

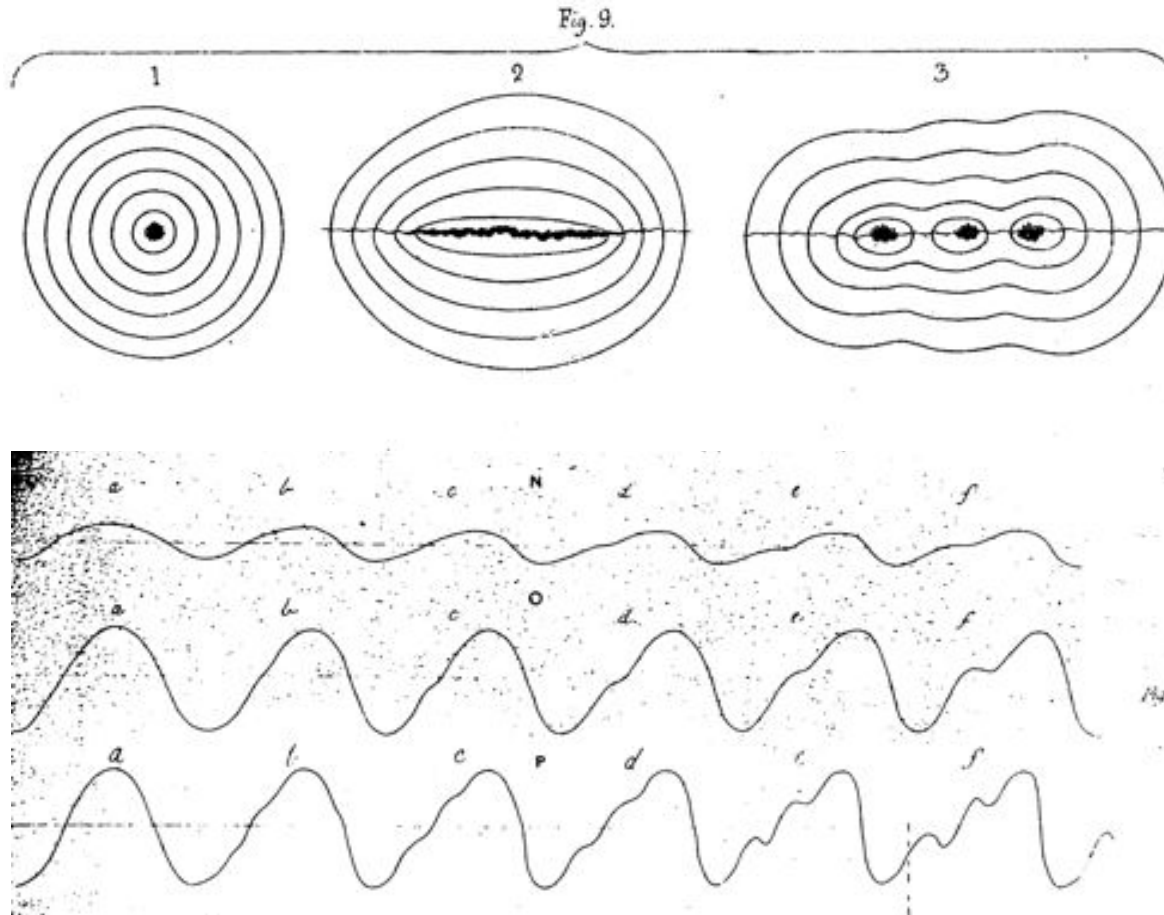


# Wat zit er in de aarde en wat beweegt haar

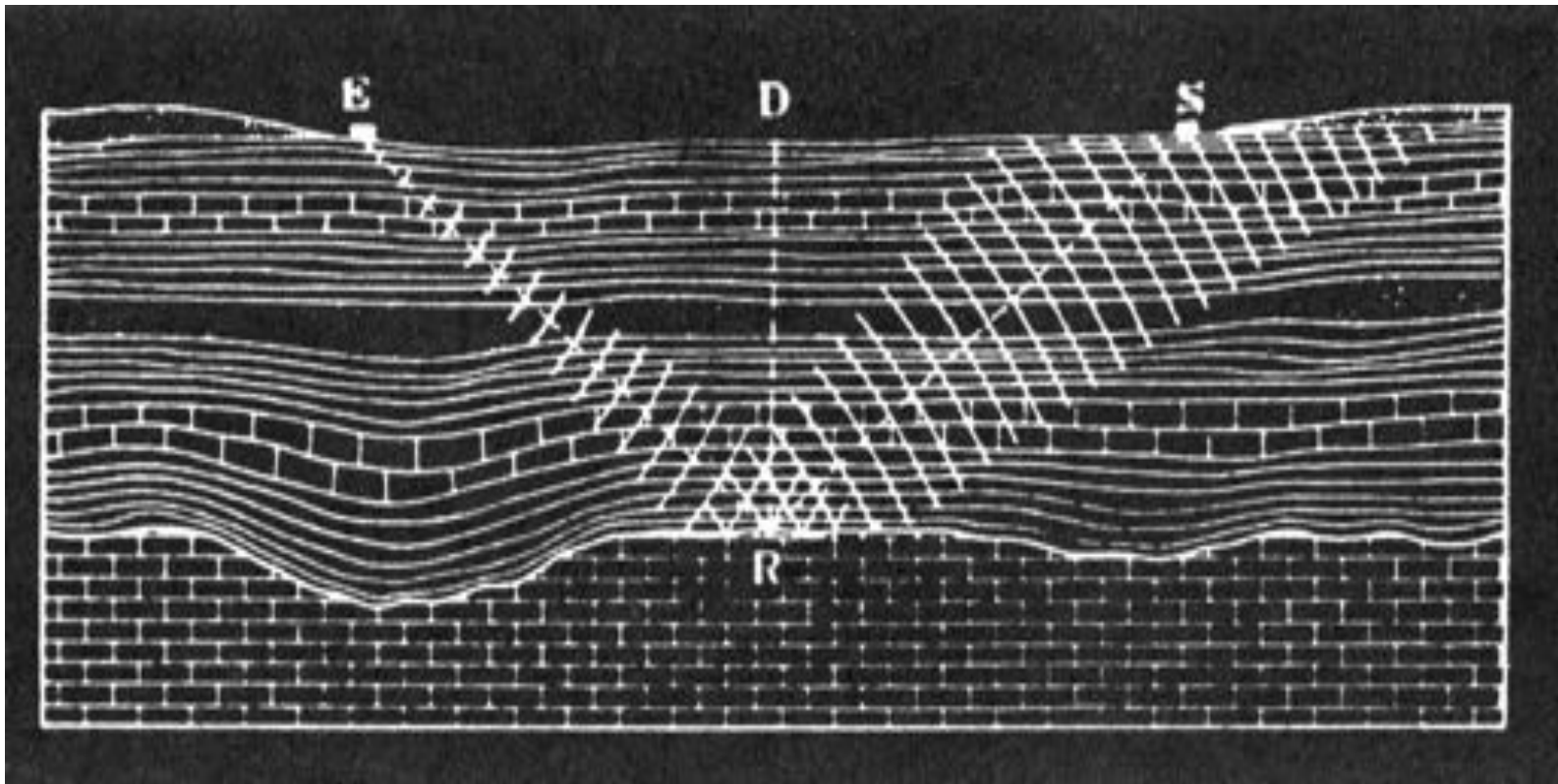
Jacob T. Fokkema

Bataafsche Genootschap

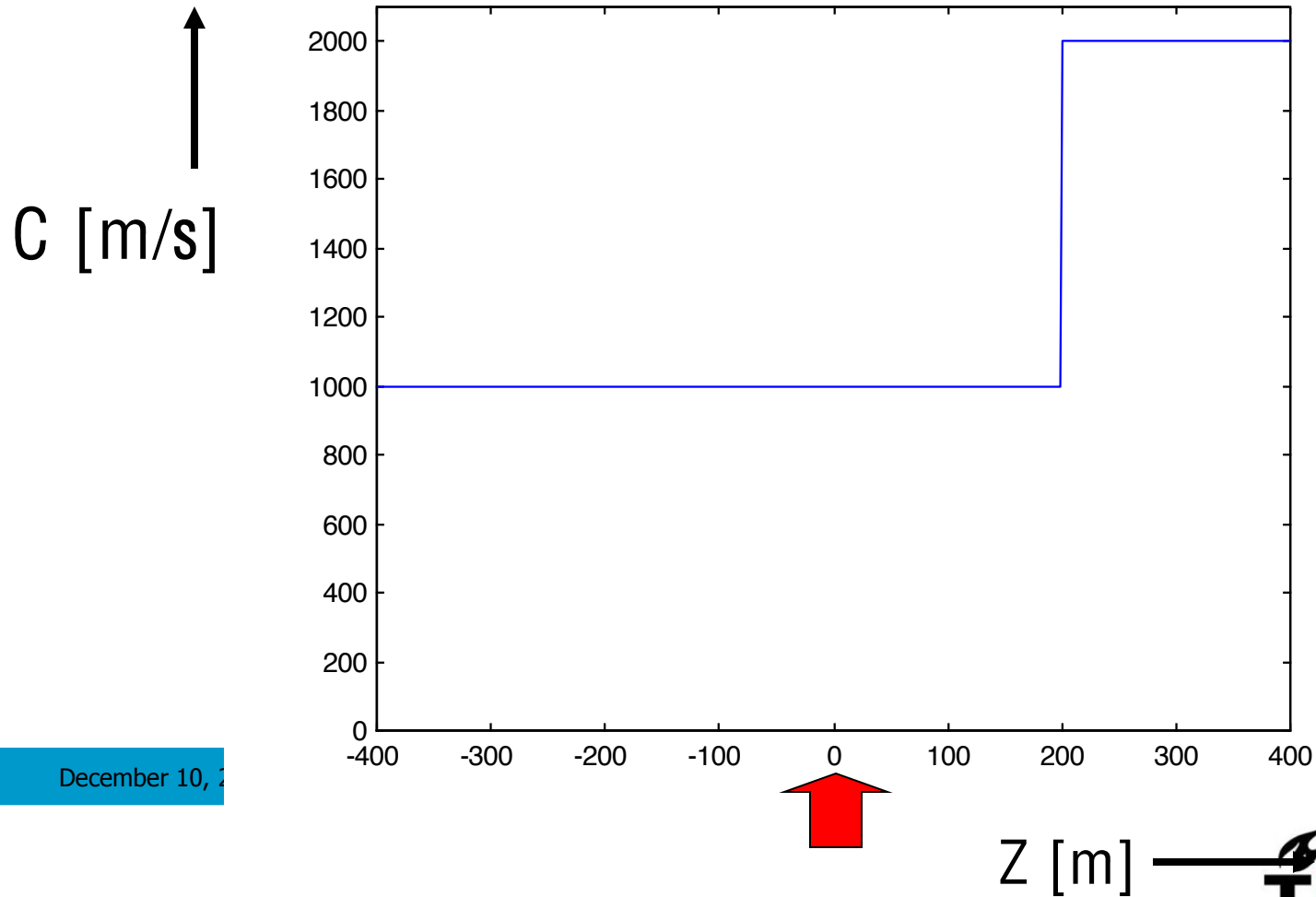
# Golf patronen van Mallet in 1848

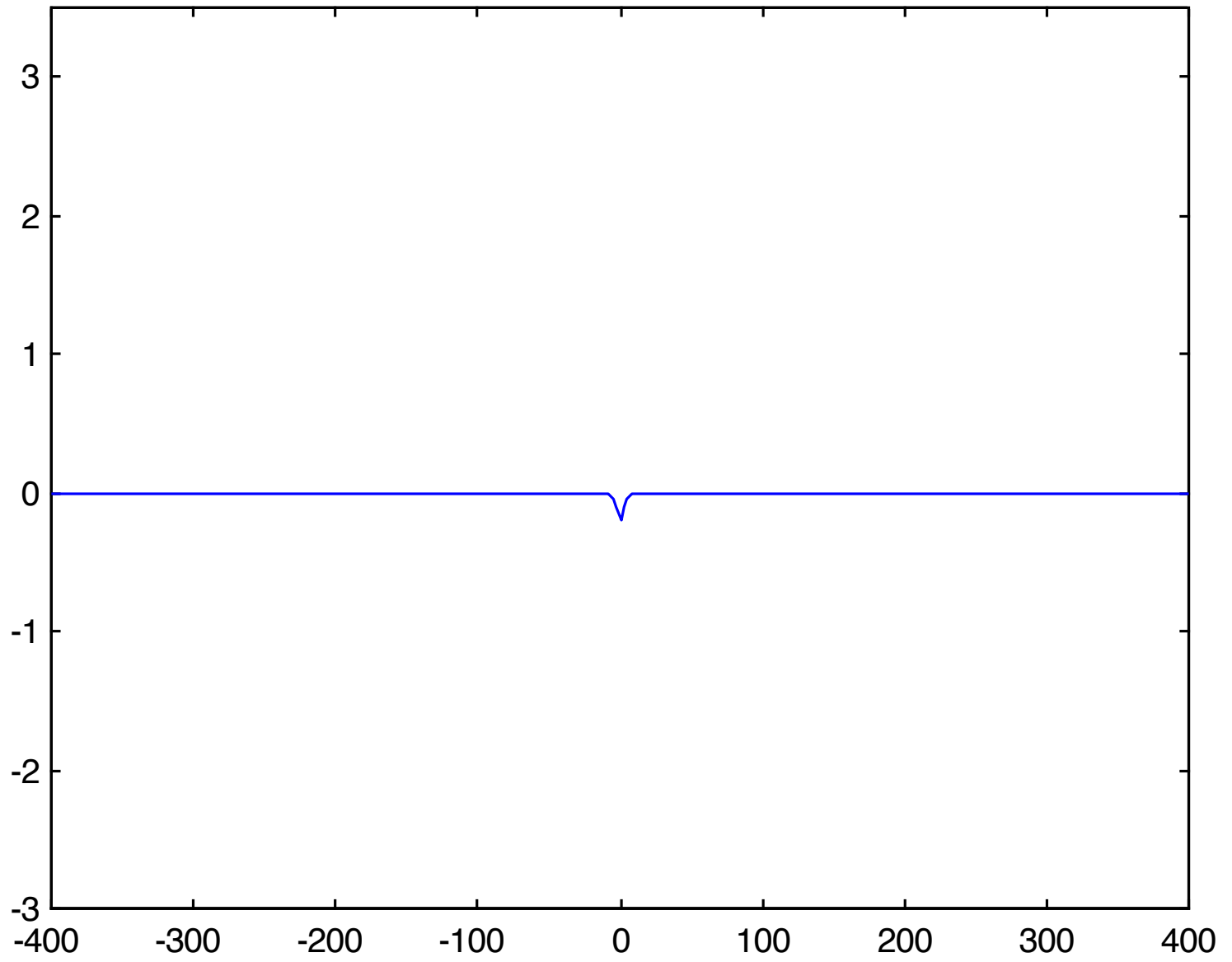


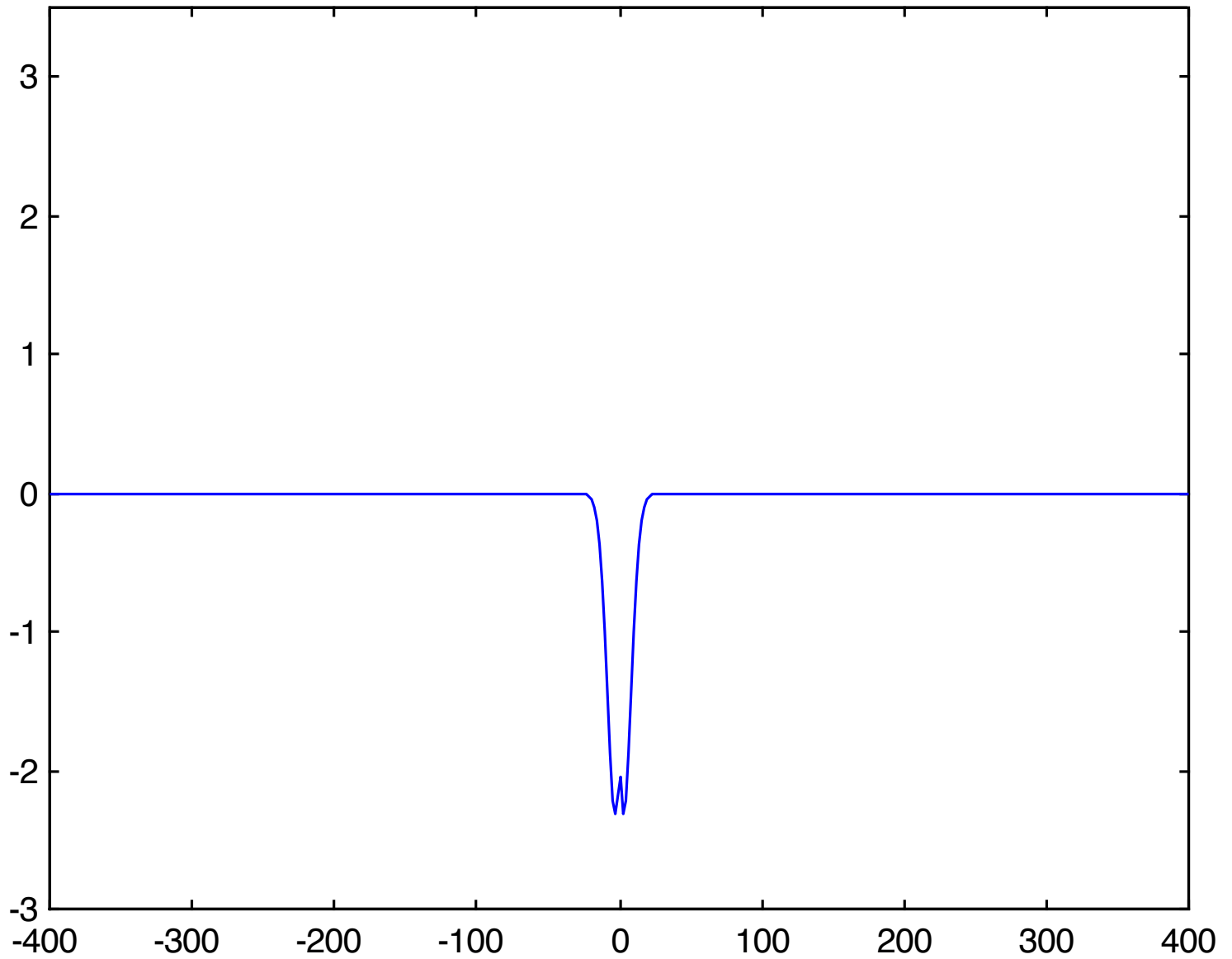
# Het eerste concept van seismische reflectie (1922)

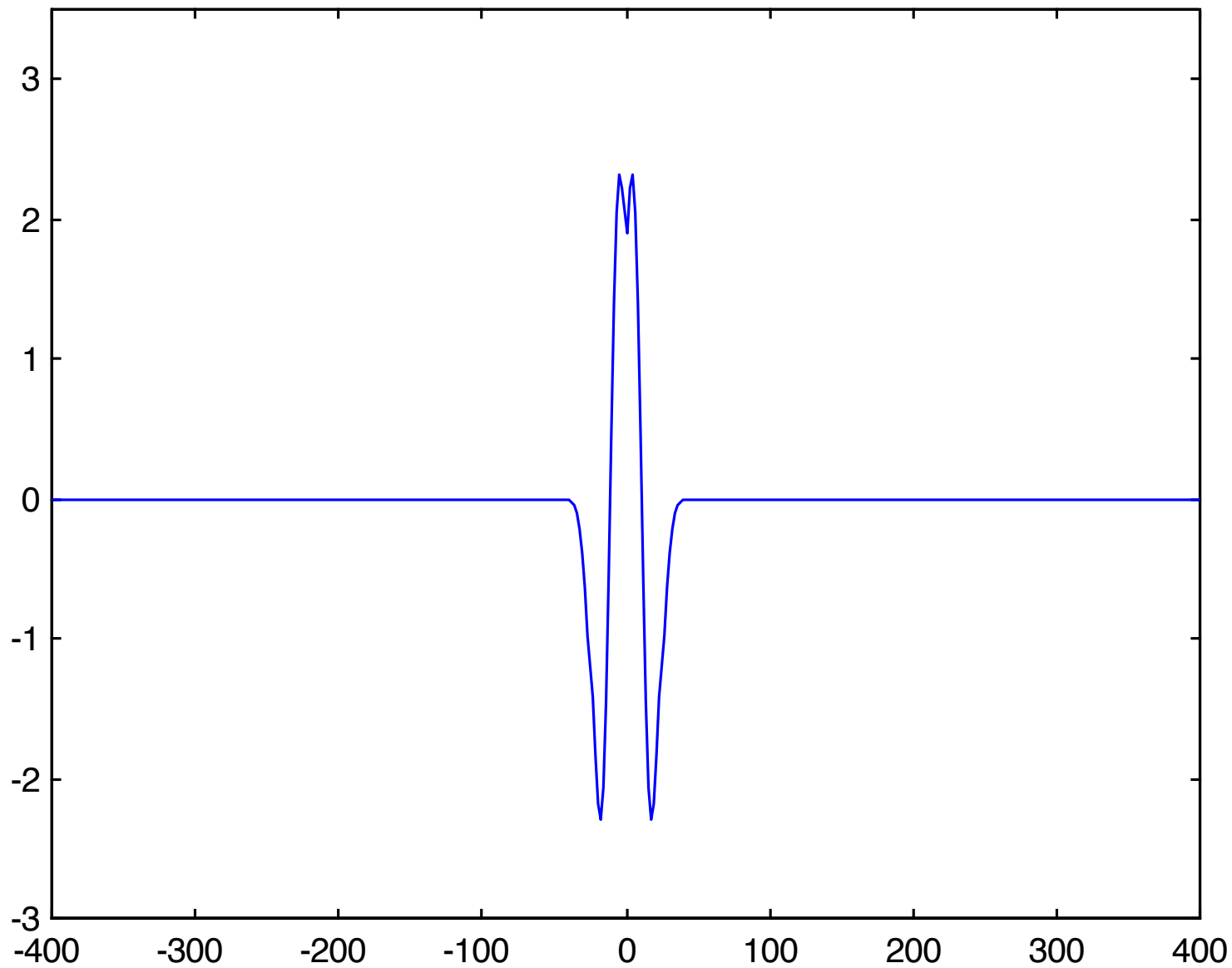


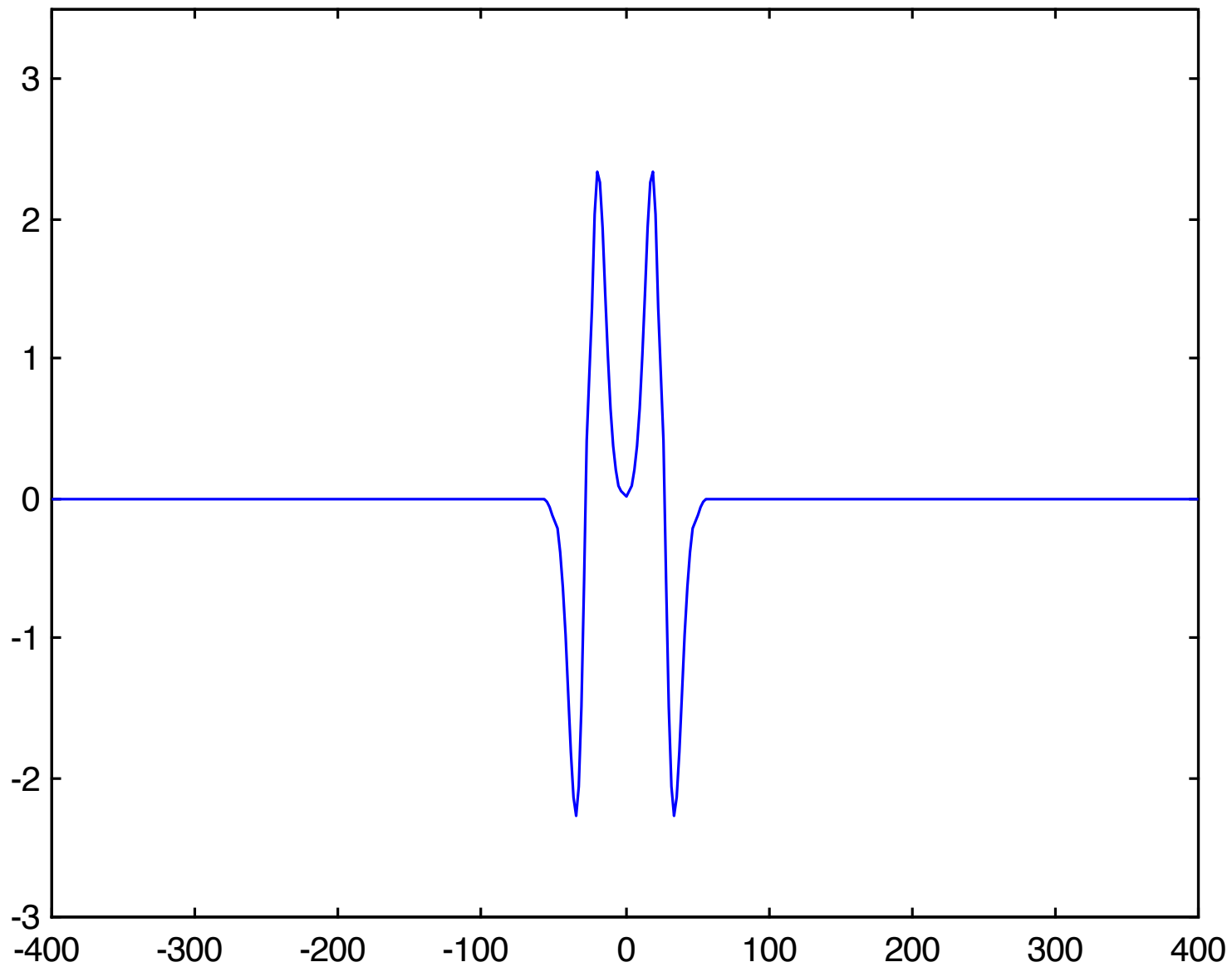
# Model I $\Delta z = 2 \text{ m}$



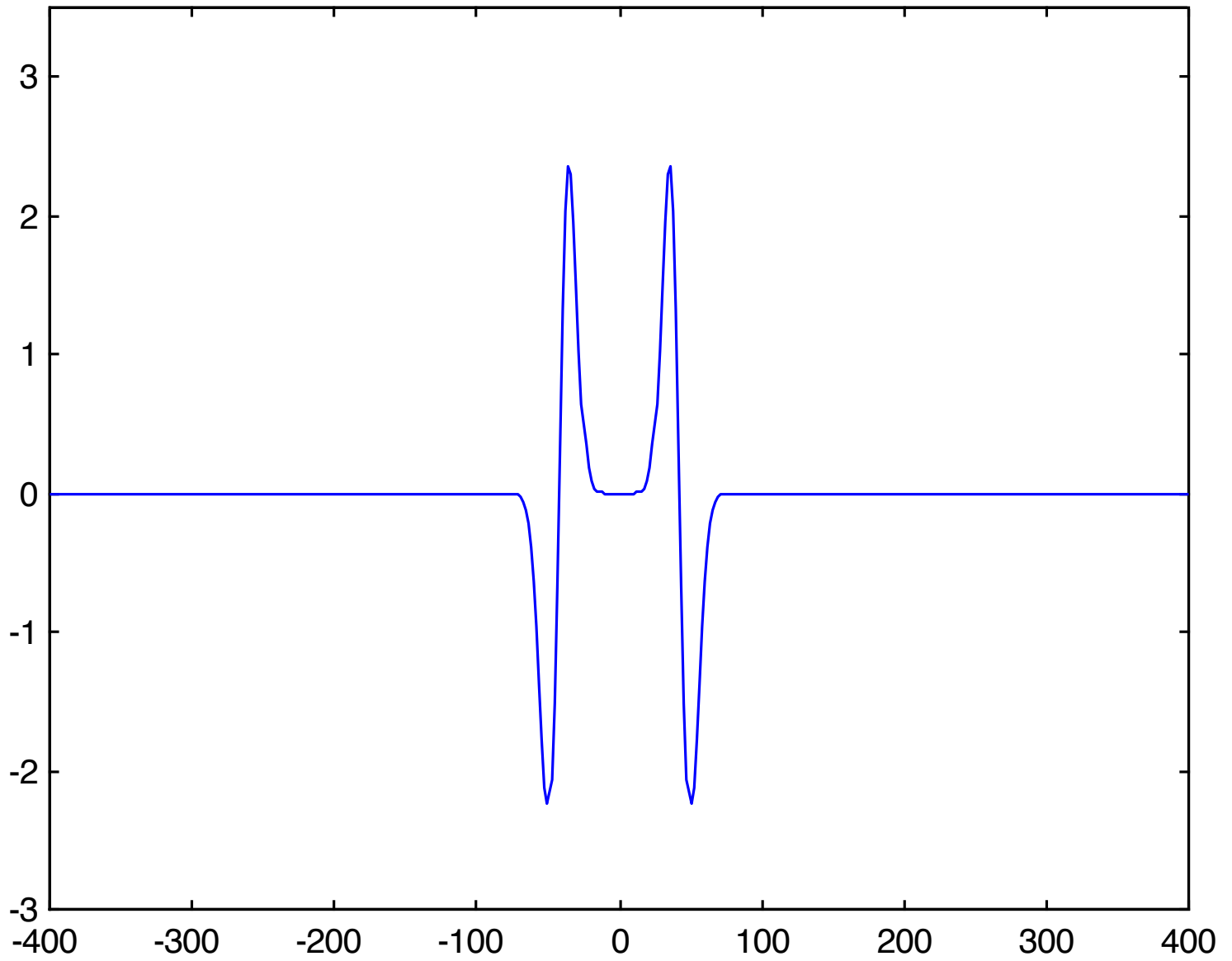


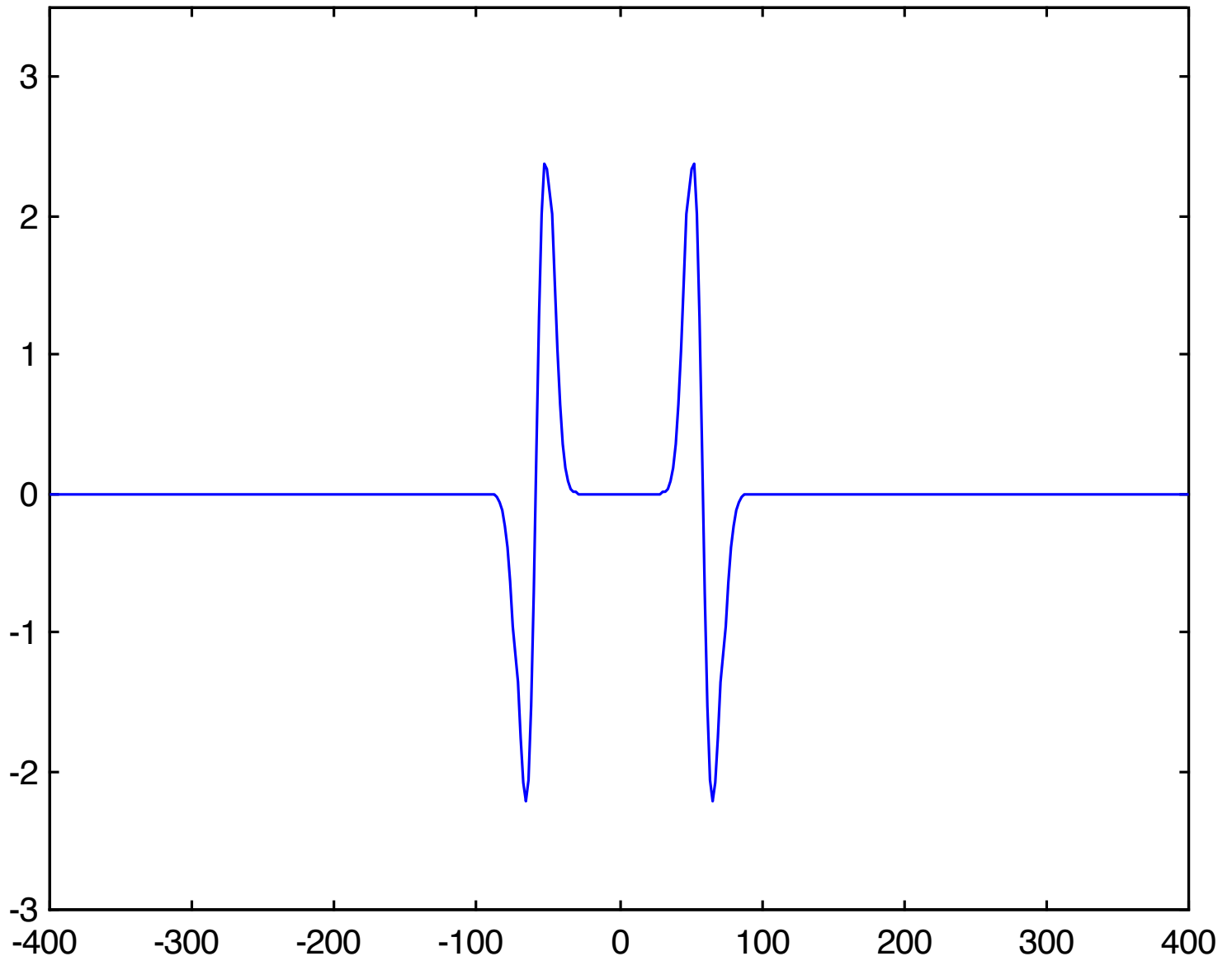


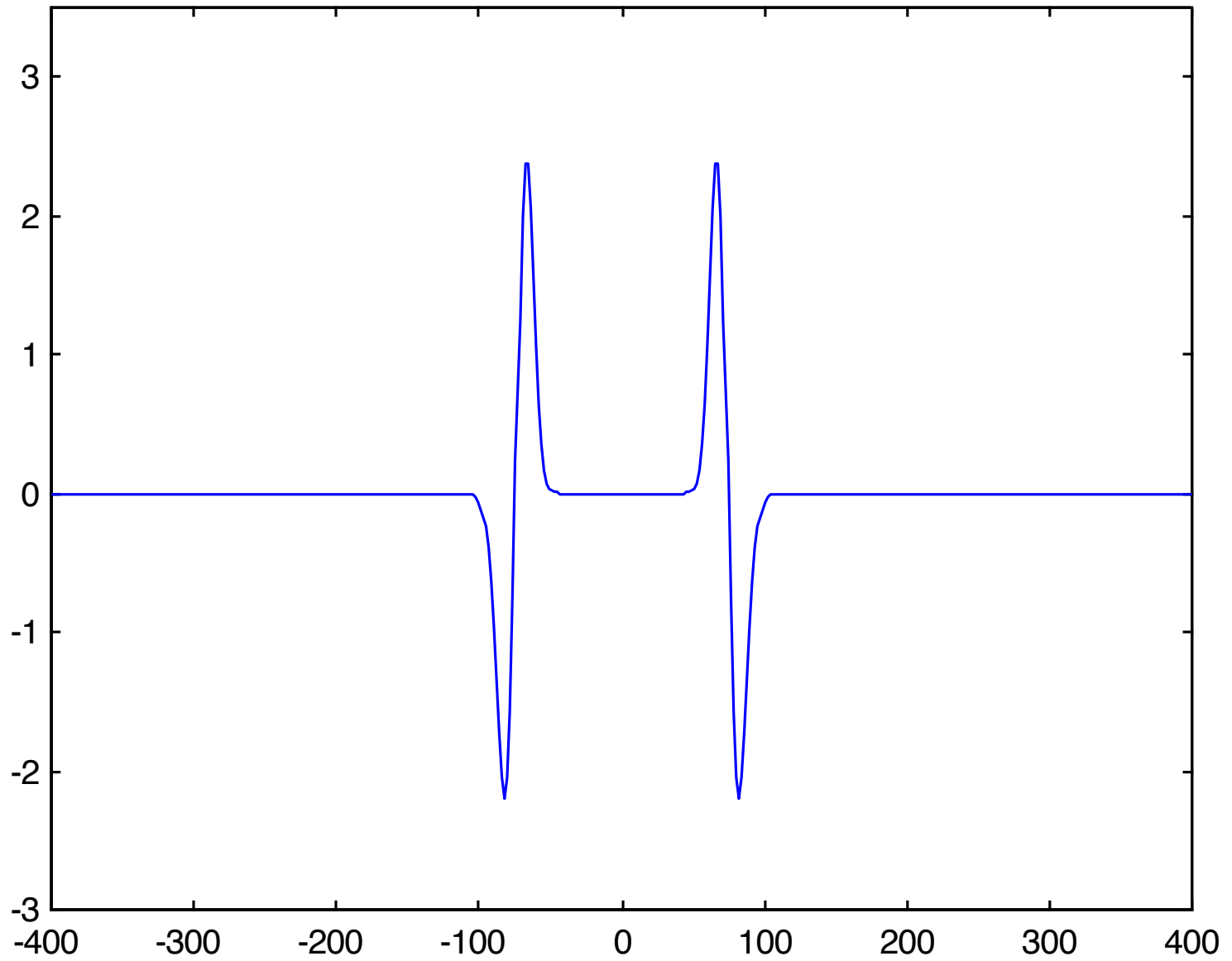


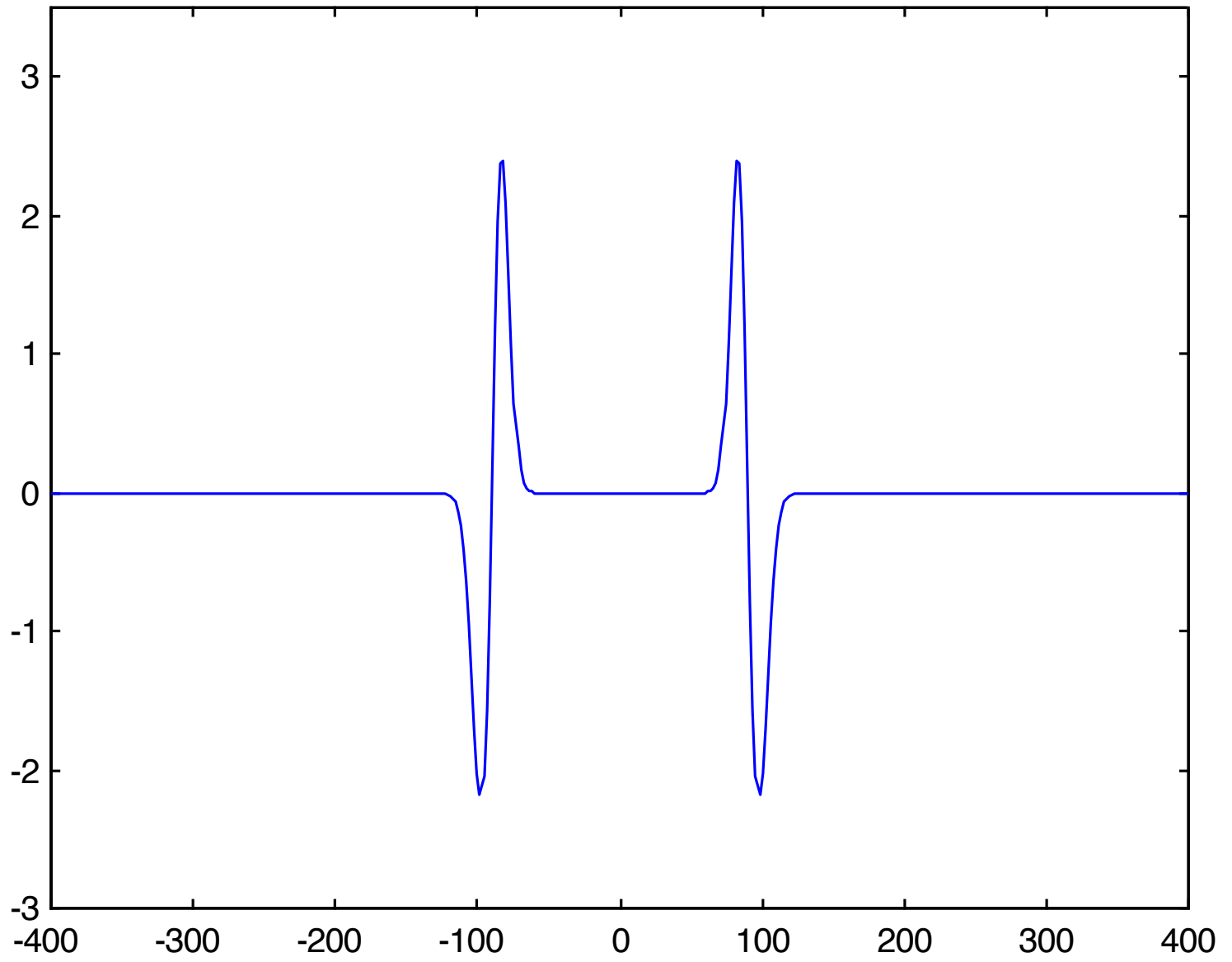


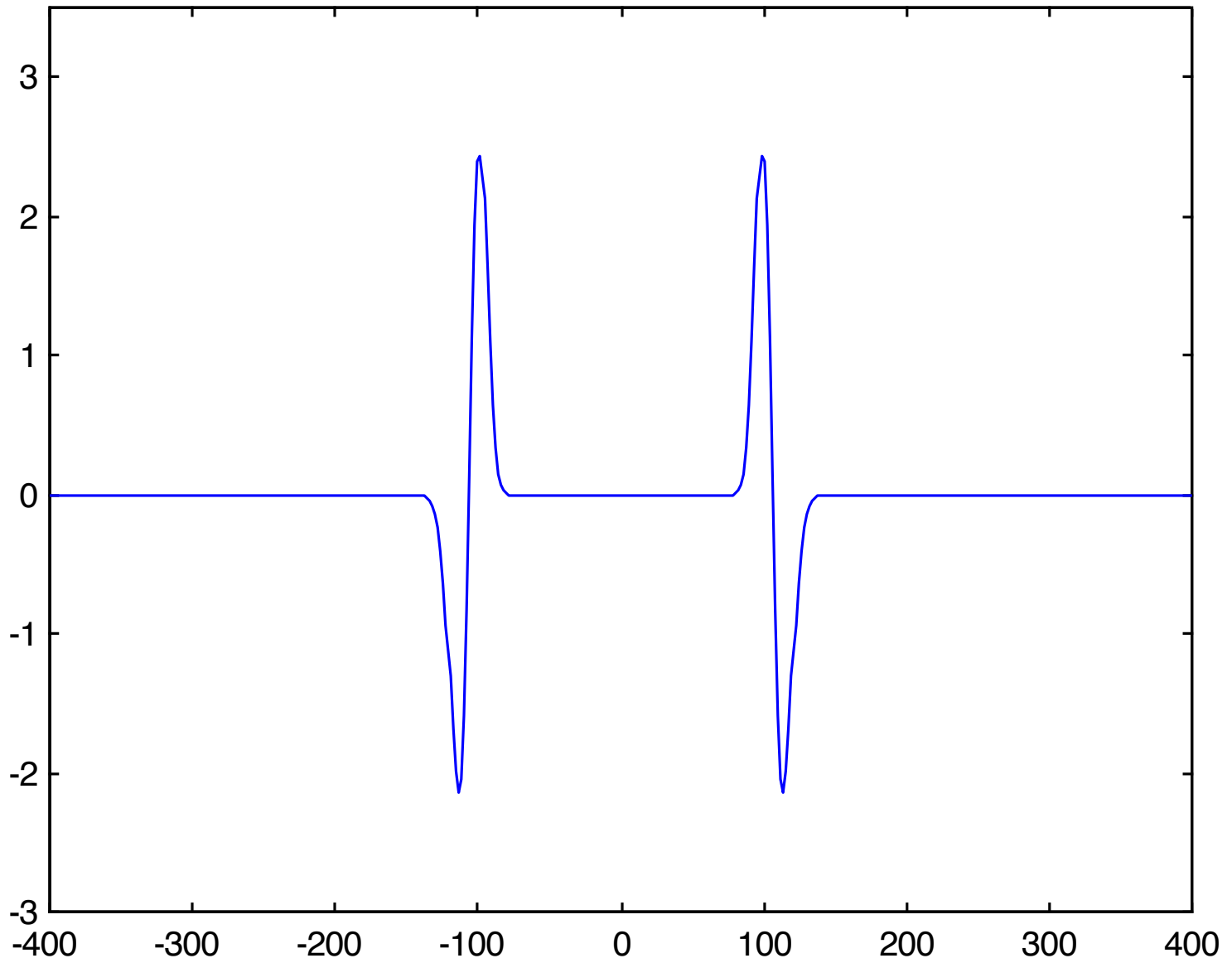


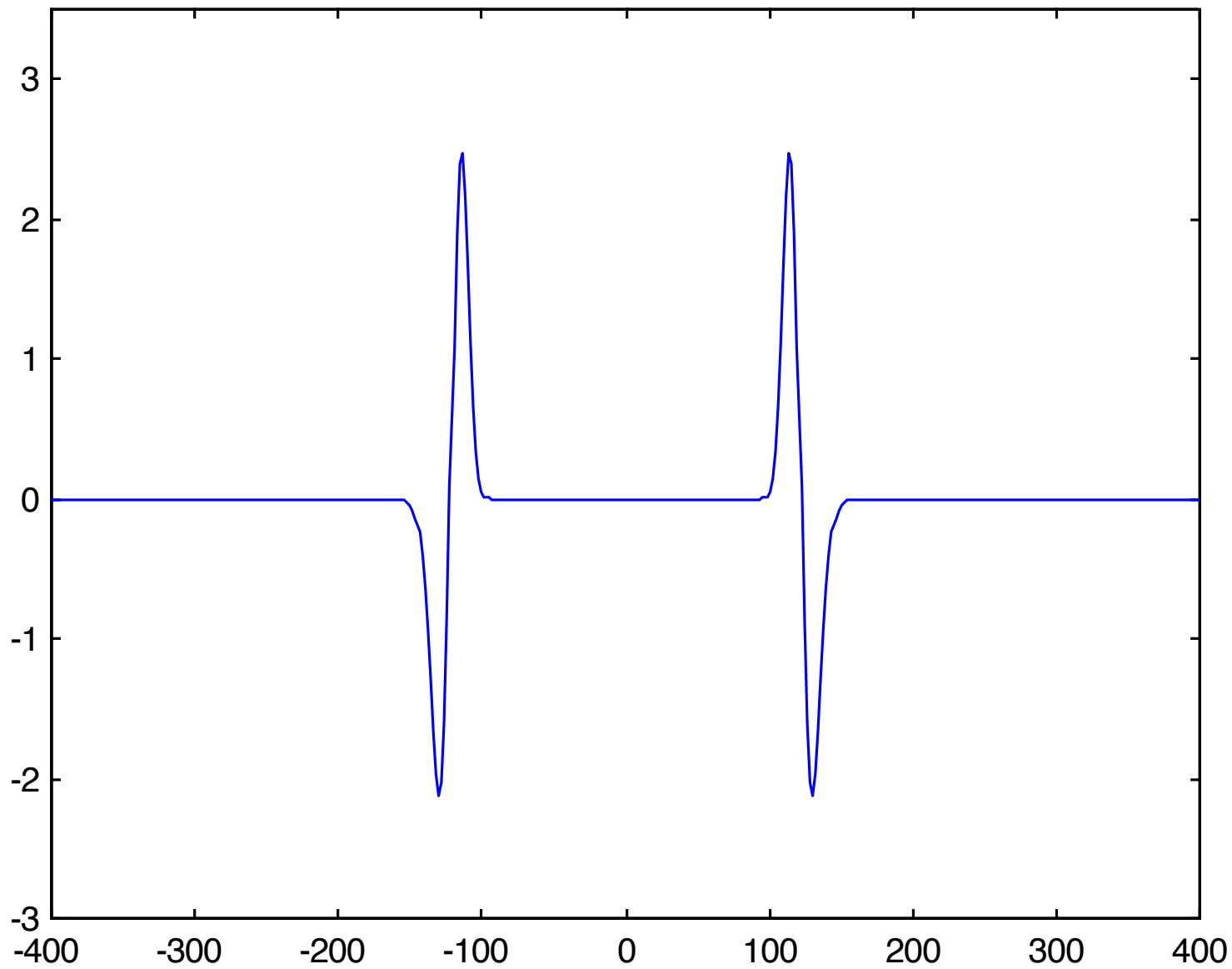


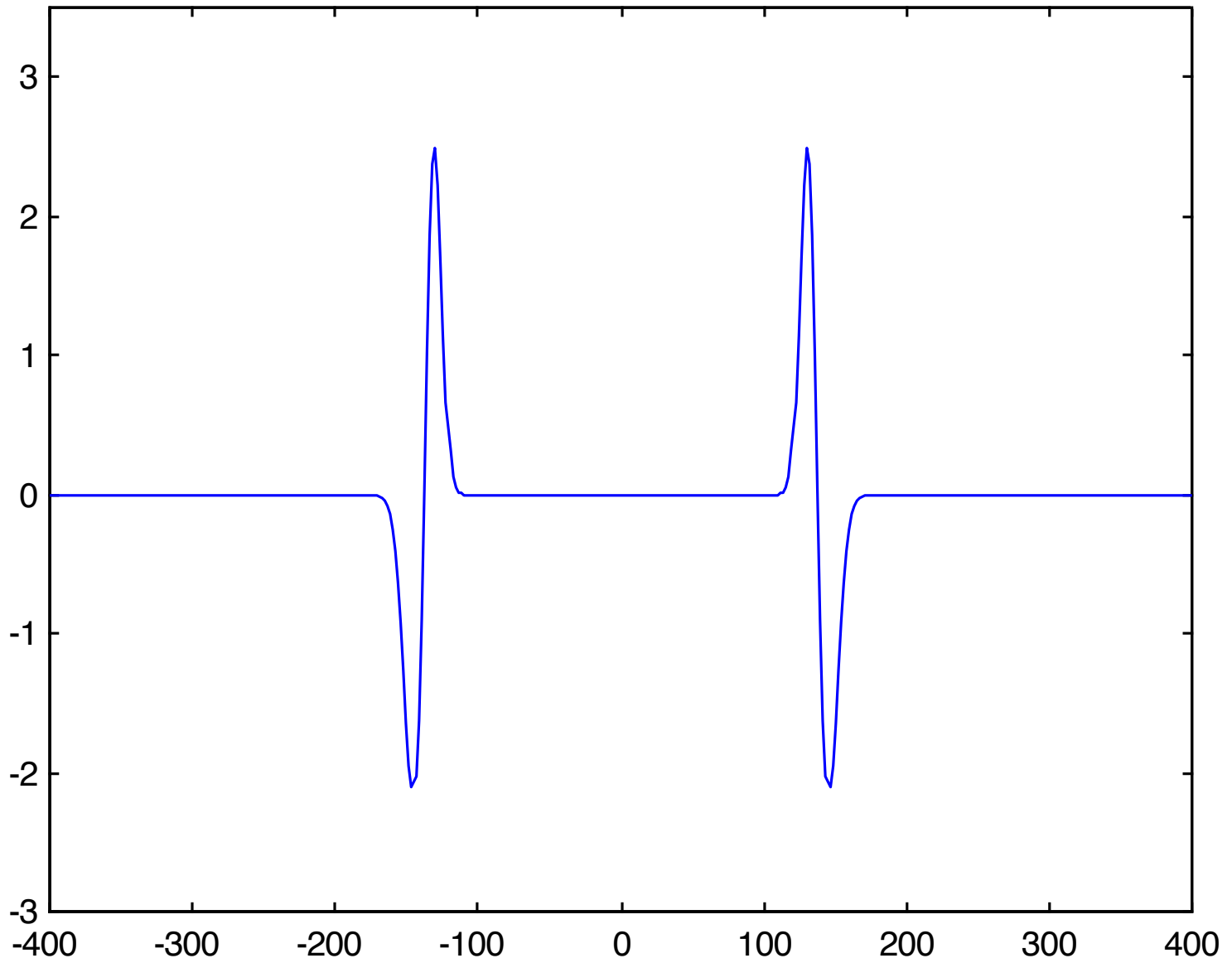


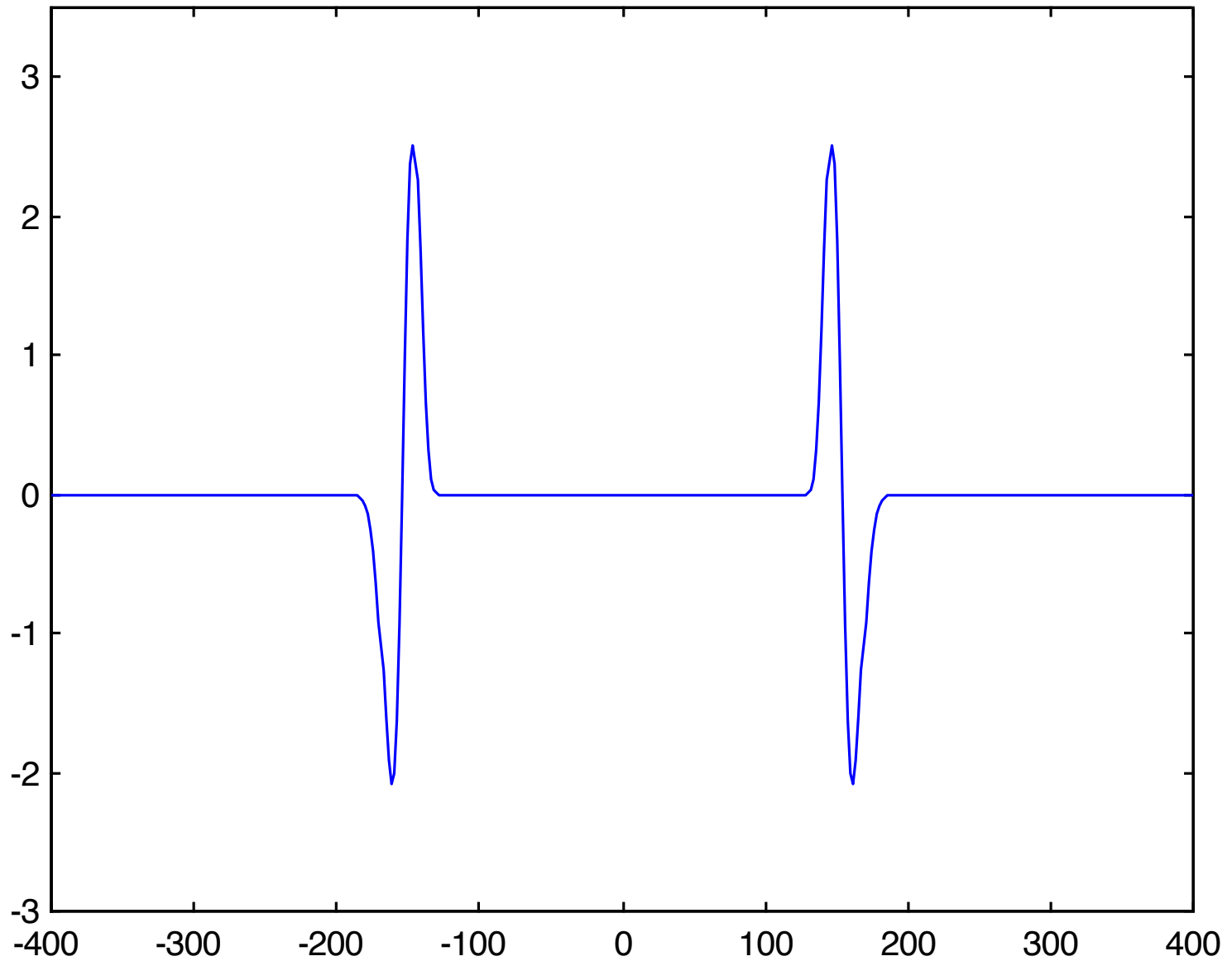




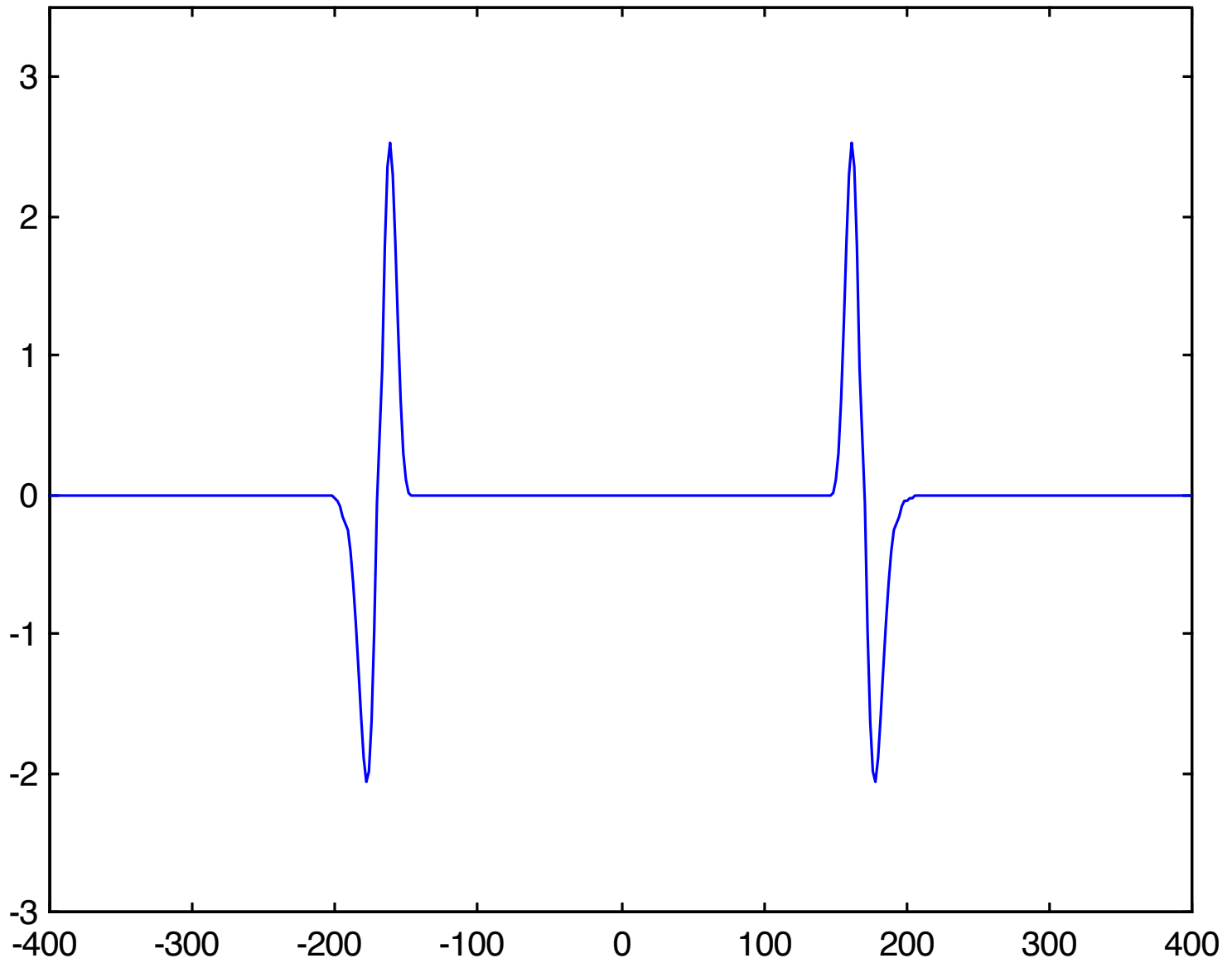


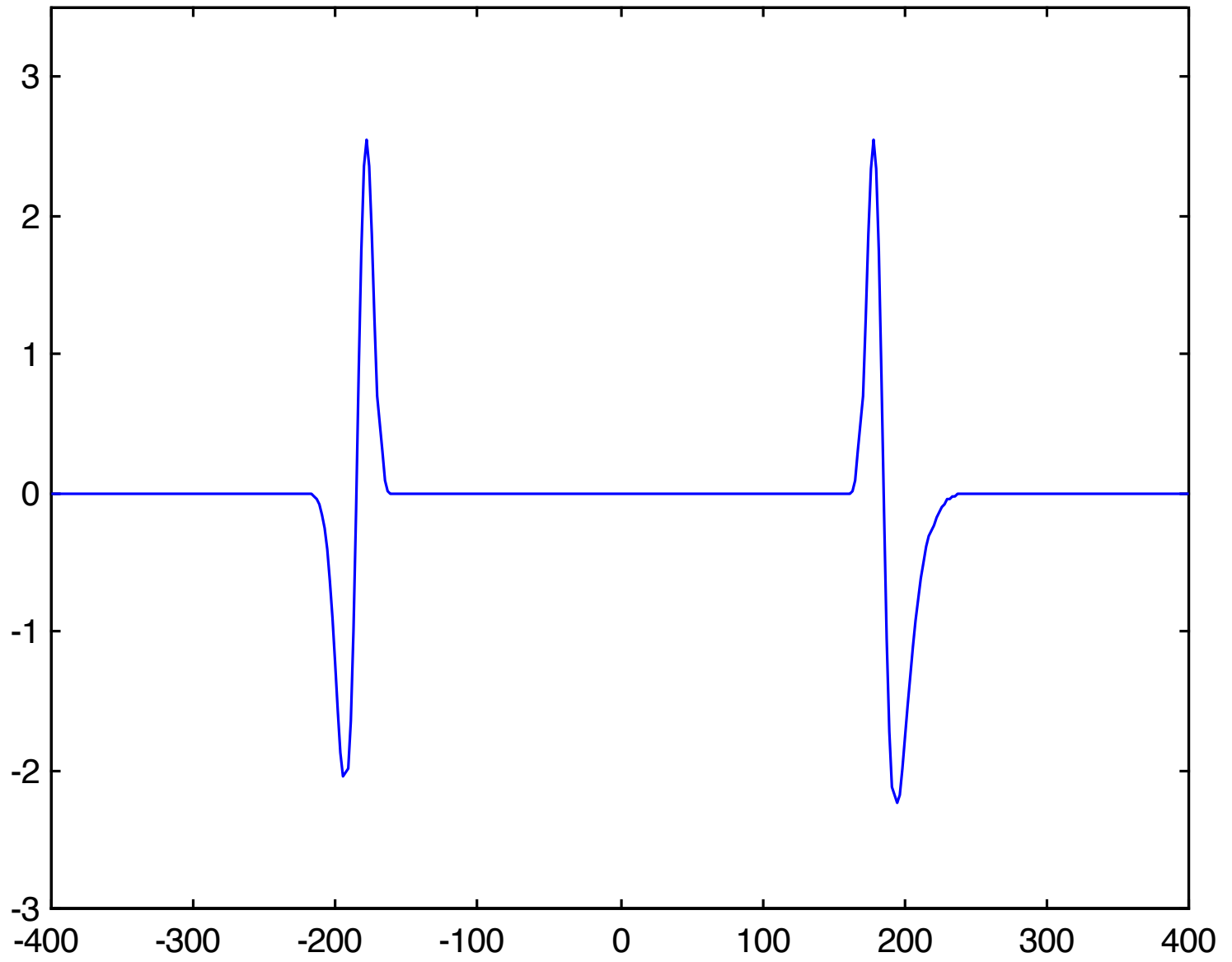


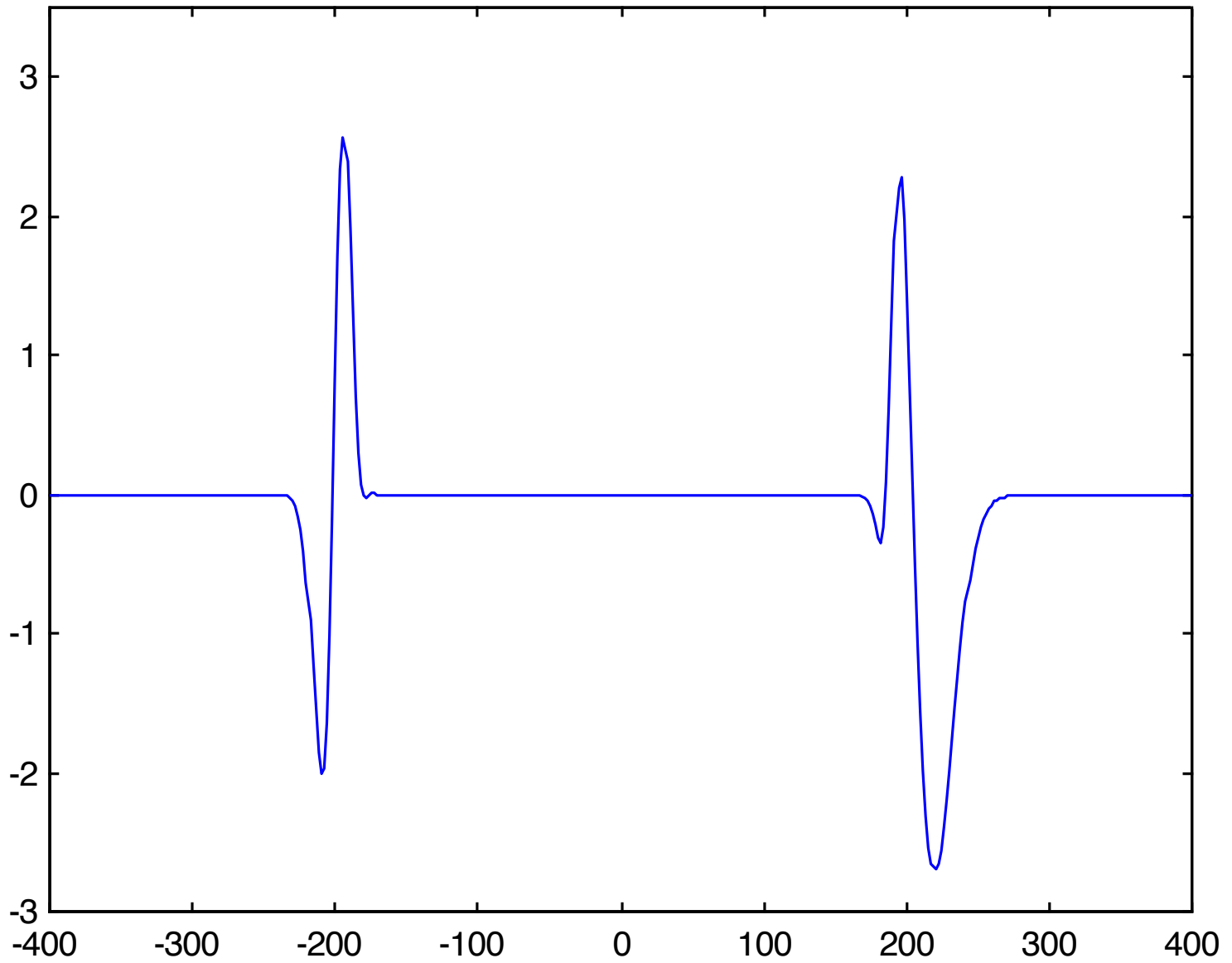


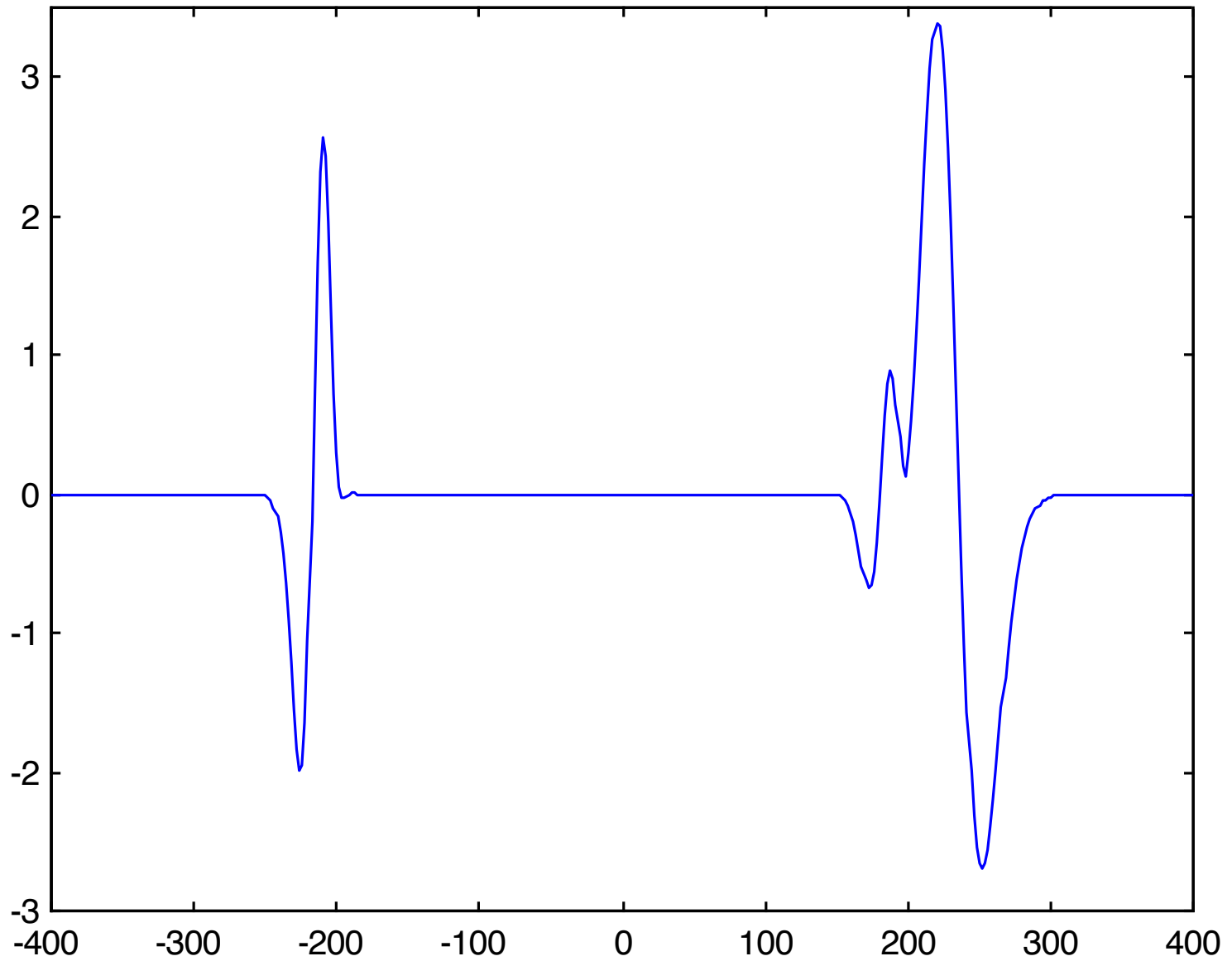


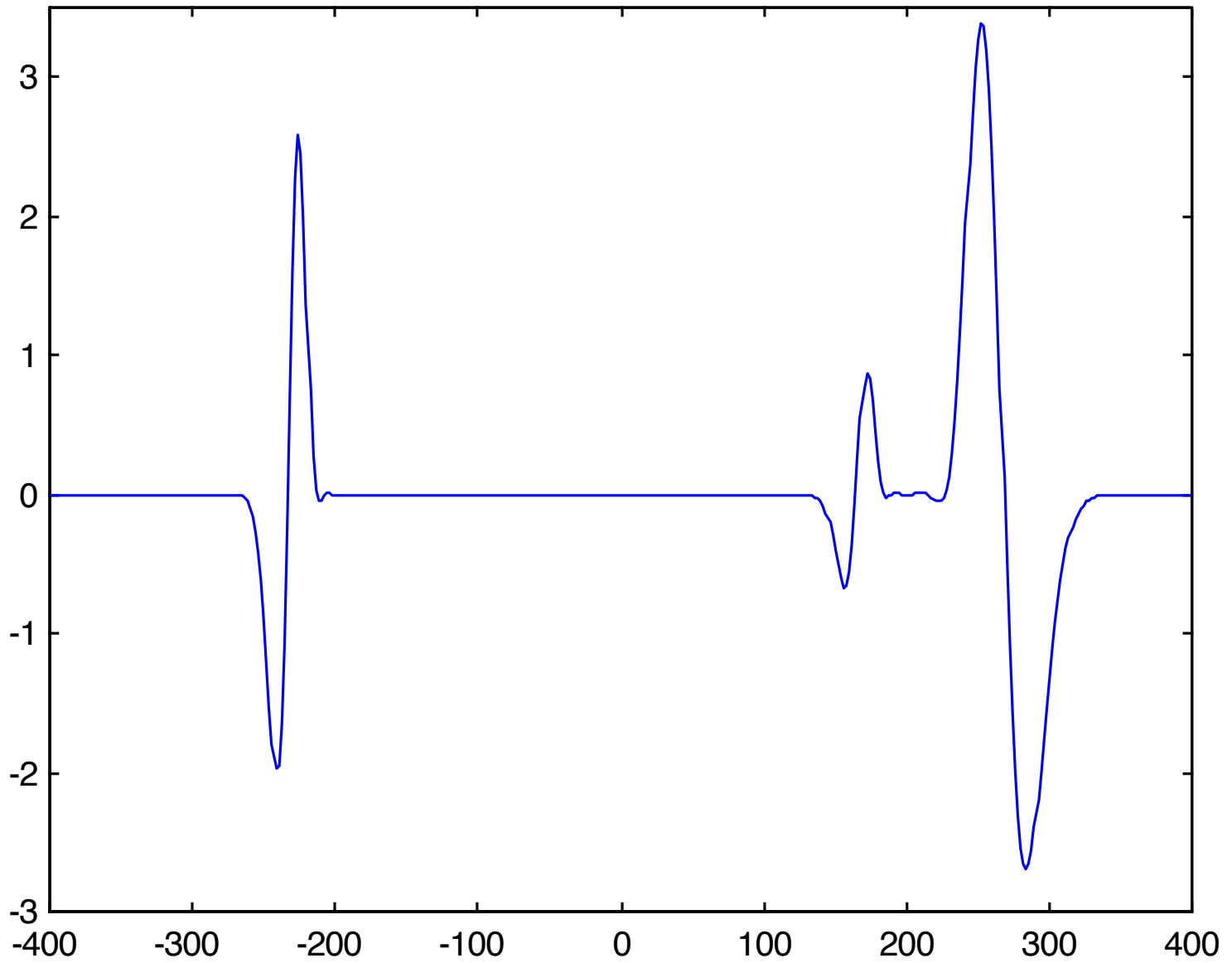


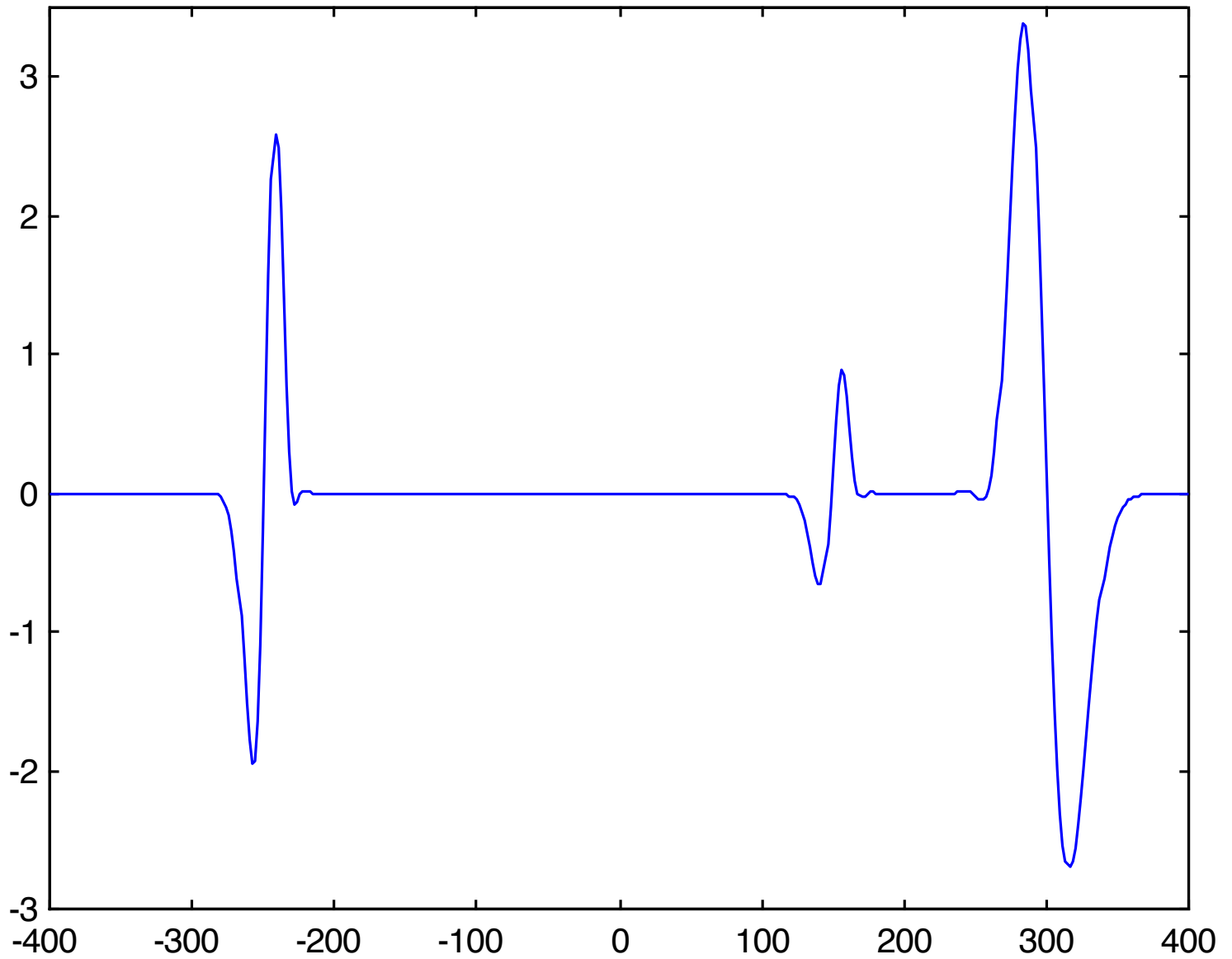


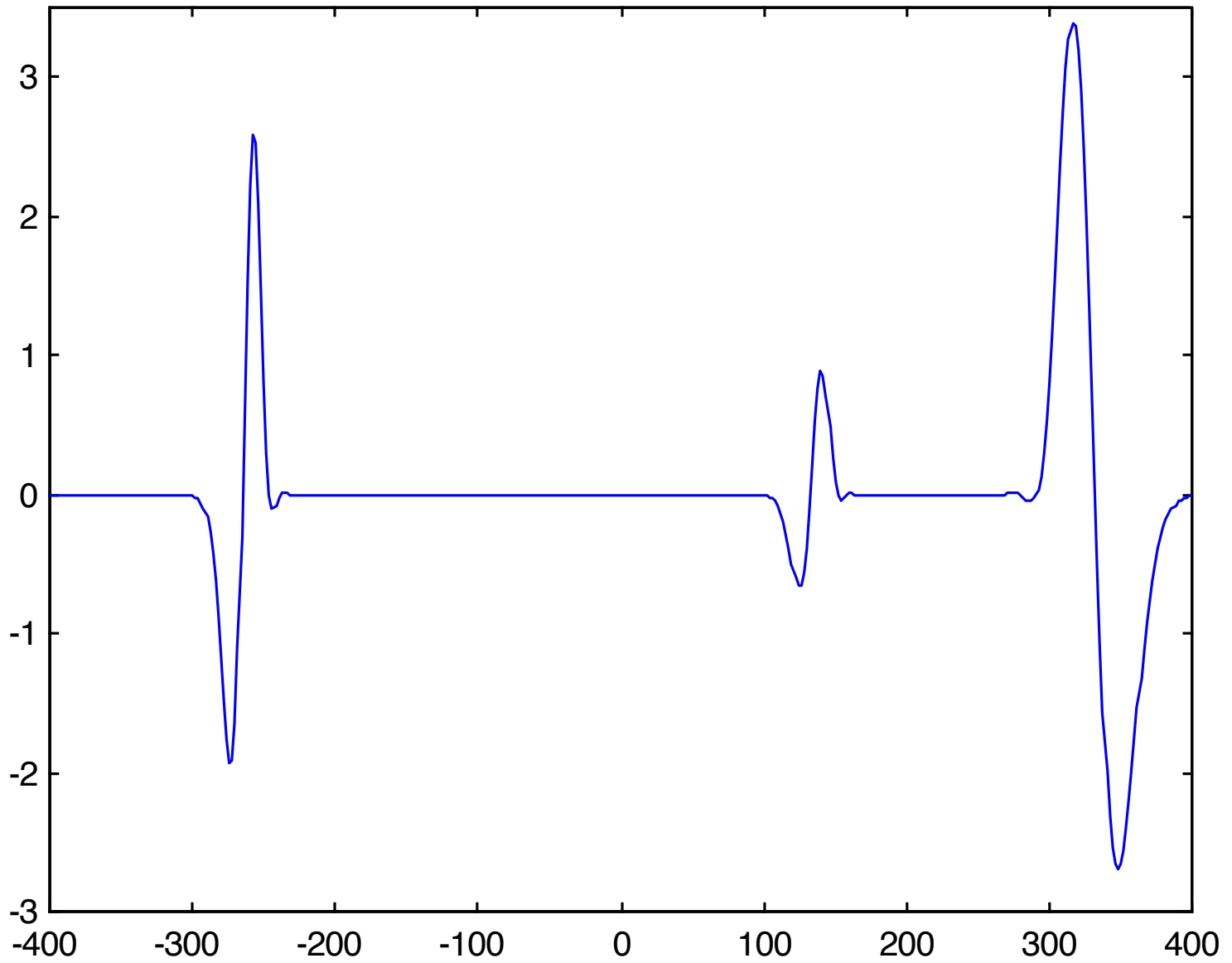


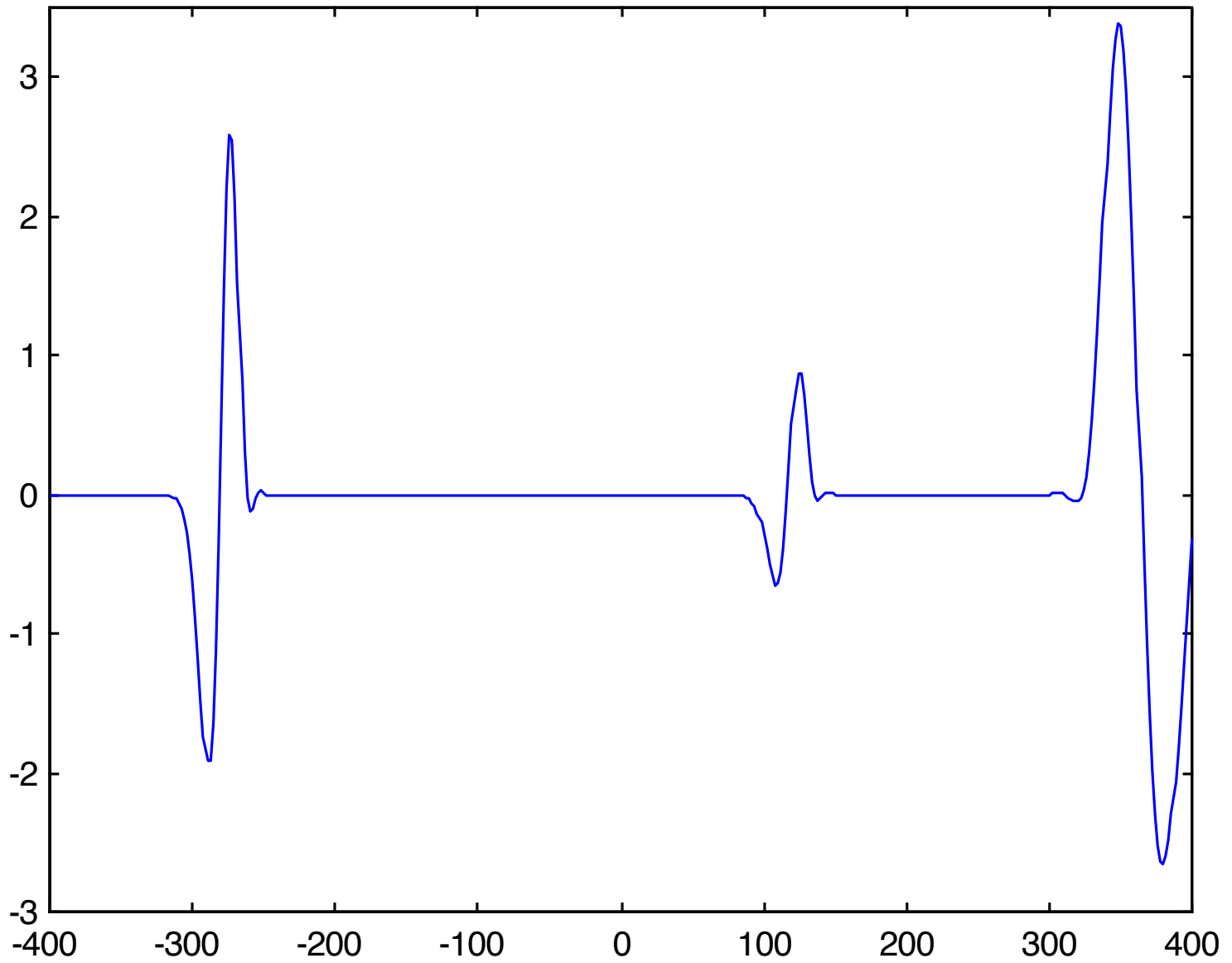




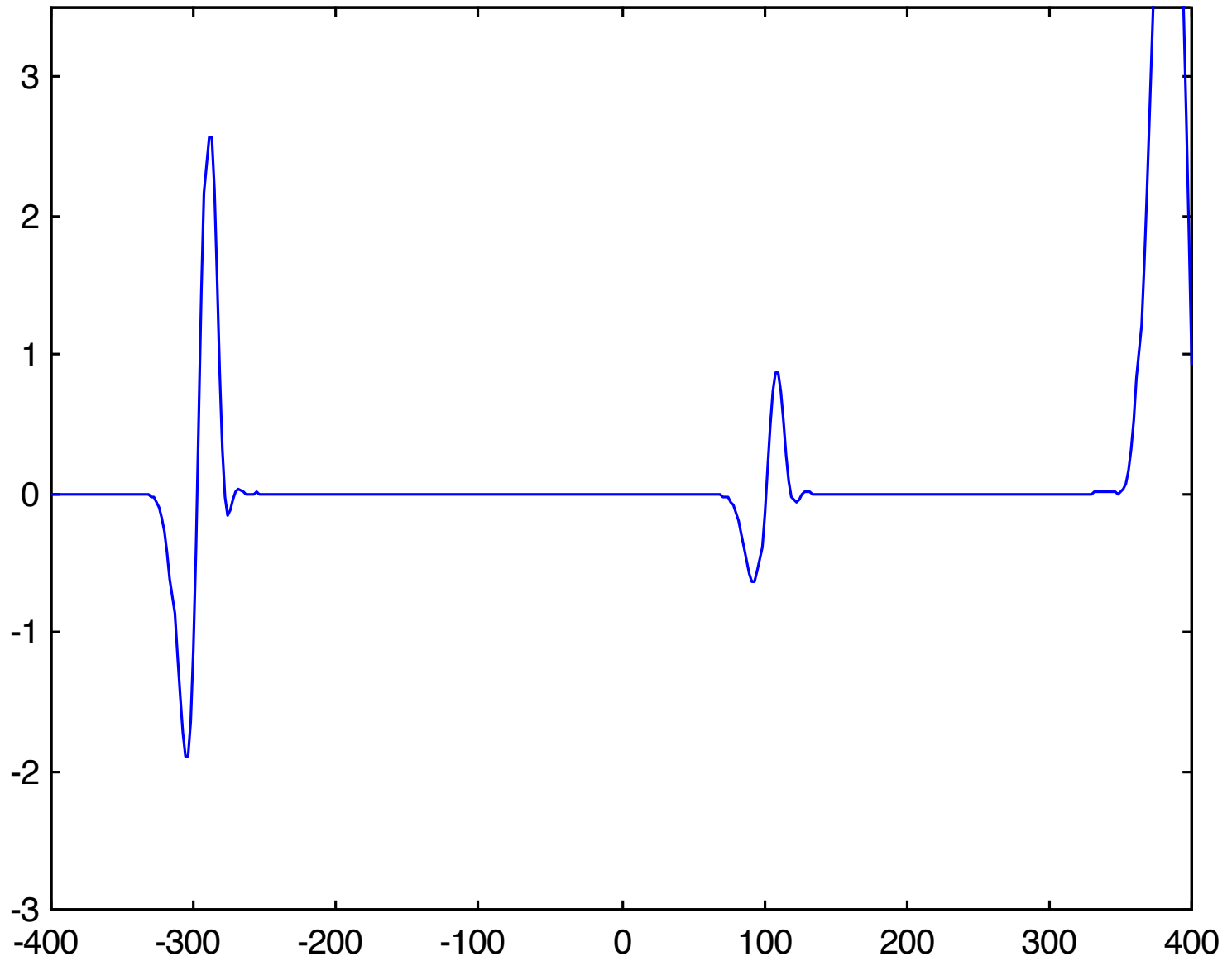




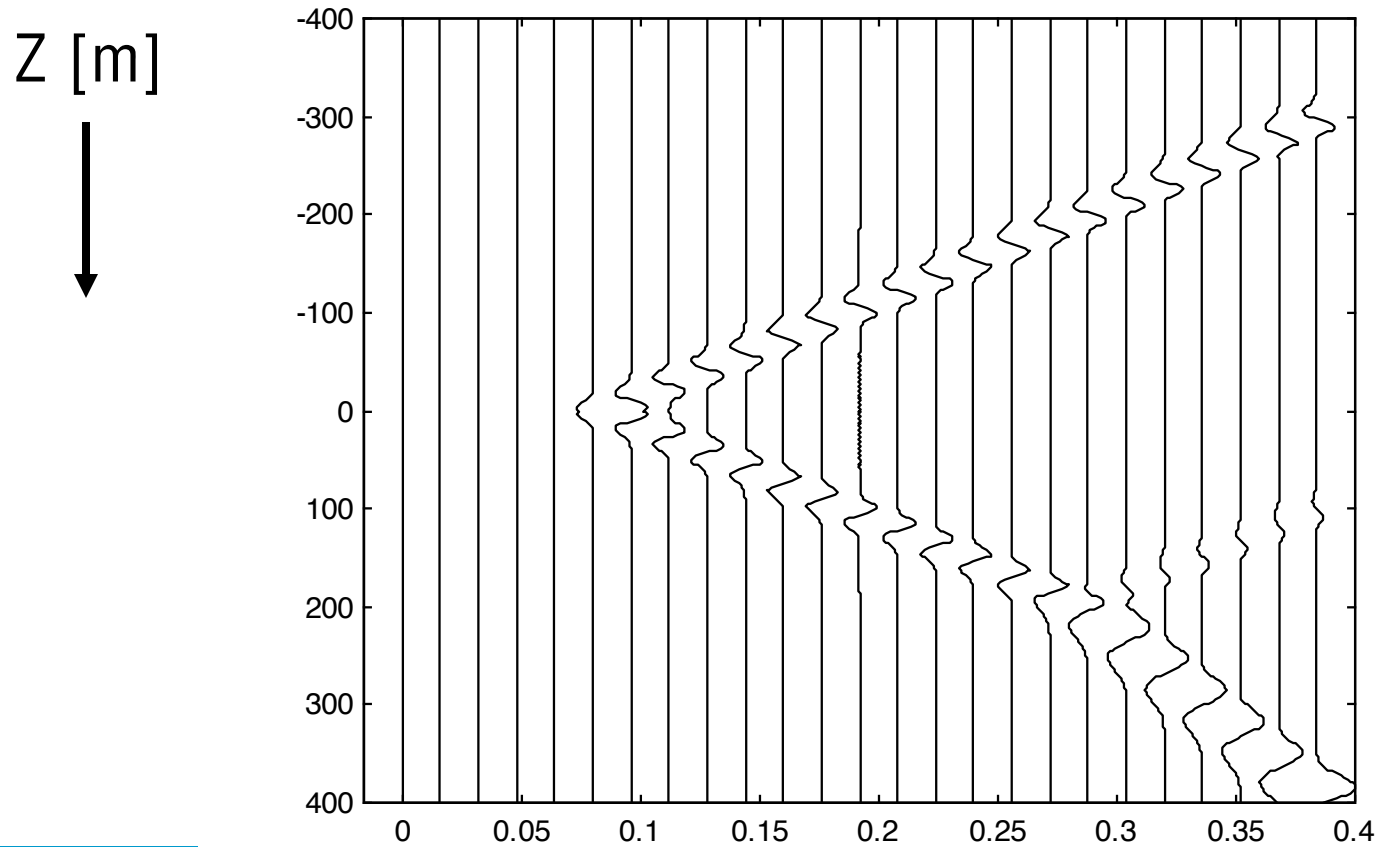




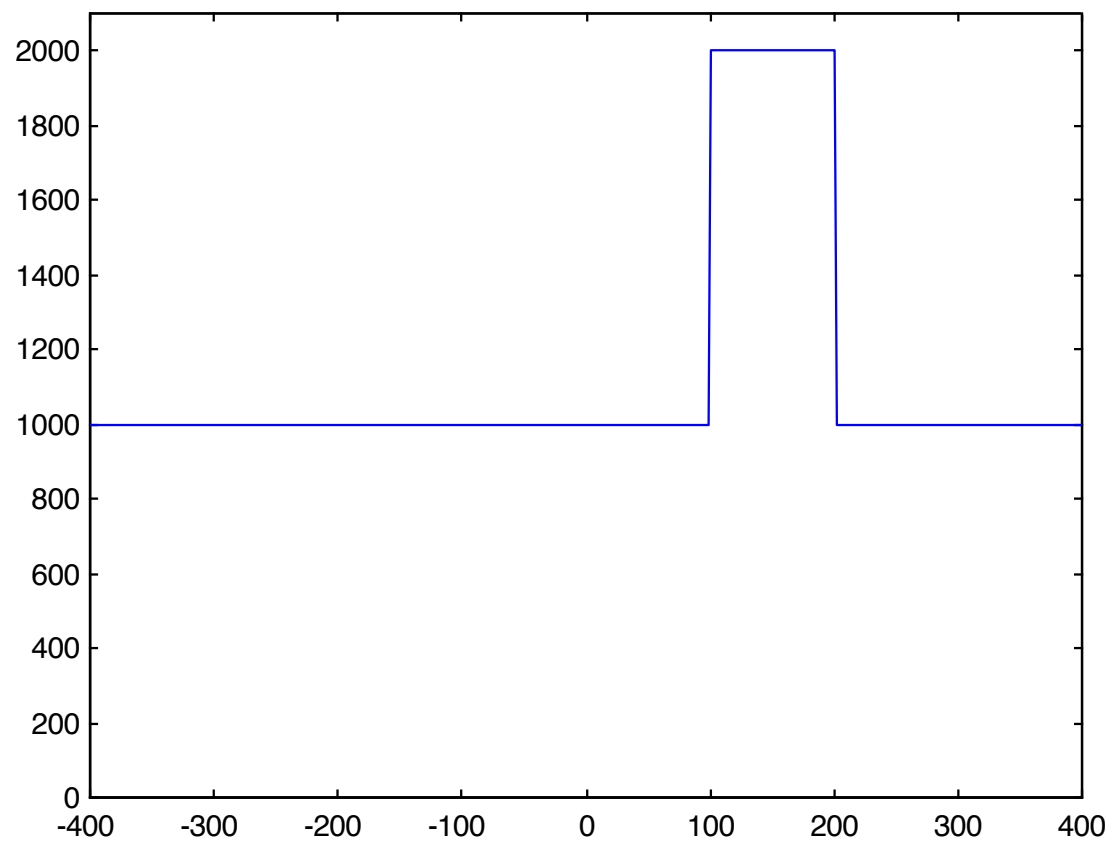




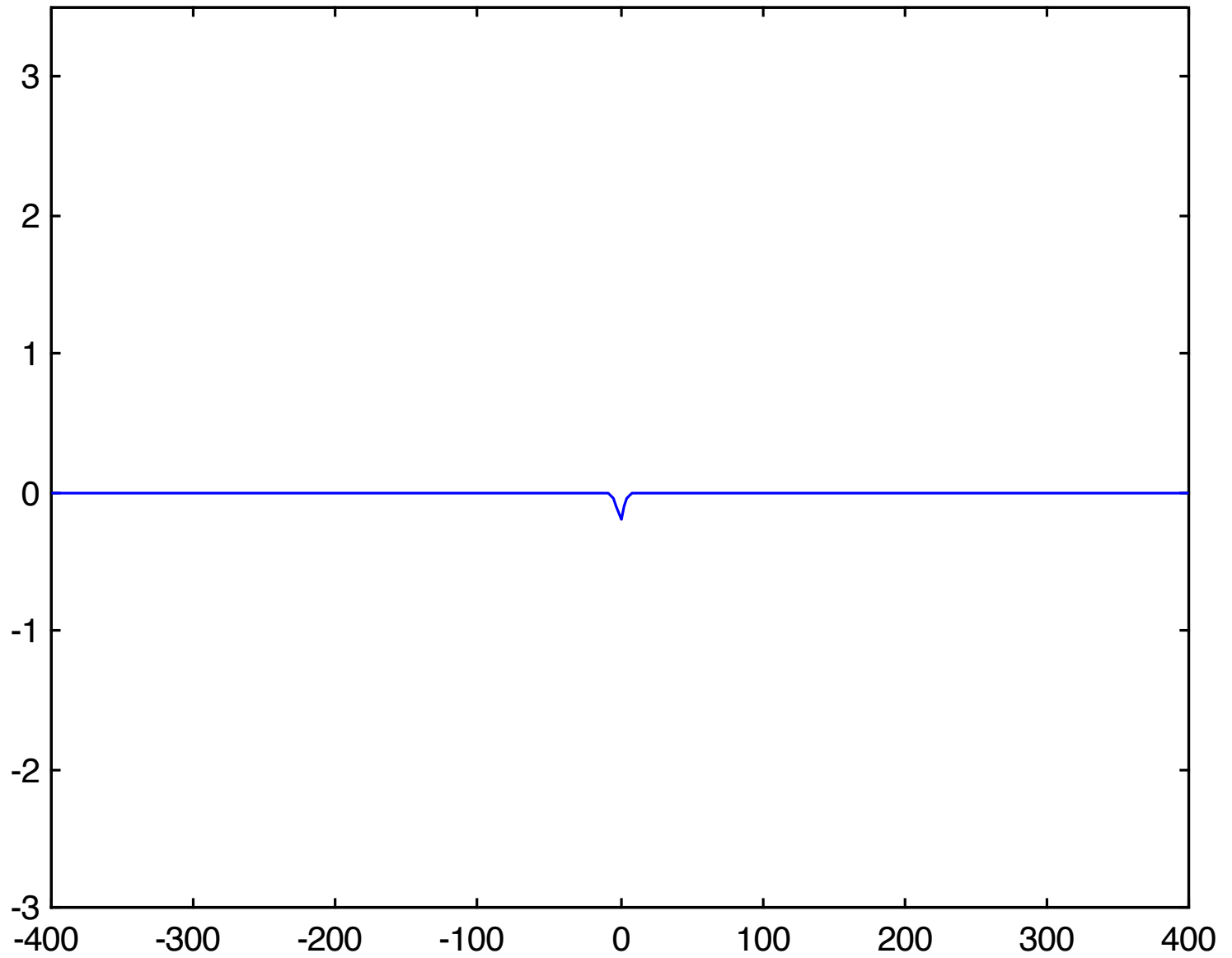
# Snapshots in (z,t)

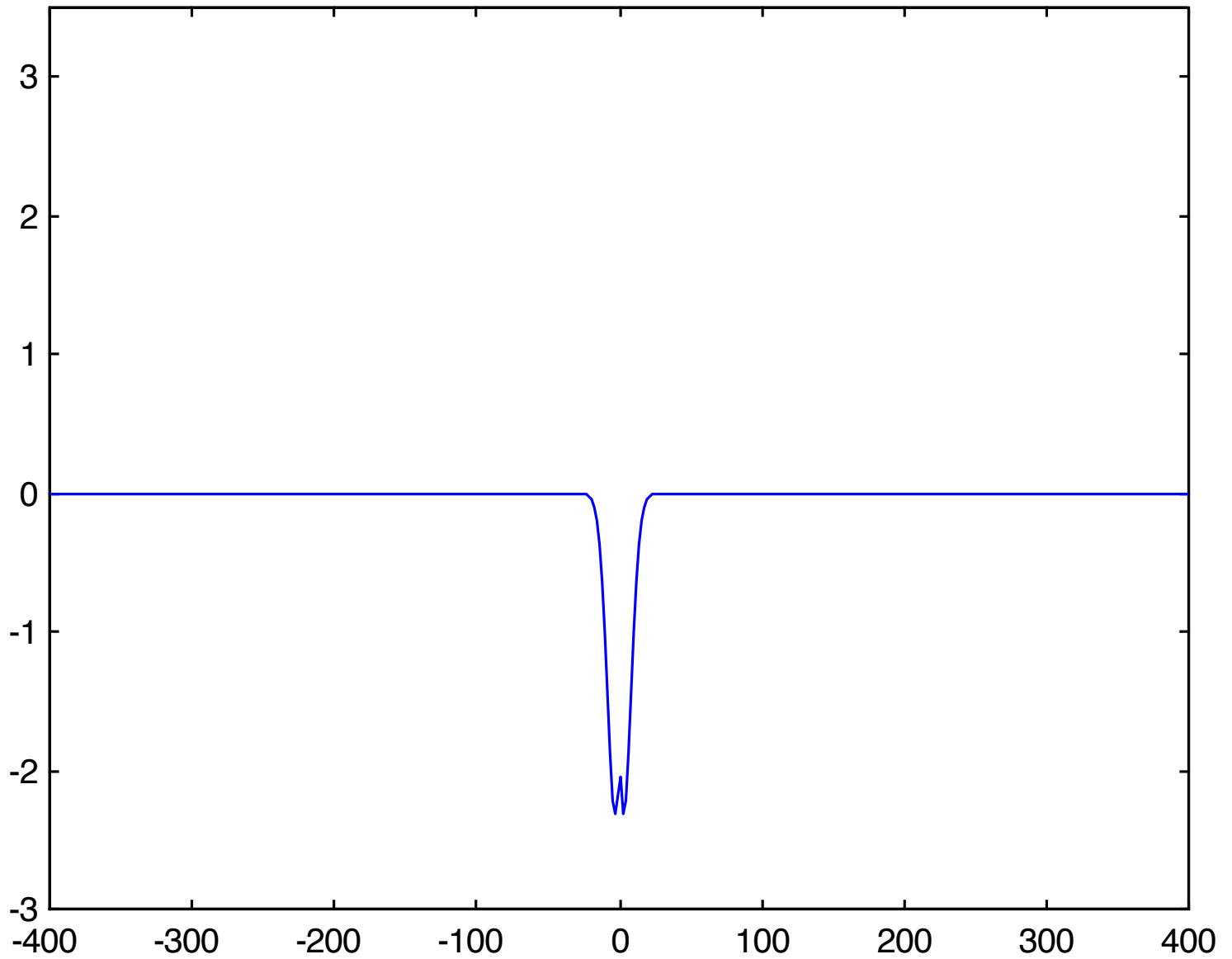


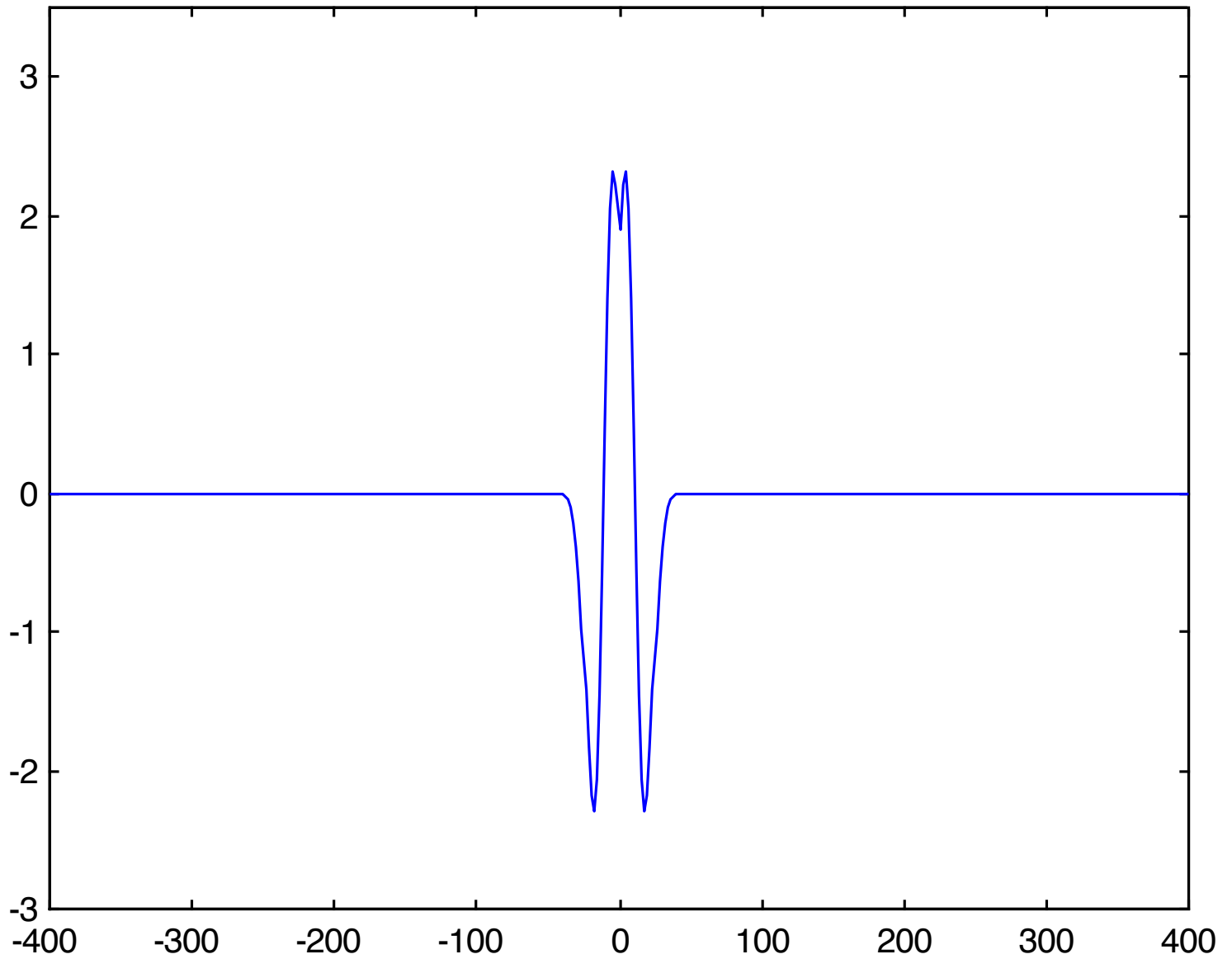
C [m/s]

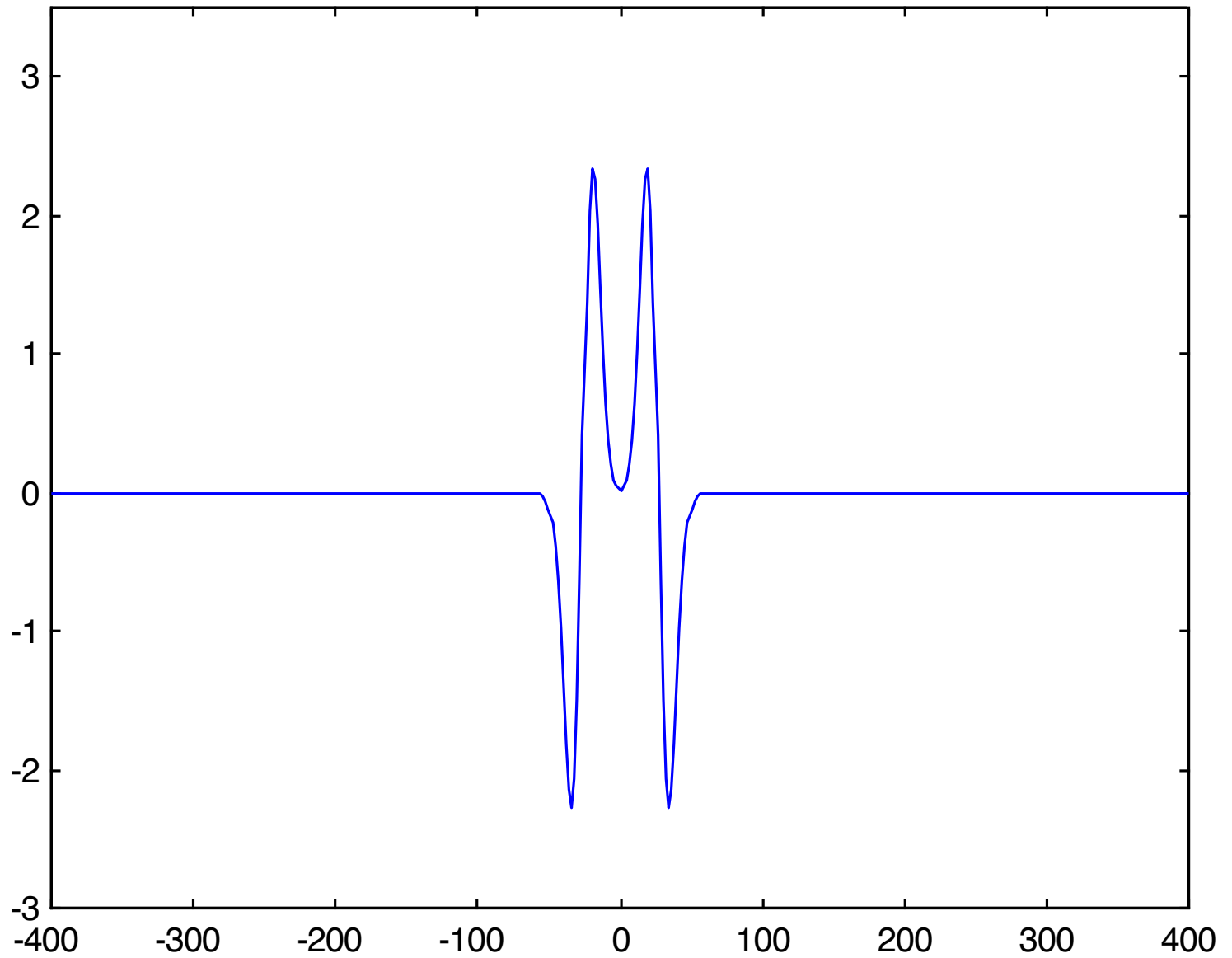


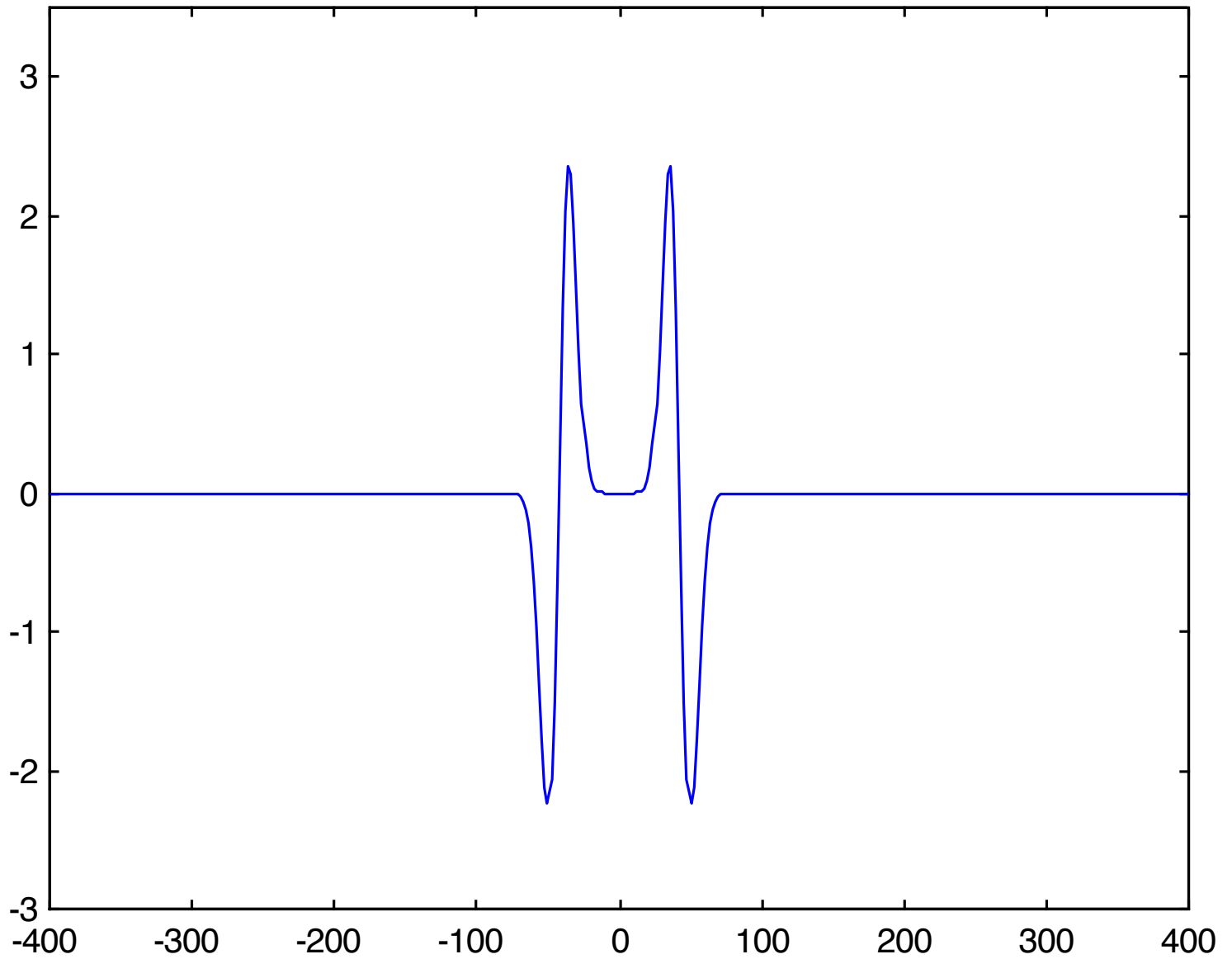
Z [m]



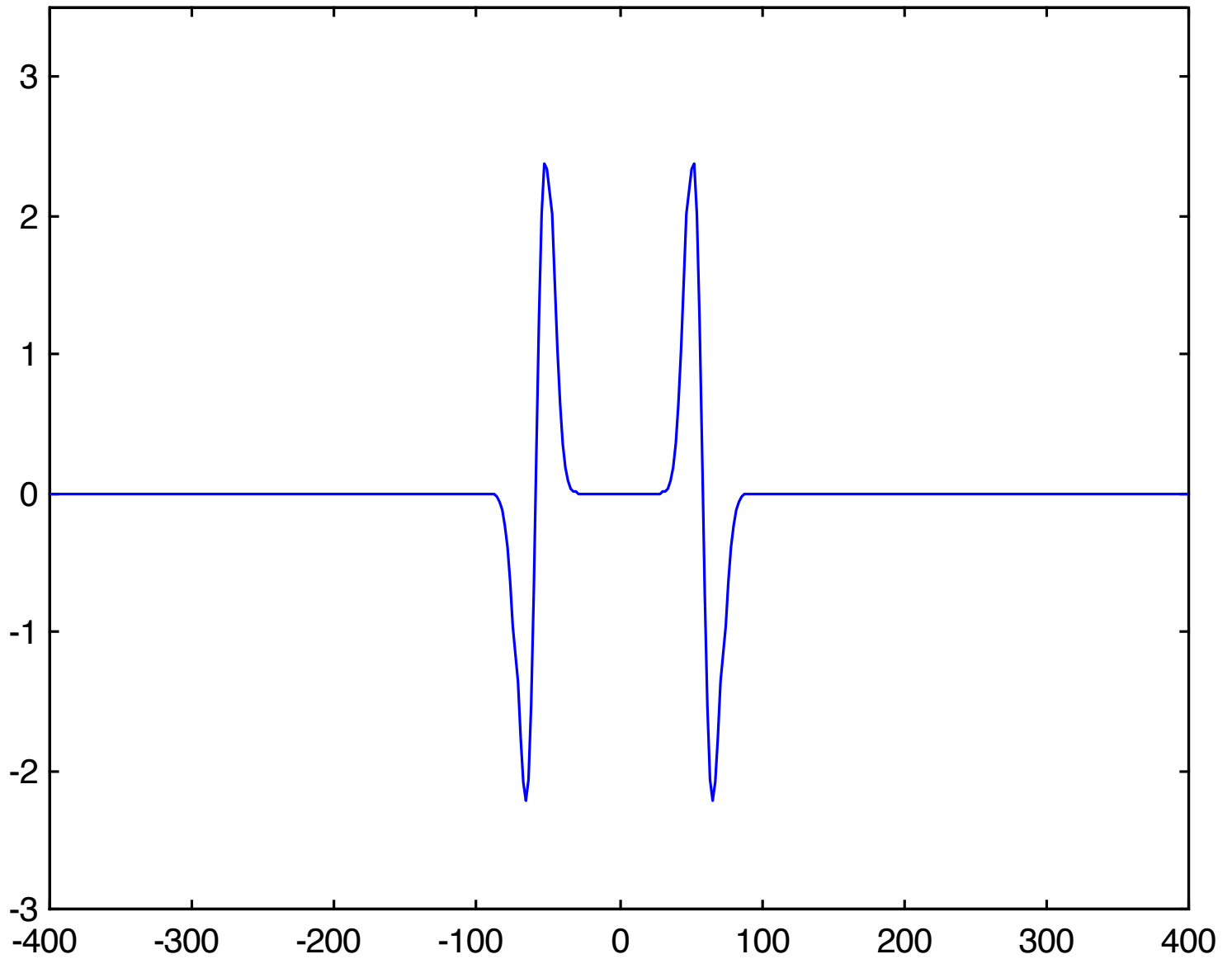


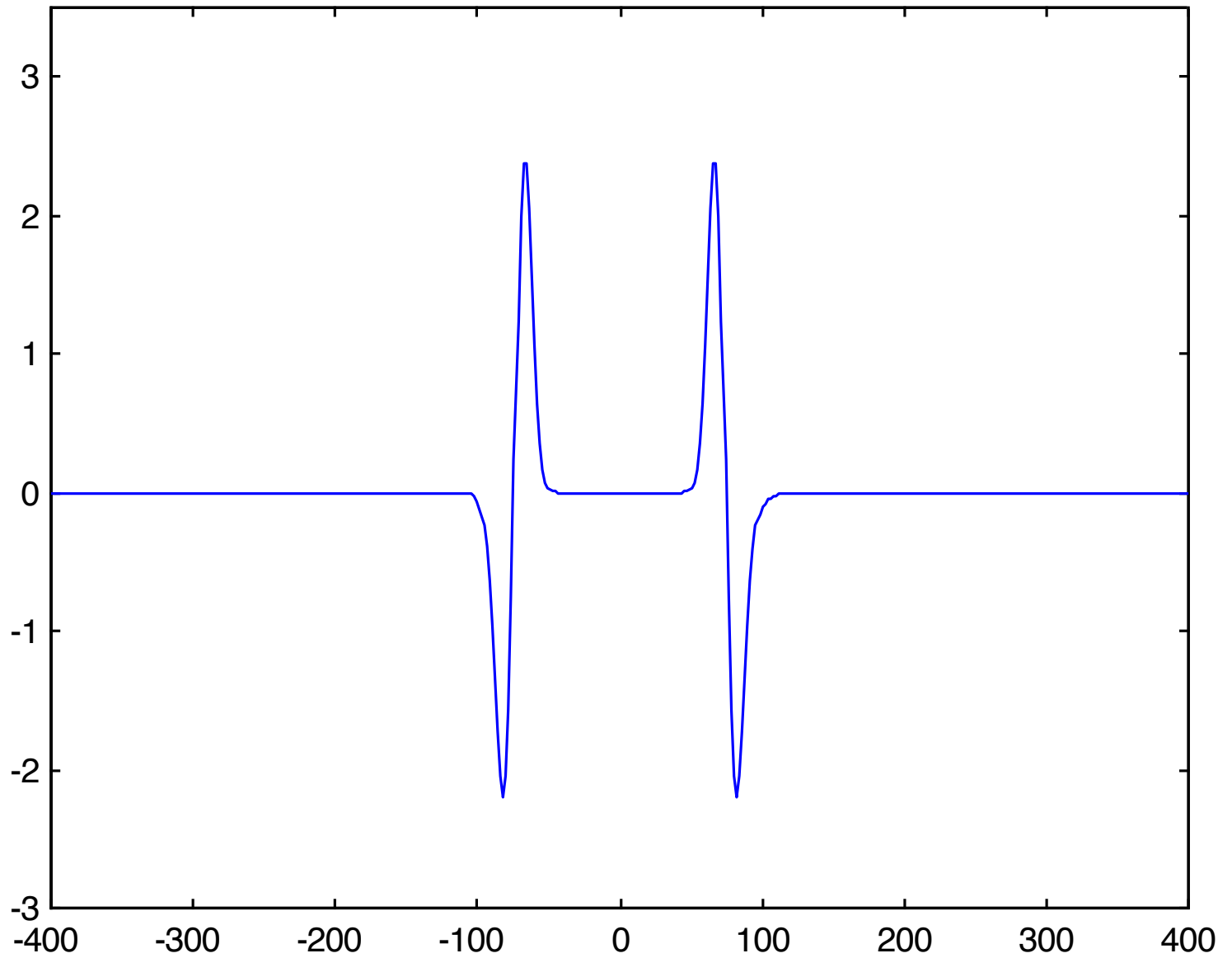


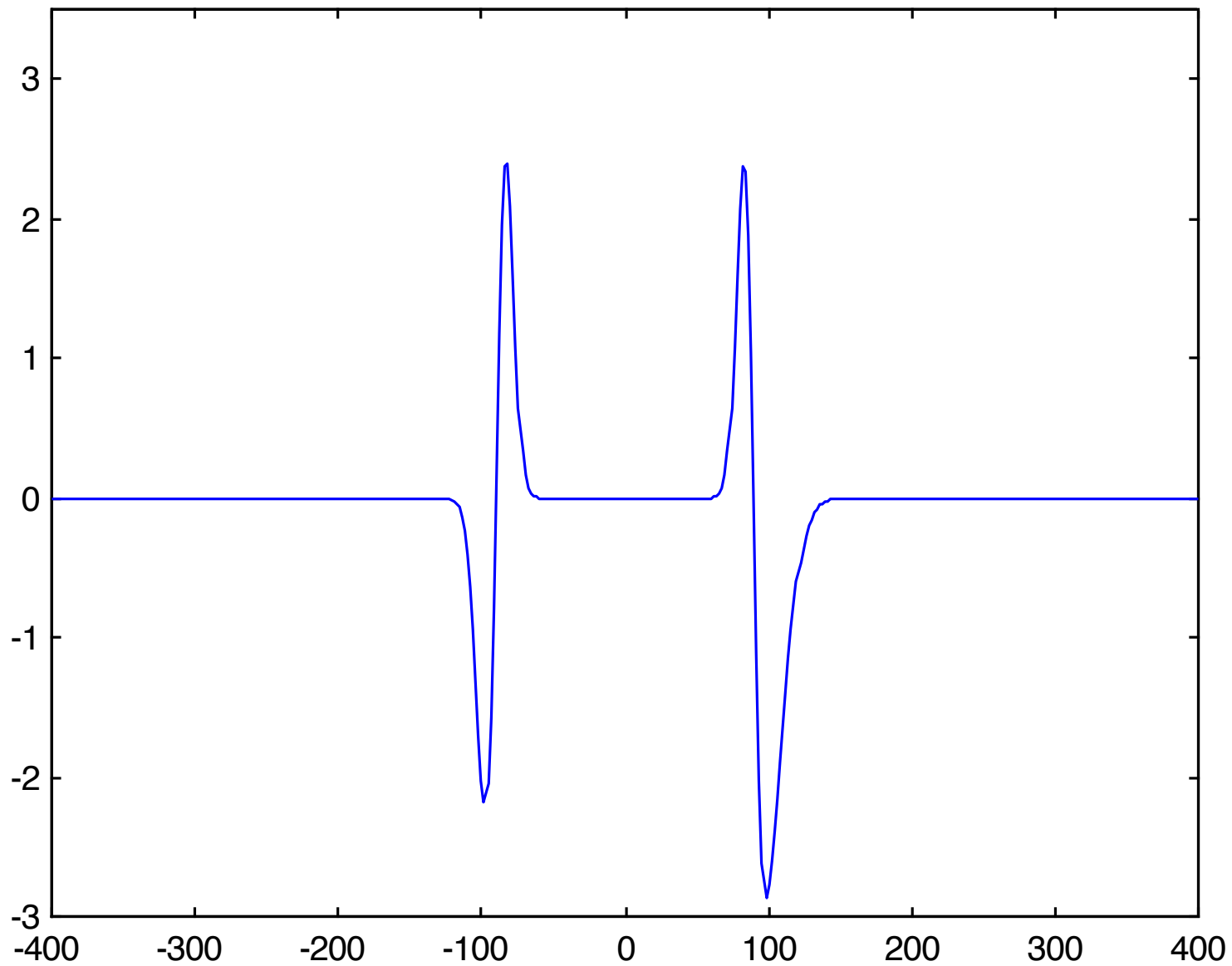


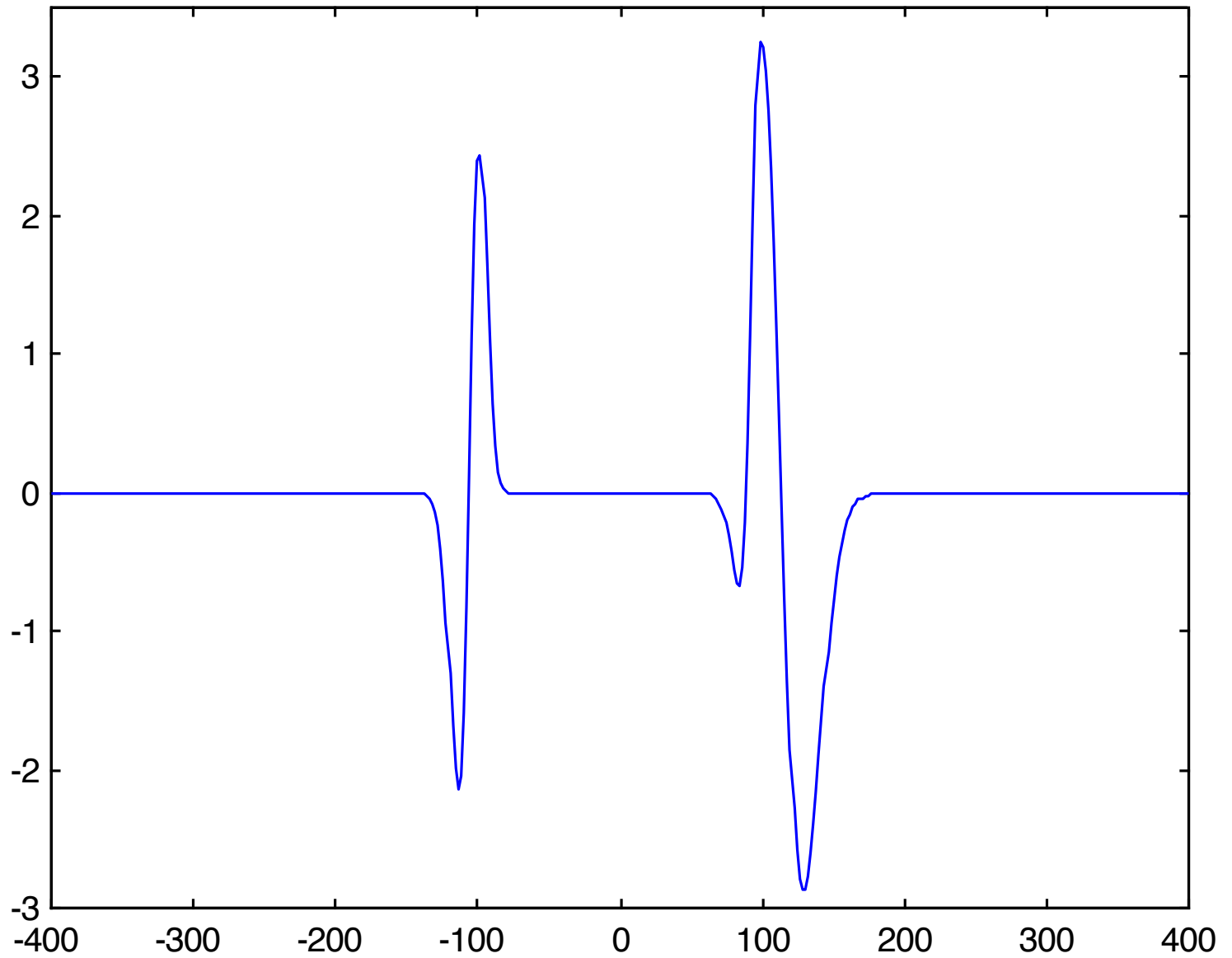


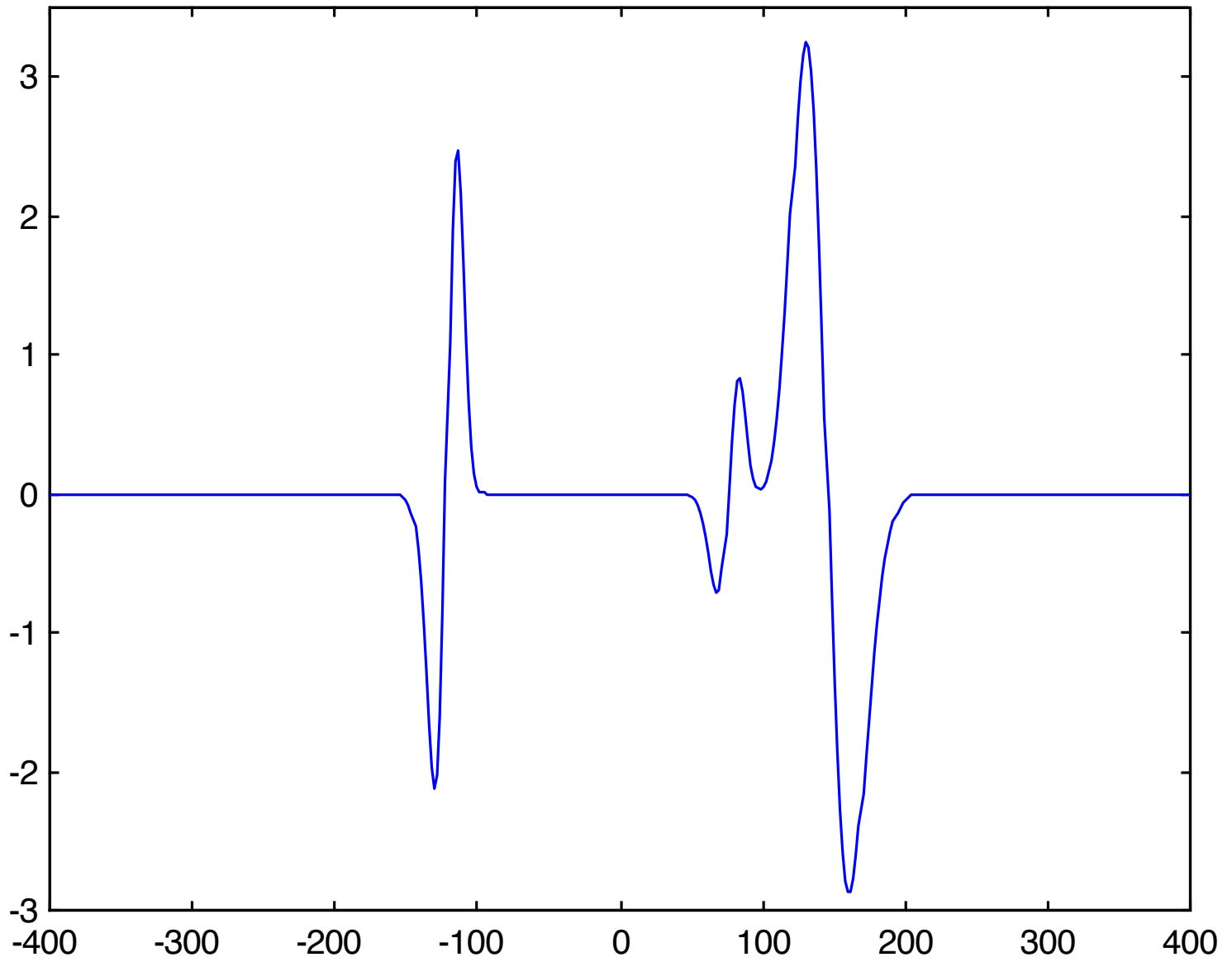


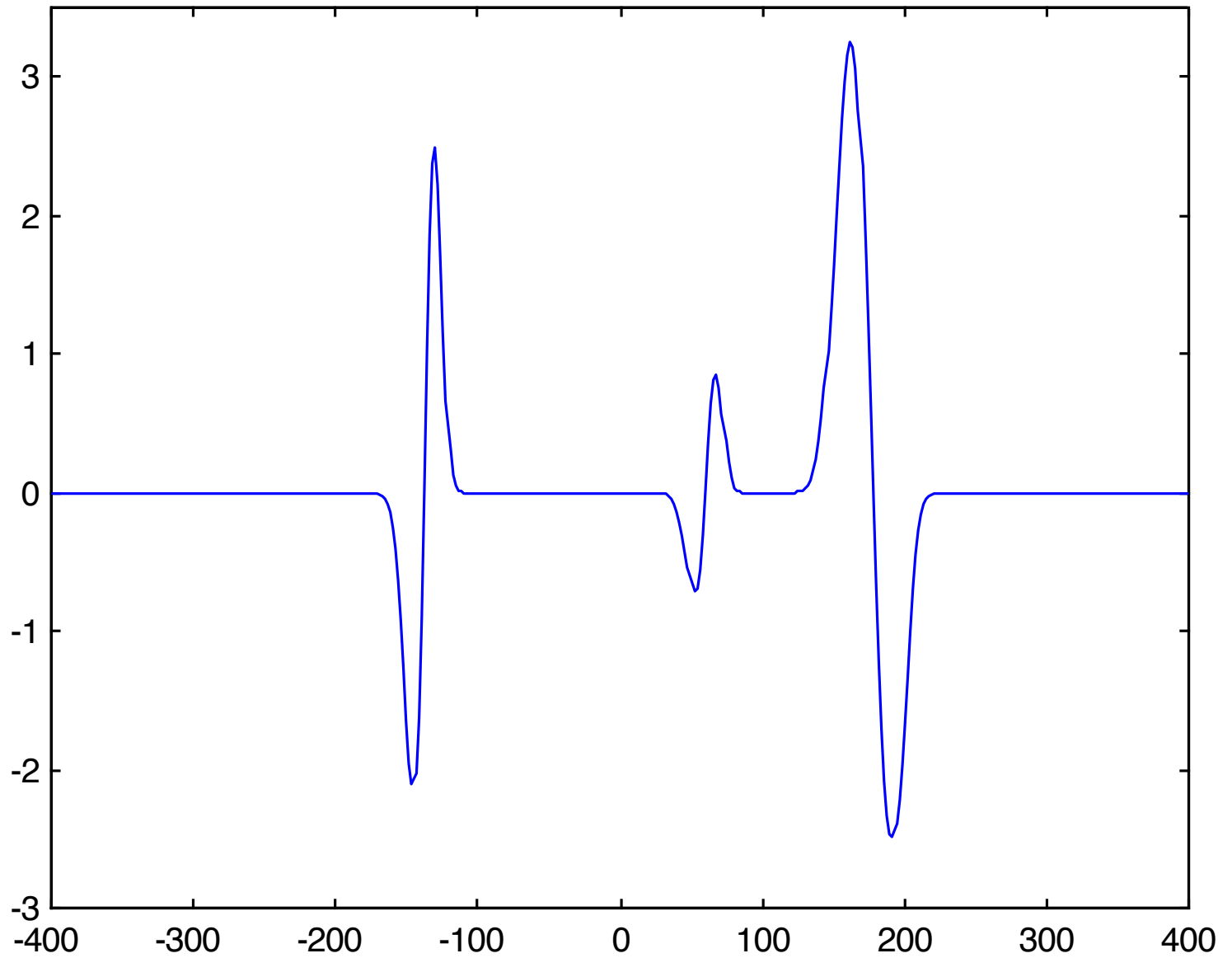


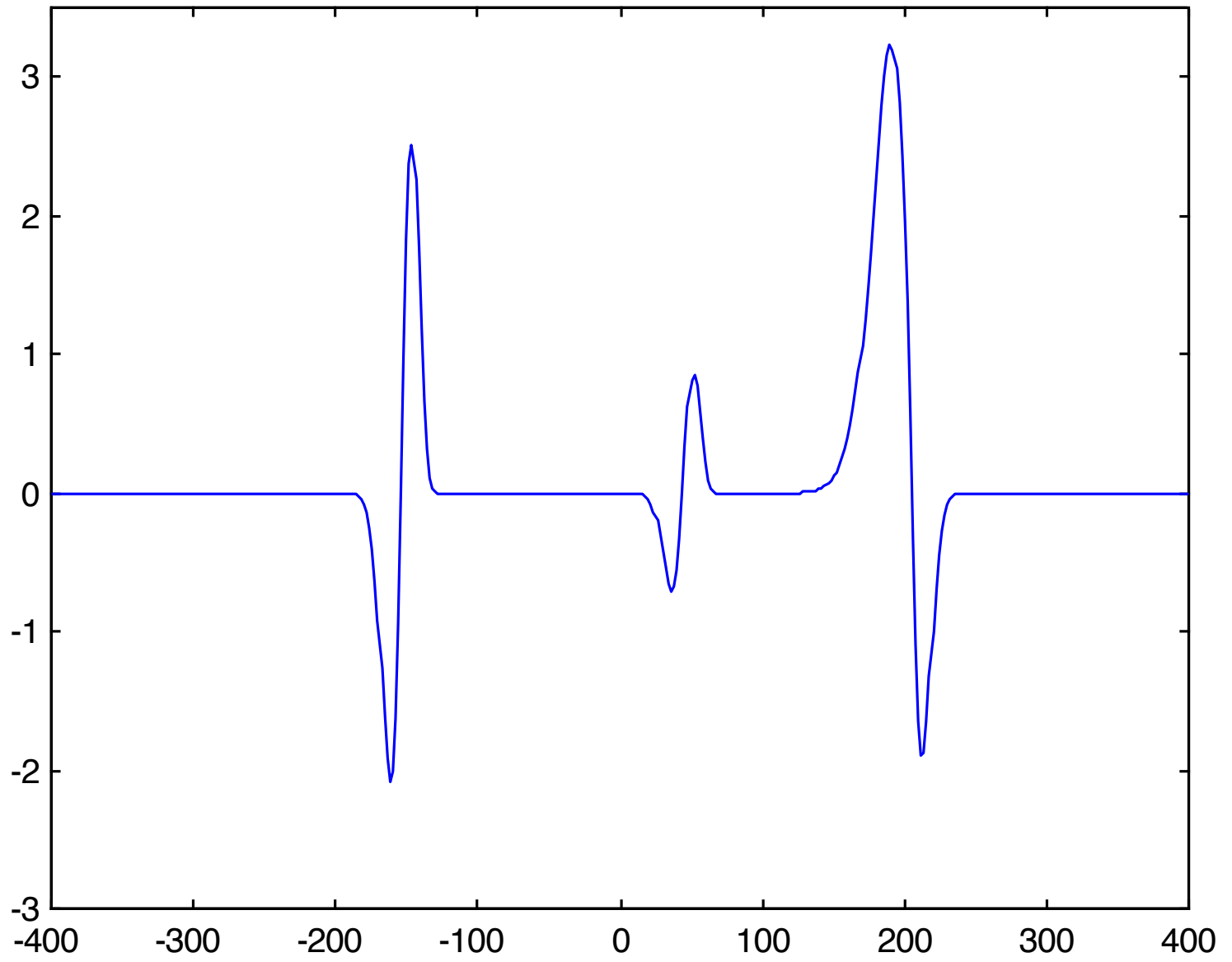


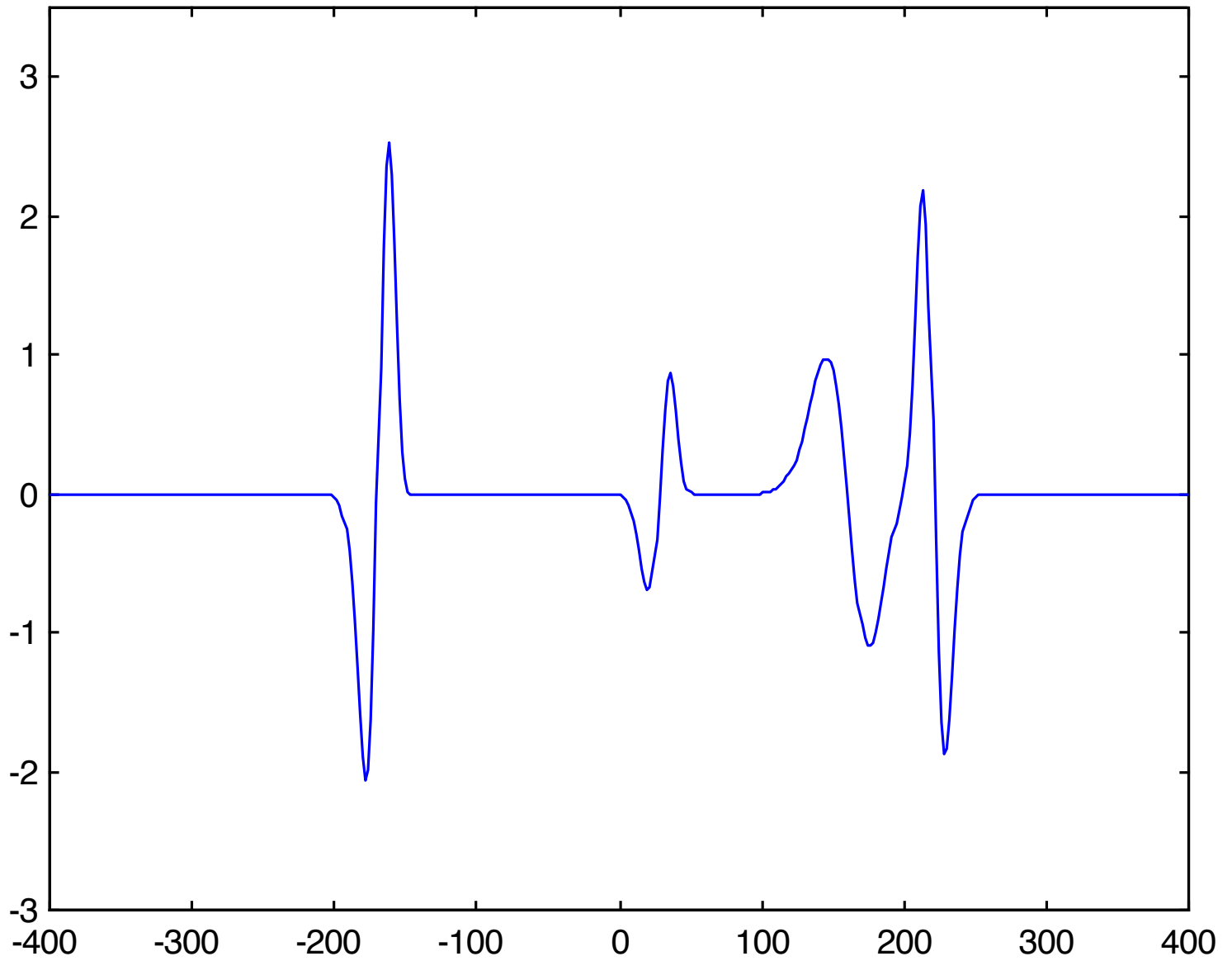




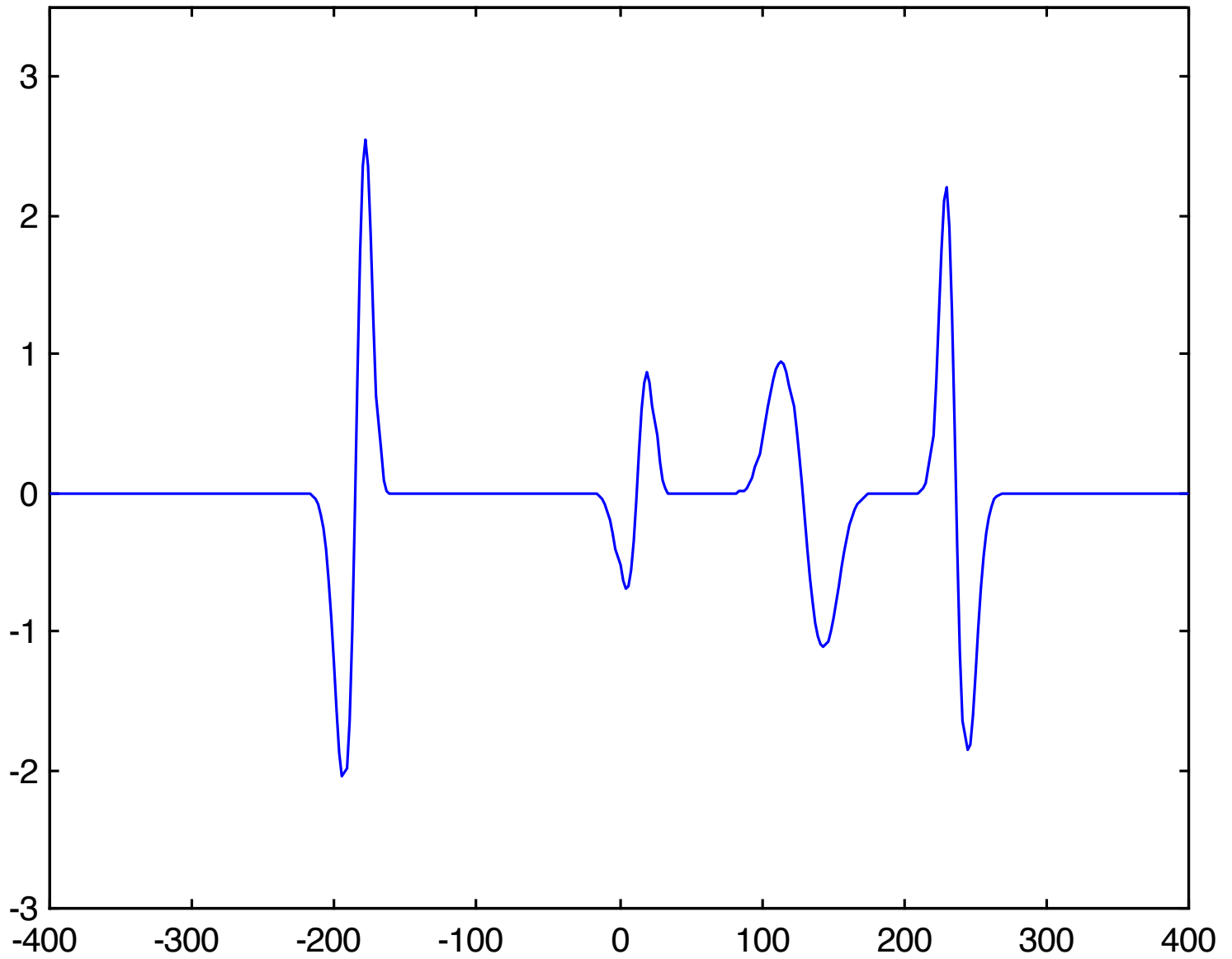


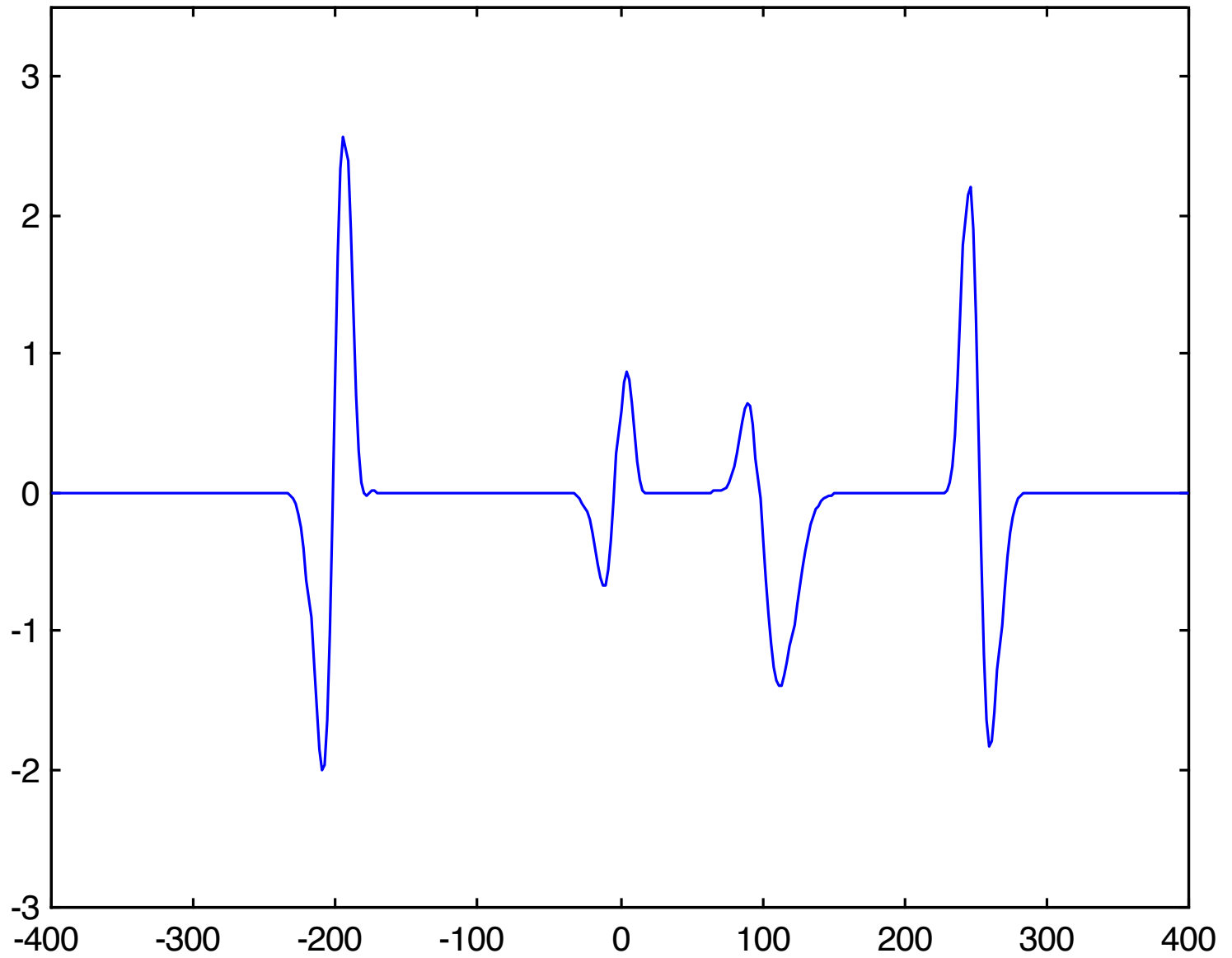


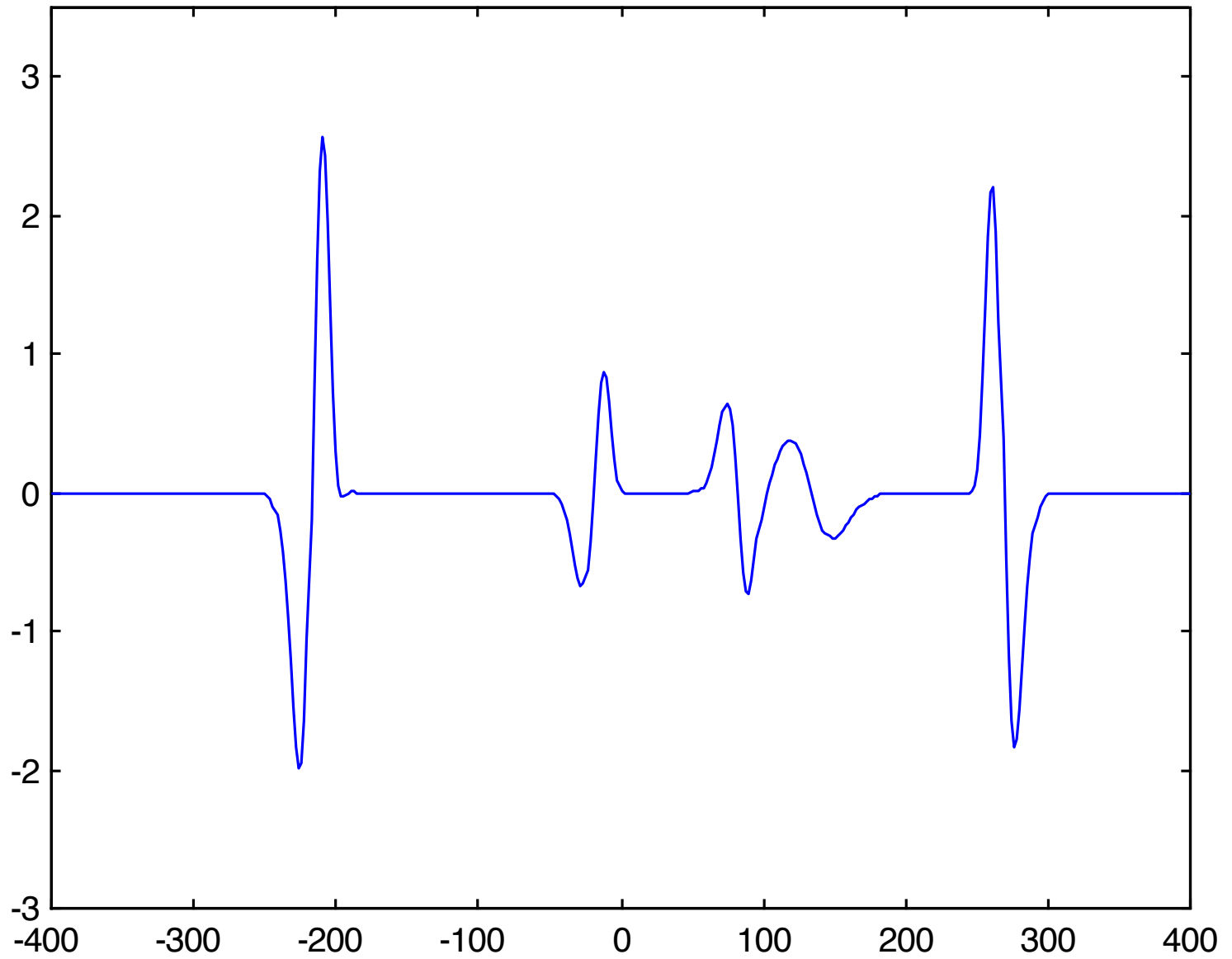


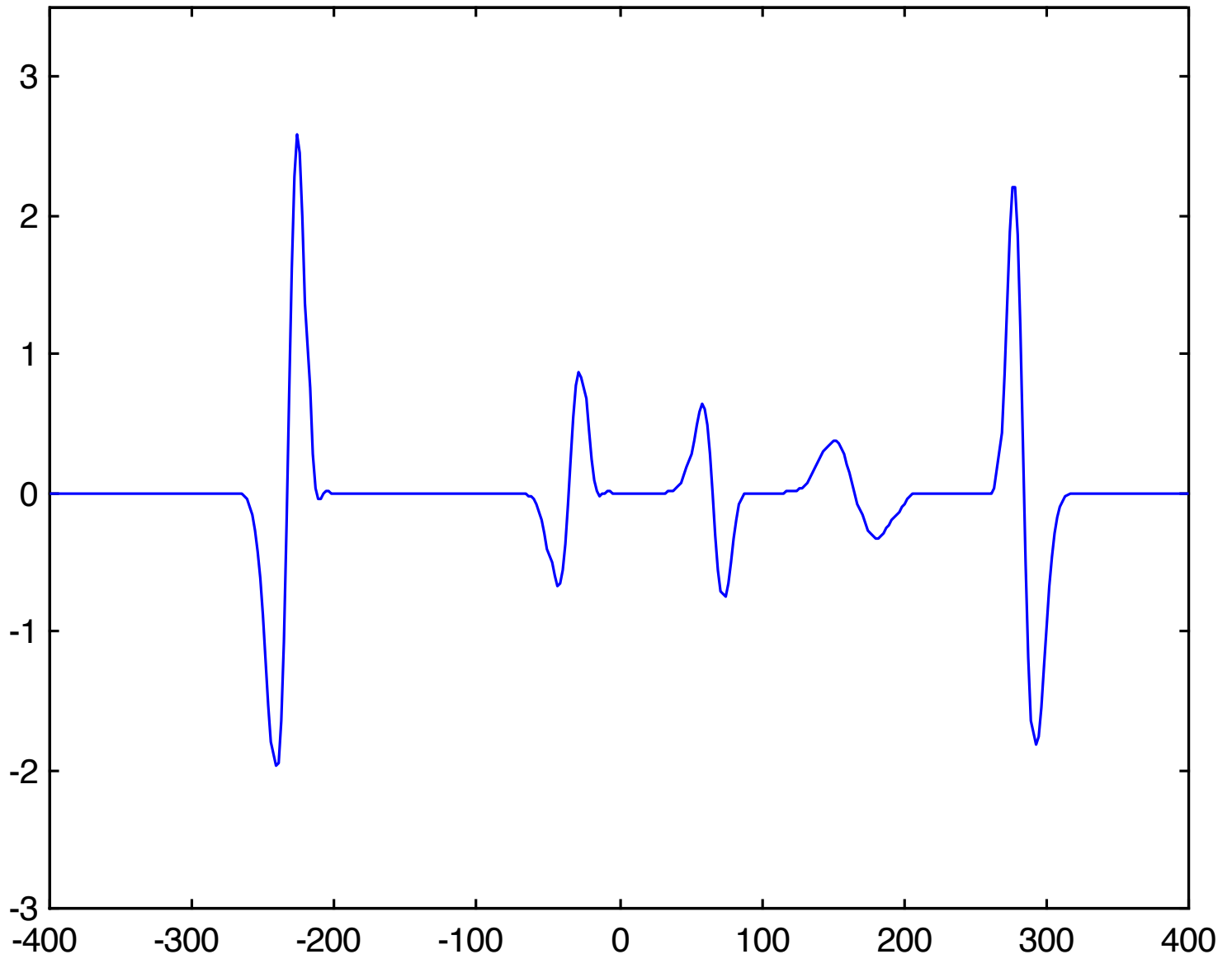


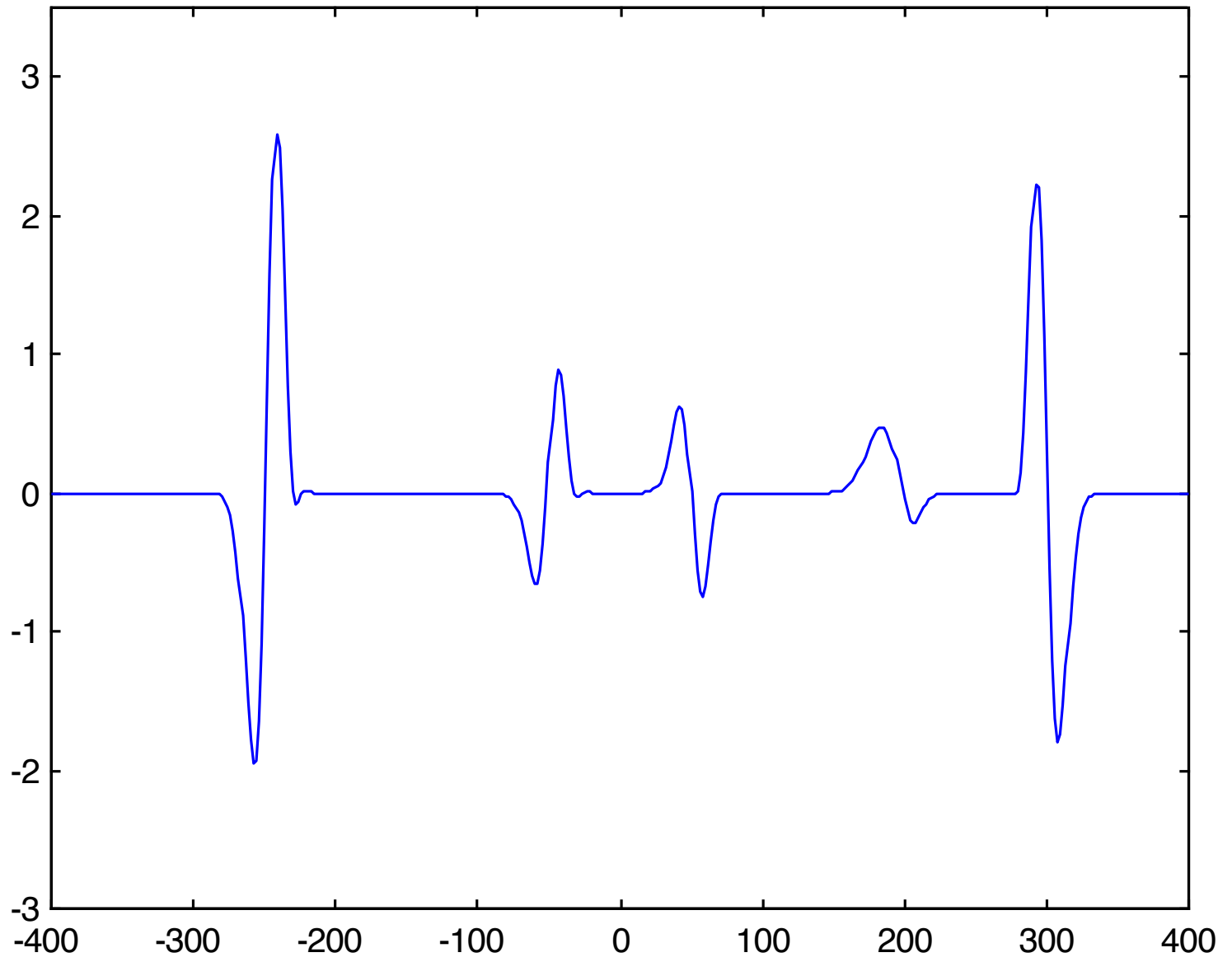


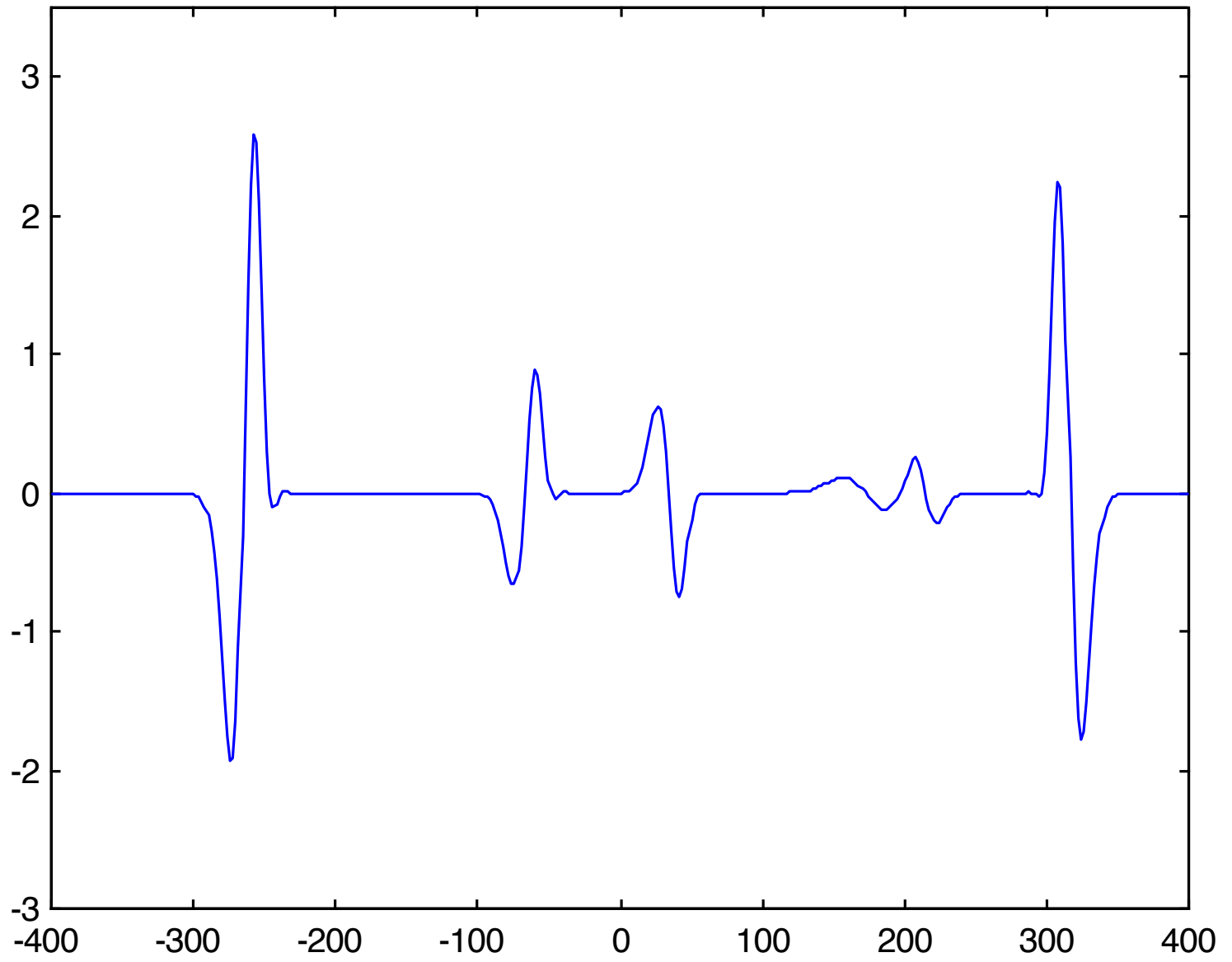


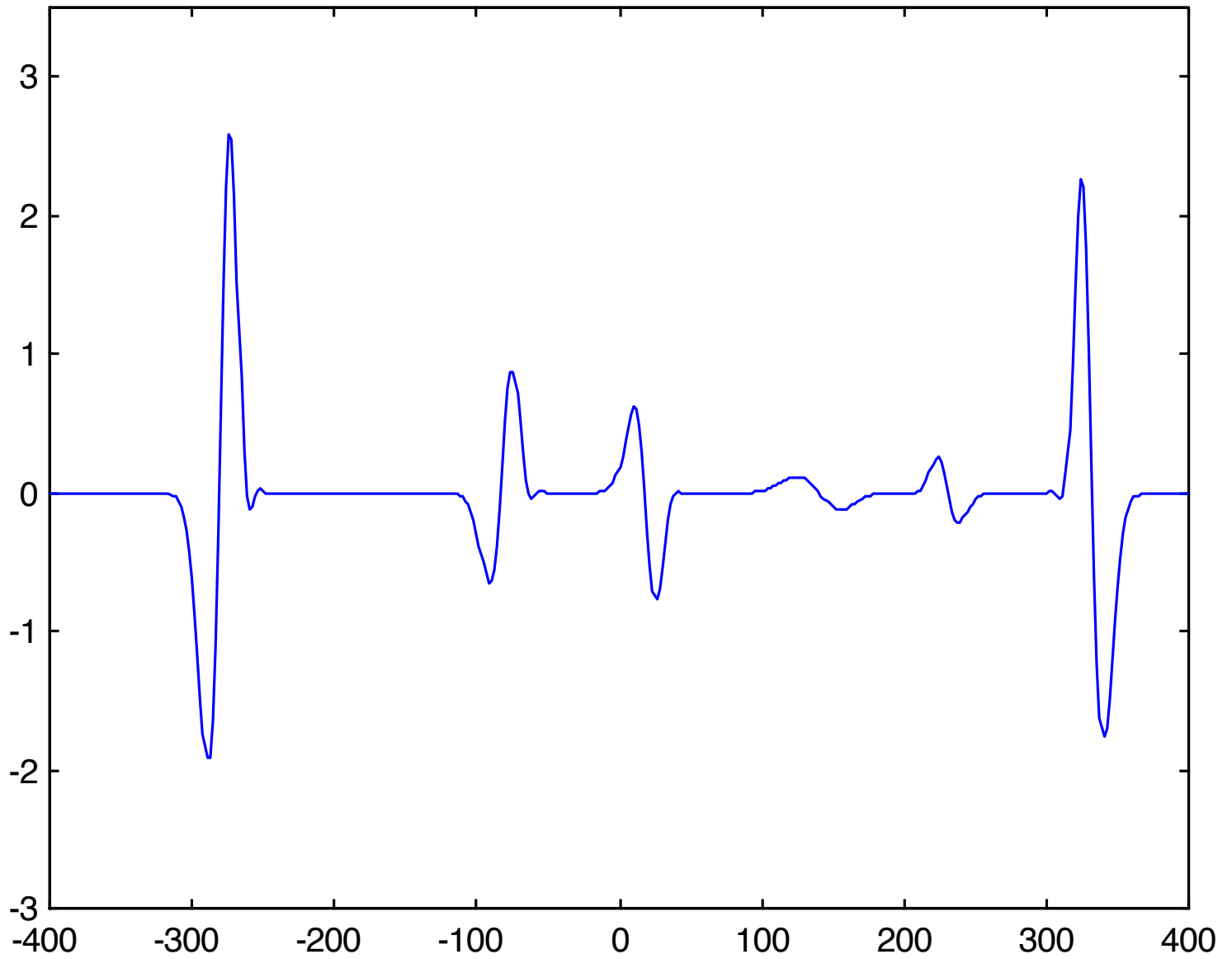


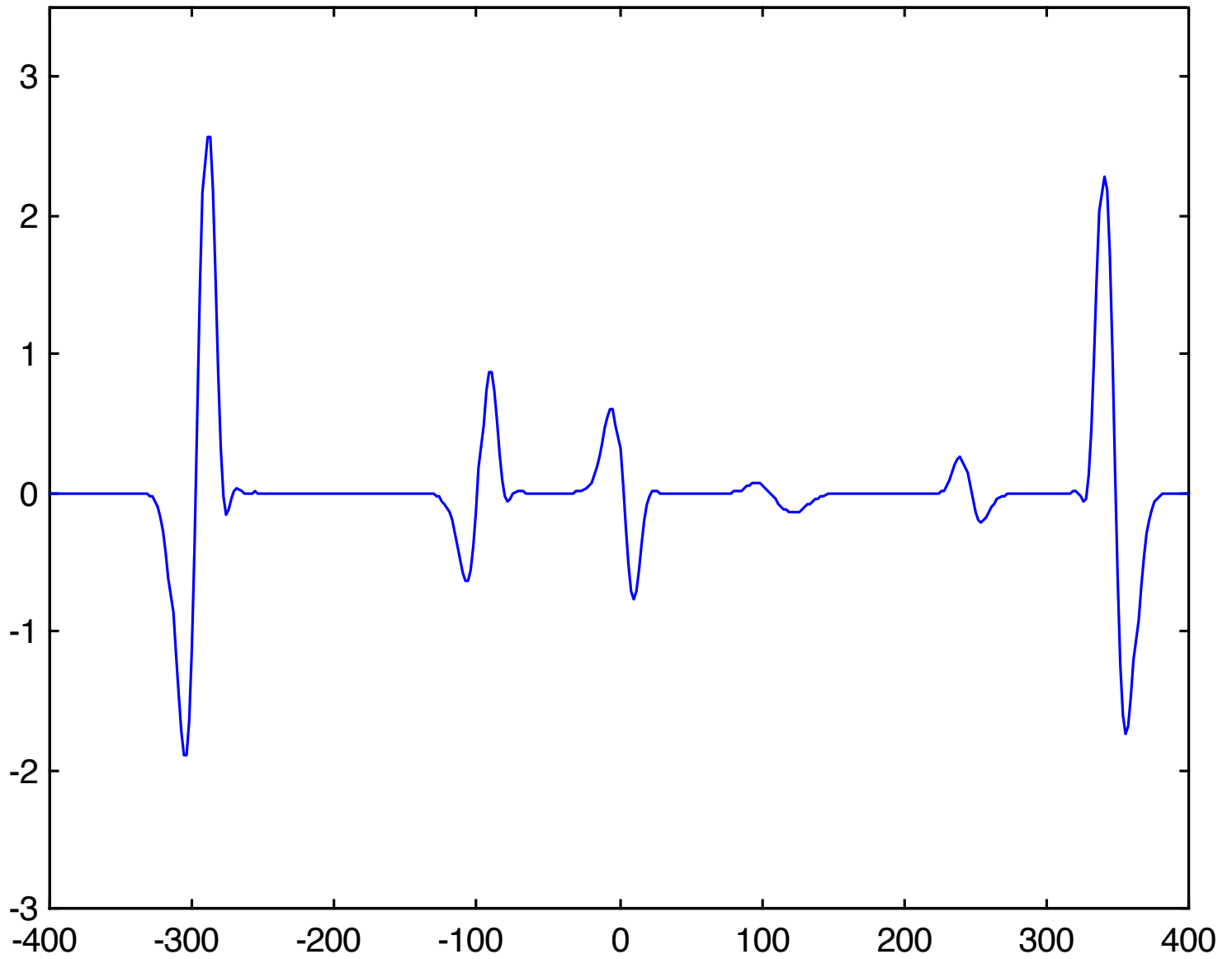






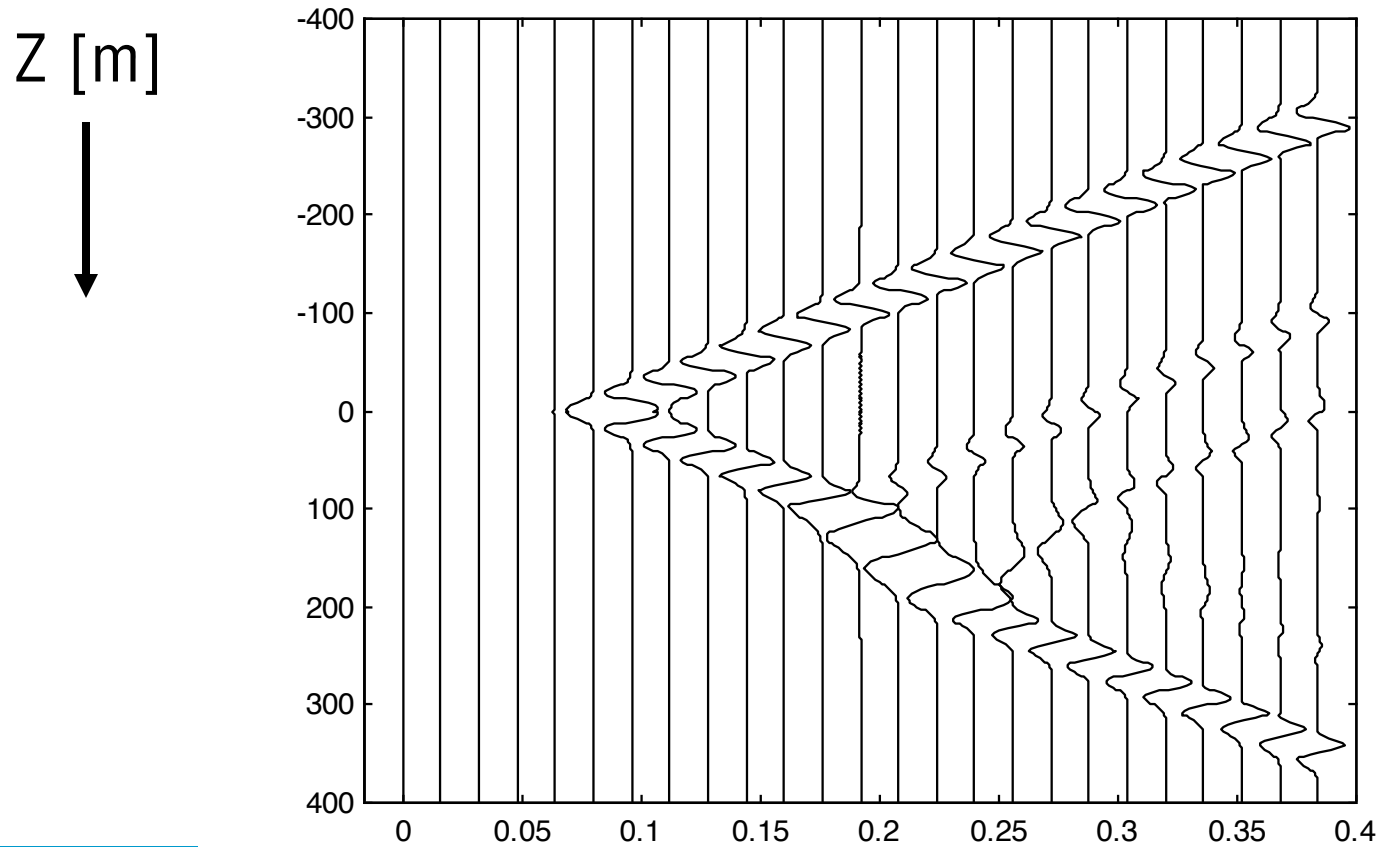




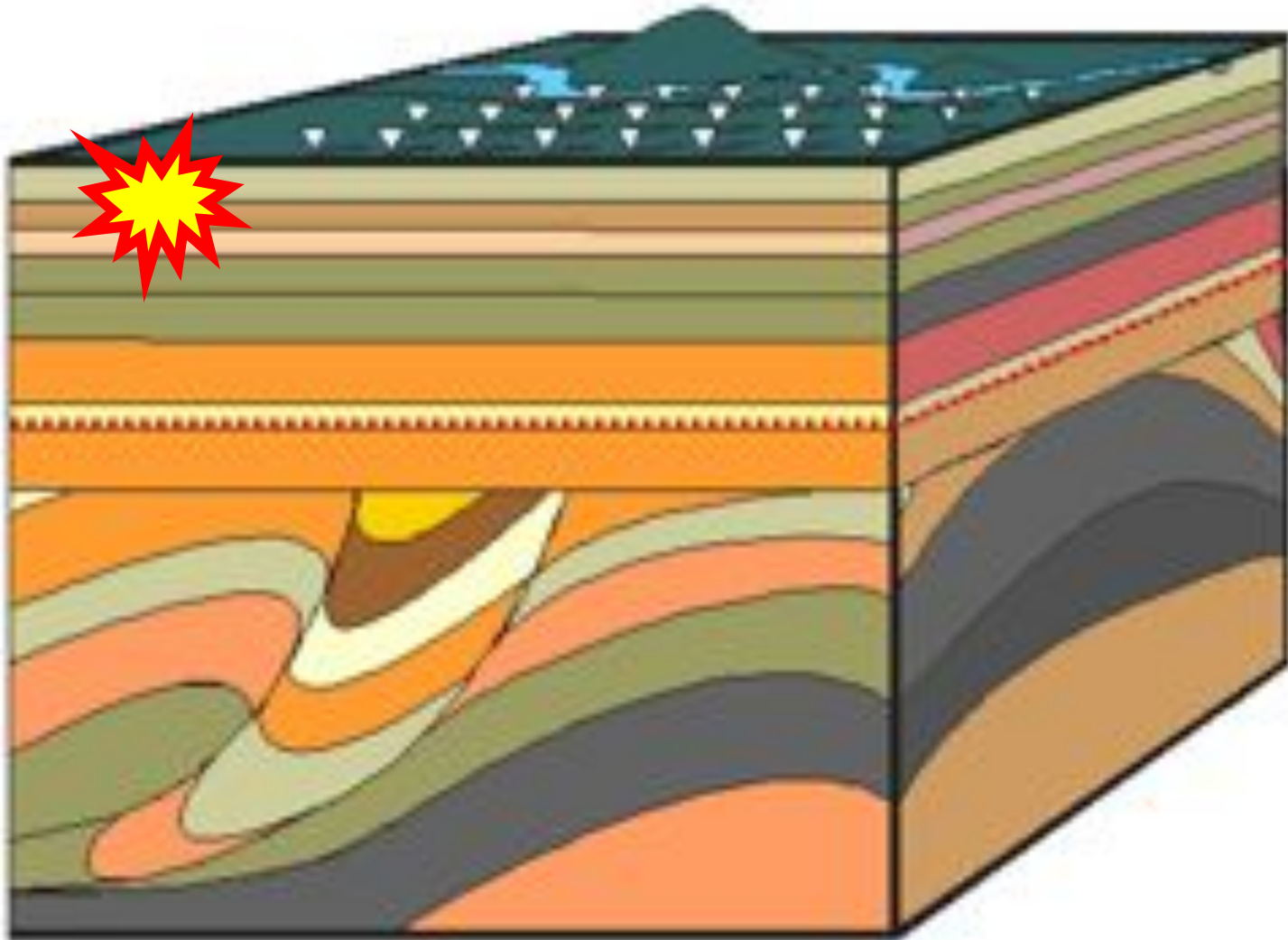




# Snapshots

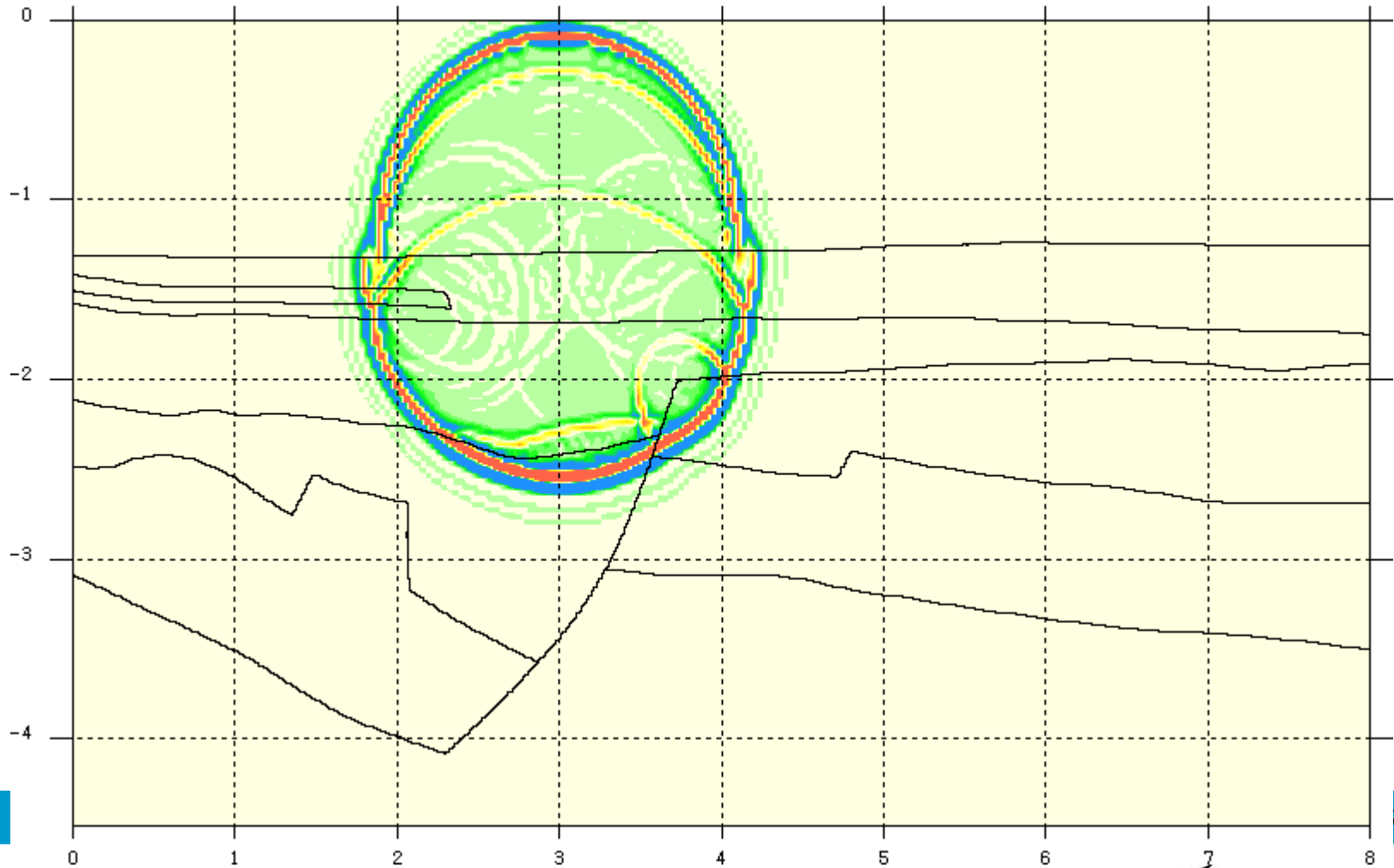


# Het Seismisch Experiment



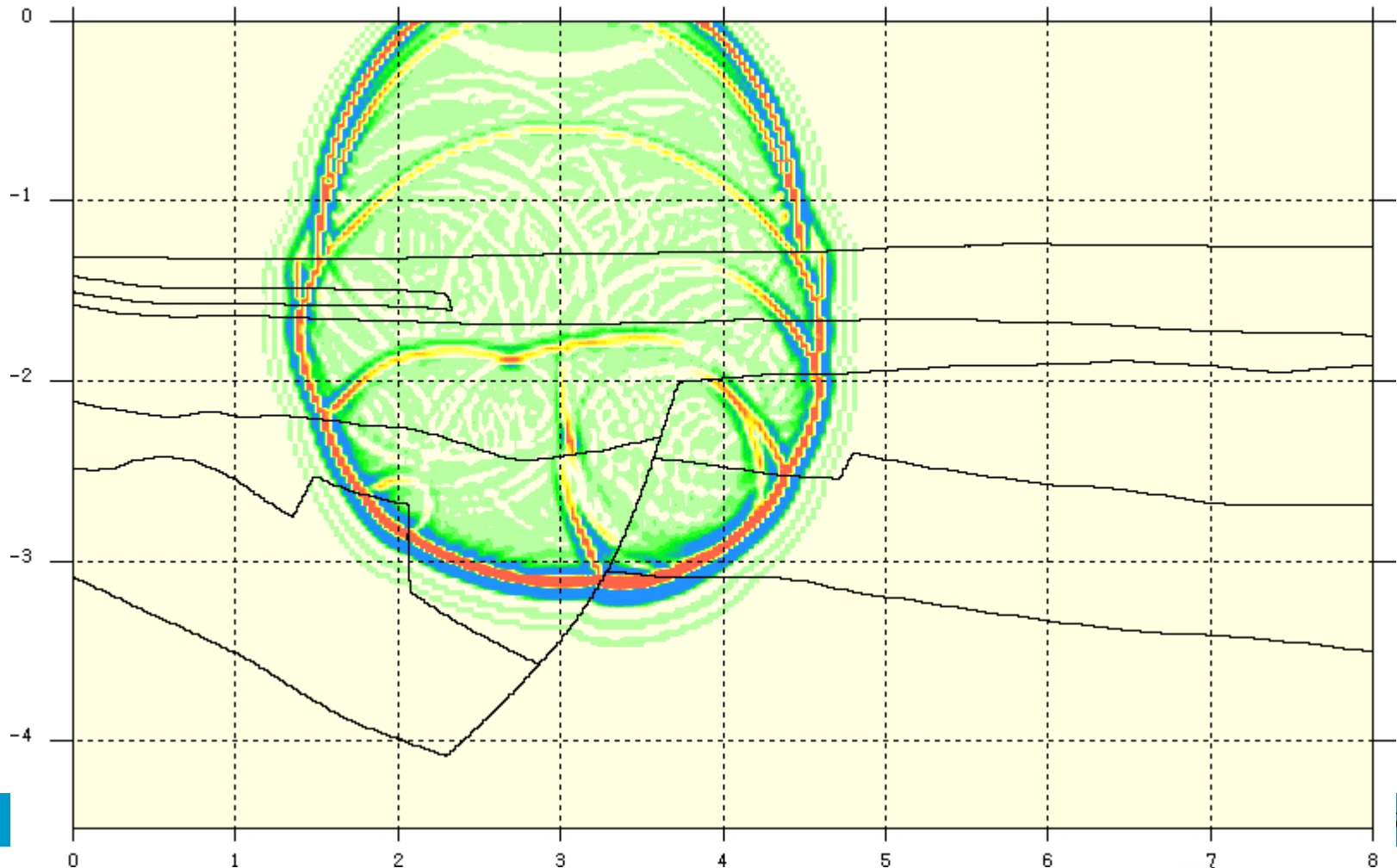
# Snapshots van golfvoortplanting

Snapshot time (msec) - 748.0



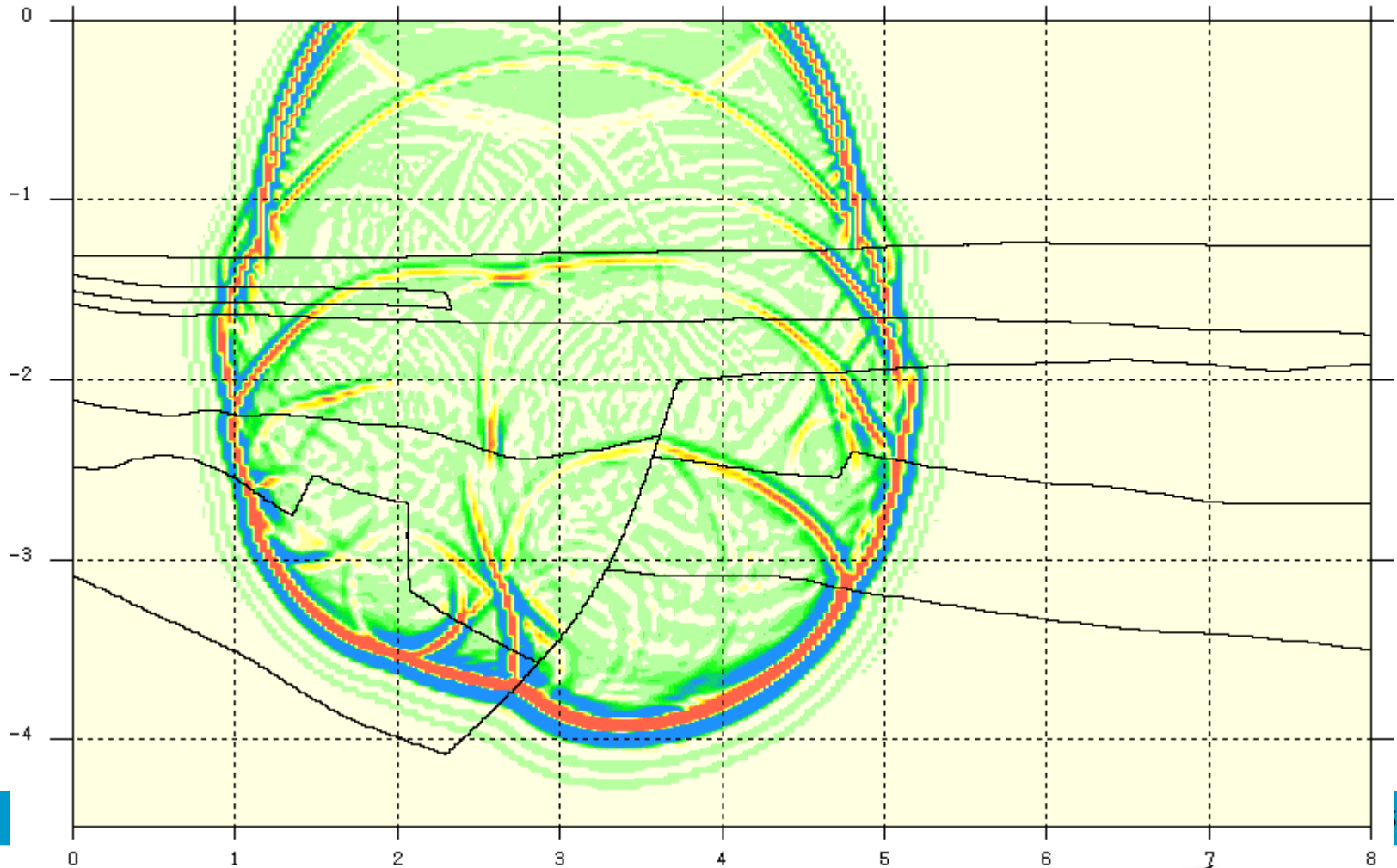
# Snapshots van golfvoortplanting

Snapshot time (msec) - 997.3



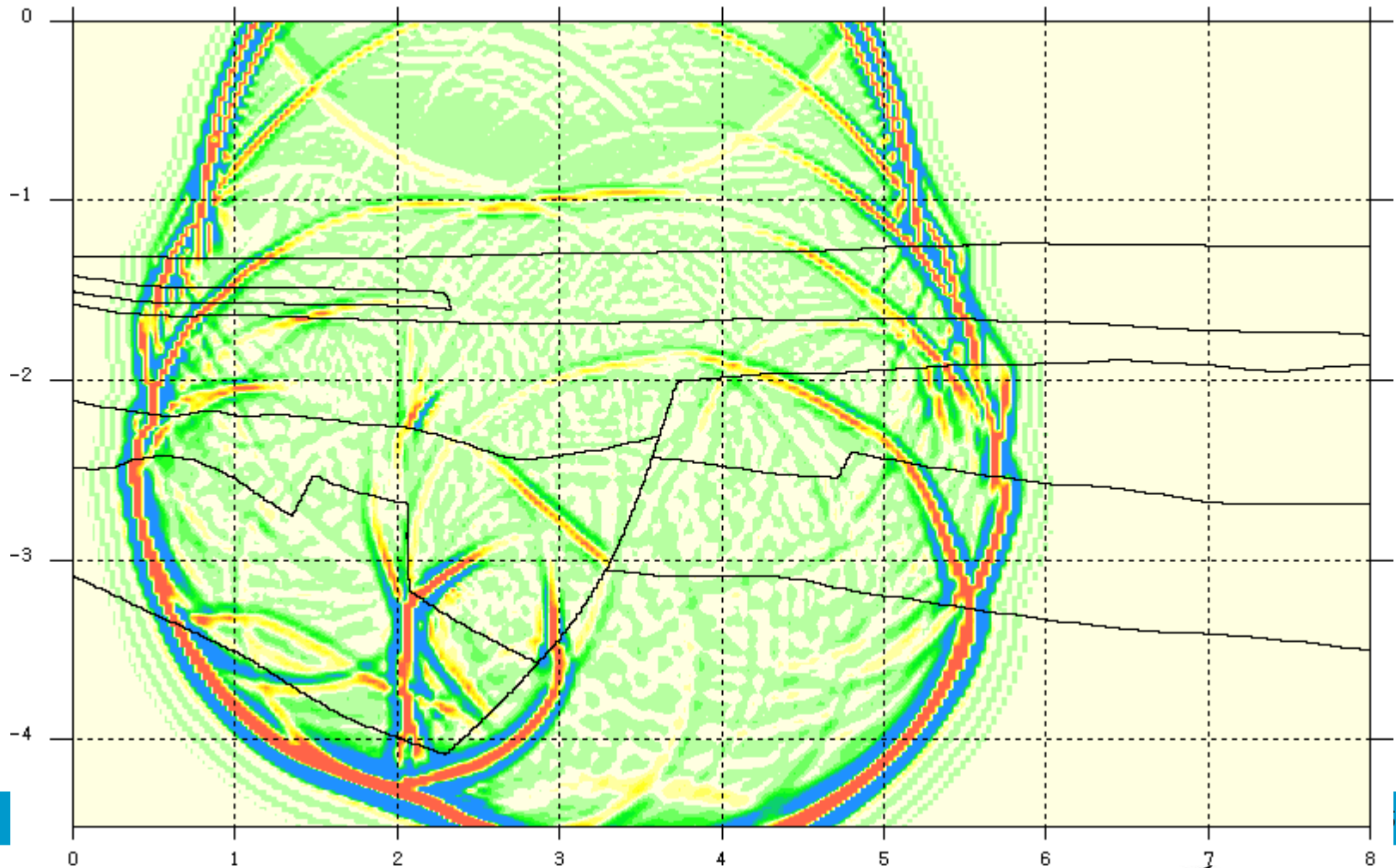
# Snapshots van golfvoortplanting

Snapshot time (msec) - 1246.7



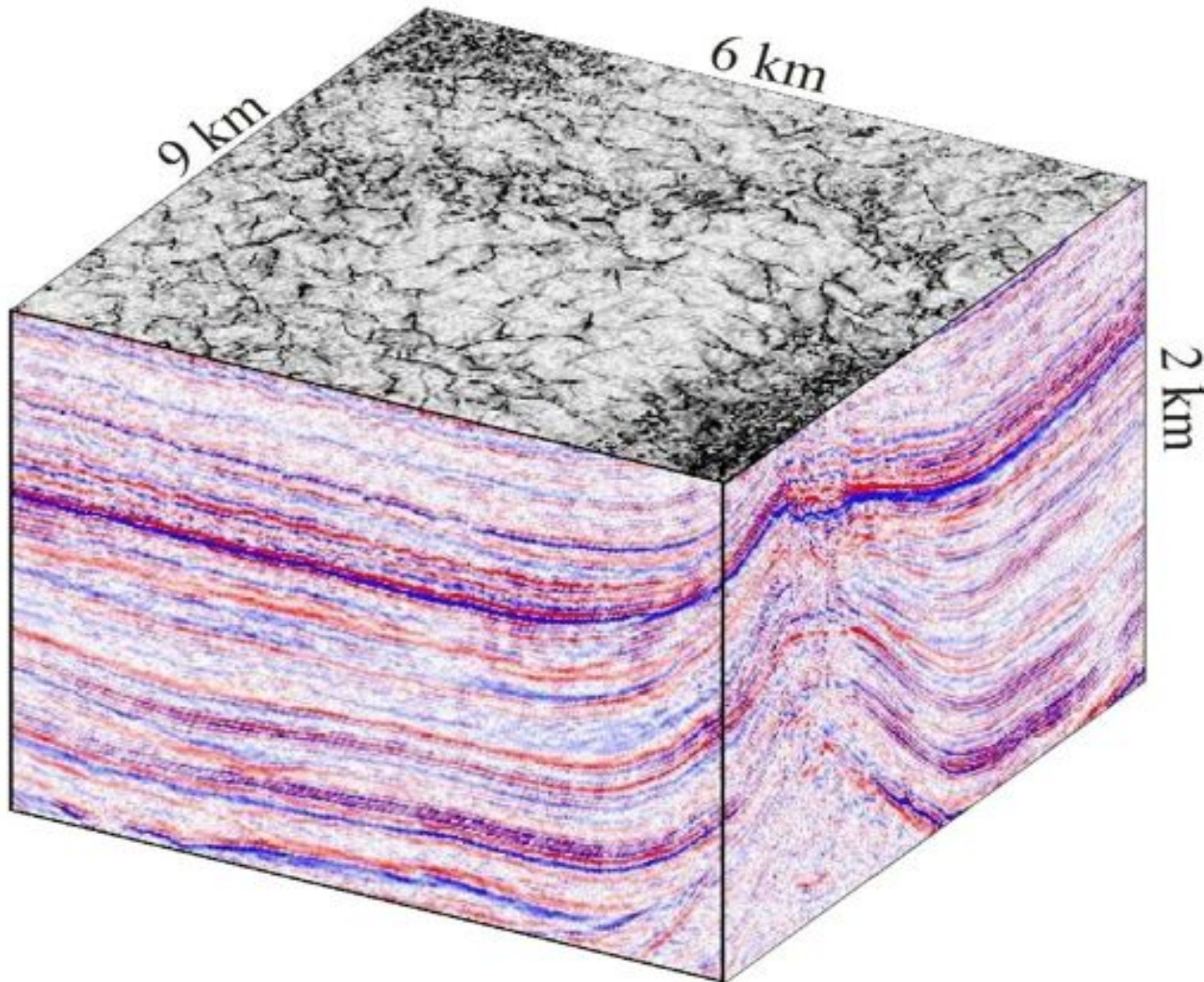
# Snapshots van golfvoortplanting

Snapshot time (msec) - 1496.0



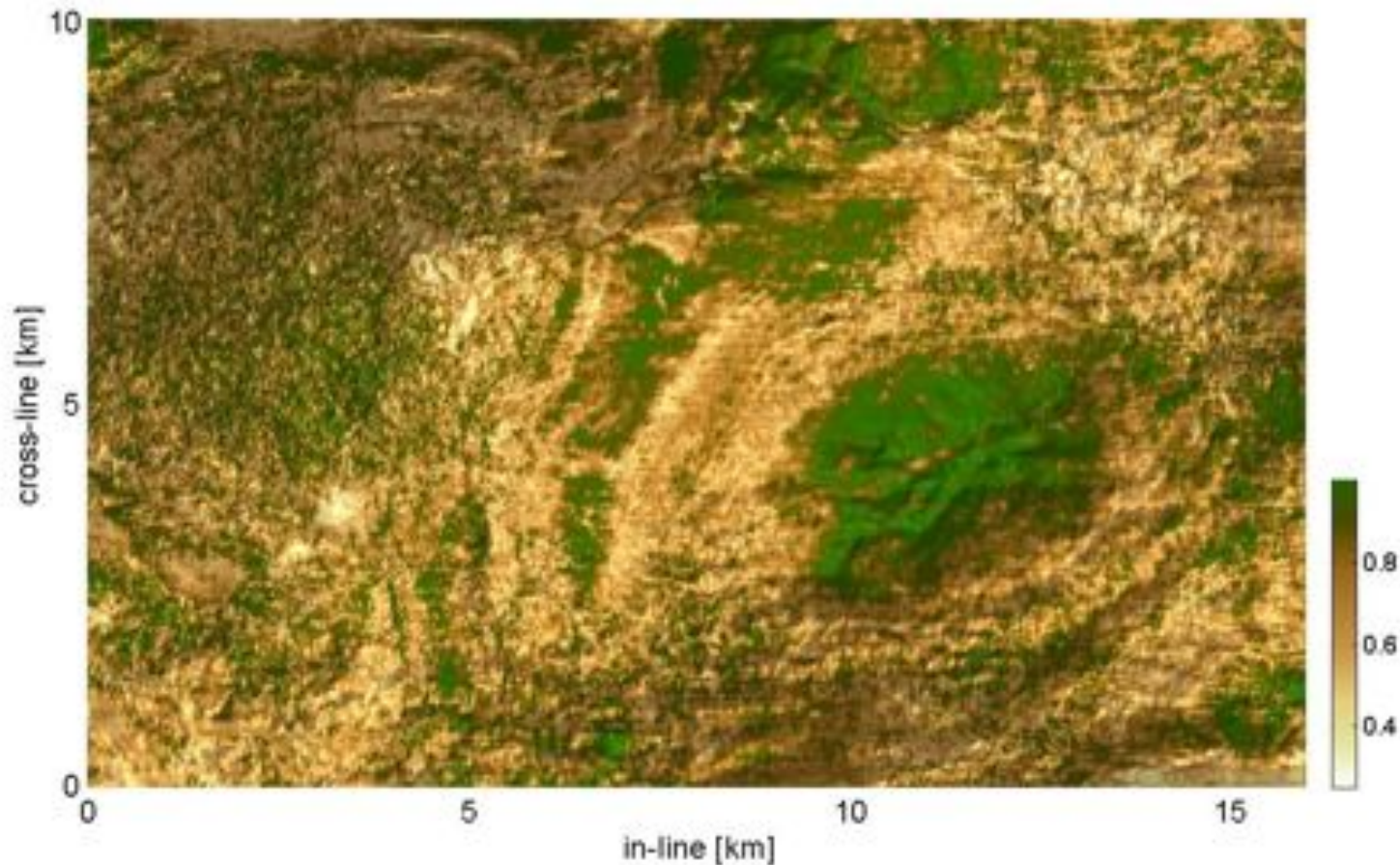


# Seismische Data Kubus

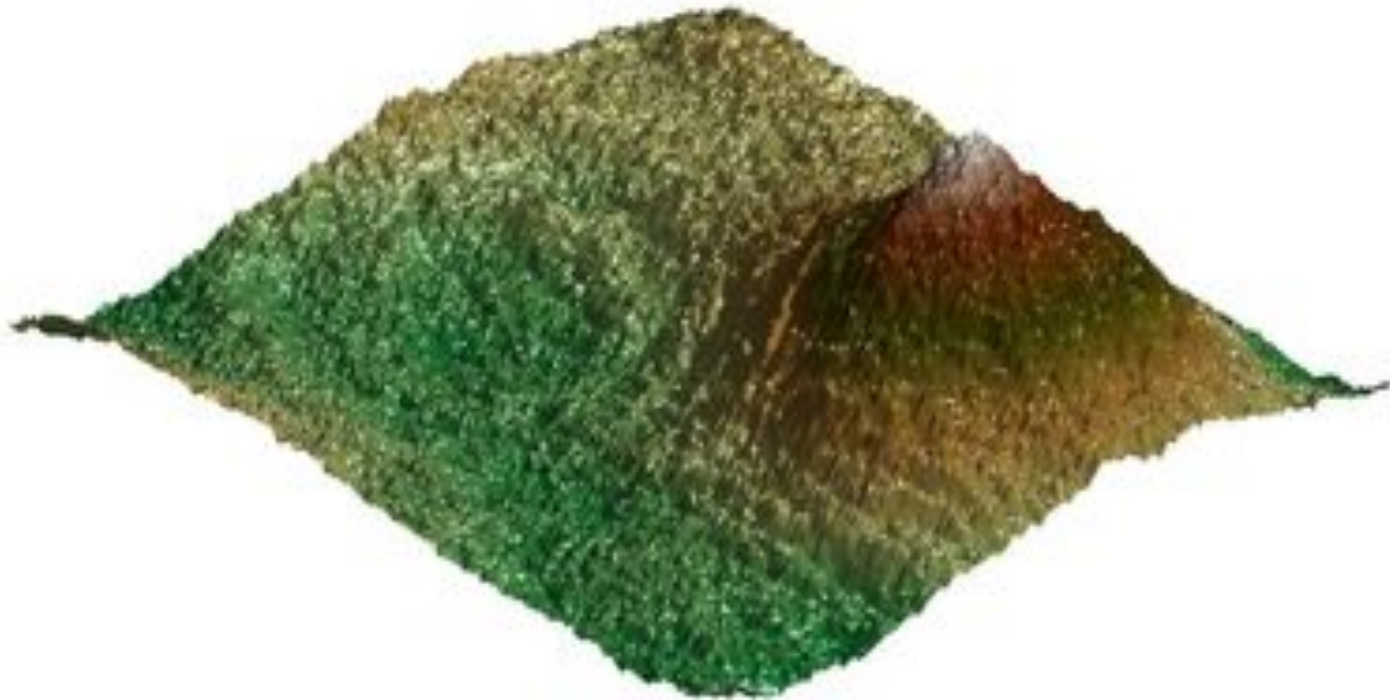




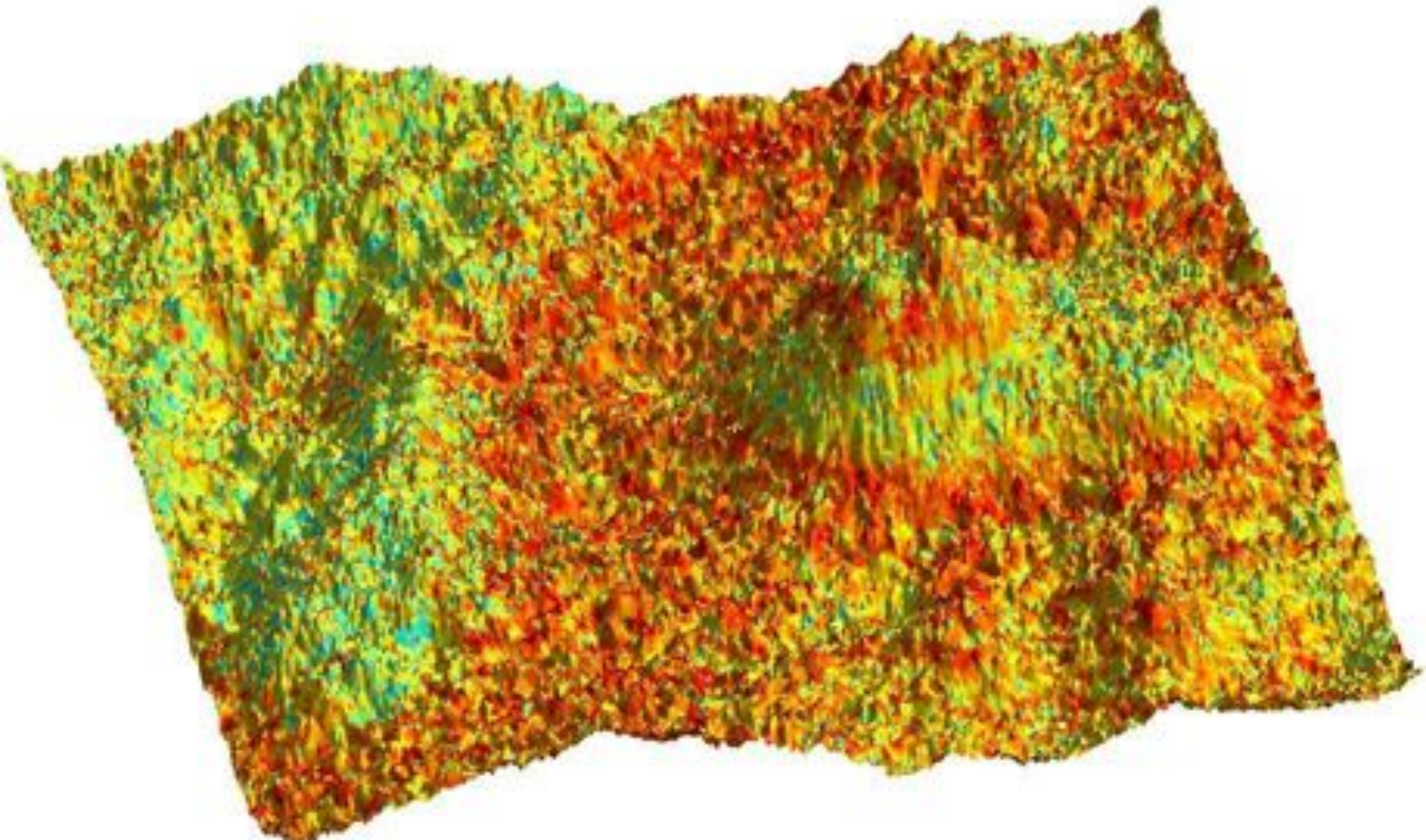
# Het volgen van de canyon op diep



# Pseudo topografie Gulf of Mexico



# Pseudo topografie F09 block



# Olie en gas exploratie



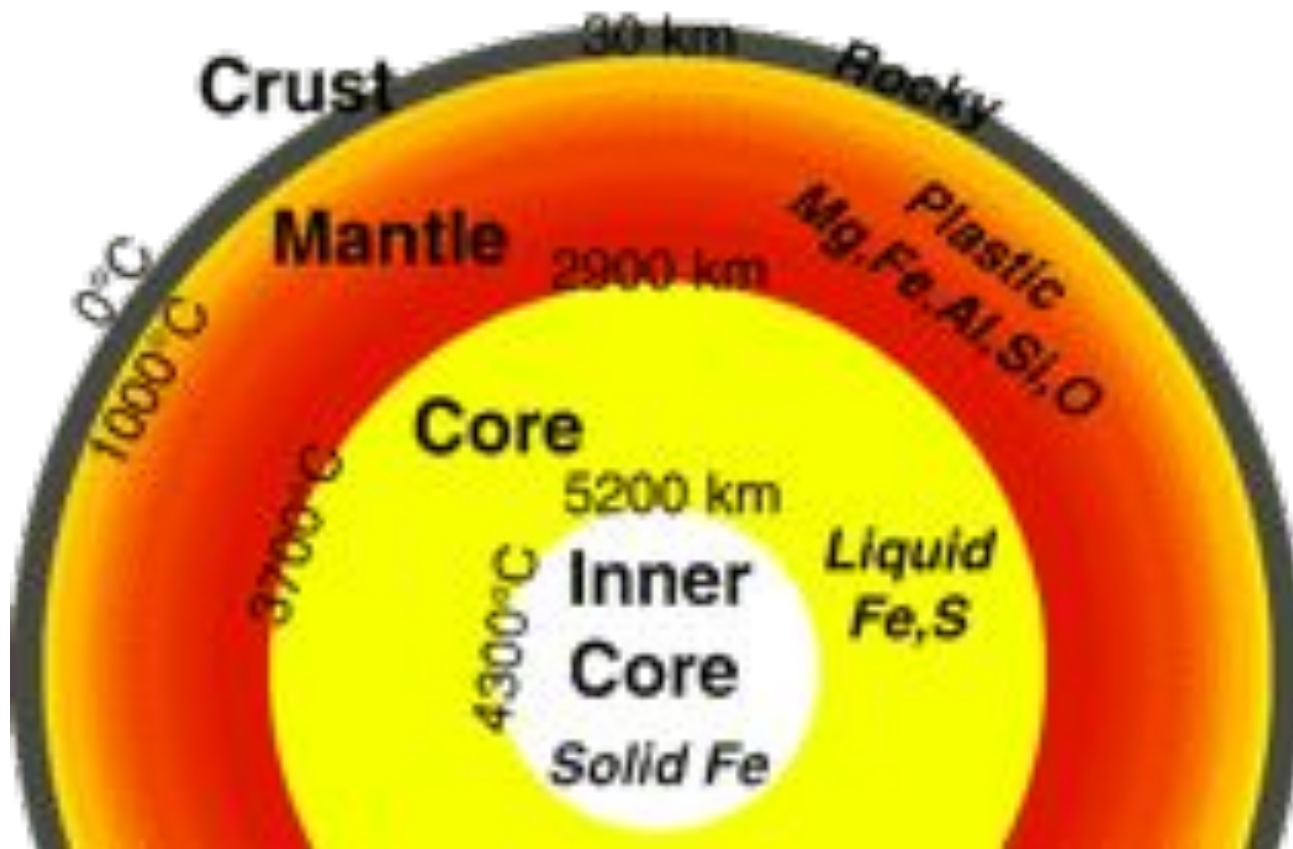
December 10, 2010

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**De Universiteit van Utrecht (Prof Wortel); de Vrije Universiteit van Amsterdam (Prof Cloetingh) en de Technische Universiteit Delft (Prof Fokkema) werken samen in de onderzoeksschool:**

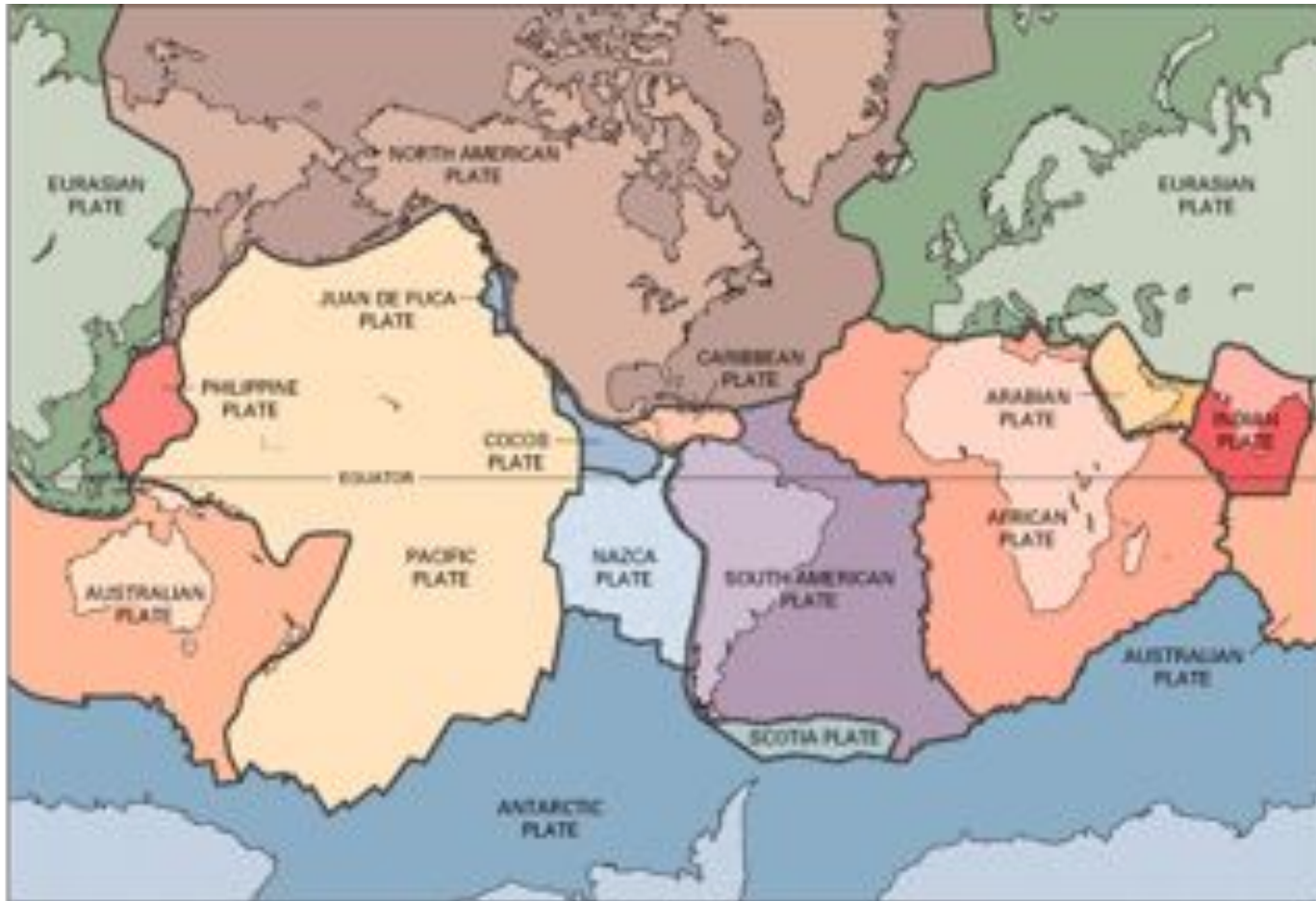
## **Integrated Solid Earth Science (ISES)**

**De belangrijkste doelstelling van ISES is leidend te zijn in fundamenteel onderzoek gericht op geopredictie.**



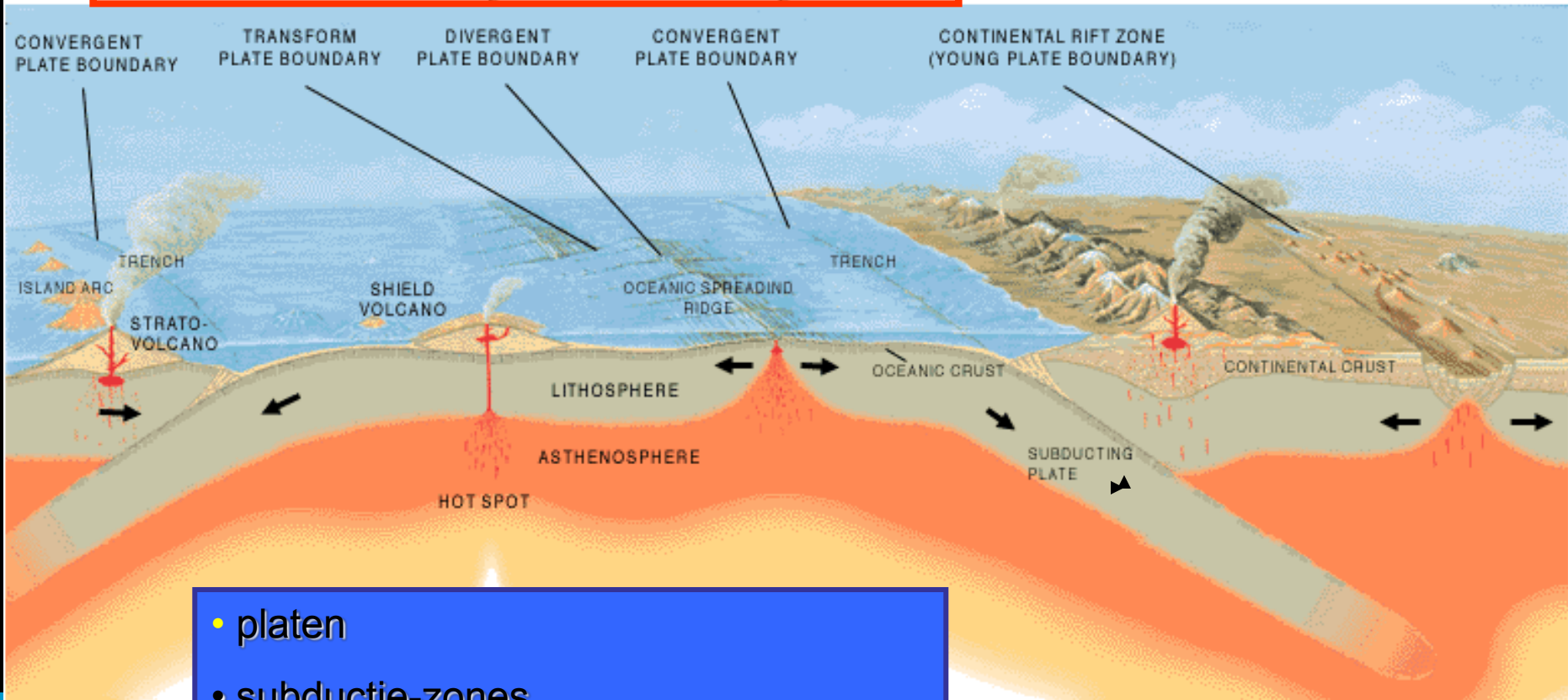
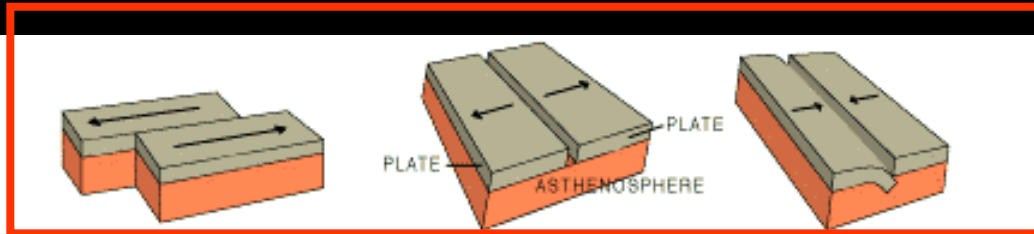


# De Verschillende Platen



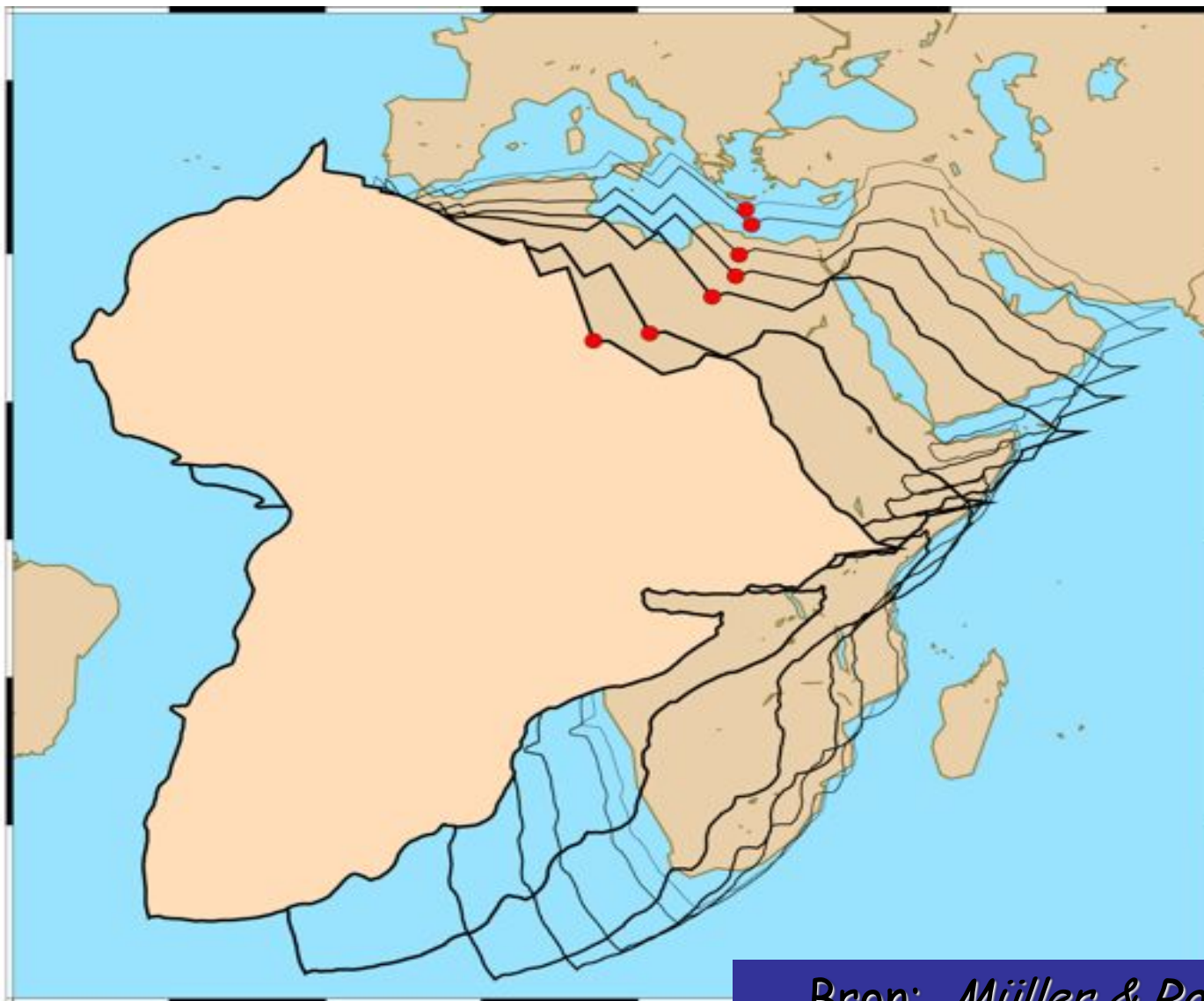


# Basis elementen van de plaattektoniek



- platen
- subductie-zones
- spreidende ruggen
- transform breuken (zijschuivingen)

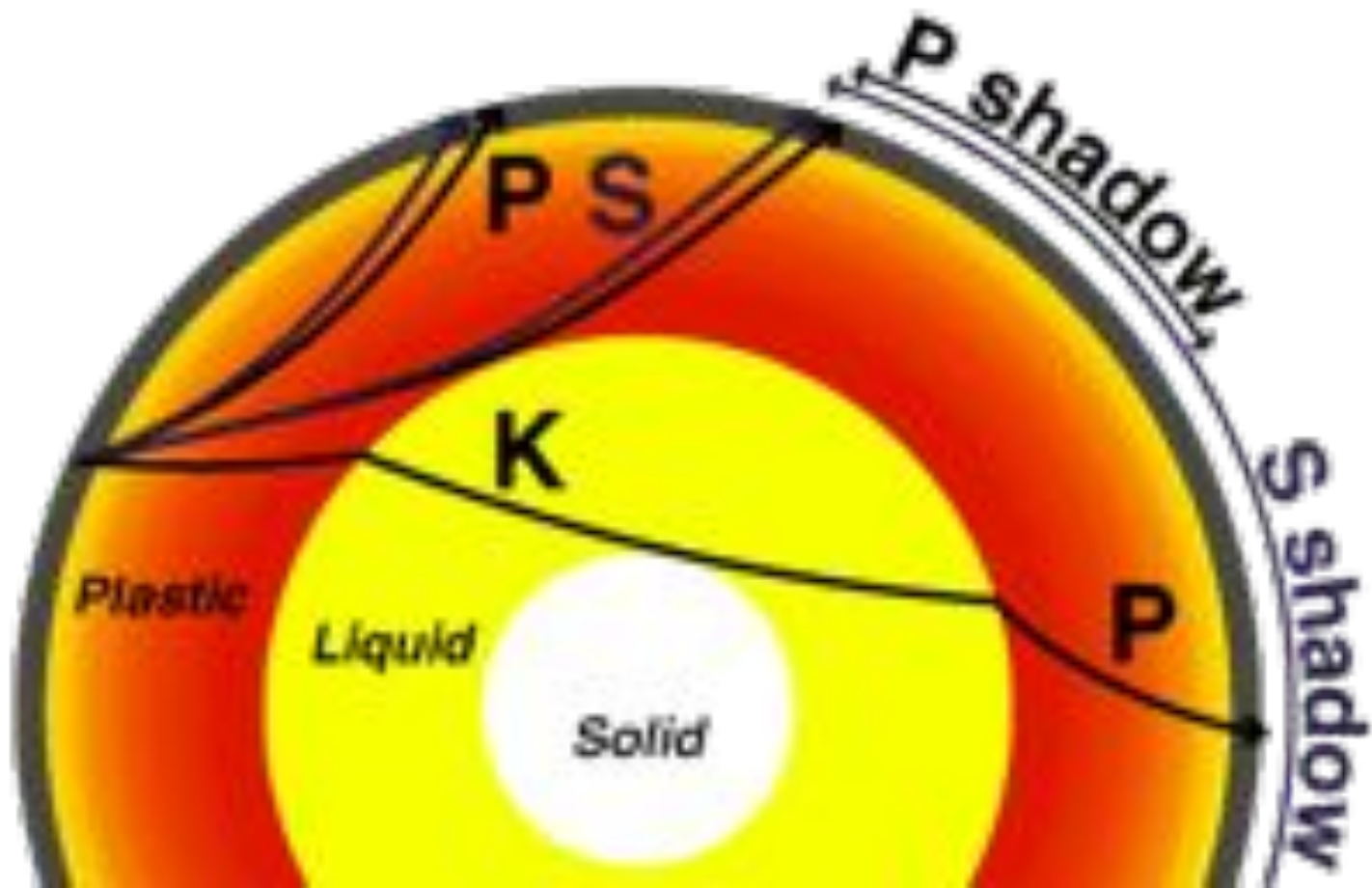
De nadering van Eurazie en Afrika:  
van 120 miljoen jaar geleden tot nu, in stappen van 20 miljoen jaar



Decem

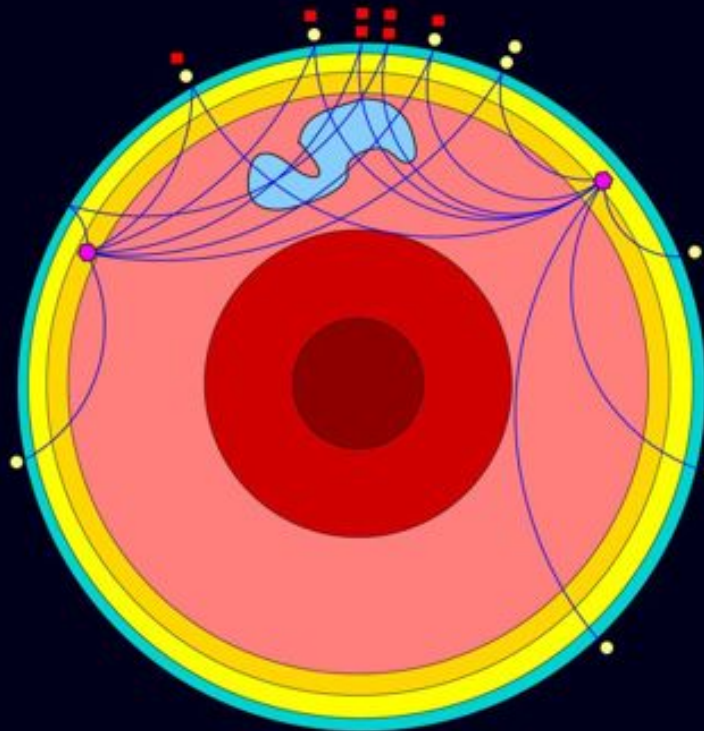
66

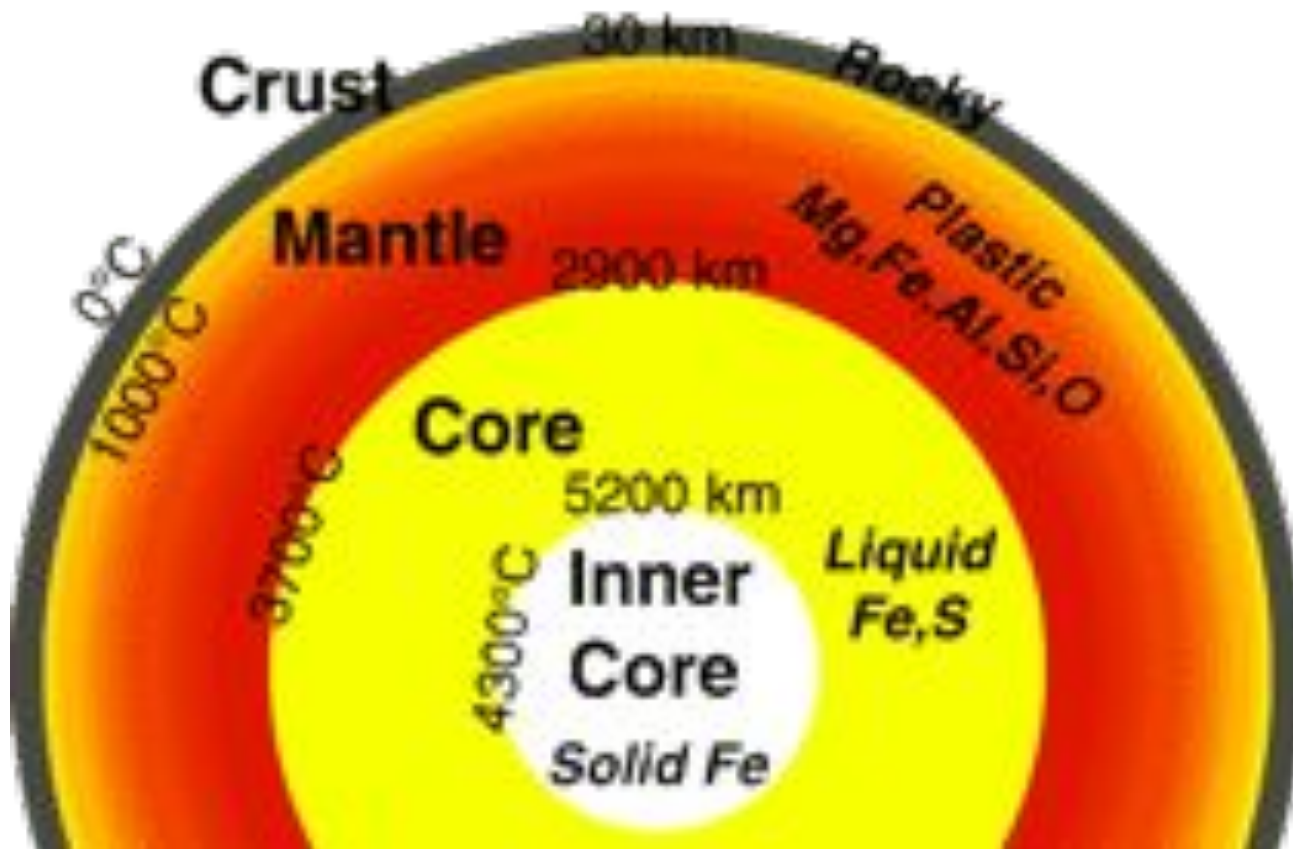
Bron: Müller & Roest (1992)



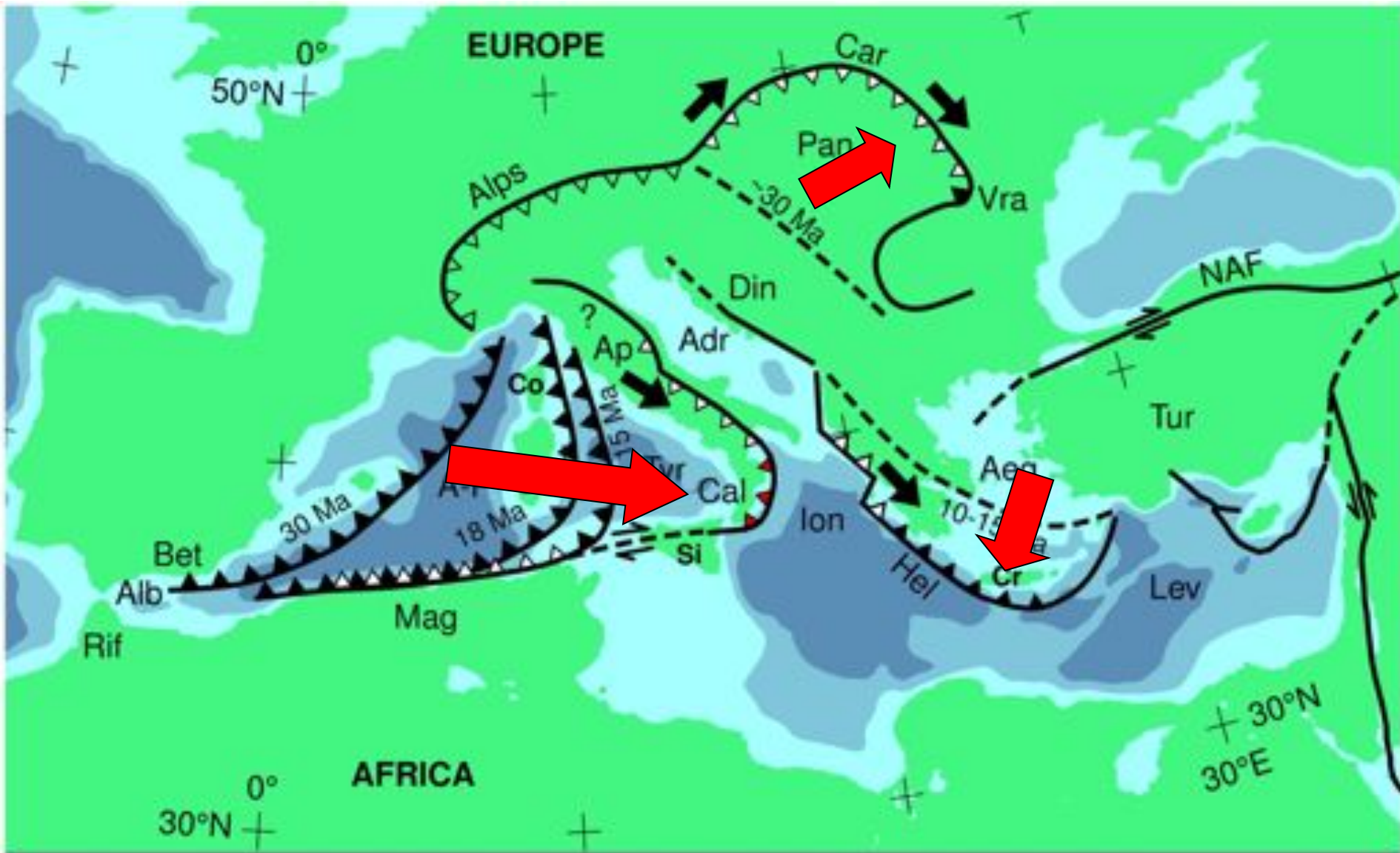
## SEISMIC TRAVEL TIME TOMOGRAPHY

- Earthquake
- Reference model travel time (computed)
- Perturbed travel time (observed)
- — ● —> Anomalous structure along ray paths

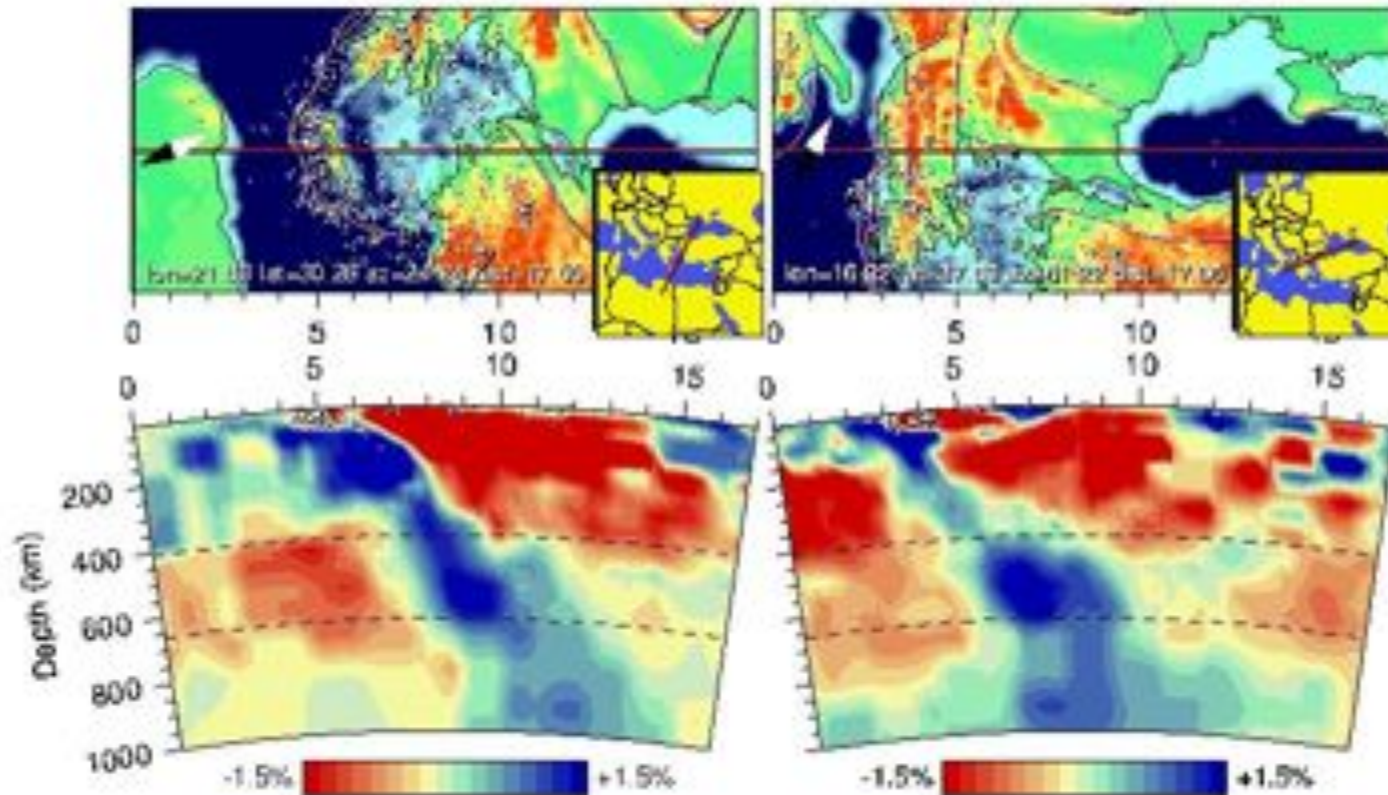




# Beweging van plaatgrenzen (subductiezones) in het Middellandse Zee en Karpaten gebied

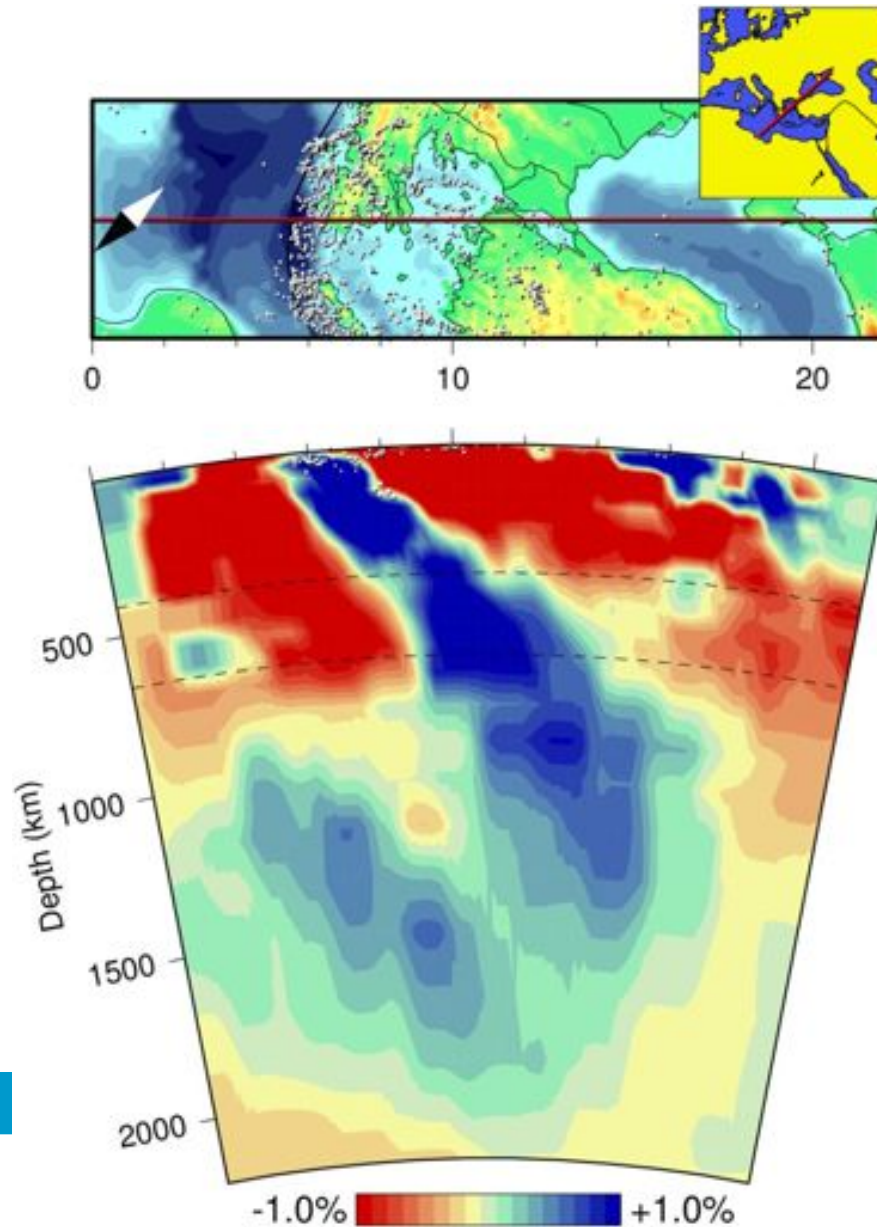


# Helleense Boog (Kreta, Rhodos, etc)



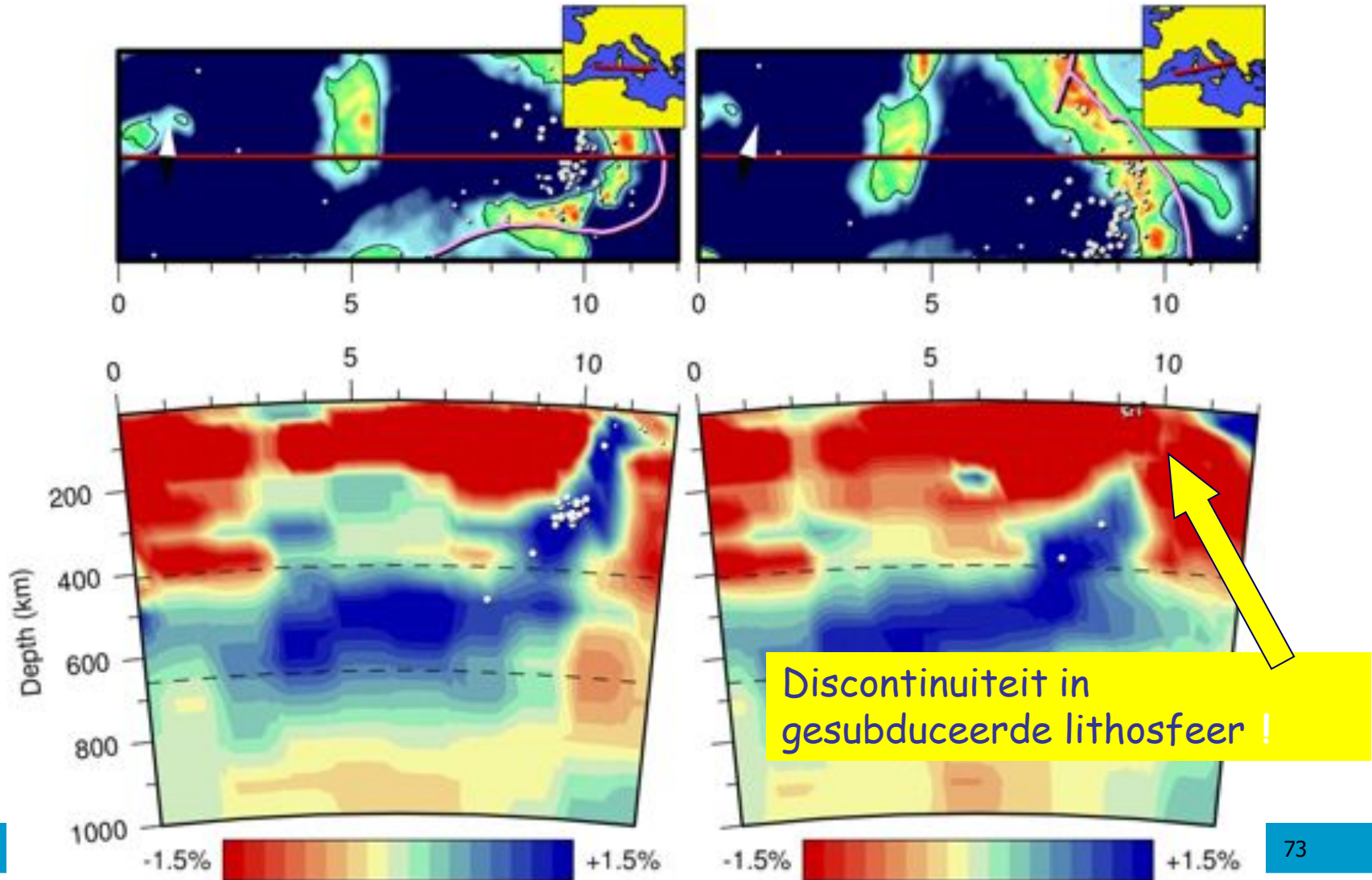
Bijwaard and Spakman, GJI, 141, 2000

# Helleense Boog: diepe structuur

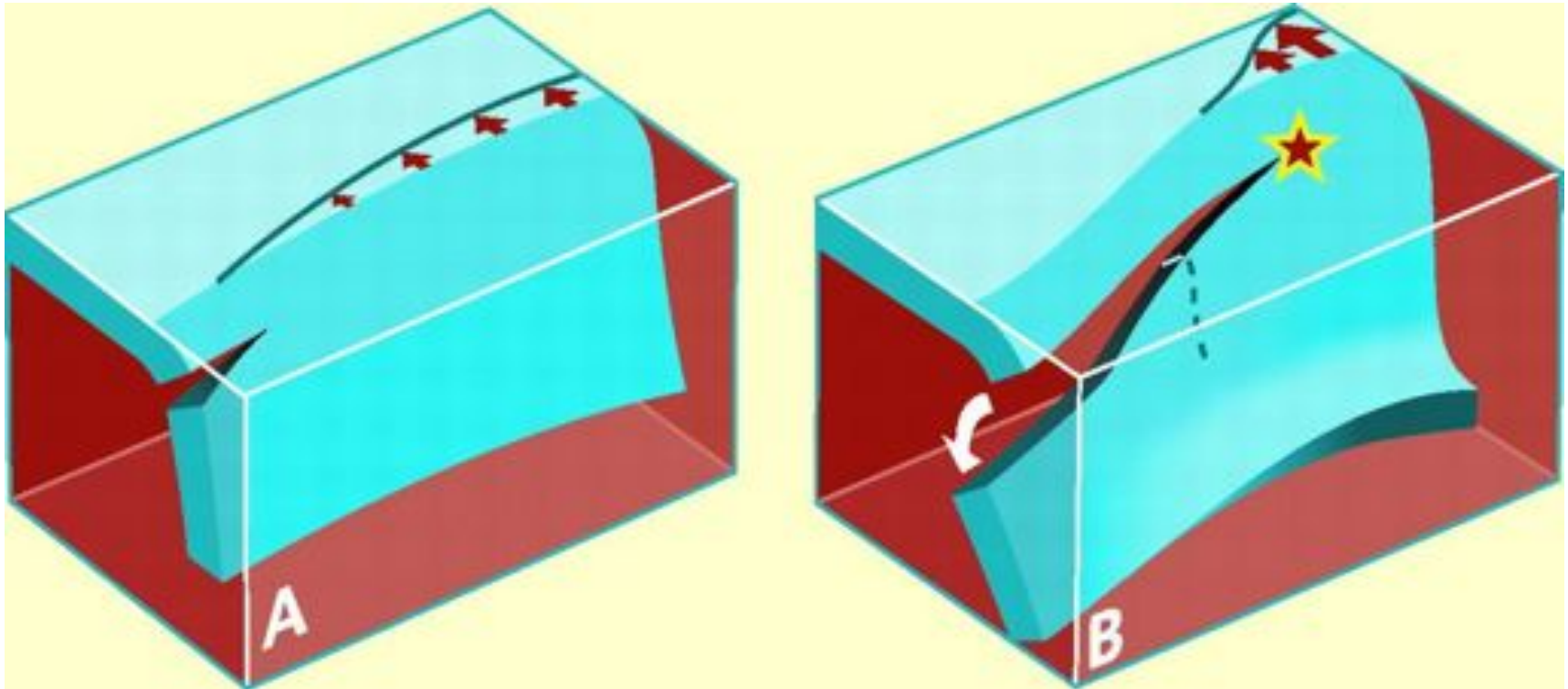




# Centraal deel van de Middellandse Zee



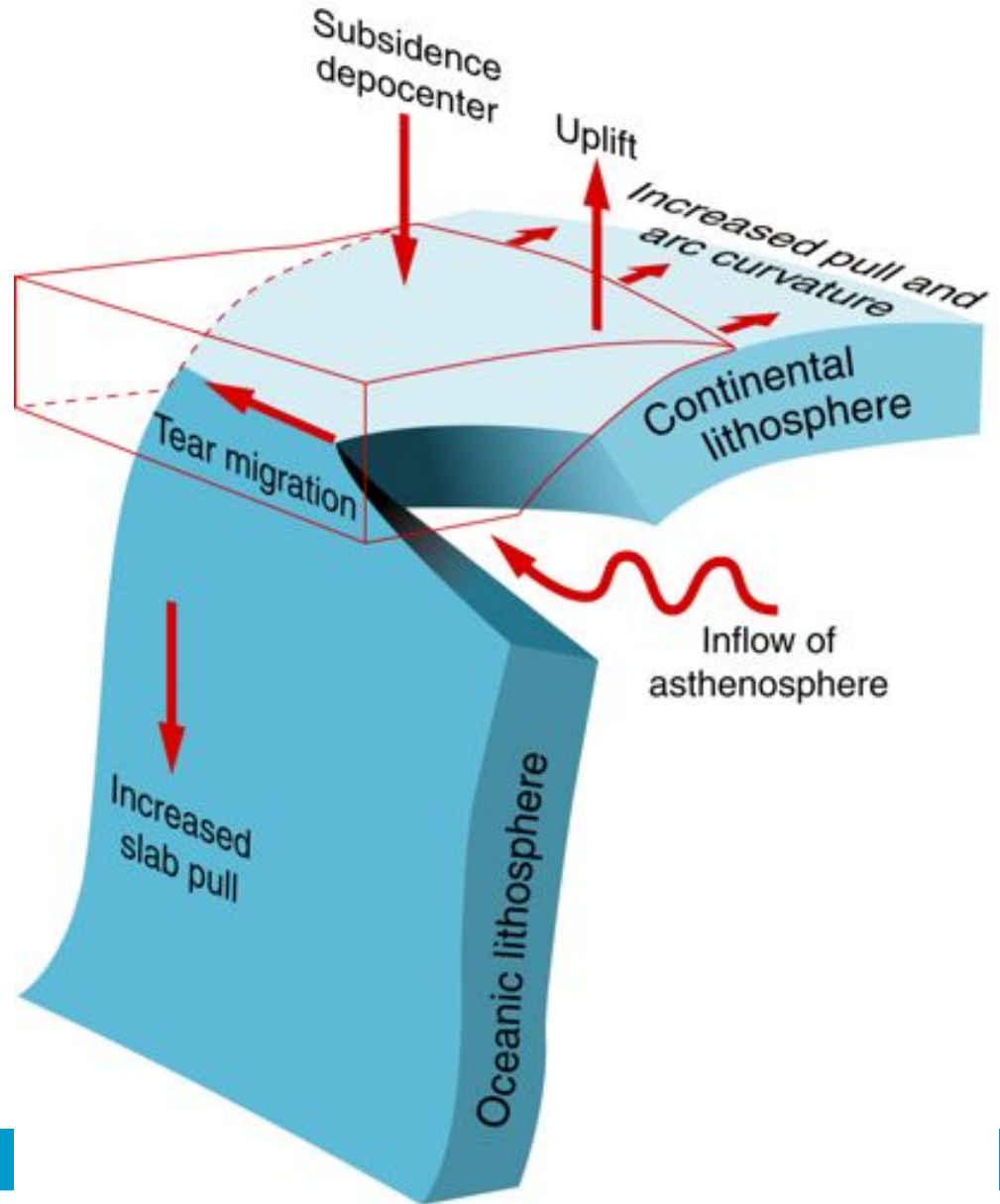
# Het afbreken van gesubduceerde lithosfeer (o.a. in/onder Italië)



Plaatgrens-processen die naar verwachting optreden bij afbreken van lithosfeer:

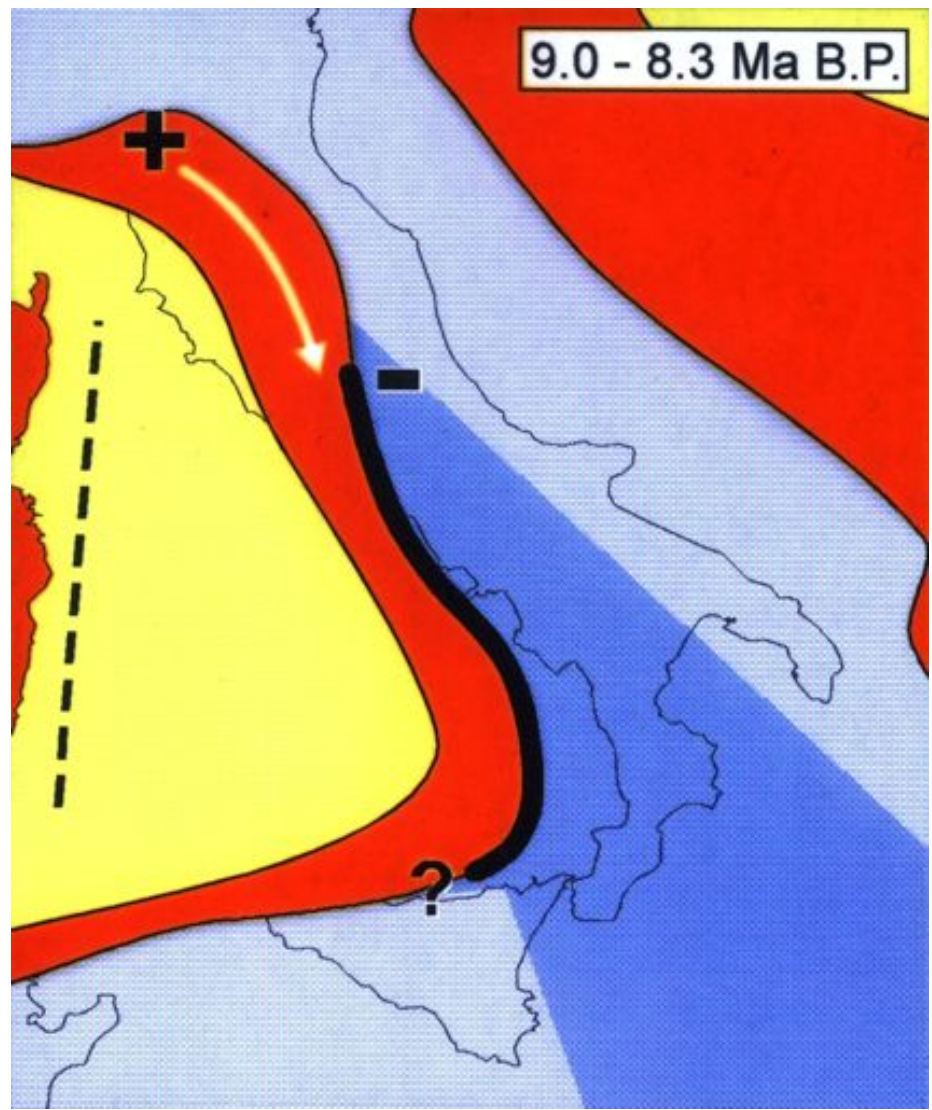
- doorgaande boogvorming en horizontale bewegingen
- verticale bewegingen
- spanningstoestand in de korst
- vulkanisme

Testen van model van afbrekende lithosfeer door vergelijking van modelvoorspellingen en observaties



December 10, 2010

Test van model:  
Vertikale bewegingen in de Apennijnen, bepaald uit eigenschappen (o.a. fossielinhoud) van sedimenten



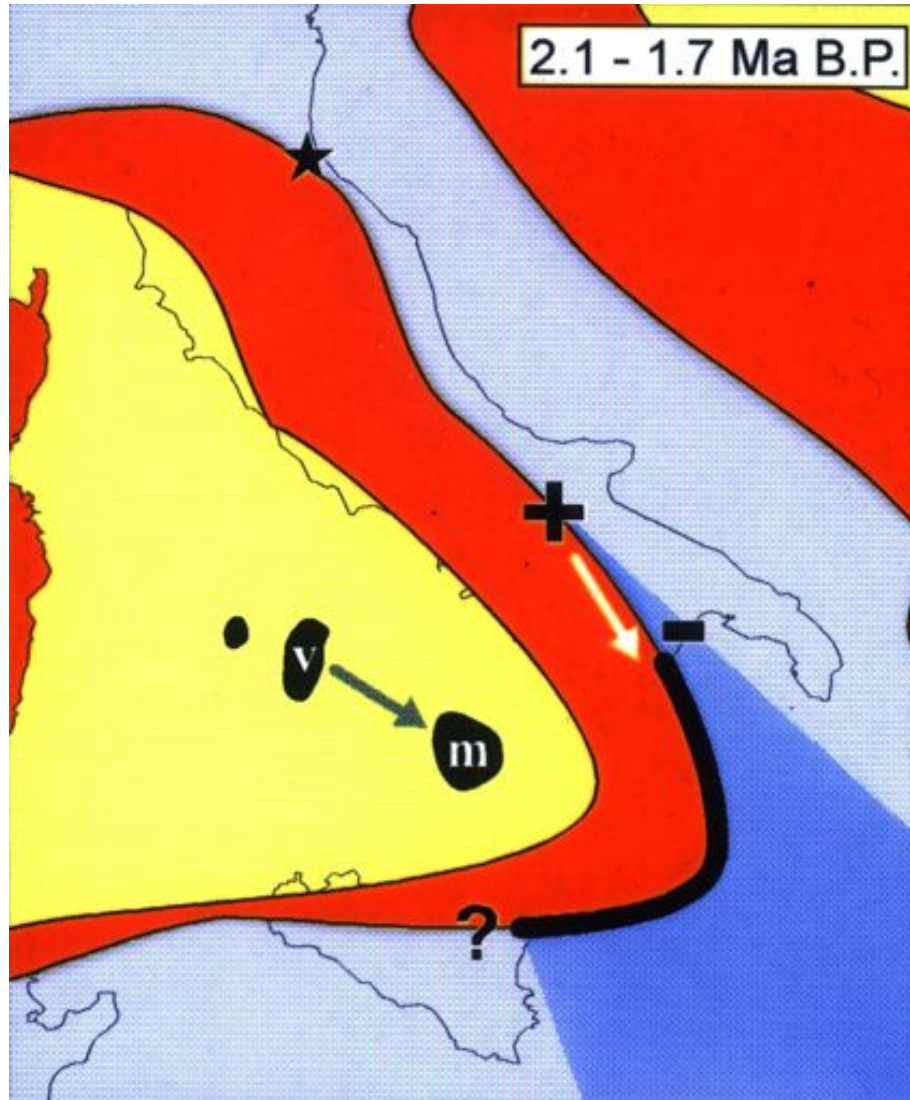
- daling en depocentrum  
+ opheffing



December 10, 2010 **Vertikale bewegingen en afbreken van de lithosfeer**

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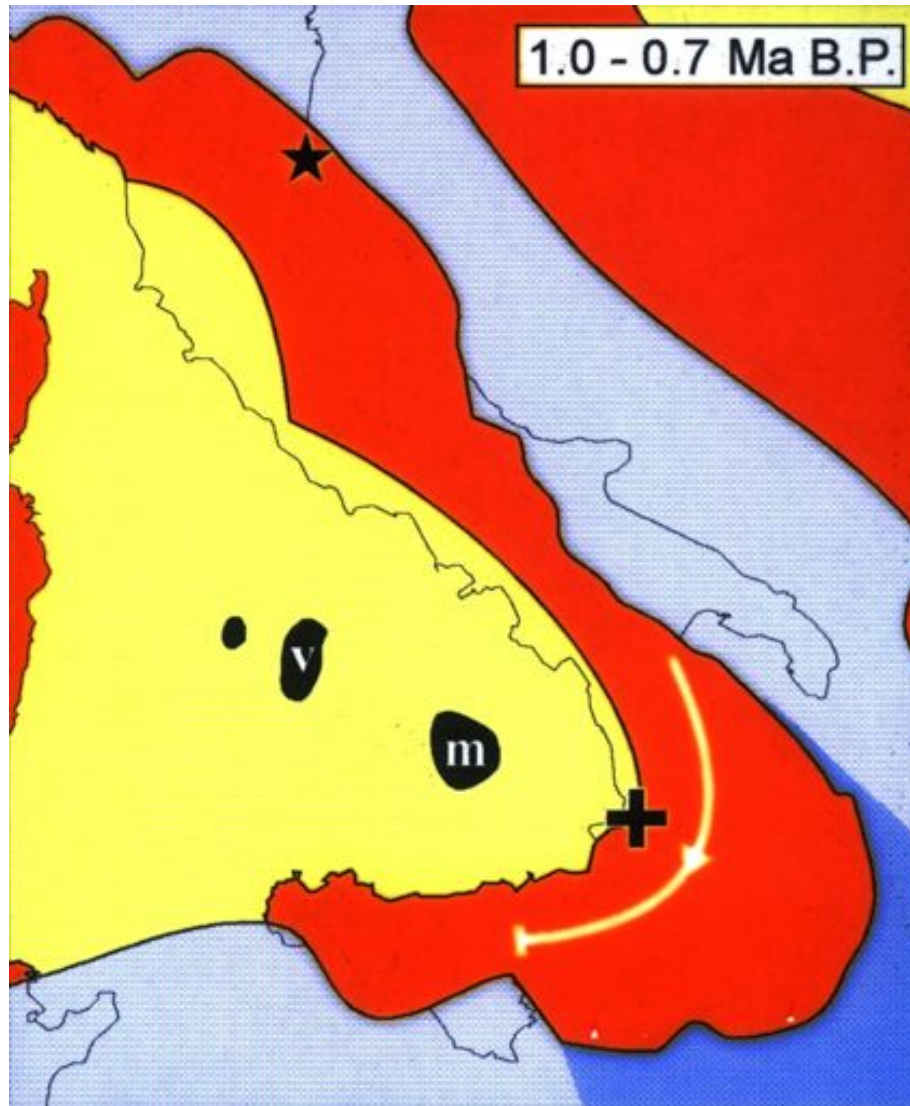
Bron: van der Meulen, 1999  
**TU Delft**



December 10, 2010 **Vertikale bewegingen en afbreken van de lithosfeer**

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Bron: van der Meulen, 1999  
**TU Delft**



December 10, 2010

## Vertikale bewegingen en afbreken van de lithosfeer

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Bron: van der Meulen, 1999  
TU Delft

"Salinity Crisis" in het Messinien  
(ca. 6 miljoen jaar geleden):

Door afsluiting van de  
Atlantische Oceaan en  
verdamping is de Middellandse  
Zee drooggevallen



Messinian salinity crisis !

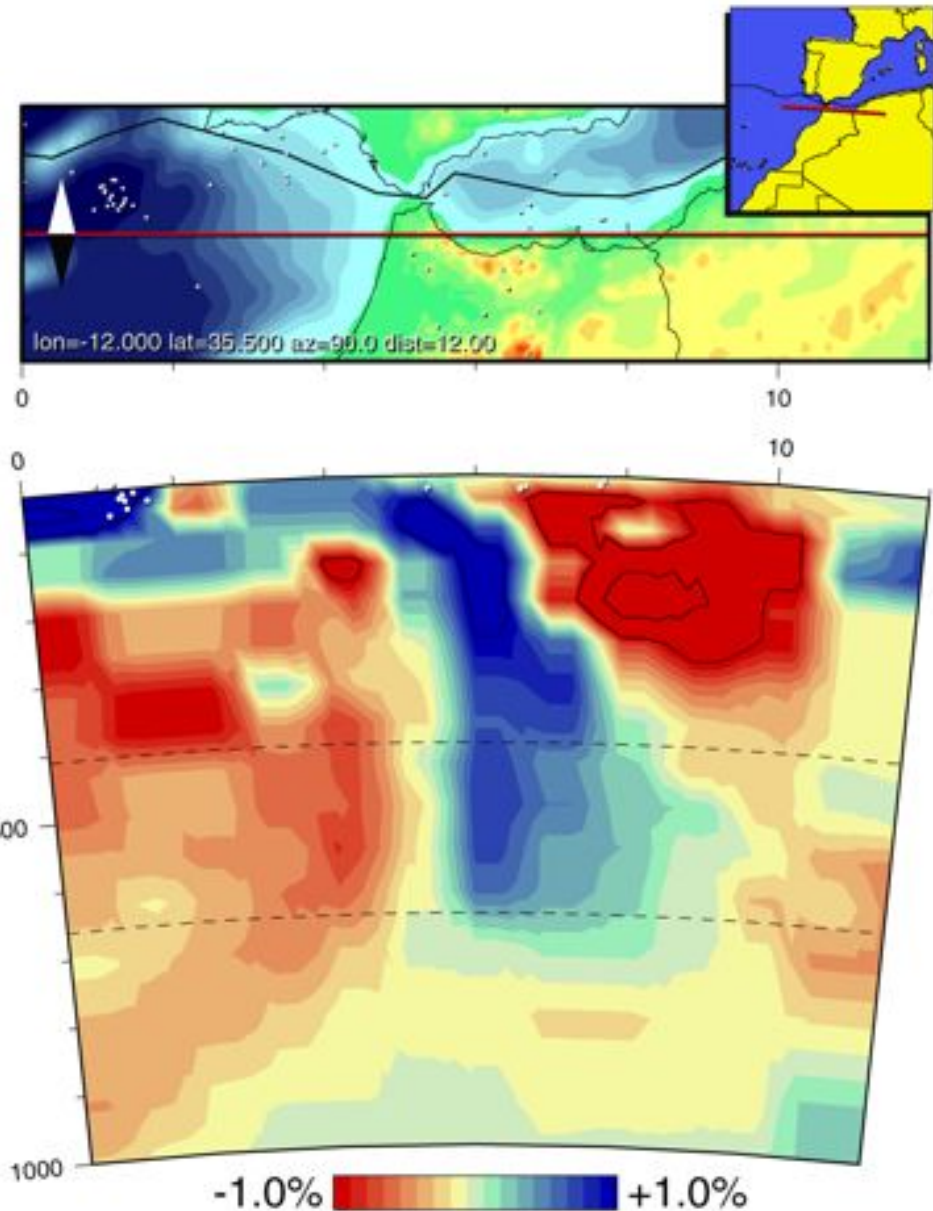


# Gibraltar boog

Onder Gibraltar boog vindt subductie plaats.

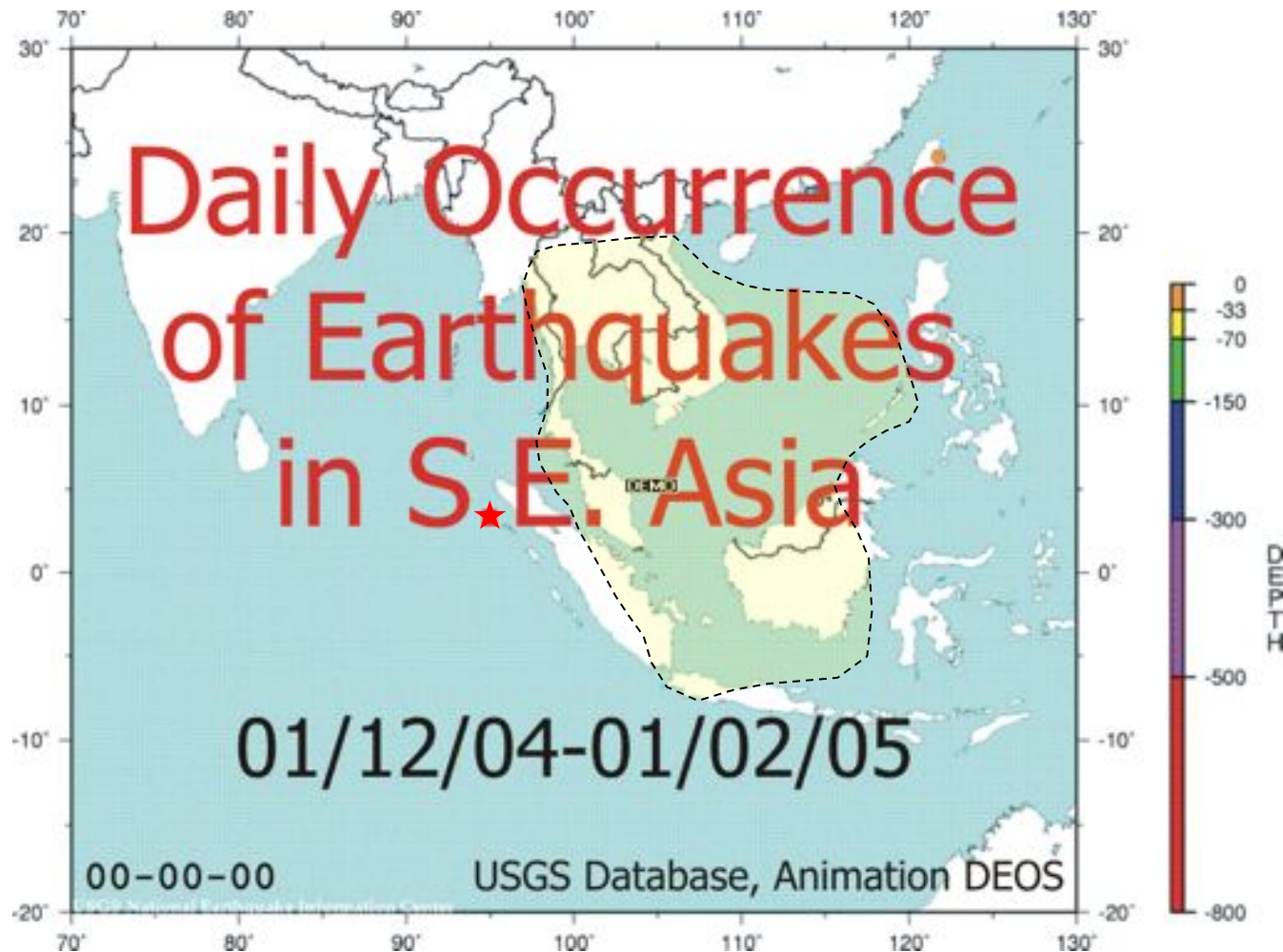
Subductie kan gepaard gaan met verticale bewegingen aan het aardoppervlak -> afsluiting van de Straat van Gibraltar.

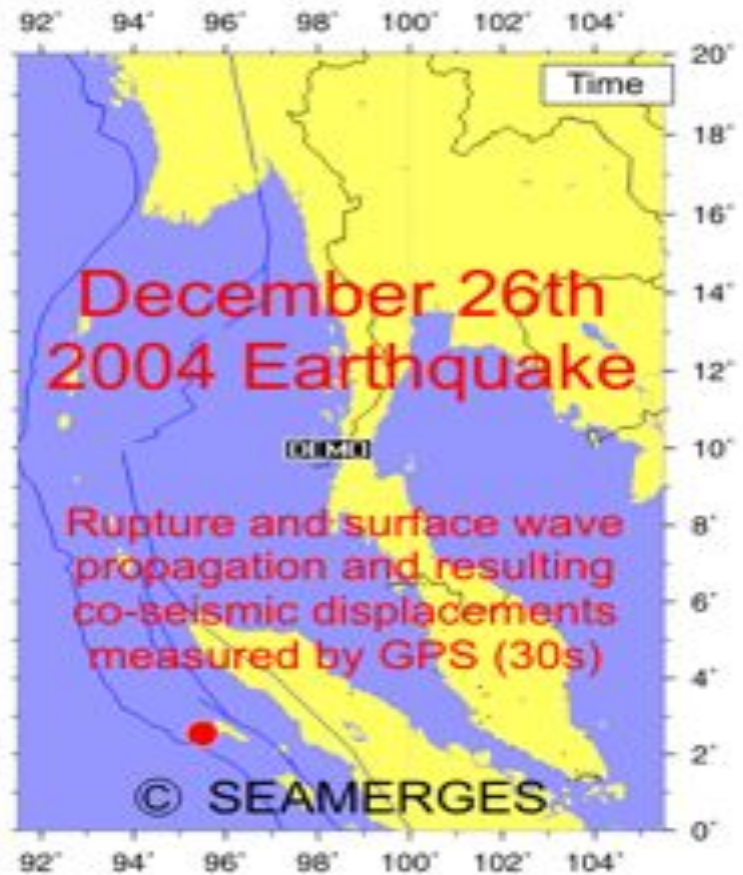
Lissabon aardbeving van 1755 heeft waarschijnlijk in deze subductiezone plaatsgevonden!



**Waarnemen**  
**is**  
**de observatie**  
**VOOR WAAR NEMEN**

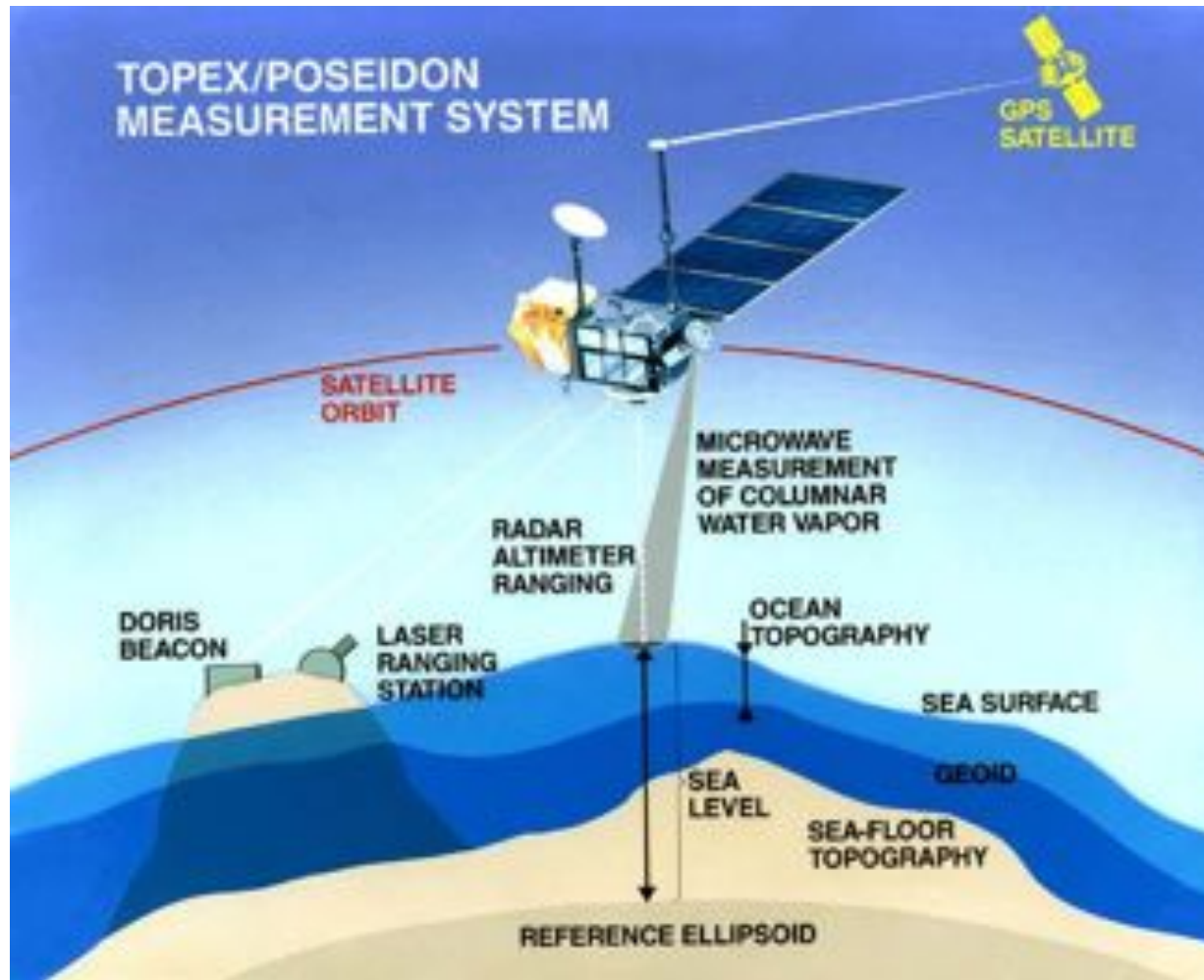
# Daily occurrence of earthquakes in SE Asia

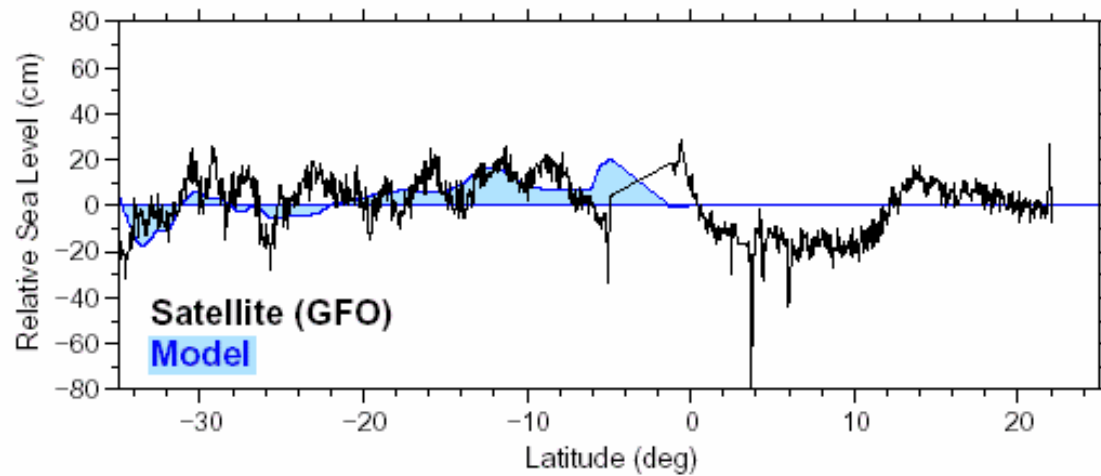
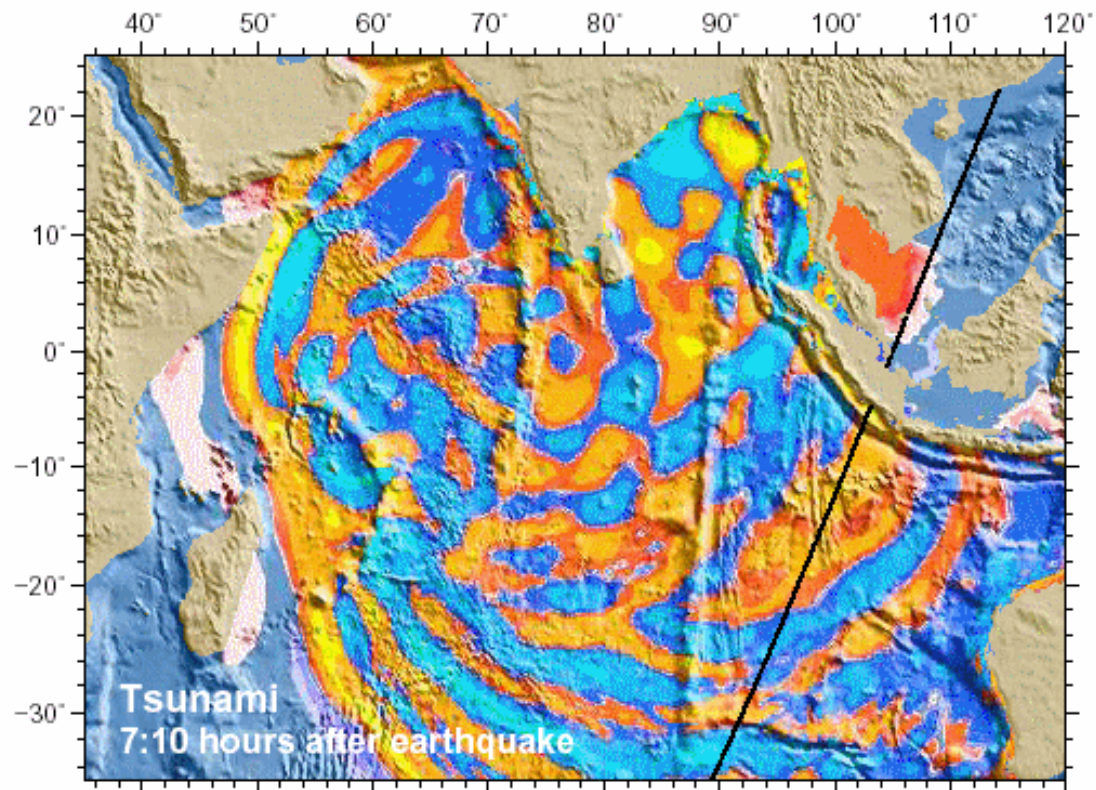




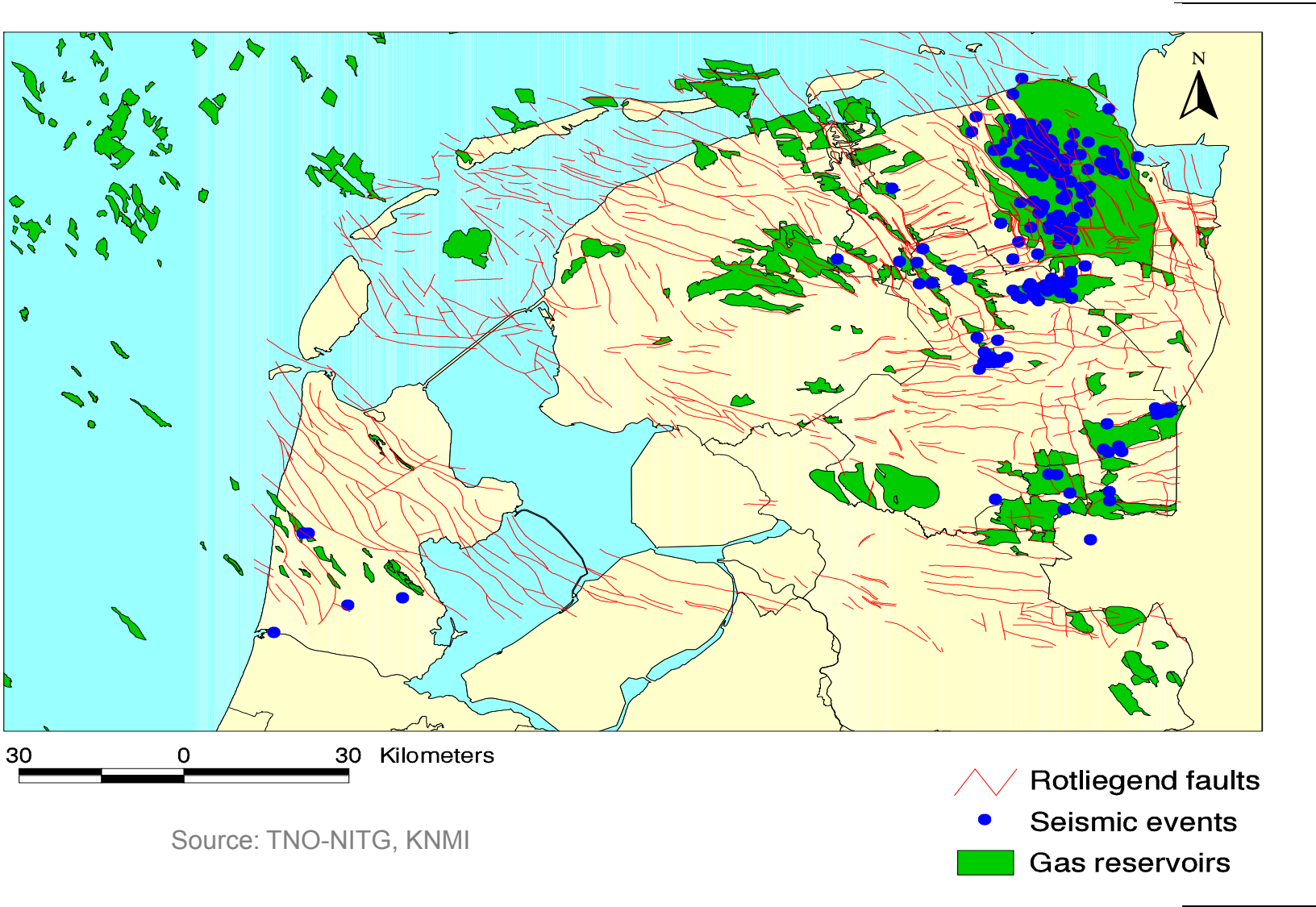
<http://www.deos.tudelft.nl/seamerges>

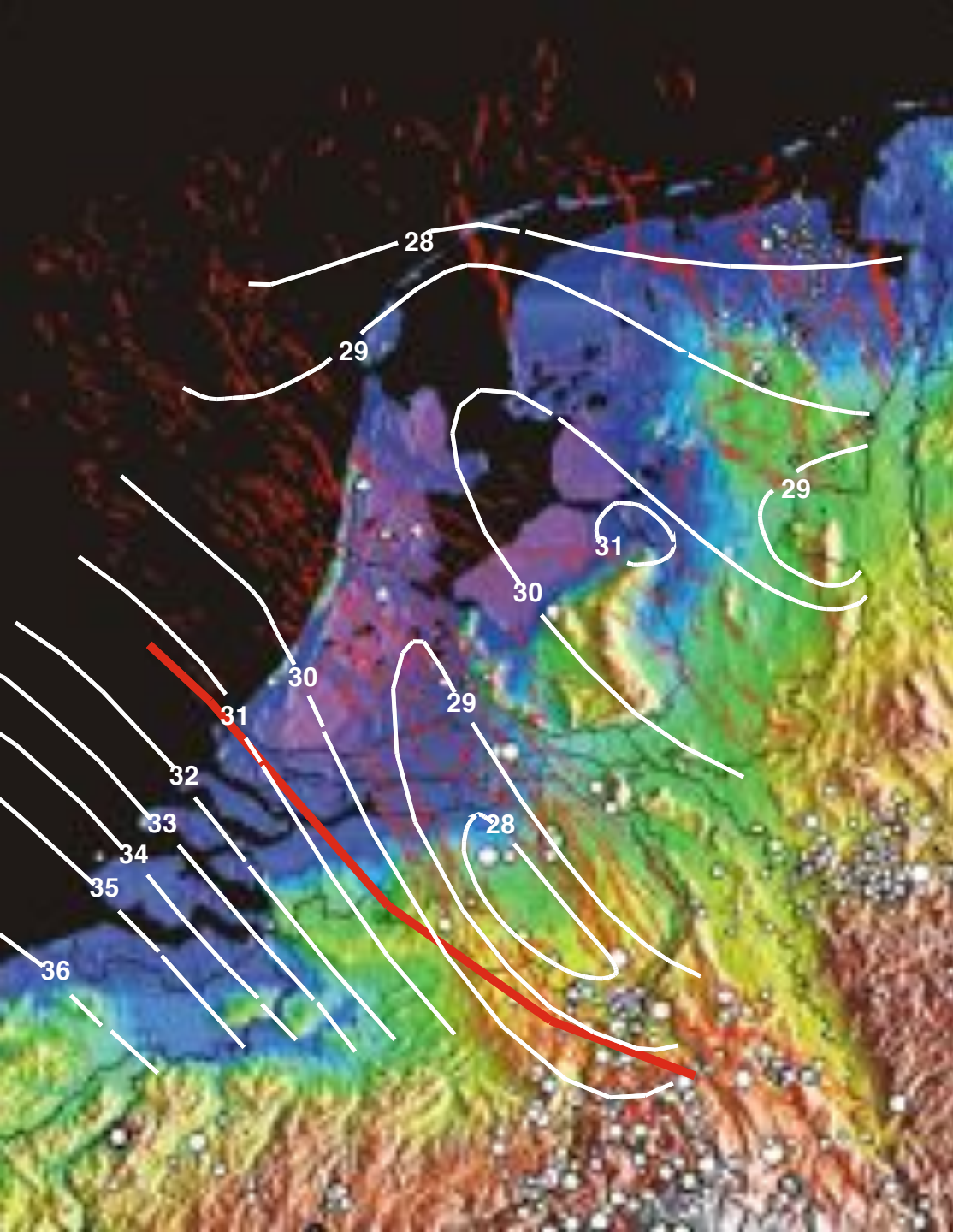
# Satellite altimetry





# Gas Reservoirs in Nederland





Recente seismische activiteit en diepe structuur van de Nederlandse ondergrond



# Geofysica en infr

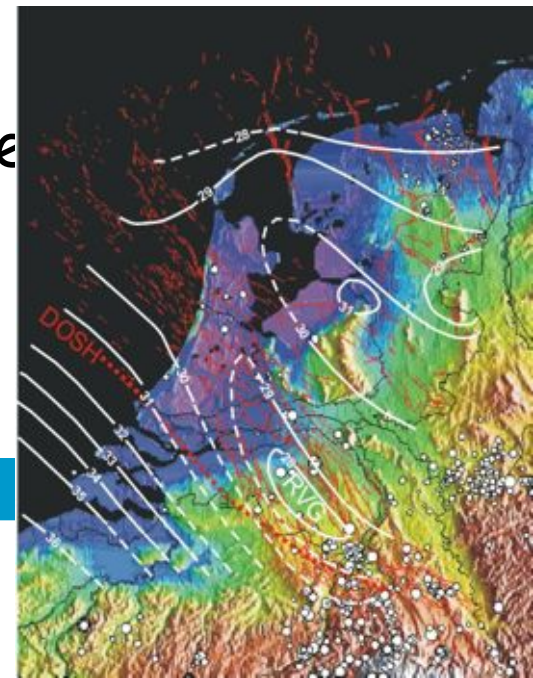
Nederland lijkt stabiel, n



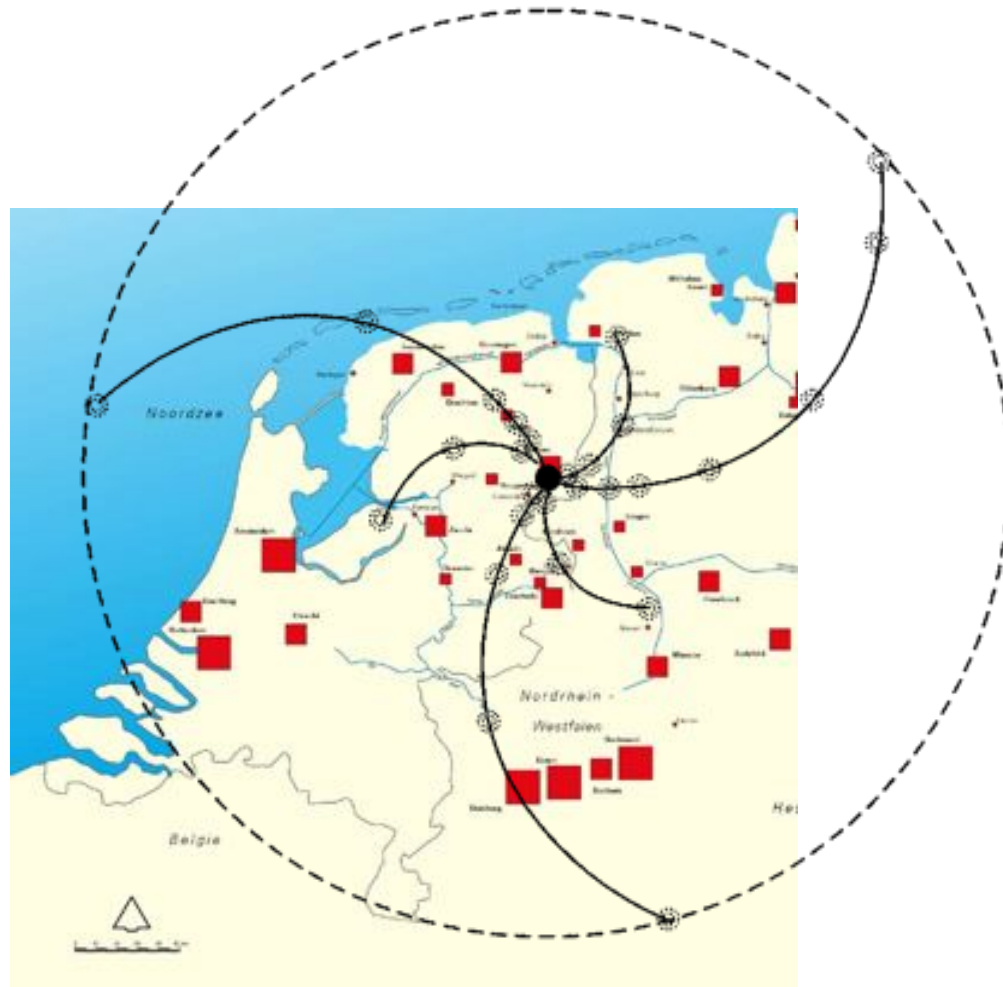
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# LOFAR



# Triaxial Pressure Machine



D

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**FASCINATIE + AMBITIE**



December 10, 2010

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En dan begint de fascinatie **TU**Delft