments.
Table I

Separation factors (relative to curium)
for ammonium α-hydroxyisobutyrate eluant

<table>
<thead>
<tr>
<th>Element</th>
<th>Separation factors</th>
<th>Element</th>
<th>Separation factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>0.038±0.008&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Lu</td>
<td>0.016</td>
</tr>
<tr>
<td>Lv</td>
<td>0.050±0.005</td>
<td>Yb</td>
<td>0.022</td>
</tr>
<tr>
<td>Fm</td>
<td>0.069</td>
<td>Tm</td>
<td>0.029</td>
</tr>
<tr>
<td>E</td>
<td>0.13</td>
<td>Er</td>
<td>0.038</td>
</tr>
<tr>
<td>Cf</td>
<td>0.20</td>
<td>Ho</td>
<td>0.046</td>
</tr>
<tr>
<td>Bk</td>
<td>0.45</td>
<td>Dy</td>
<td>0.075</td>
</tr>
<tr>
<td>Cm</td>
<td>1.00</td>
<td>Tb</td>
<td>0.14</td>
</tr>
<tr>
<td>Am</td>
<td>1.45</td>
<td>Gd</td>
<td>0.29</td>
</tr>
<tr>
<td>Y</td>
<td>0.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Eu</td>
<td>0.41</td>
</tr>
</tbody>
</table>

<sup>a</sup>Predicted value.
REFERENCES


The image shows a graph with the following labels:

- α counts
- β counts
- Fission counts

The graph is labeled with the following elements:

- Tm
- Mv Y Fm
- E
- Cf

The x-axis represents the Elution drop number, ranging from 0 to 80.

The y-axis represents the α c/m or fission events, ranging from 0 to 26.

The β c/m axis ranges from 8000 to 56000.

Key points include:

- The graph is designated by histogram.
Actinides: 95
Lanthanides: 63 65 67 69 71

Atomic number

Separation factor relative to curium

MU-16587
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