

Rearrangement of The TMS ester of 4-Difluoromethoxy-N-methylbenzylamine and analogs in EI mass spectra

Quan-Long Pu, Yufang Zheng, Kirill Tretyakov, Edward Erisman

National Institute of Standards and Technology, Gaithersburg, MD 20899

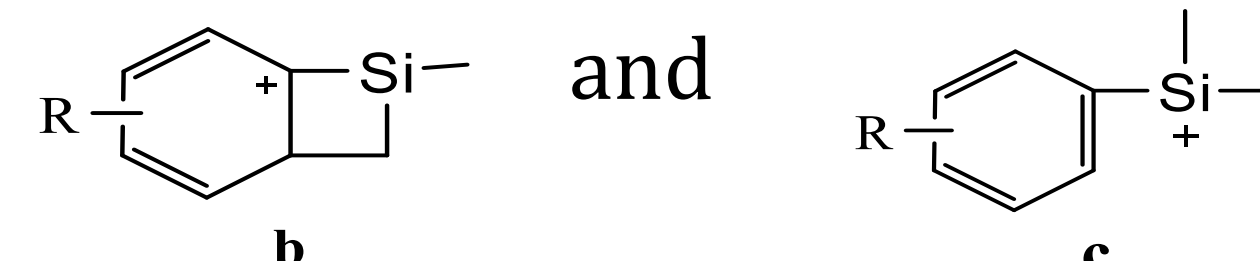


Overview

During the interpretation of the TMS ester of 4-Difluoromethoxy-N-methylbenzylamine and analogs, the occurrence in mass spectra of the characteristic ion formed by the rearrangement of the TMS group and intramolecular reaction with simultaneous loss of CH_2NH or CH_2NCH_3 .

Introduction

In the course of adding spectra to the NIST/EPA/NIH Mass Spectral Library, we investigated the unusual migration of a trimethylsilyl group in a TMS ester of 4-Difluoromethoxy-N-methylbenzylamine and analogs. Specifically, we report corroborated by GC/MS, GC/MS/MS, and HRMS a mechanism of the formation of characteristic ions from the $[\text{M}-\text{CH}_3]$ (ion **a**):

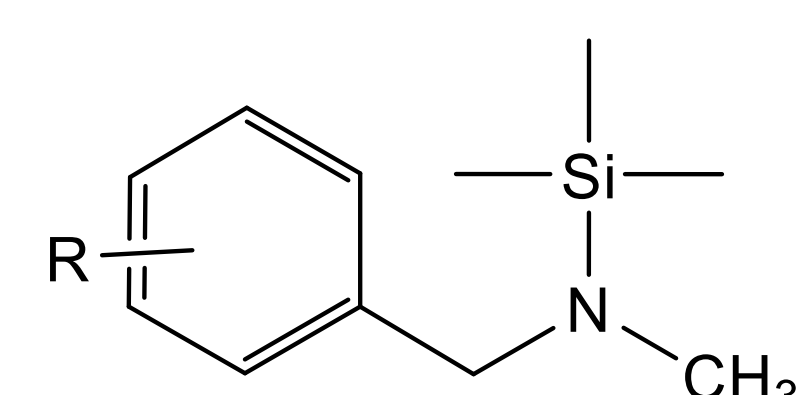


by rearrangement and the intramolecular reaction of the TMS ester in thirteen analogs (see Table 1).

Materials and Methods

4-Difluoromethoxy-N-methylbenzylamine (compound **1**) and other 7 compounds (**2-4**, **7-11**) were purchased from a commercial source and dissolved in acetonitrile at concentrations of about 1mg/ml, and the TMS derivatives were prepared by adding 30ul of BSTFA to 95ul of sample solution at 60°C for 2 hrs.

The mass spectrum was acquired at 70eV on a triple quadrupole GC/MS instrument, in the EI mode, and in tandem EI mode. The collision gas of GC/MS/MS was N_2 and the collision energy was 5V, 10V, 20V, and 40V. The HRMS was collected on a time-of-flight MS instrument with EI mode. Other mass spectra of the analogs (compounds **5**, **6**, **11-13**) were from the NIST/EPA/NIH Mass Spectral Library.



Com.	R	R pos.	M (m/z)	ion a (m/z, %)	ion b, m/z (%)	ion c, m/z (%)
1	CHF_2O	p	259	244 (60)	215 (9)	201 (85)
2	CH_3	p	207	192 (52)	163 (24)	149 (100)
3	CH_3CH_2	p	221	206 (48)	177 (20)	163 (100)
4	$(\text{CH}_3)_3\text{C}$	p	249	234 (26)	205 (6)	191 (41)
5	H		193	178 (72)	149 (29)	135 (73)
6	CH_3O	p	223	208 (51)	179 (6)	165 (100)
7	$(\text{CH}_3)_2\text{CHO}$	p	251	236 (34)	207 (1)	193 (76)
8	CN	p	218	203 (91)	174 (35)	160 (52)
9	Br	p	271	256 (53)	227 (13)	213 (38)
10	Cl	p	227	212 (59)	183 (24)	169 (89)
11	Cl	o	227	212 (96)	183 (14)	169 (46)
12	CF_3	p	261	246 (100)	217 (31)	203 (36)
13	CF_3	m	261	246 (9)	217 (2)	203 (8)

Table 1. Studying compounds and characteristic ions list

Results

GC/MS

The mass spectrum of 4-Difluoromethoxy-N-methylbenzylamine, TMS (Figure 1) has characteristic ion **b** (m/z 215) and ion **c** (m/z 201).

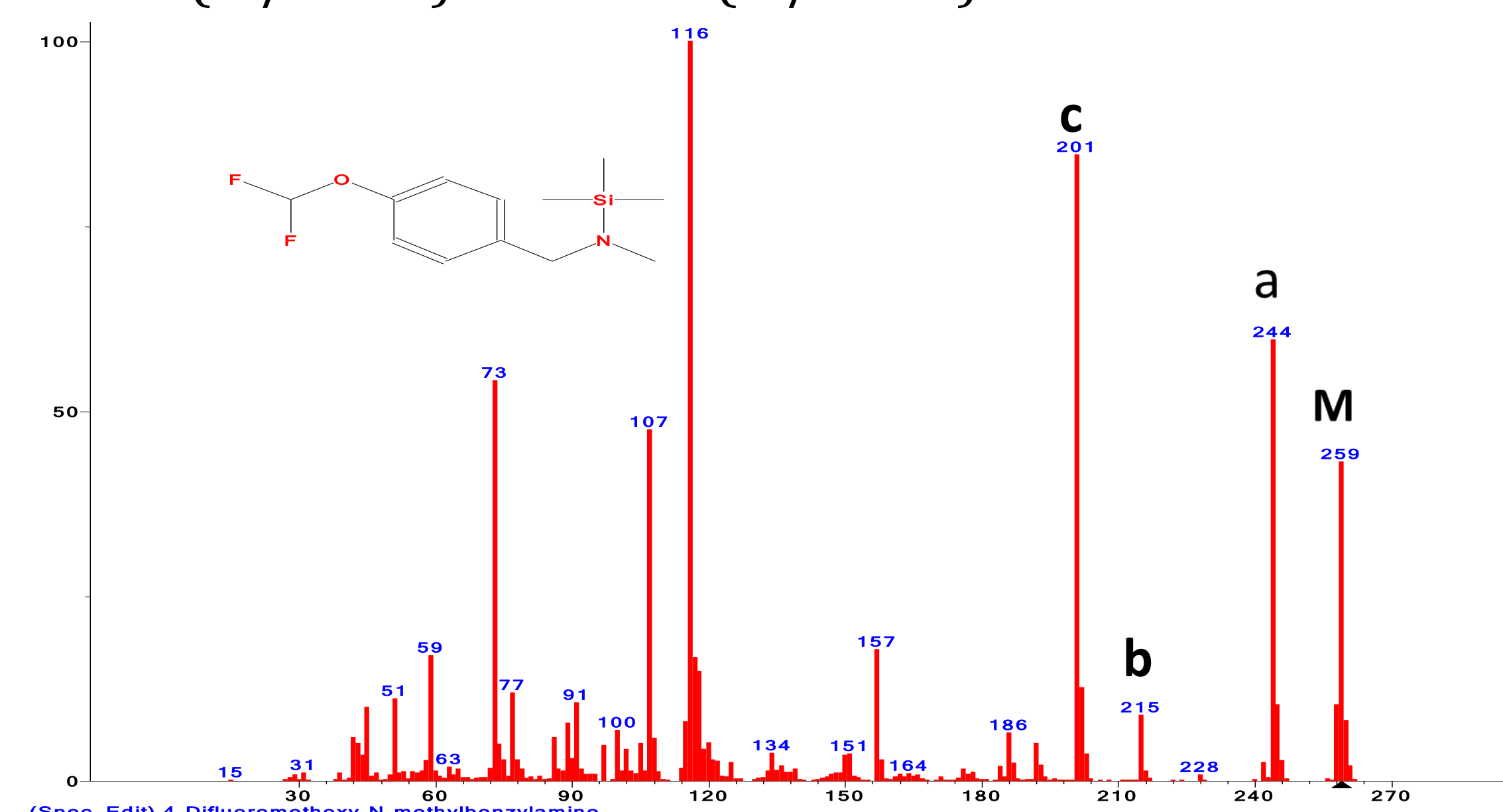


Figure 1. Mass spectrum of 4-Difluoromethoxy-N-methylbenzylamine, TMS

The ion **b** and ion **c** can't be recognized by the MS interpreter tool and cannot be explained by a simple reaction.

GC/MS/MS

1. Product ion scan of the ion M^+ (m/z 259) by collision energy of 5V.

The ion **a** ($\text{M}-\text{CH}_3$, m/z 244) is a daughter ion of the ion M^+ .

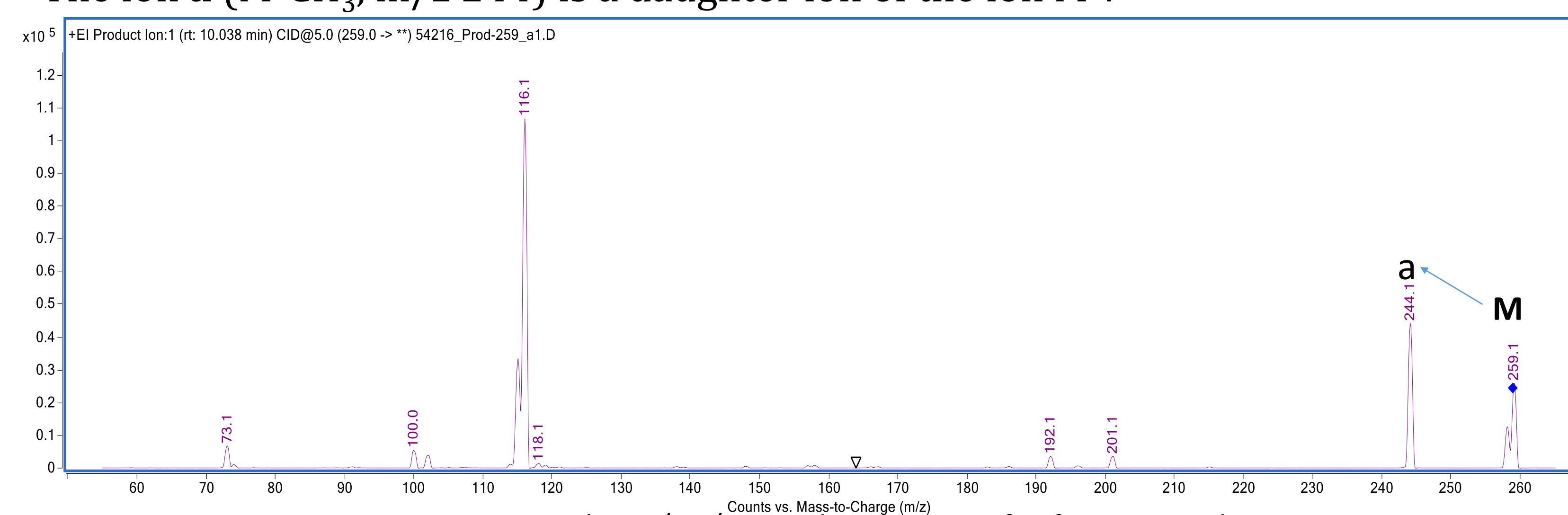


Figure 2. The GC/MS/MS product scanning of M^+ for compound 1

2. Product ion scan of the ion **a** [$\text{M}-\text{CH}_3$] by collision energy of 10V.

The ion **b** (m/z 215) and ion **c** (m/z 201) are daughter ions of the ion **a** ($\text{M}-\text{CH}_3$).

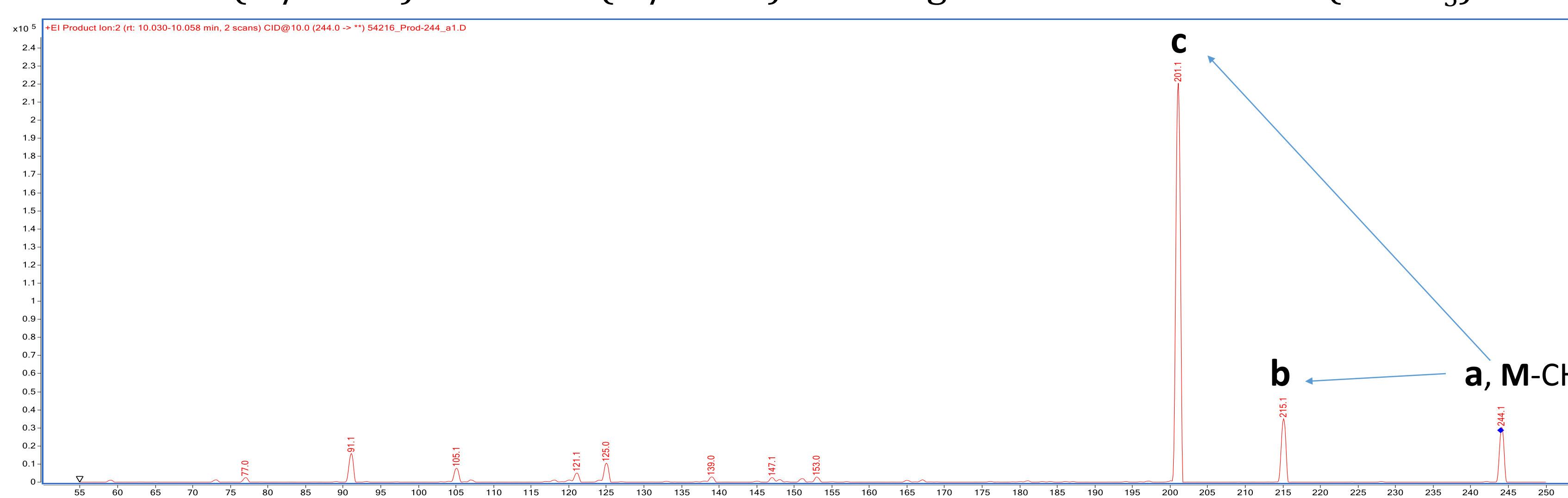
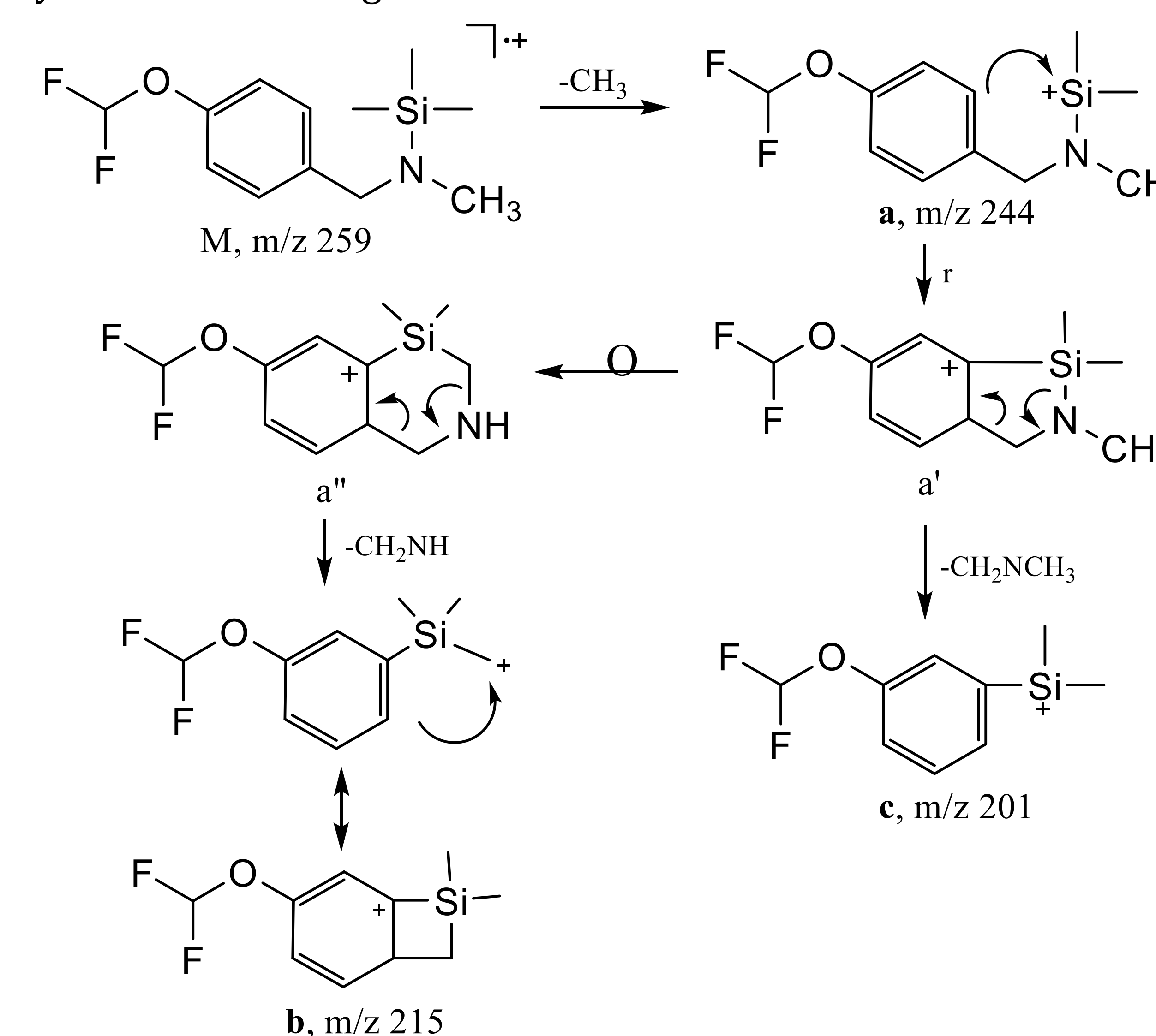


Figure 3. The GC/MS/MS product scanning of $[\text{M}-\text{CH}_3]^+$ for compound 1

HRMS

Ion	Formula	Calculated	Measured	Mass Diff. (mDa)
M	$\text{C}_{12}\text{H}_{19}\text{F}_2\text{NO}_2\text{Si}$	295.1204	295.12056	0.16
a, M-CH₃	$\text{C}_{11}\text{H}_{16}\text{F}_2\text{NO}_2\text{Si}$	244.09637	244.09715	0.78
b	$\text{C}_{10}\text{H}_{13}\text{F}_2\text{OSi}$	215.06982	215.07017	0.35
c	$\text{C}_9\text{H}_{11}\text{F}_2\text{OSi}$	201.05417	201.05479	0.62

The fragmentation pathway of the TMS ester of 4-Difluoromethoxy-N-methylbenzylamine and analogs is below



The results show that the 13 analogs studied have the same fragmentation pathway and characteristic ions (see Table 1). But there are substituent effects.

The intensity of ions **b** and **c** substituted by the para-position of the same substituent is significantly greater than that of the ortho- or meta-position. (compound **10/11**, **12/13**).

Conclusion and discussion

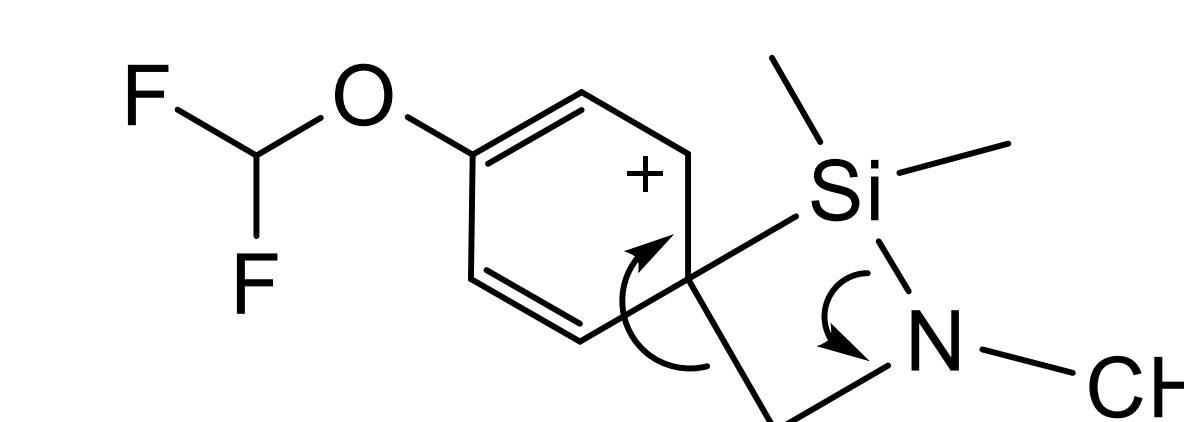
The ion **b** $[\text{CHF}_2\text{O}(\text{C}_6\text{H}_4)\text{CH}_2\text{Si}(\text{CH}_3)_2]^+$ and ion **c** $[\text{CHF}_2\text{O}(\text{C}_6\text{H}_4)\text{Si}(\text{CH}_3)_2]^+$ are characteristic ion of the TMS ester of 4-Difluoromethoxy-N-methylbenzylamine and analogs in EI mass spectra. The ion **b** and **c** result from $[\text{M}-\text{CH}_3]^+$ via an intermediate ring (ion **a'** or **a''**) with simultaneous loss of a CH_2NH or CH_2NCH_3 .

It does not appear to have been previously reported to lose a CH_2NH in the fragmentation progress of organic compounds in EI mass spectrometry.

There are substituent effects. The intensity of the characteristic ions is related to the position of the substituent (p-, or m-, or o-). The intensity of the para substituent is greatest.

Another expression of the structure of the transition state

The ion **a'** is:



The ion **a''** is:

