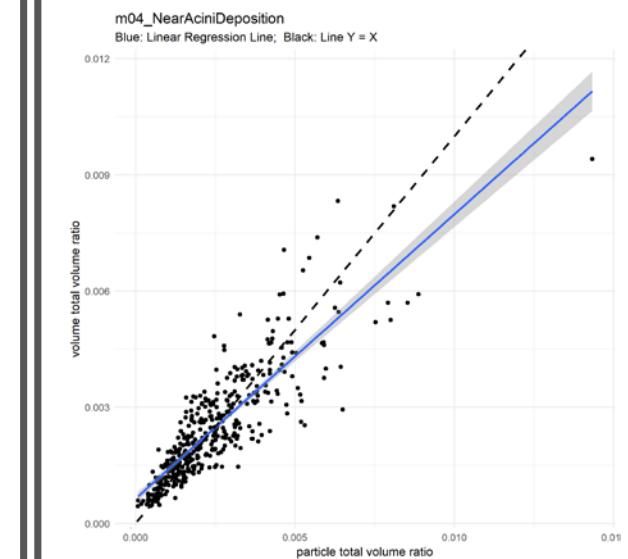
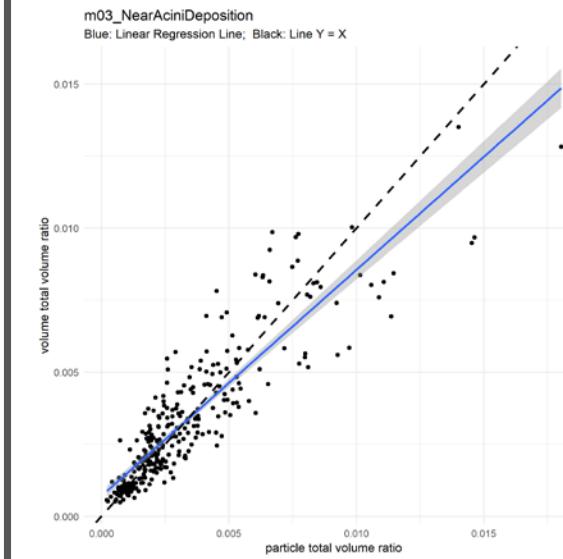
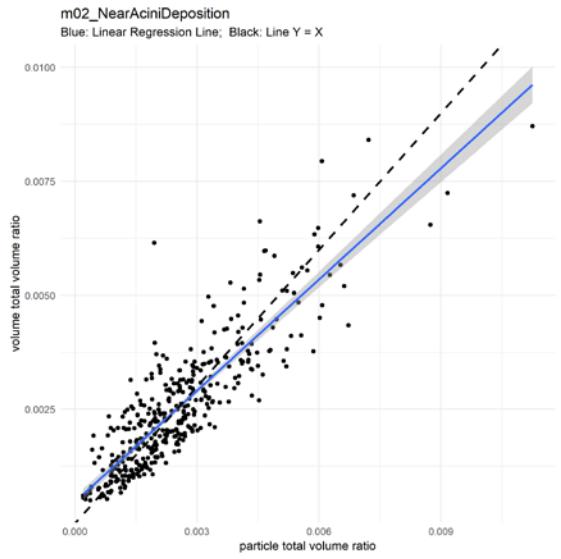
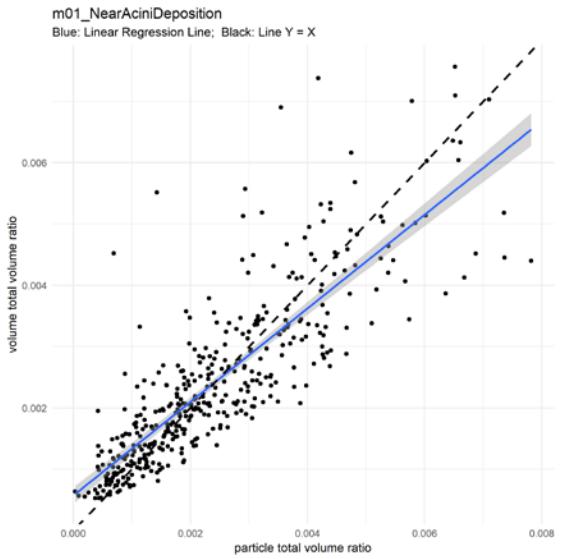


# Aerosol Particle Deposition Analysis Using LAPD Dataset

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Chantal Darquenne Lab  
UCSD School of Medicine

# Data Representation

- Ratio plot of  $\frac{\text{Particle Count}}{\text{Total Volume}}$  vs.  $\frac{\text{Partition Volume}}{\text{Total Volume}}$
- Bar plot of  $\frac{\text{Particle Count}}{\text{Total Volume}}$  and  $\frac{\text{Partition Volume}}{\text{Total Volume}}$
- MD file and sample profile comparative analysis



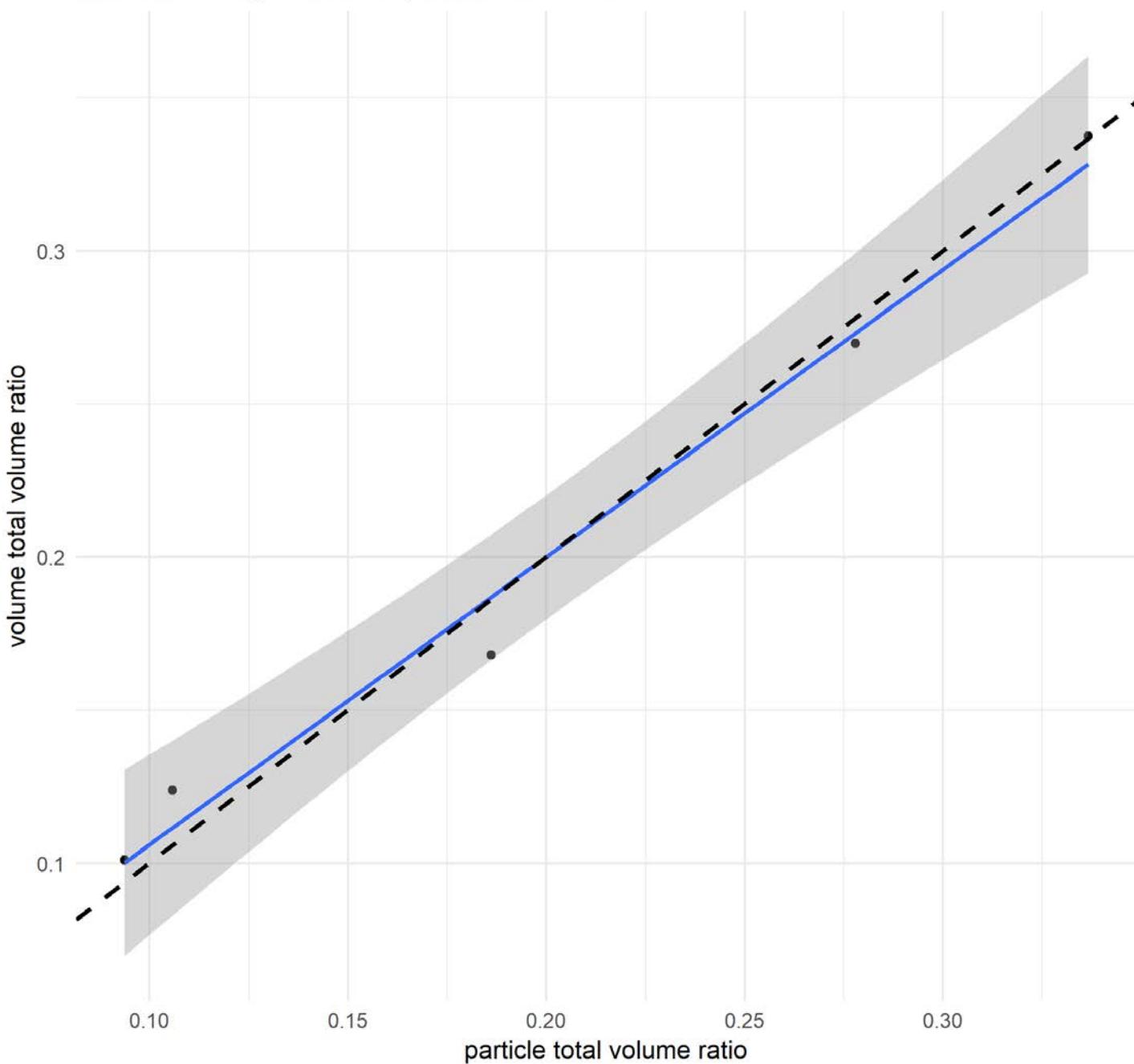
# Ratio Plot



Lobe Level

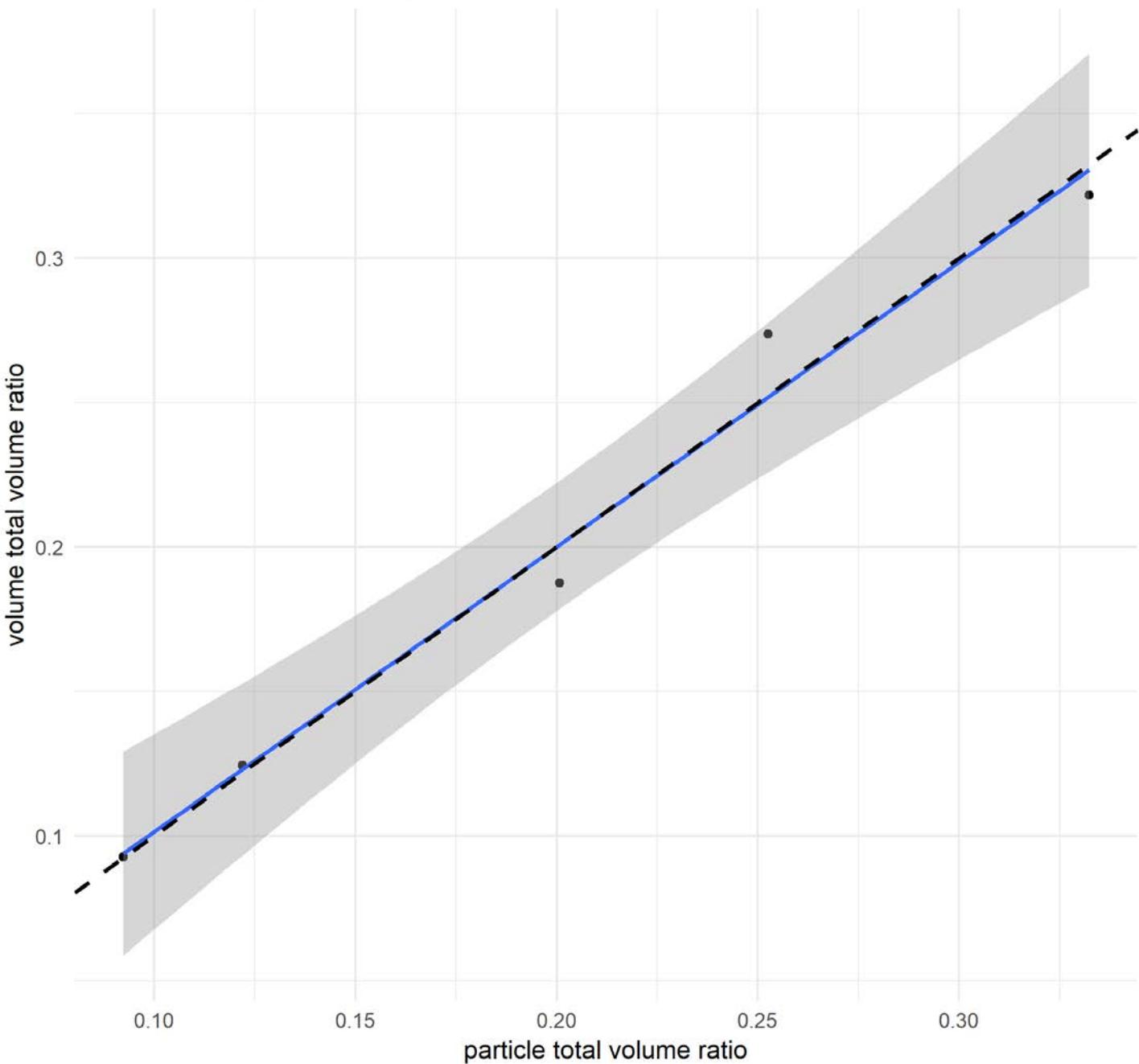
# m01\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



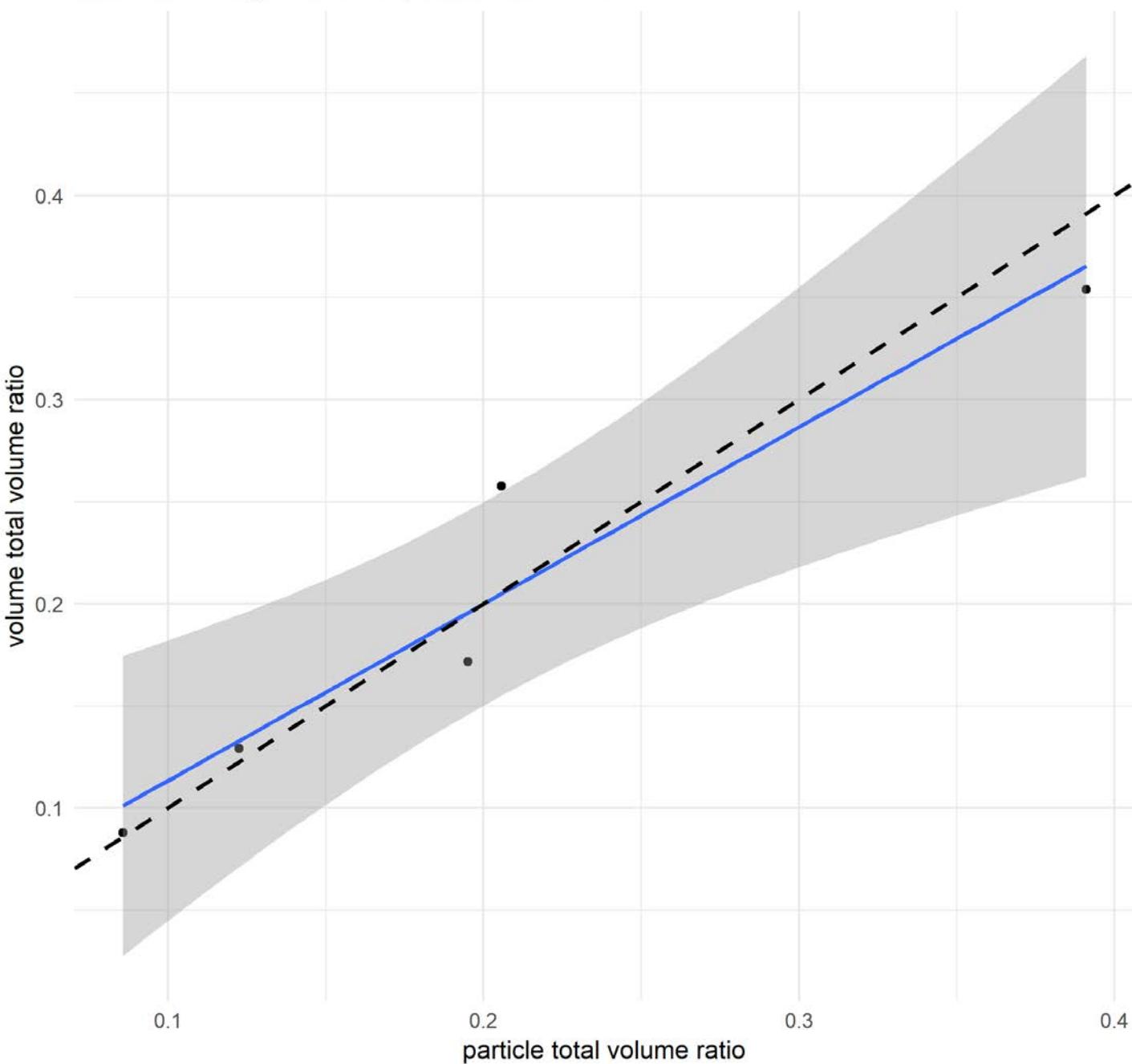
# m02\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



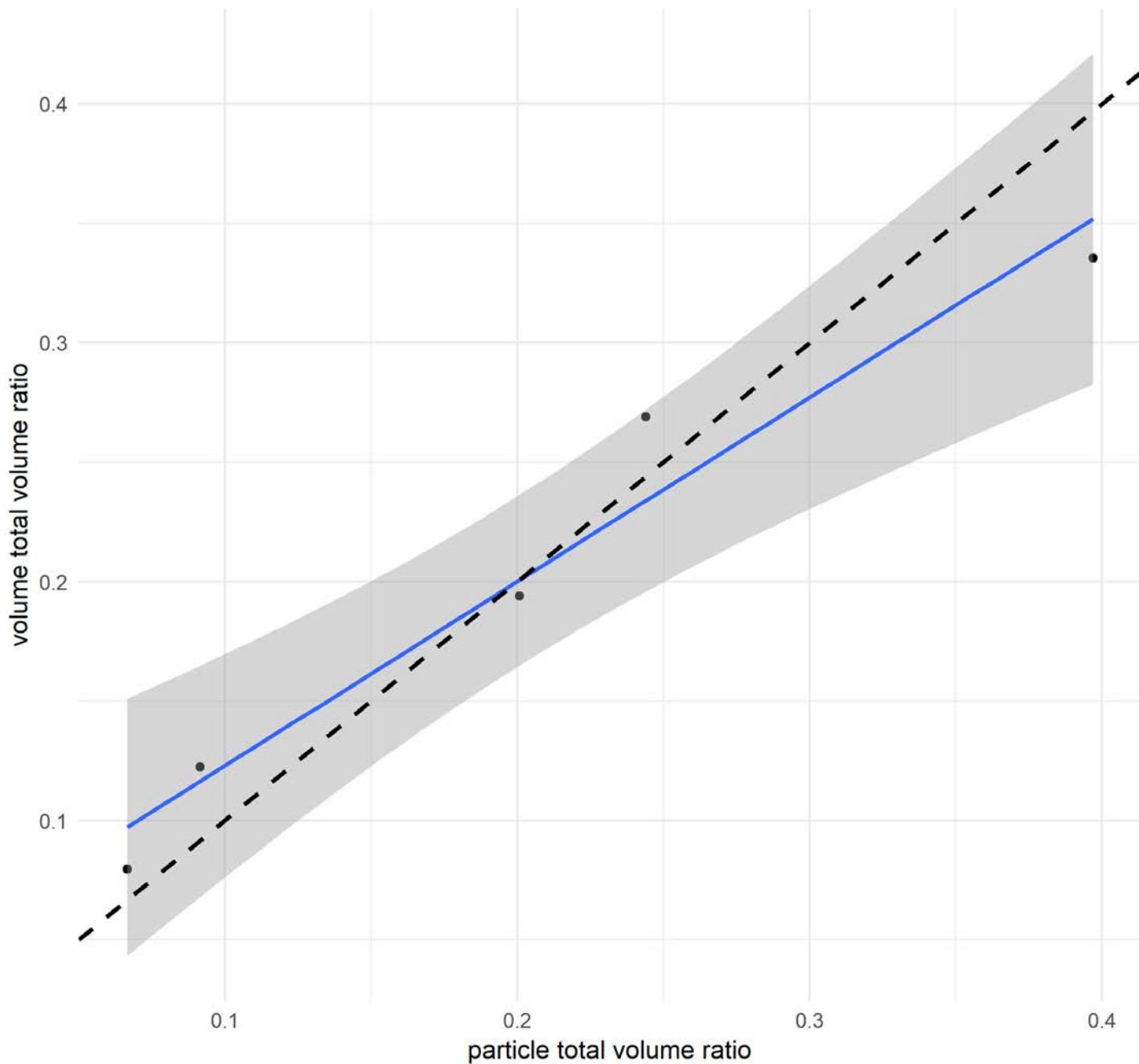
### m03\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



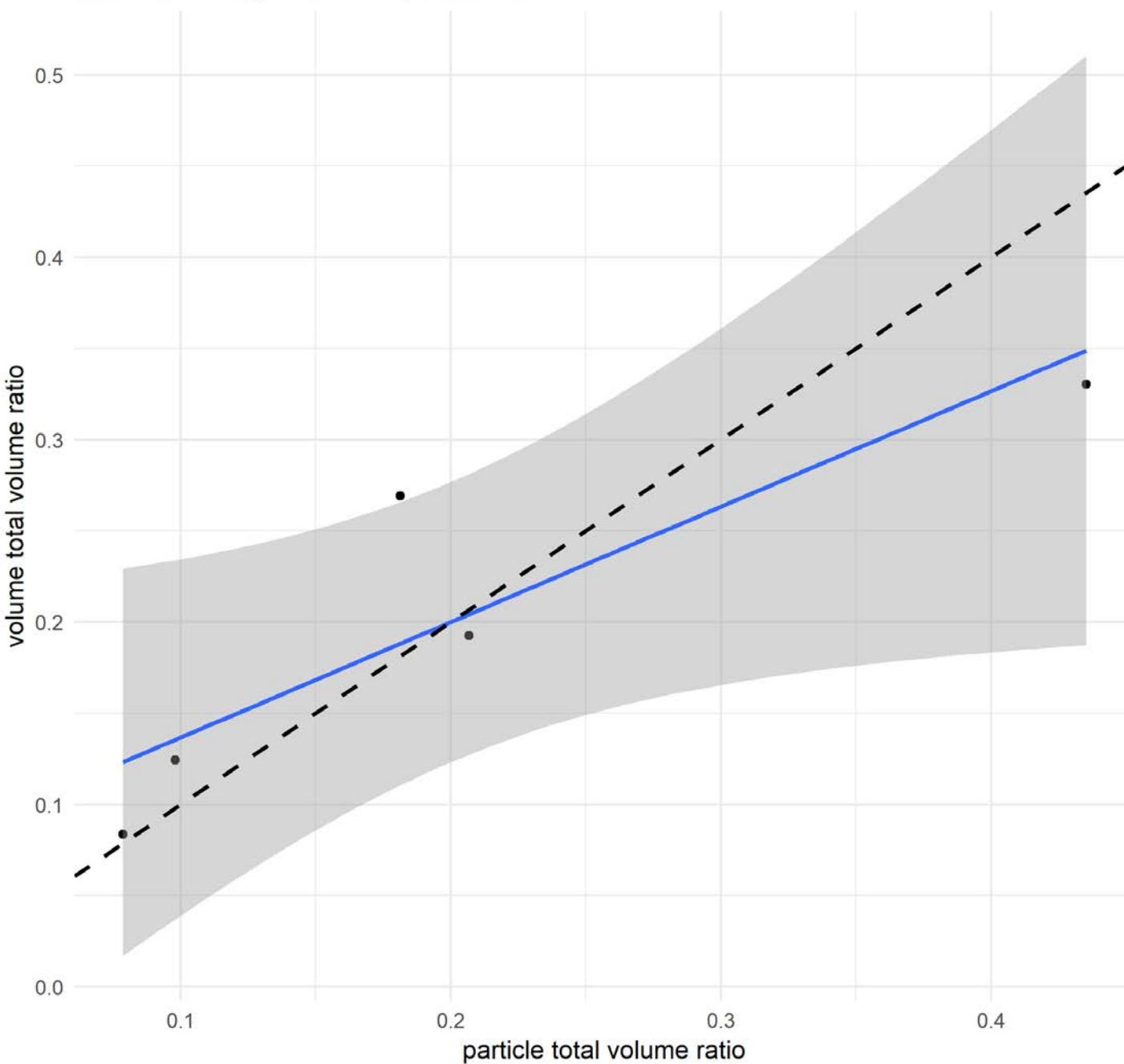
# m04\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



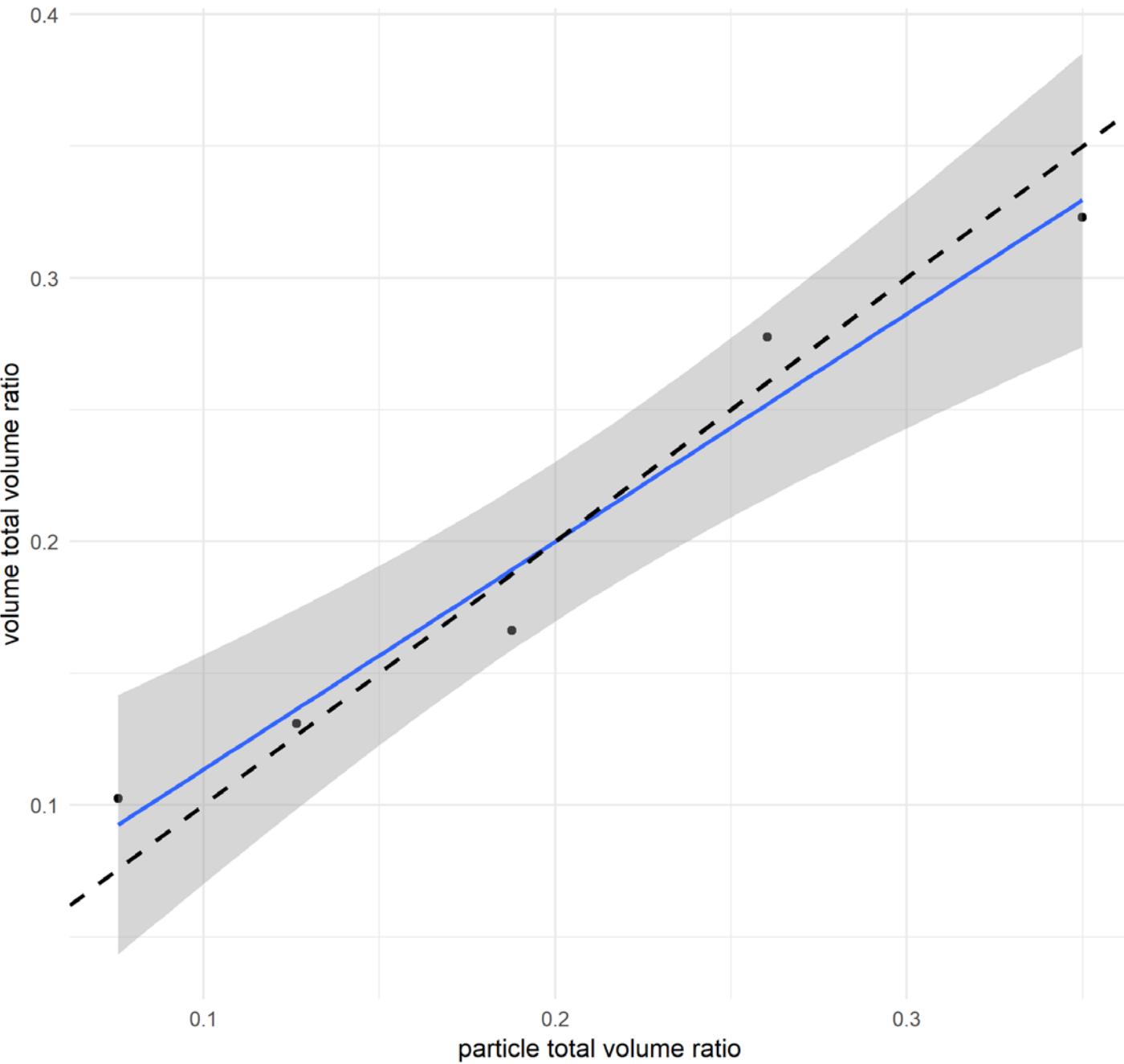
# m05\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



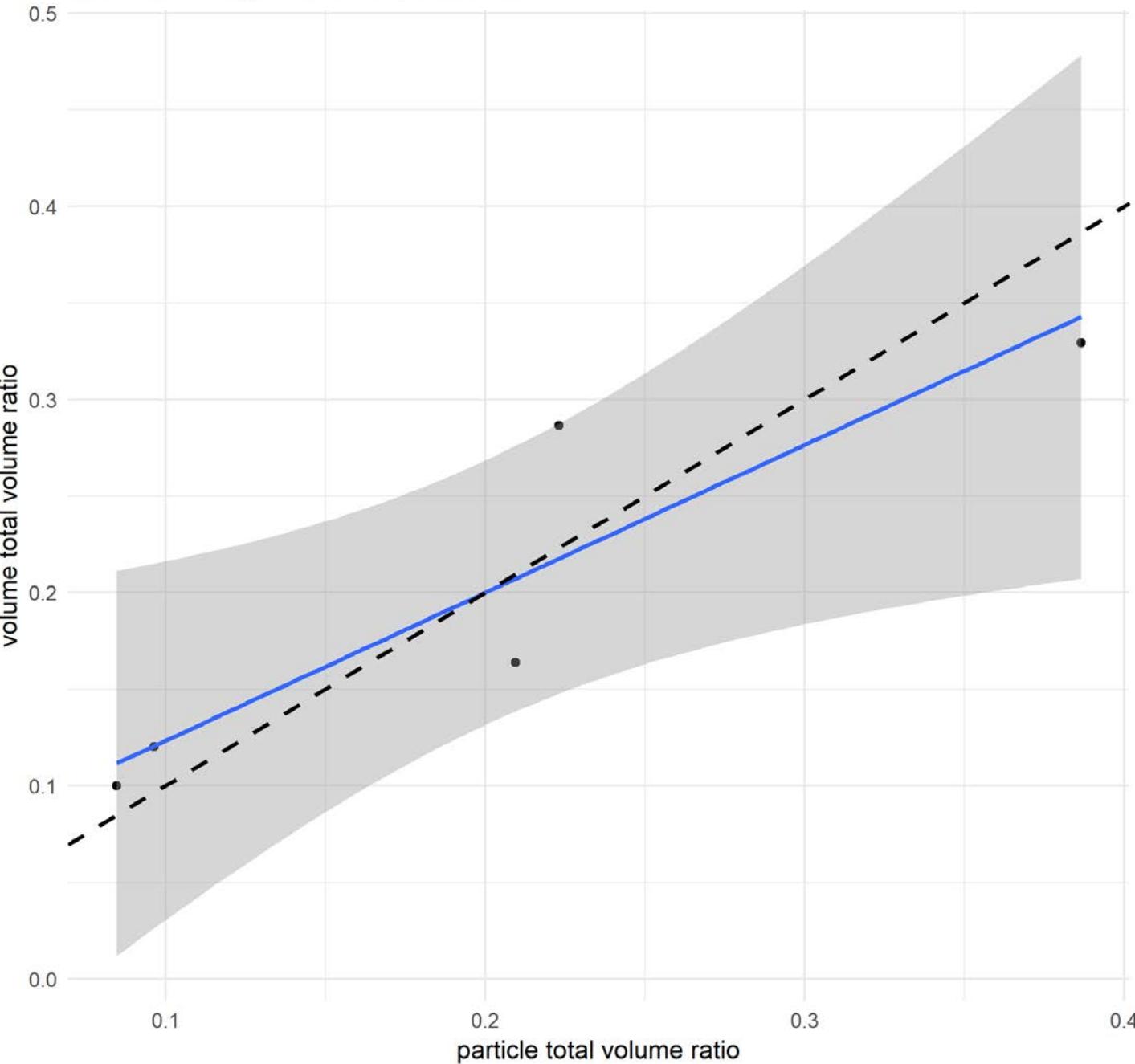
# m06\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



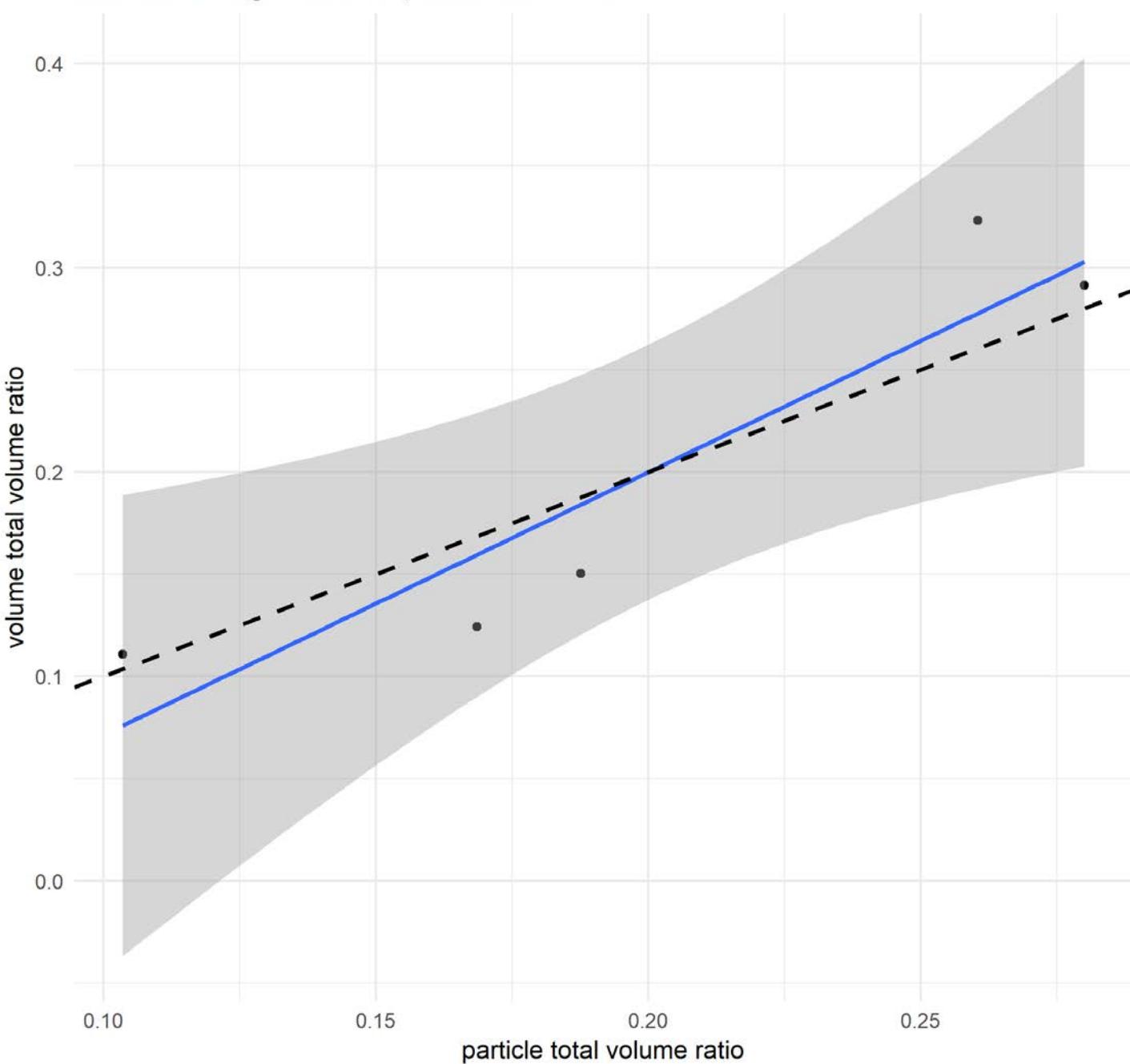
# m07\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



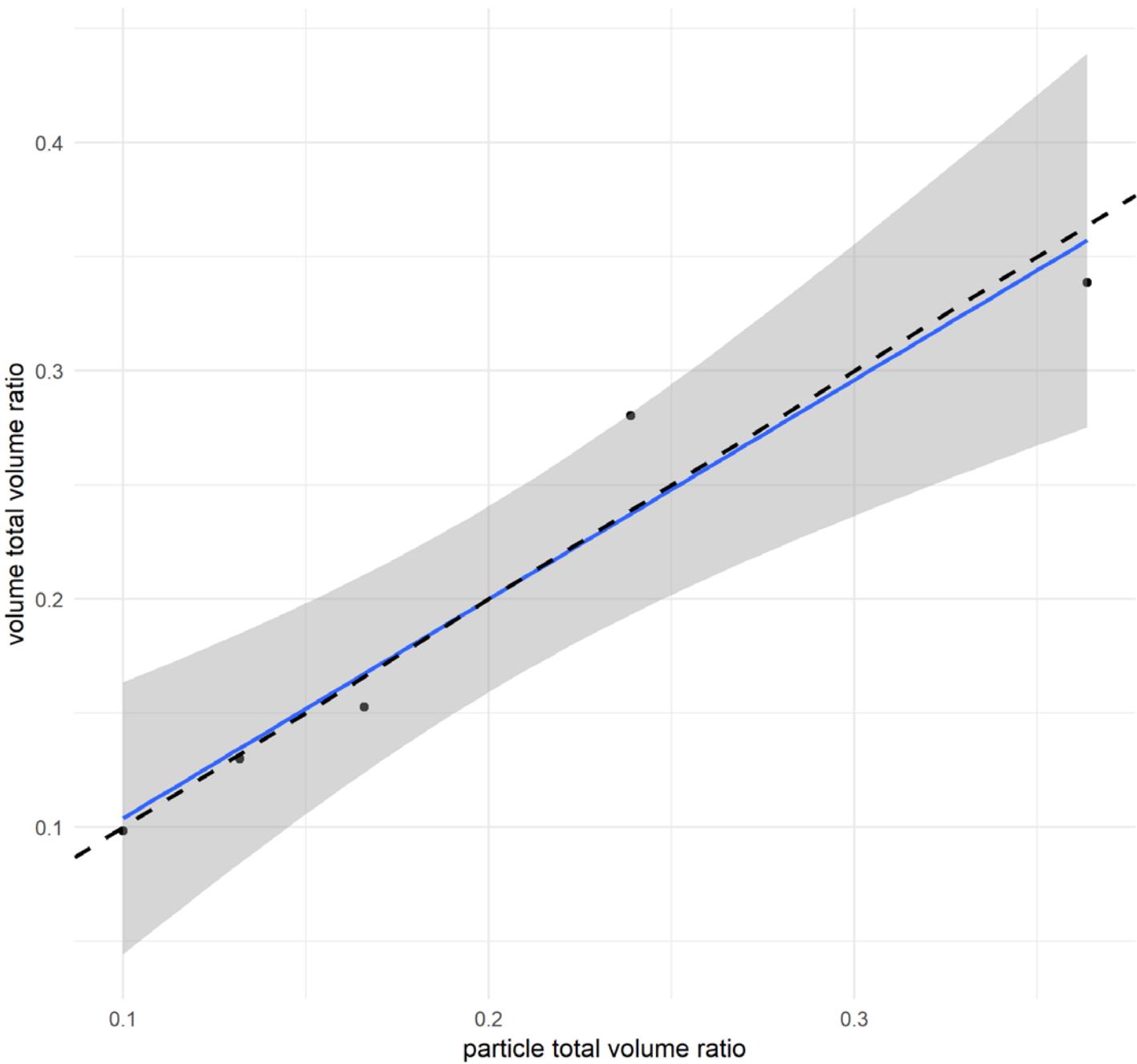
# m08\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



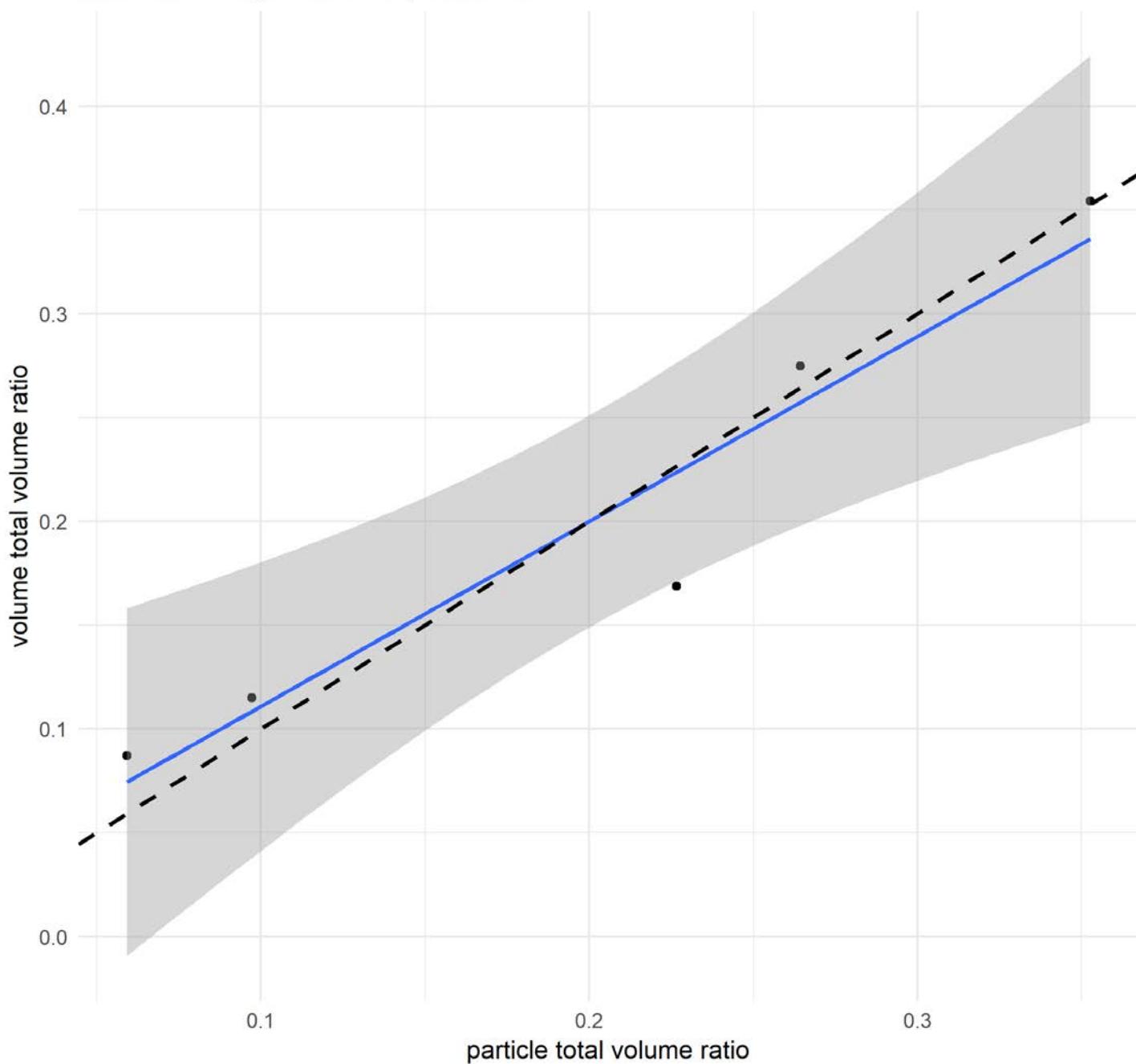
# m09\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



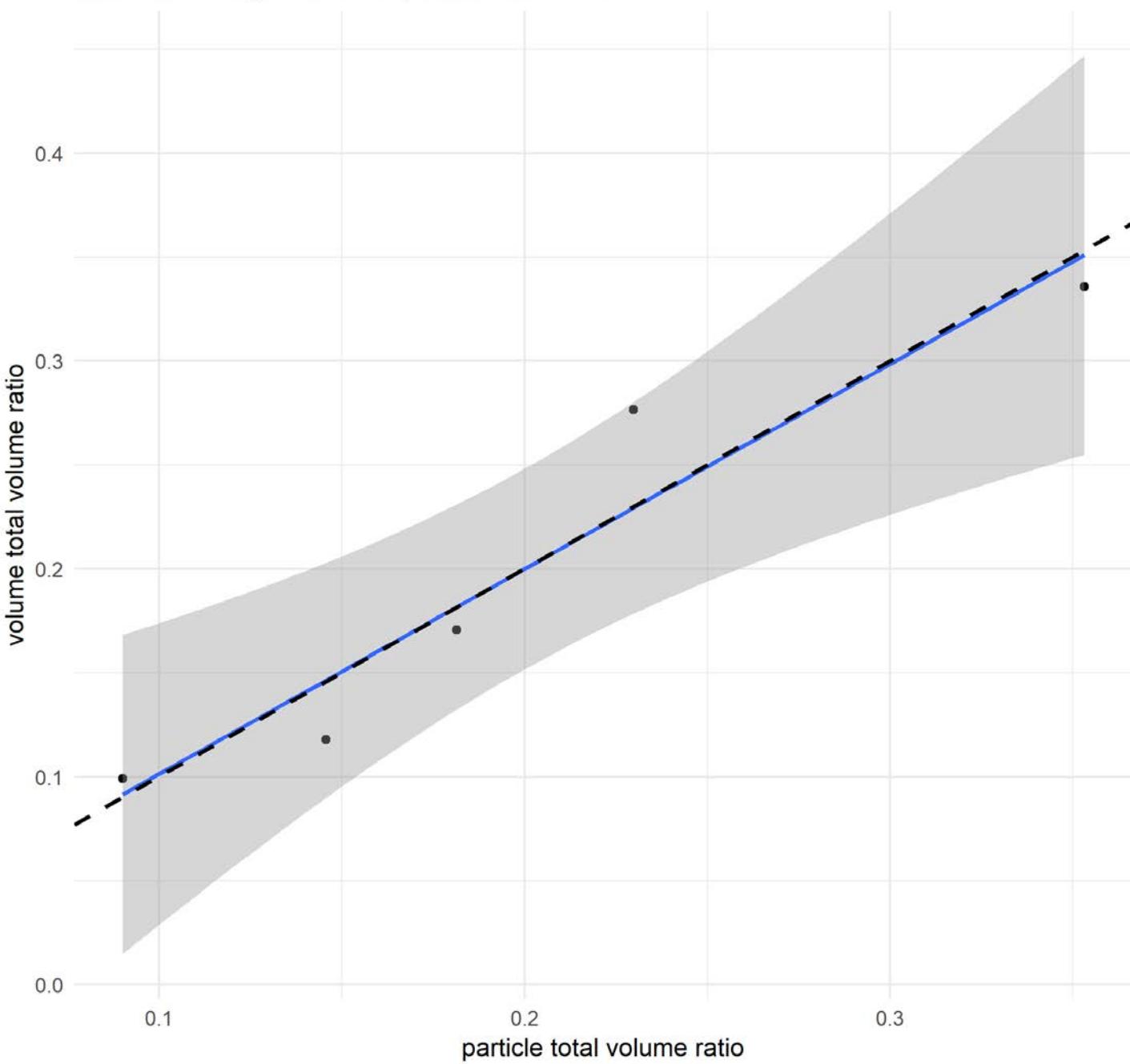
# m10\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



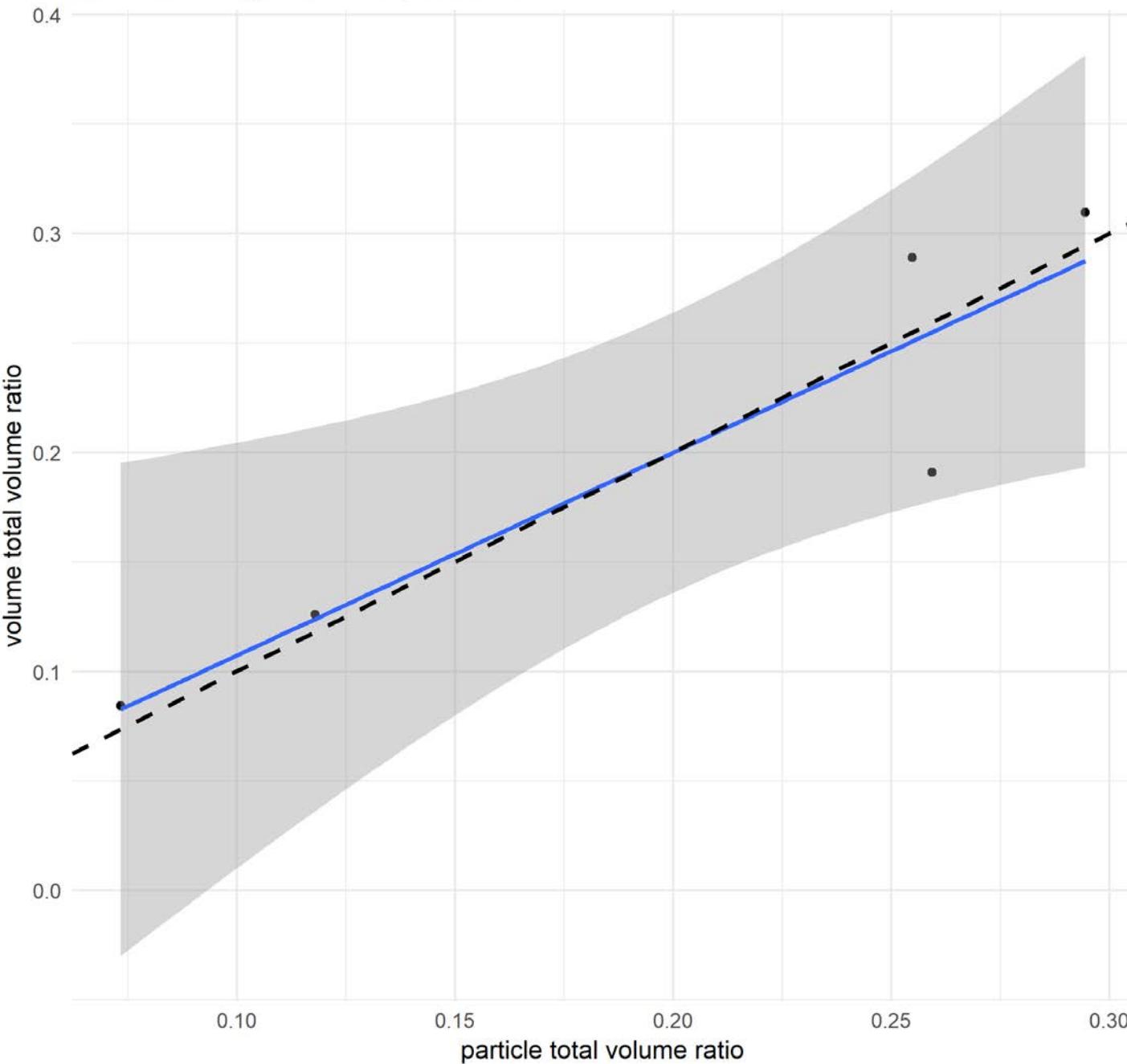
# m11\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



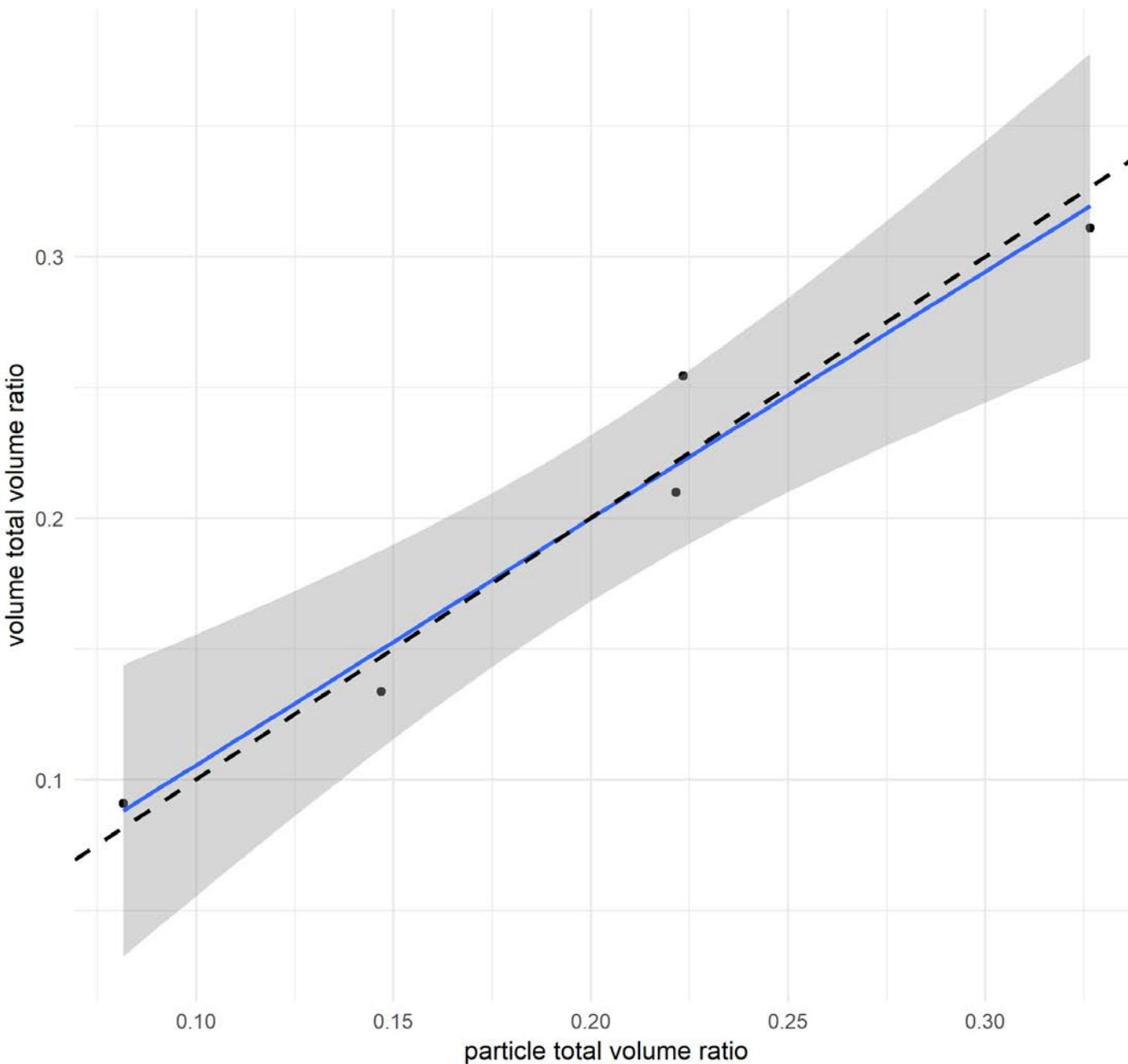
# m12\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



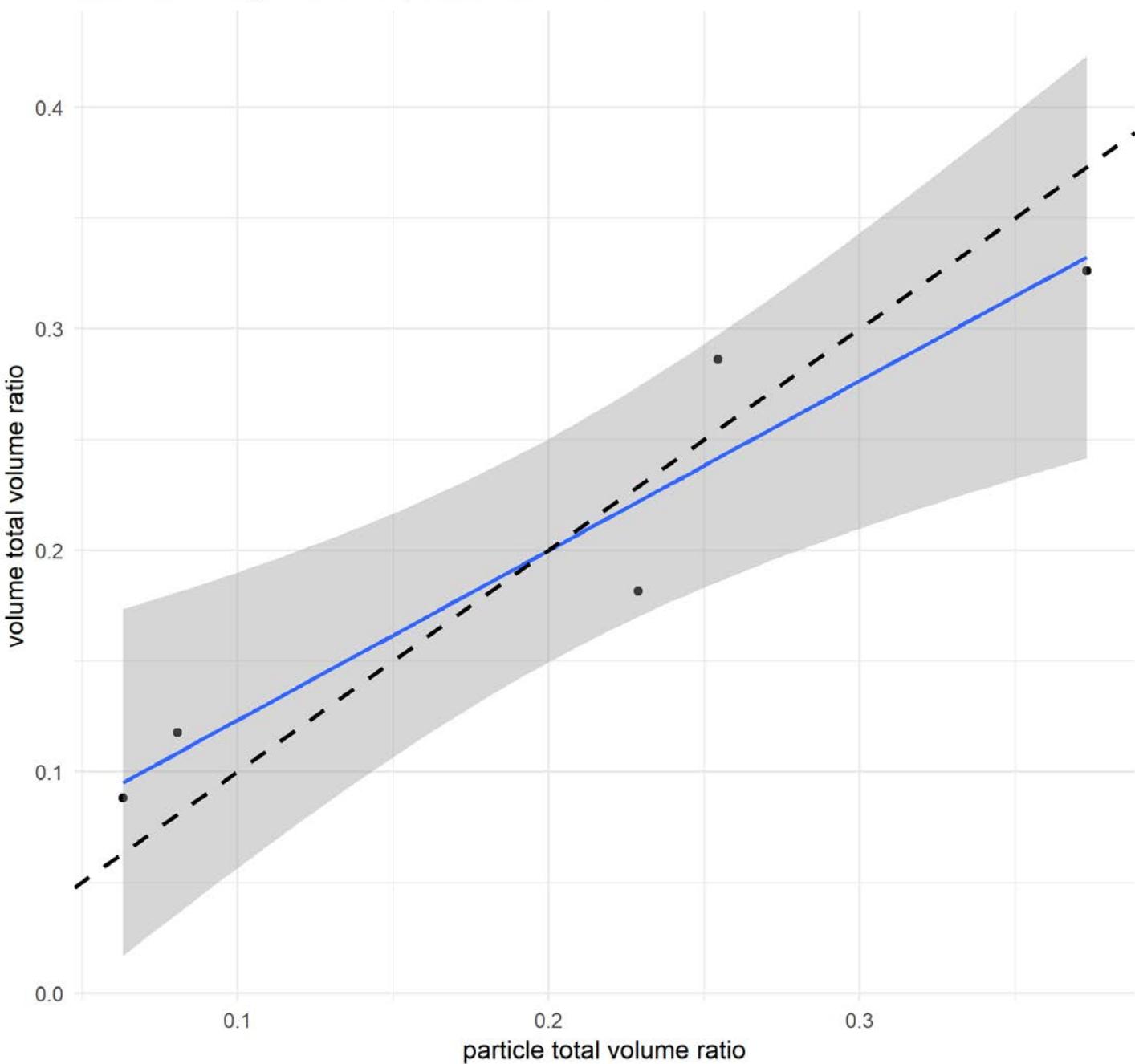
# m13\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



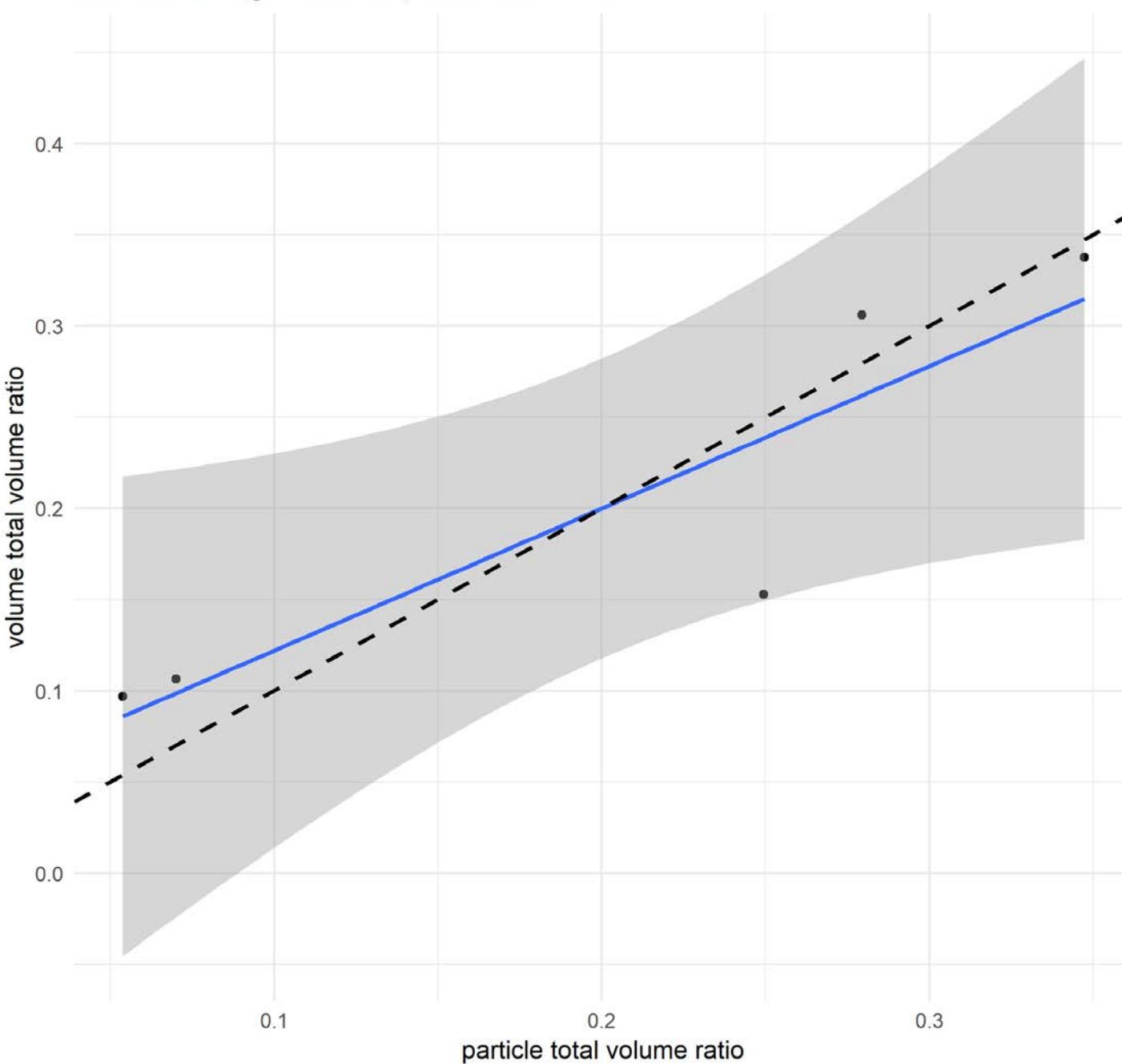
# m14\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



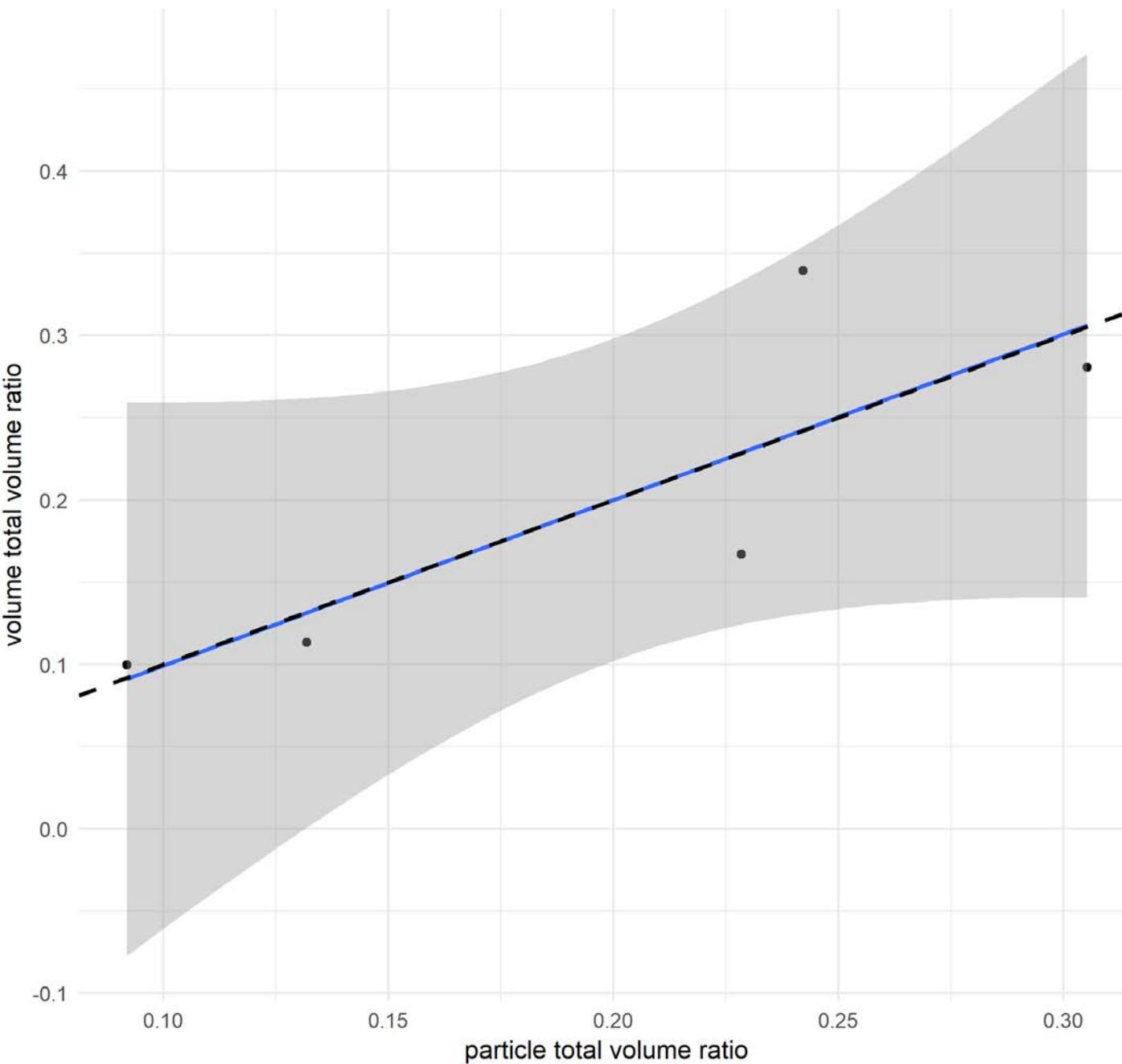
# m15\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



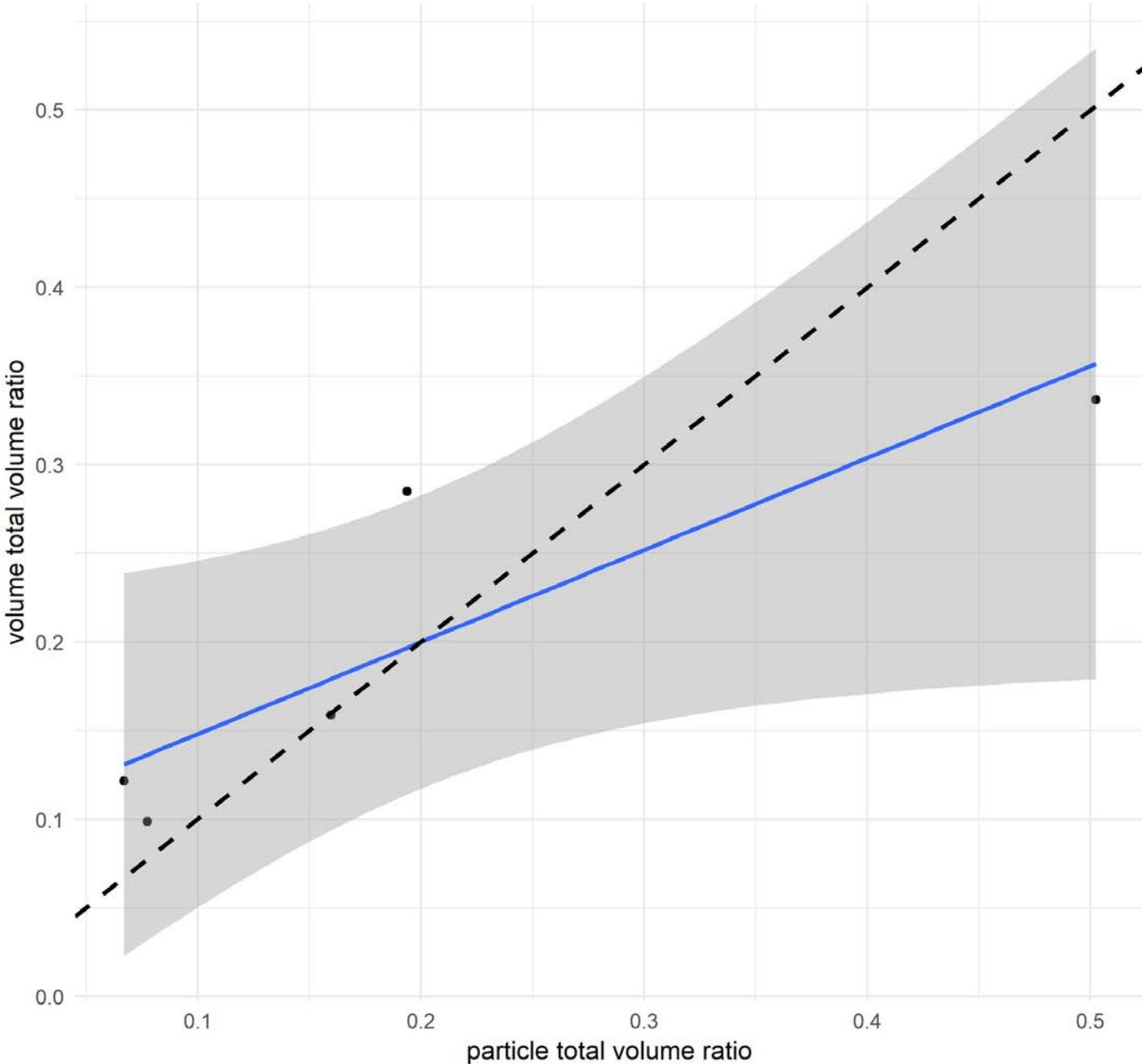
# m16\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



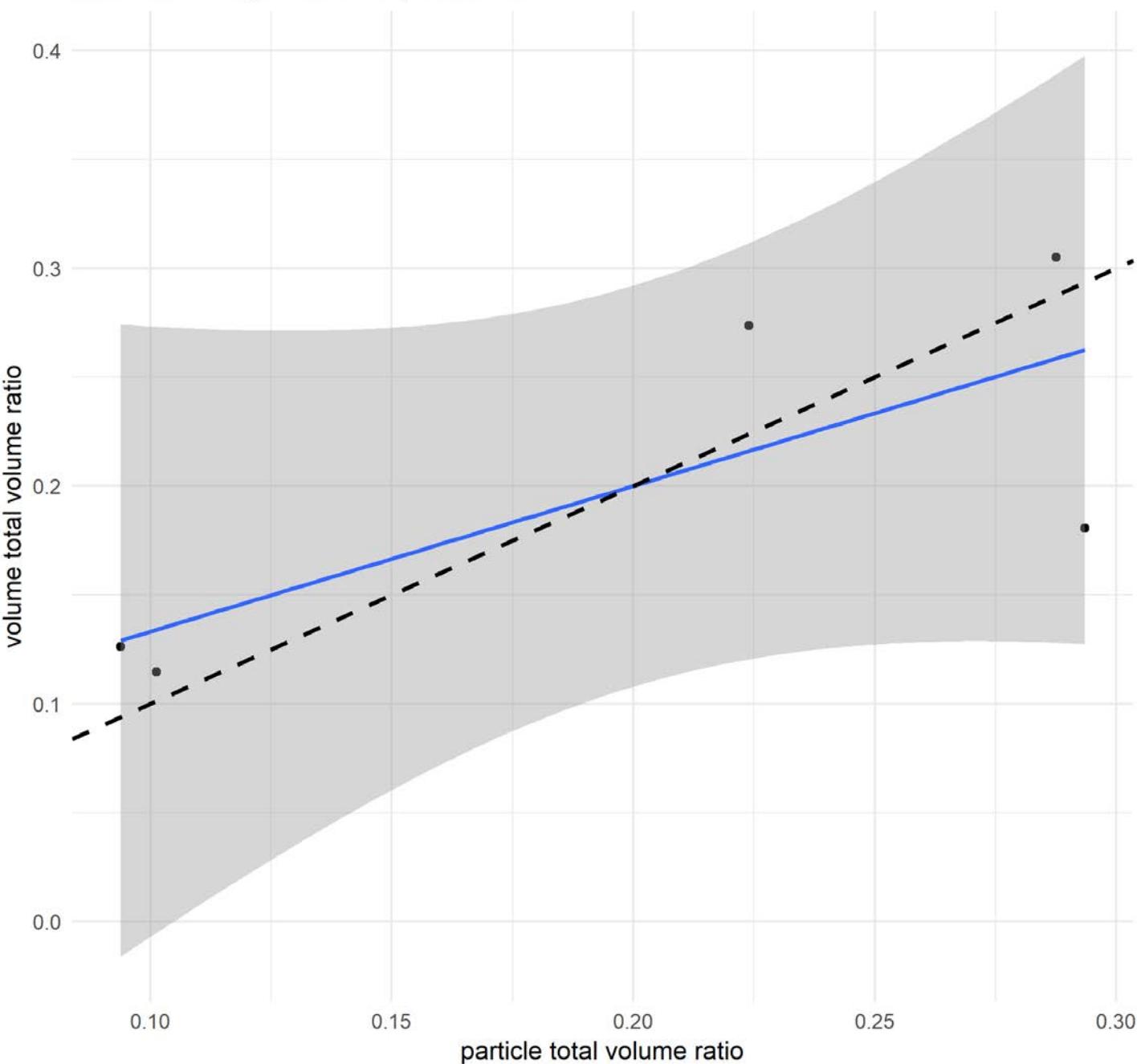
# m17\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



# m18\_LobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$

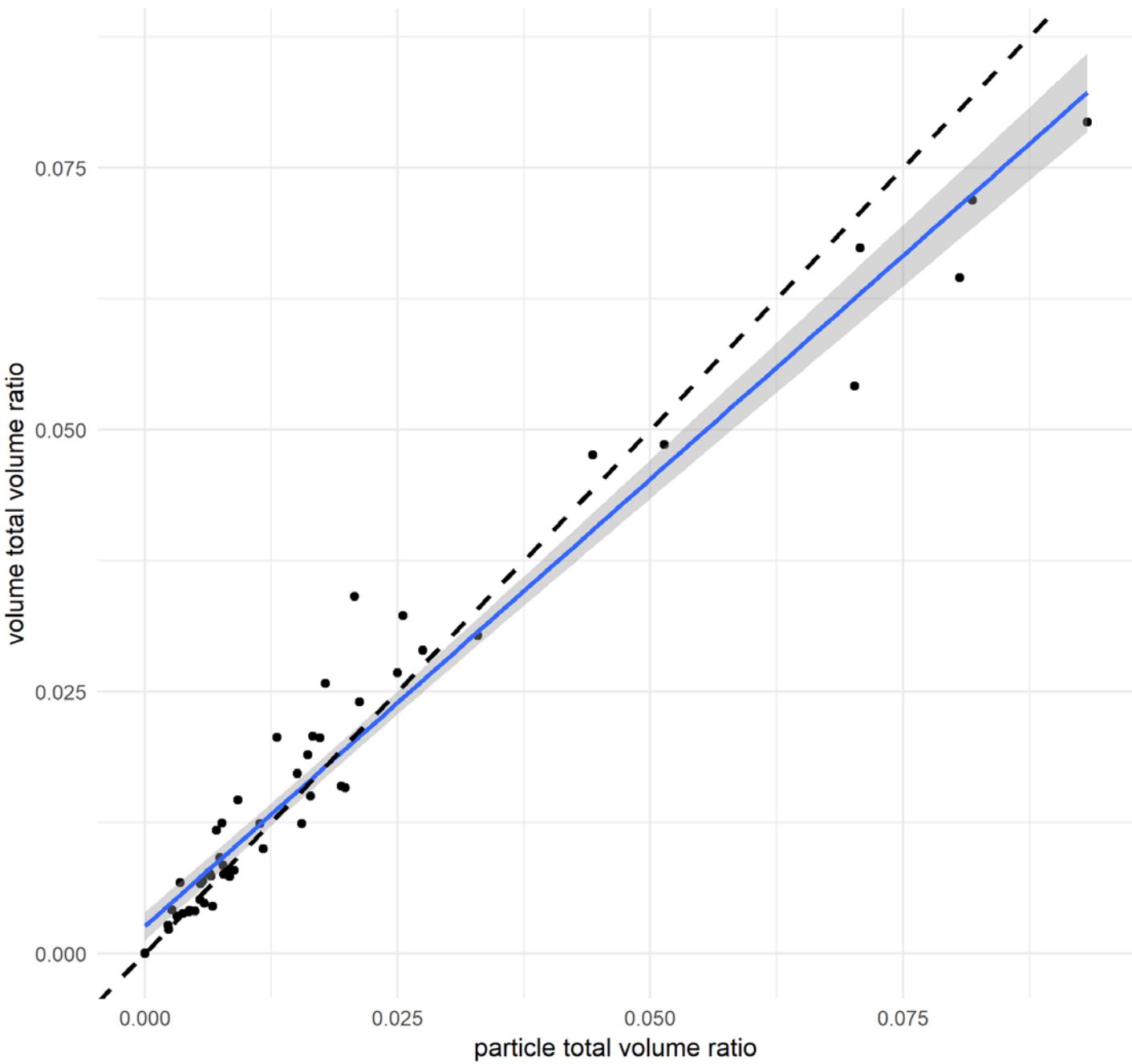




Sub lobe Level

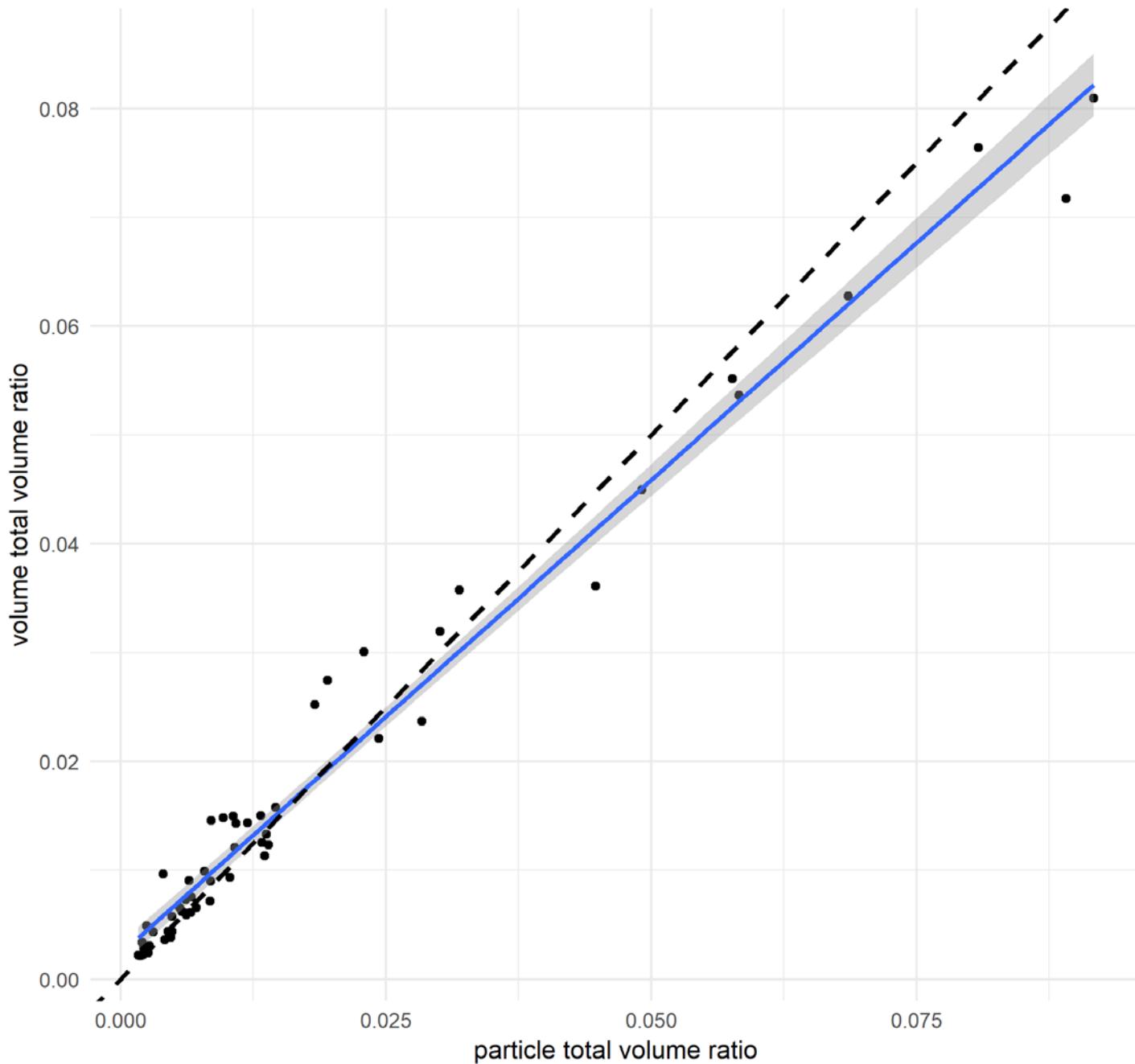
# m01\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



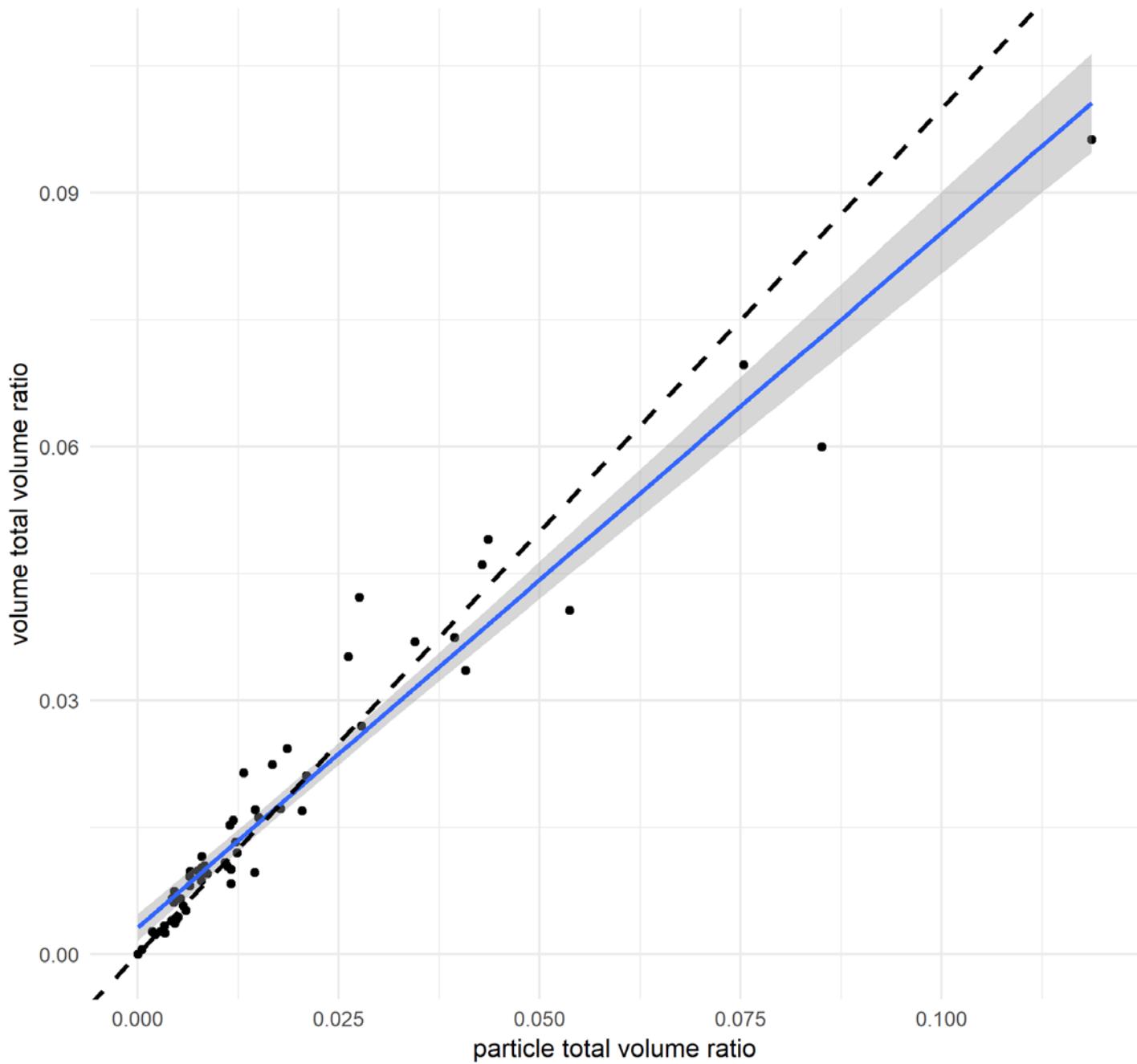
# m02\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



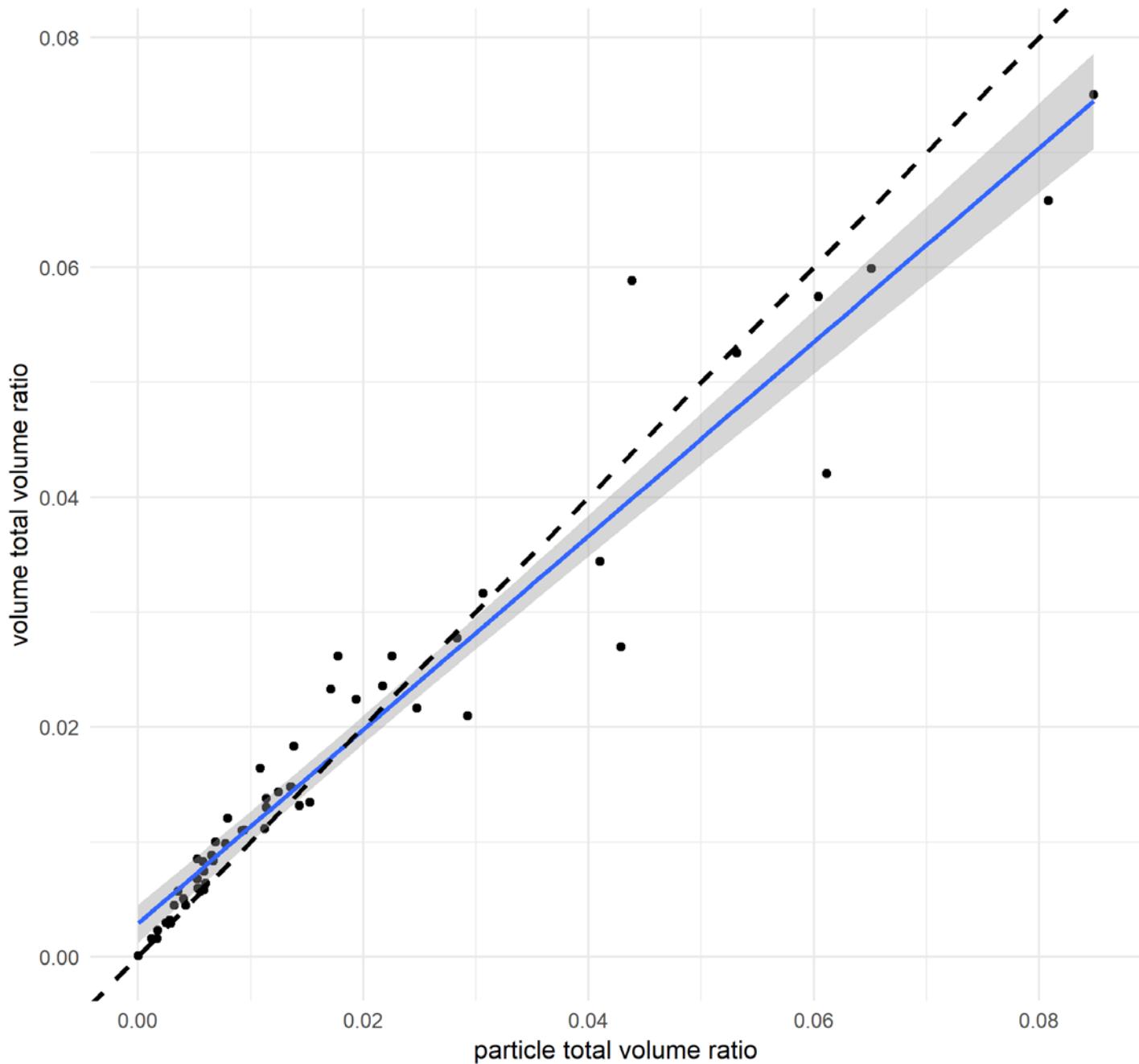
### m03\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



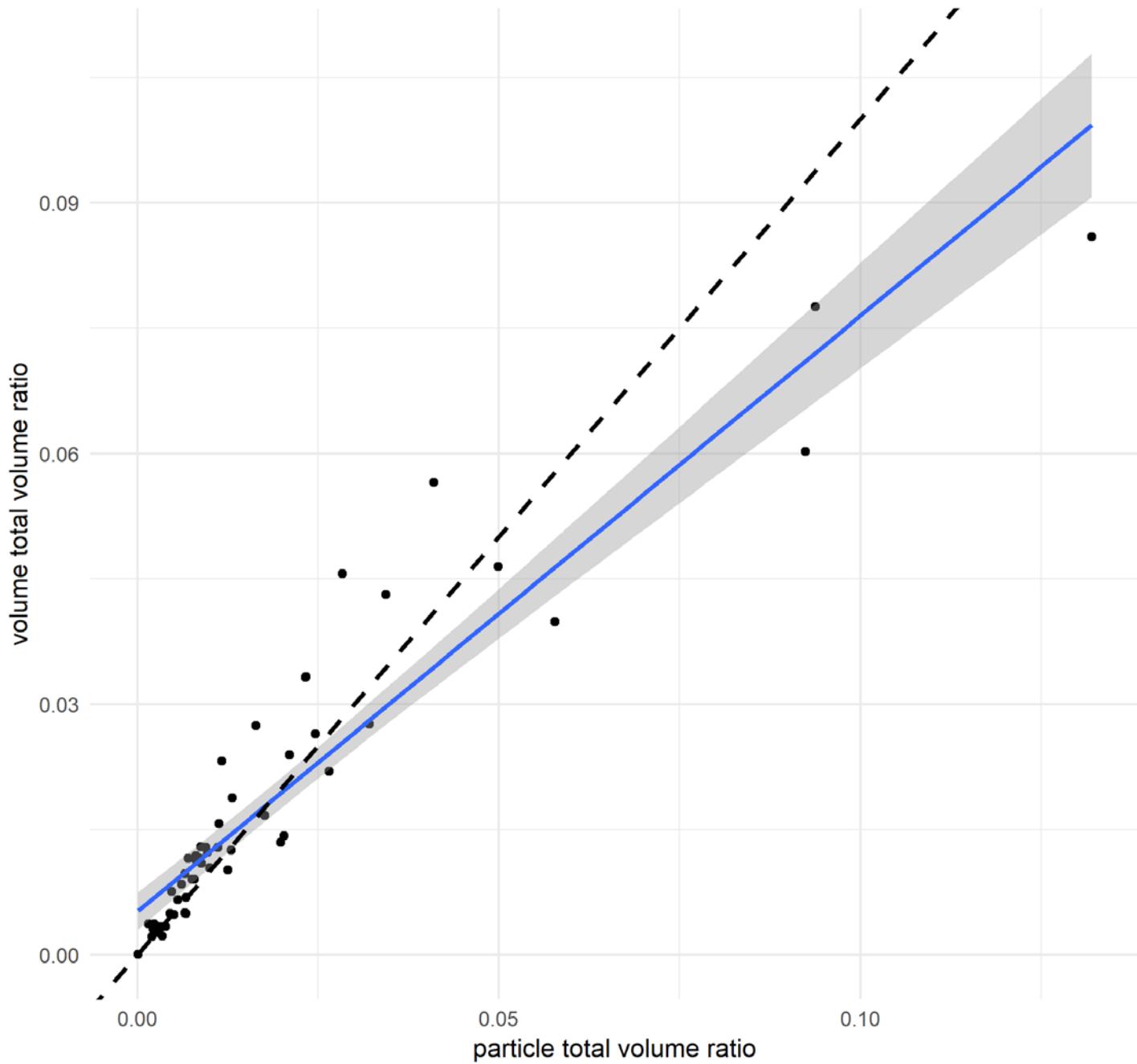
# m04\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



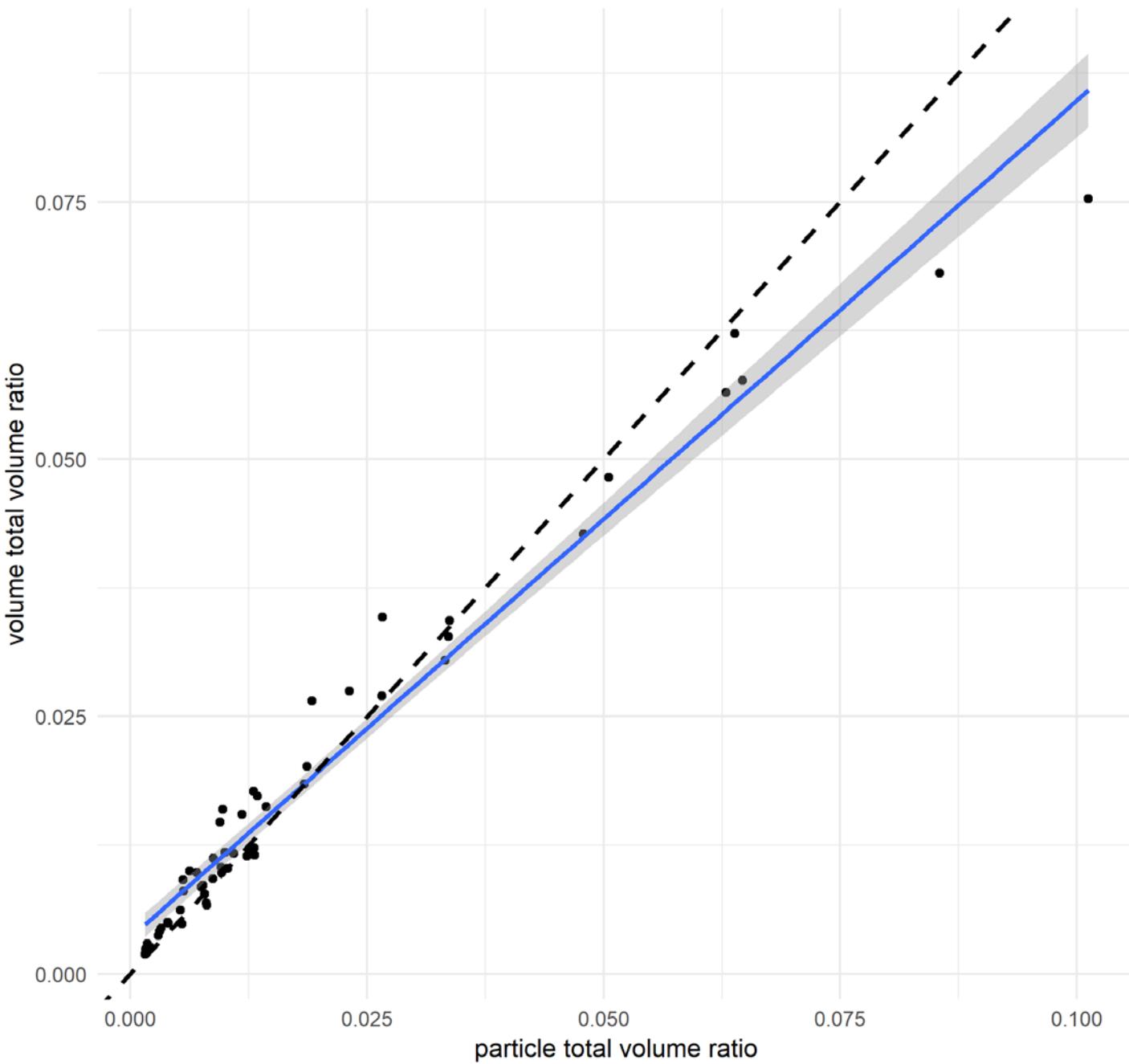
# m05\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



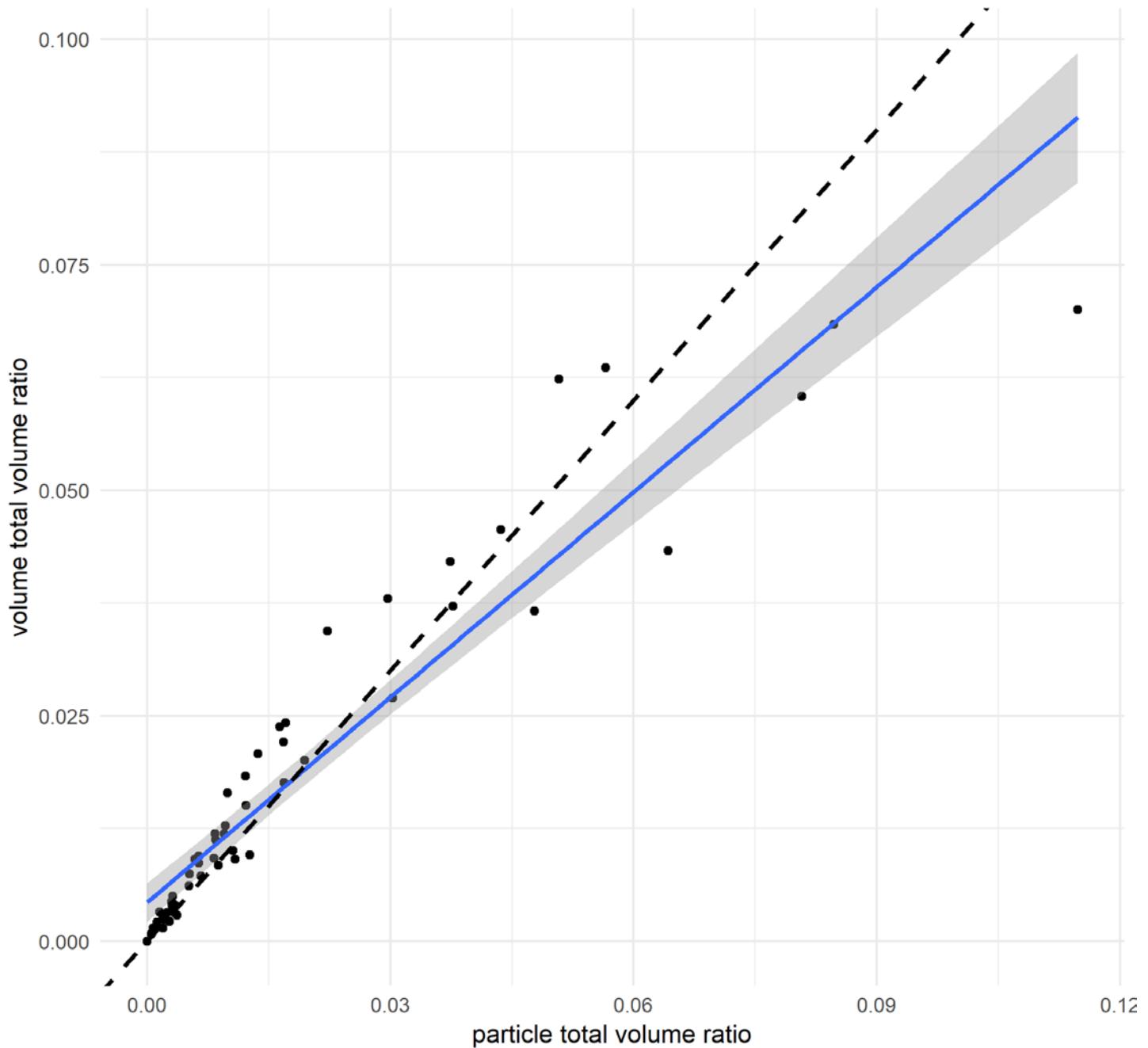
# m06\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



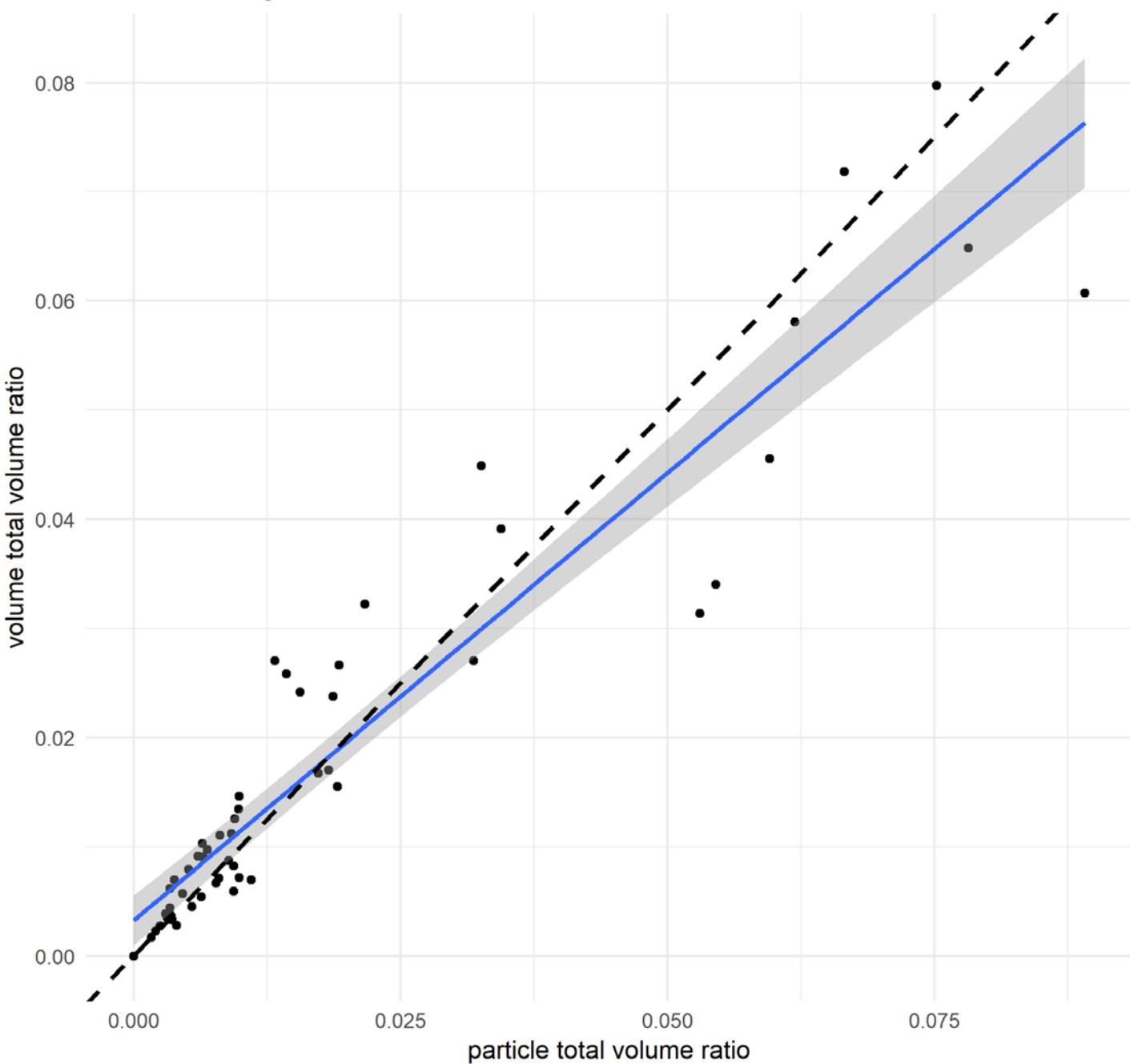
# m07\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



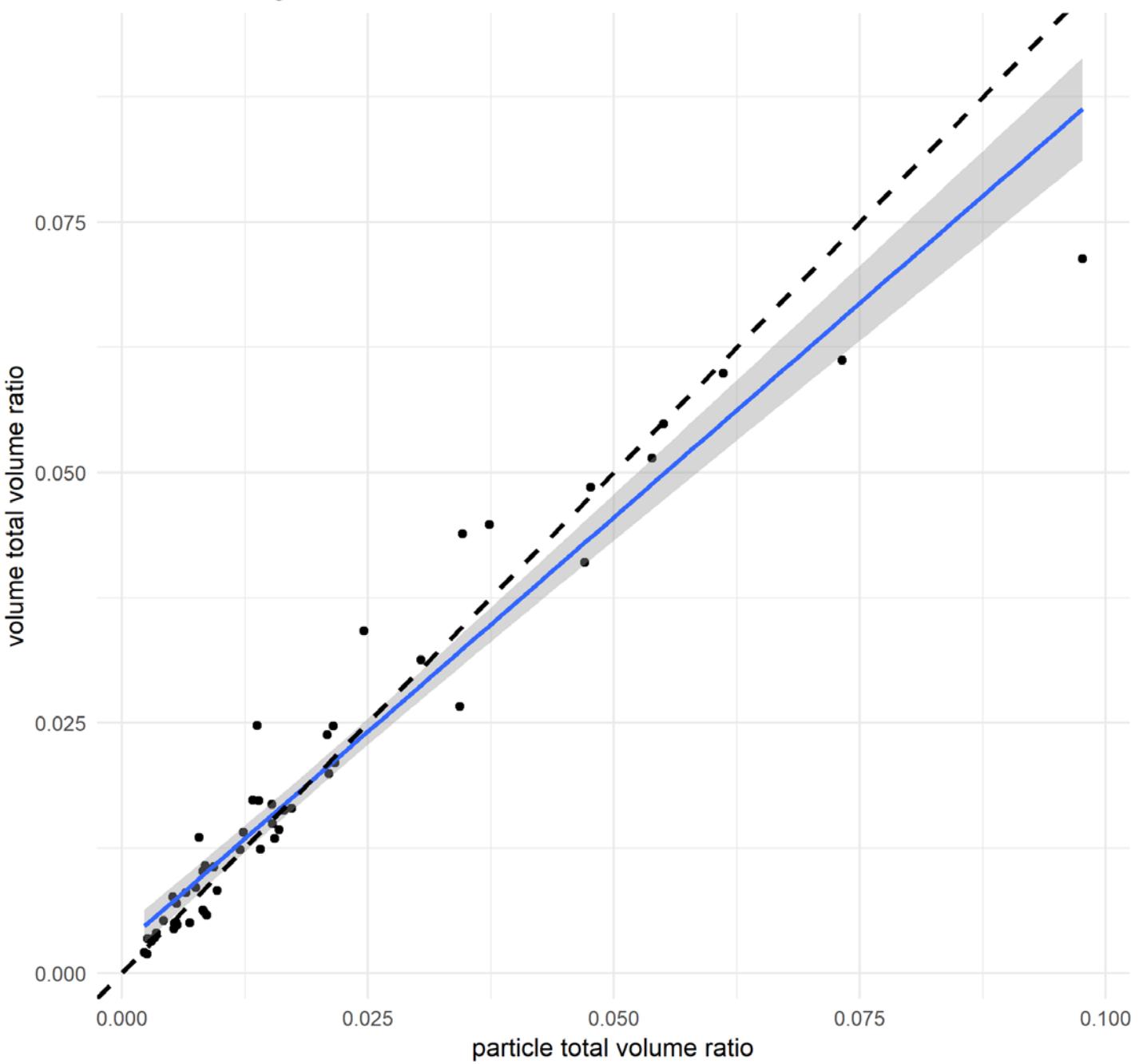
# m08\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



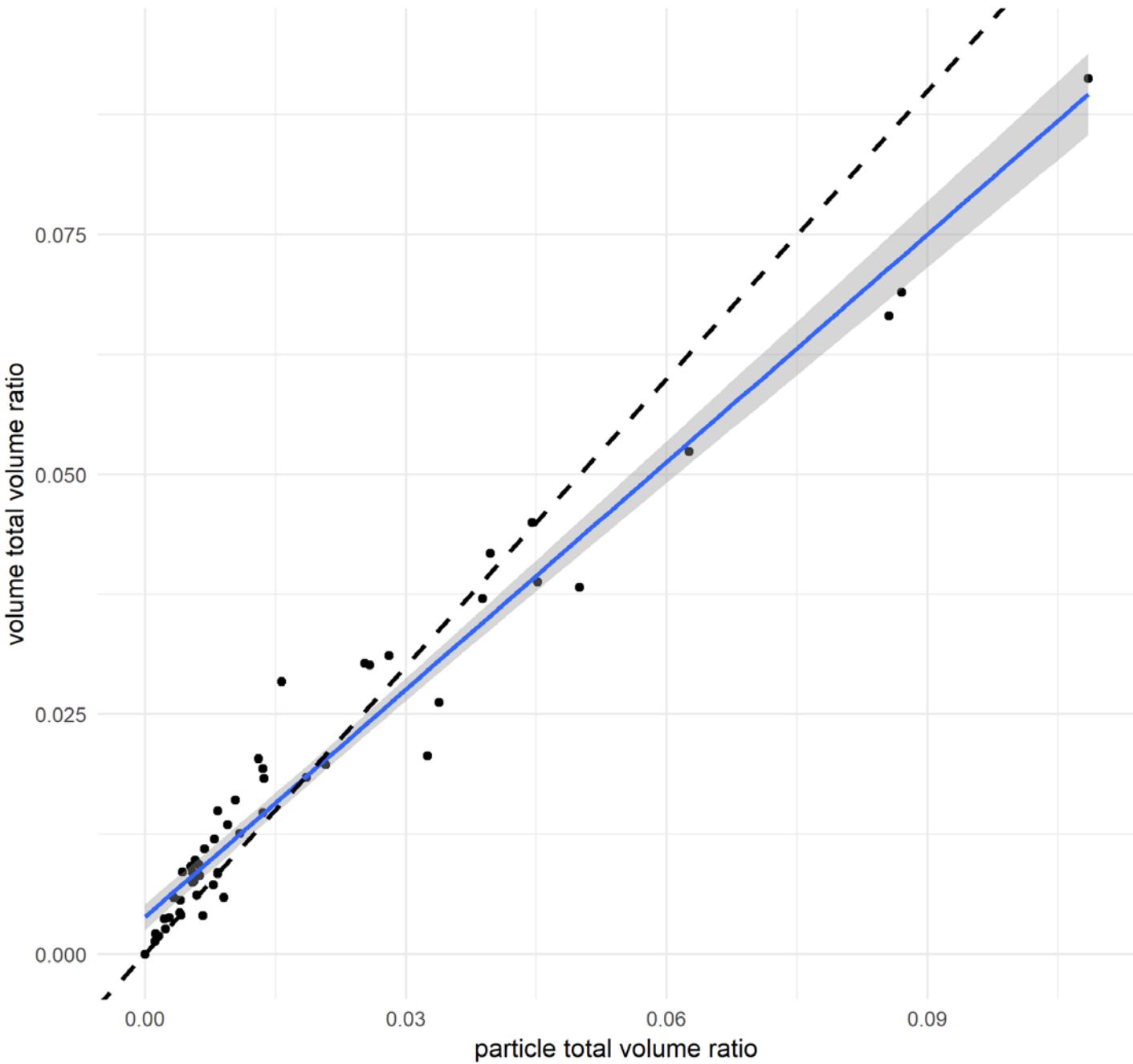
# m09\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



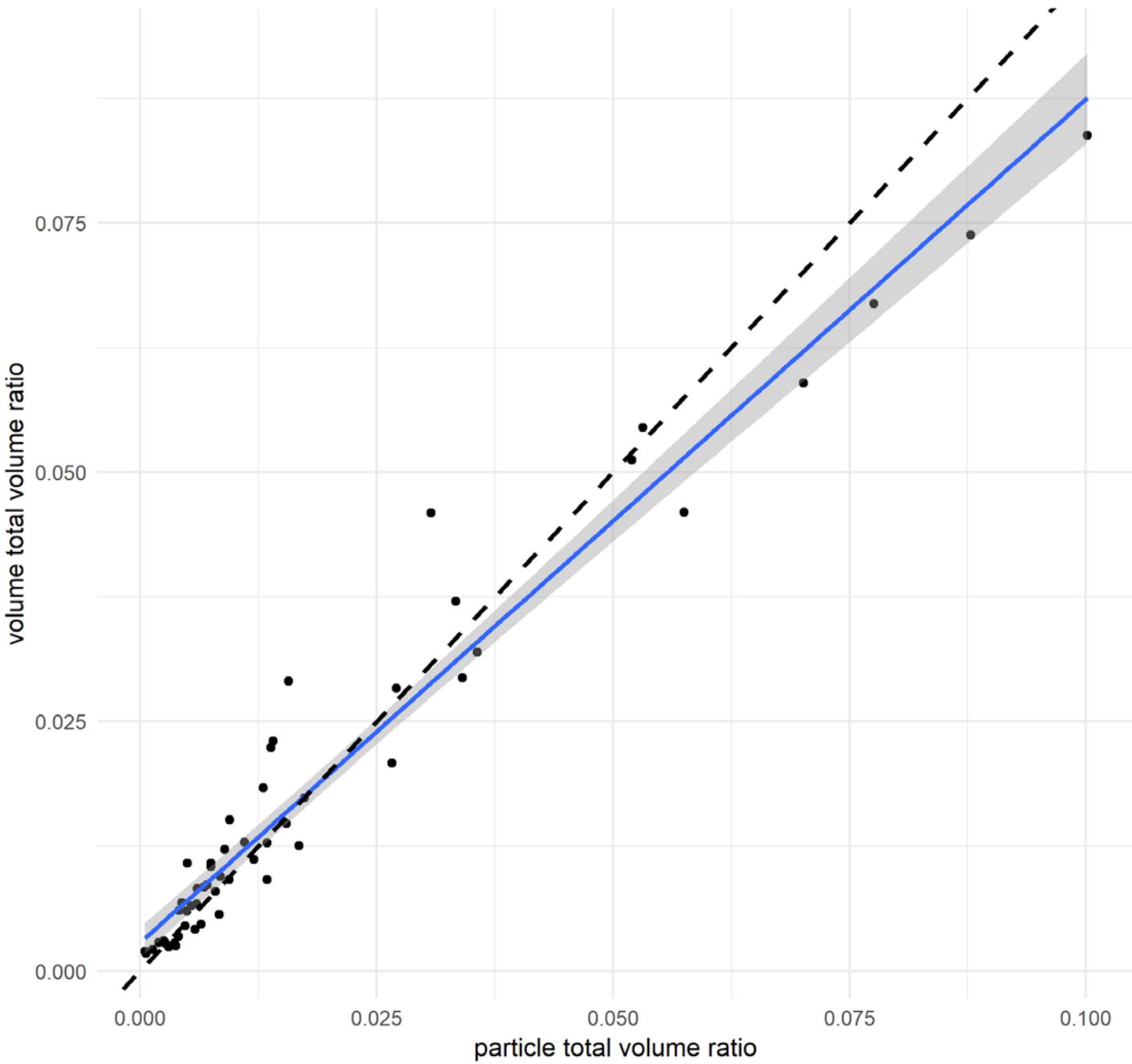
# m10\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



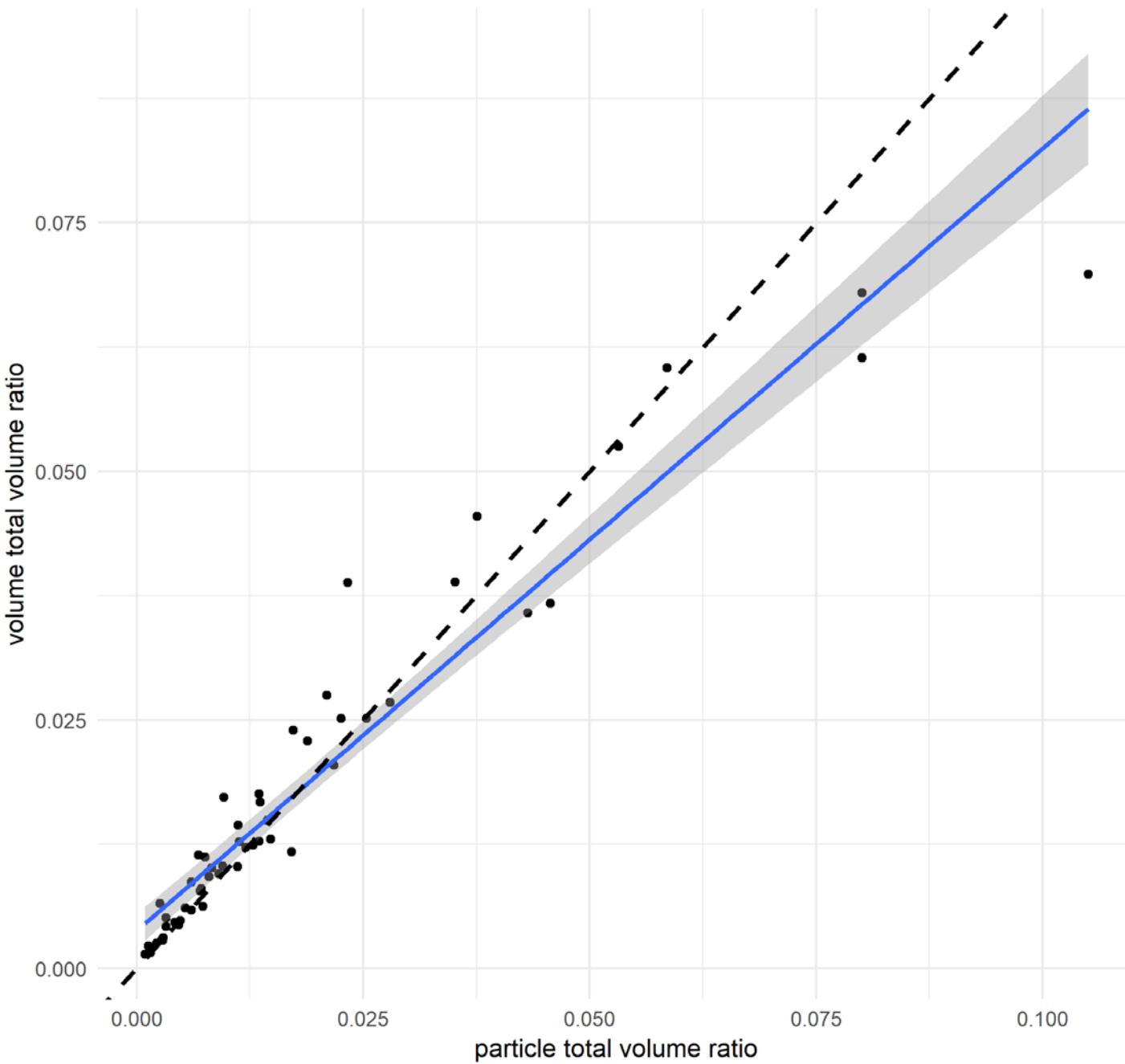
# m11\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



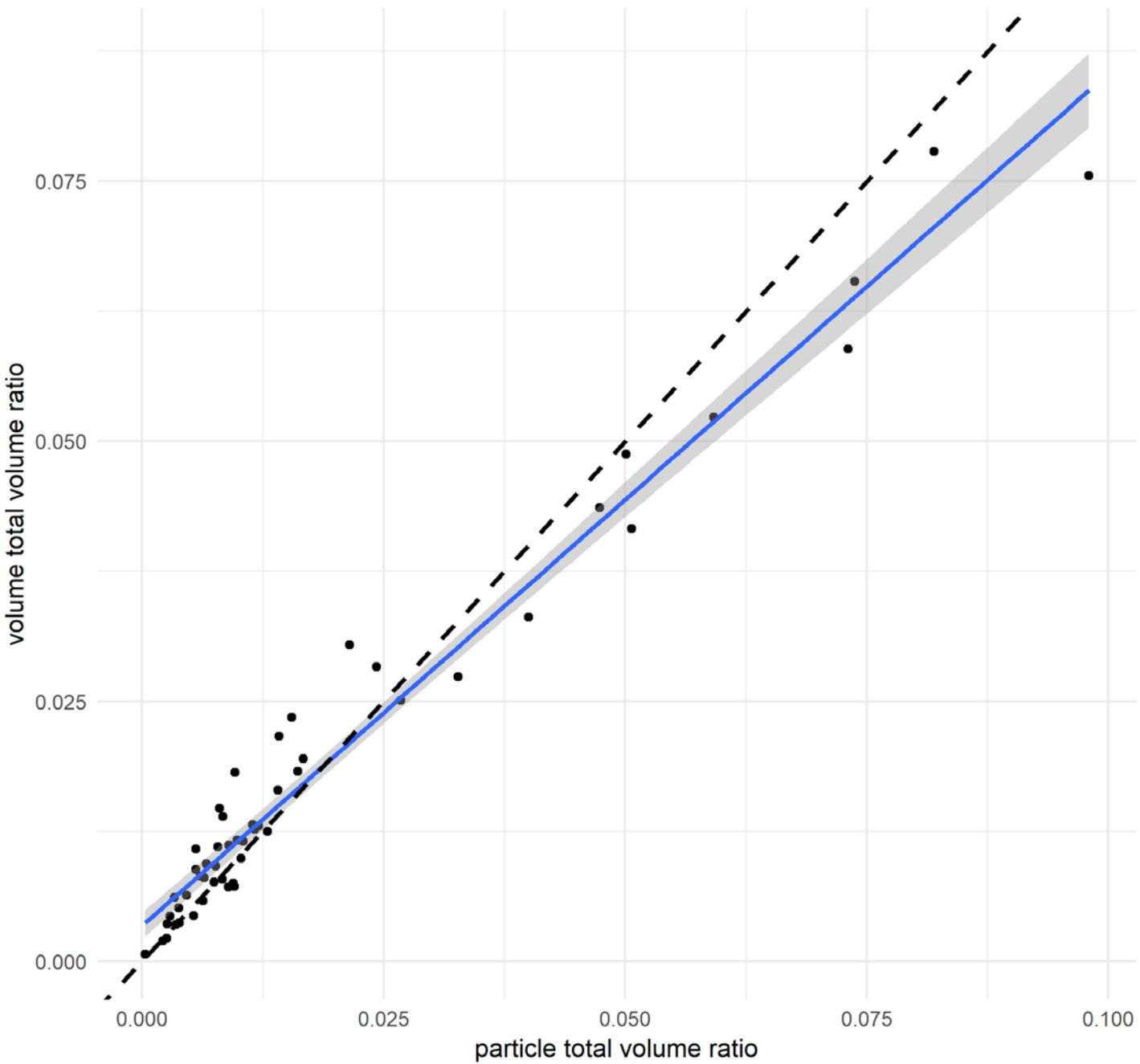
# m12\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



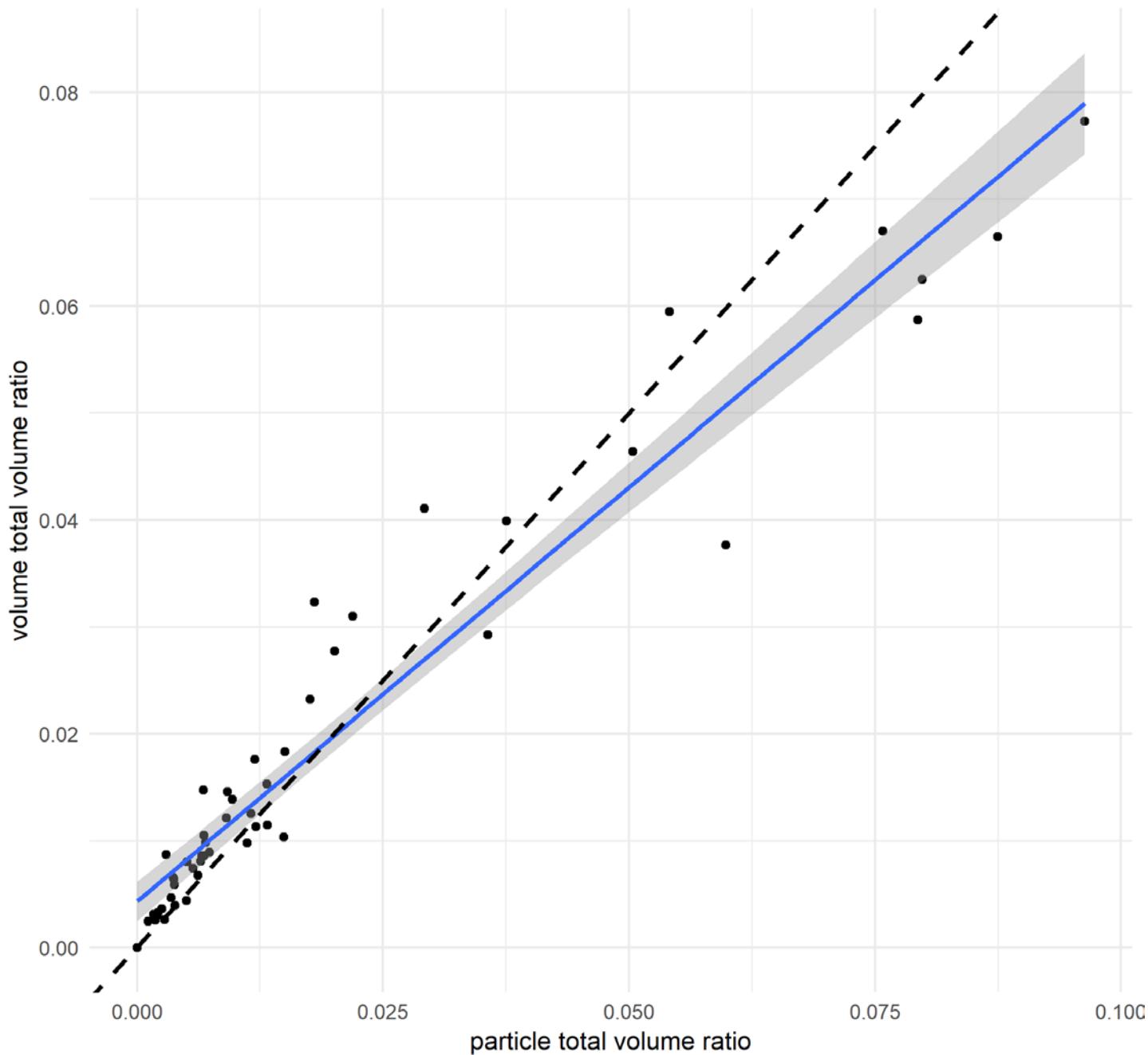
# m13\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



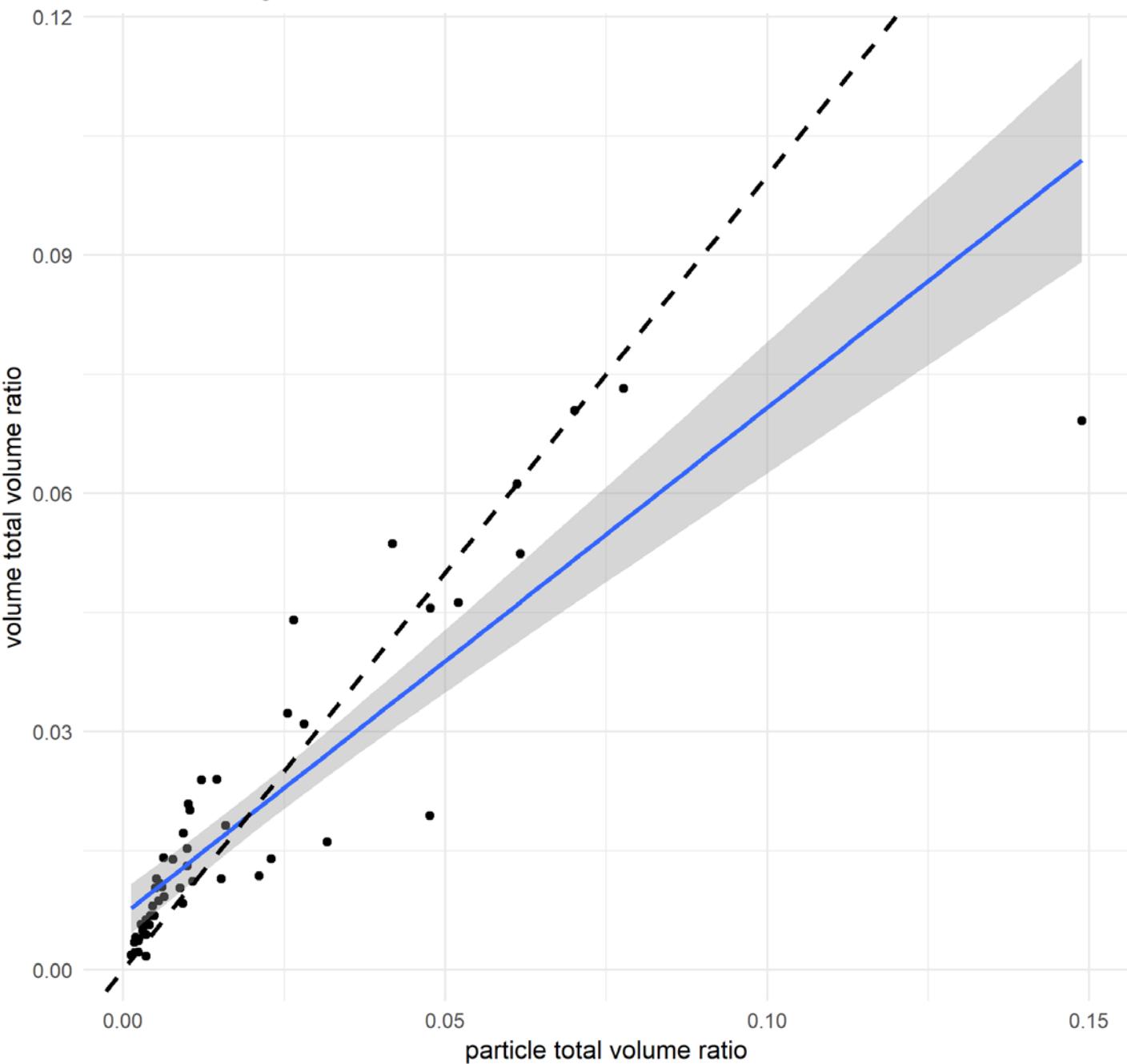
# m14\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



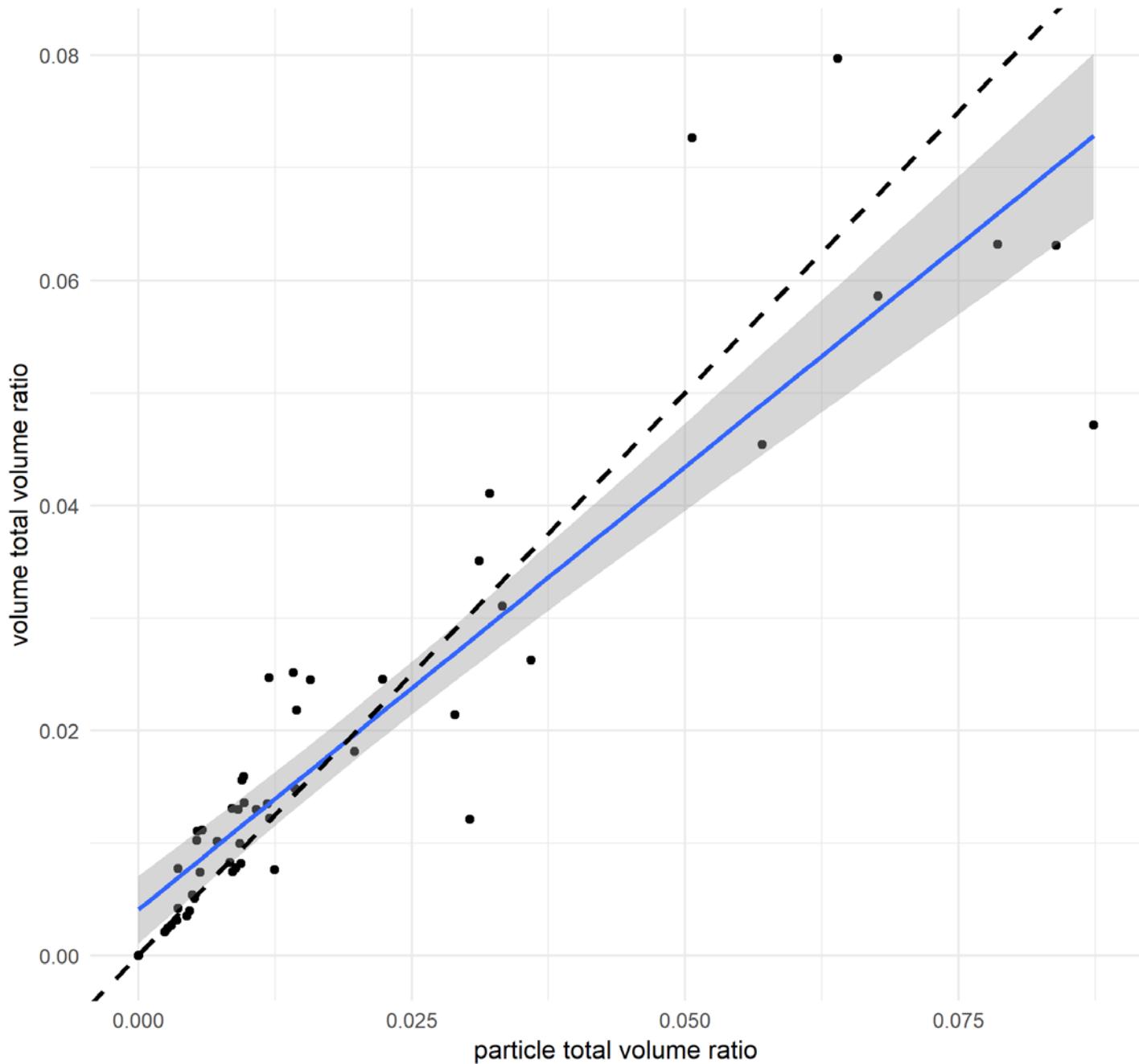
# m15\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



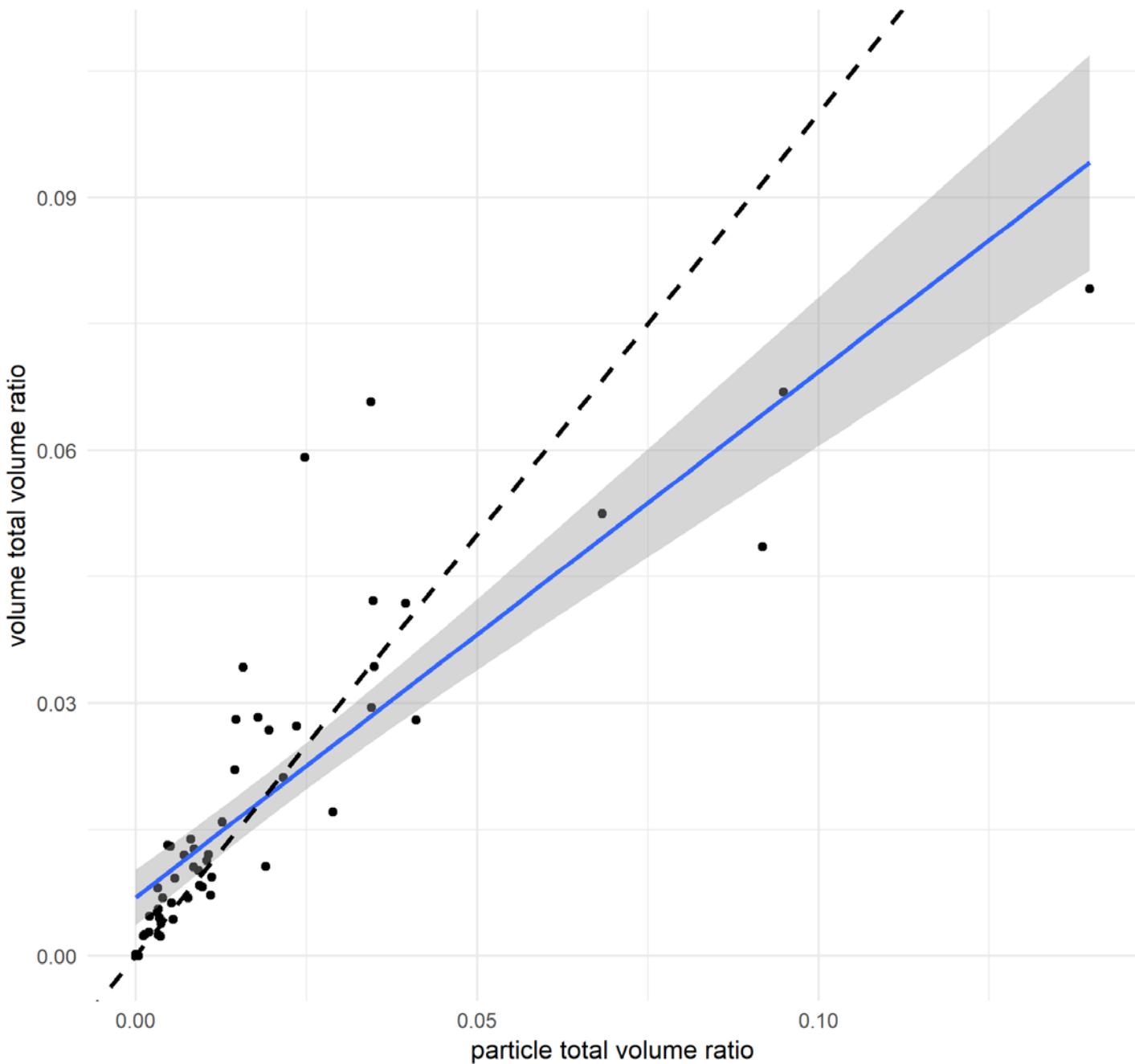
# m16\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



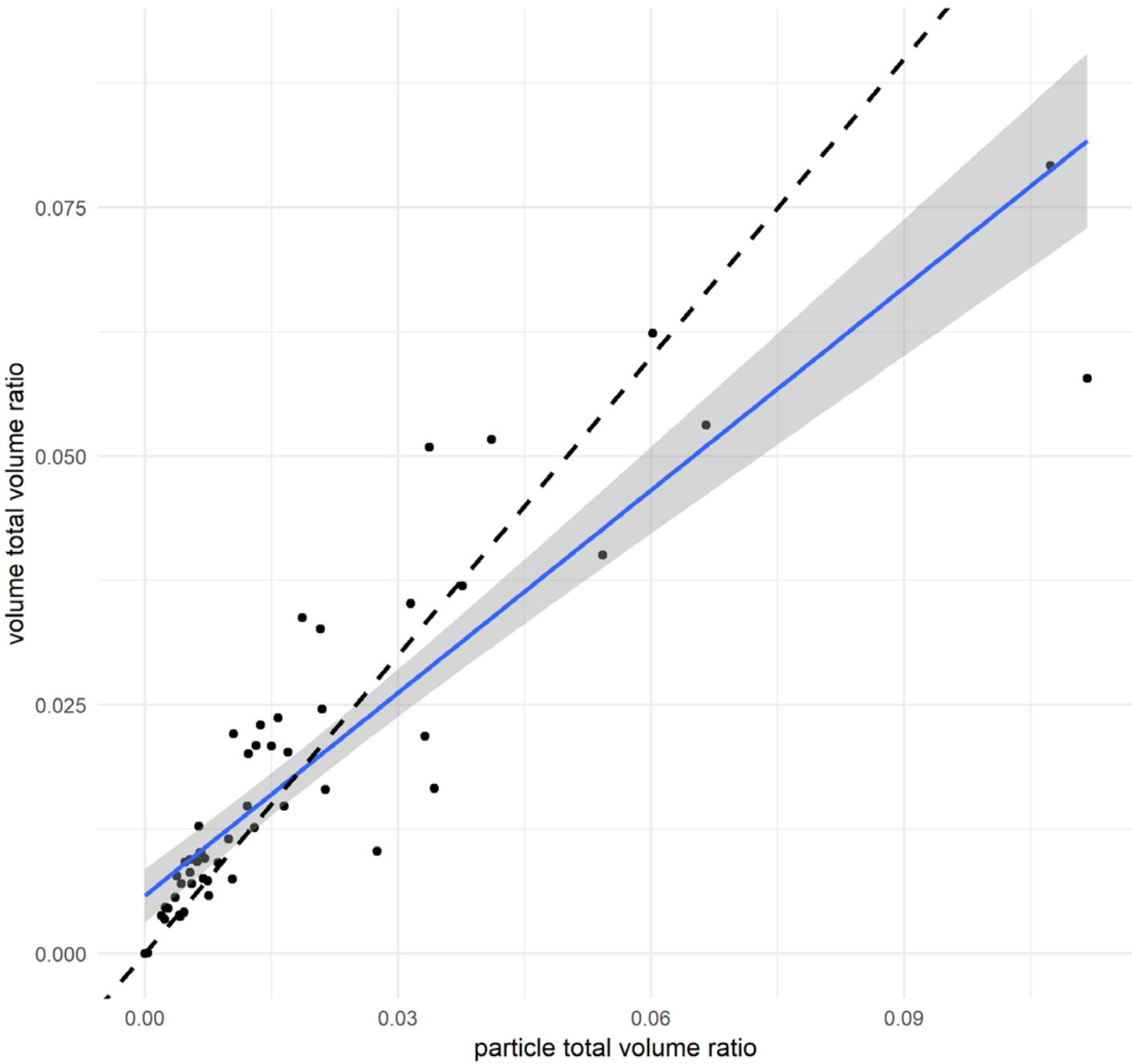
# m17\_SublobesDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



# m18\_SublobesDeposition

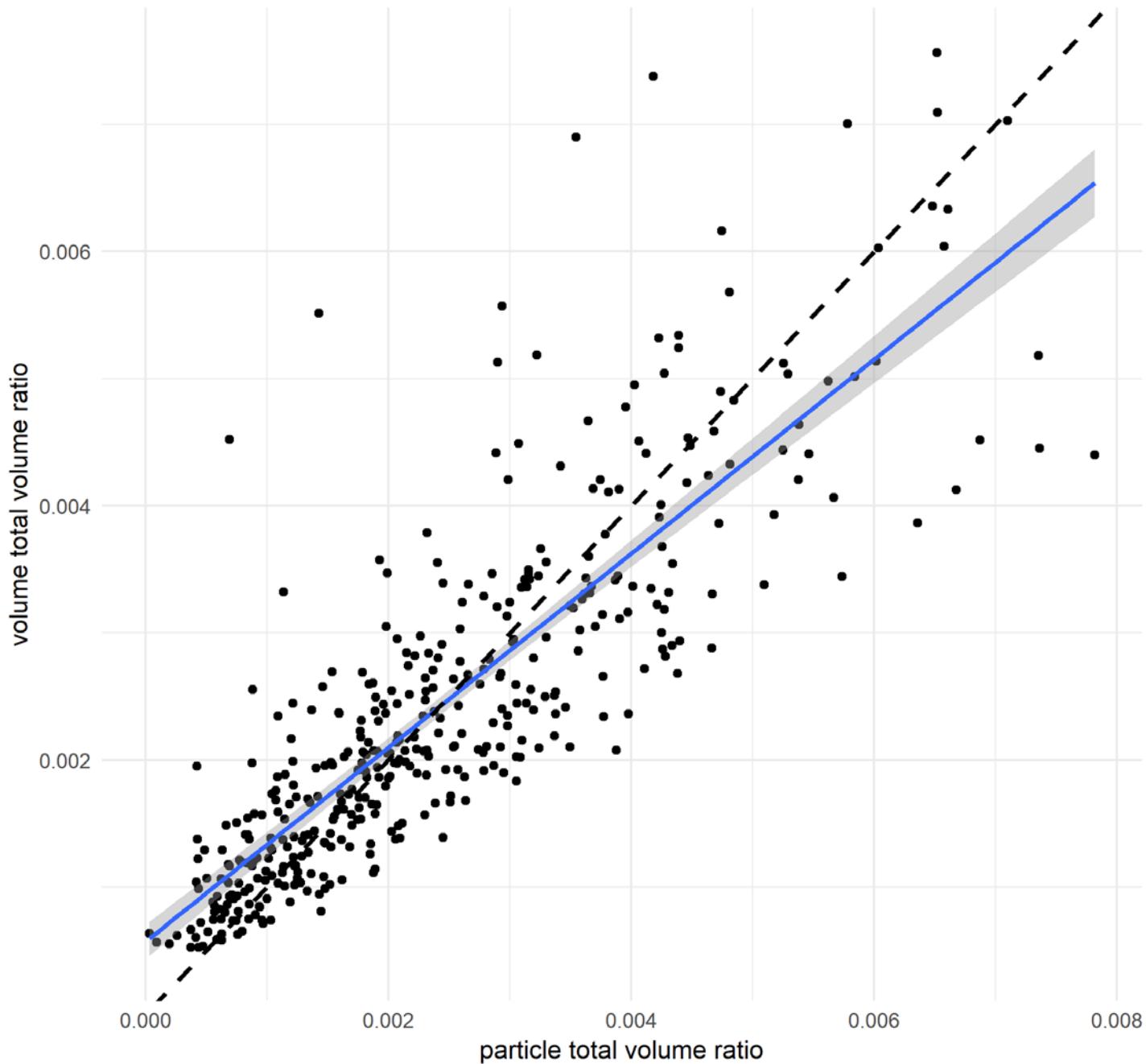
Blue: Linear Regression Line; Black: Line  $Y = X$



Near Acini Level

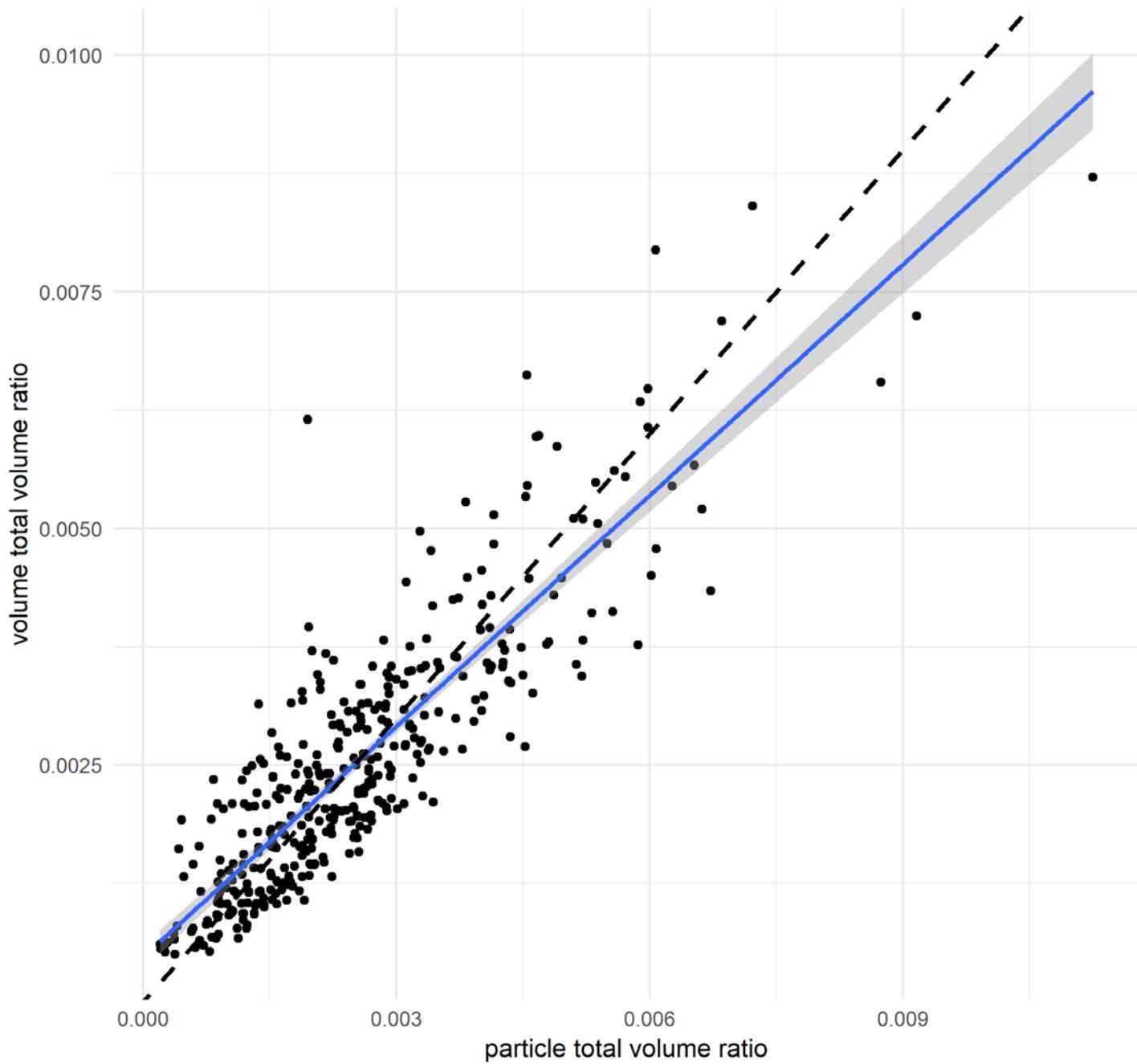
# m01\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



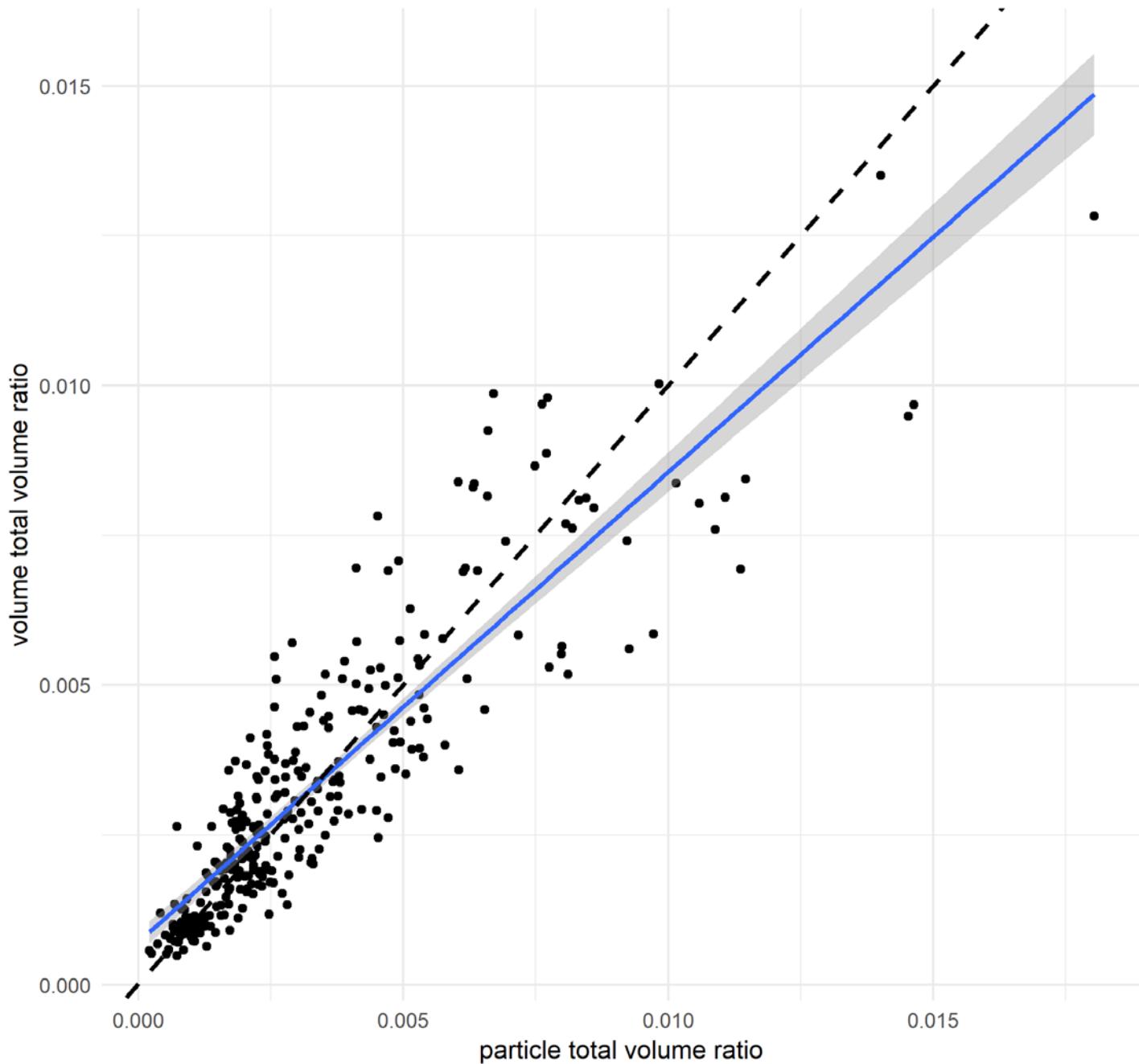
# m02\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



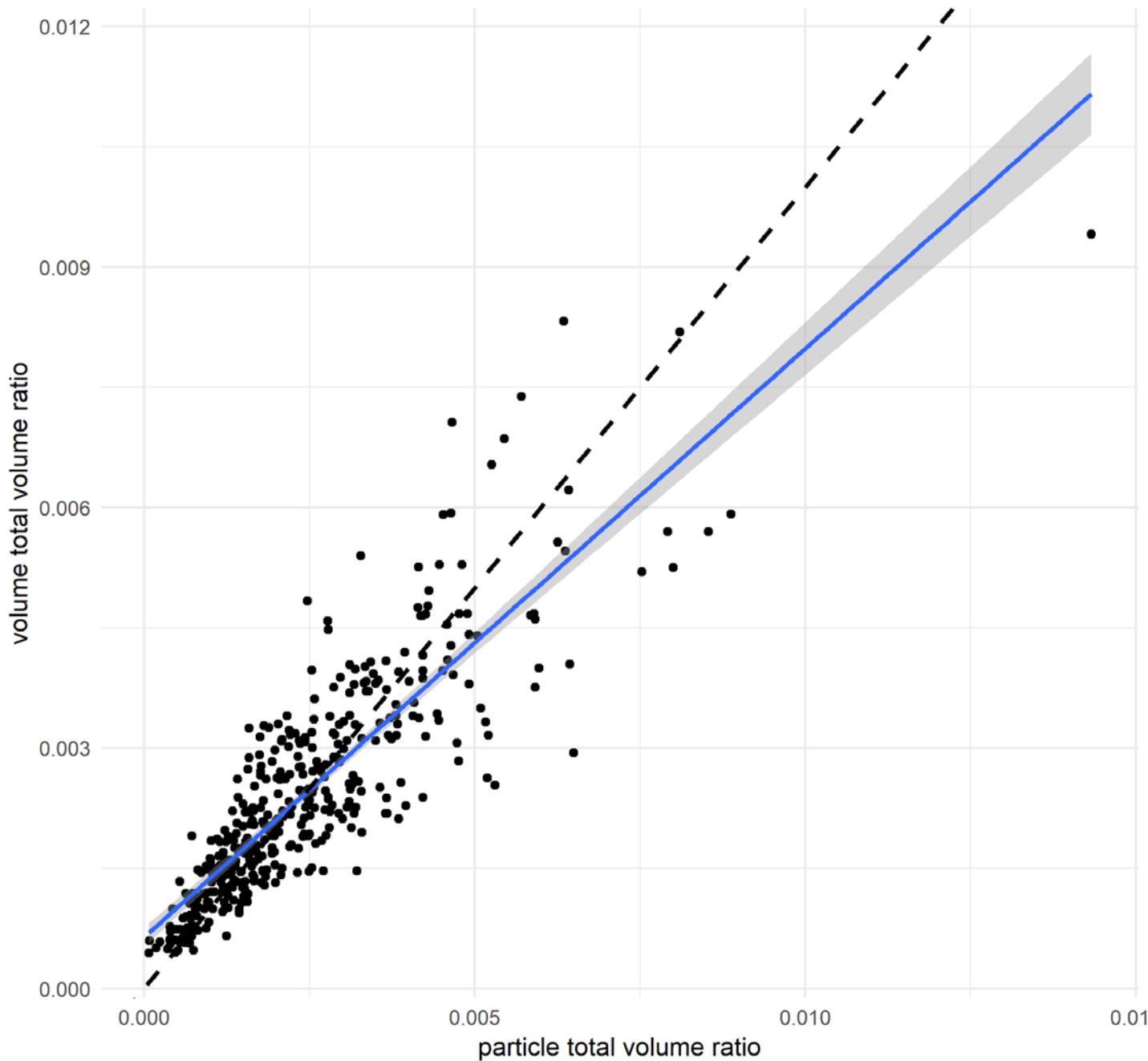
### m03\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



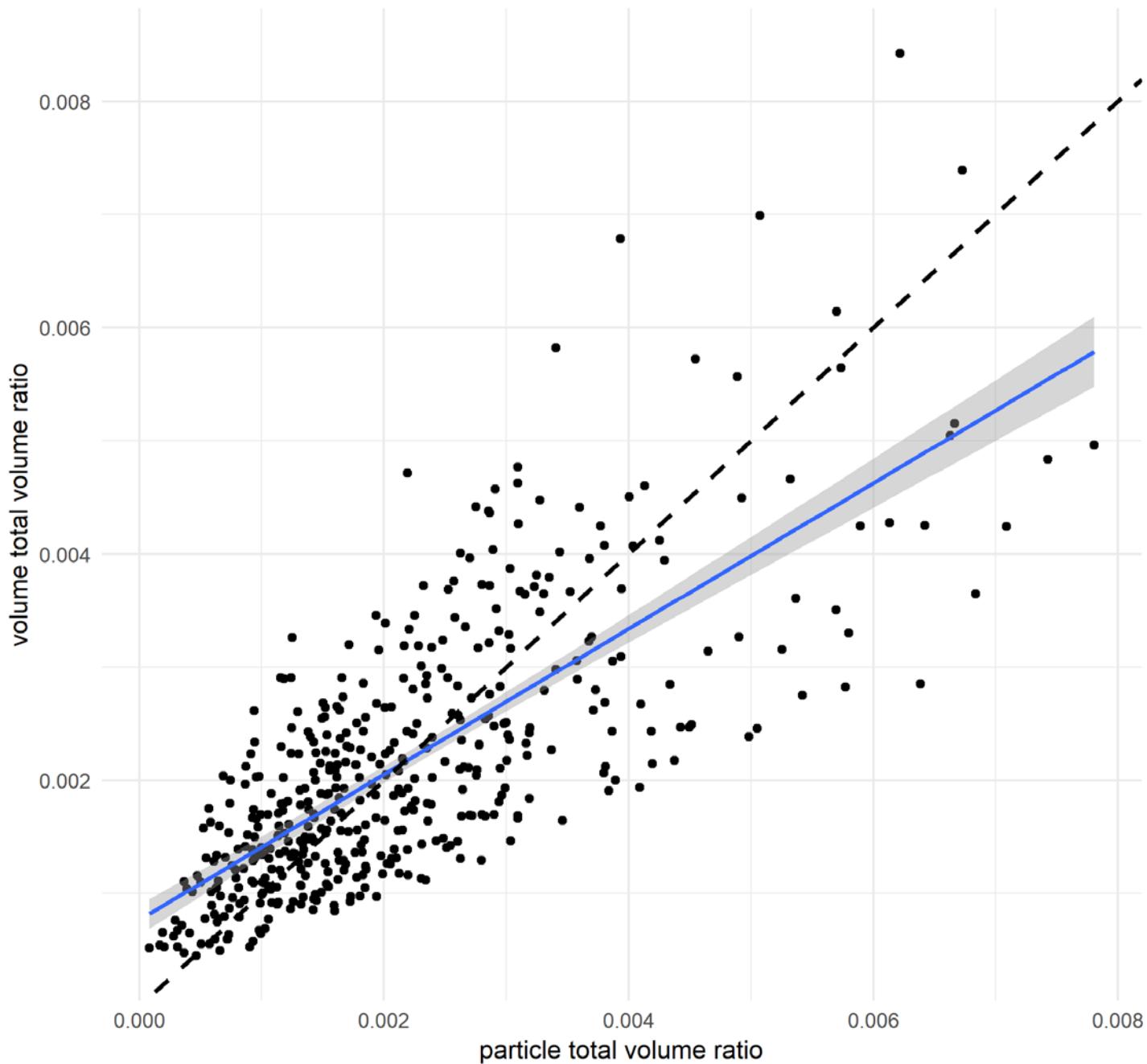
# m04\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



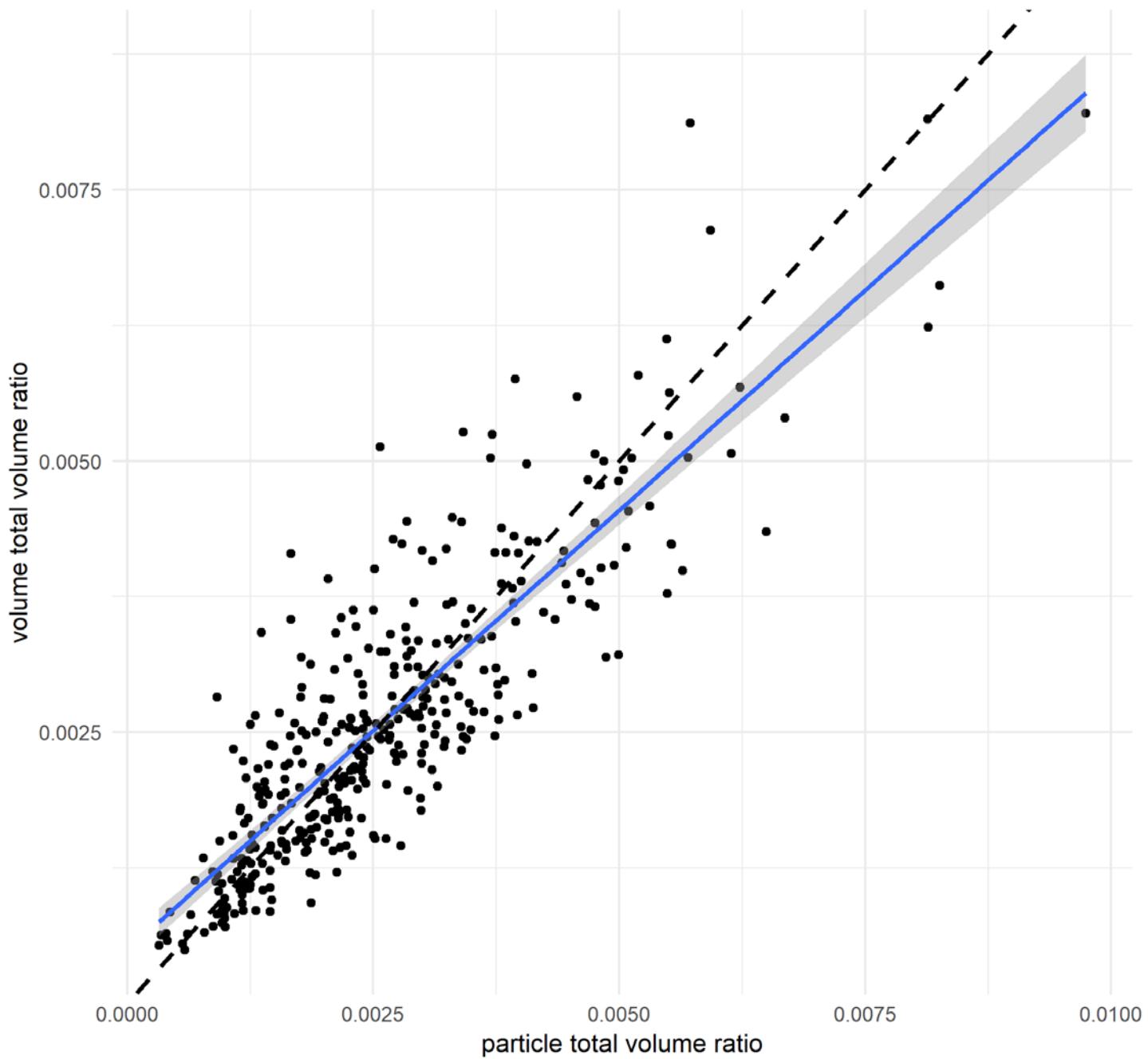
# m05\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



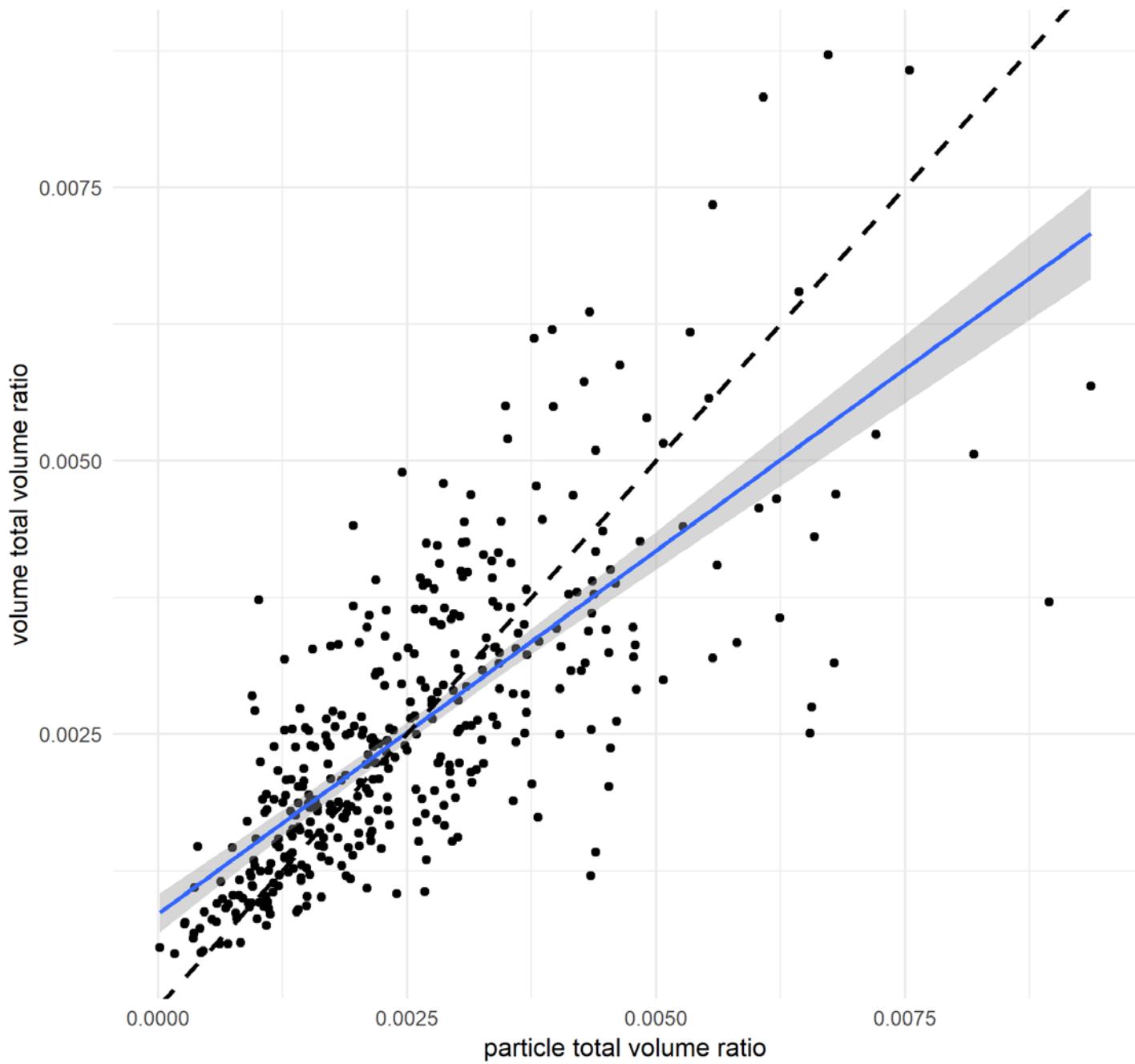
# m06\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



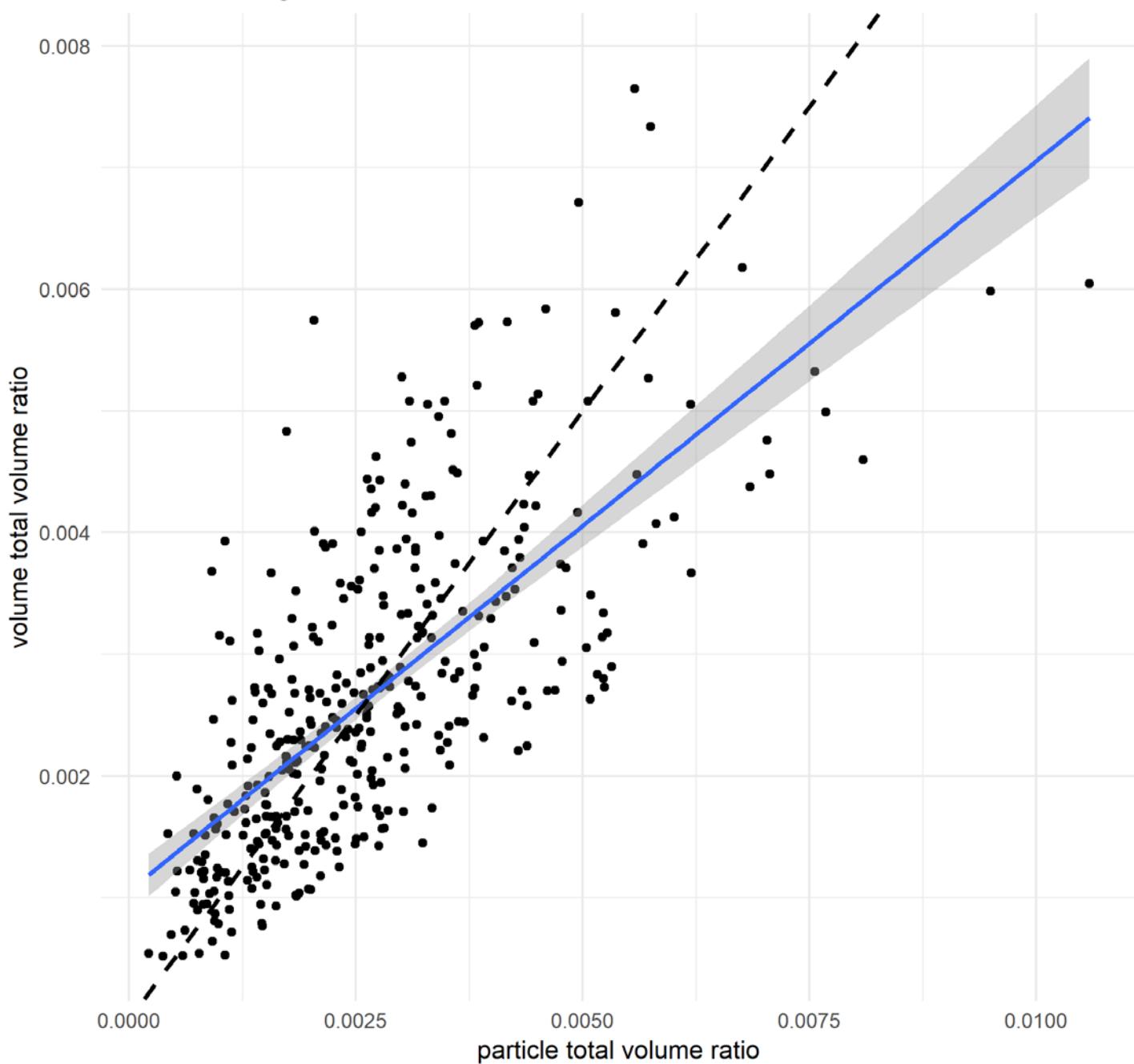
# m07\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



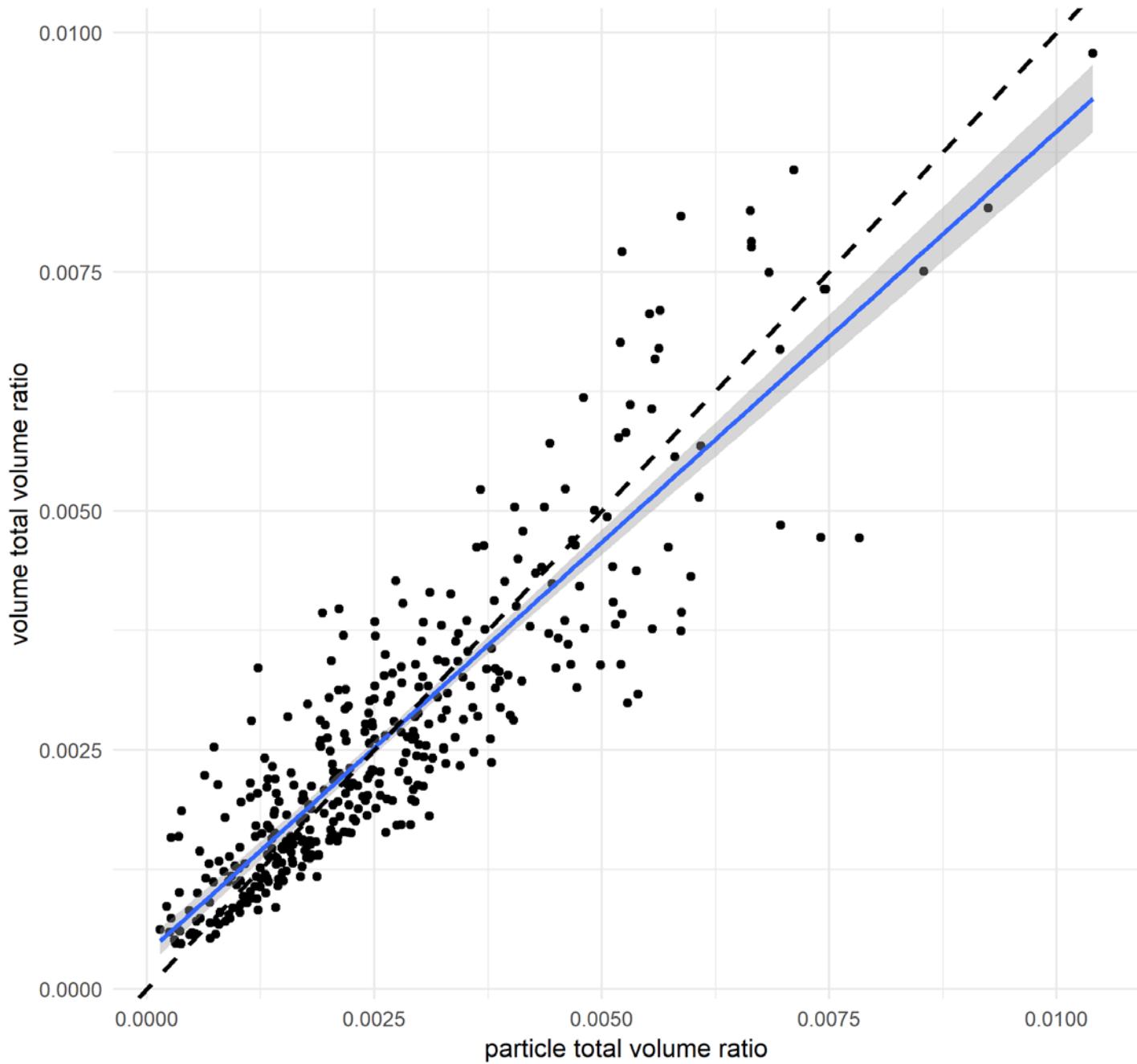
# m08\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



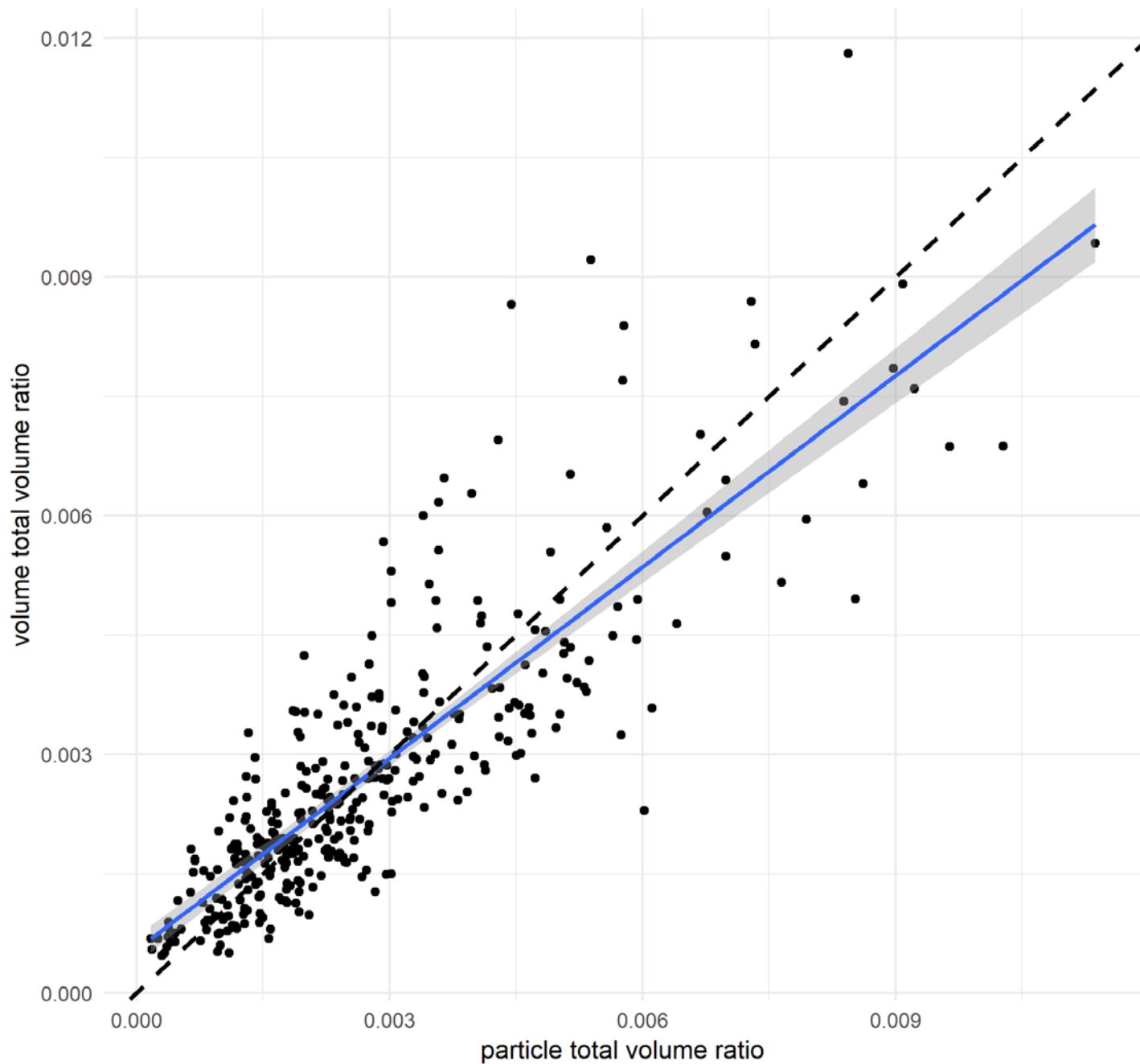
# m09\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



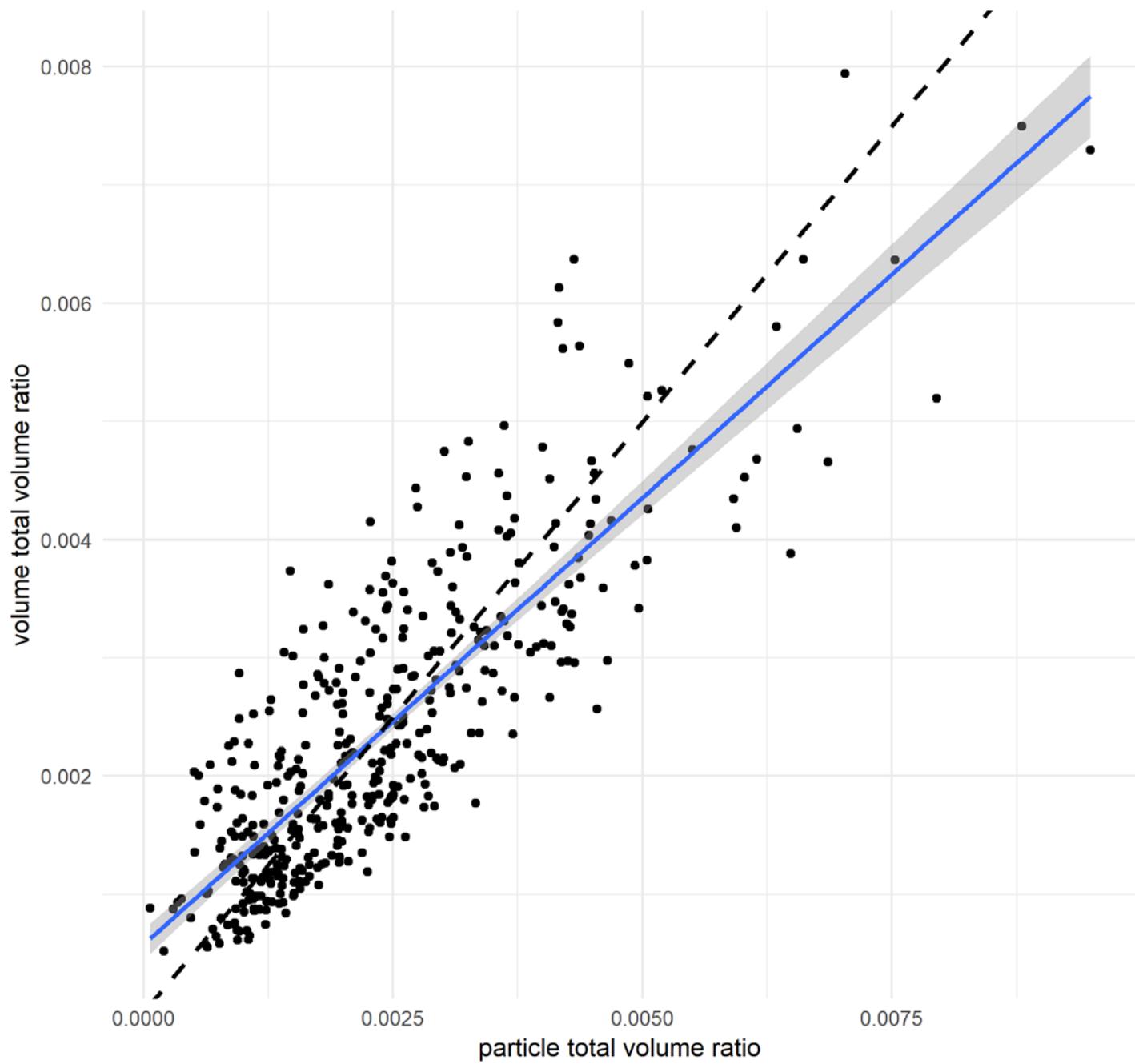
# m10\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



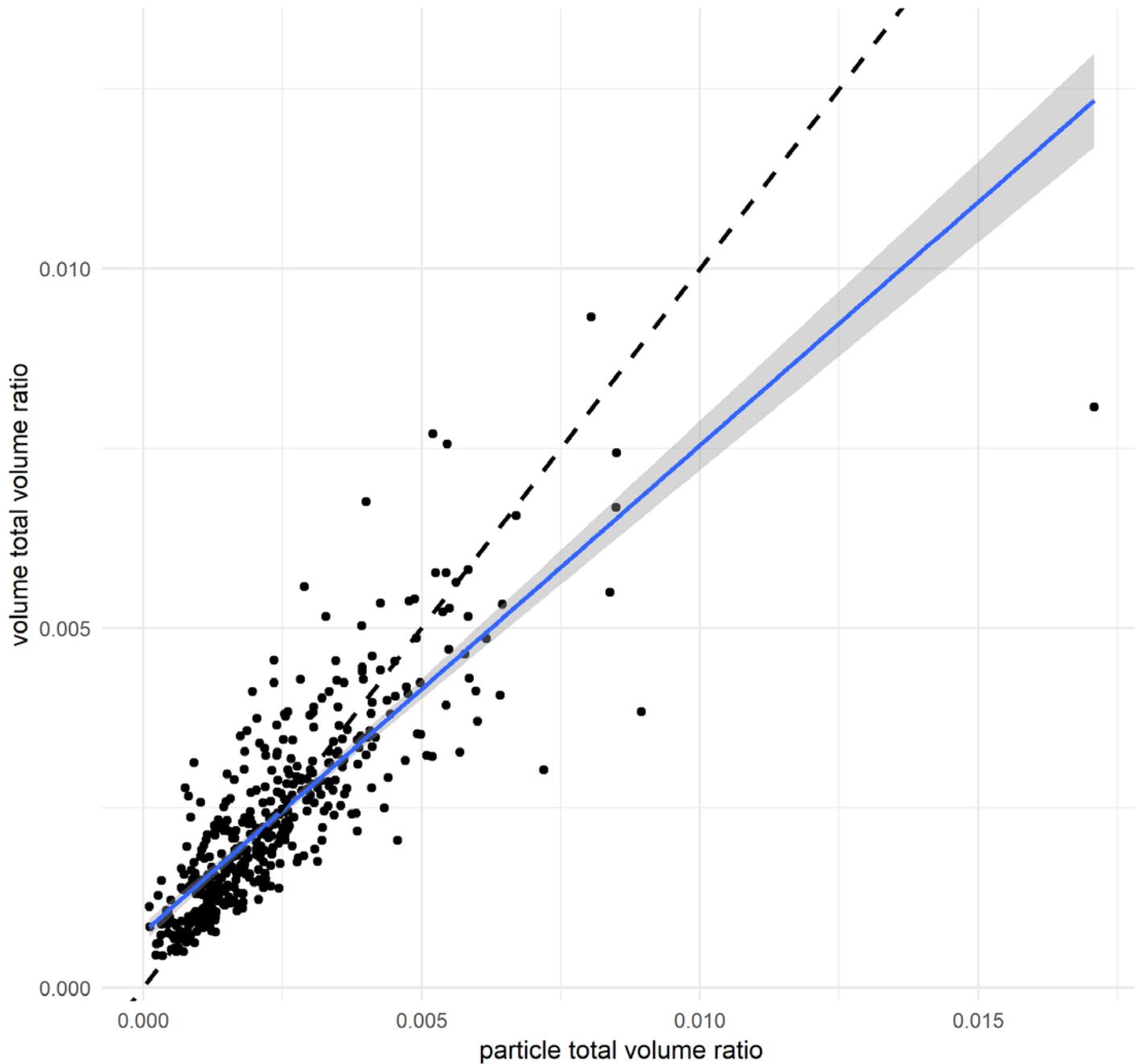
# m11\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



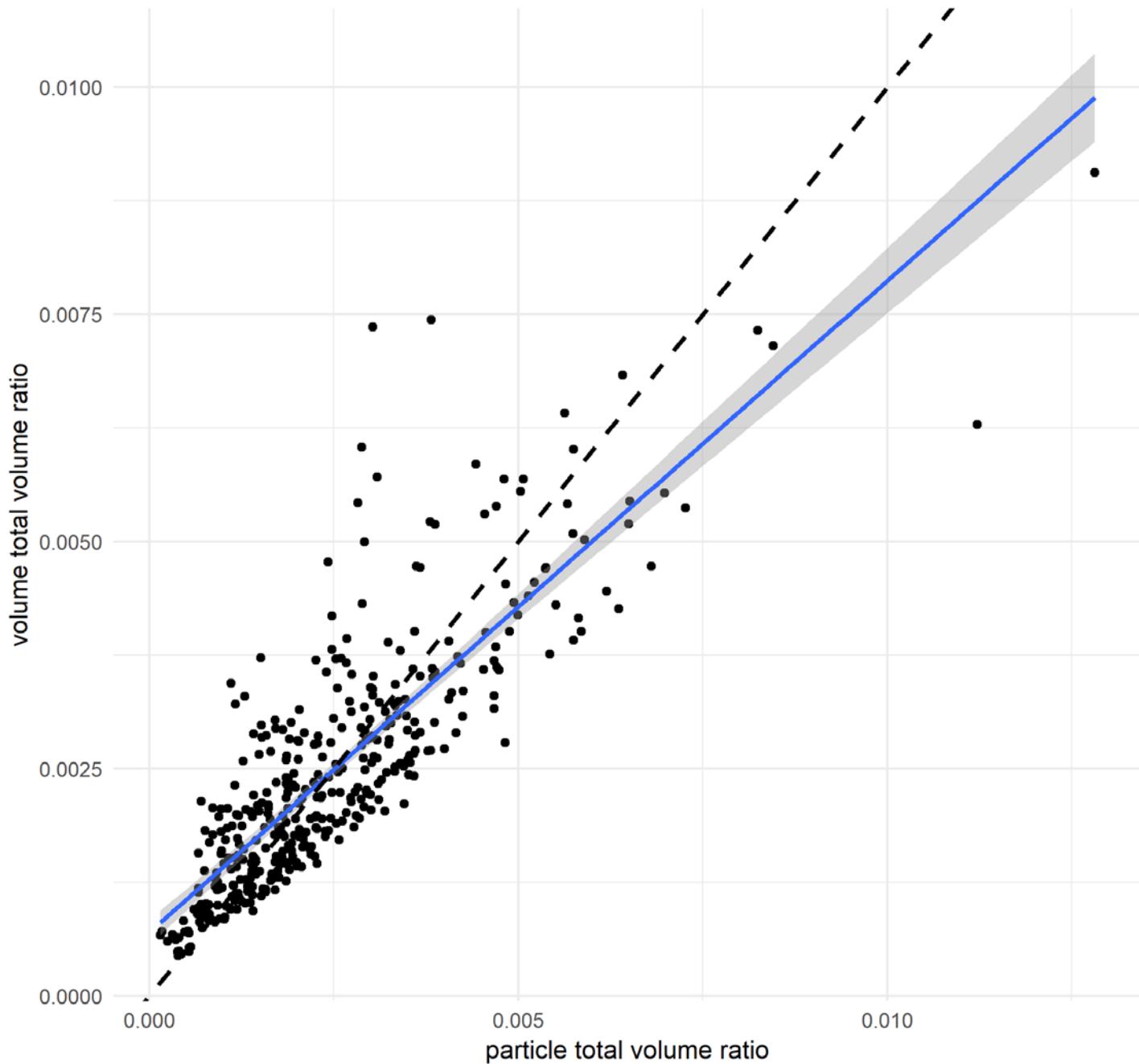
# m12\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



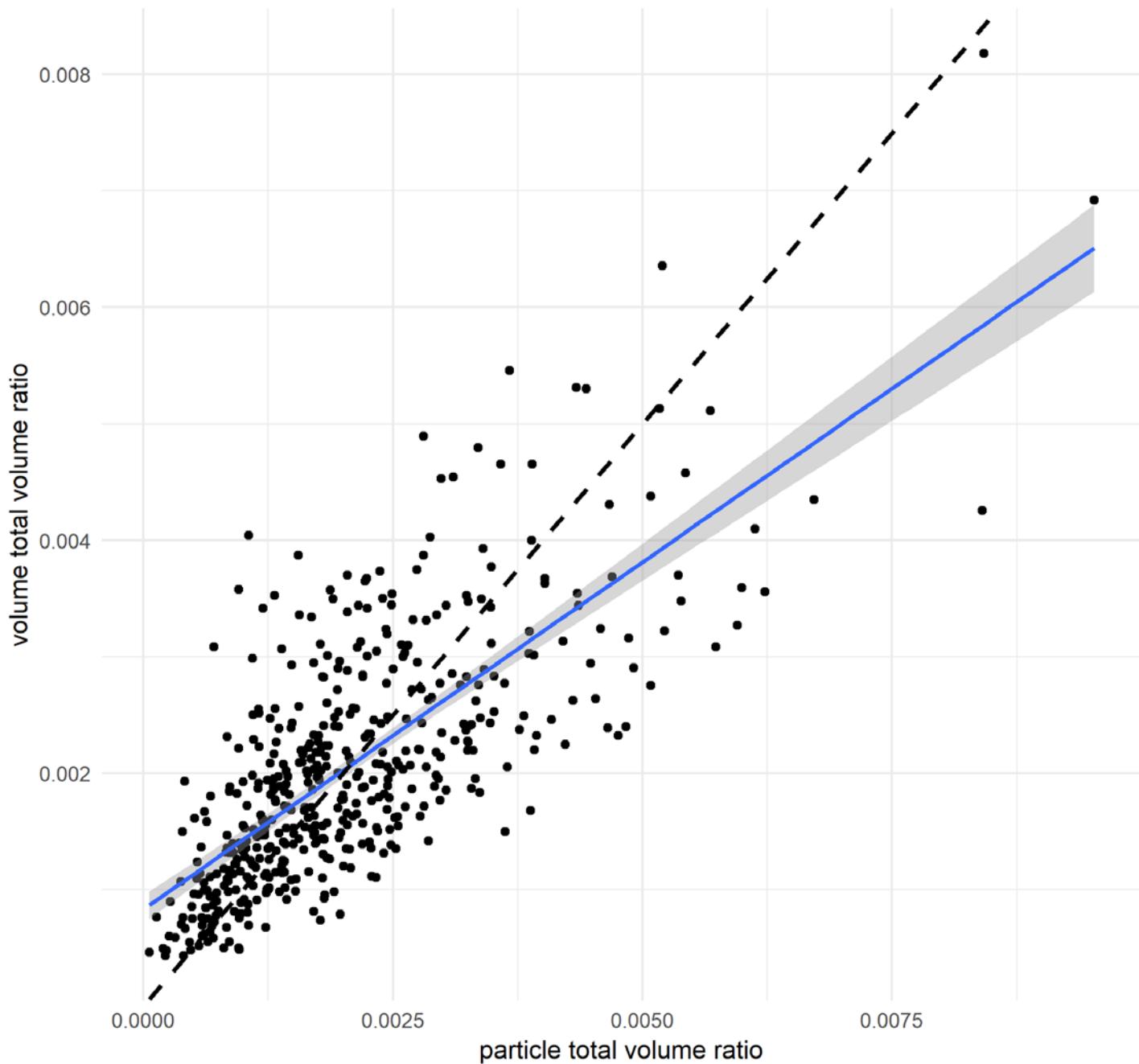
# m13\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



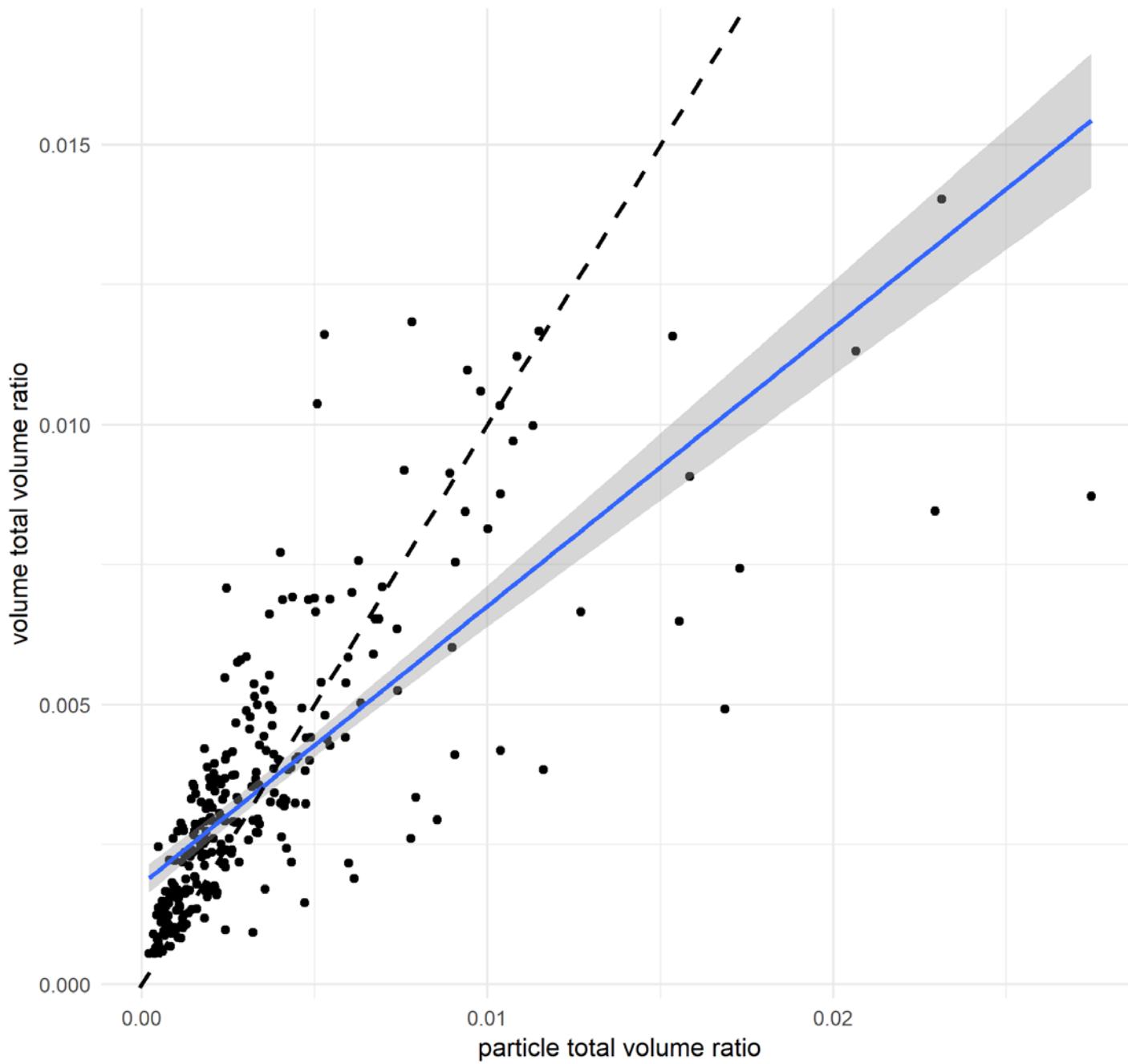
# m14\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



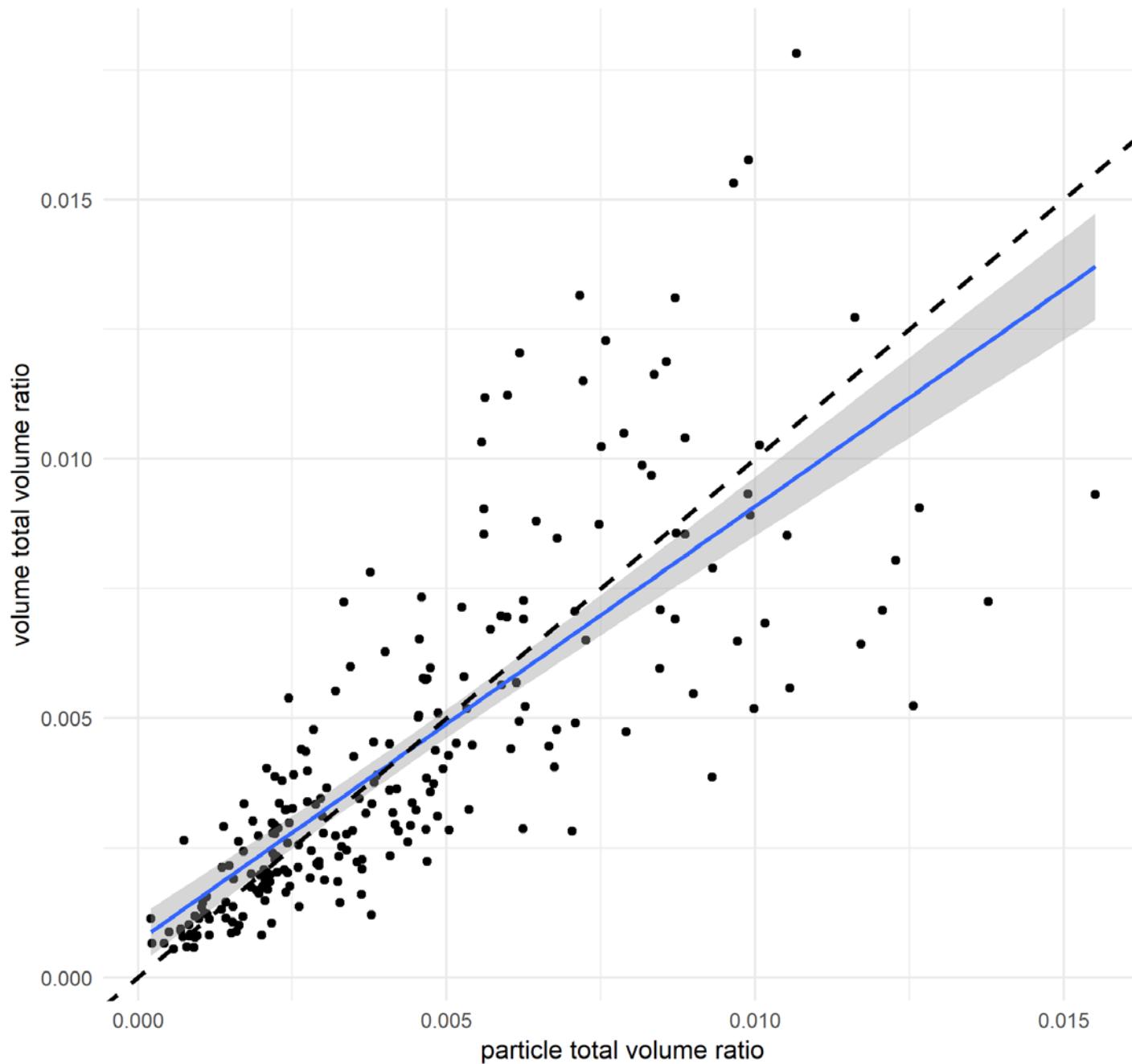
# m15\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



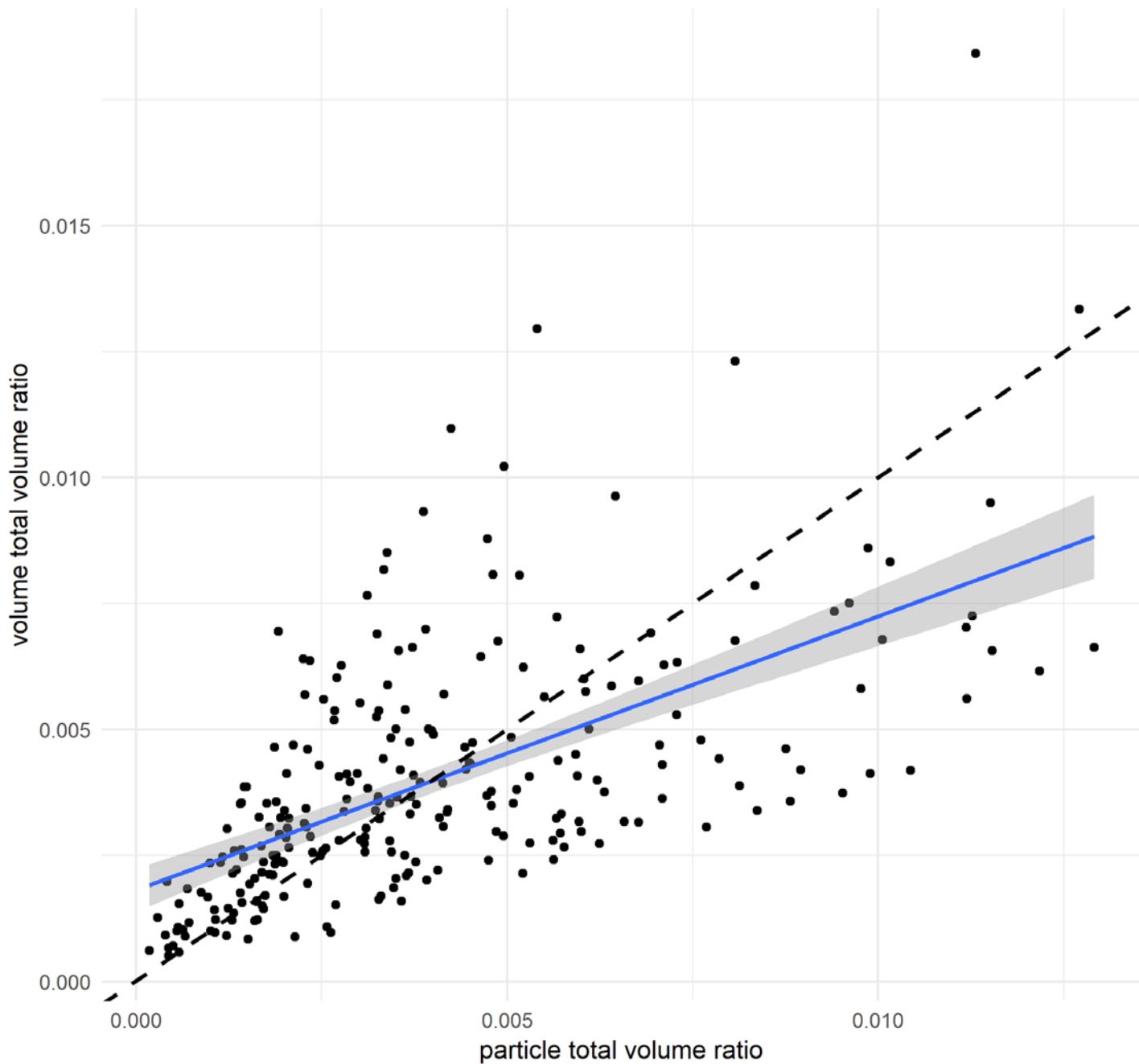
# m16\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



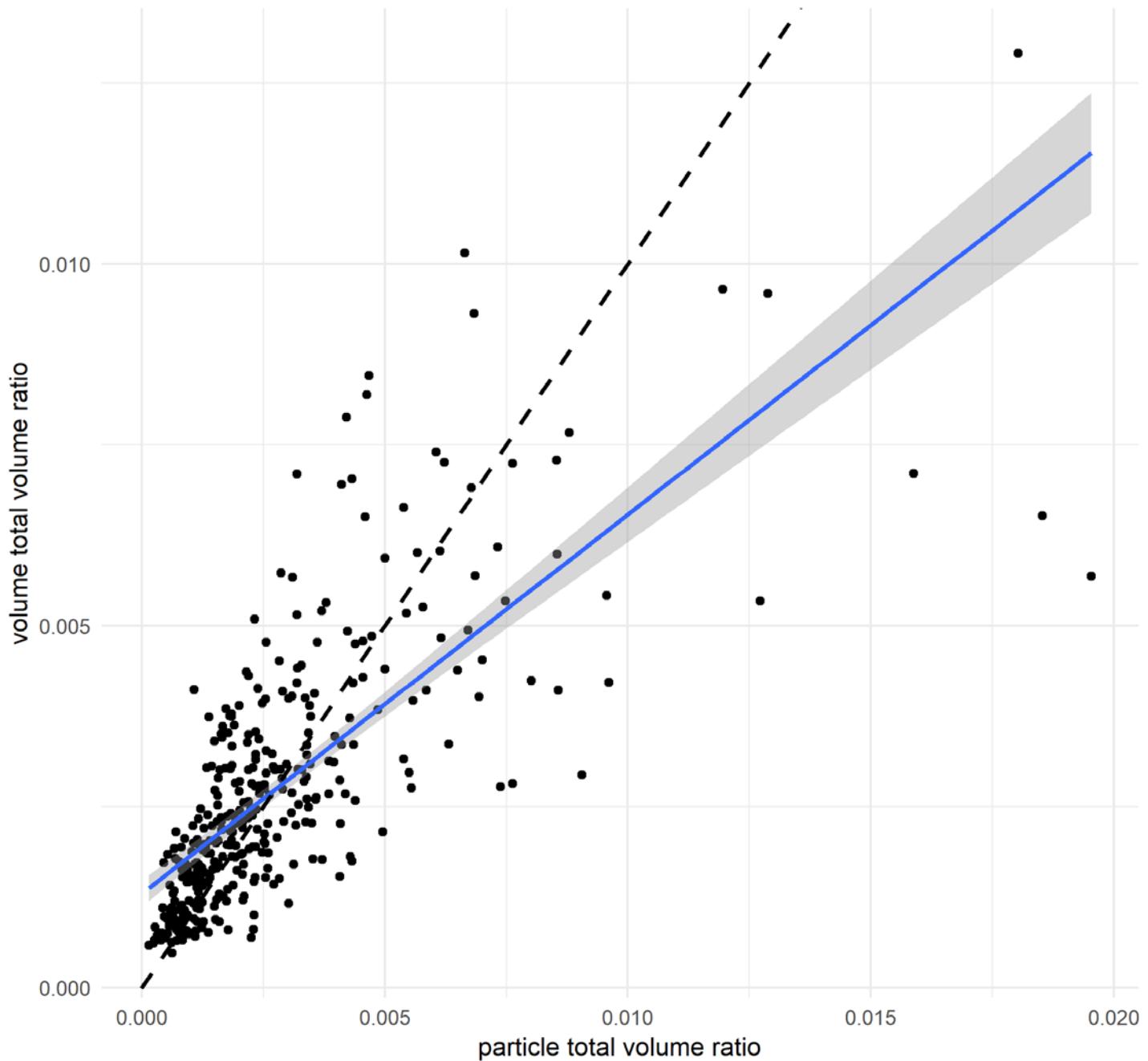
# m17\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$



# m18\_NearAciniDeposition

Blue: Linear Regression Line; Black: Line  $Y = X$

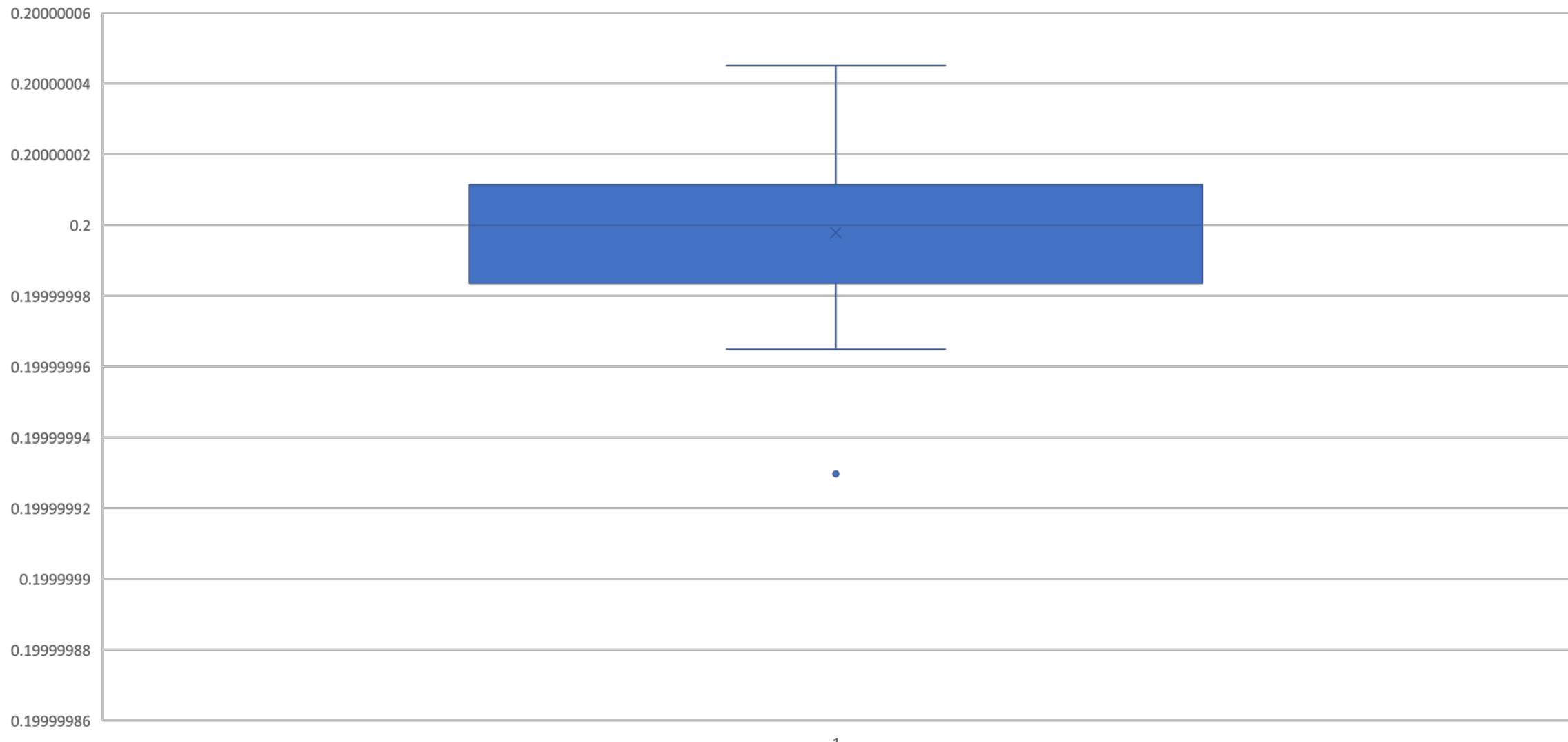


Lobe			Sublobe			NearAcini		
MEAN	SD	REL_SD	MEAN	SD	REL_SD	MEAN	SD	REL_SD
0.2	2.73E-08	1.36E-07	0.014864	0.010853	0.730166	0.000936	0.006316	6.746918

## Overall



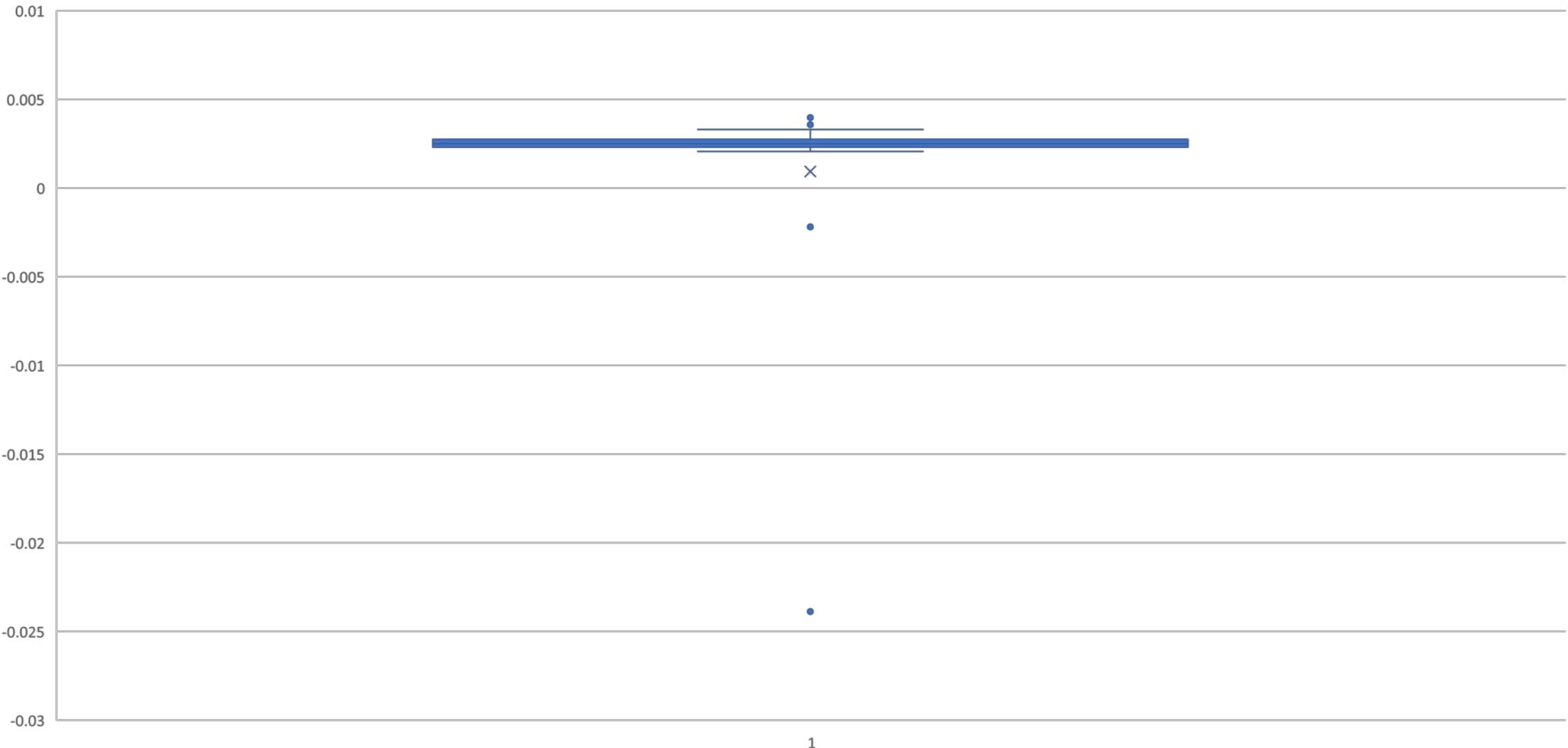
### Lobe



### Sublobe

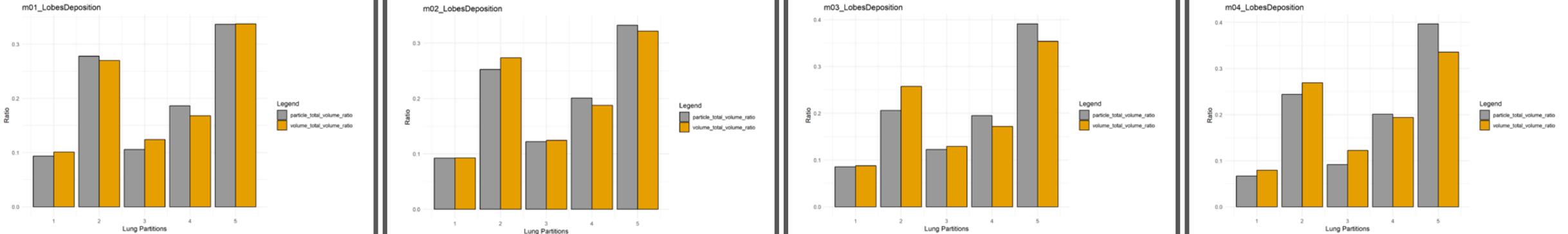


### NearAcini



## Assumptions

- Note:  $\frac{\text{Particle Count}}{\text{Total Volume}} [=] \text{mm}^{-3}$ , thus it is not dimensionless
- There may exist a critical volume ratio for mice.
  - Partitions of lung that are above the ratio tend to aggregate more particles
  - Partitions of lung that are below the ratio tend to even hinder particles from depositing

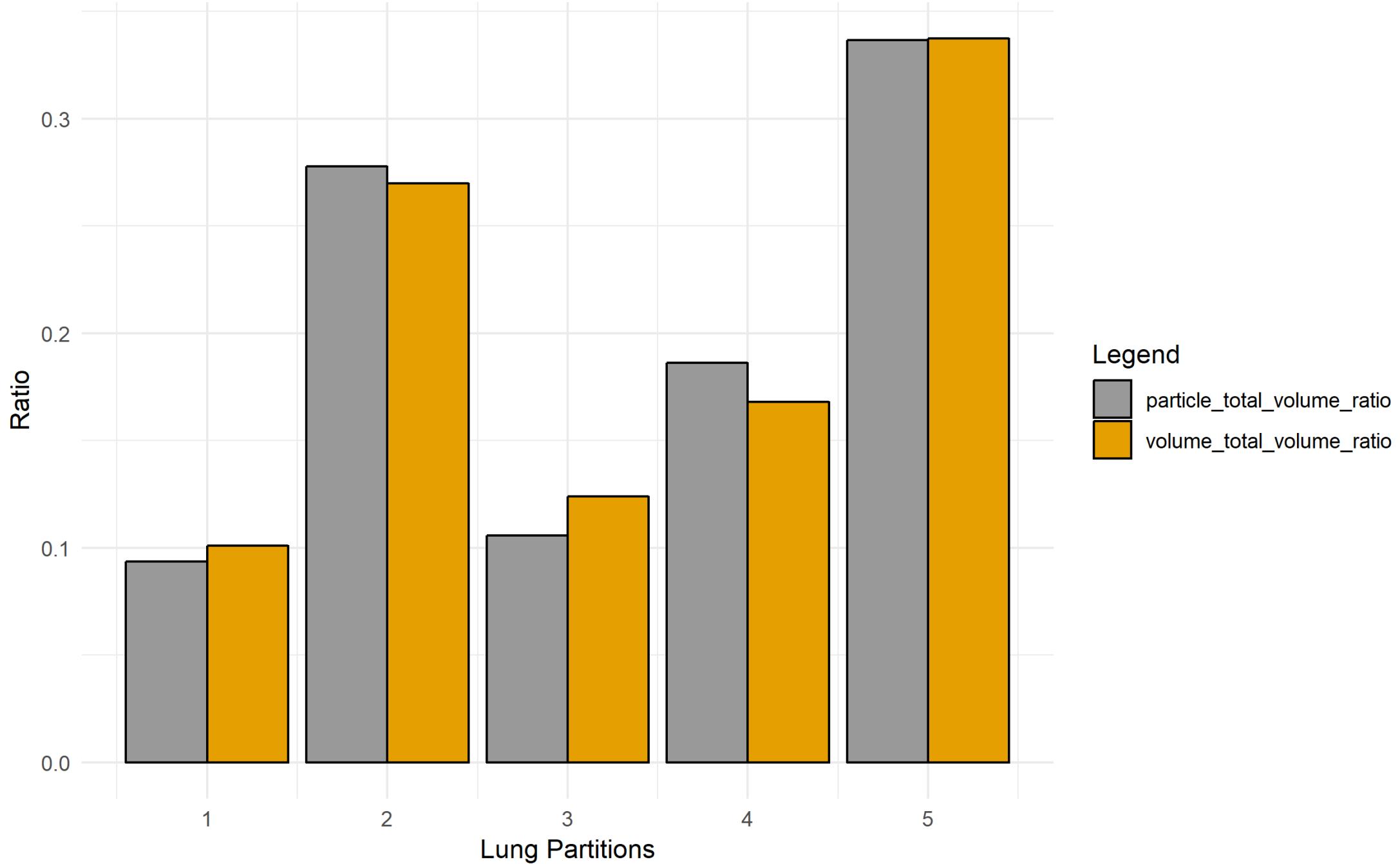


# Bar Plot

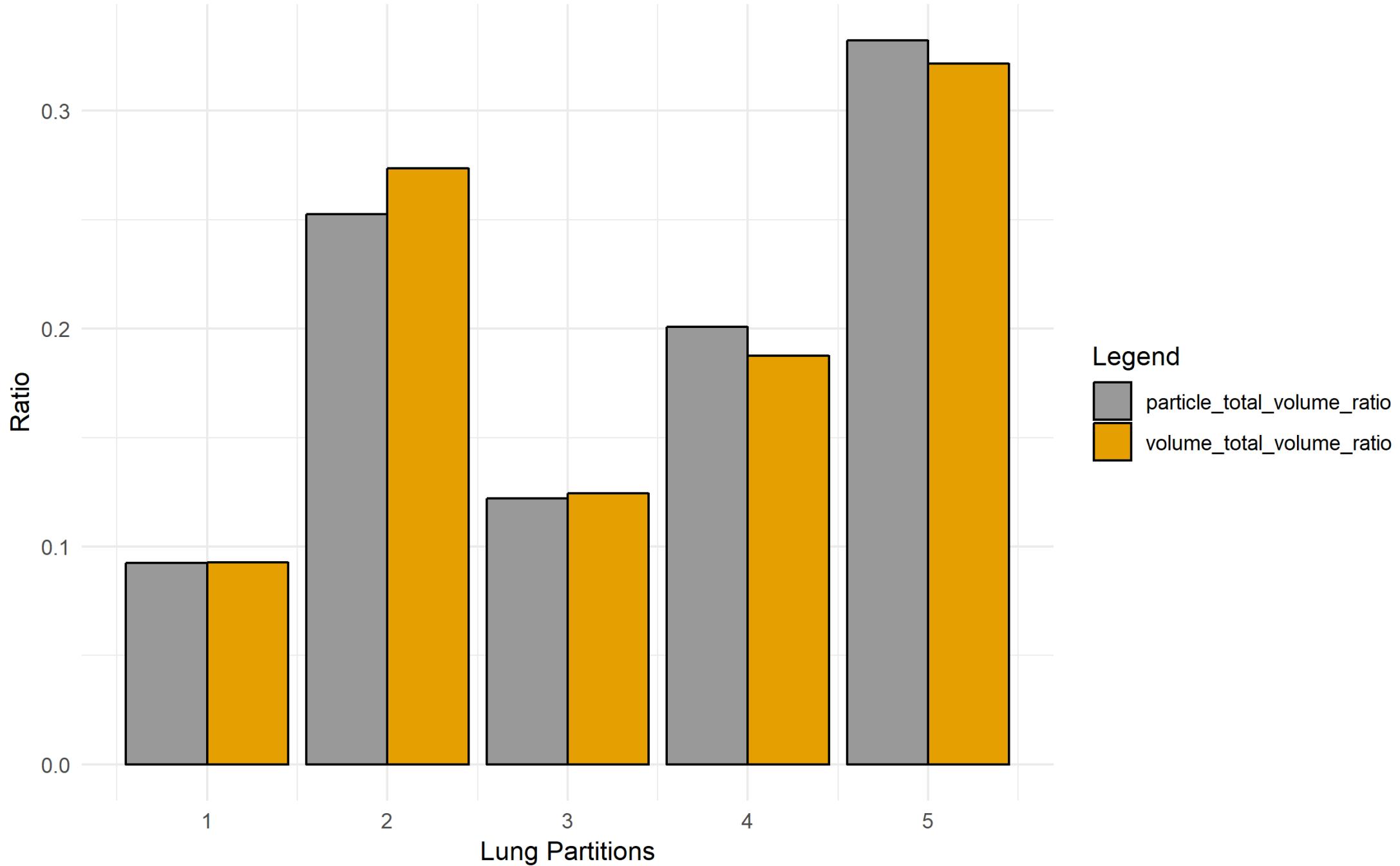


Lobe Level

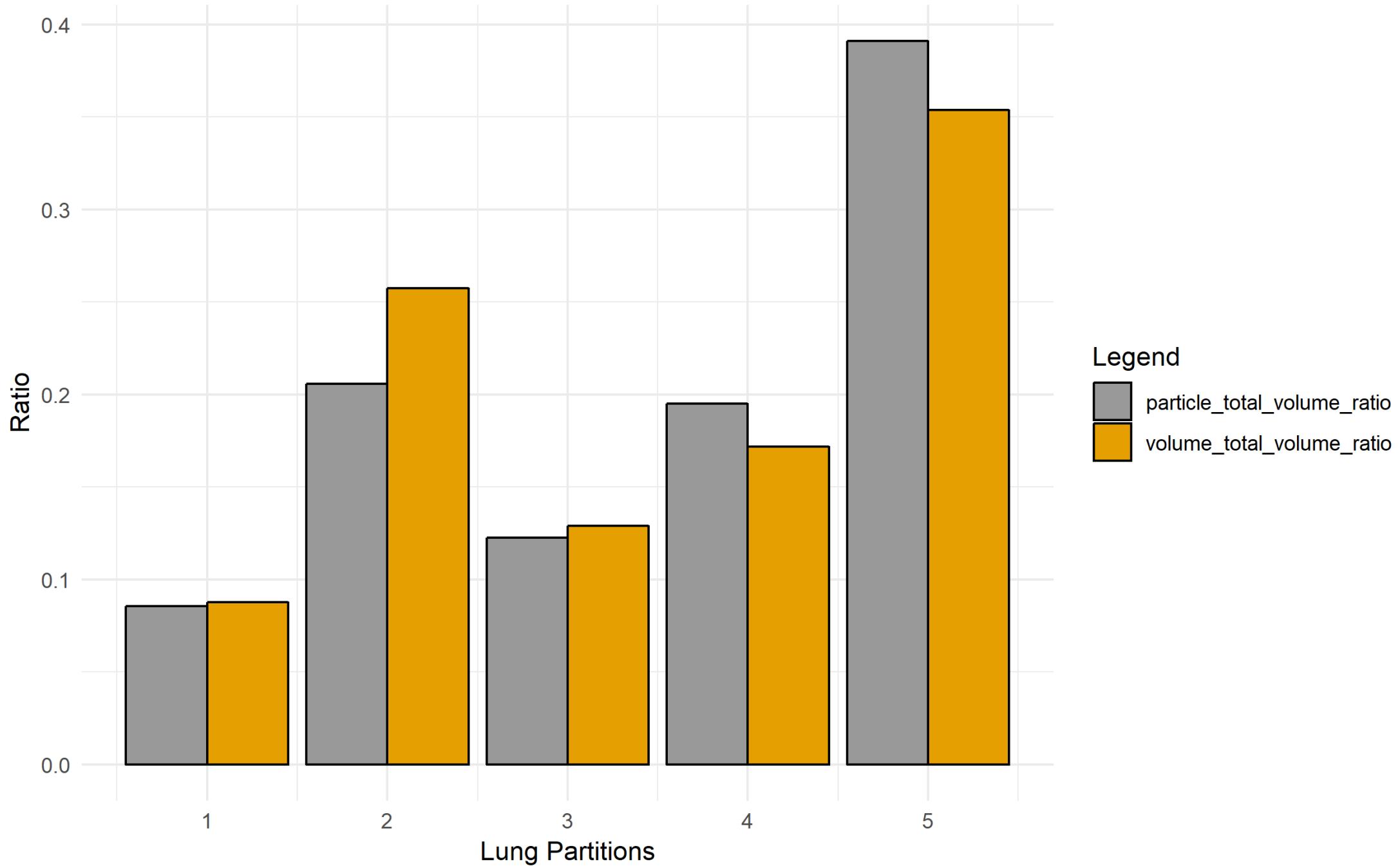
# m01\_LobesDeposition



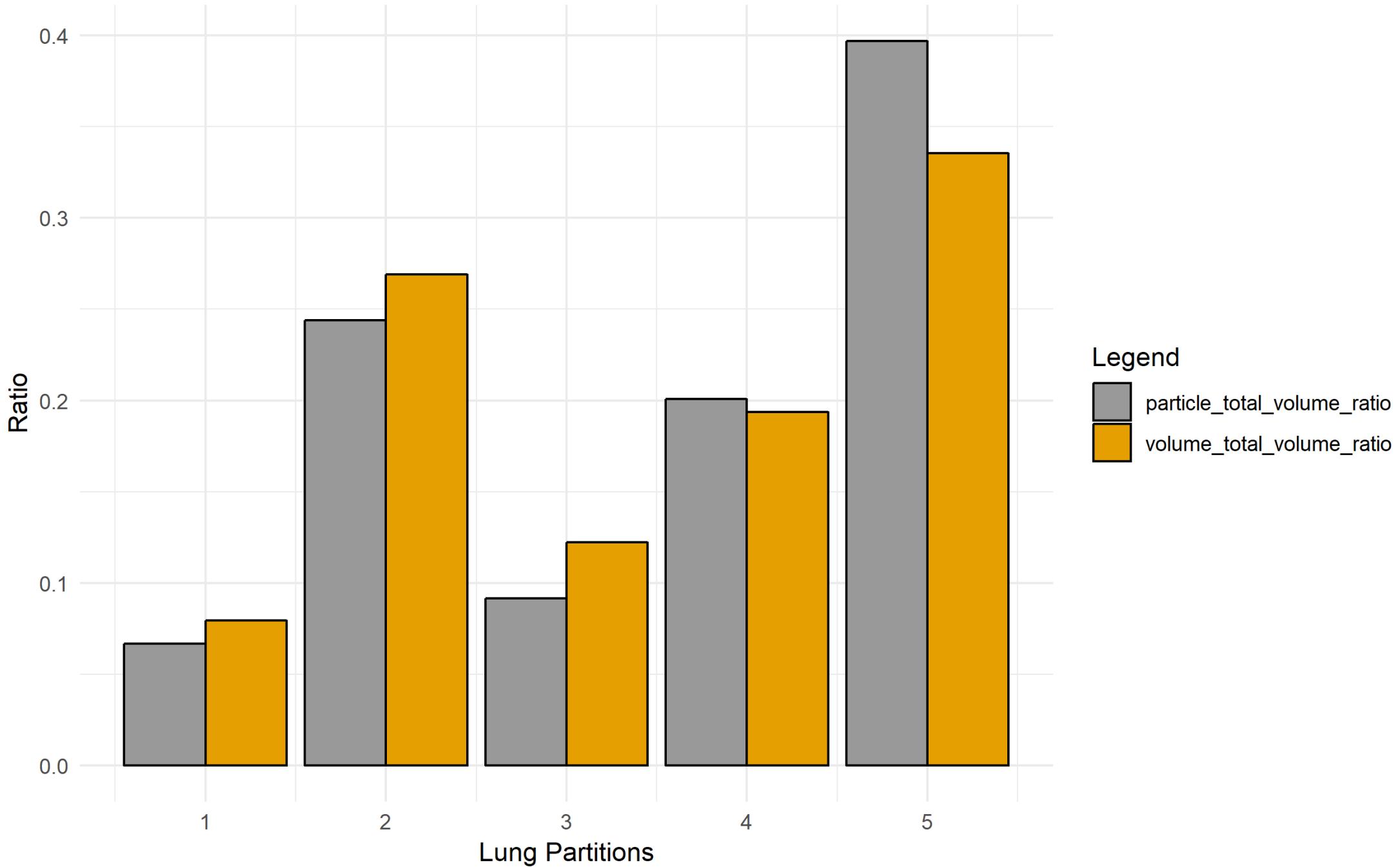
# m02\_LobesDeposition



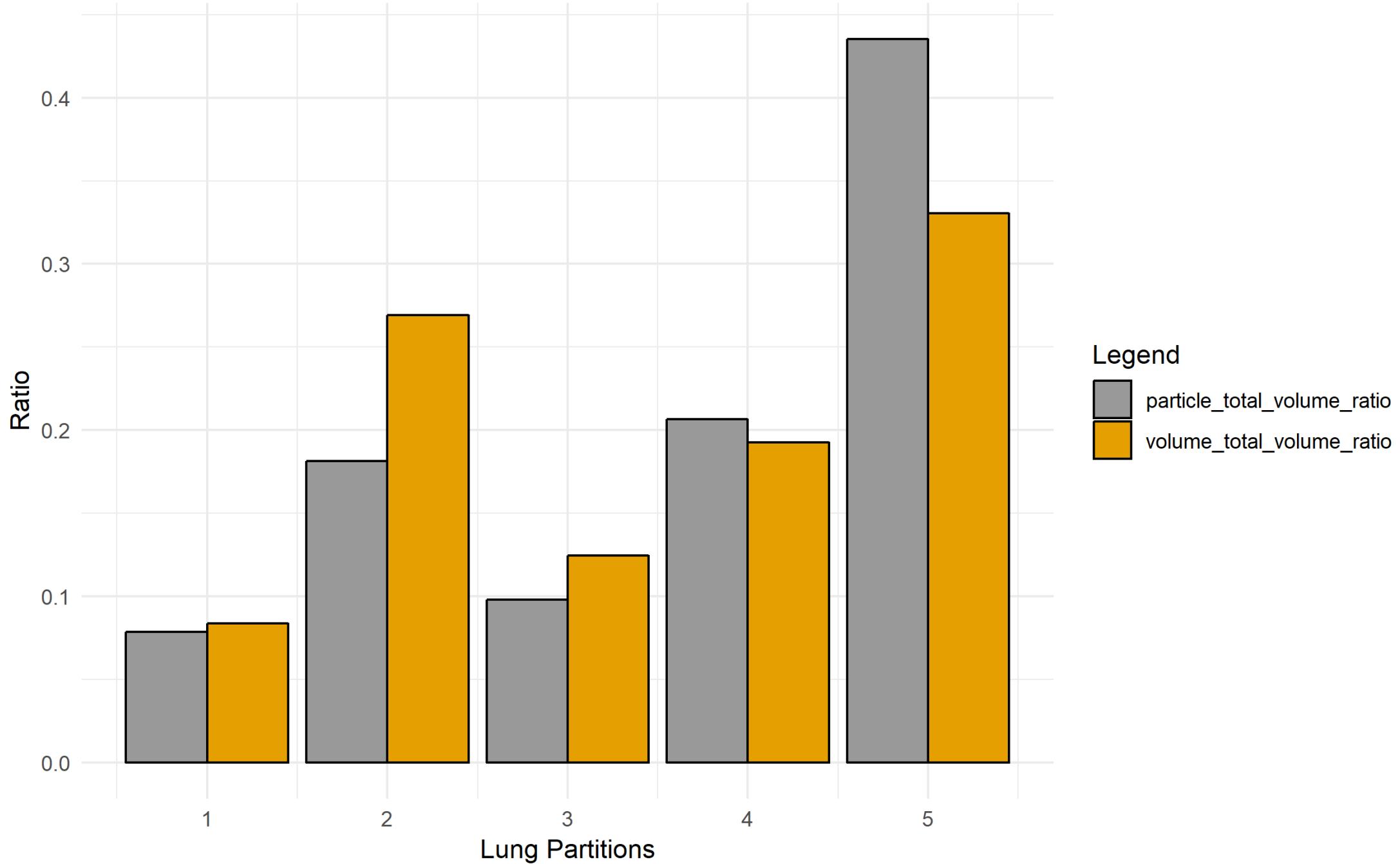
# m03\_LobesDeposition



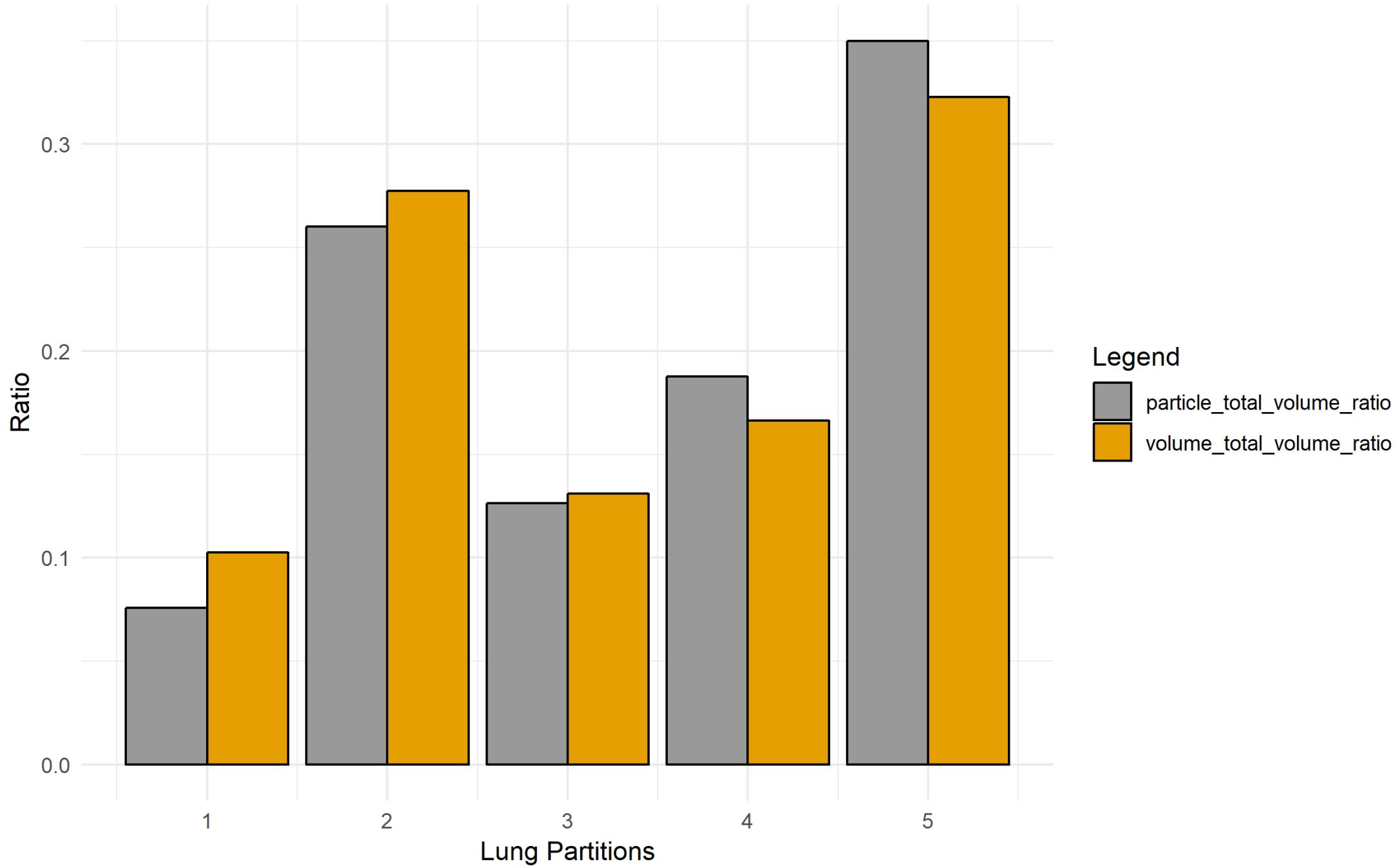
# m04\_LobesDeposition



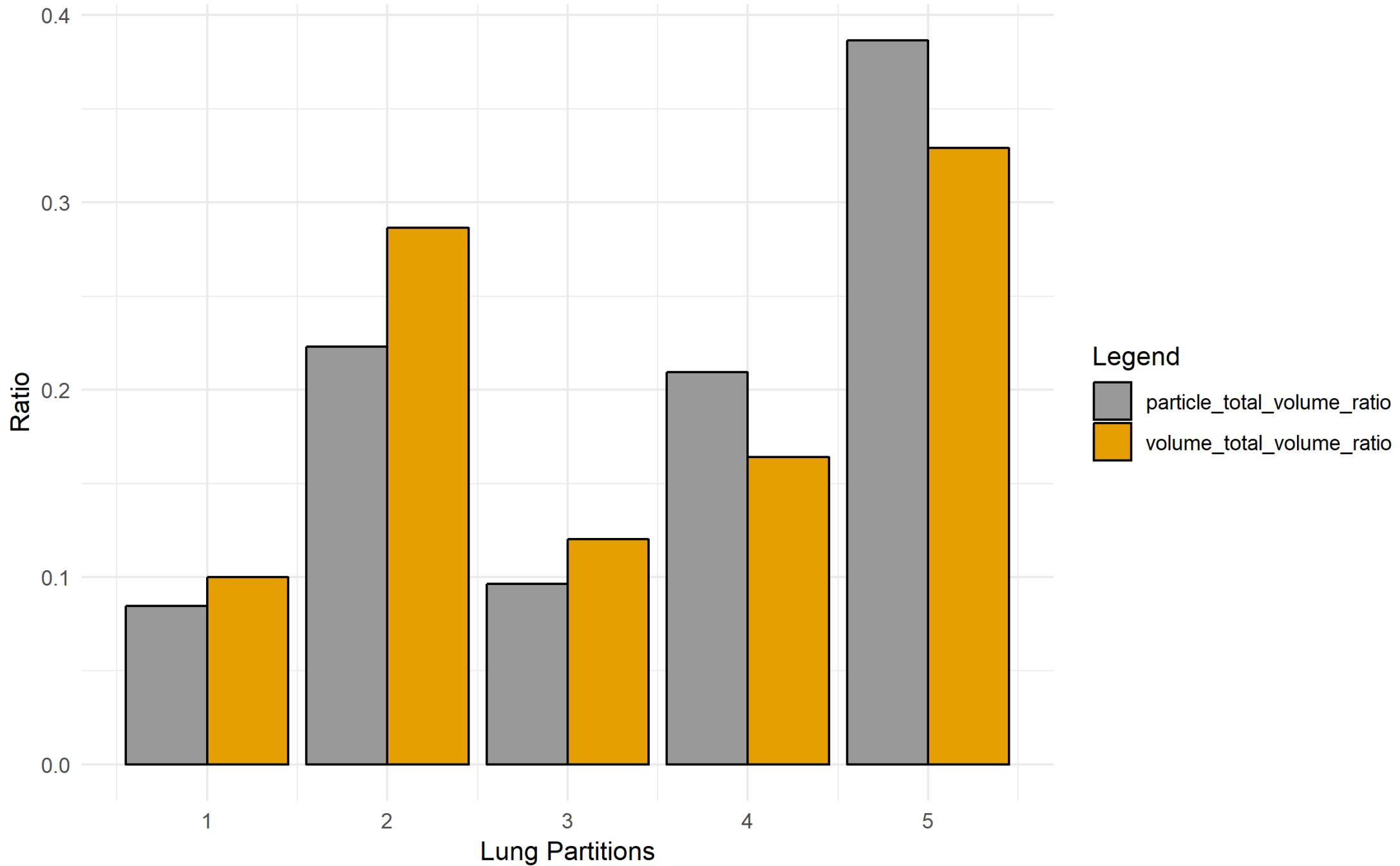
# m05\_LobesDeposition



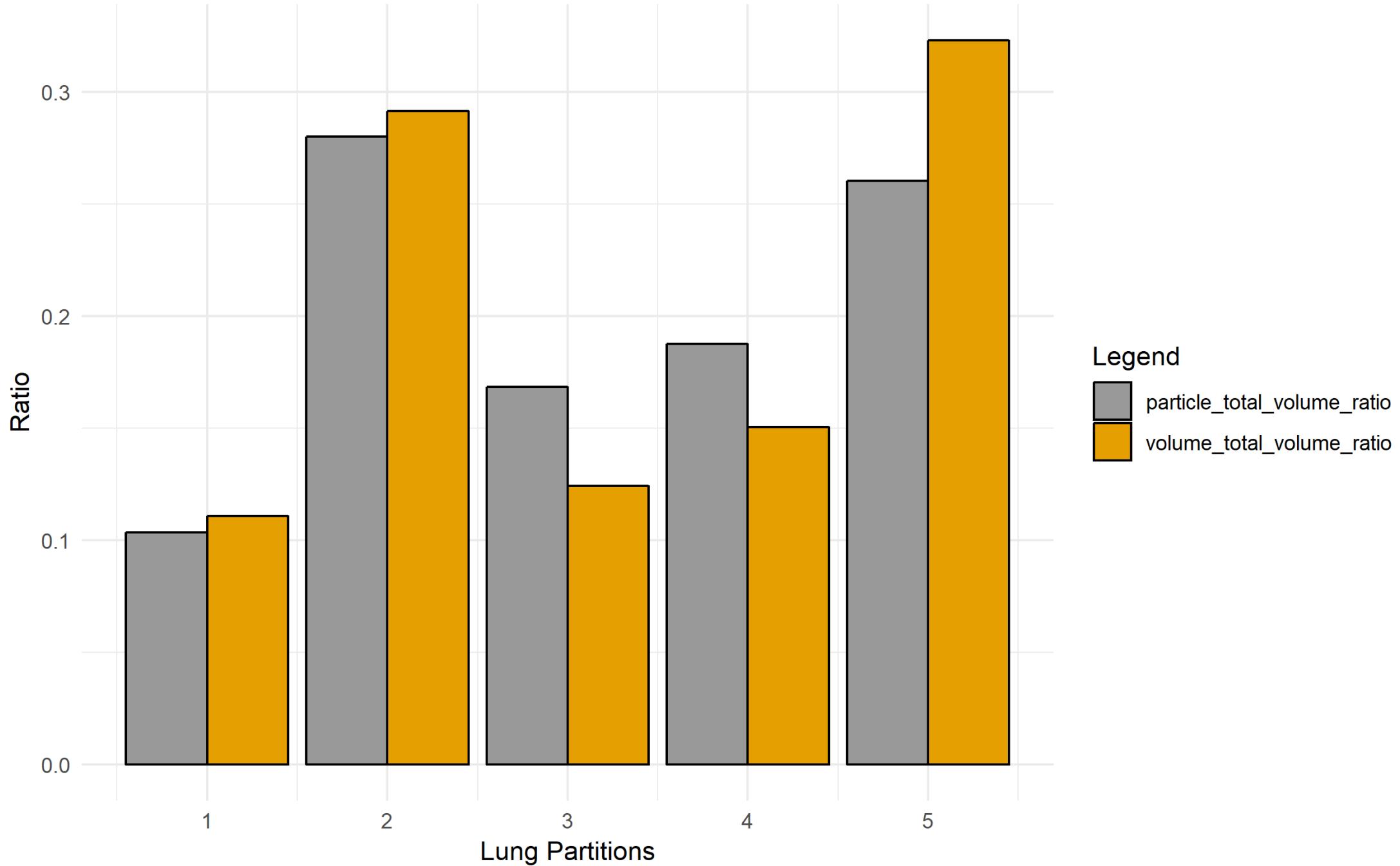
# m06\_LobesDeposition



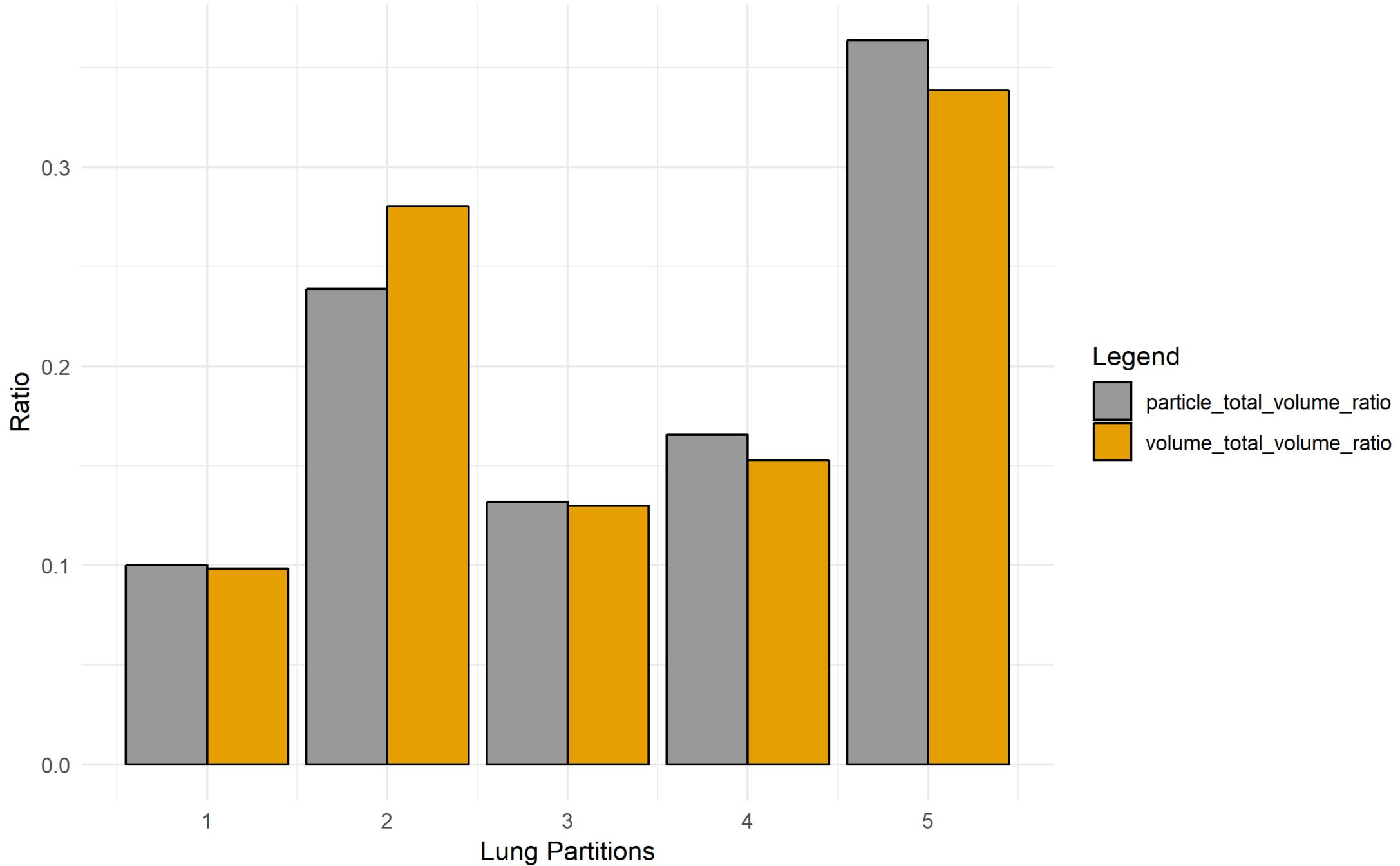
# m07\_LobesDeposition



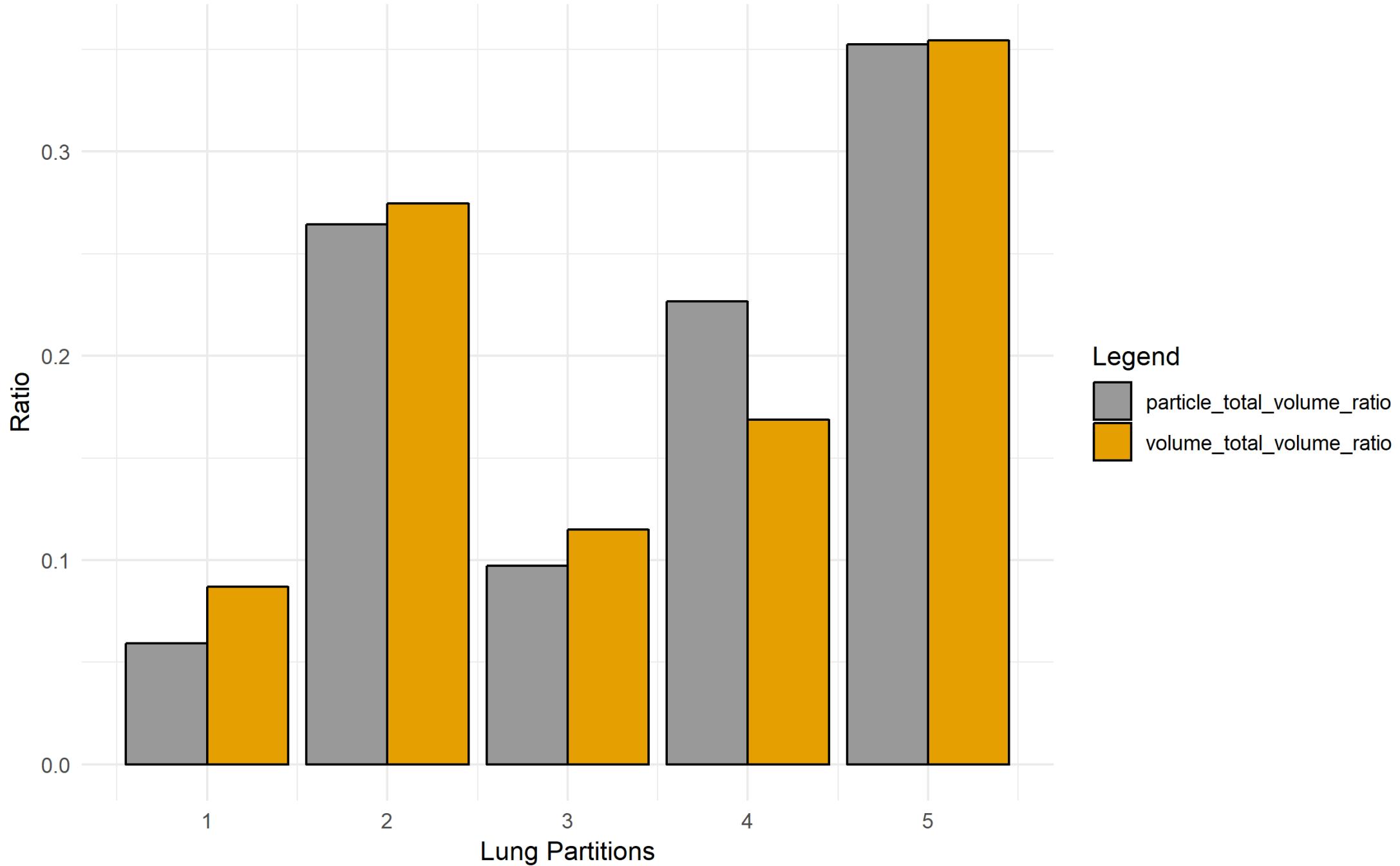
# m08\_LobesDeposition



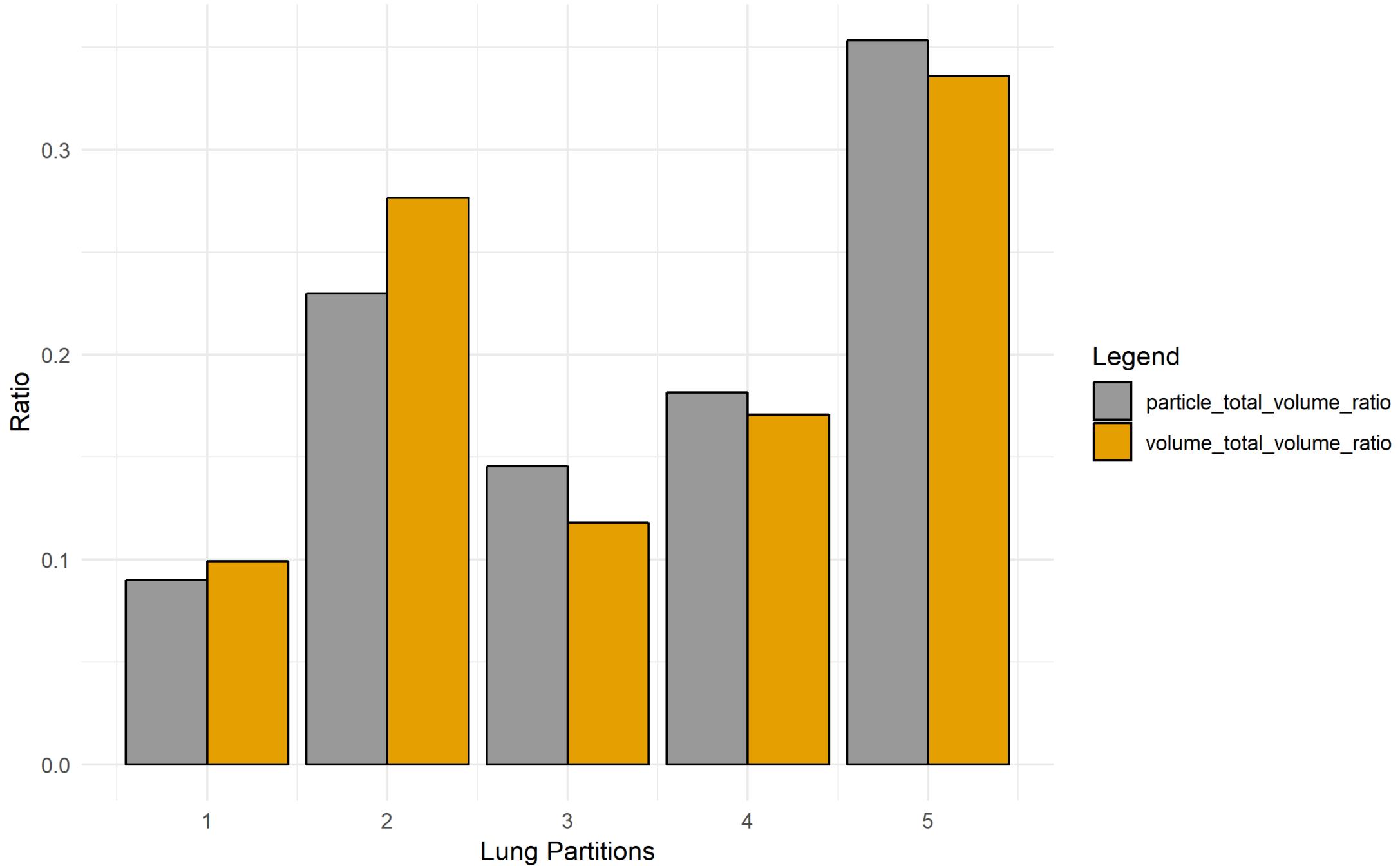
# m09\_LobesDeposition



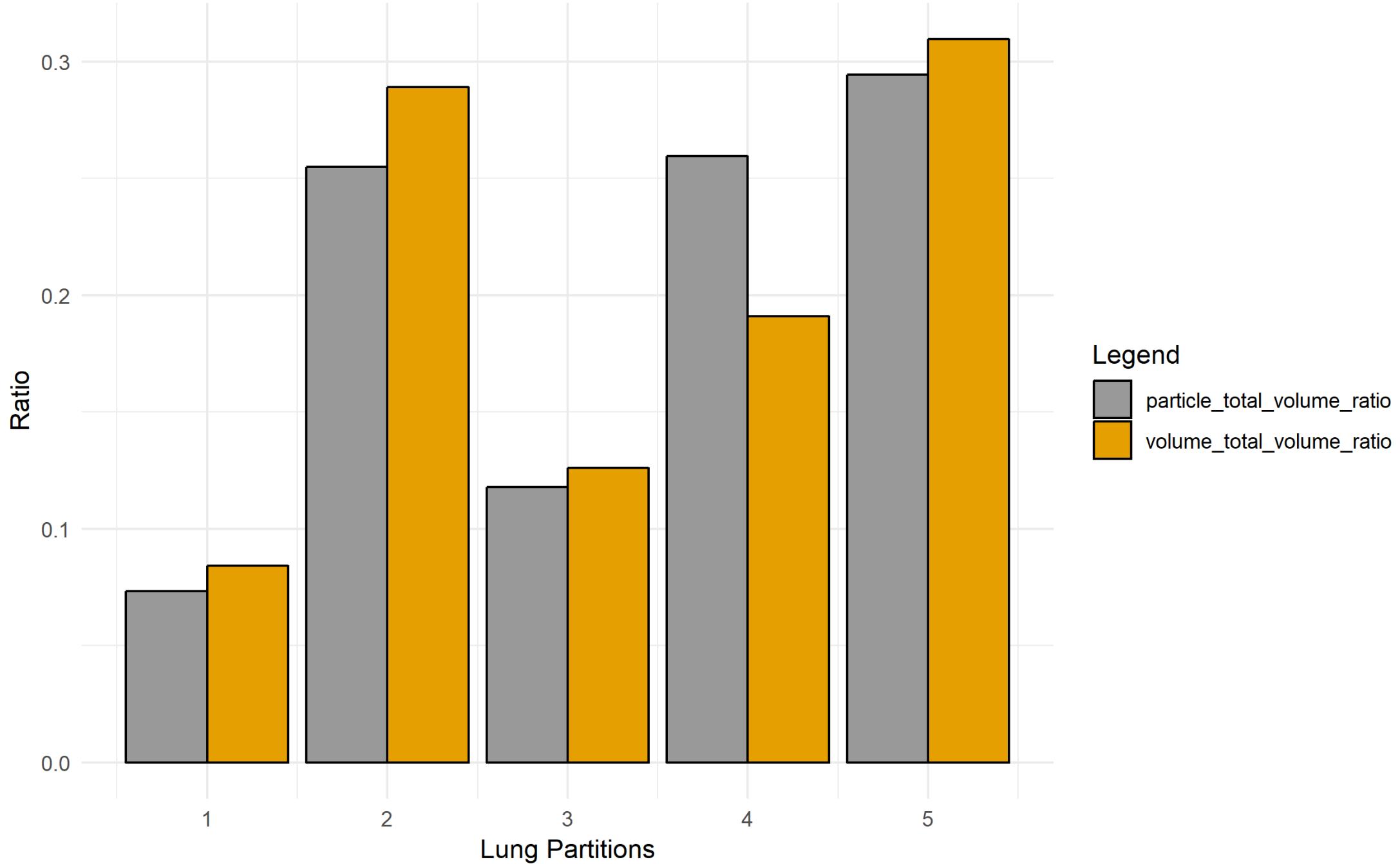
# m10\_LobesDeposition



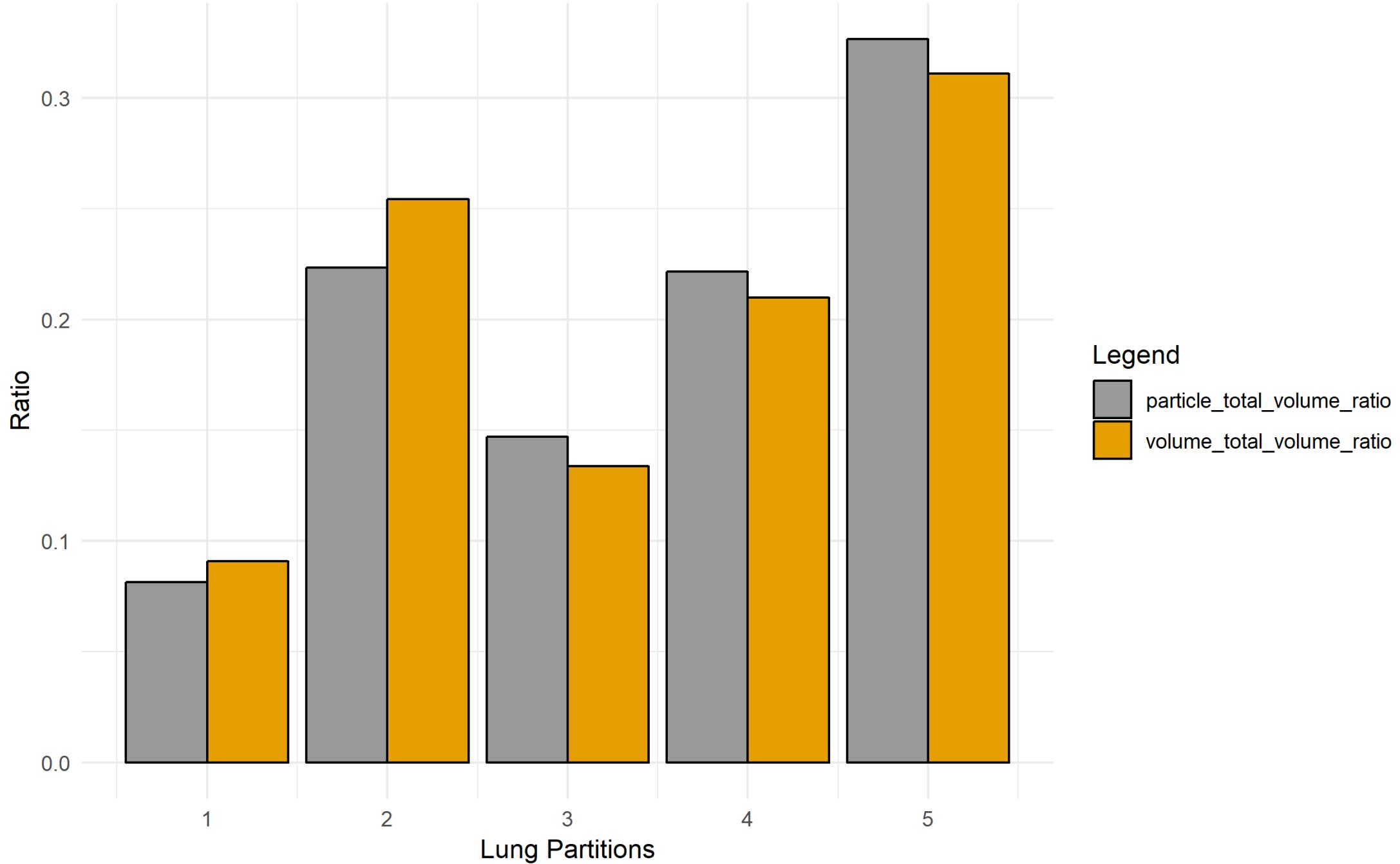
# m11\_LobesDeposition



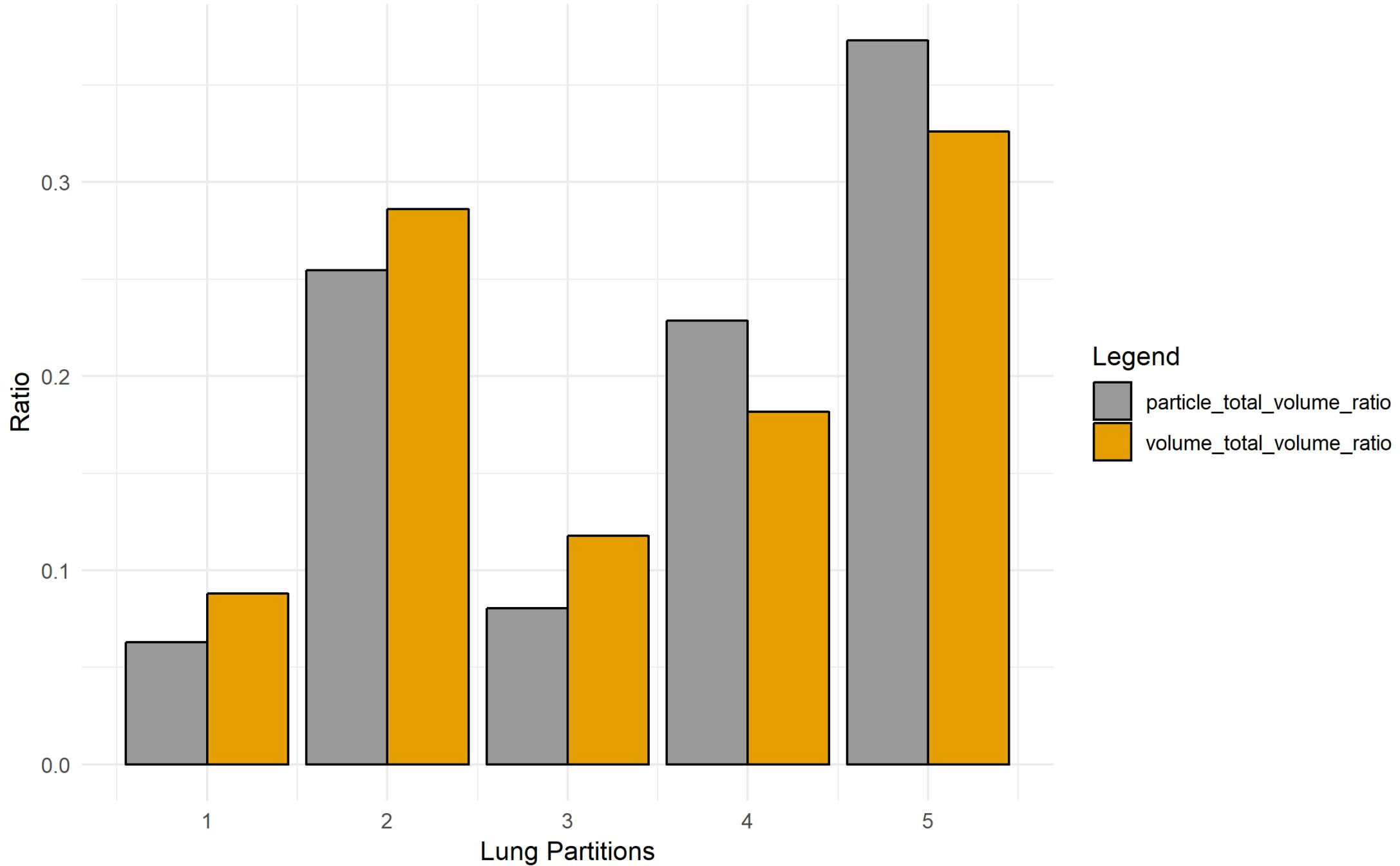
# m12\_LobesDeposition



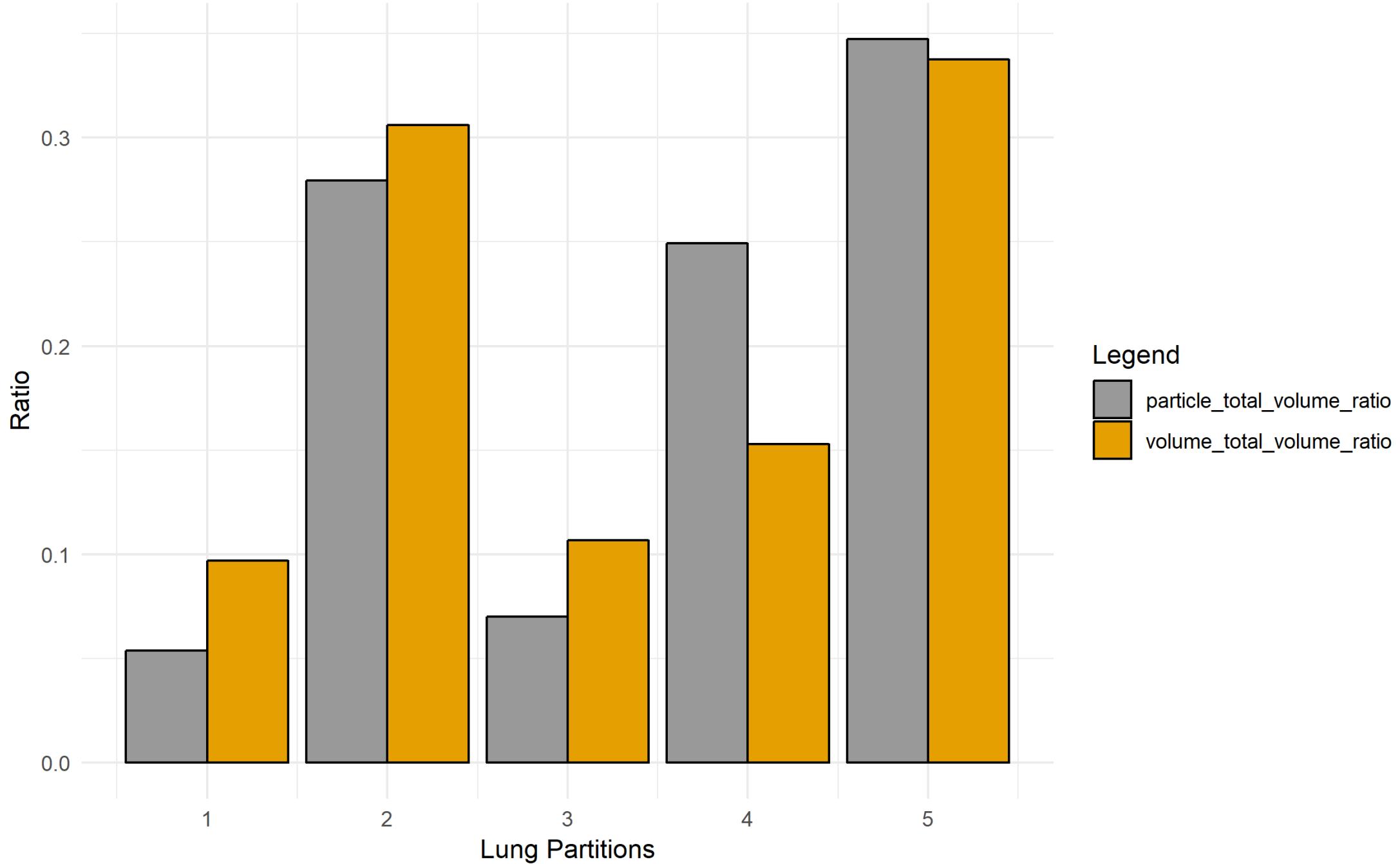
# m13\_LobesDeposition



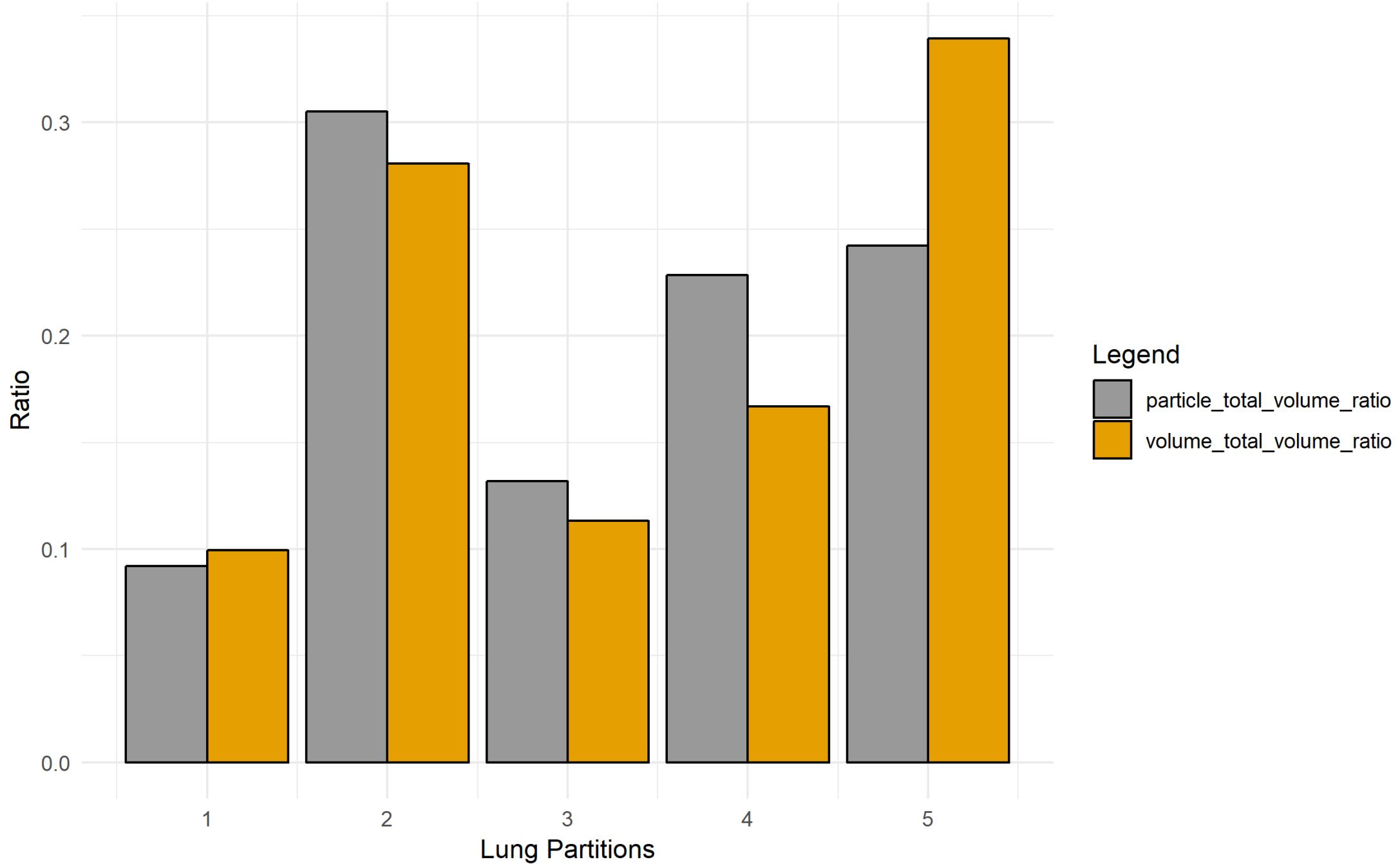
# m14\_LobesDeposition



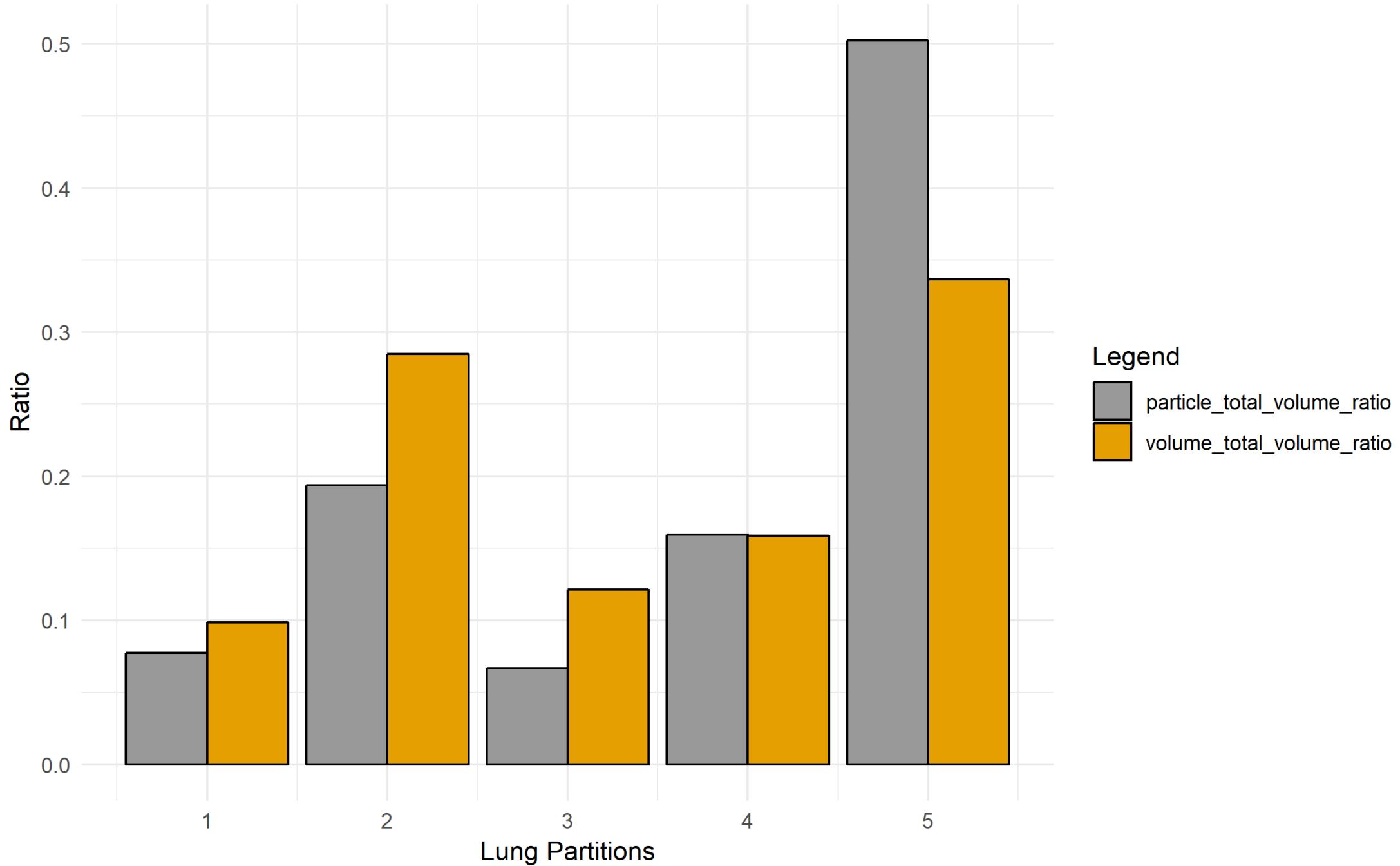
# m15\_LobesDeposition



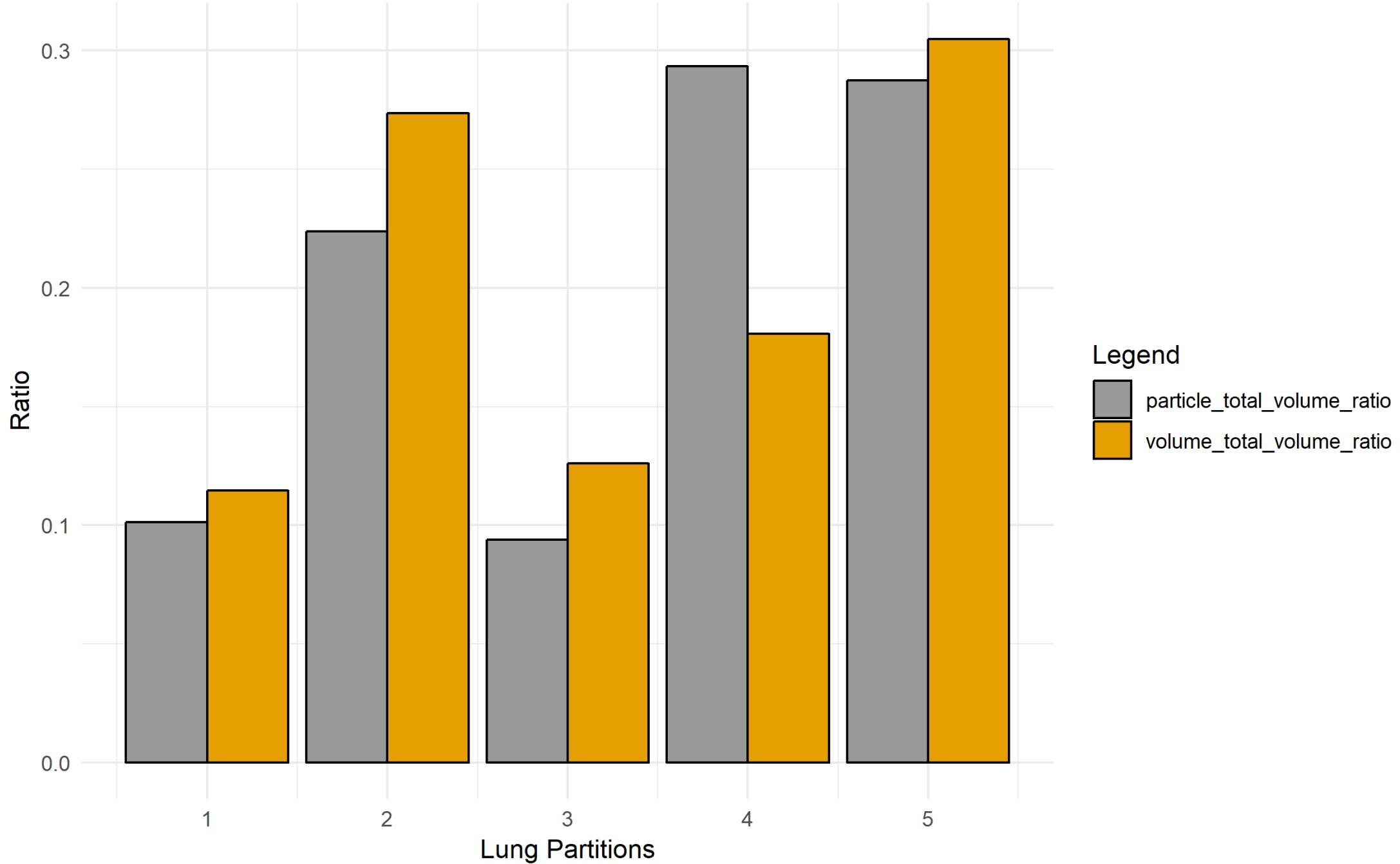
# m16\_LobesDeposition



# m17\_LobesDeposition

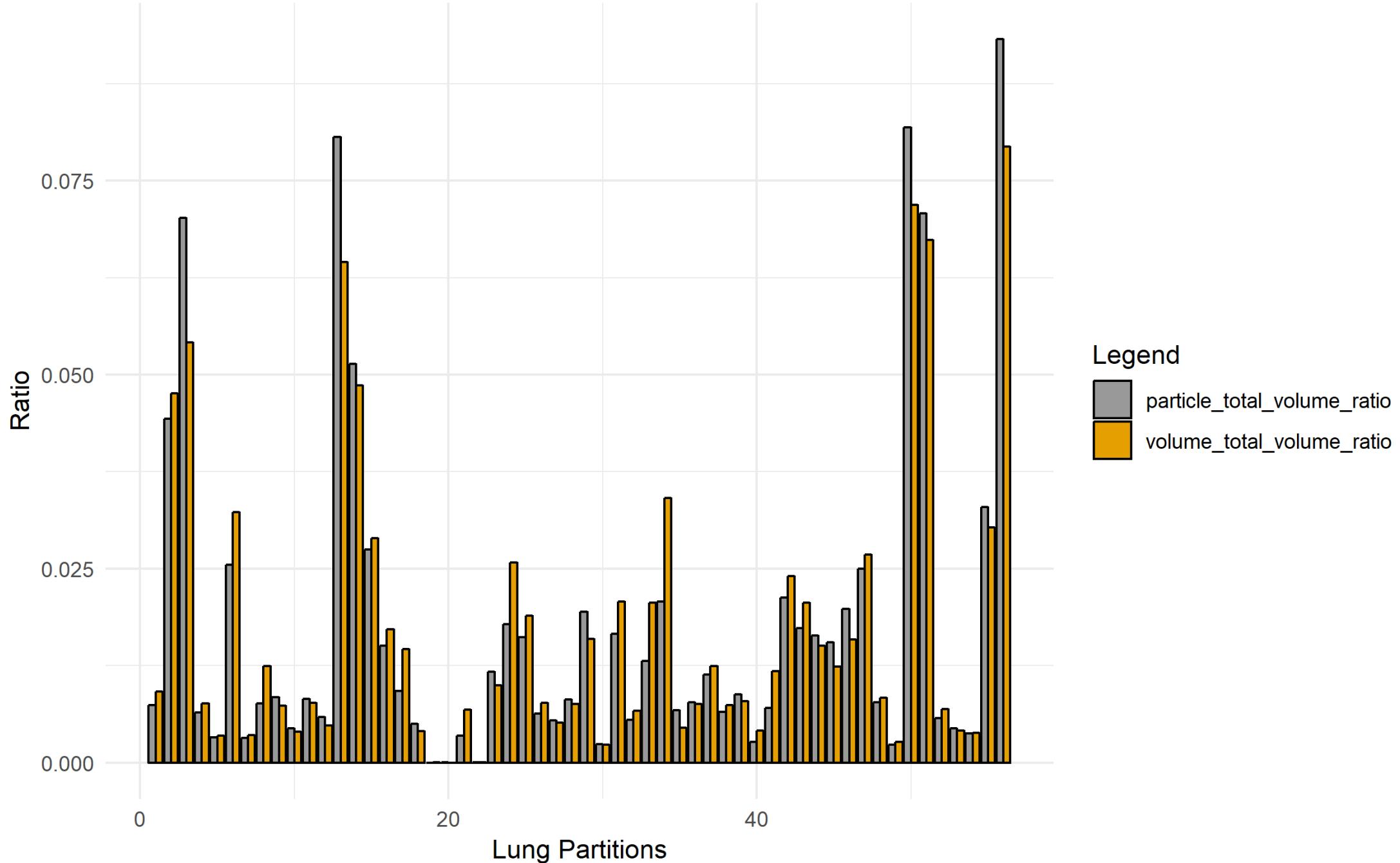


# m18\_LobesDeposition

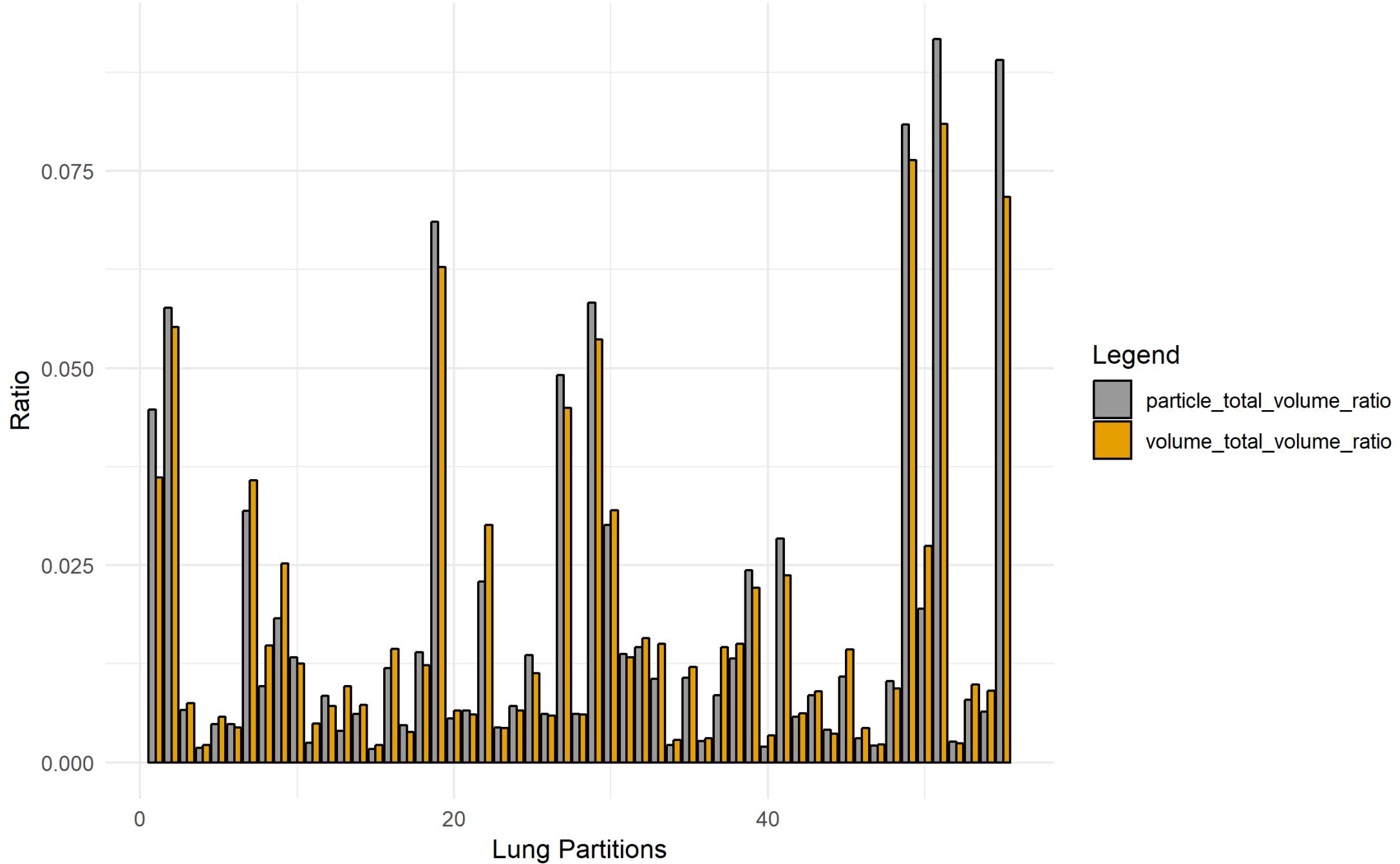


Sub Lobe Level

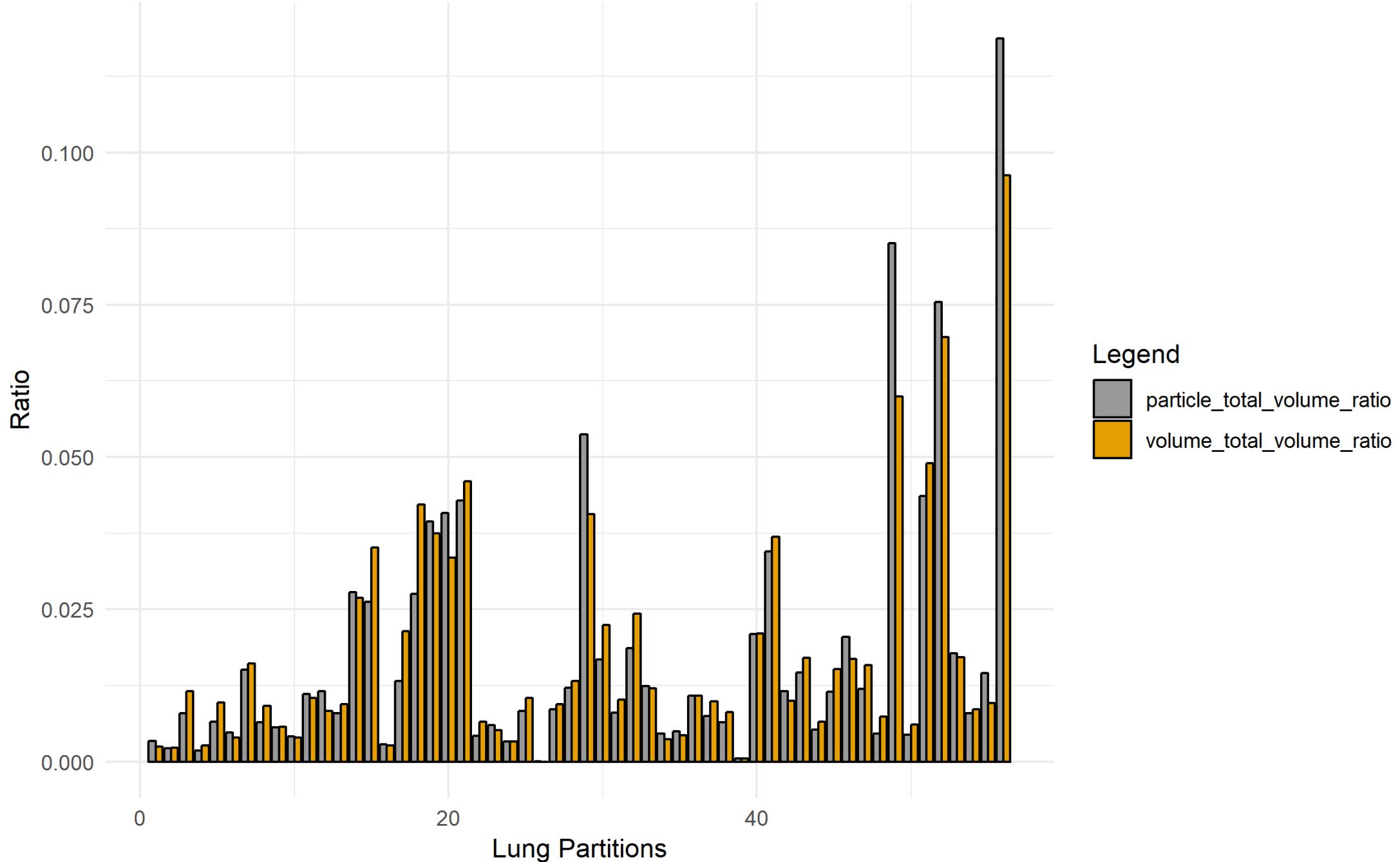
# m01\_SublobesDeposition



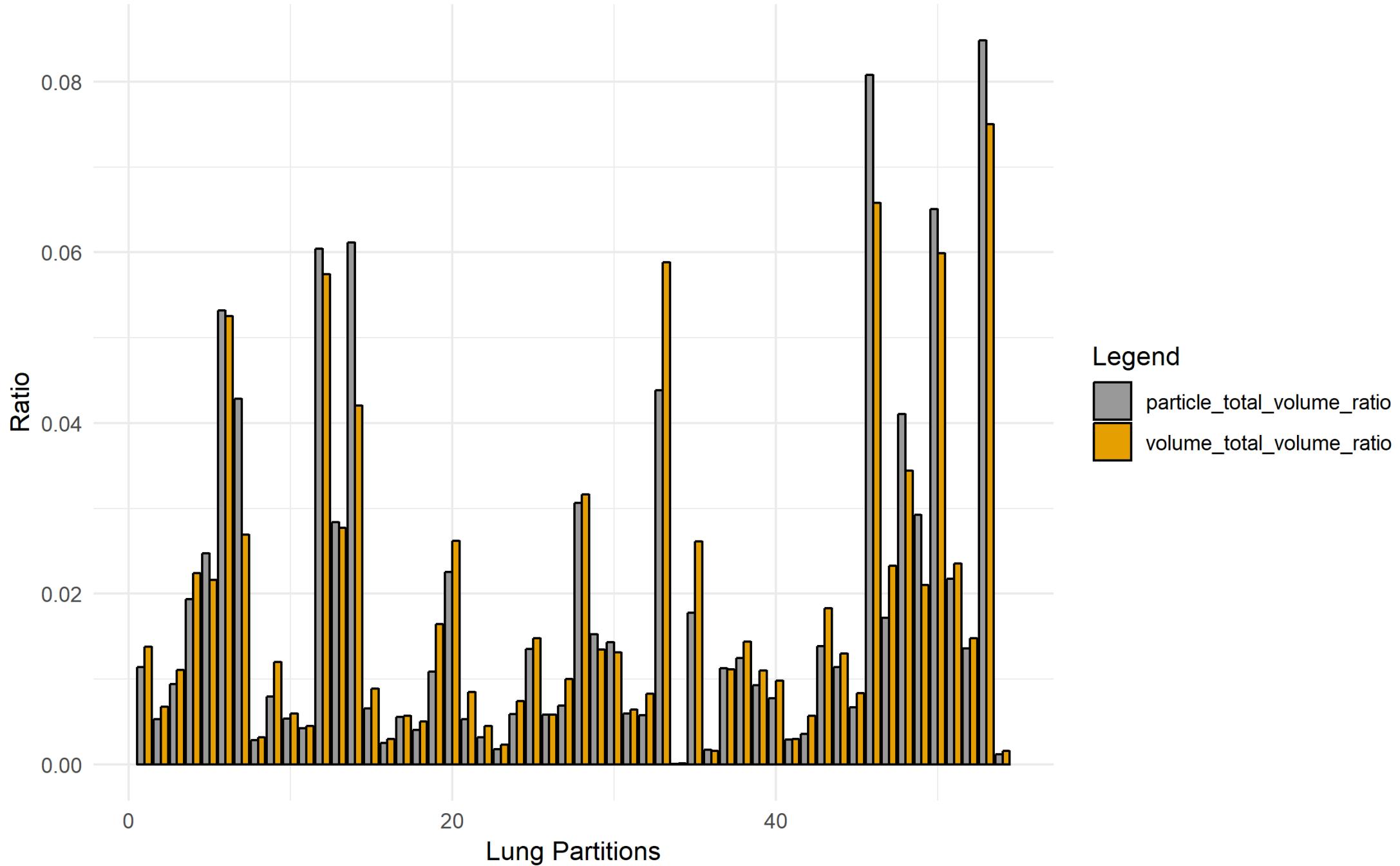
# m02\_SublobesDeposition



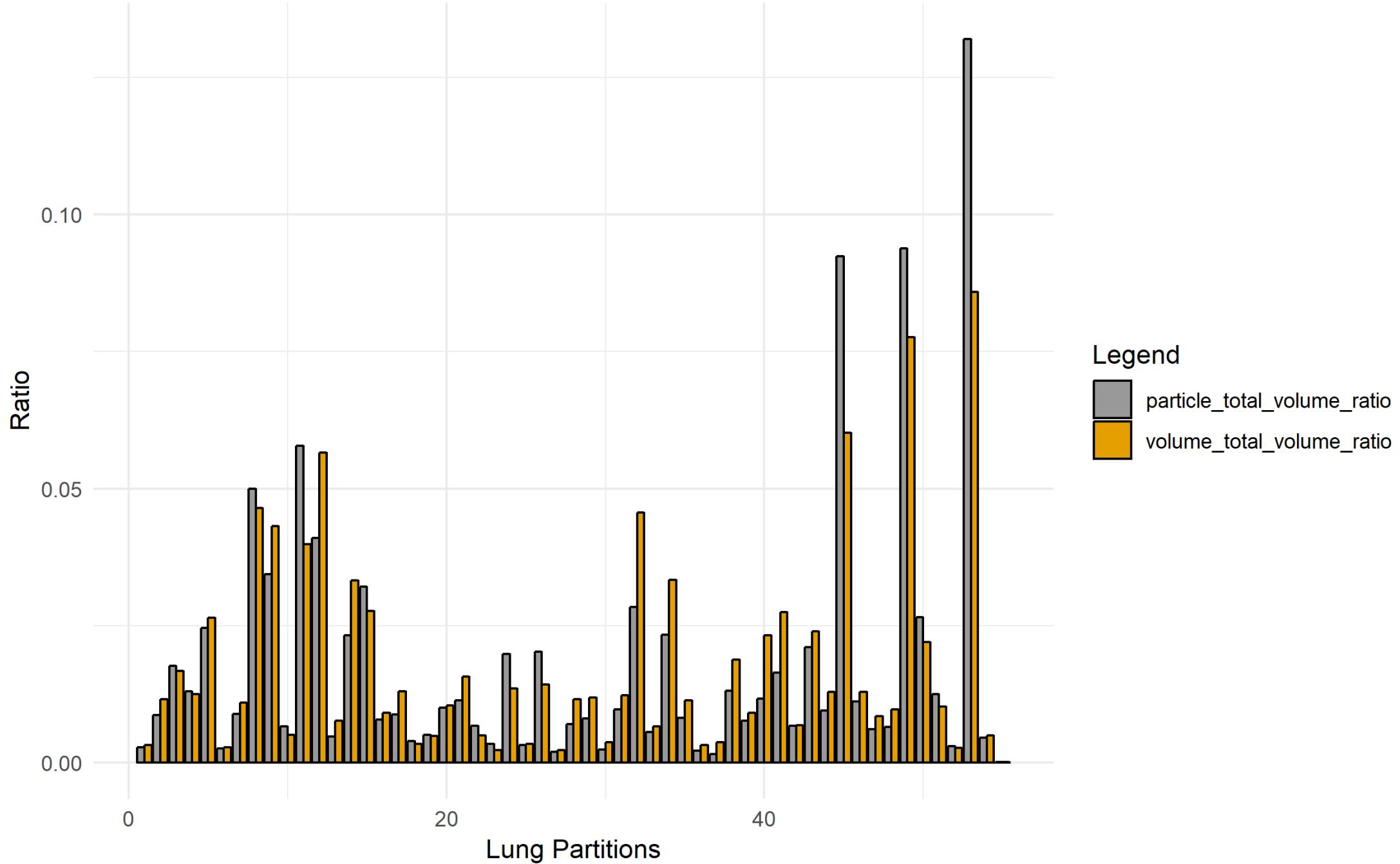
# m03\_SublobesDeposition



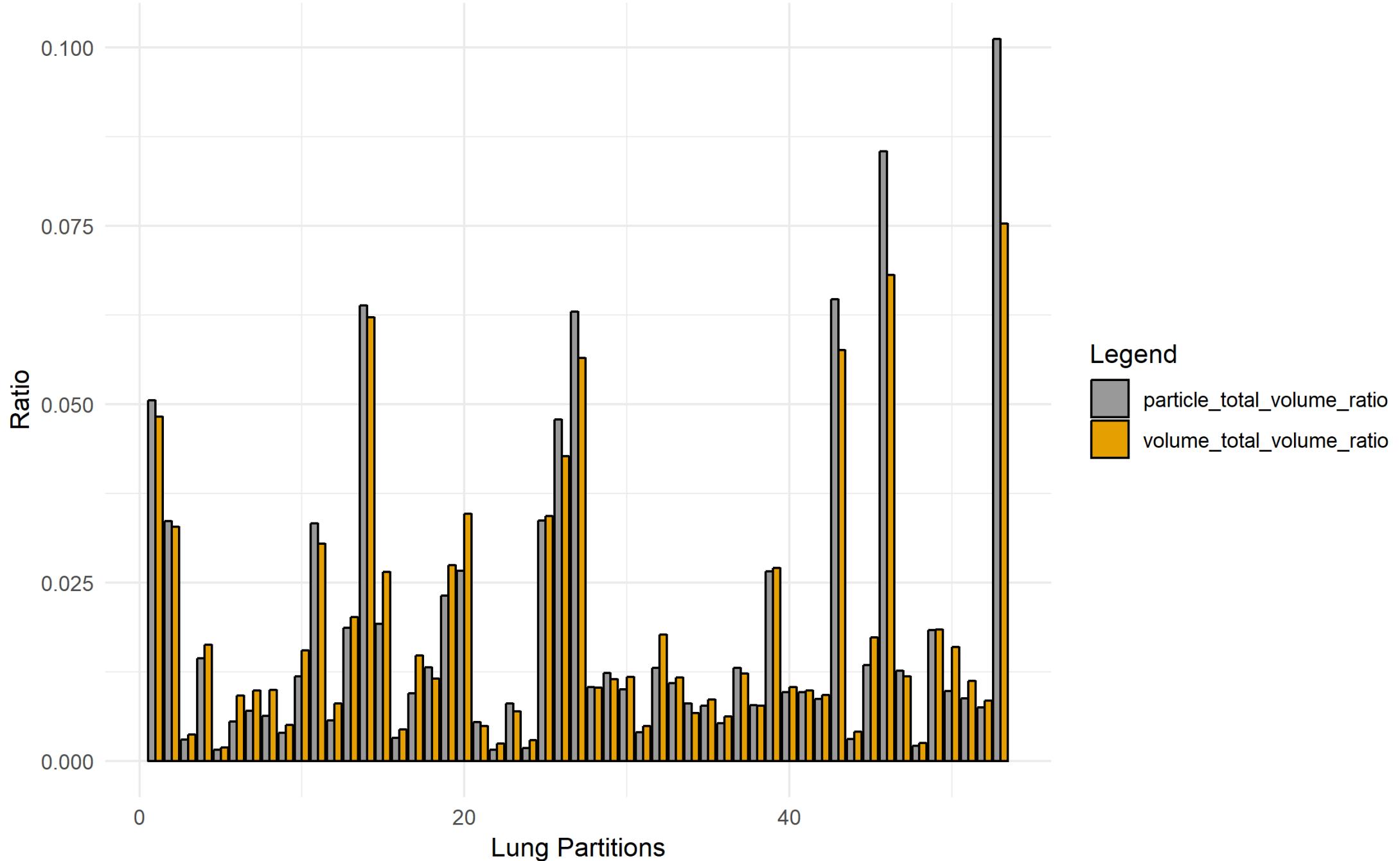
# m04\_SublobesDeposition



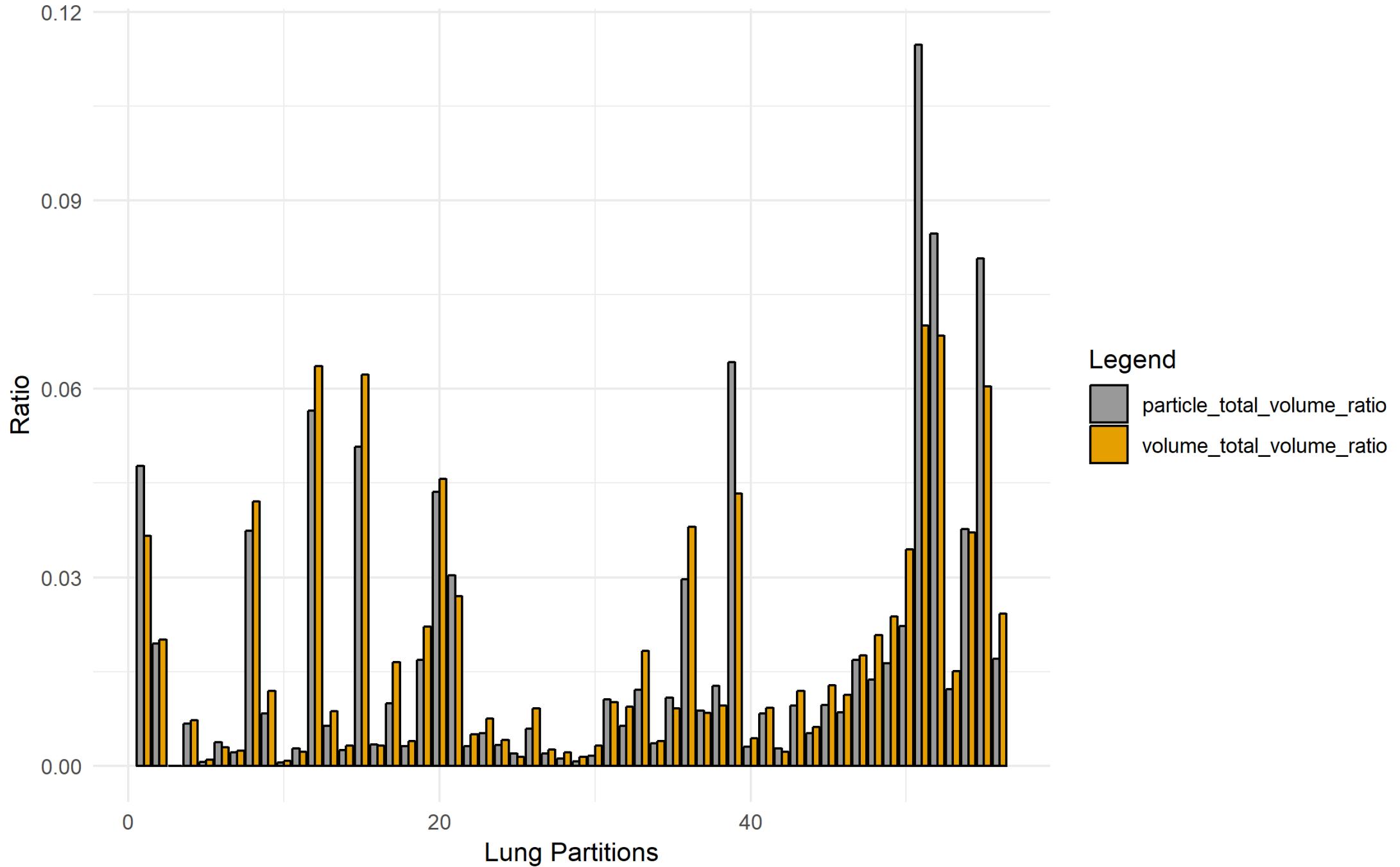
# m05\_SublobesDeposition



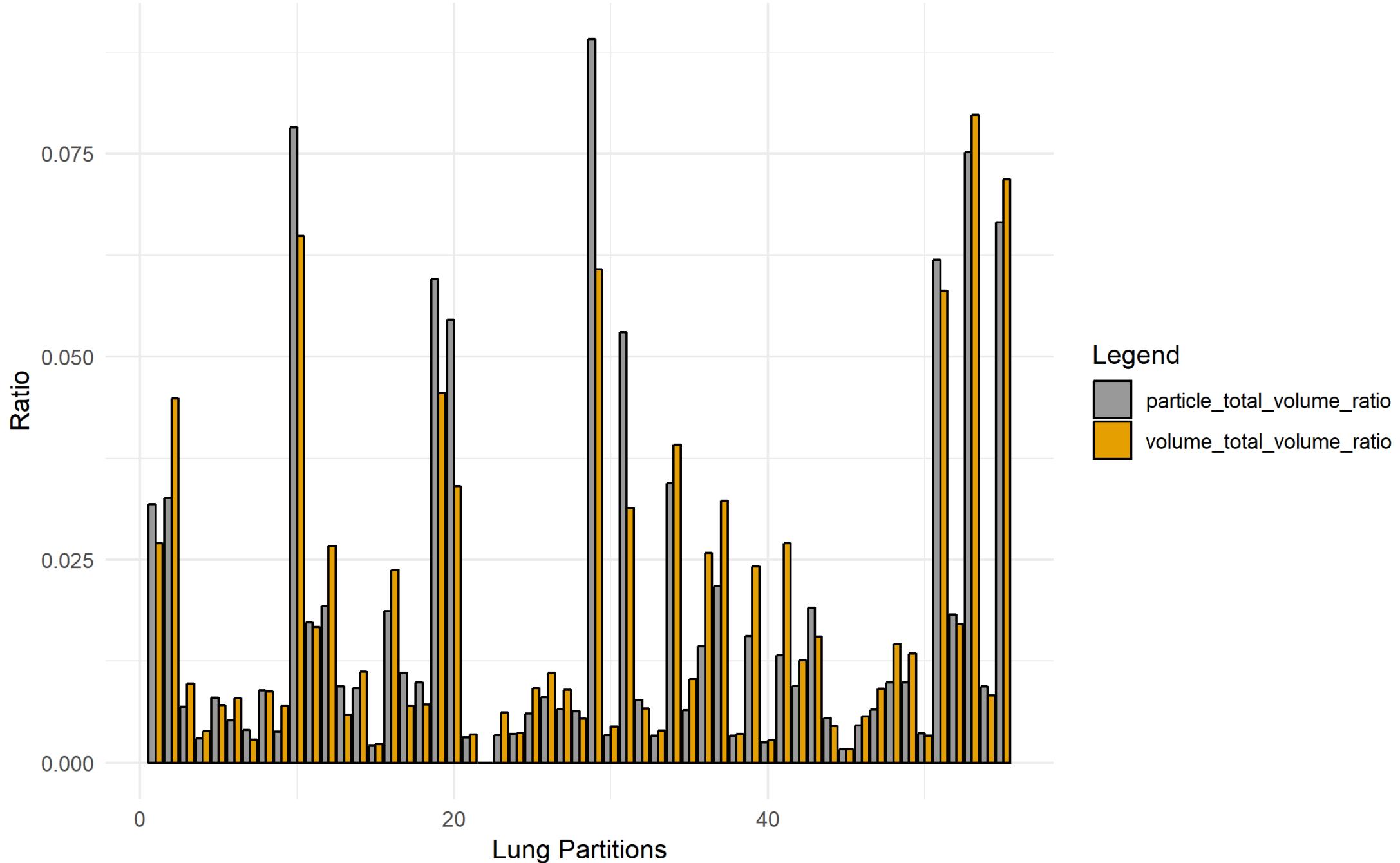
# m06\_SublobesDeposition



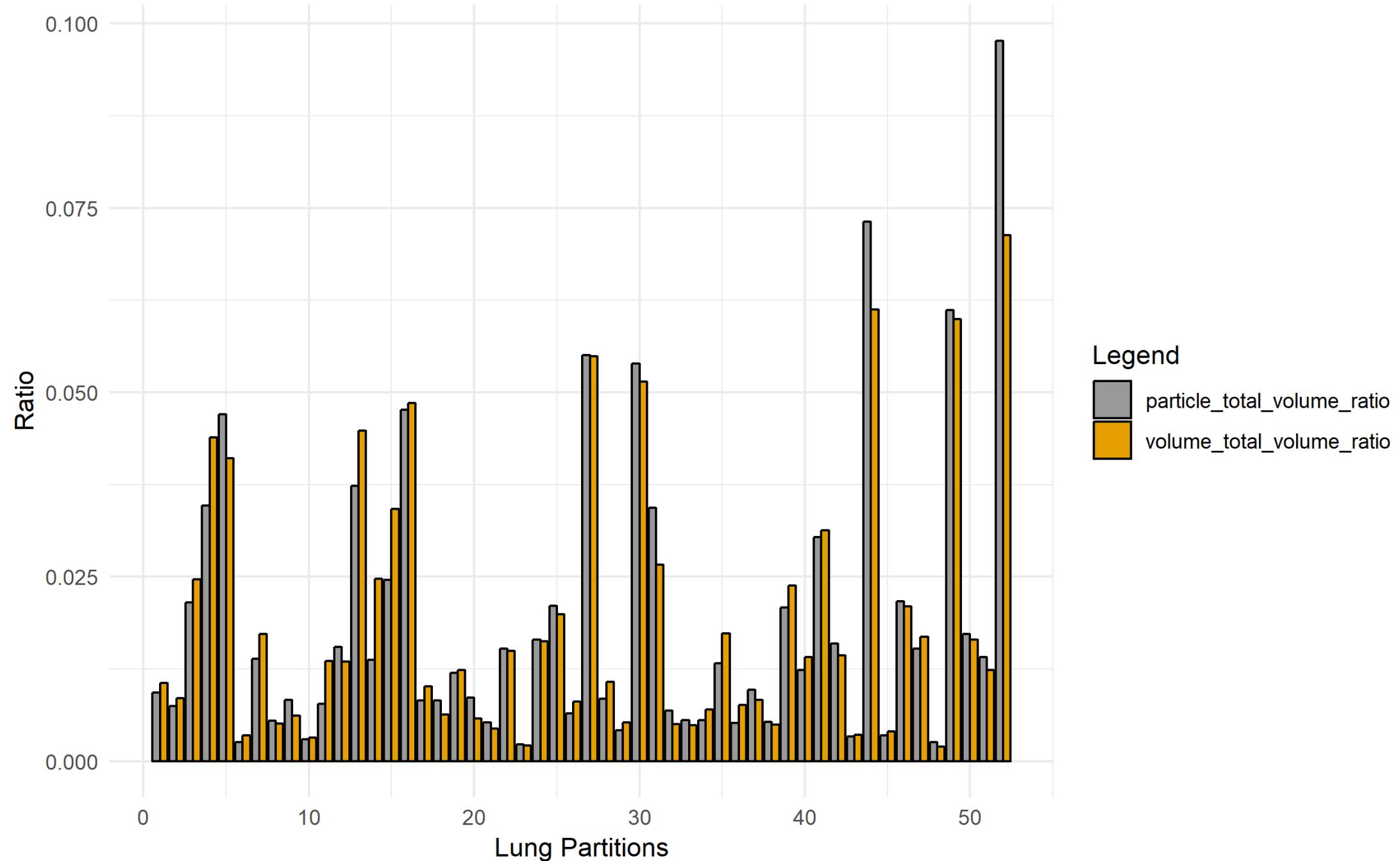
# m07\_SublobesDeposition



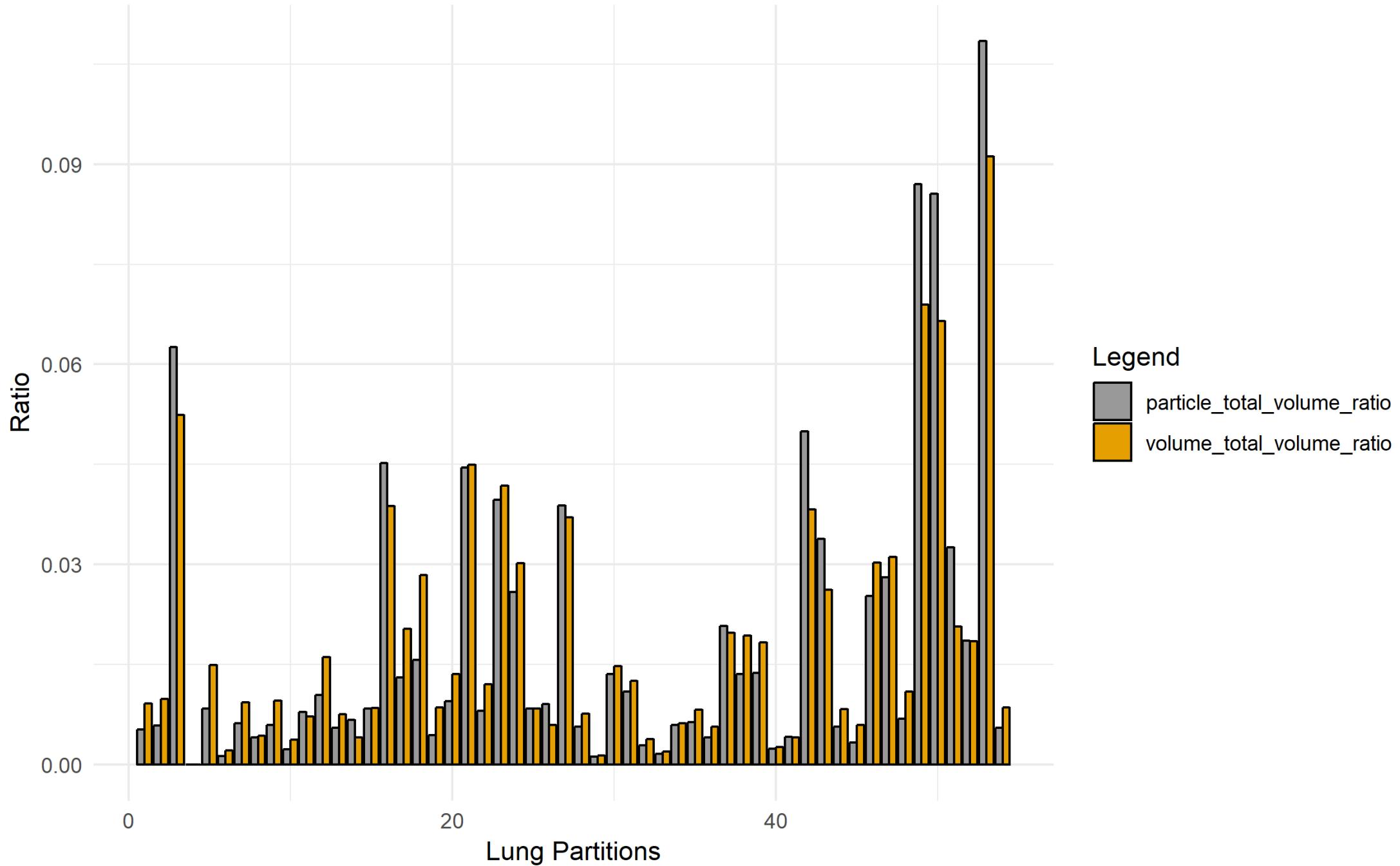
# m08\_SublobesDeposition



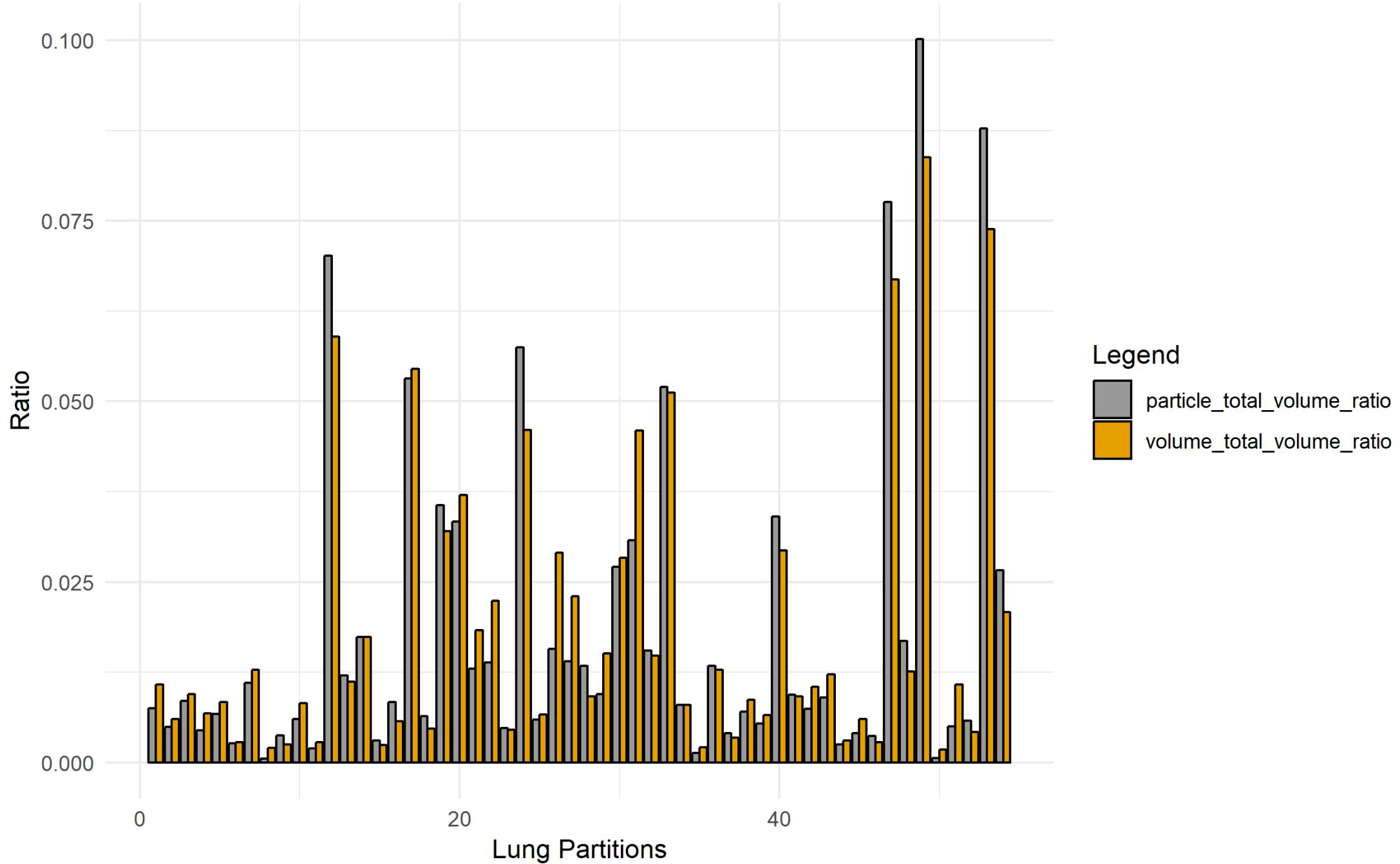
# m09\_SublobesDeposition



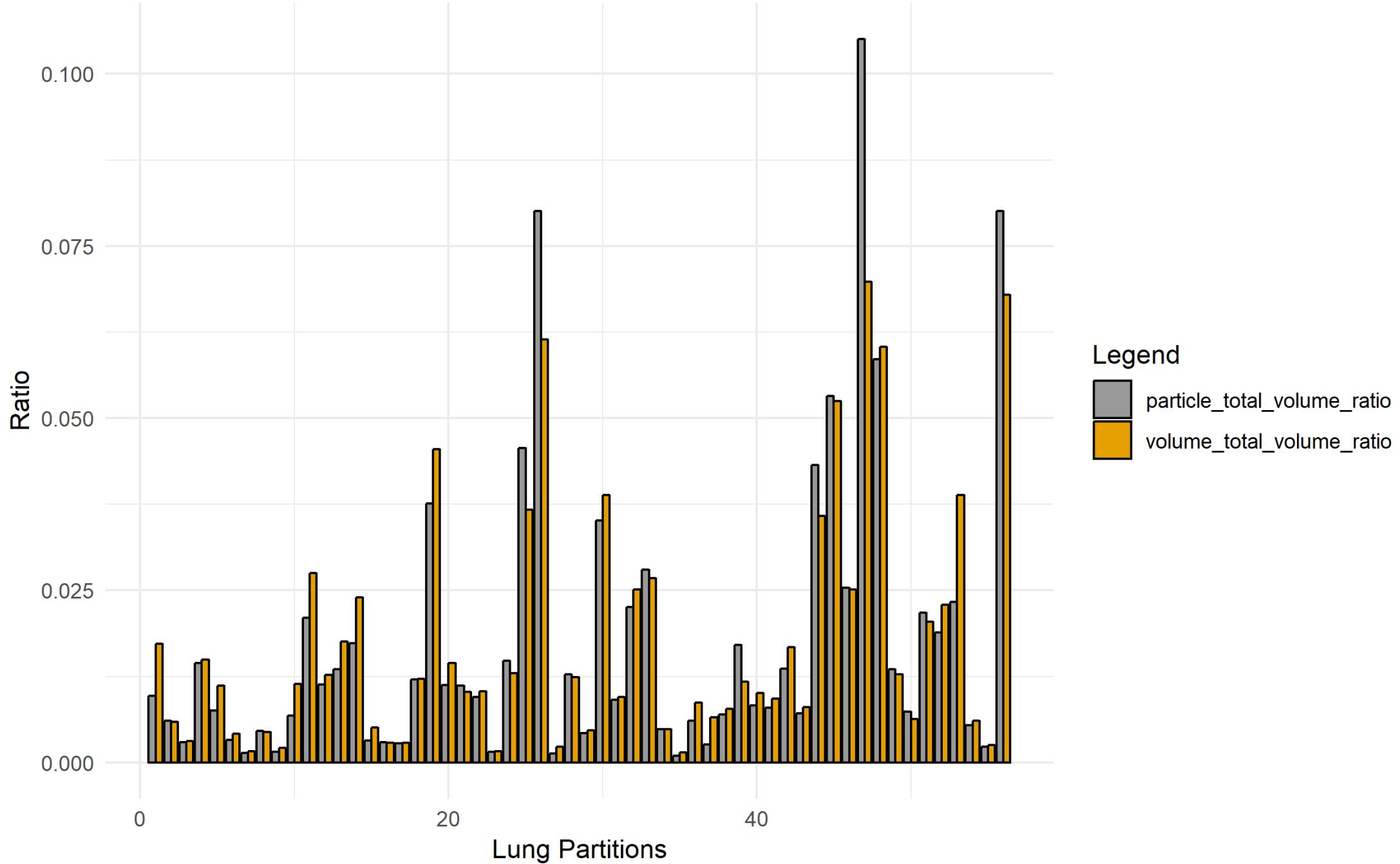
# m10\_SublobesDeposition



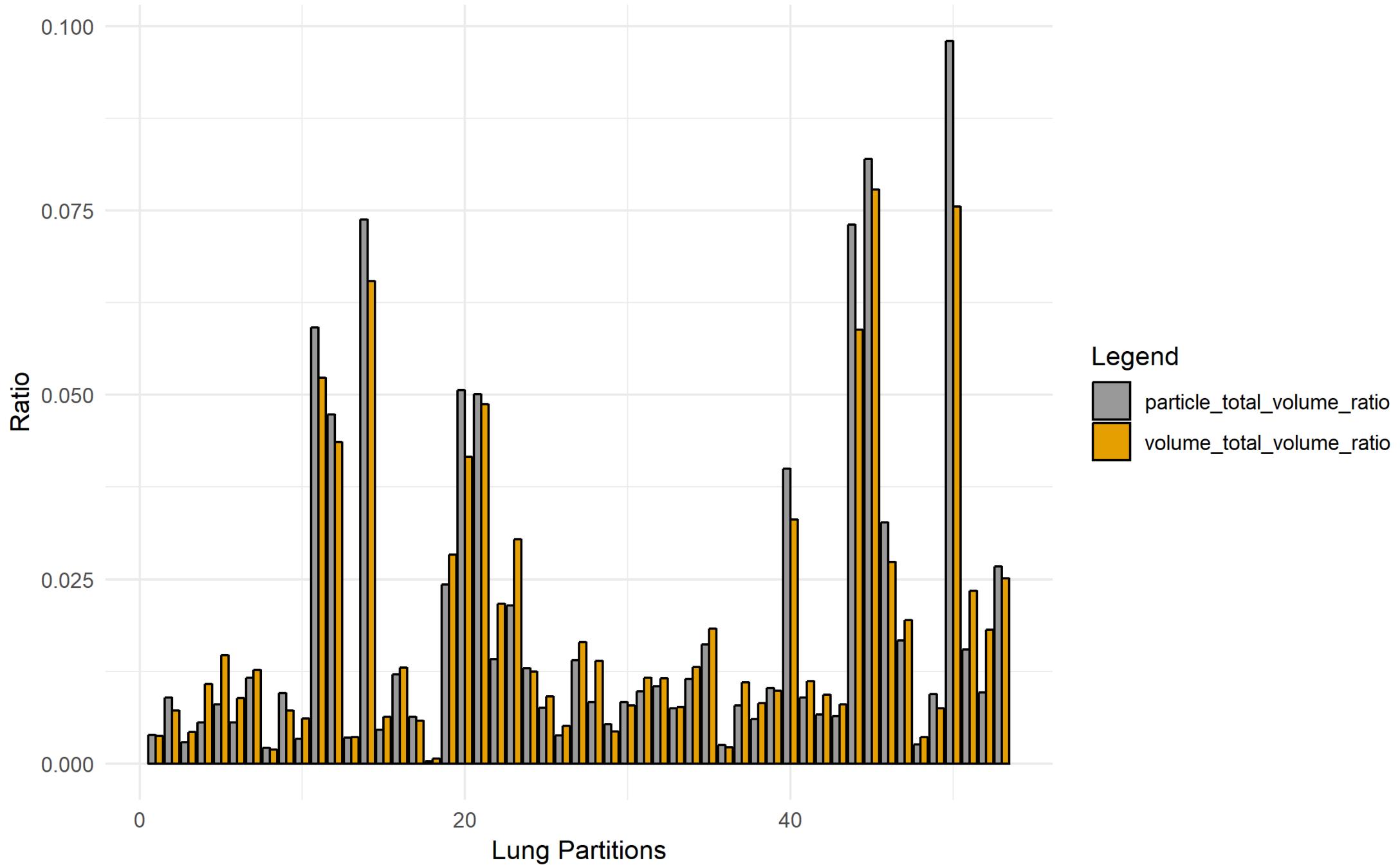
# m11\_SublobesDeposition



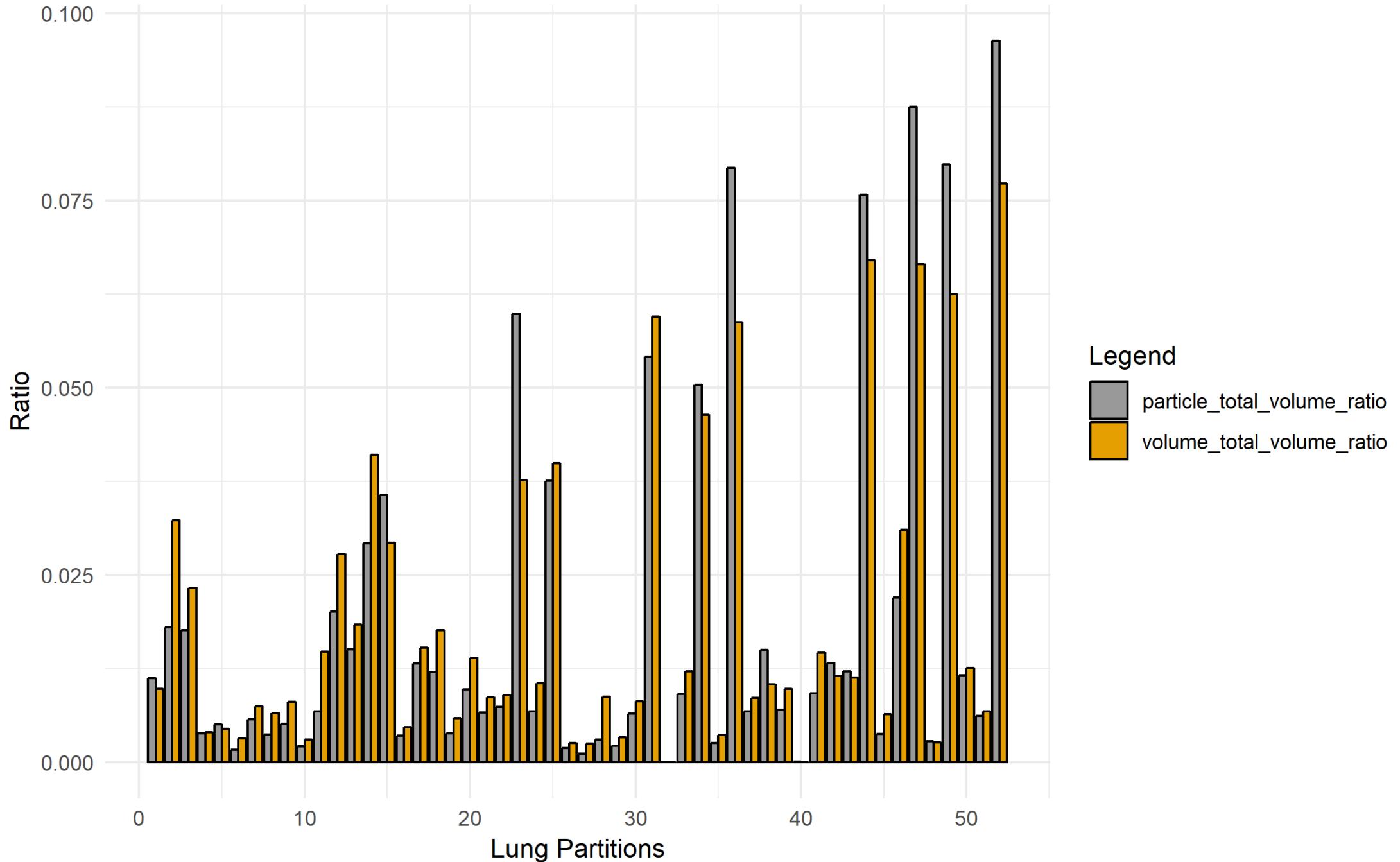
# m12\_SublobesDeposition



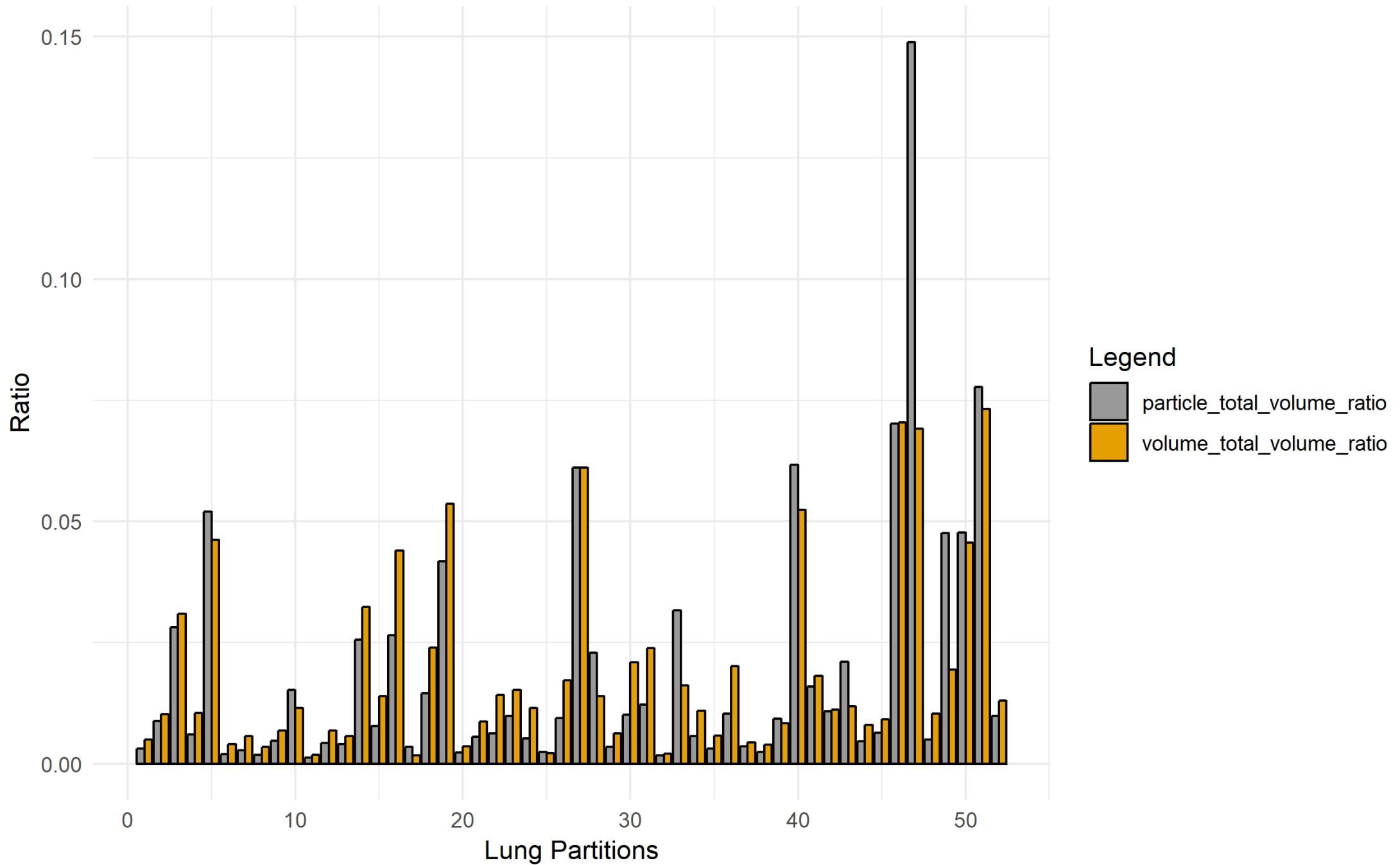
# m13\_SublobesDeposition



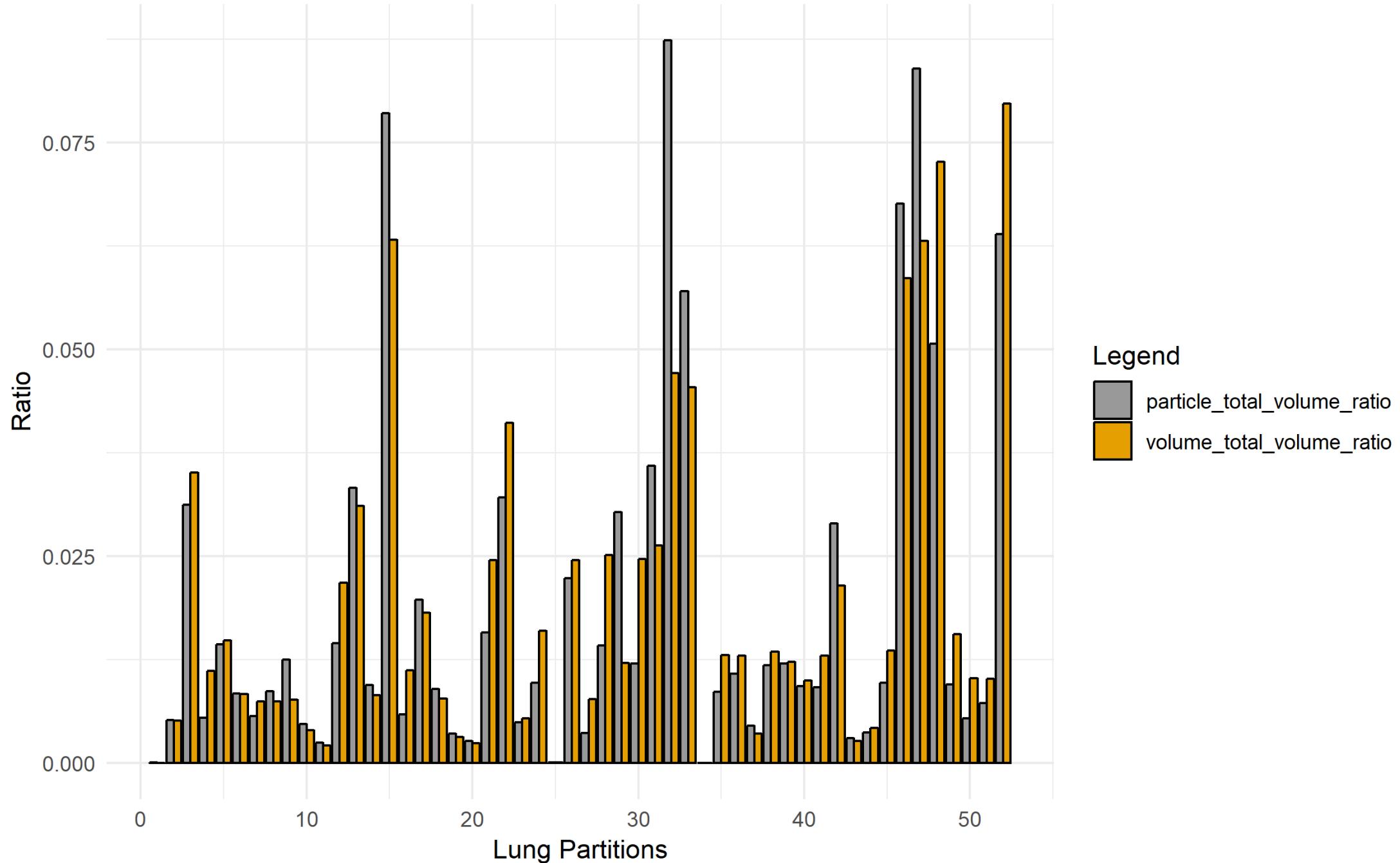
# m14\_SublobesDeposition



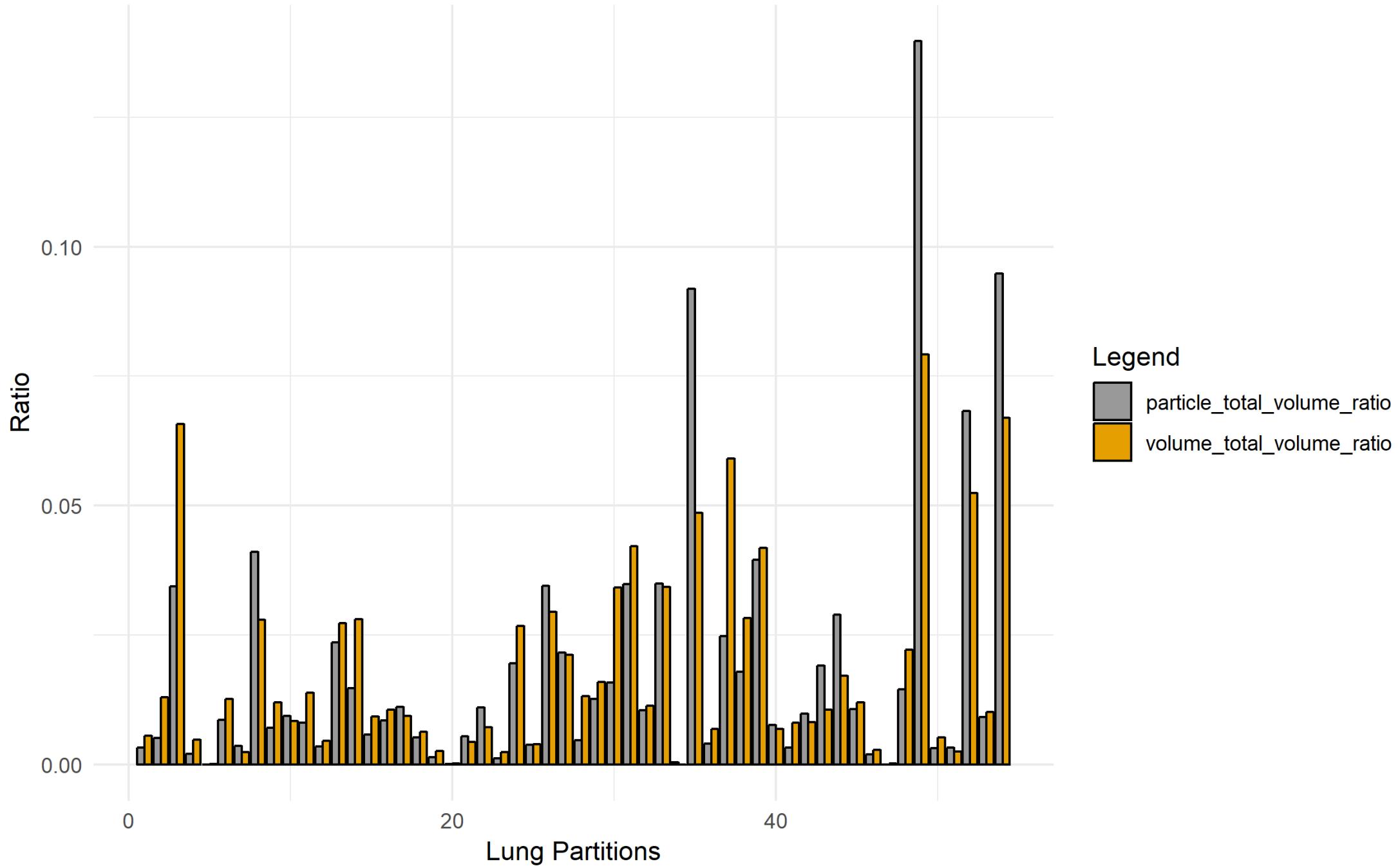
# m15\_SublobesDeposition



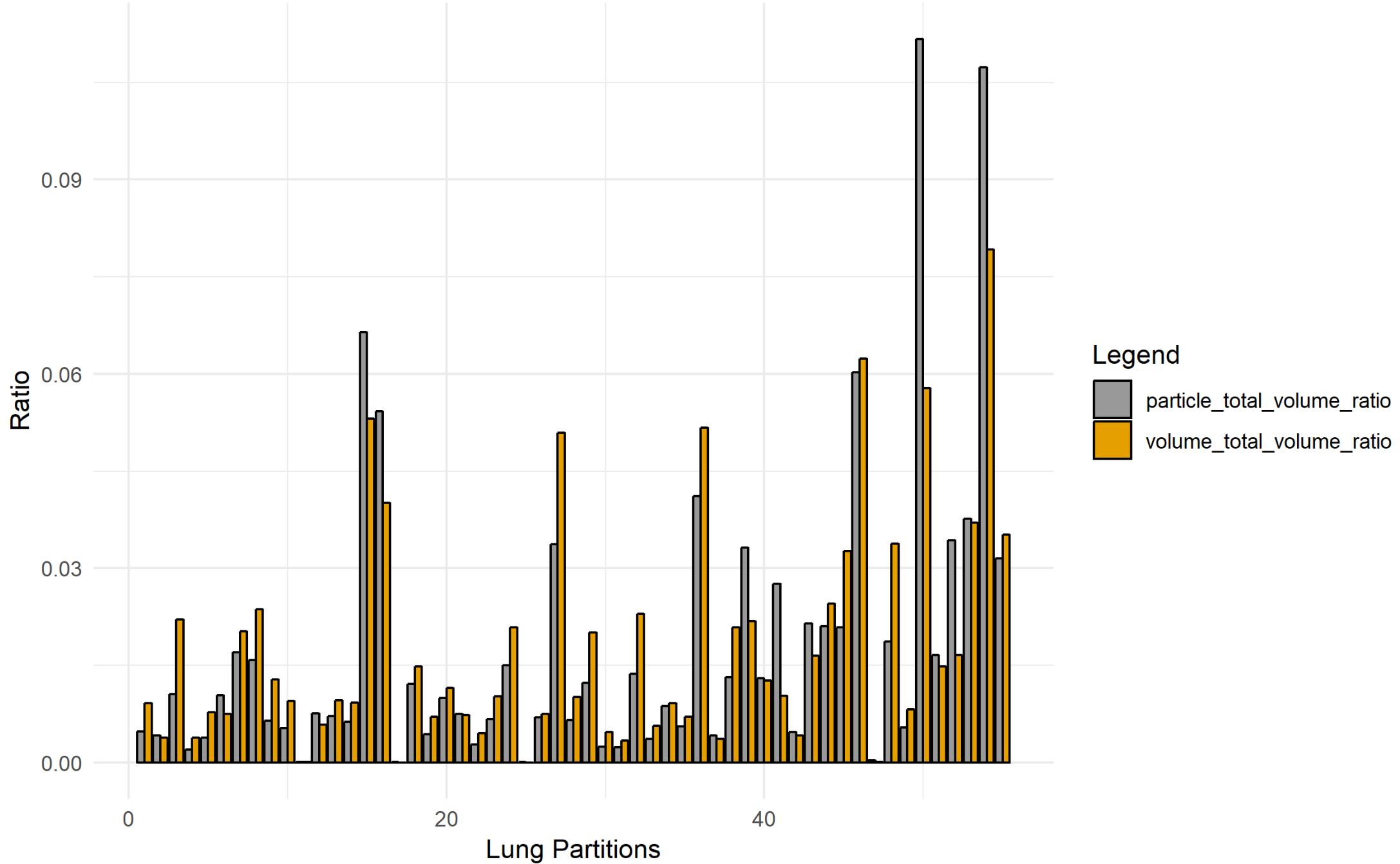
# m16\_SublobesDeposition



# m17\_SublobesDeposition



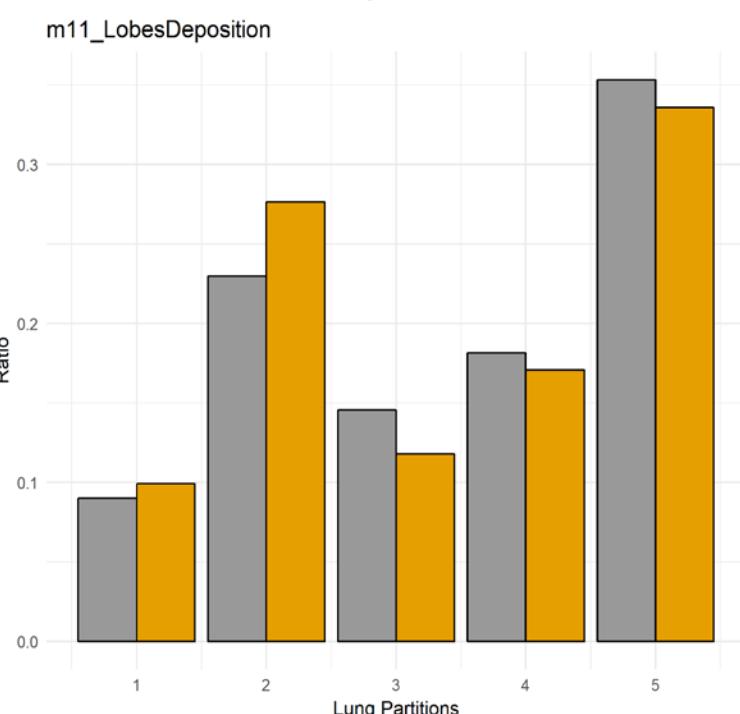
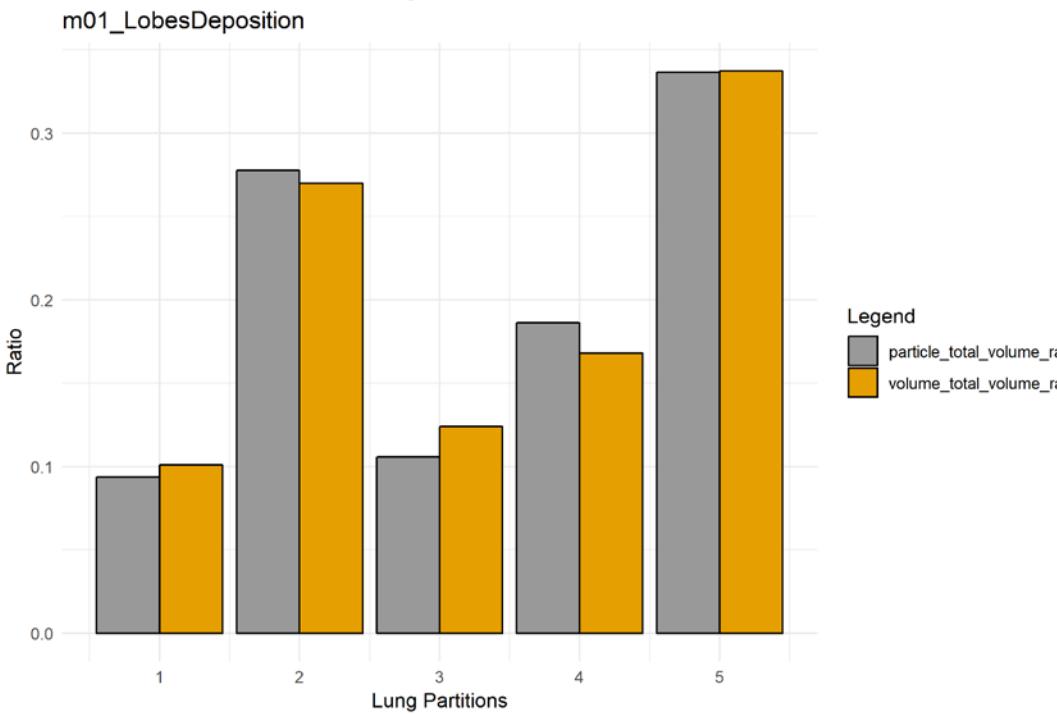
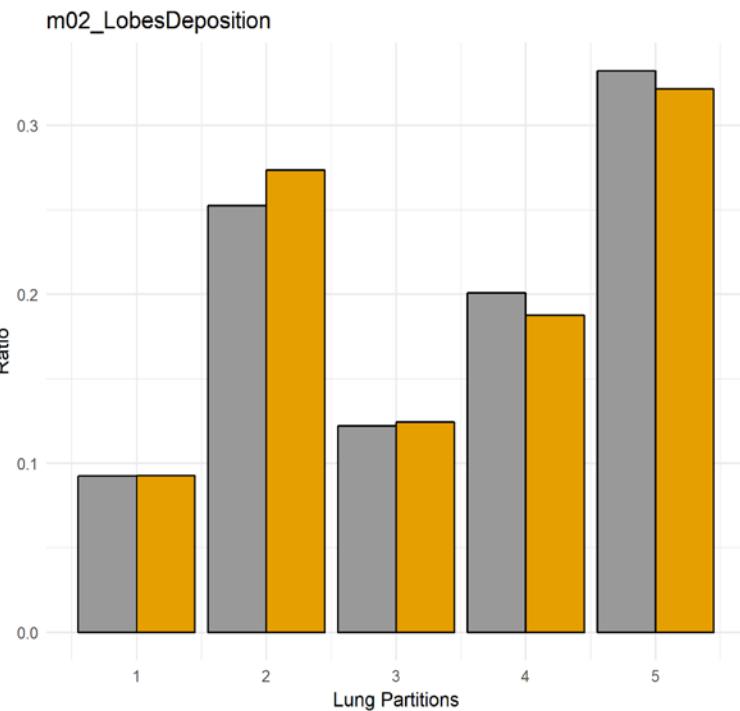
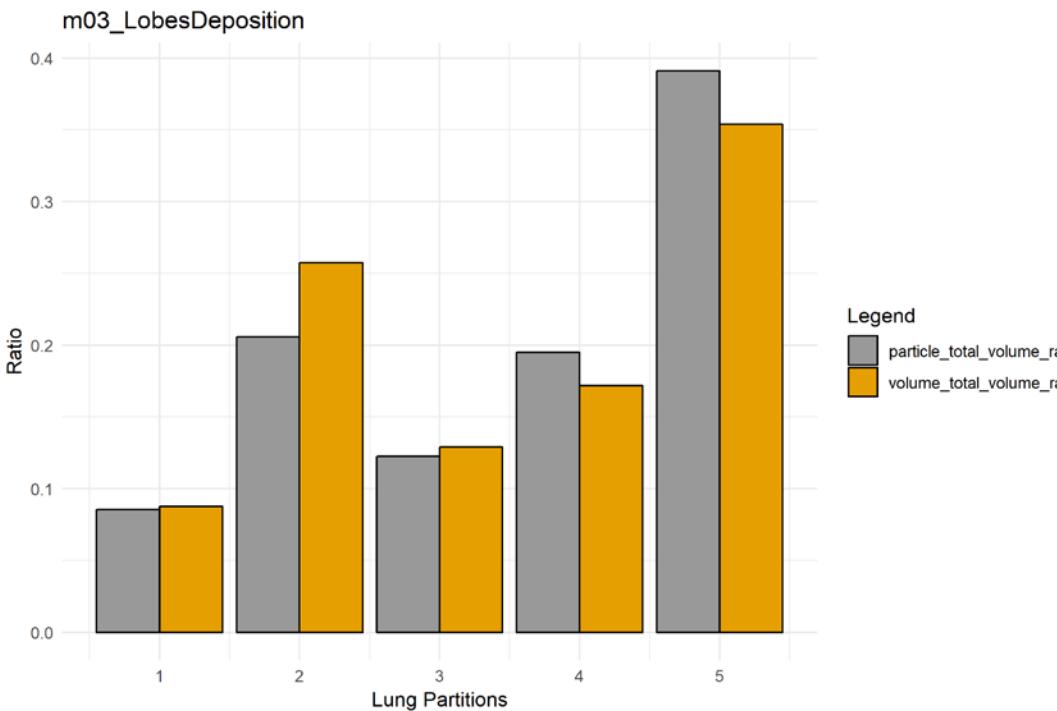
# m18\_SublobesDeposition



Class One

Usually discrepancy  
happens in Lobe #5

Class 1 are samples  
whose lobe #5 particles  
are equally distributed

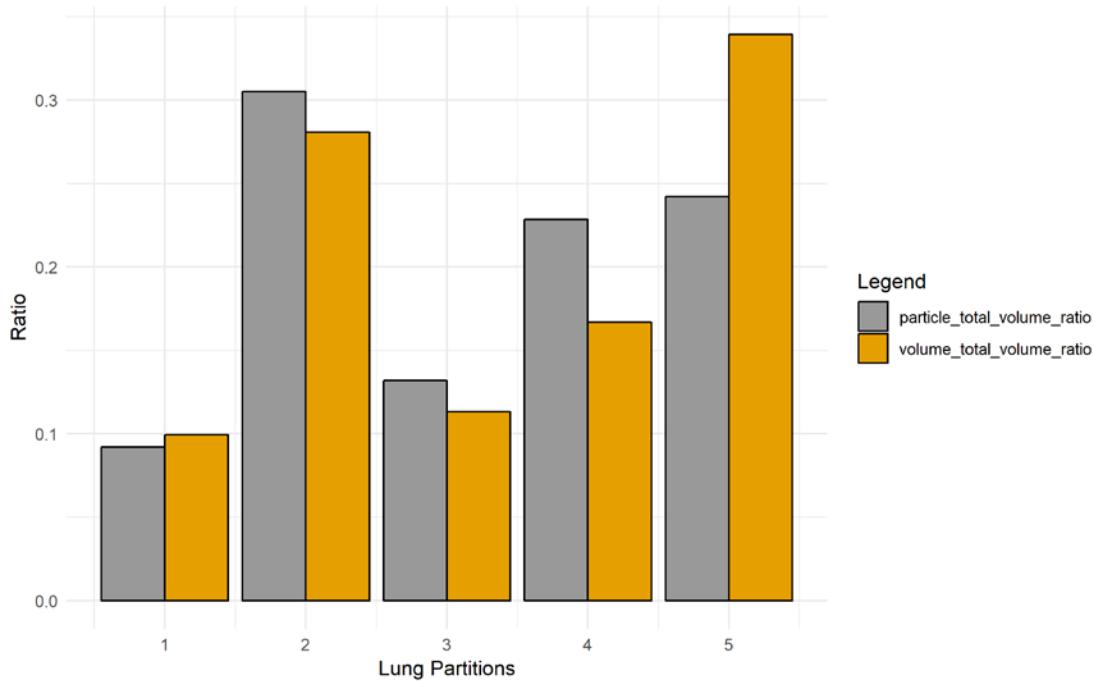


## Class Two

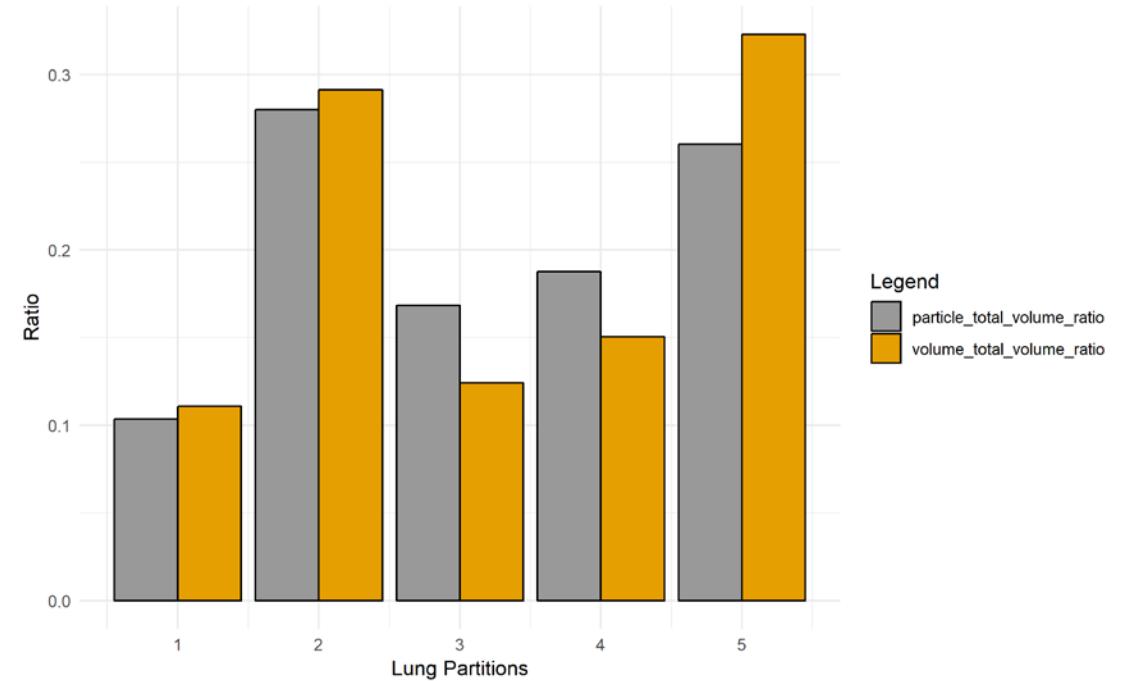
Usually discrepancy  
happens in Lobe #5

Class 2 are samples  
whose lobe #5 particles  
are scarcely distributed

m16\_LobesDeposition



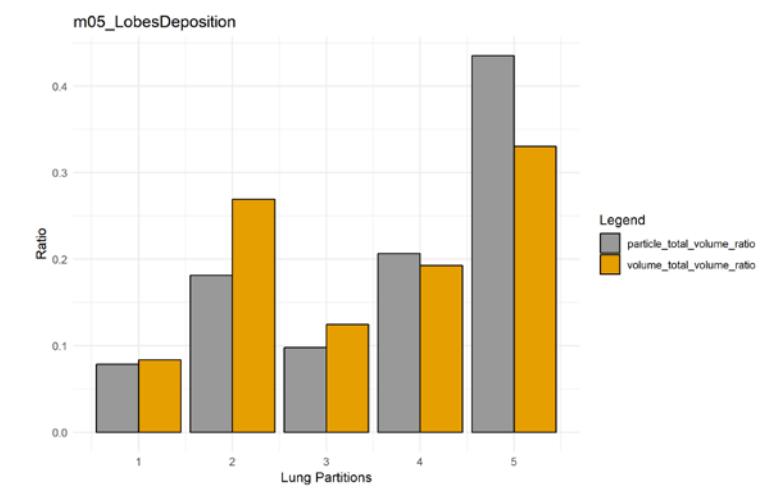
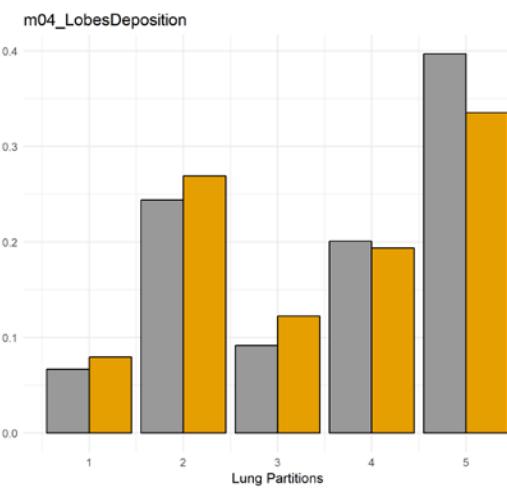
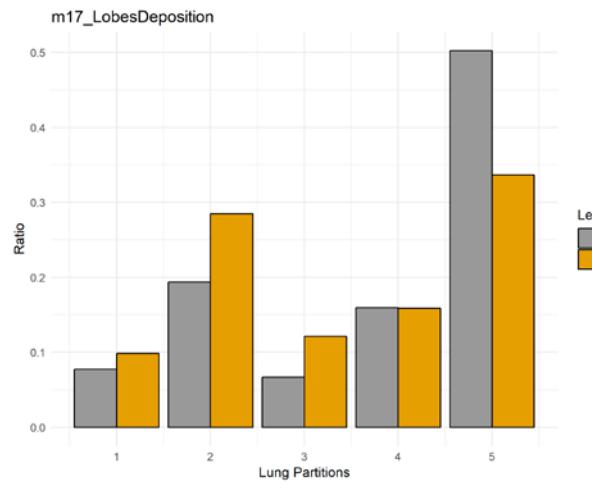
m08\_LobesDeposition



## Class Three

Usually discrepancy  
happens in Lobe #5

Class 3 are samples  
whose lobe #5 particles  
are densely distributed



# MD files and Sample Profile Analysis

---

Class	Representative Samples
Class 1	#1 #2 #3 #11
Class 2	#8 #16
Class 3	#4 #5 #17

Select a node...

```
object {13}
  gender : Male
  particle_size : 1
  exposure_time : 10
  voxel_size [3]
    overall_quality : A
    total_centerline_length : 658.742
    number_of_branches : 1849
    number_of_terminal_branches : 927
    maximum_generation_number : 25
    number_of_outlet_areas : 2004
    lung_volume : 1154
    total_aerosol_deposition : 181665.91
```

Select a node...

```
object {13}
  gender : Male
  particle_size : 1
  exposure_time : 10
  voxel_size [3]
    overall_quality : B
    total_centerline_length : 453.592
    number_of_branches : 994
    number_of_terminal_branches : 498
    maximum_generation_number : 24
    number_of_outlet_areas : 1167
    lung_volume : 1224.19
    total_aerosol_deposition : 581325.67
```

Select a node...

```
object {13}
  gender : Female
  particle_size : 1
  exposure_time : 10
  voxel_size [3]
    overall_quality : A
    total_centerline_length : 586.798
    number_of_branches : 1556
    number_of_terminal_branches : 780
    maximum_generation_number : 24
    number_of_outlet_areas : 1817
    lung_volume : 1067.14
    total_aerosol_deposition : 473421.95
```

Select a node...

```
object {13}
  gender : Male
  particle_size : 1
  exposure_time : 10
  voxel_size [3]
    overall_quality : B
    total_centerline_length : 556.905
    number_of_branches : 1309
    number_of_terminal_branches : 655
    maximum_generation_number : 25
    number_of_outlet_areas : 1725
    lung_volume : 1142.07
    total_aerosol_deposition : 409899.22
```

Tree ▾

Select a node...

object {13}
gender : Female
particle_size : 1
exposure_time : 10
► voxel_size [3]
overall_quality : A
total_centerline_length : 597.903
number_of_branches : 1718
number_of_terminal_branches : 861
maximum_generation_number : 25
number_of_outlet_areas : 1995
lung_volume : 1055.4
total_aerosol_deposition : 671053.58
relative_exposure_estimate : null

Tree ▾

Select a node...

object {13}
gender : M
particle_size : 2
exposure_time : 15
► voxel_size [3]
overall_quality : A
total_centerline_length : 699.275
number_of_branches : 2211
number_of_terminal_branches : 1109
maximum_generation_number : 27
number_of_outlet_areas : 2327
lung_volume : 1122.84
total_aerosol_deposition : 123191.56
relative_exposure_estimate : null

Tree ▾

Select a node...

```
object {13}
  gender : Male
  particle_size : 1
  exposure_time : 10
  voxel_size [3]
    overall_quality : B
    total_centerline_length : 453.592
    number_of_branches : 994
    number_of_terminal_branches : 498
    maximum_generation_number : 24
    number_of_outlet_areas : 1167
    lung_volume : 1224.19
    total_aerosol_deposition : 581325.67
```

Tree ▾

Select a node...

```
object {13}
  gender : Male
  particle_size : 1
  exposure_time : 10
  voxel_size [3]
    overall_quality : B
    total_centerline_length : 569.515
    number_of_branches : 1348
    number_of_terminal_branches : 675
    maximum_generation_number : 23
    number_of_outlet_areas : 1709
    lung_volume : 1211.22
    total_aerosol_deposition : 608577.82
```

Tree ▾

Select a node...

```
object {13}
  gender : F
  particle_size : 2
  exposure_time : 15
  voxel_size [3]
    overall_quality : A
    total_centerline_length : 623.436
    number_of_branches : 1838
    number_of_terminal_branches : 921
    maximum_generation_number : 25
    number_of_outlet_areas : 1905
    lung_volume : 1062.17
    total_aerosol_deposition : 173330.7
    relative_exposure_estimate : null
```

In the future

Further Analyze the sample profile  
to find patterns

Literature search about critical lung  
partition (Lobe, Sub Lobe ... )  
volume ratio for particle deposition

Reconstruct the 3D model of the  
lung and associate it with data  
analysis

# Reference:

- H. Wickham. *ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York, 2016.
- Yihui Xie (2019). *knitr: A General-Purpose Package for Dynamic Report Generation in R*. R package version 1.22.
- LAPD Dataset for Lung Particle Deposition,  
<https://nebraska.ecn.uiowa.edu:447/v3/>
- Resource and data used for this presentation are posted on:  
[https://github.com/Broccolito/lung\\_particle\\_deposition\\_analysis/tree/master/Presentation%20031419](https://github.com/Broccolito/lung_particle_deposition_analysis/tree/master/Presentation%20031419)



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