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REPORT ON CHEMICAL ANALYSES OF PROVIDED SAMPLES

Christopher H. Becker
Molecular Physics Laboratory

SRI Project 3557
Contract No. 1-1EH-46755

MP 93-084

Prepared for:

NASA Marshall Space Flight Center
Huntsville, AL 35812

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REPORT DOCUMENTATION PAGE

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6. AUTHOR(S)
Christopher H. Becker

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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Menlo Park, CA 94025

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13. ABSTRACT *(Maximum 200 words)*

A batch of four samples were received and chemical analysis was performed of the surface and near surface regions of the samples by the surface analysis by laser ionization (SALI) method. The samples included four one-inch diameter optics labeled windows # PR14 and PR17 and MgF2 mirrors 9-93 PPPC exp. and control DMES 26-92. The analyses emphasized surface contamination or modification. In these studies, pulsed desorption by 355 nm laser light and single-photon ionization (SPI) above the sample by coherent 118 nm radiation (at ~5 x 105 W/cm2) were used, emphasizing organic analysis.

For the two windows with an apparent yellowish contaminant film, higher desorption laser power was needed to provide substantial signals, indicating a less volatile contamination than for the two mirrors. Window PR14 and the 9-93 mirror showed more hydrocarbon components than the other two samples. The mass spectra, which show considerable complexity, are discussed in terms of various potential chemical assignments.

14. SUBJECT TERMS	15. NUMBER OF PAGES
EDEF, surface analysis, surface contamination, space environmental effects	17
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17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

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While SPI by 118 nm (10.5 eV) light is considered a generally "soft" (nonfragmenting) form of radiation, stimulated desorption can cause fragmentation and also produce internally hot molecules which photofragment relatively easily compared to lower temperature sources of molecules. Typically, the low mass regions of the mass spectra contain a good deal of molecular fragment information.

Some other comments on the mass spectra are appropriate. The signals from the microchannel plate detector were recorded in analog fashion by a 100 MHz transient digitizer; thus the voltage signals are given as "relative intensity" and not as ion counts. For the two windows with apparent yellowish contaminant films (PR14 and 17), higher desorption laser intensities were needed to provide substantial signals, indicating a less volatile contamination than for the two mirrors (or possibly poorer absorptivity of 355 nm light). For sample PR17, and a little bit for the control mirror (DMES 26-92), direct ion signals (intense and broad mass peaks on a different mass scale--different time zero) are seen in the low mass region.

Some of the mass assignments have been marked on the figures, especially for the major peaks. Considerable effort can be invoked for mass interpretation. Some possible brief general interpretations now follow. Window PR14 and the 9-93 MgF2 mirror show considerably more hydrocarbon fragments at low masses and thus likely contain much more hydrocarbon components than the other two samples.

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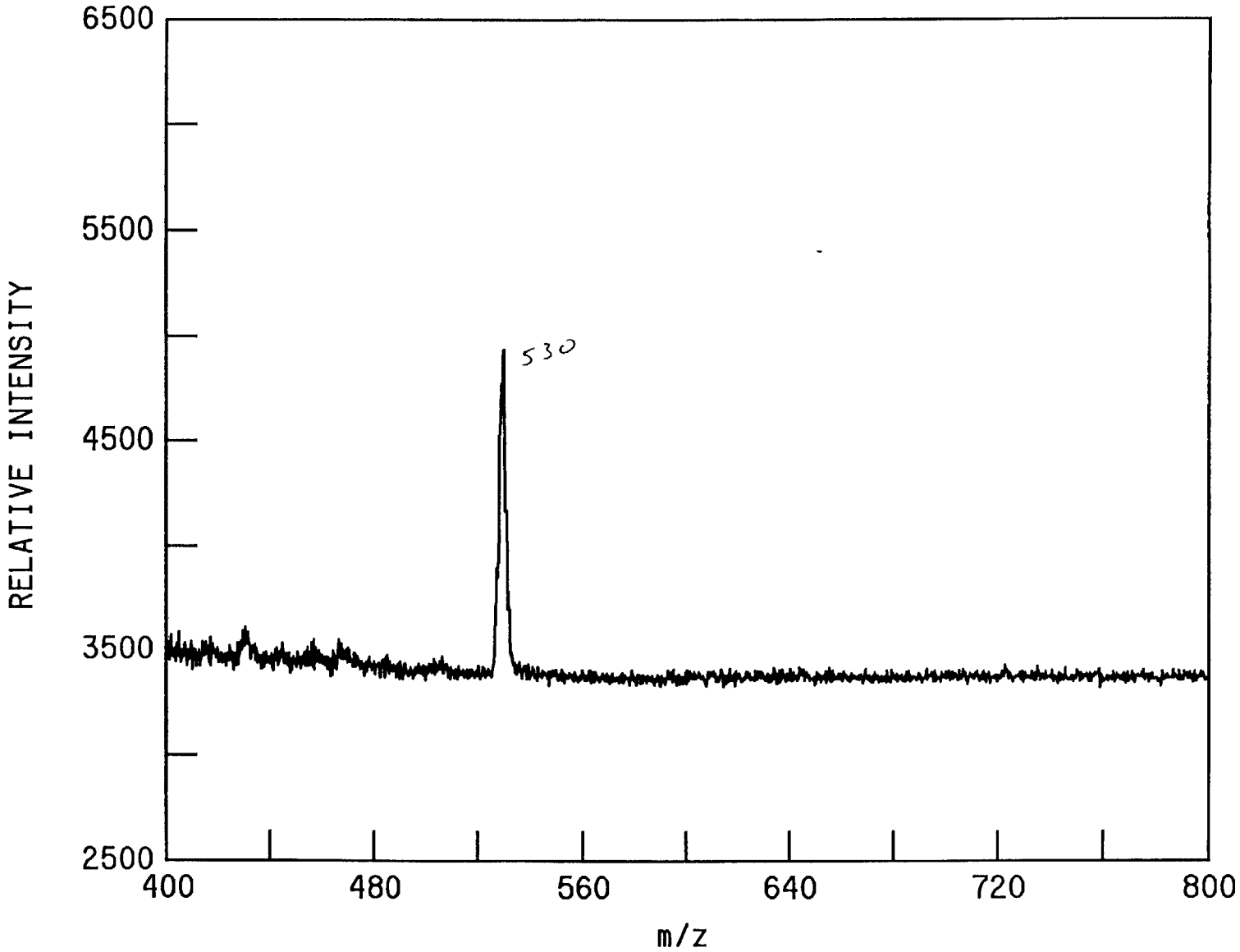
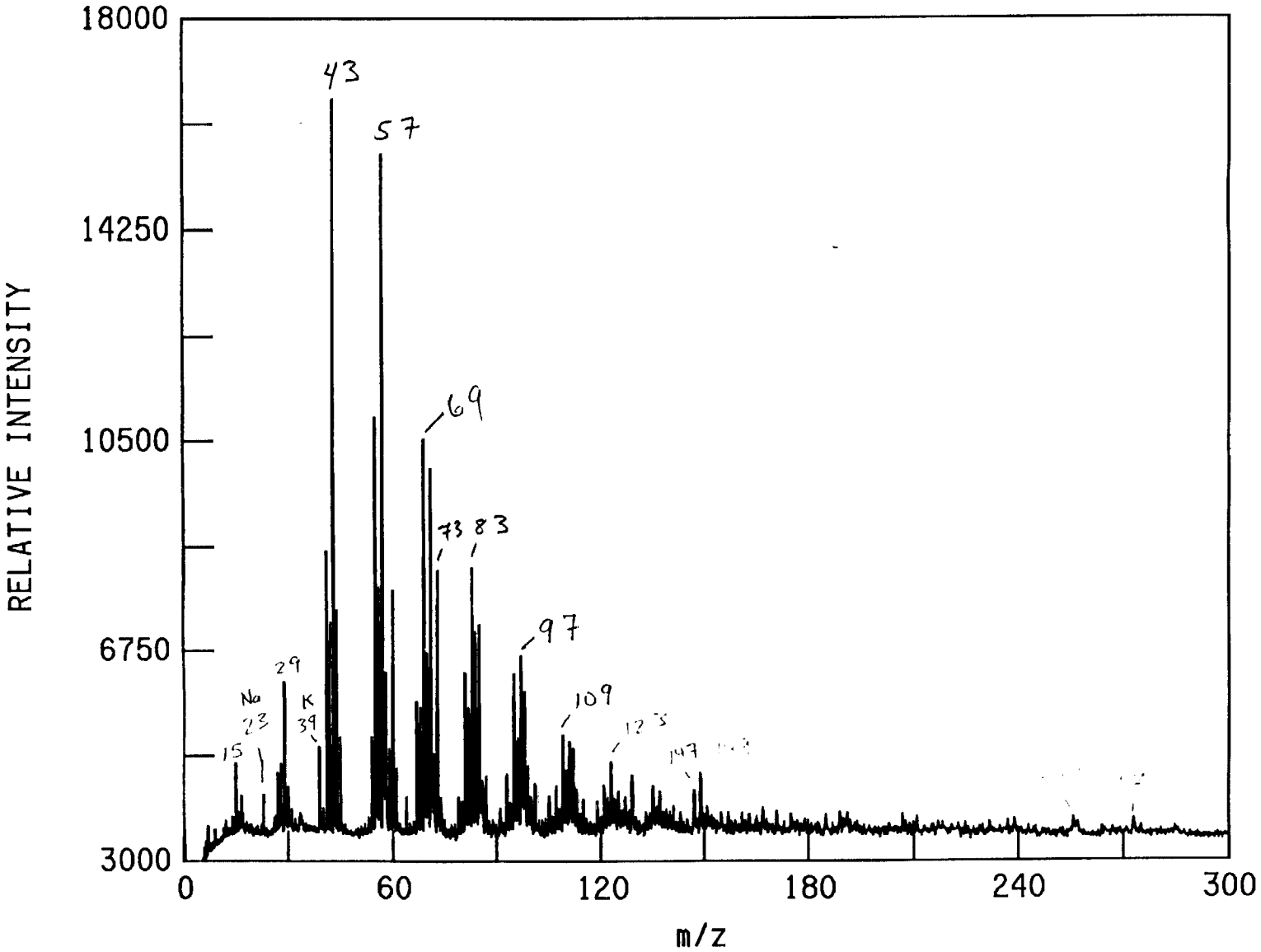
For the two MgF2 mirrors, there are numerous major mass peaks in common such as 43, 57, 97, 112, 149, 167. 185 and 221. Note that 221 can possibly be assigned to a silicone, but the other peaks are not commonly associated with silicones except m/z 129 in the 9-93 mirror which can be rationalized as a Si2C5H13 structure. Masses 97, 112, 149, 167, and 185 can be assigned to CxFyOz structures. As to the higher mass assignments for the control mirror, it is not clear (especially with no detailed knowledge of sample history) what structures are associated with these masses; however, these peaks will be very characteristic of whatever compound(s) is present.



MgF2 MIRROR CONTROL, DMES 26-92, 355+118 NM, AP1417



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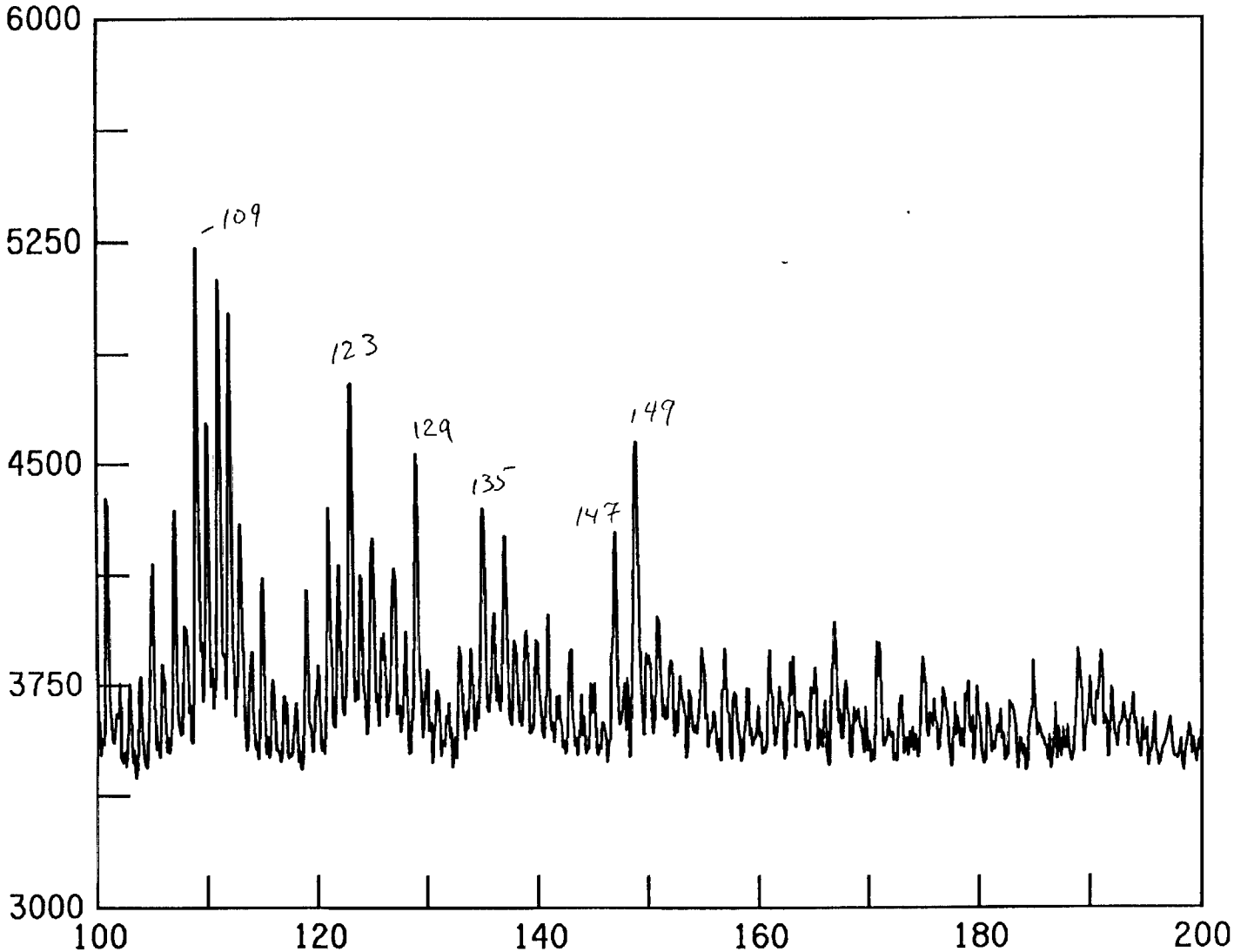

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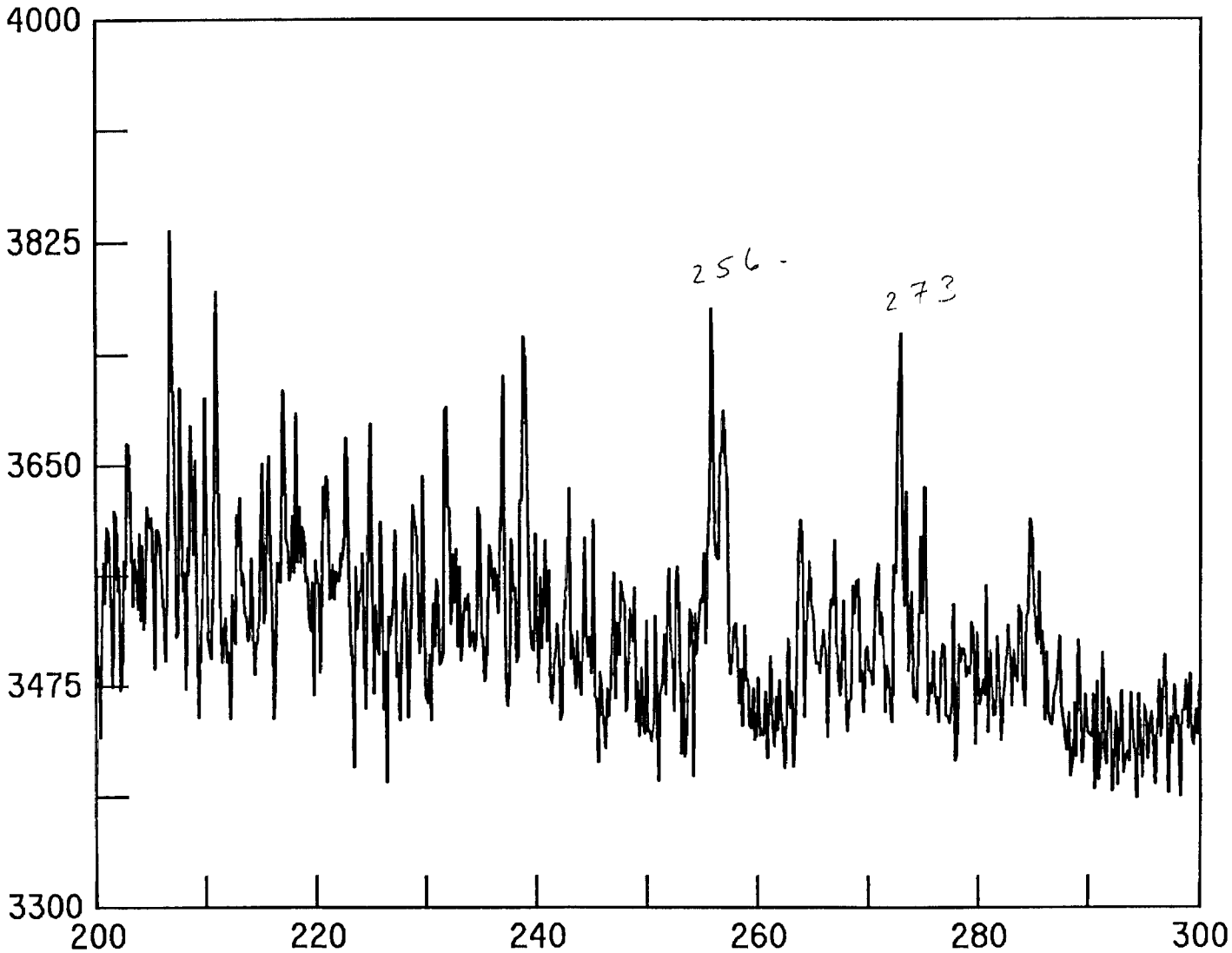

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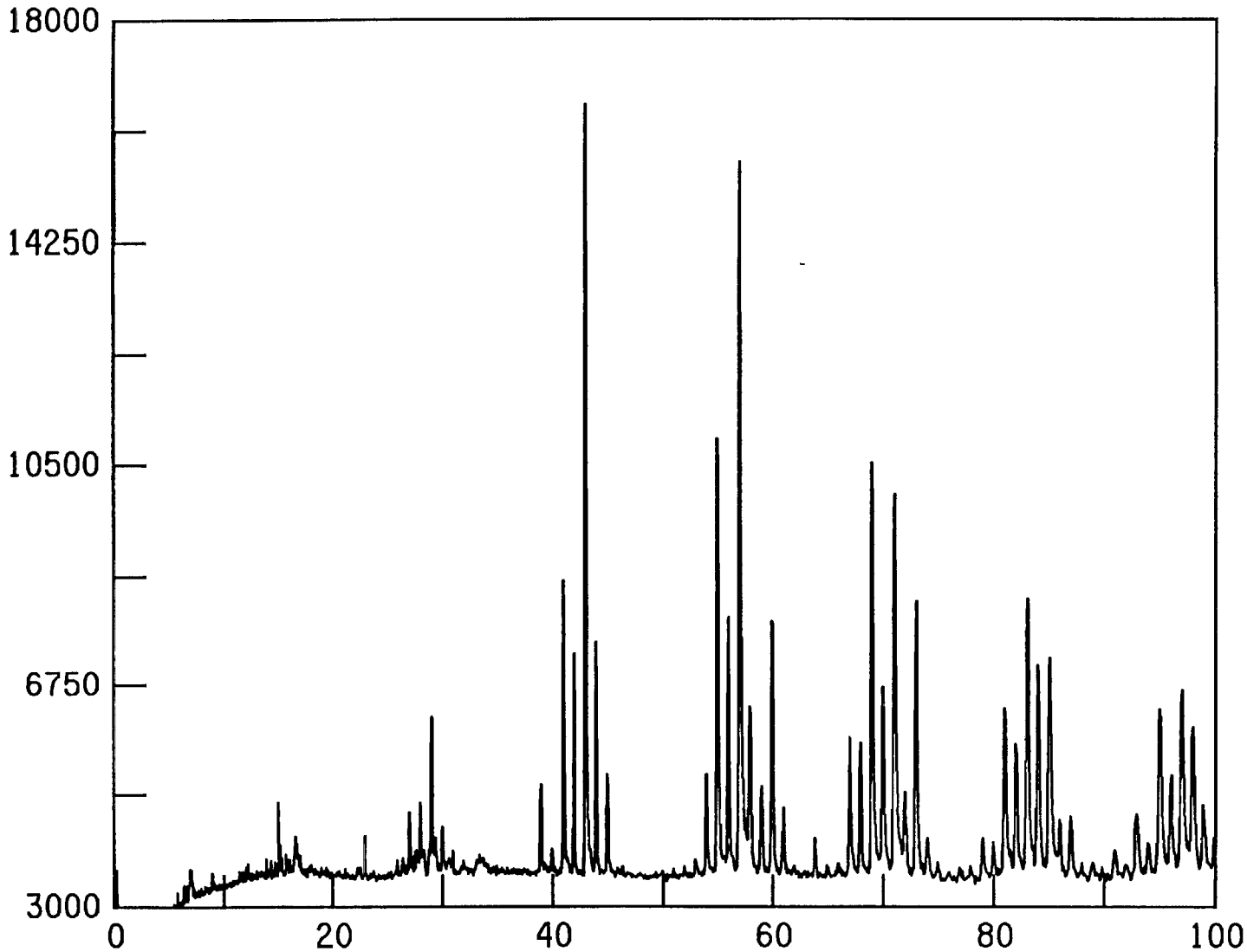

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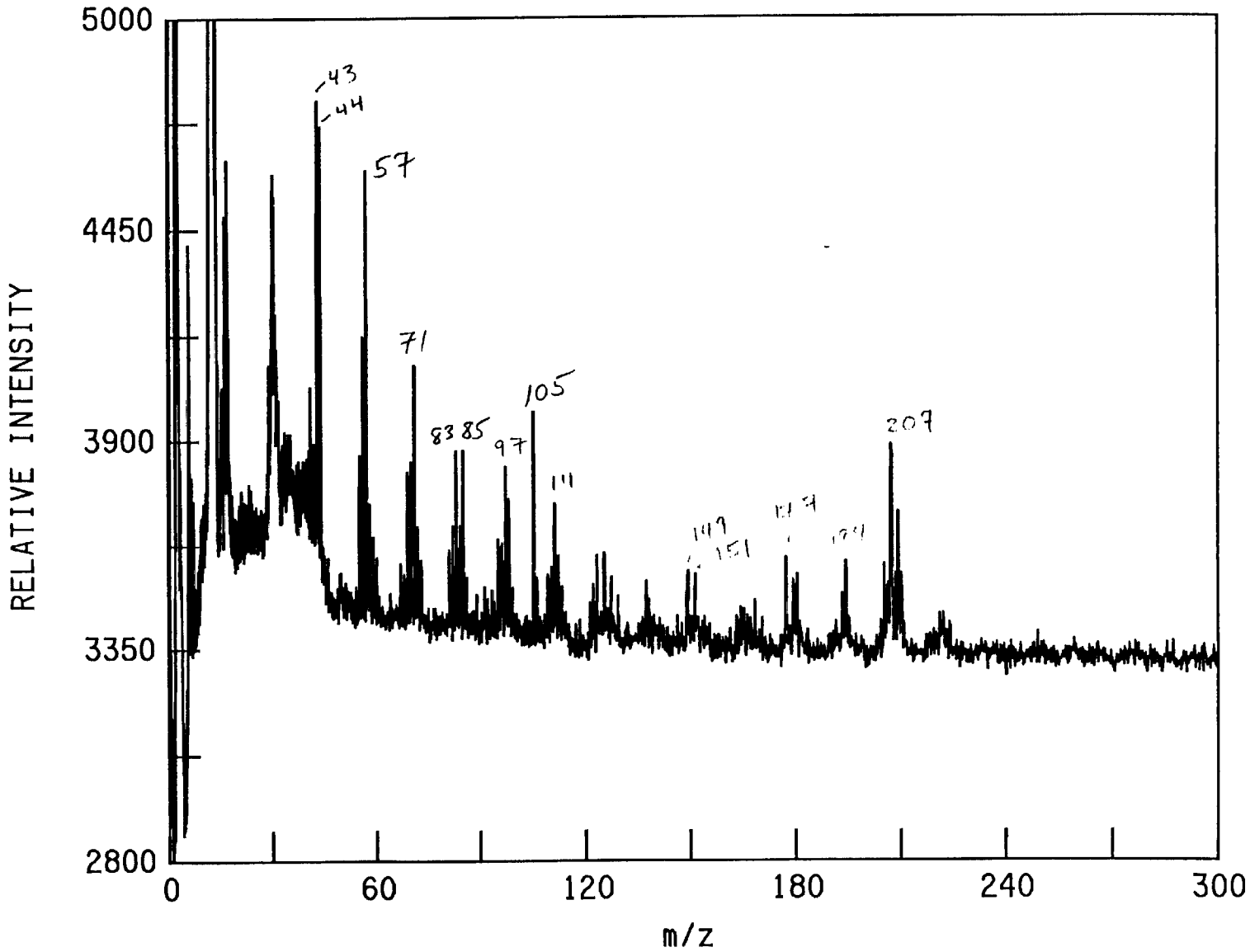

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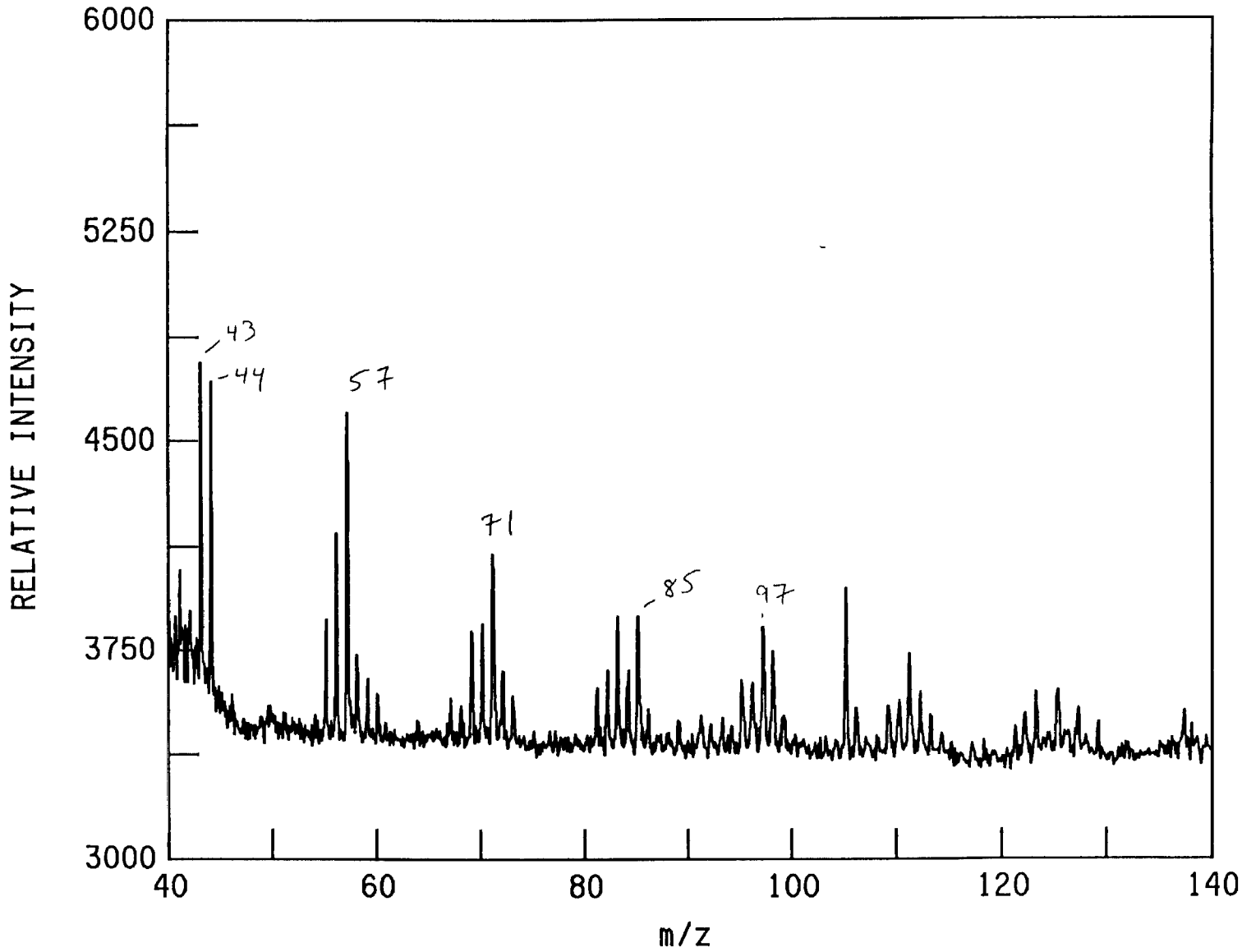

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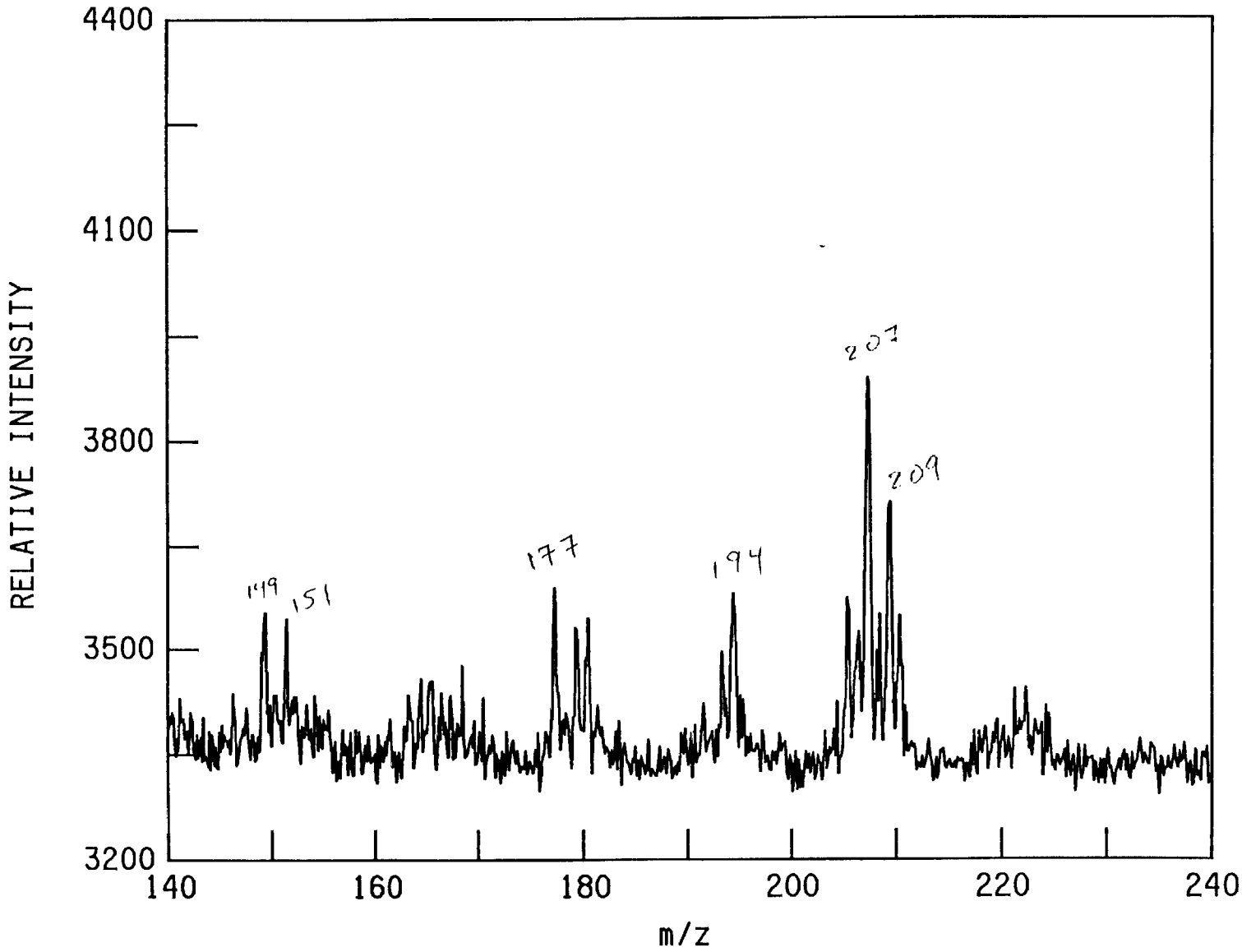

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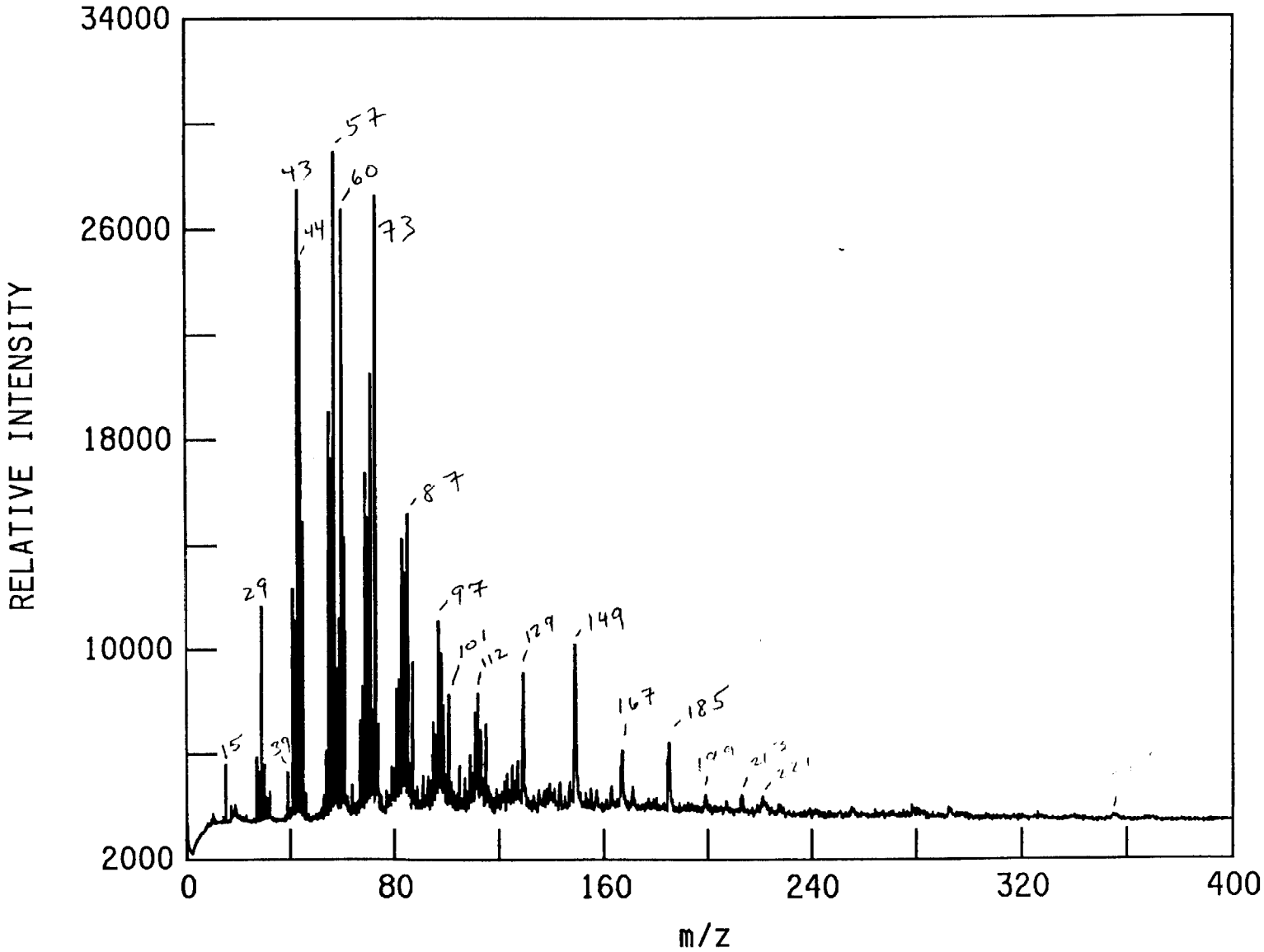
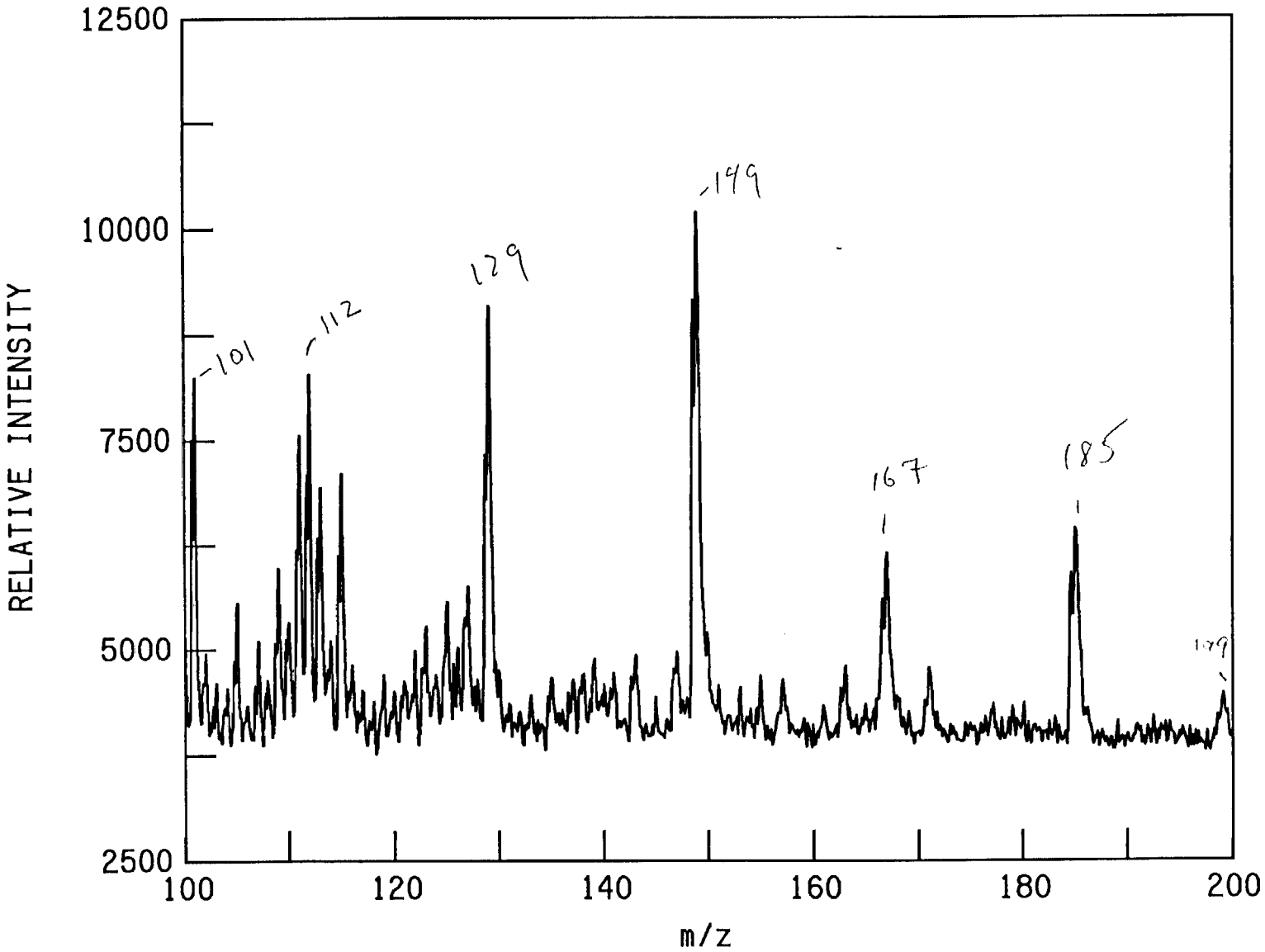


MgF2 MIRROR 9-93 PPPC exp., 355+118 NM, AP1414



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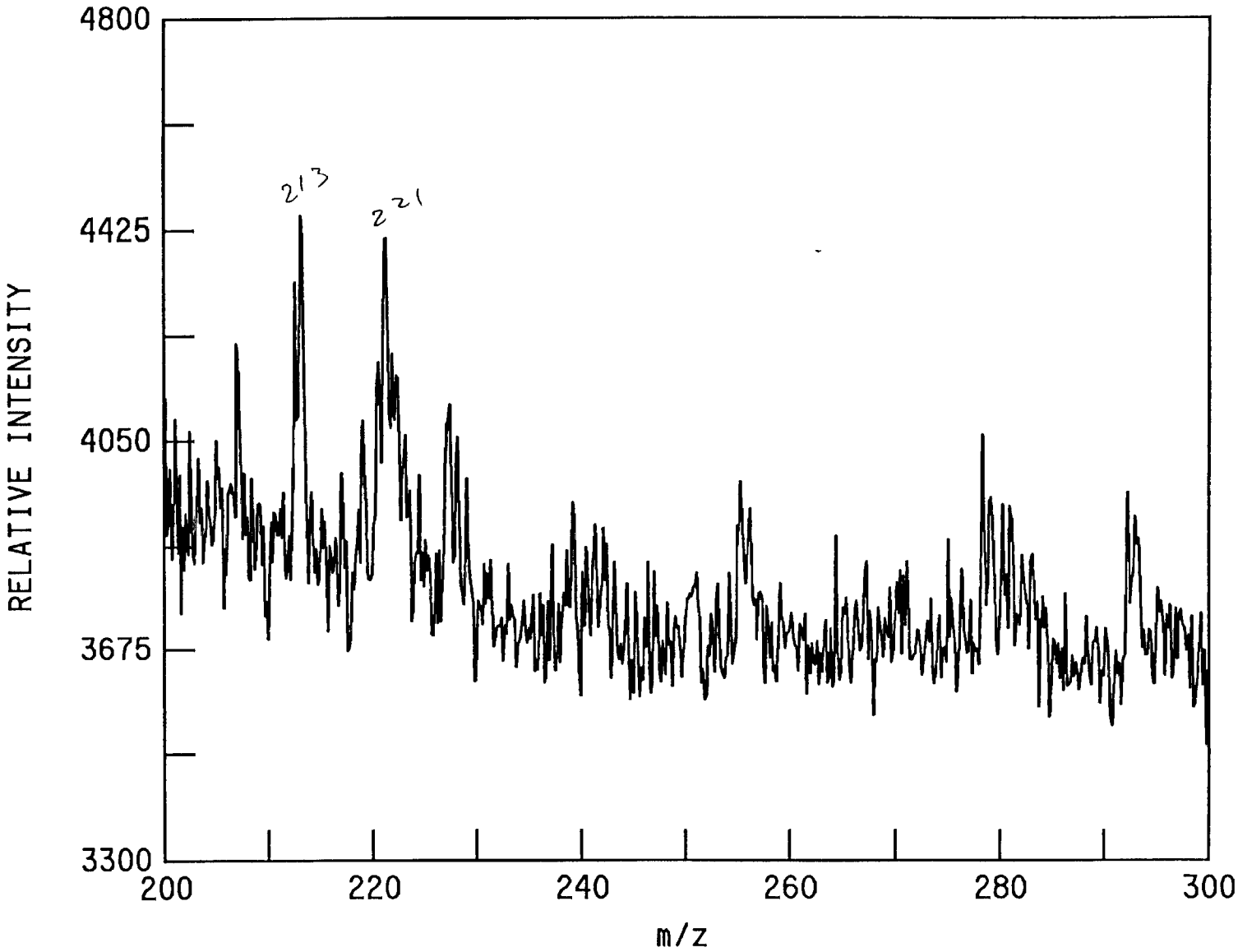

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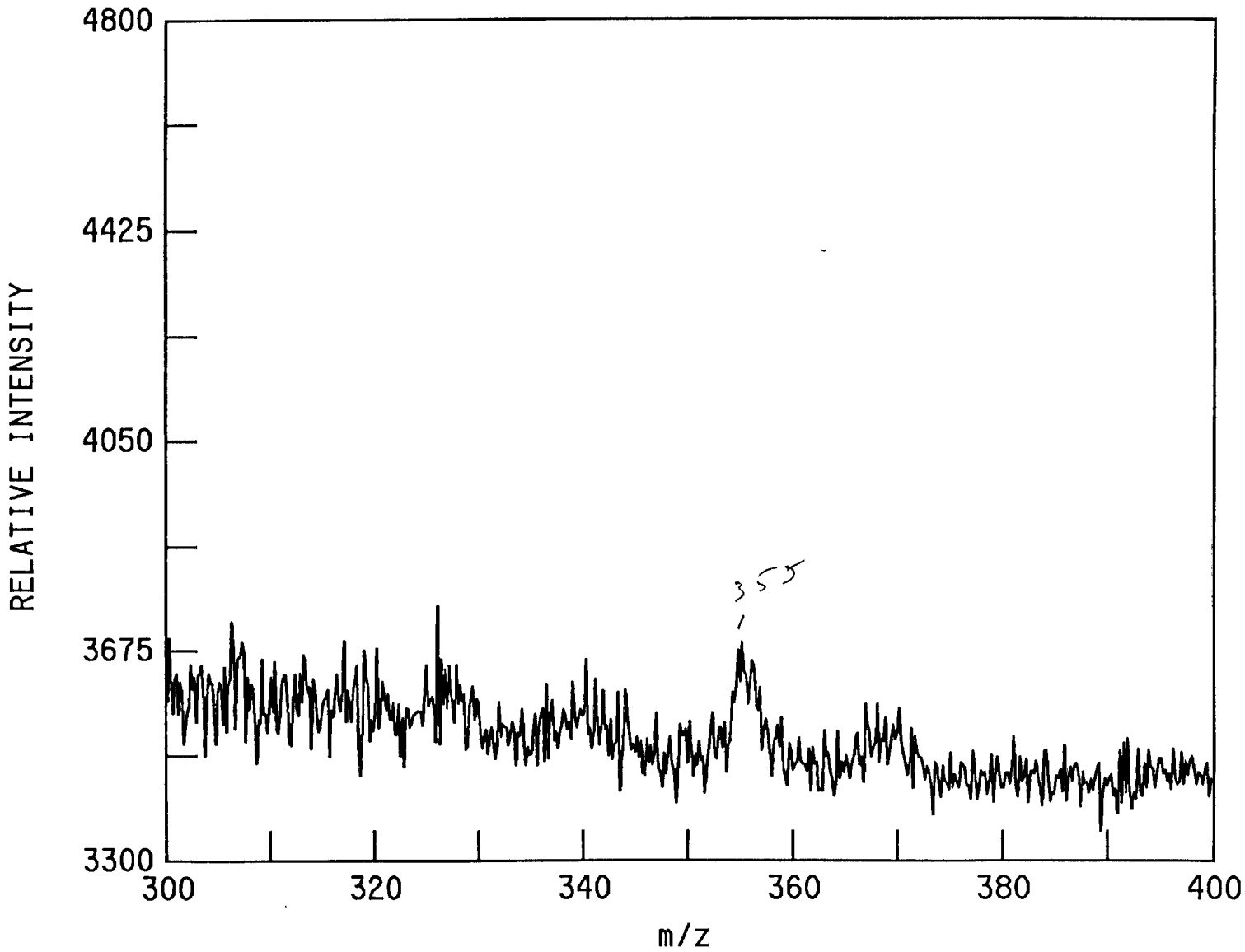

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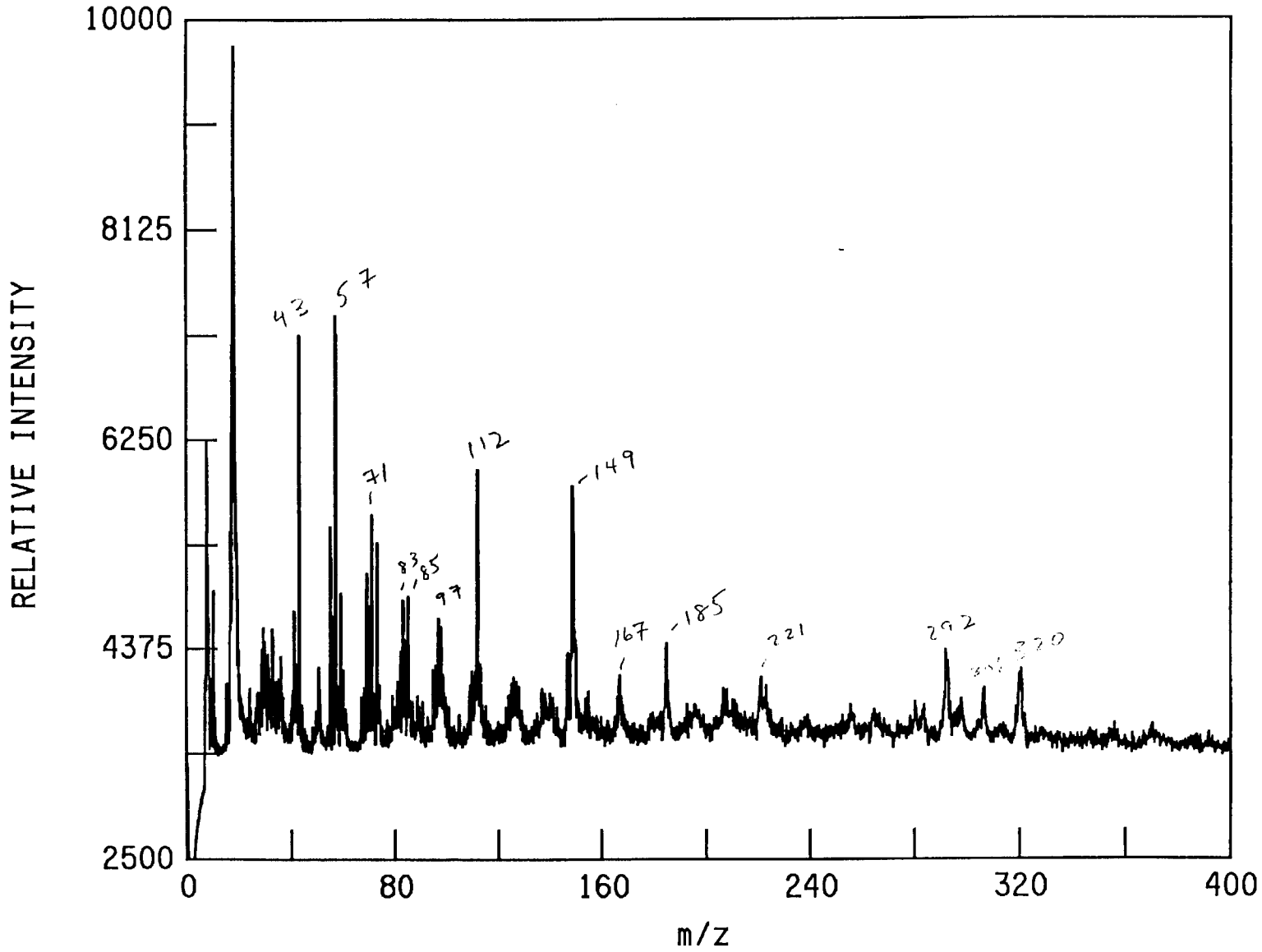
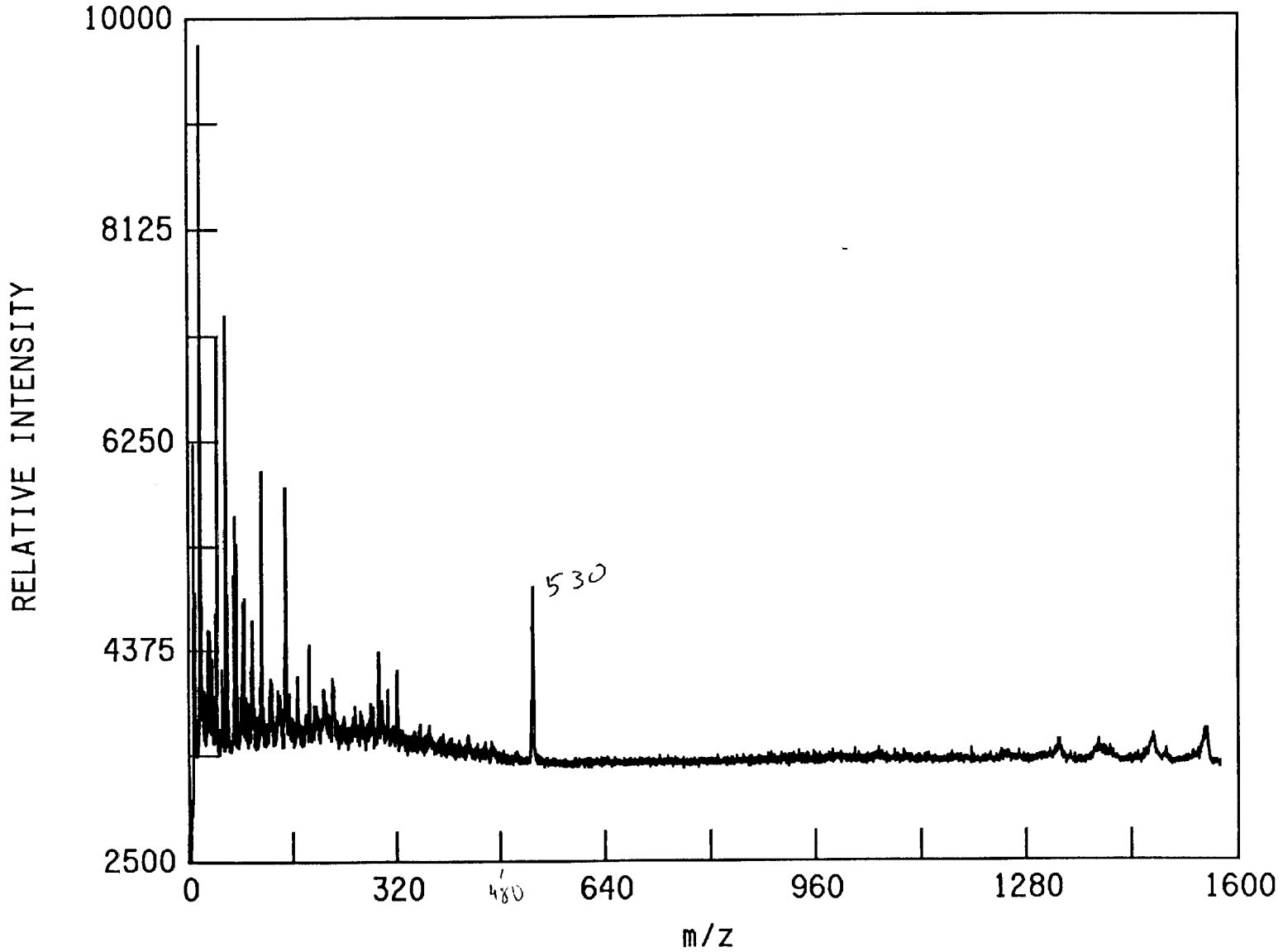


MgF2 MIRROR CONTROL, DMES 26-92, 355+118 NM, AP1417



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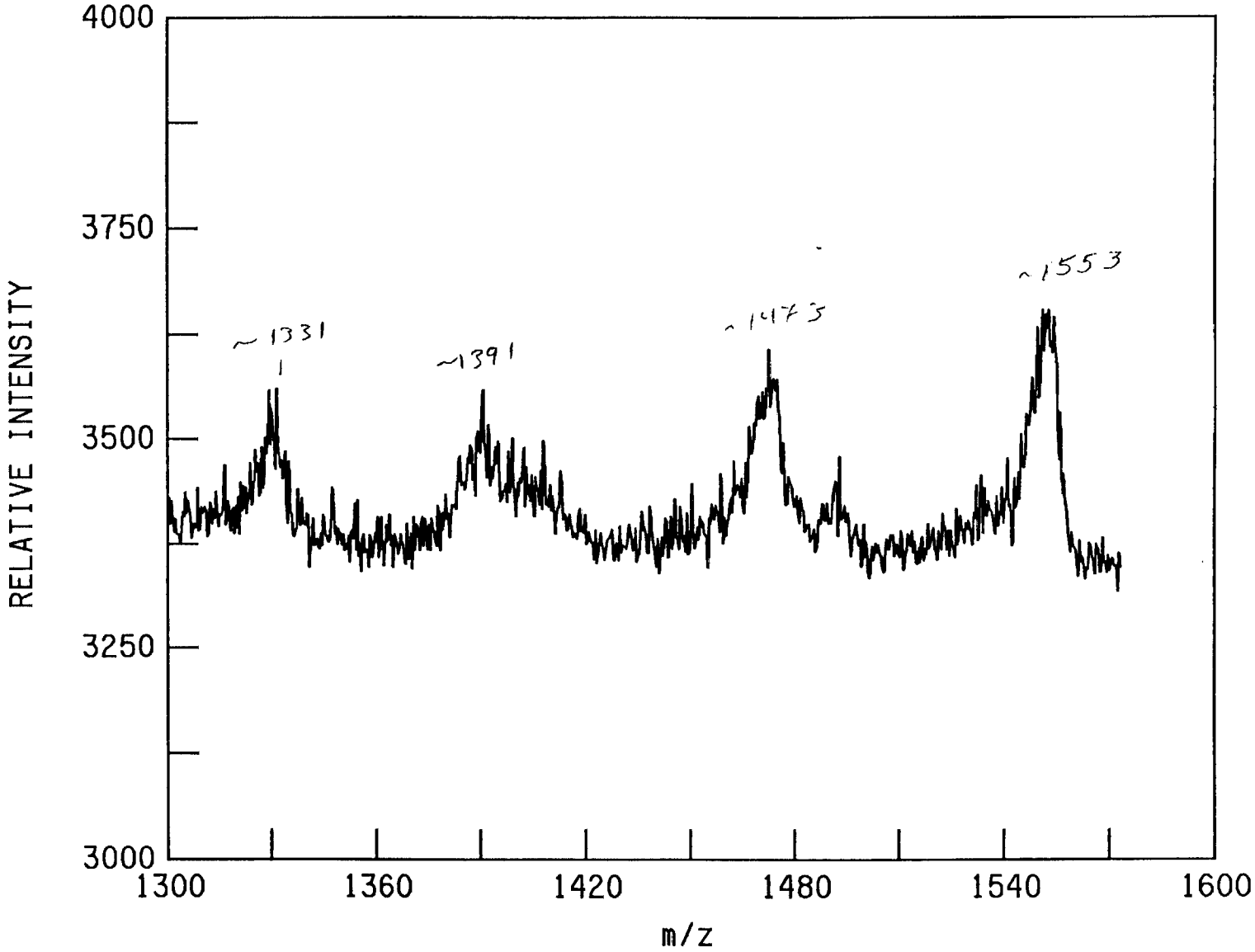

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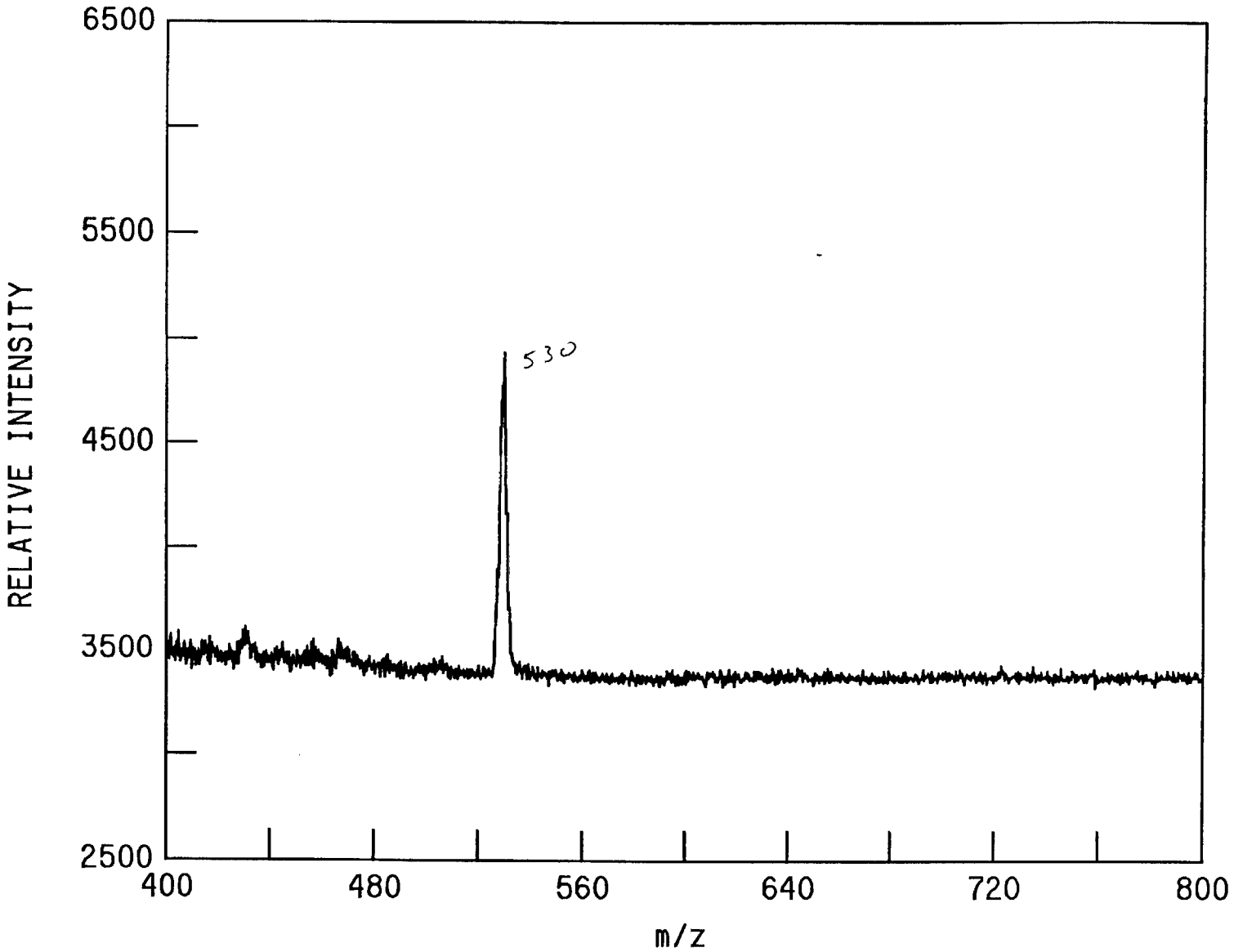
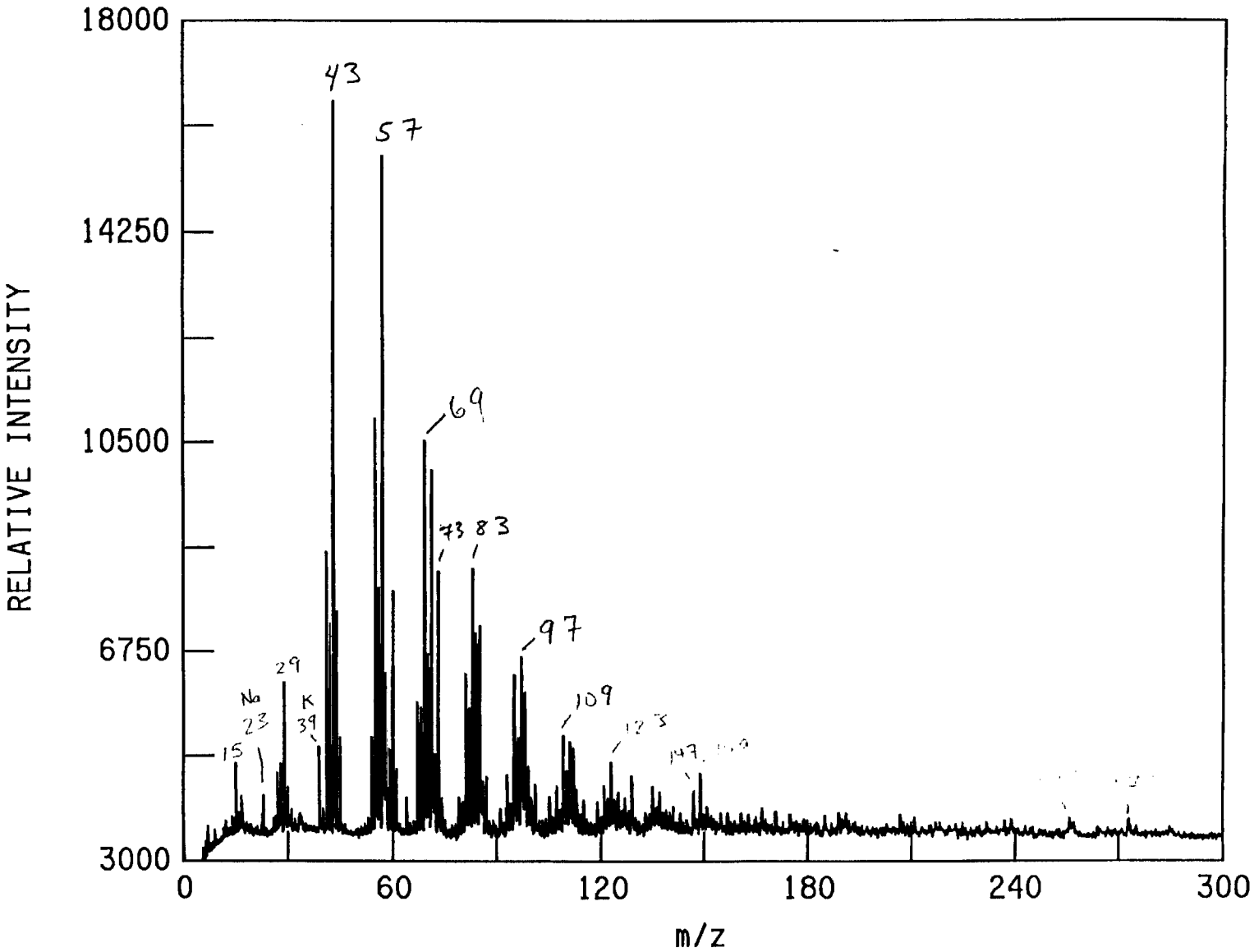


MgF2 MIRROR CONTROL, DMES 26-92, 355+118 NM, AP1417



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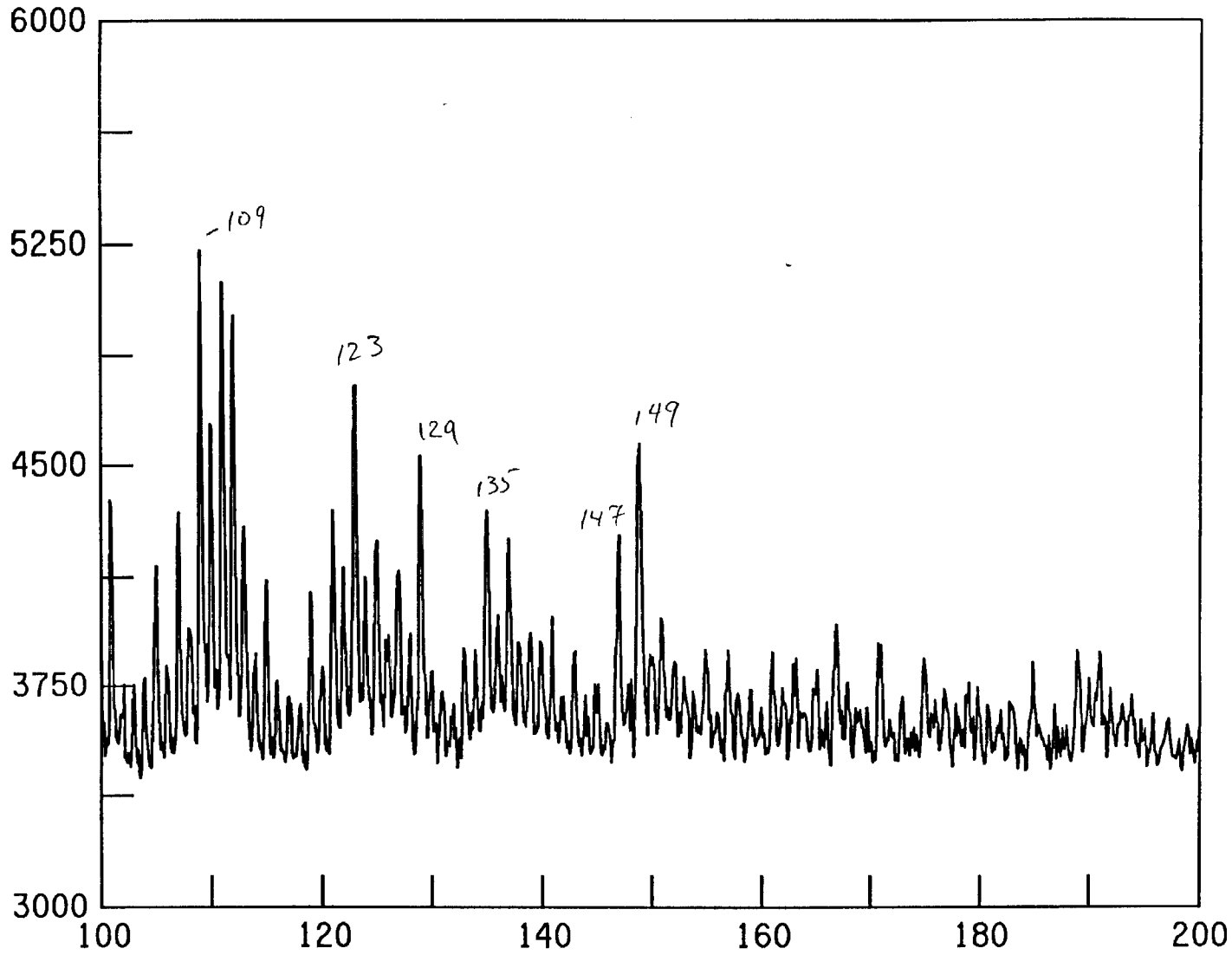

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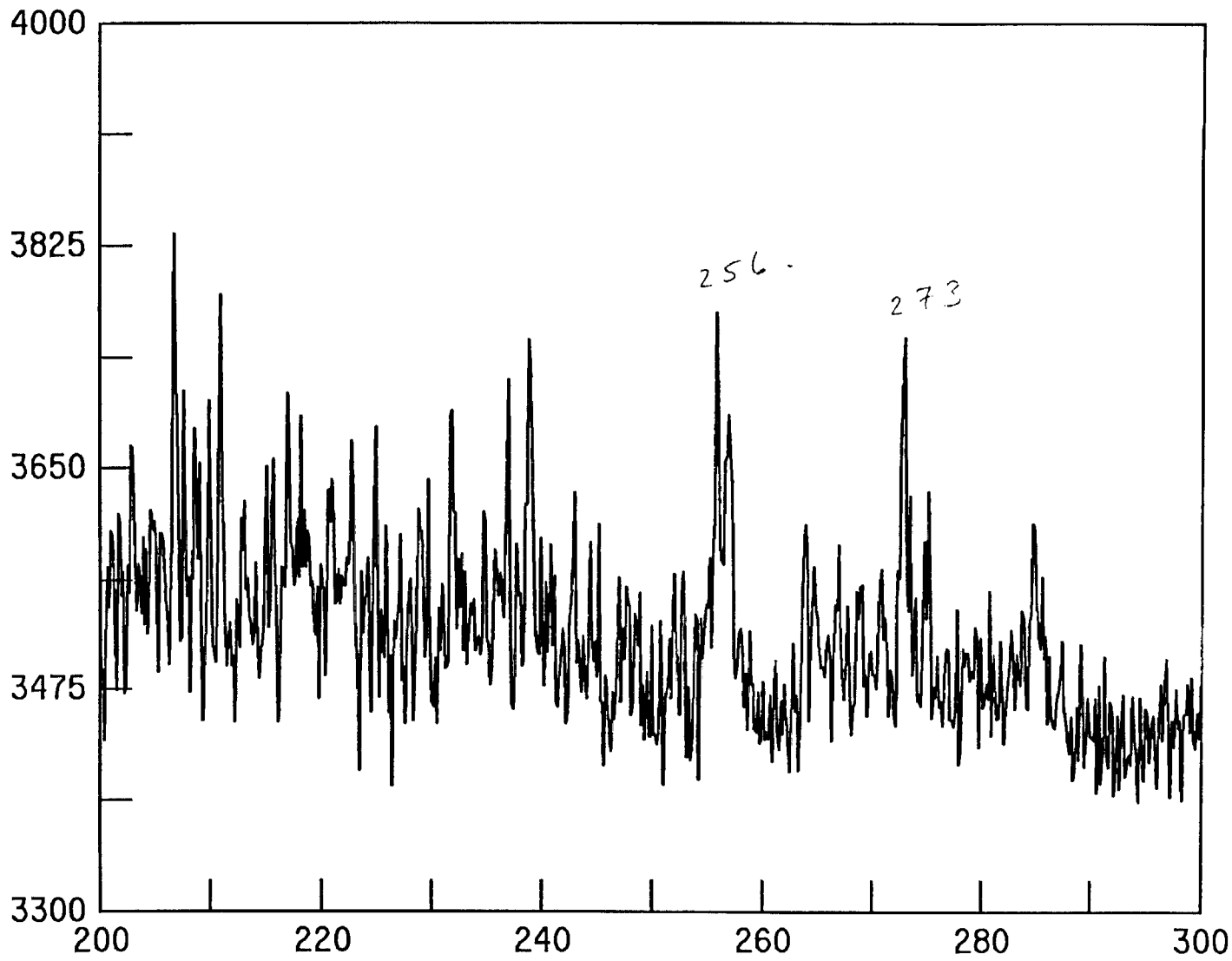
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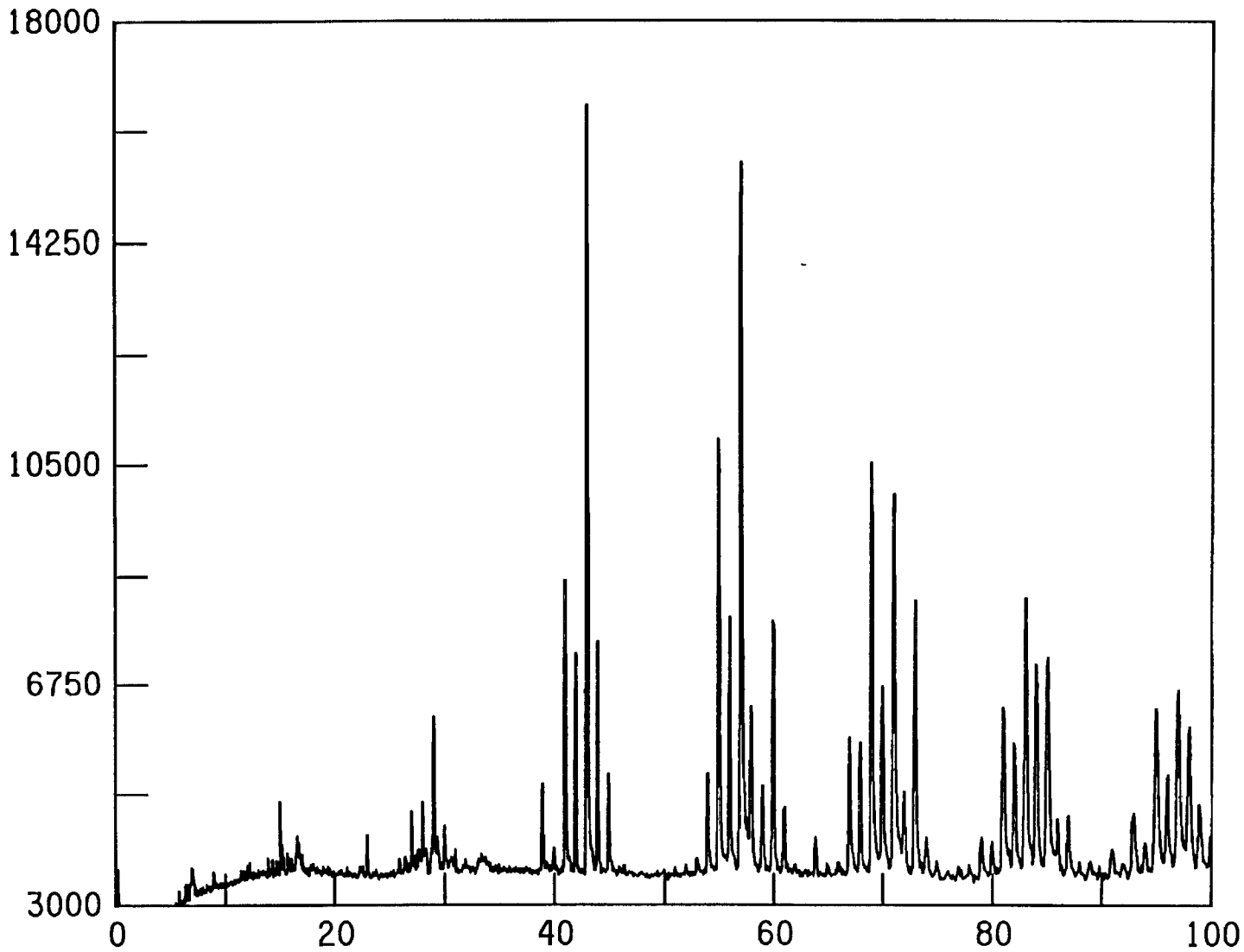

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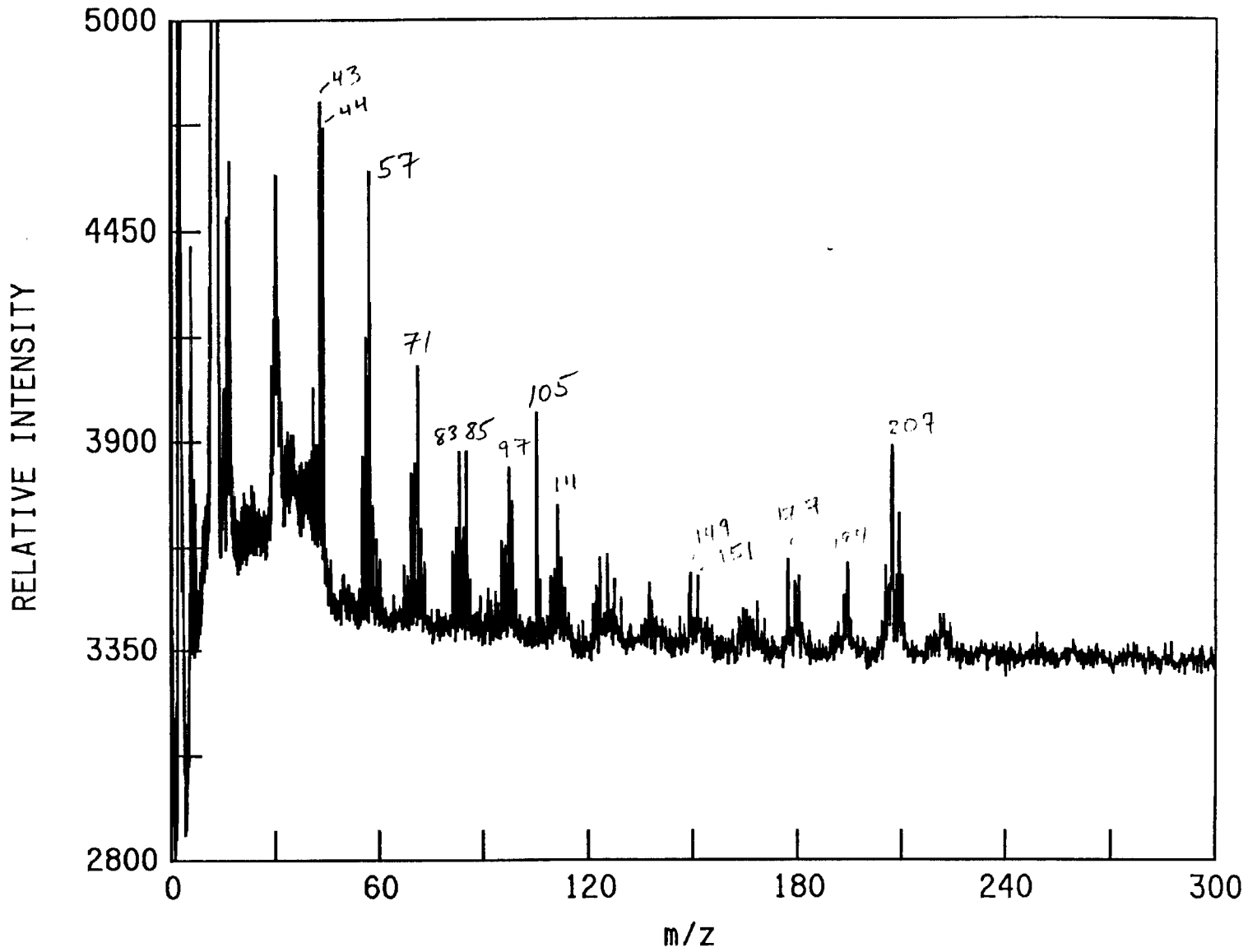

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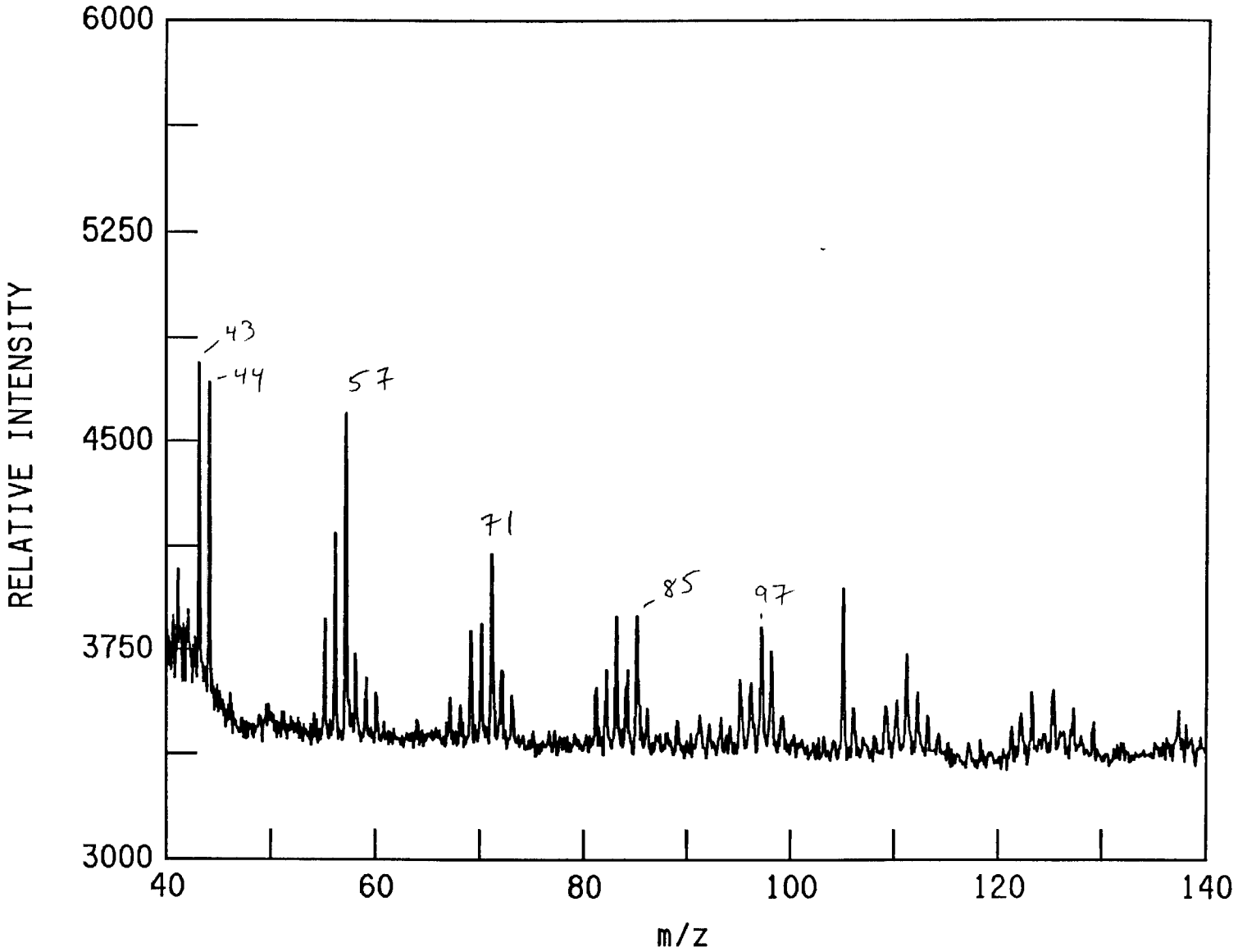

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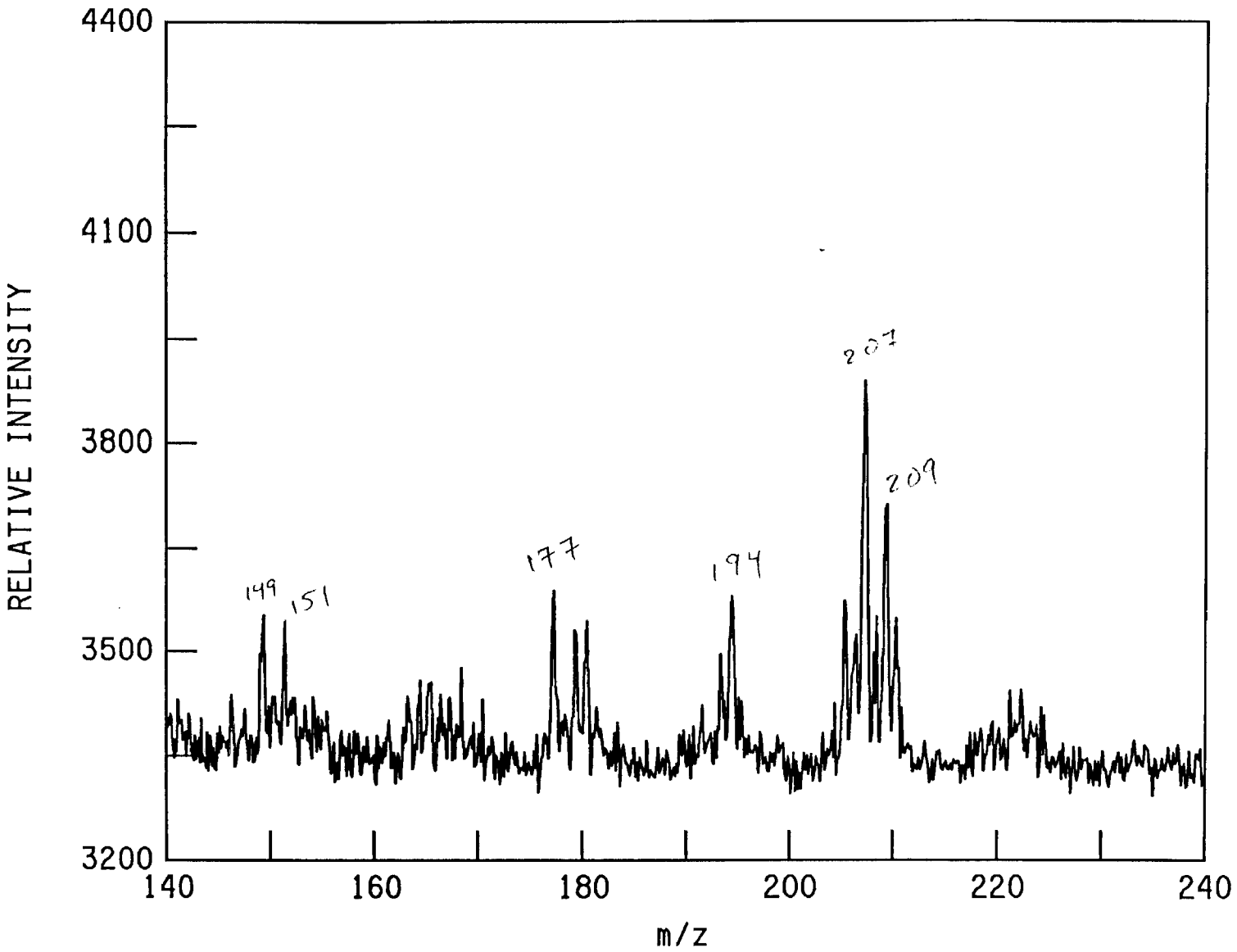

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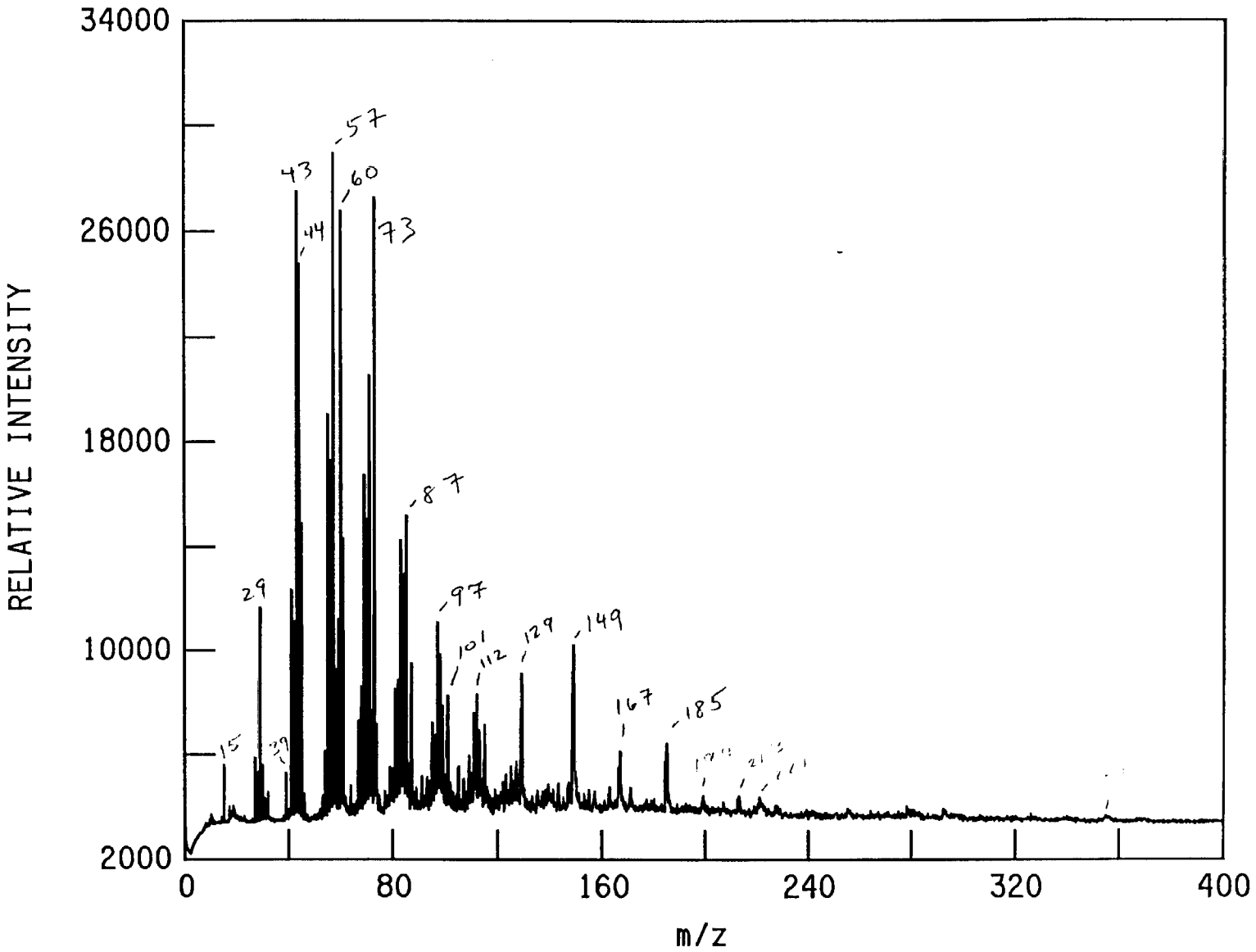

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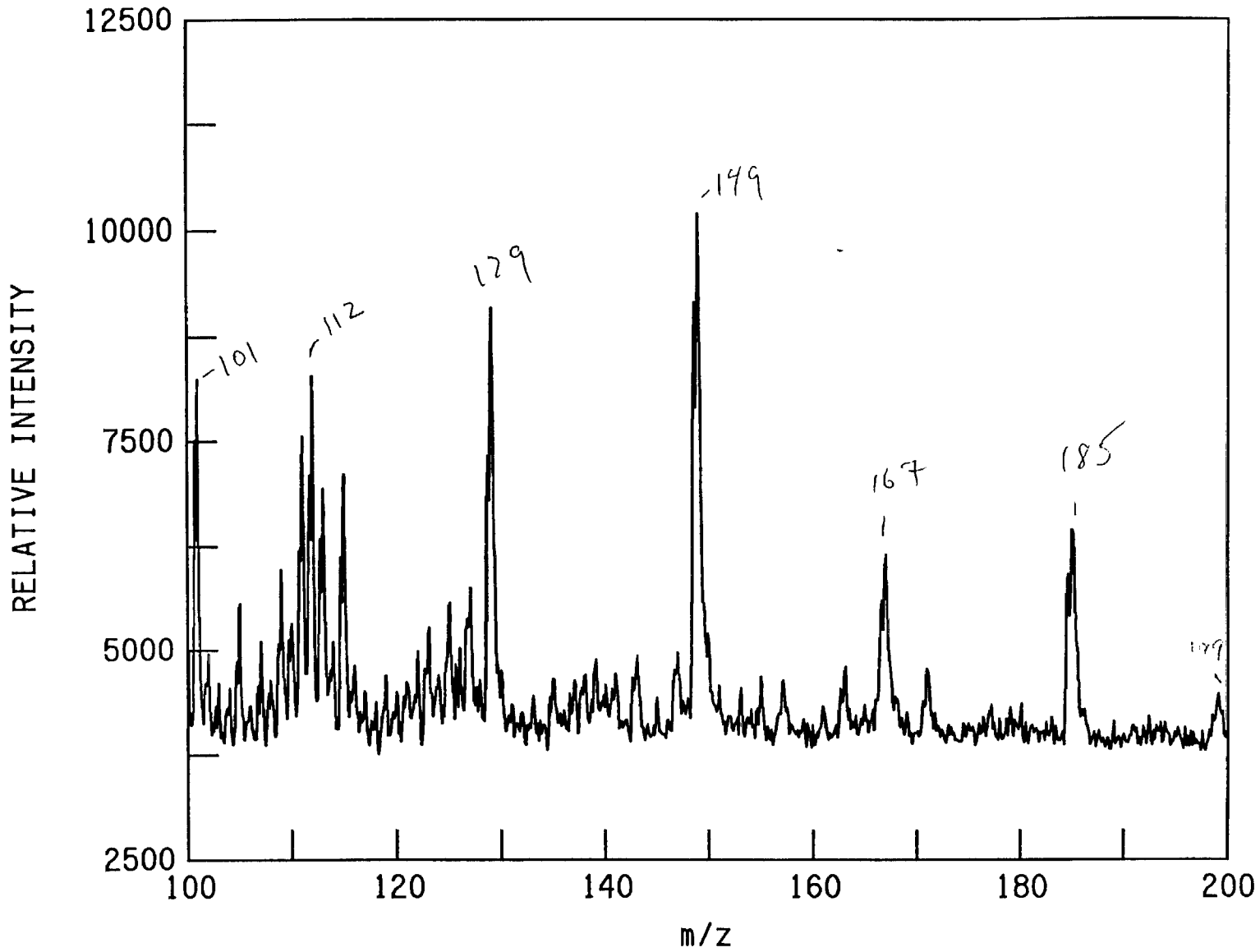

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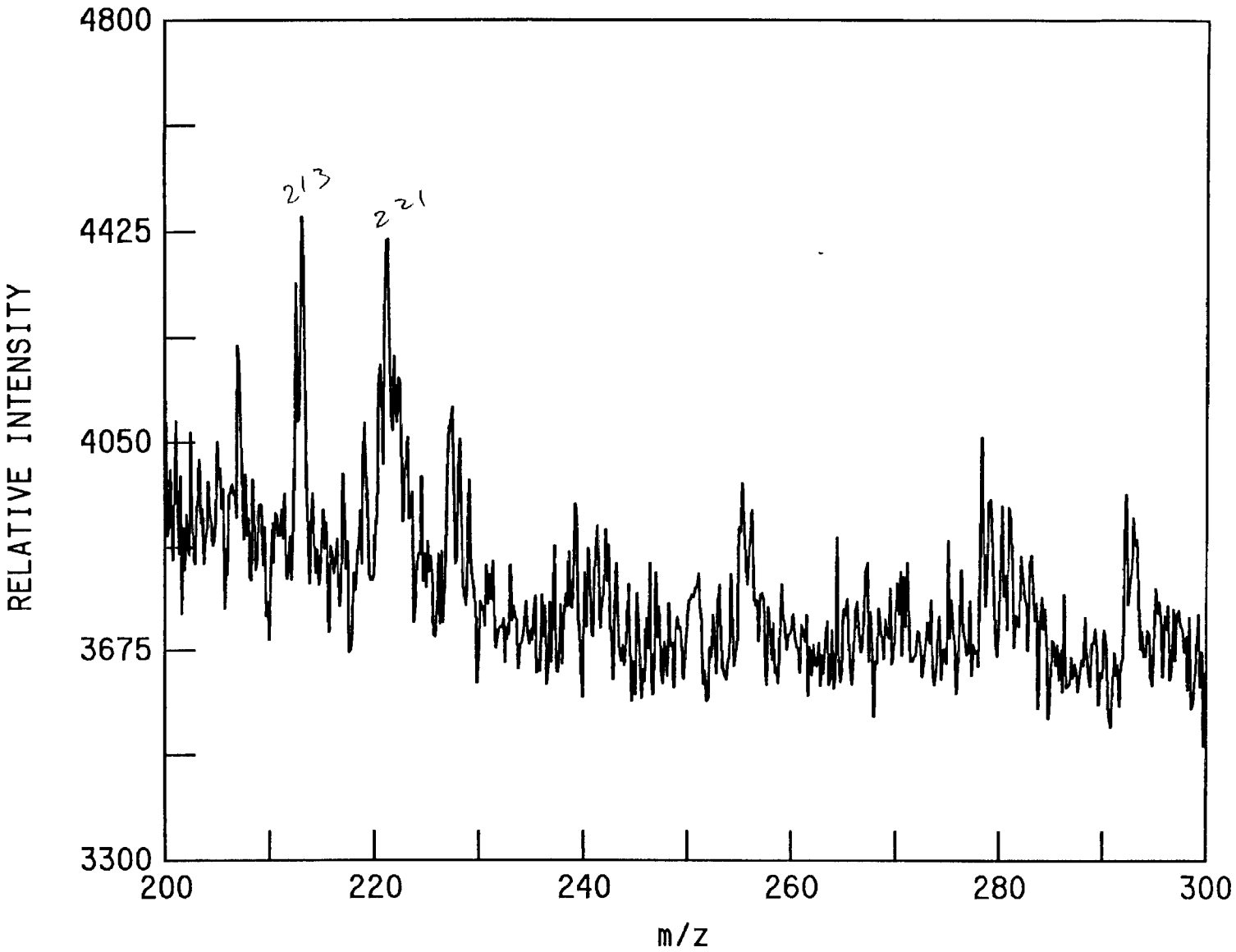

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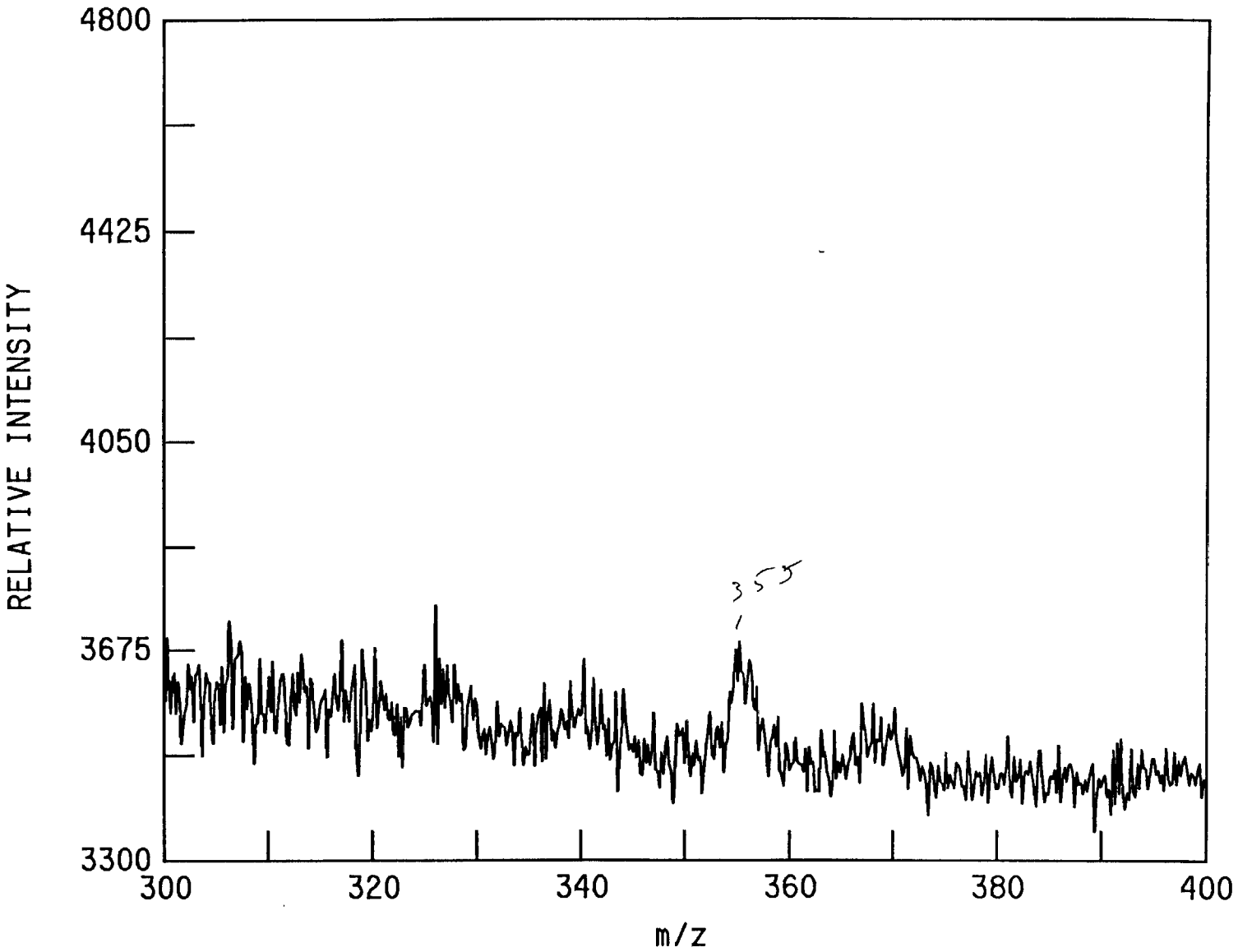

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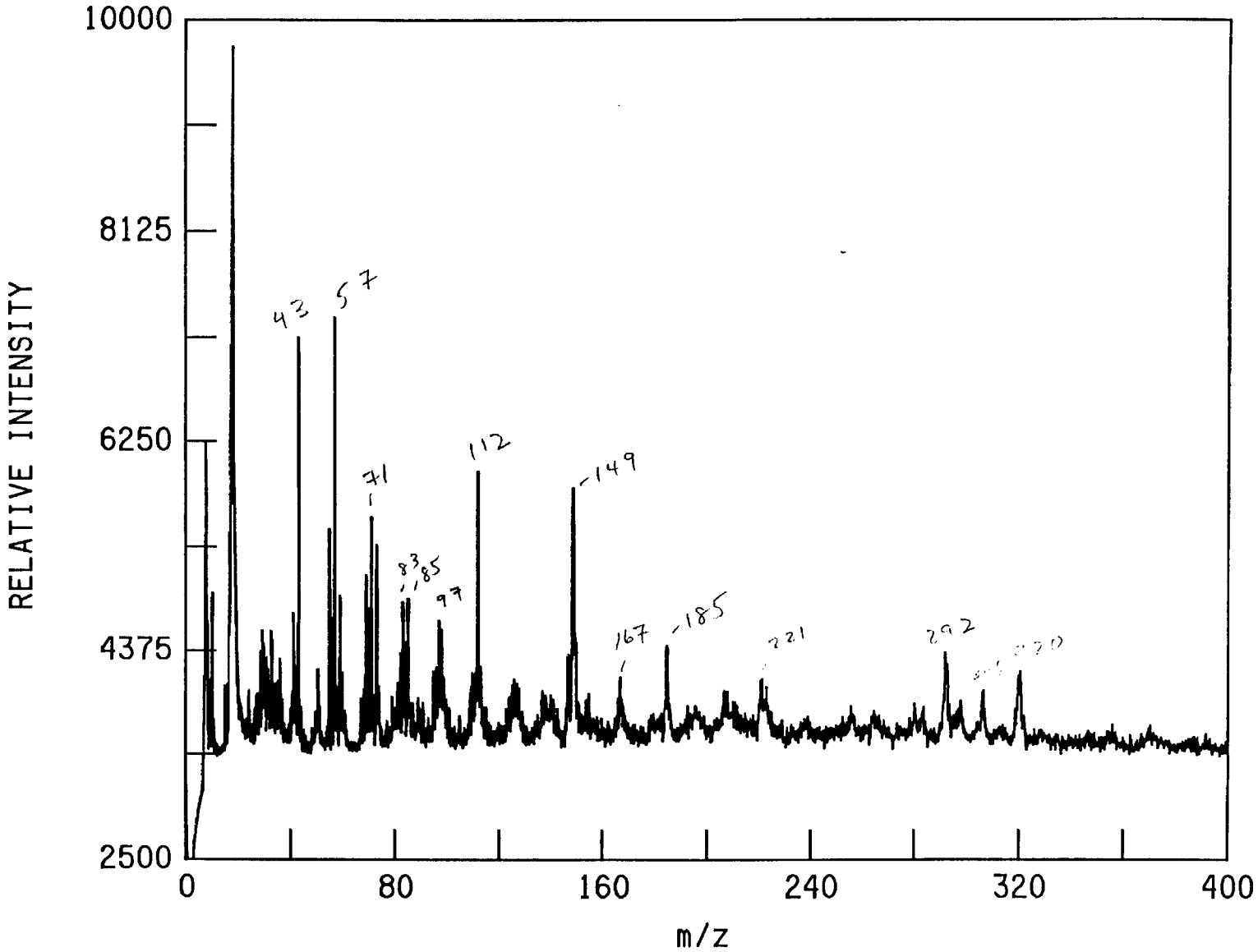
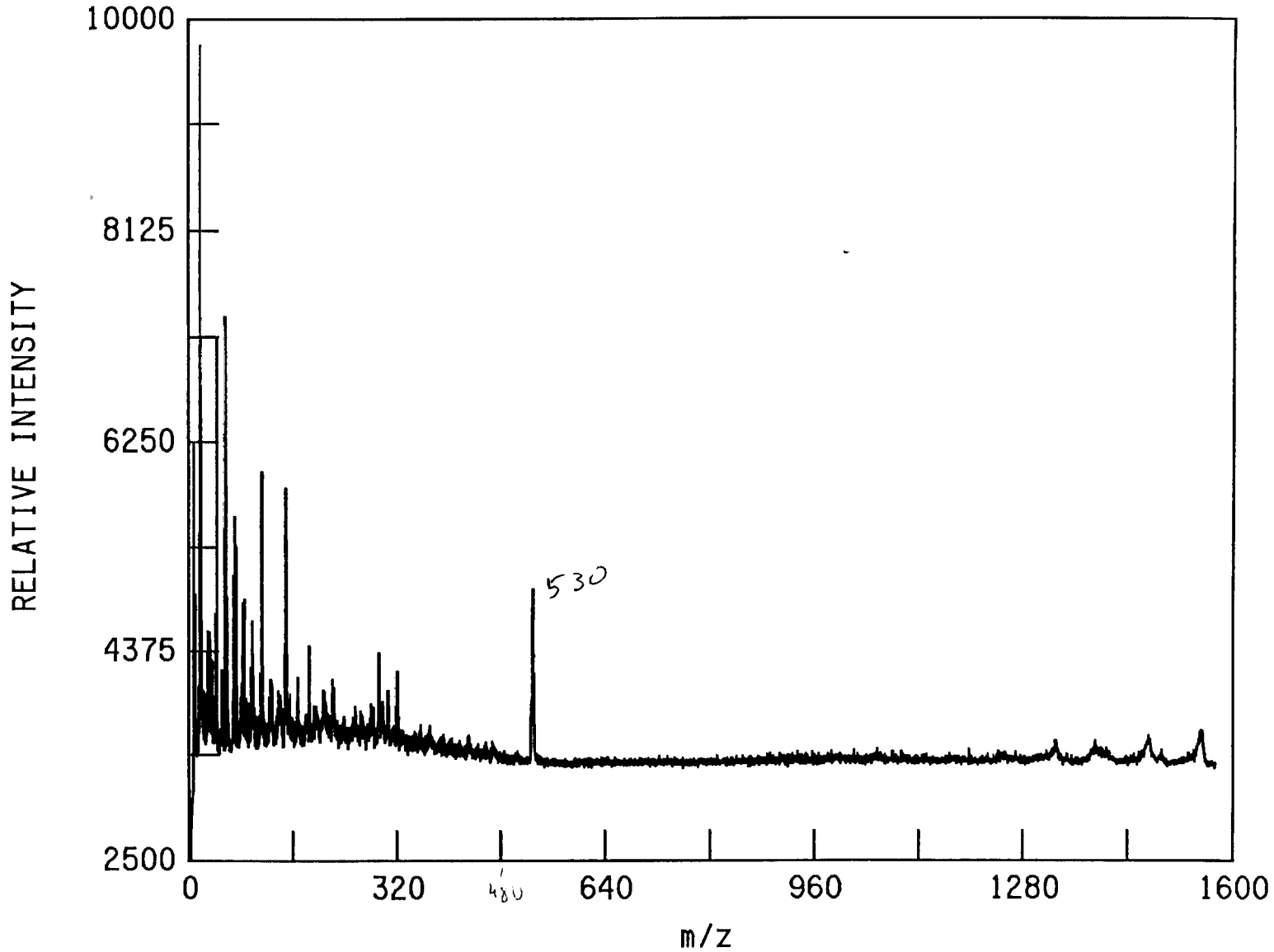


MgF2 MIRROR CONTROL, DMES 26-92, 355+118 NM, AP1417



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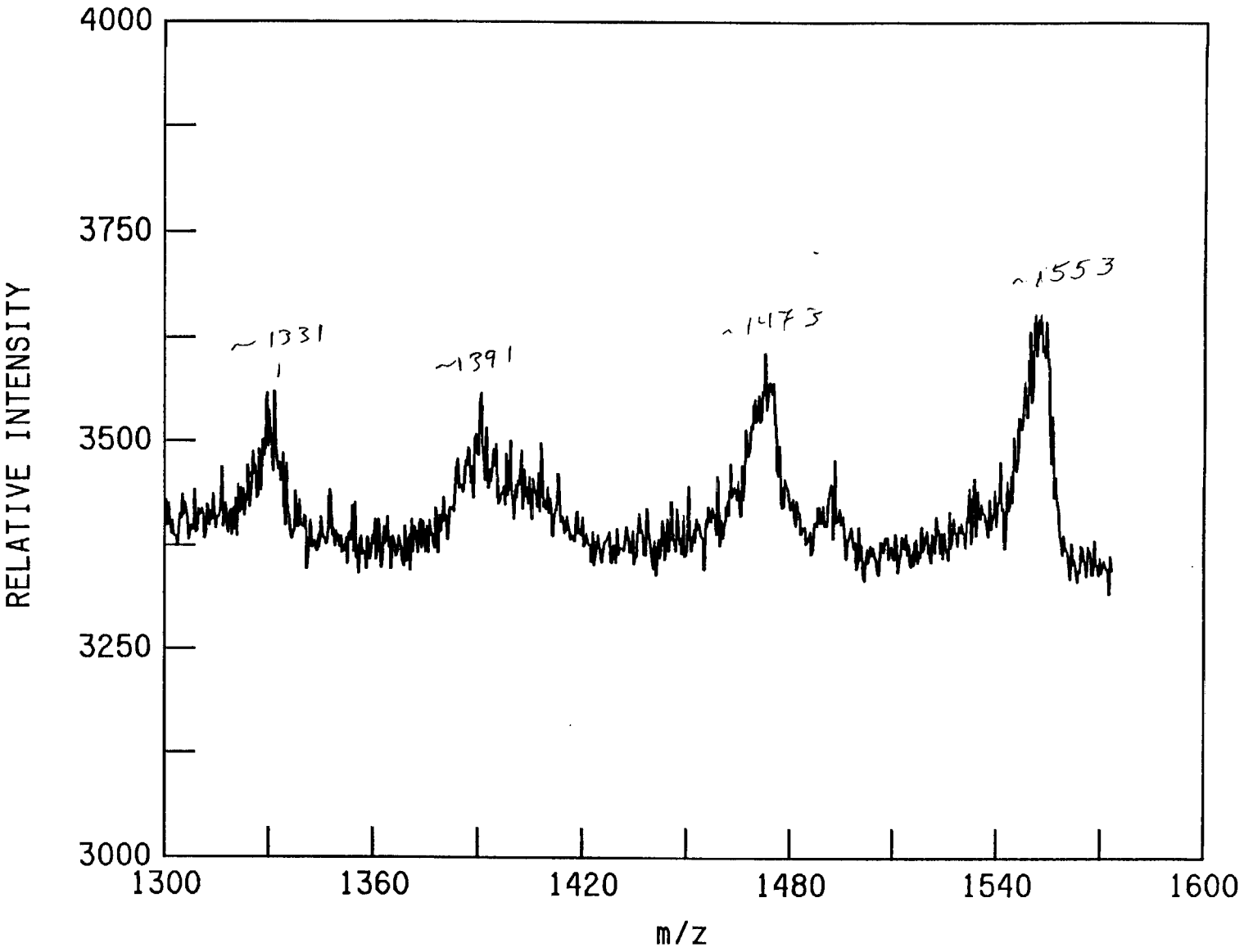

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