

## Appendix A3: Time Series Full Scale Column Influent and Effluent Constituent Concentration Breakthrough Plots

This appendix shows sets of line graphs illustrating effluent concentrations as a function of total treated water volume, If the effluent concentrations approach the influent concentrations, then breakthrough is assumed to have occurred. If the effluent concentrations decrease with use, then performance would be improving with “aging” of the filter media.

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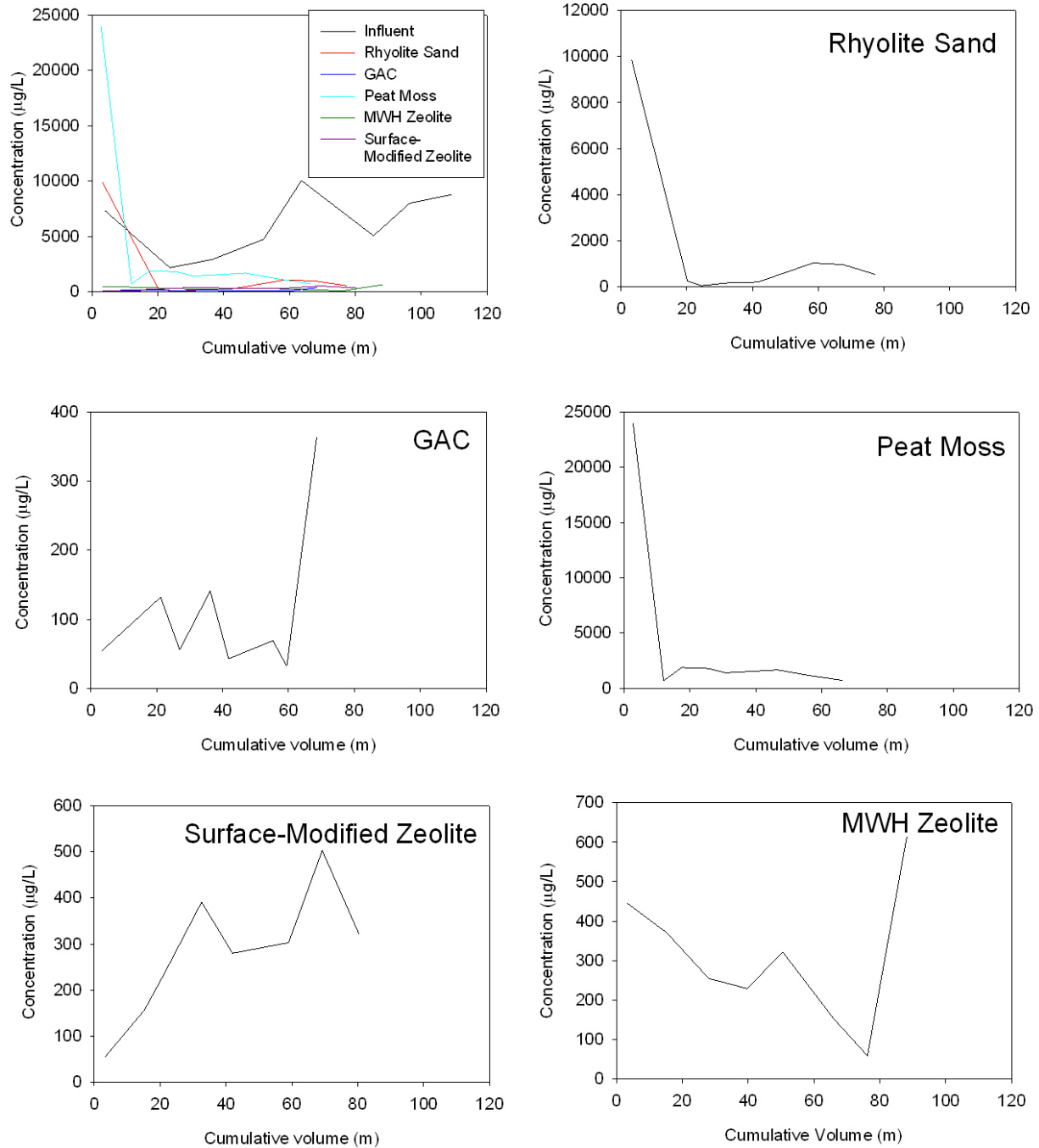
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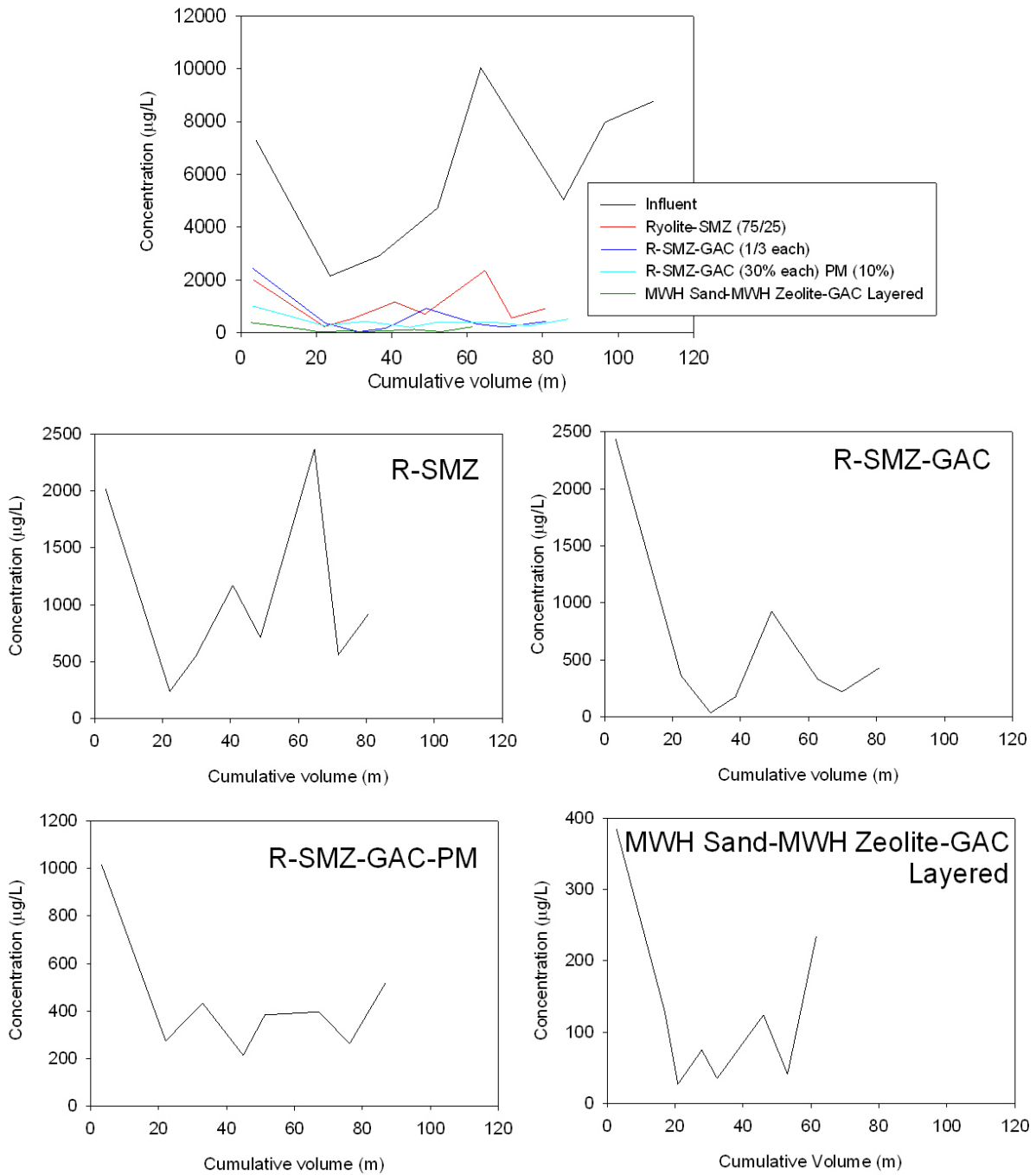
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## Aluminum, Total: Column Breakthrough Testing



**Figure A3-1. Breakthrough plots for total aluminum.**

## Aluminum, Total: Column Breakthrough Testing



**Figure A3-1. Breakthrough plots for total aluminum (cont).**

## Aluminum, Filtered: Column Breakthrough Testing

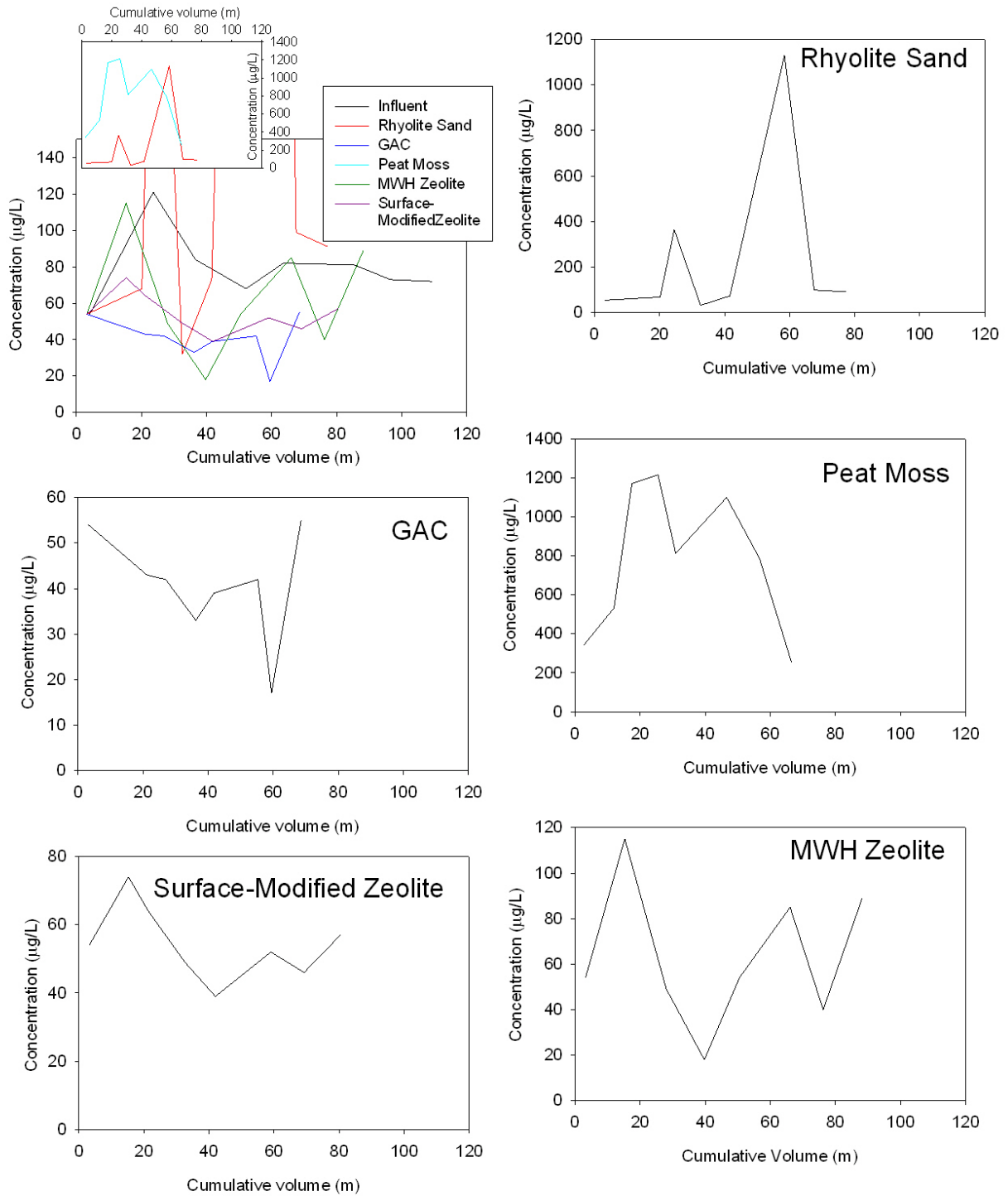
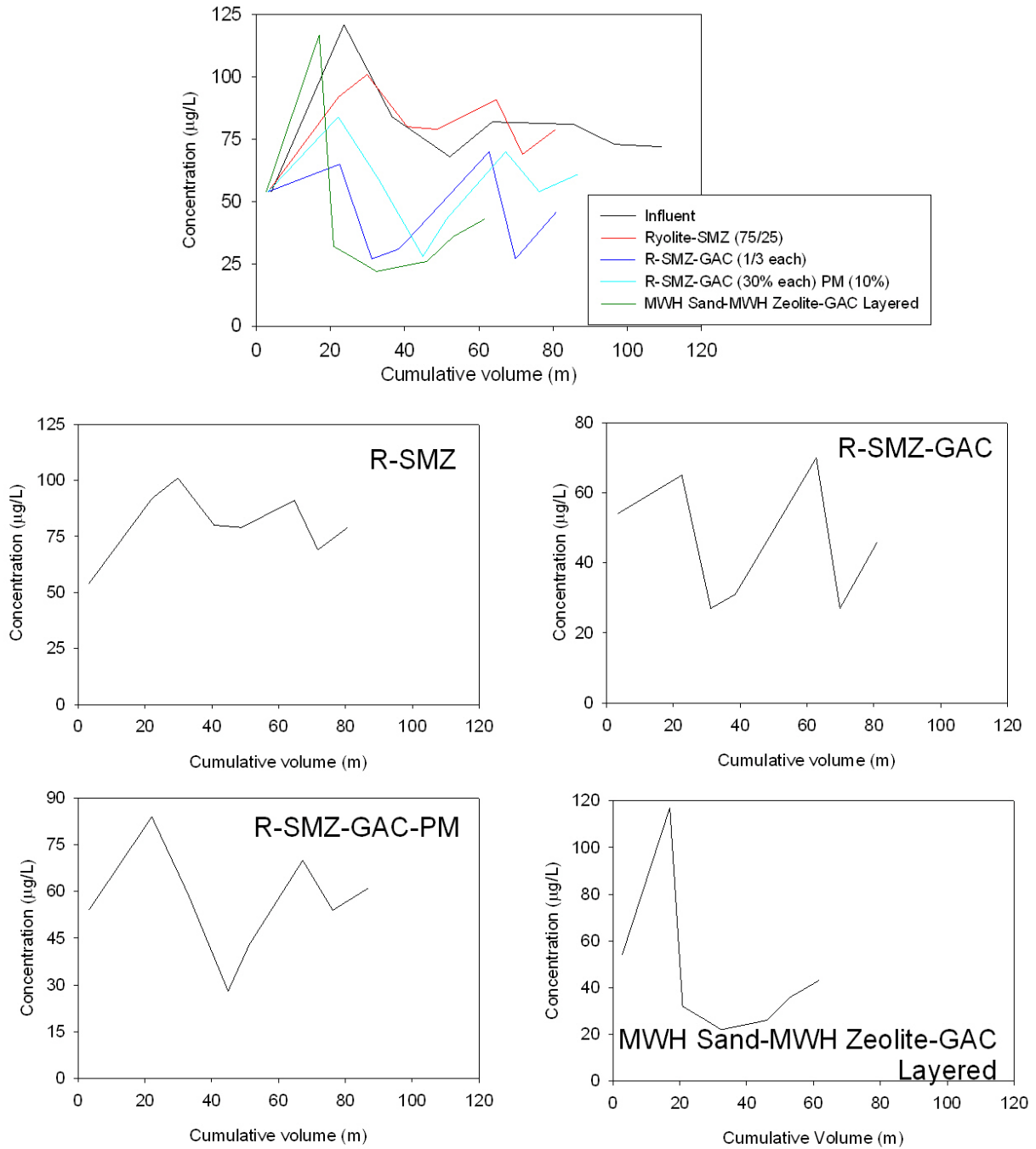


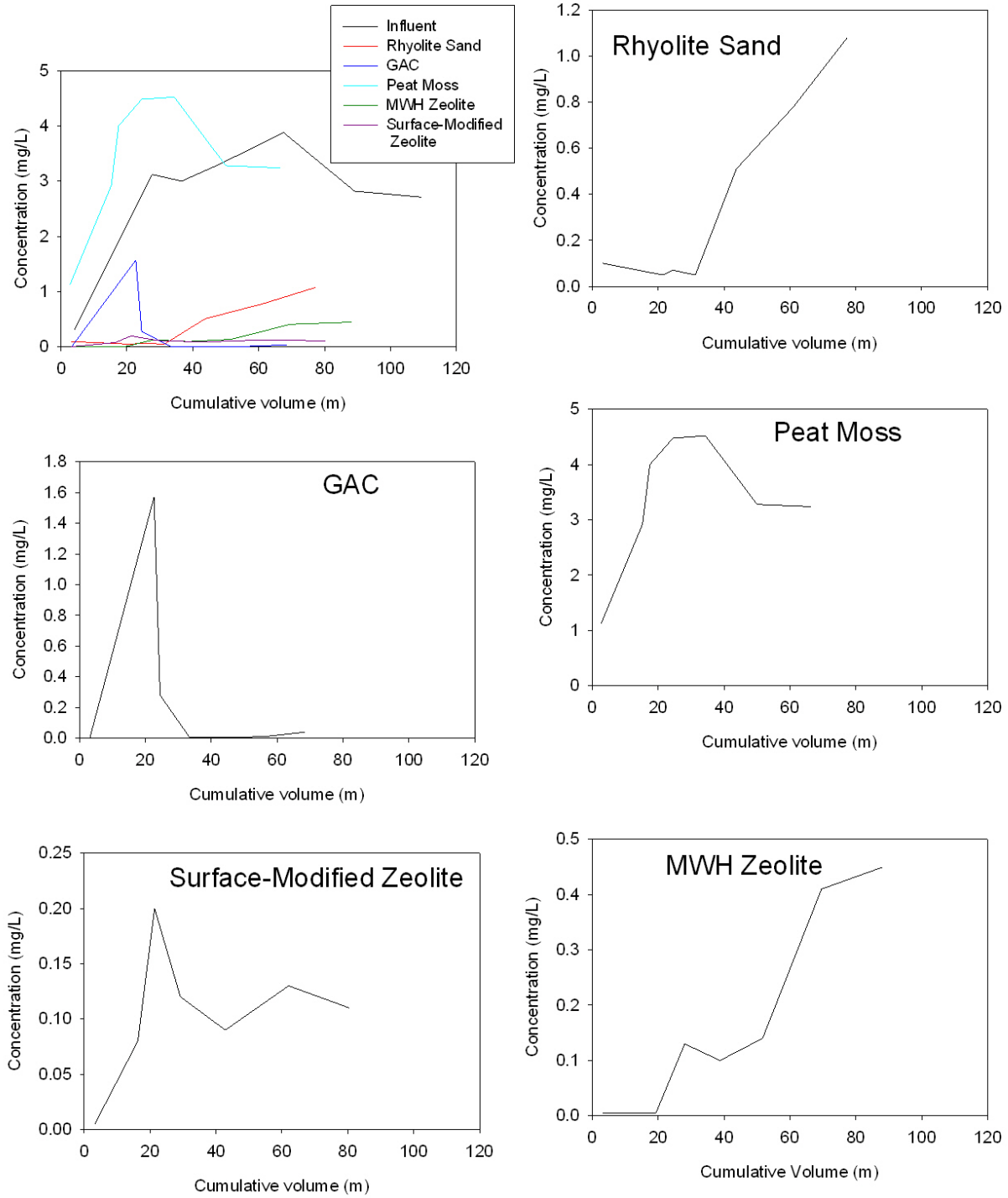
Figure A3-2. Breakthrough plots for filtered aluminum.

## Aluminum, Filtered: Column Breakthrough Testing



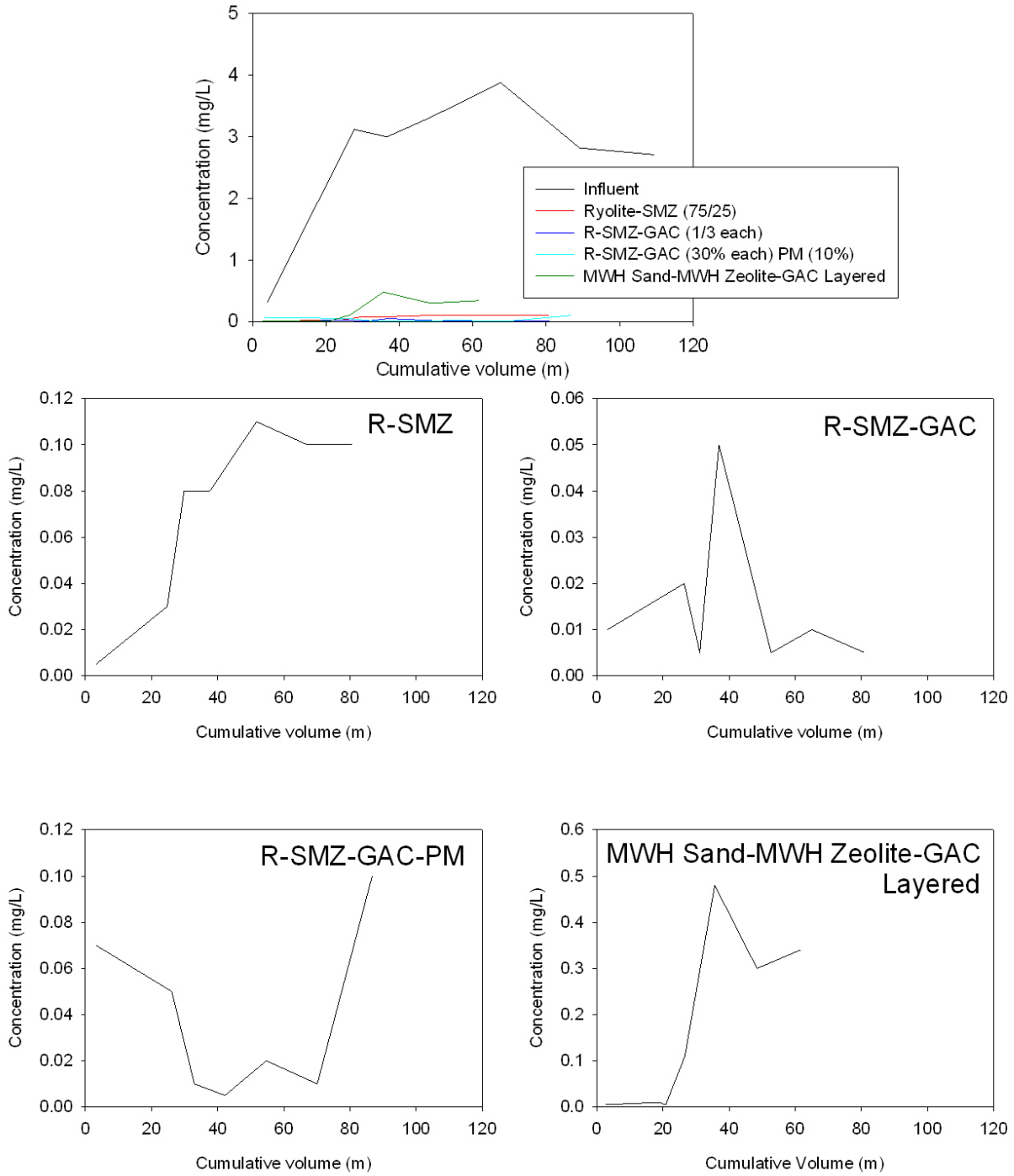
**Figure A3-2. Breakthrough plots for filtered aluminum (cont).**

## Ammonia-N: Column Breakthrough Testing



**Figure A3-3. Breakthrough plots for ammonia nitrogen.**

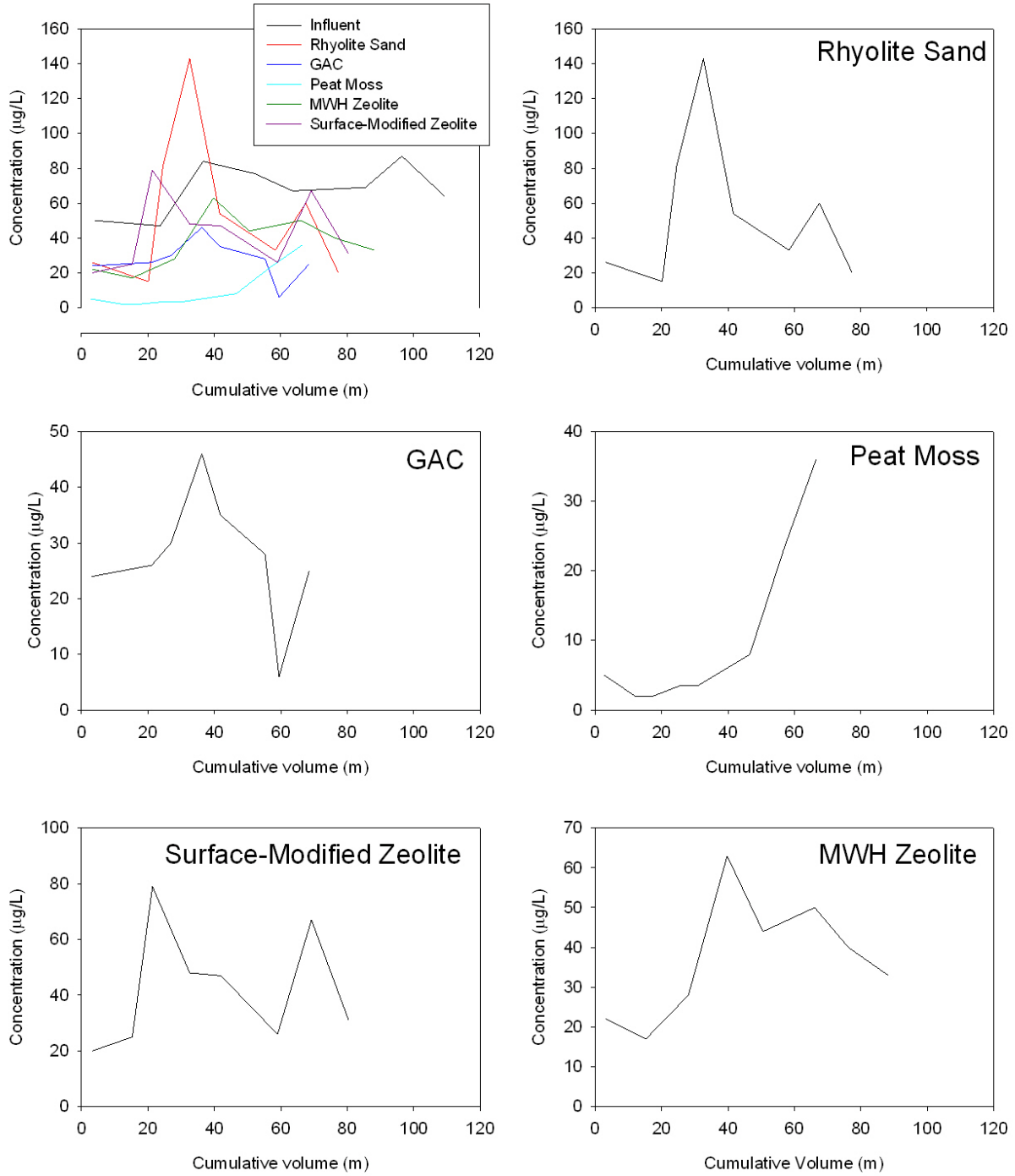
## Ammonia-N: Column Breakthrough Testing



**Figure A3-3. Breakthrough plots for ammonia nitrogen (cont.).**

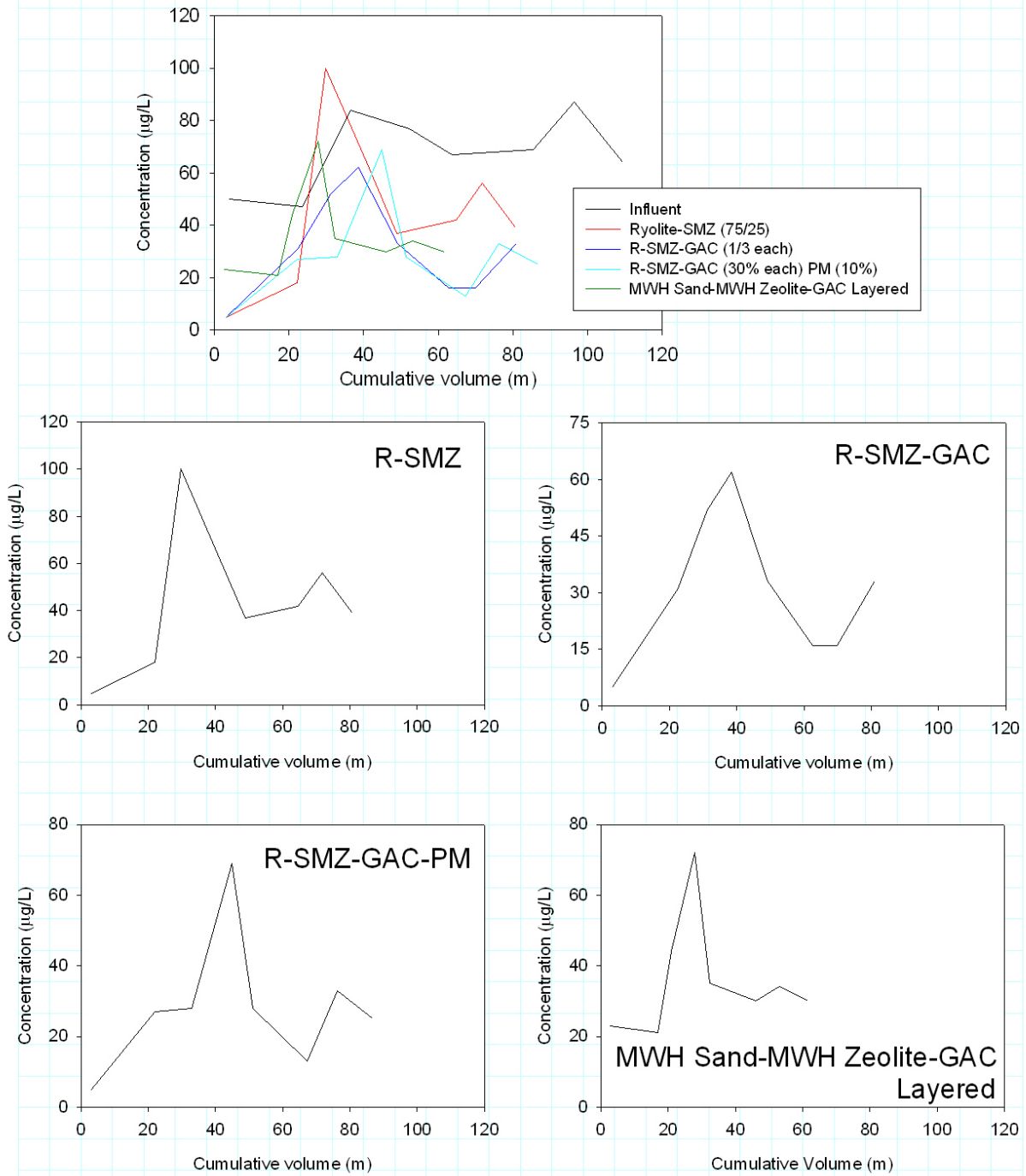


## Antimony, Total: Column Breakthrough Testing



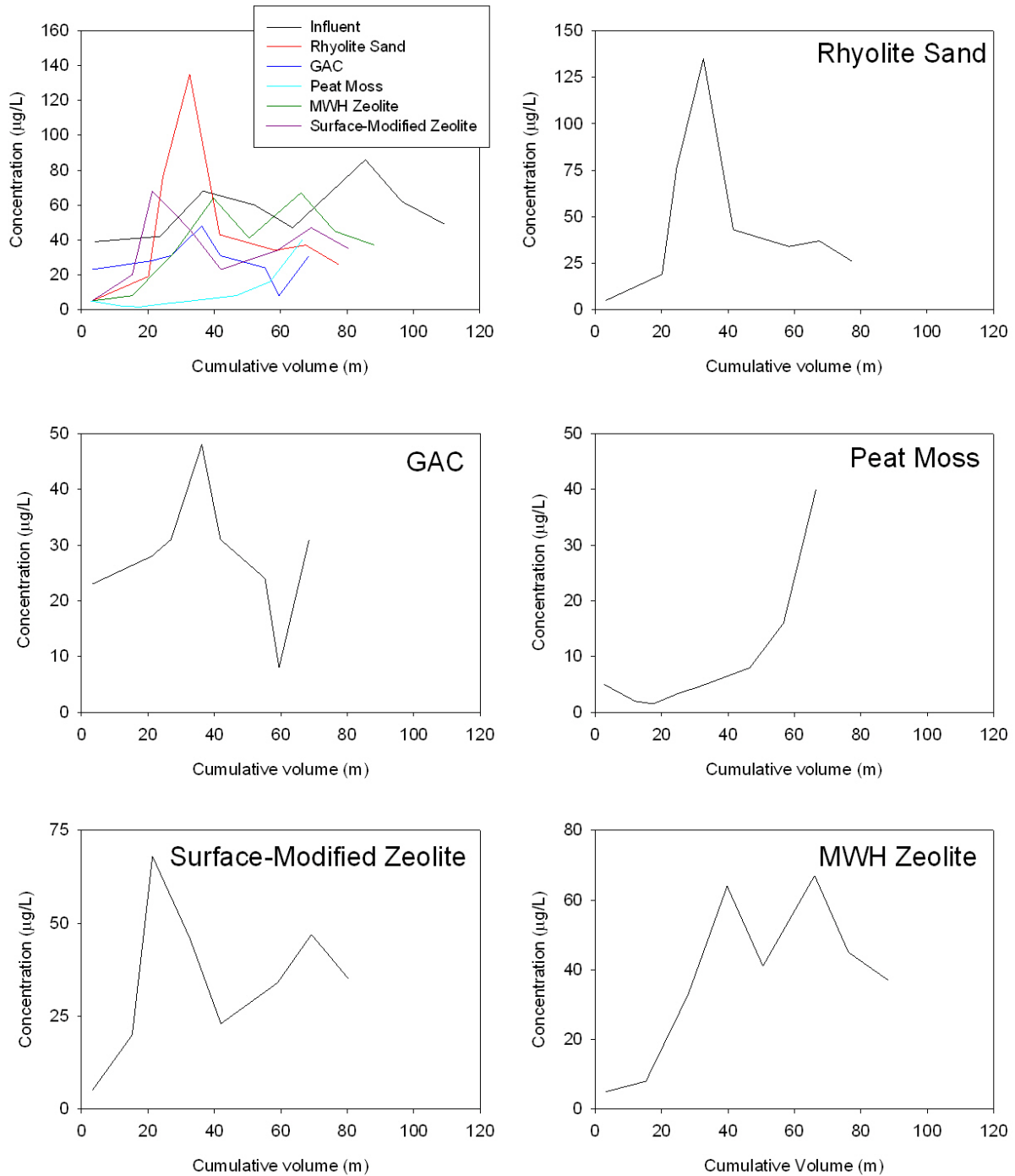
**Figure A3-4. Breakthrough plots for total antimony.**

## Antimony, Total: Column Breakthrough Testing



**Figure A3-4. Breakthrough plots for total antimony (cont).**

## Antimony, Filtered: Column Breakthrough Testing



**Figure A3-5. Breakthrough plots for filtered antimony.**

## Antimony, Filtered: Column Breakthrough Testing

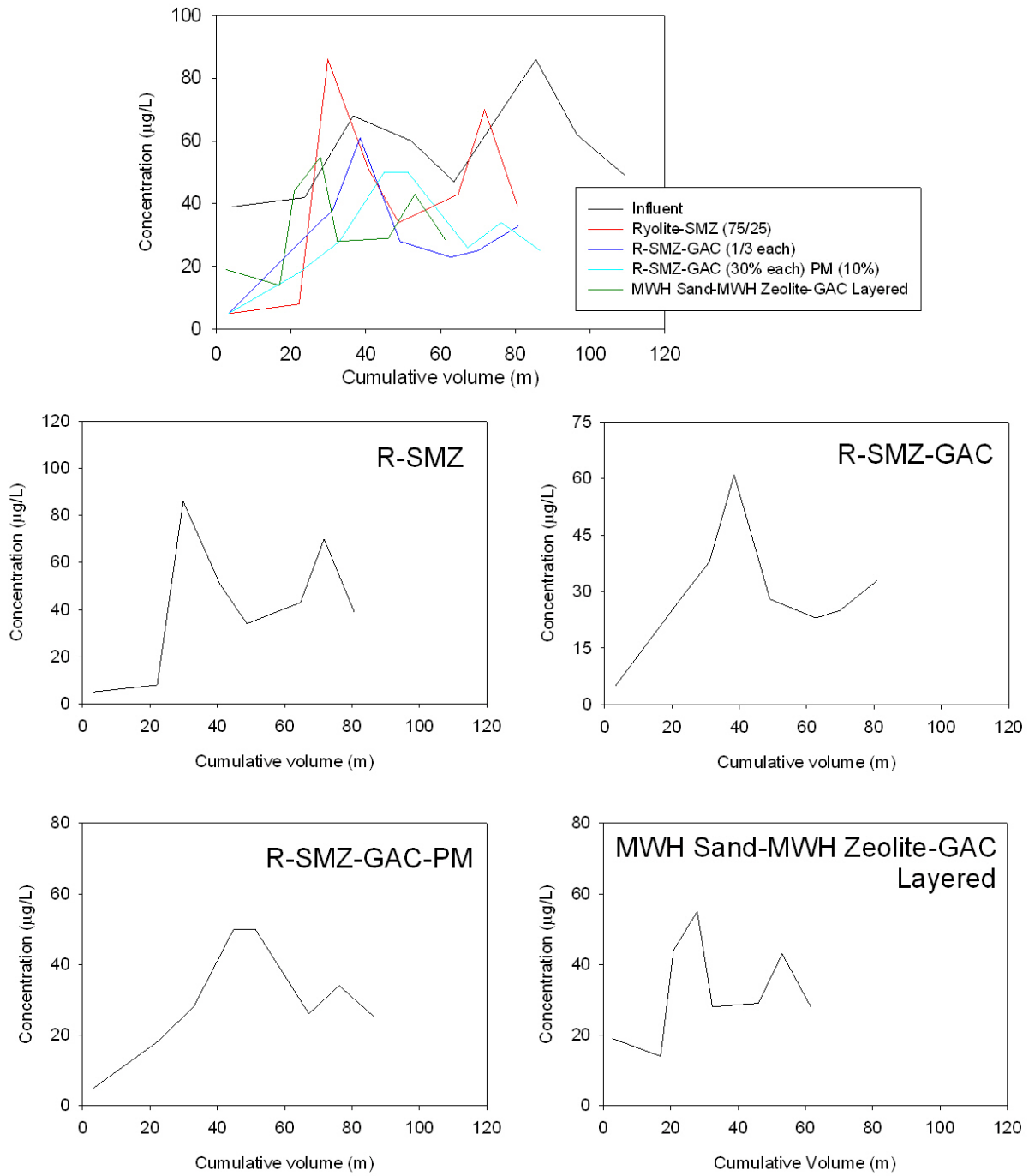
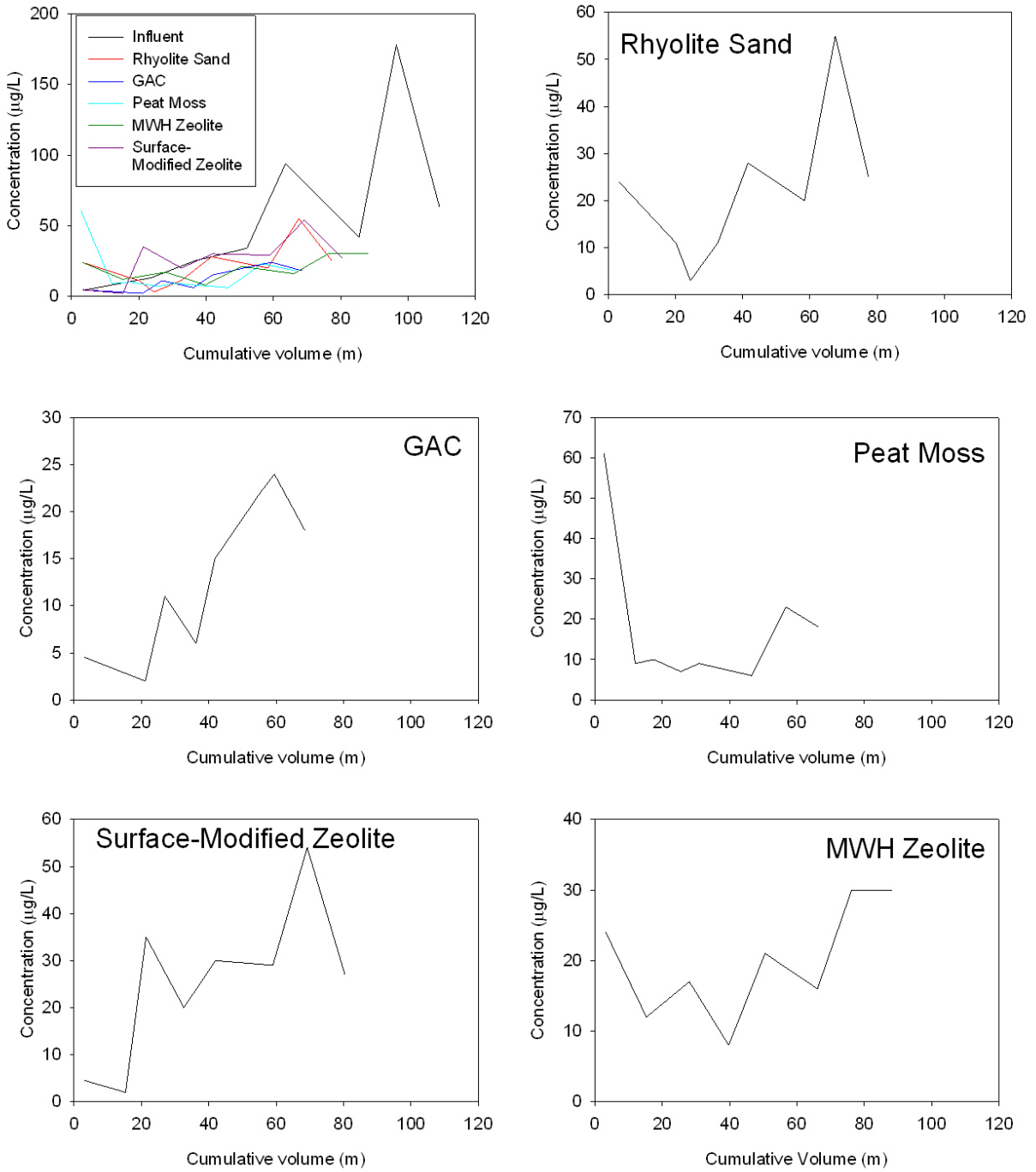


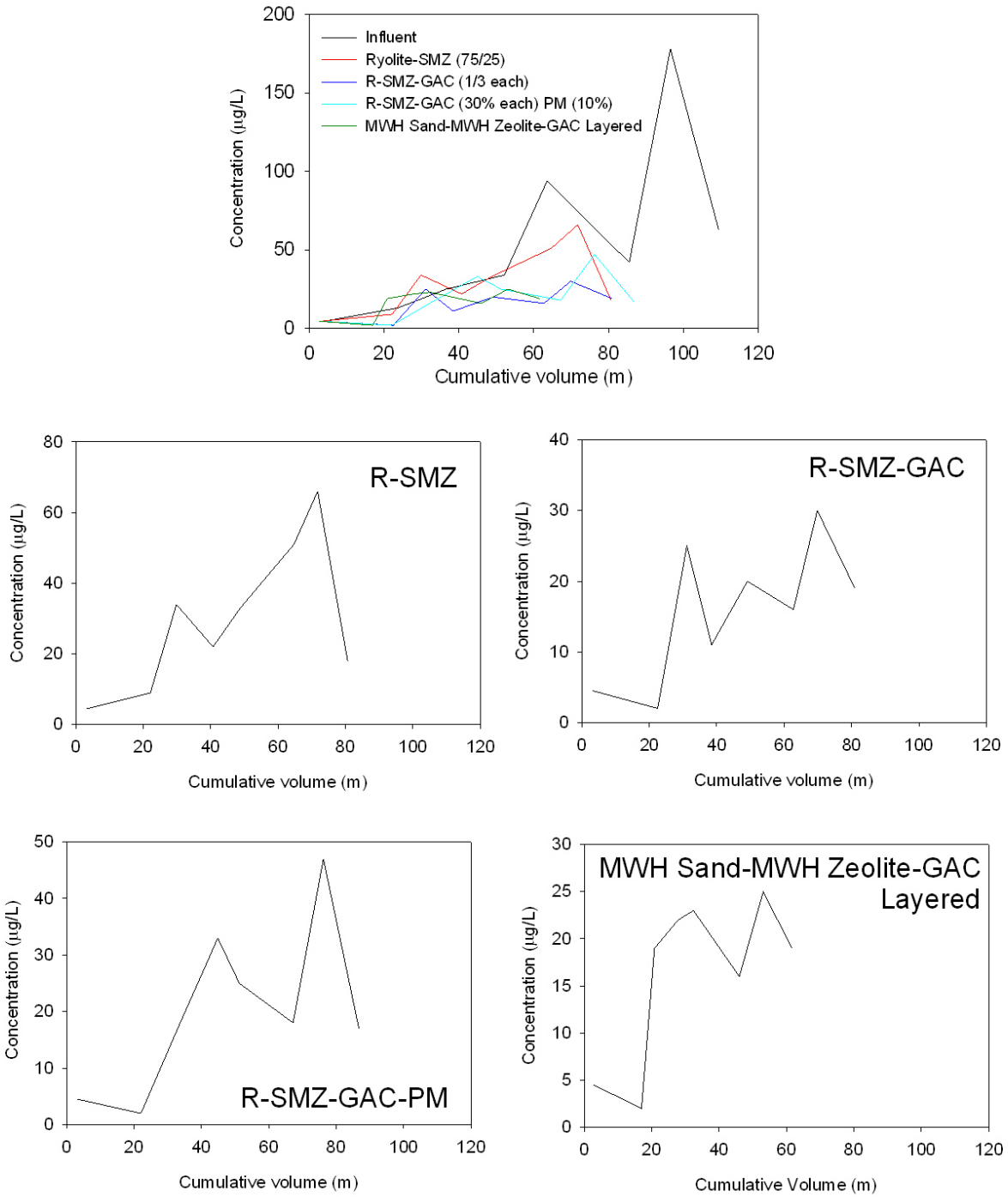
Figure A3-5. Breakthrough plots for filtered antimony (cont.).

## Arsenic, Total: Column Breakthrough Testing



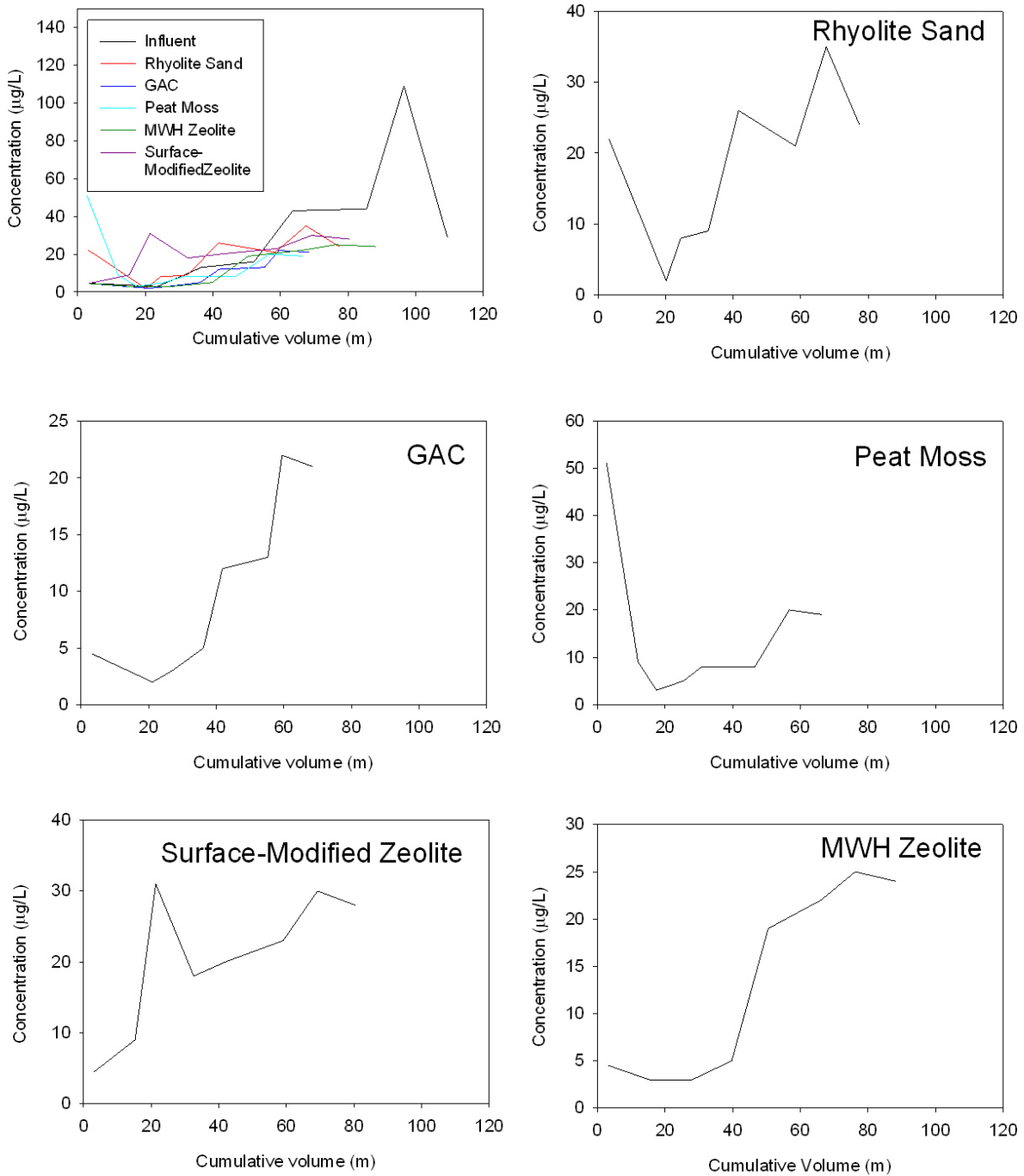
**Figure A3-6. Breakthrough plots for total arsenic.**

## Arsenic, Total: Column Breakthrough Testing



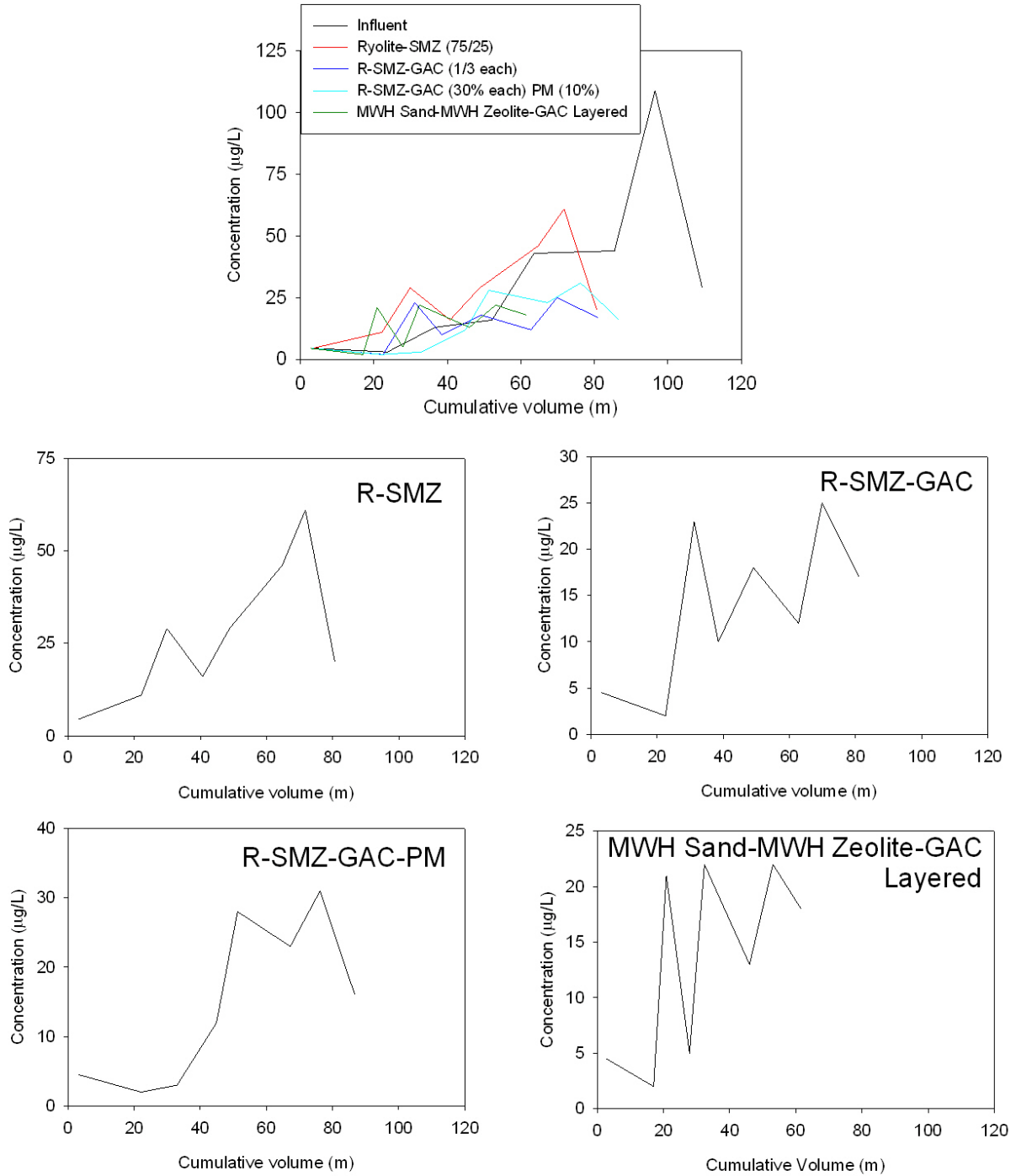
**Figure A3-6. Breakthrough plots for total arsenic (cont.).**

## Arsenic, Filtered: Column Breakthrough Testing



**Figure A3-7. Breakthrough plots for filtered arsenic.**

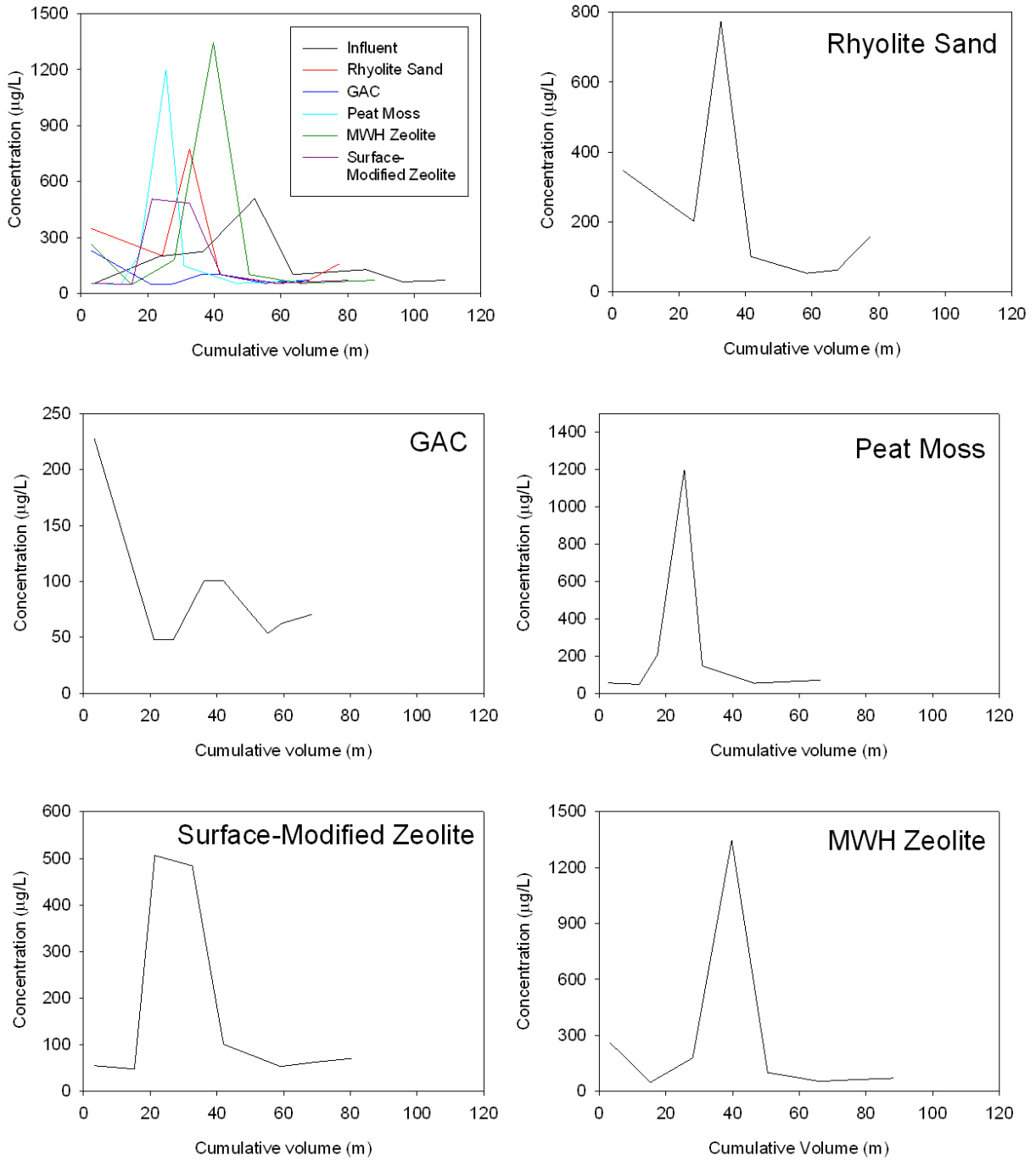
## Arsenic, Filtered: Column Breakthrough Testing



**Figure A3-7. Breakthrough plots for filtered arsenic (cont.).**

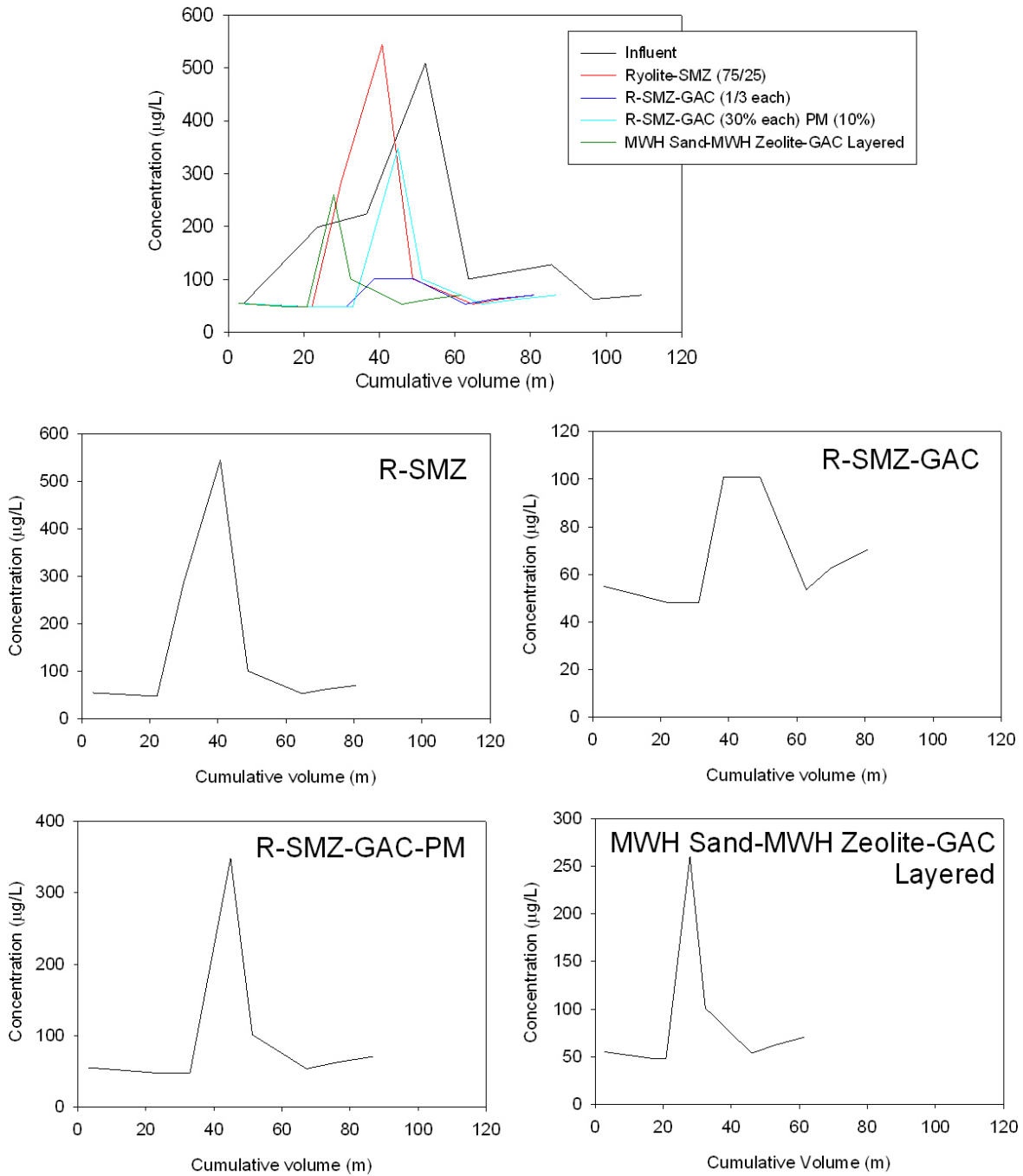


## Boron, Total: Column Breakthrough Testing



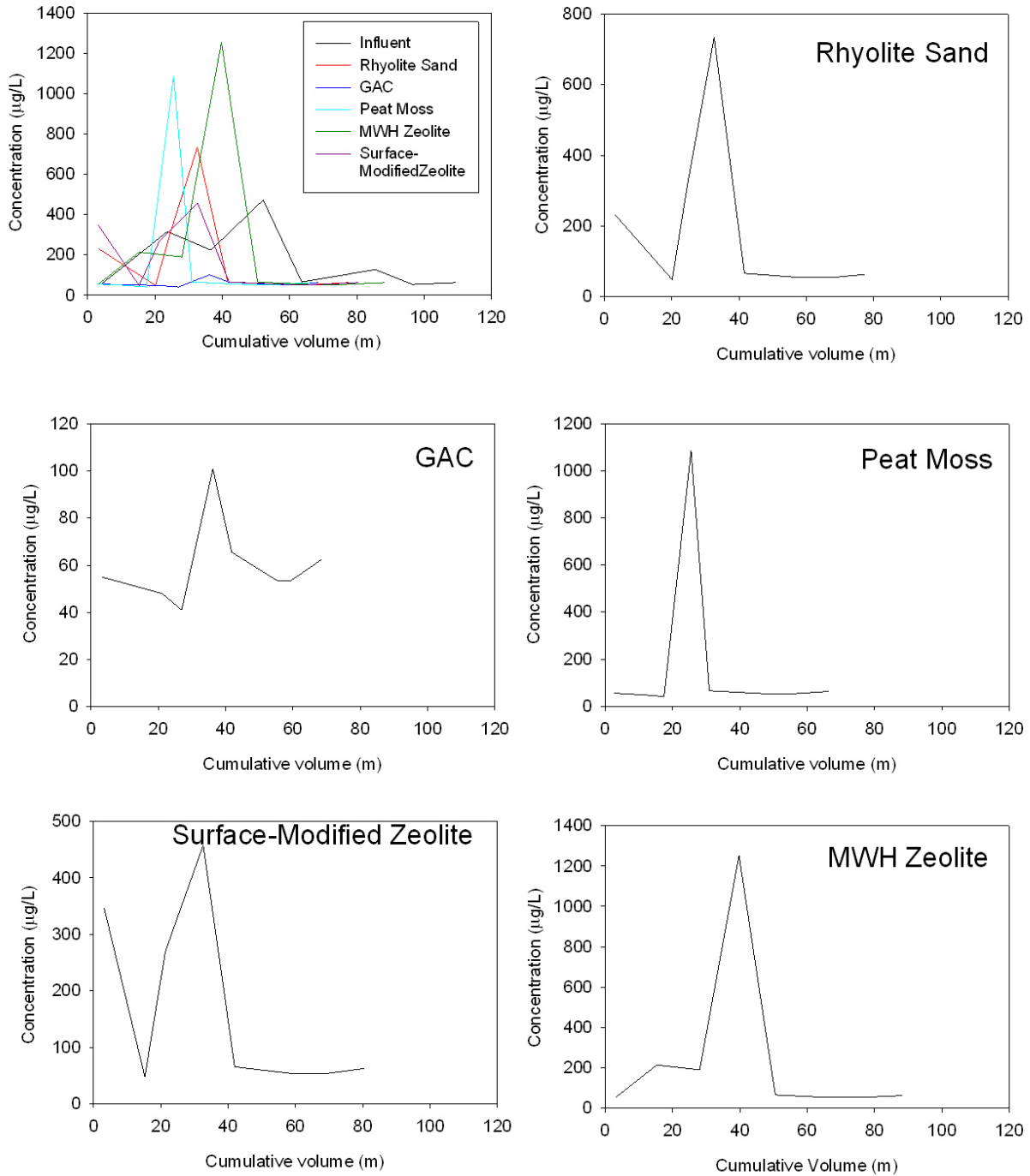
**Figure A3-8. Breakthrough plots for total boron.**

## Boron, Total: Column Breakthrough Testing



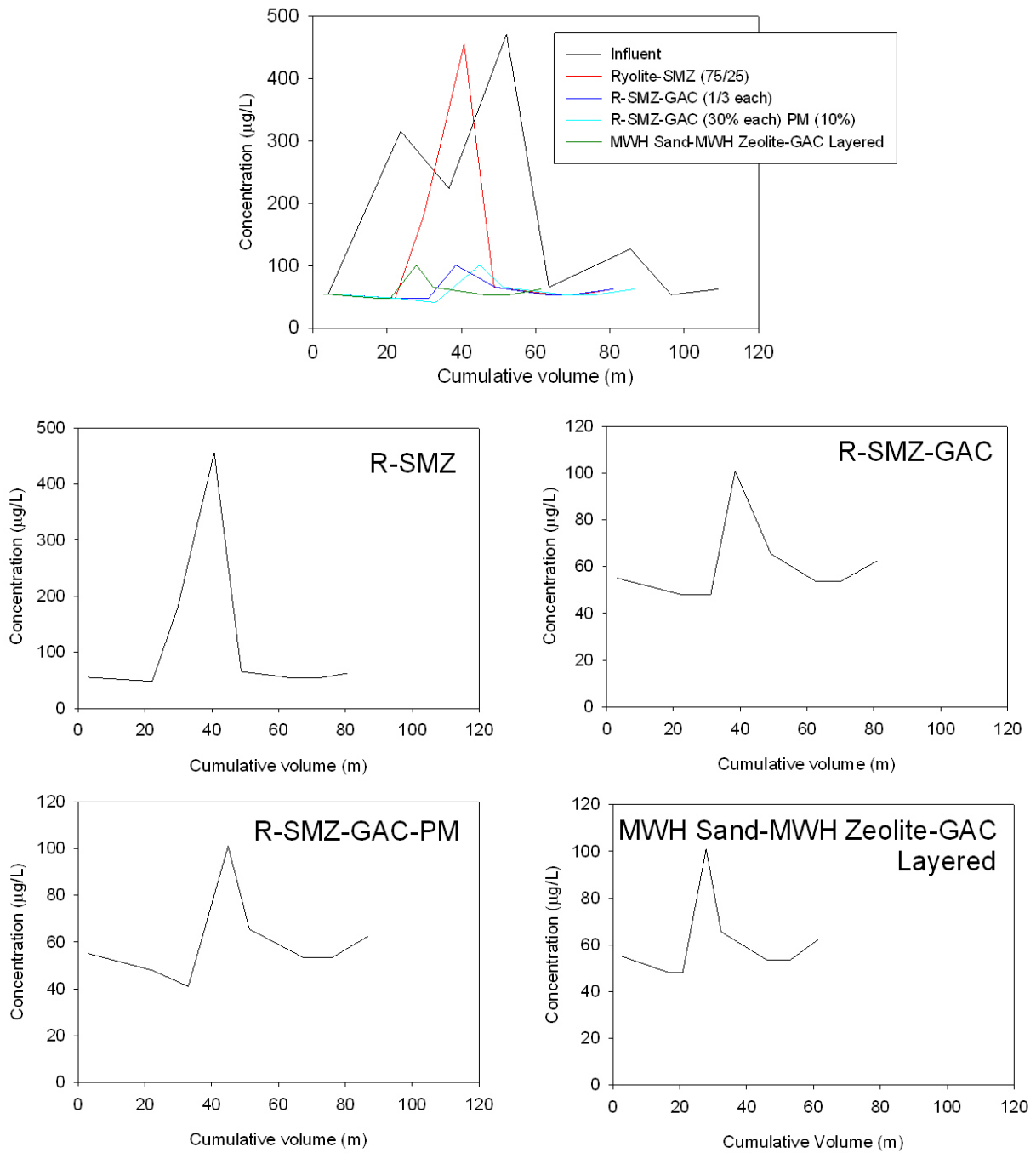
**Figure A3-8. Breakthrough plots for total boron (cont.).**

## Boron, Filtered: Column Breakthrough Testing



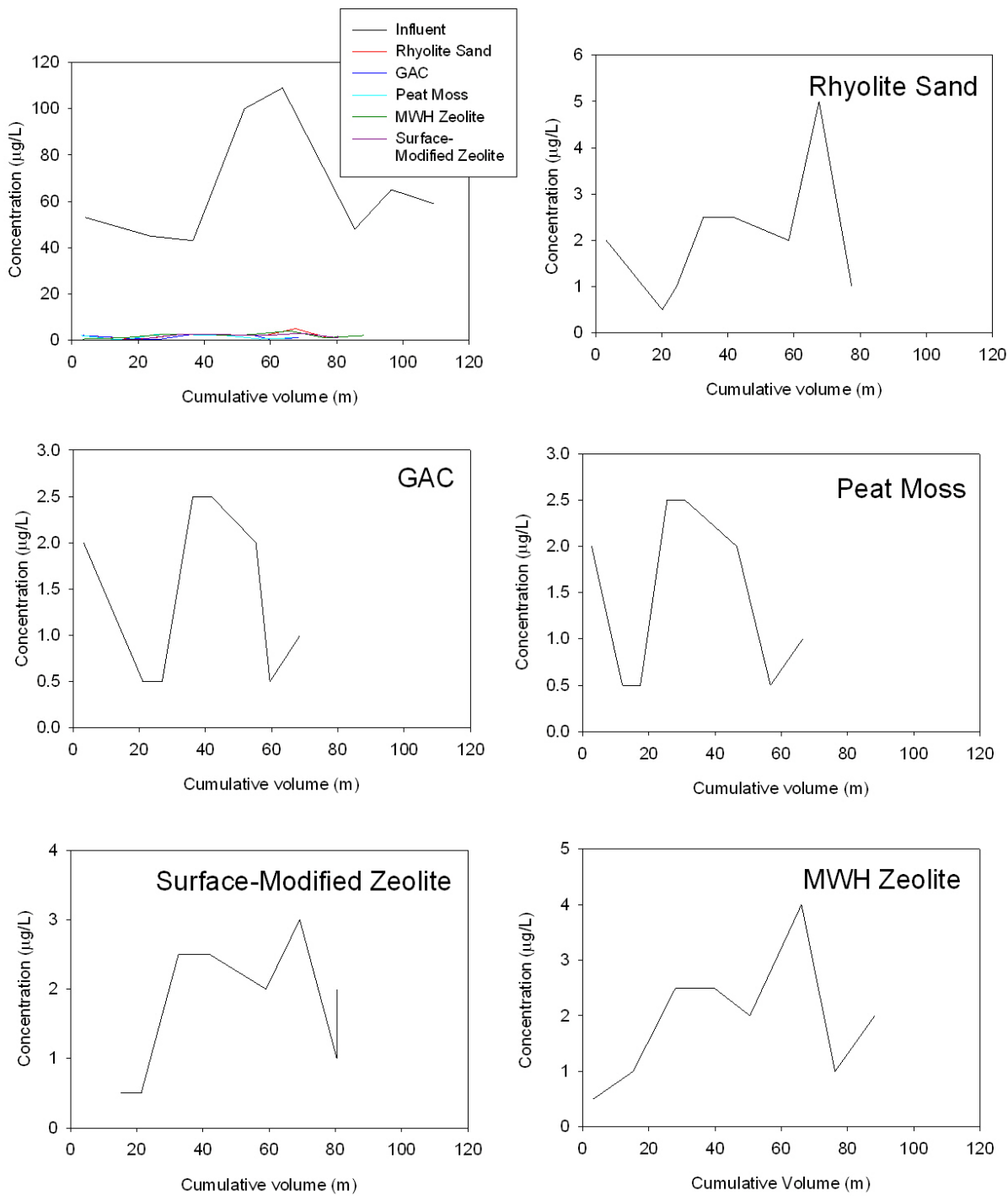
**Figure A3-9. Breakthrough plots for filtered boron.**

## Boron, Filtered: Column Breakthrough Testing



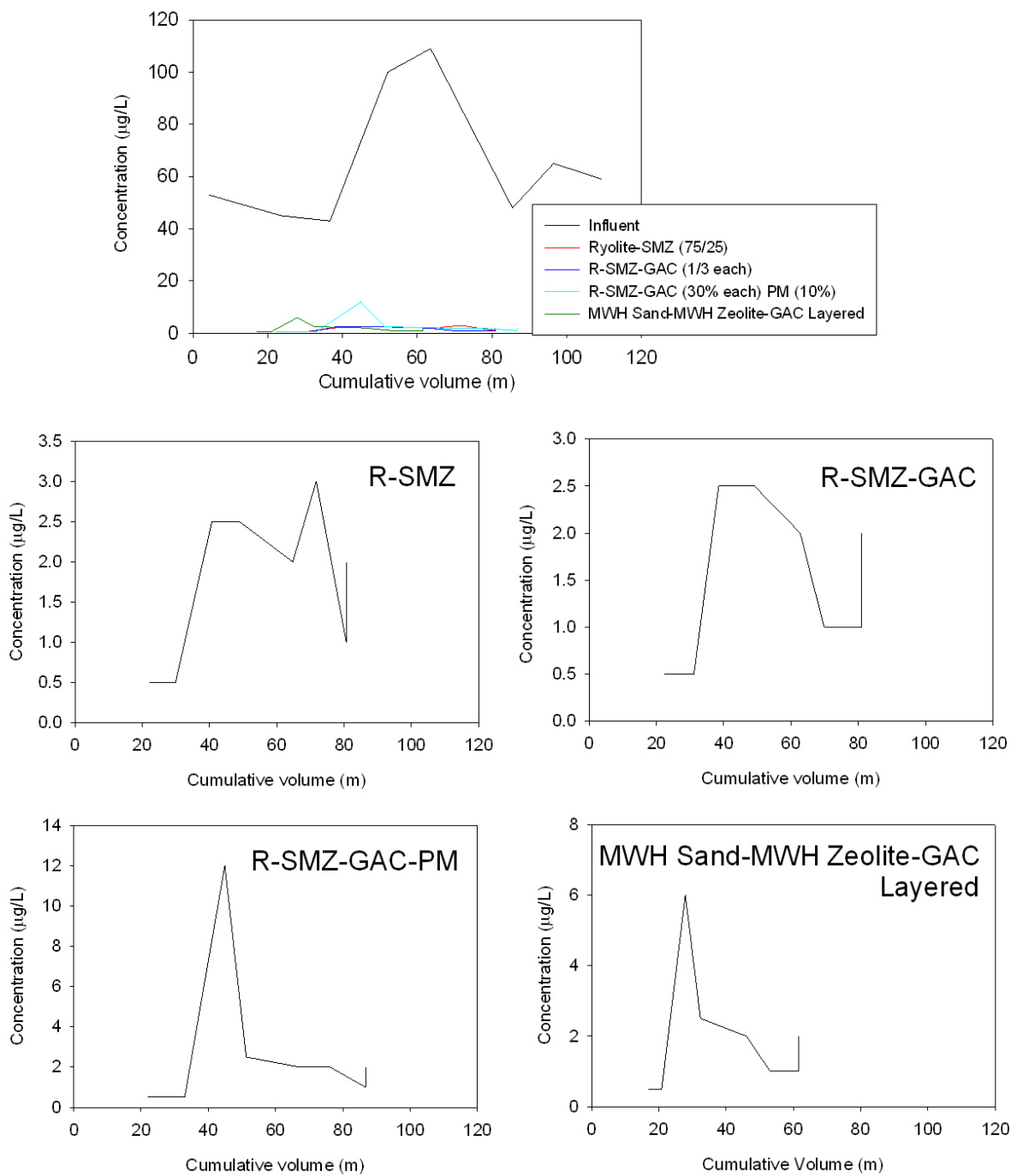
**Figure A3-9. Breakthrough plots for filtered boron (cont.).**

## Cadmium, Total: Column Breakthrough Testing



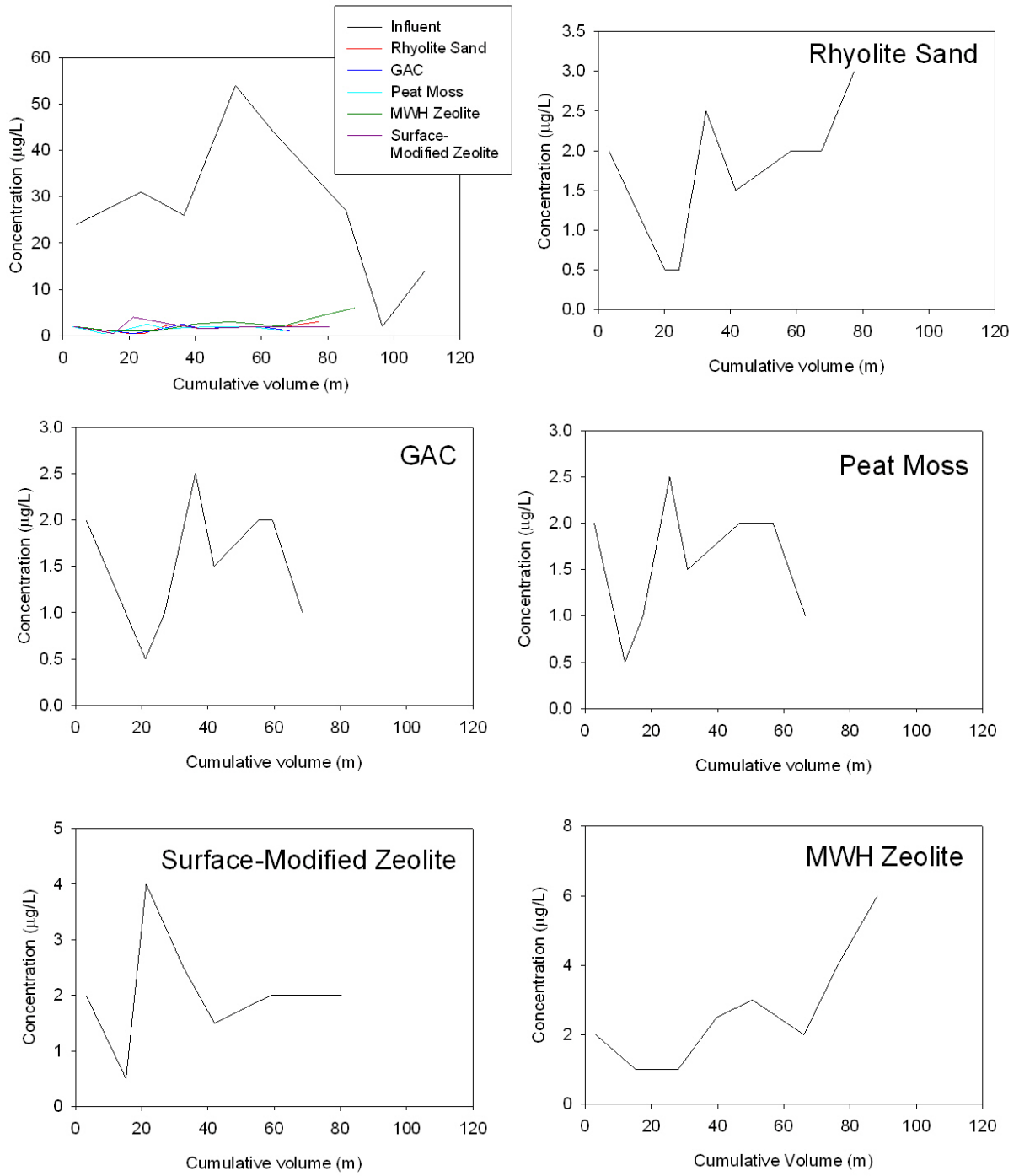
**Figure A3-10. Breakthrough plots for total cadmium.**

## Cadmium, Total: Column Breakthrough Testing



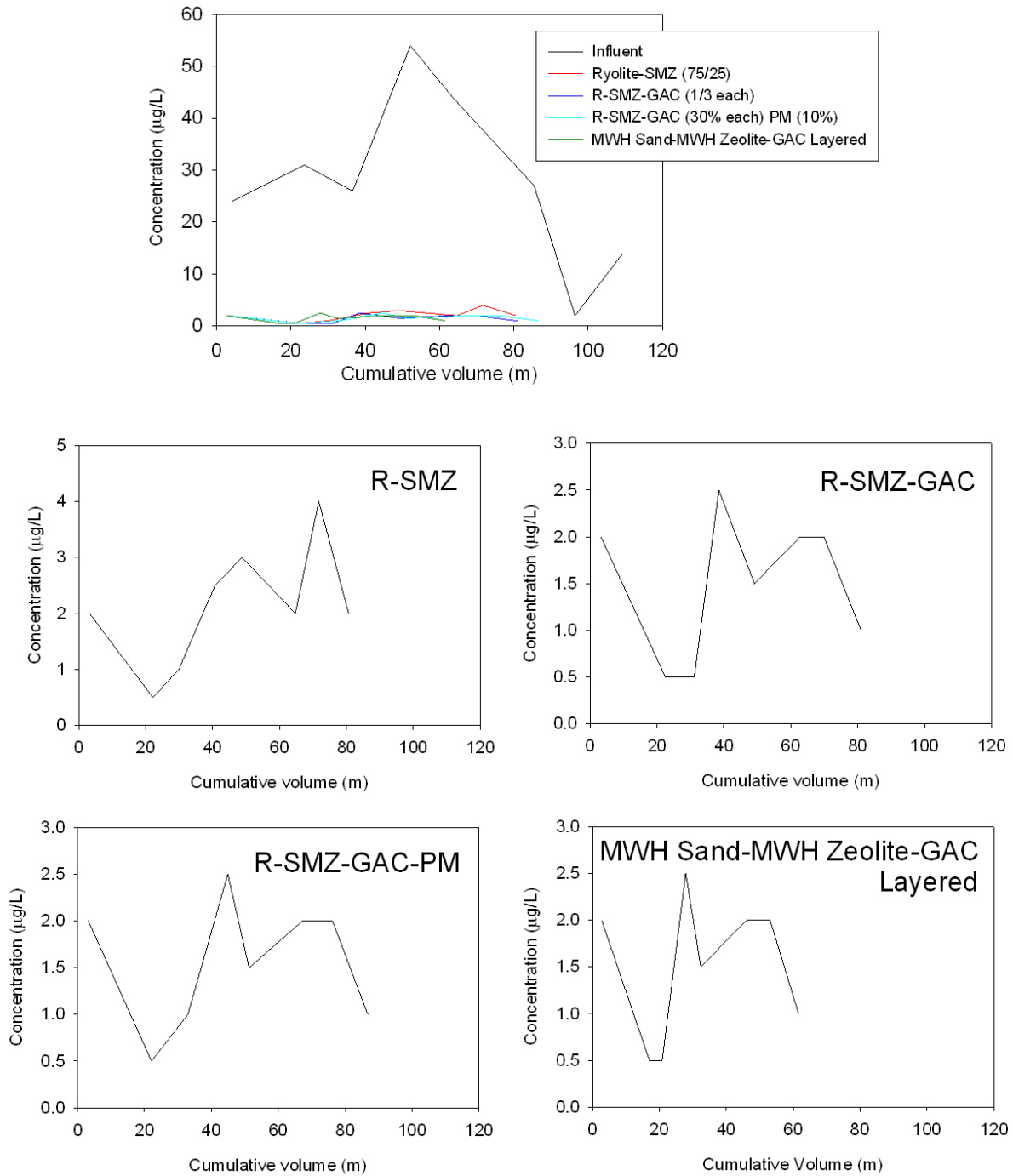
**Figure A3-10. Breakthrough plots for total cadmium (cont.).**

## Cadmium, Filtered: Column Breakthrough Testing



**Figure A3-11. Breakthrough plots for filtered cadmium.**

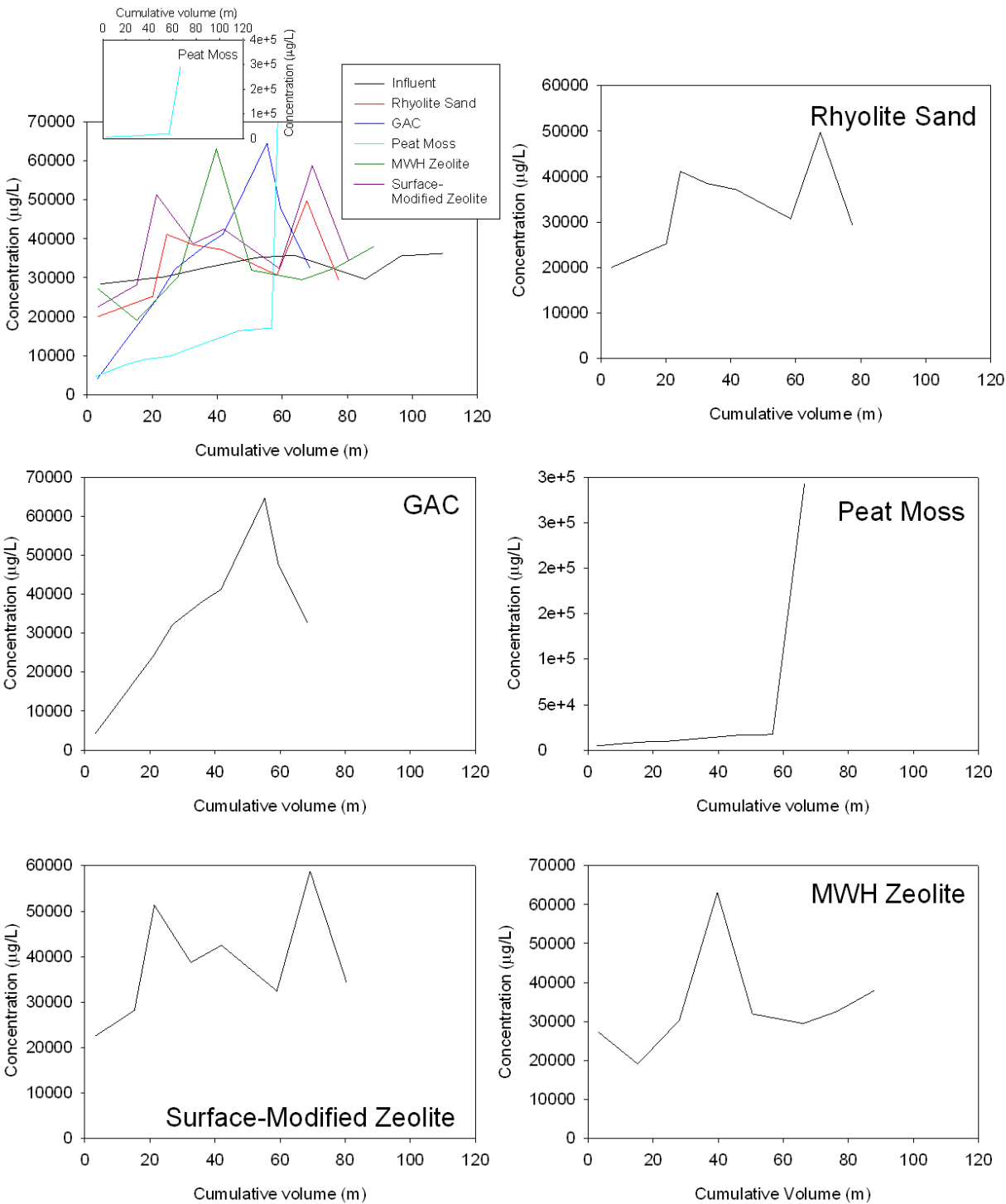
## Cadmium, Filtered: Column Breakthrough Testing



**Figure A3-11. Breakthrough plots for filtered cadmium (cont.).**



## Calcium, Total: Column Breakthrough Testing



**Figure A3-12. Breakthrough plots for total calcium.**

# Calcium, Total: Column Breakthrough Testing

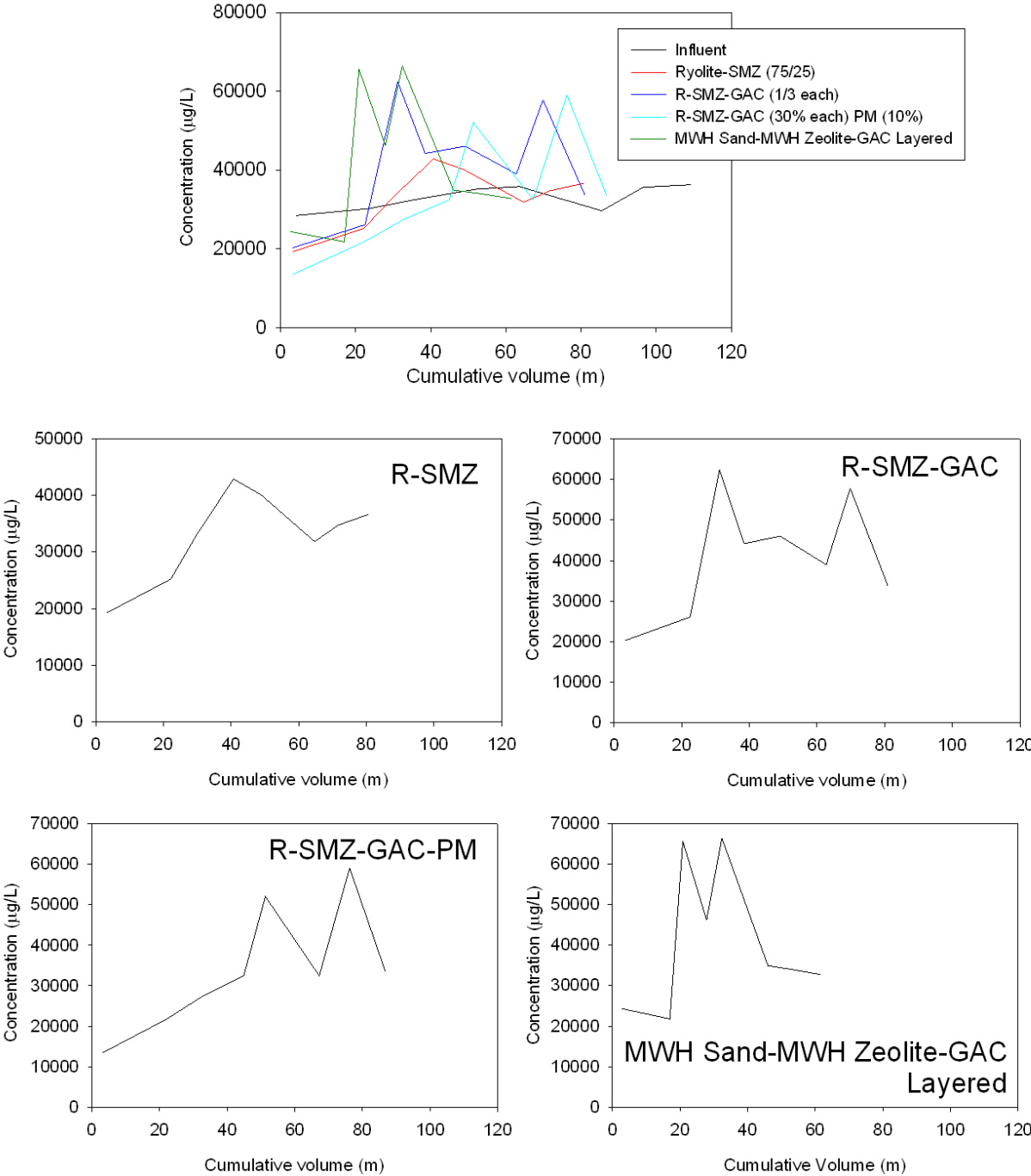
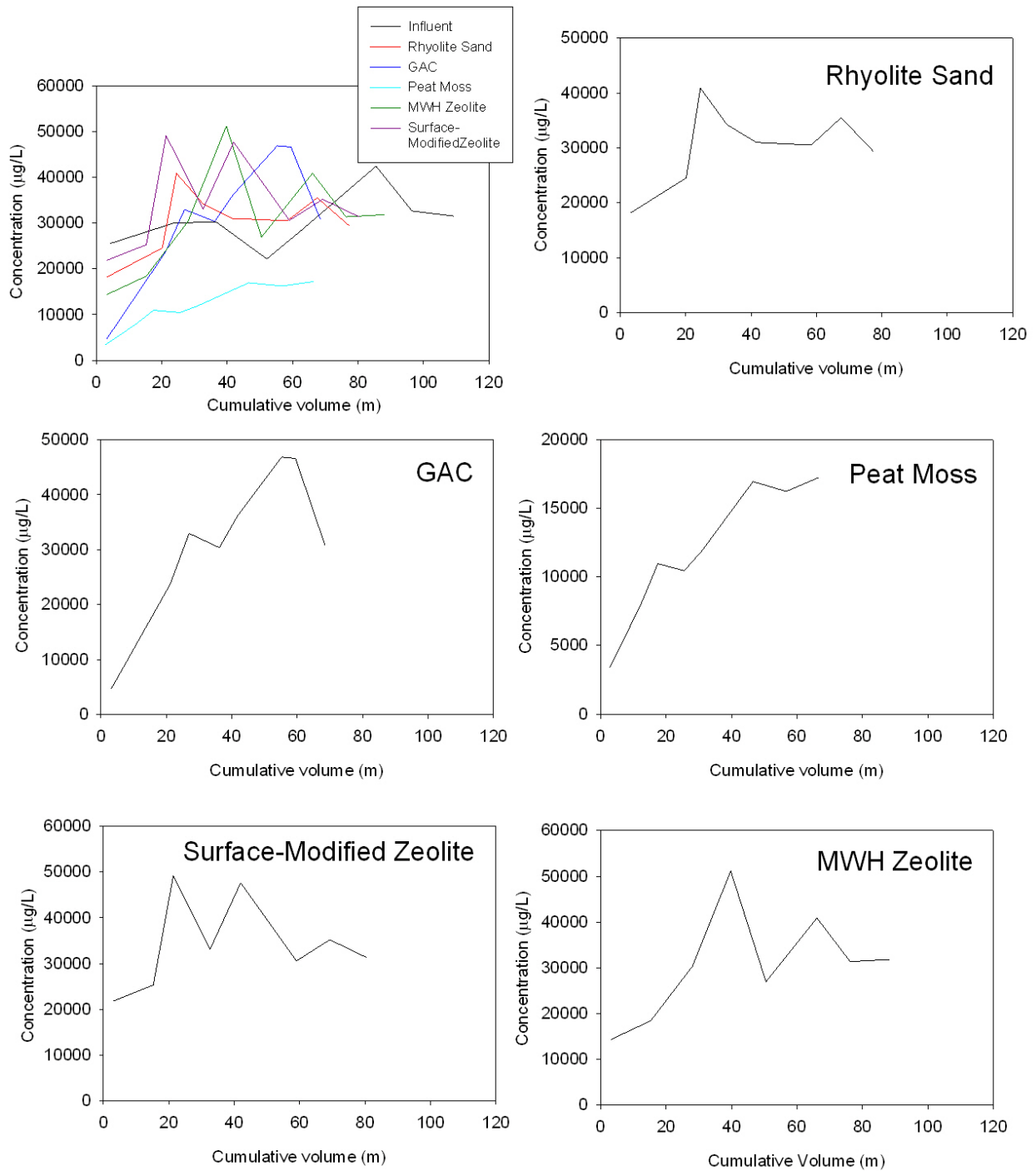


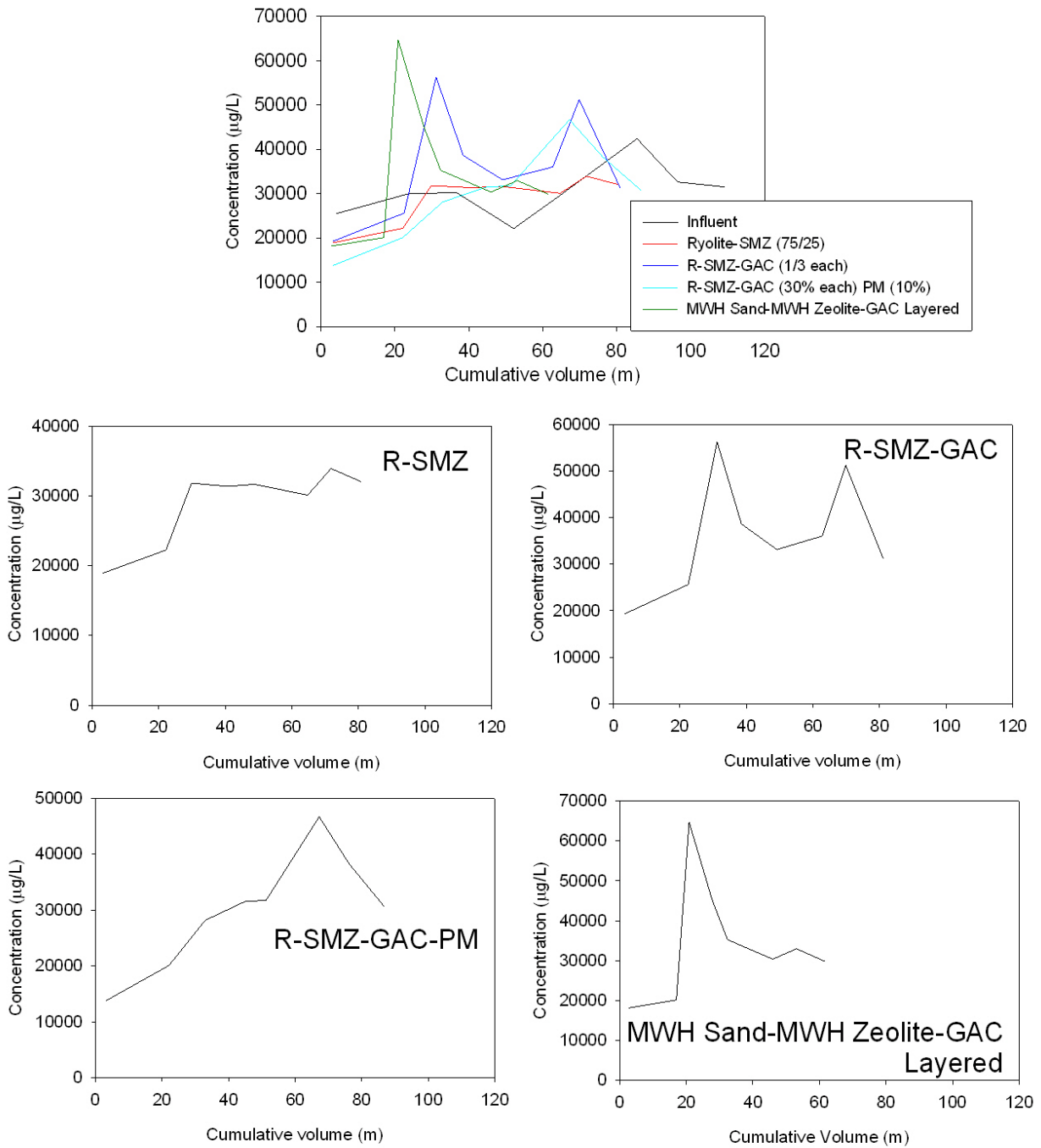
Figure A3-12. Breakthrough plots for total calcium (cont.).

## Calcium, Filtered: Column Breakthrough Testing

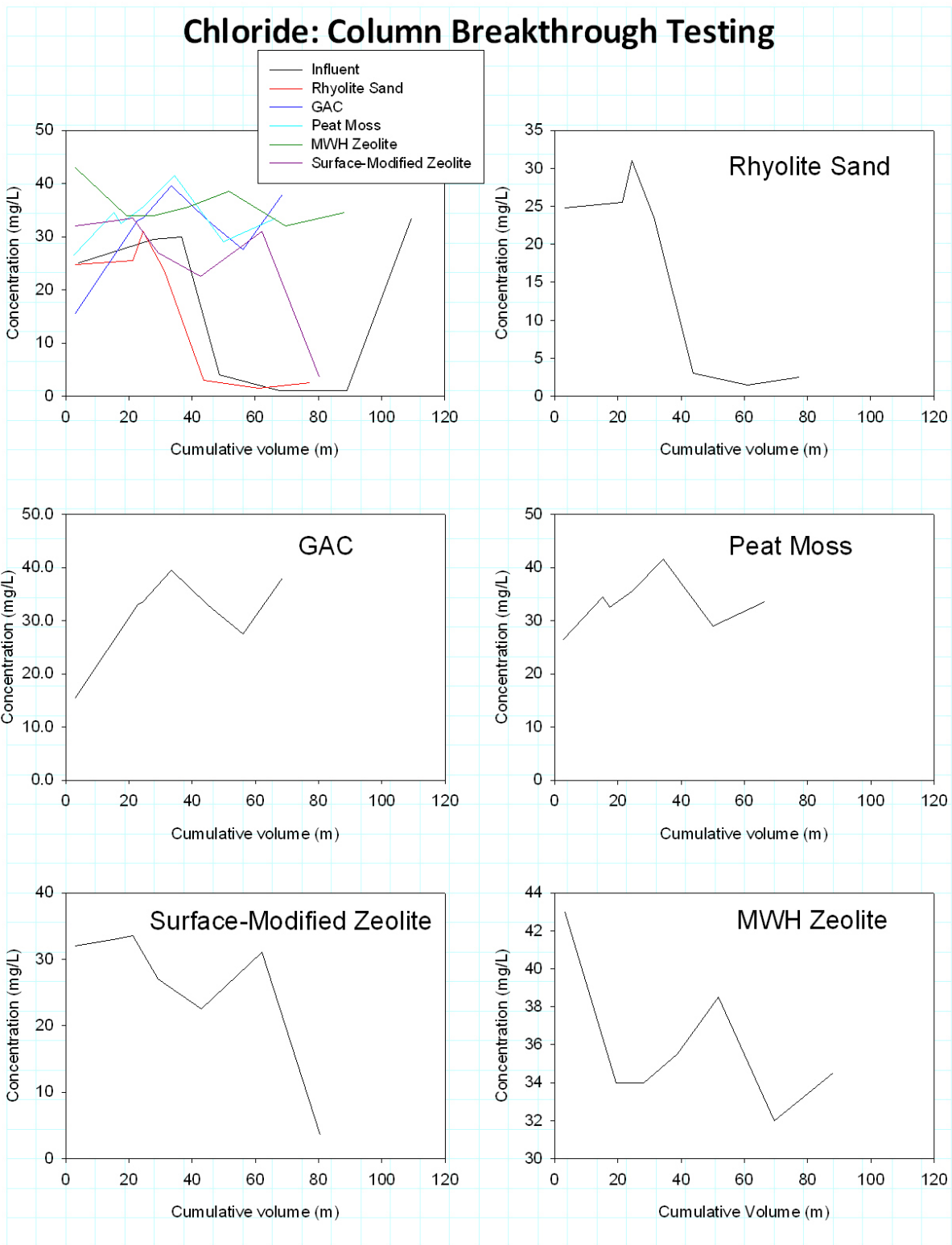


**Figure A3-13. Breakthrough plots for filtered calcium.**

## Calcium, Filtered: Column Breakthrough Testing



**Figure A3-13. Breakthrough plots for filtered calcium (cont.).**



**Figure A3-14. Breakthrough plots for chloride.**

## Chloride: Column Breakthrough Testing

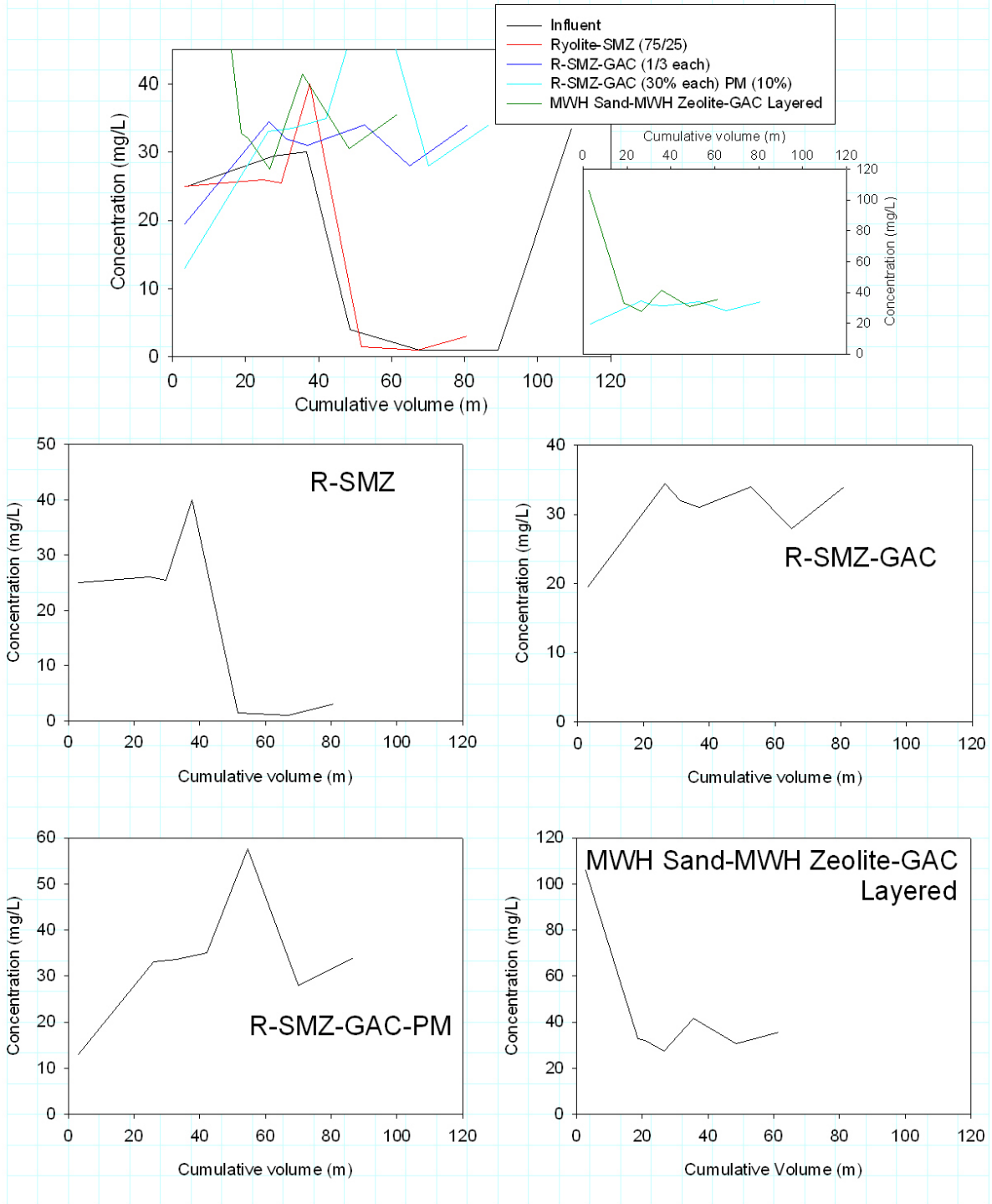
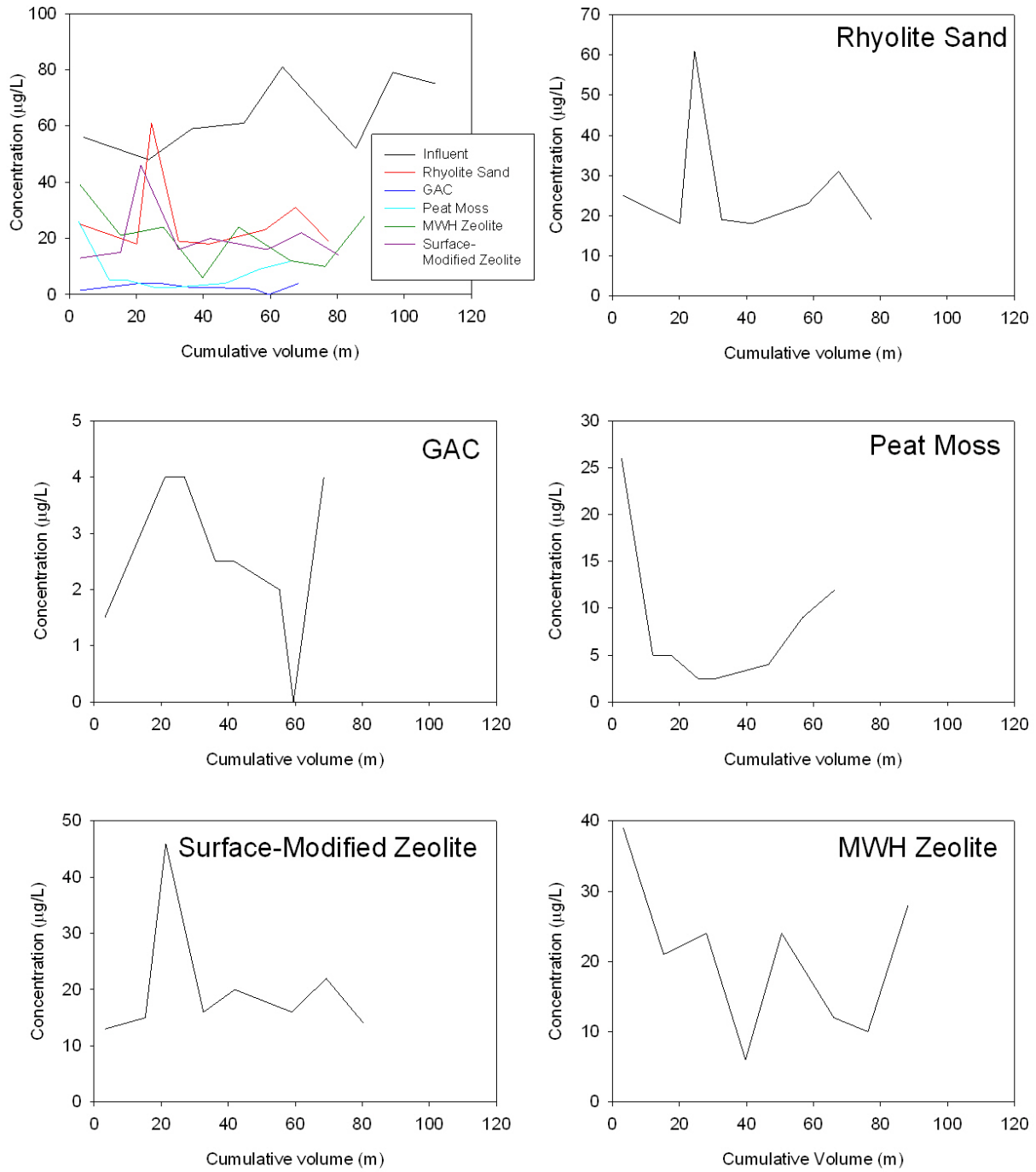


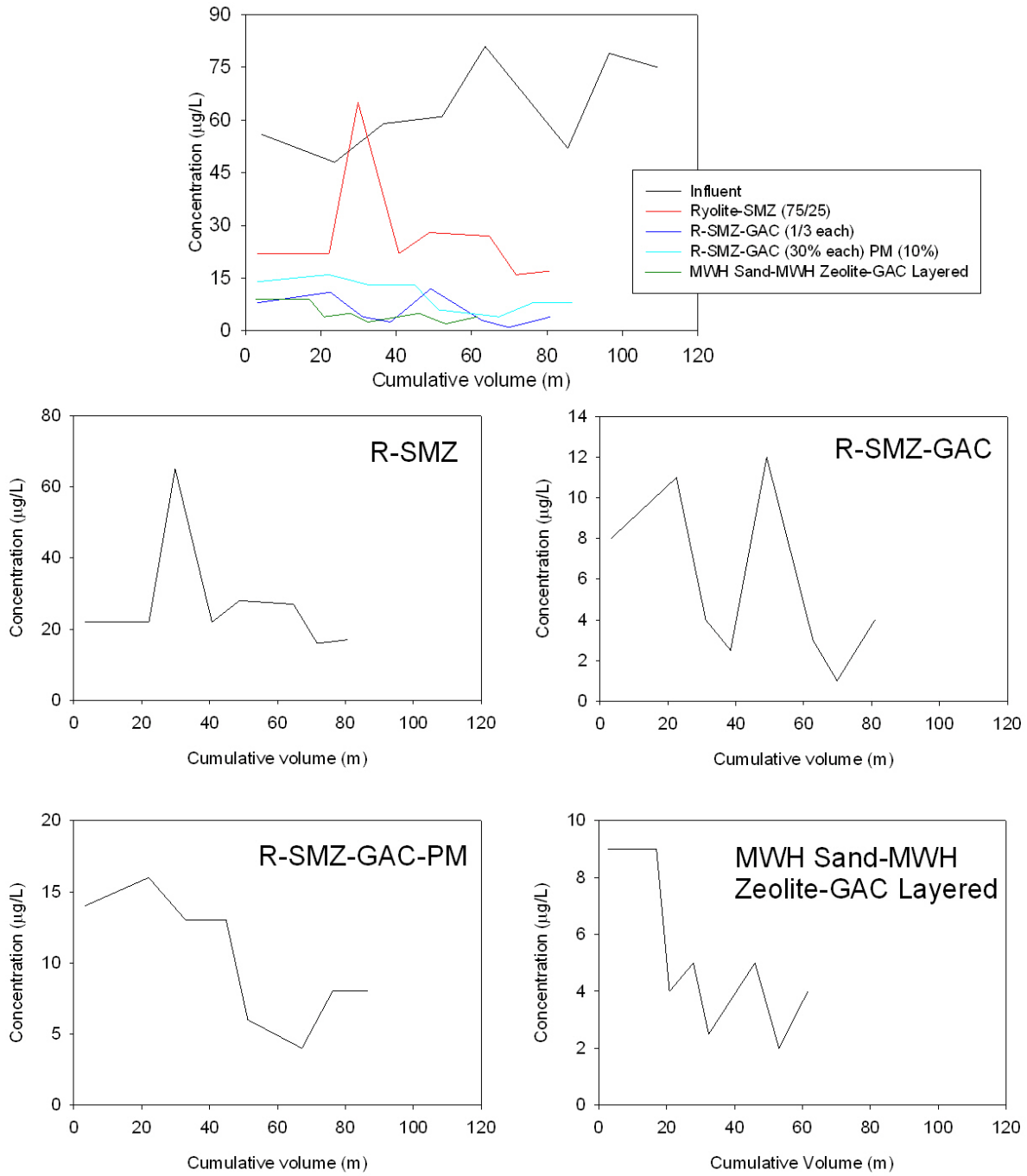
Figure A3-14. Breakthrough plots for chloride (cont.).

## Chromium, Total: Column Breakthrough Testing



**Figure A3-15. Breakthrough plots for total chromium.**

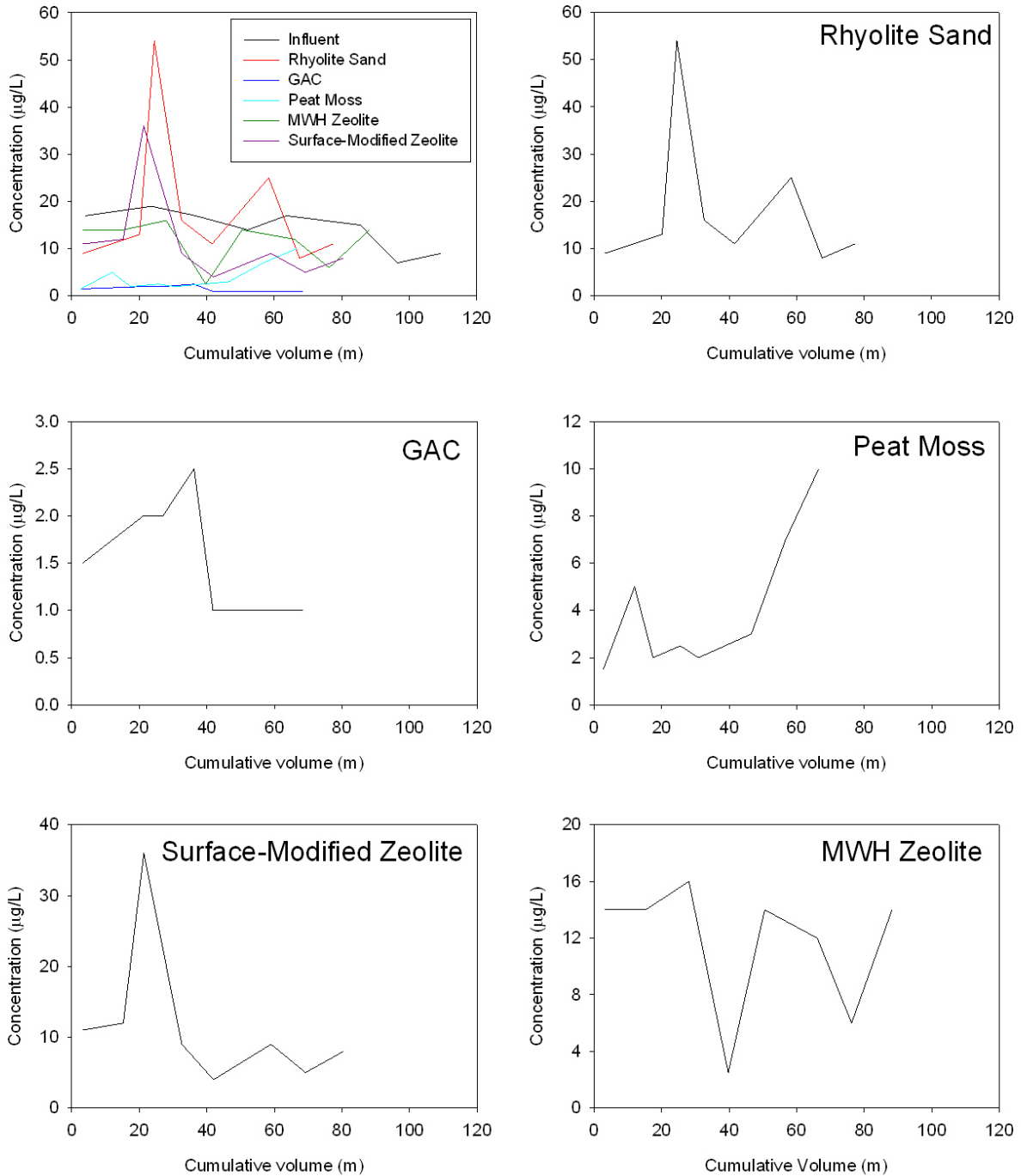
## Chromium, Total: Column Breakthrough Testing



**Figure A3-15. Breakthrough plots for total chromium (cont.).**

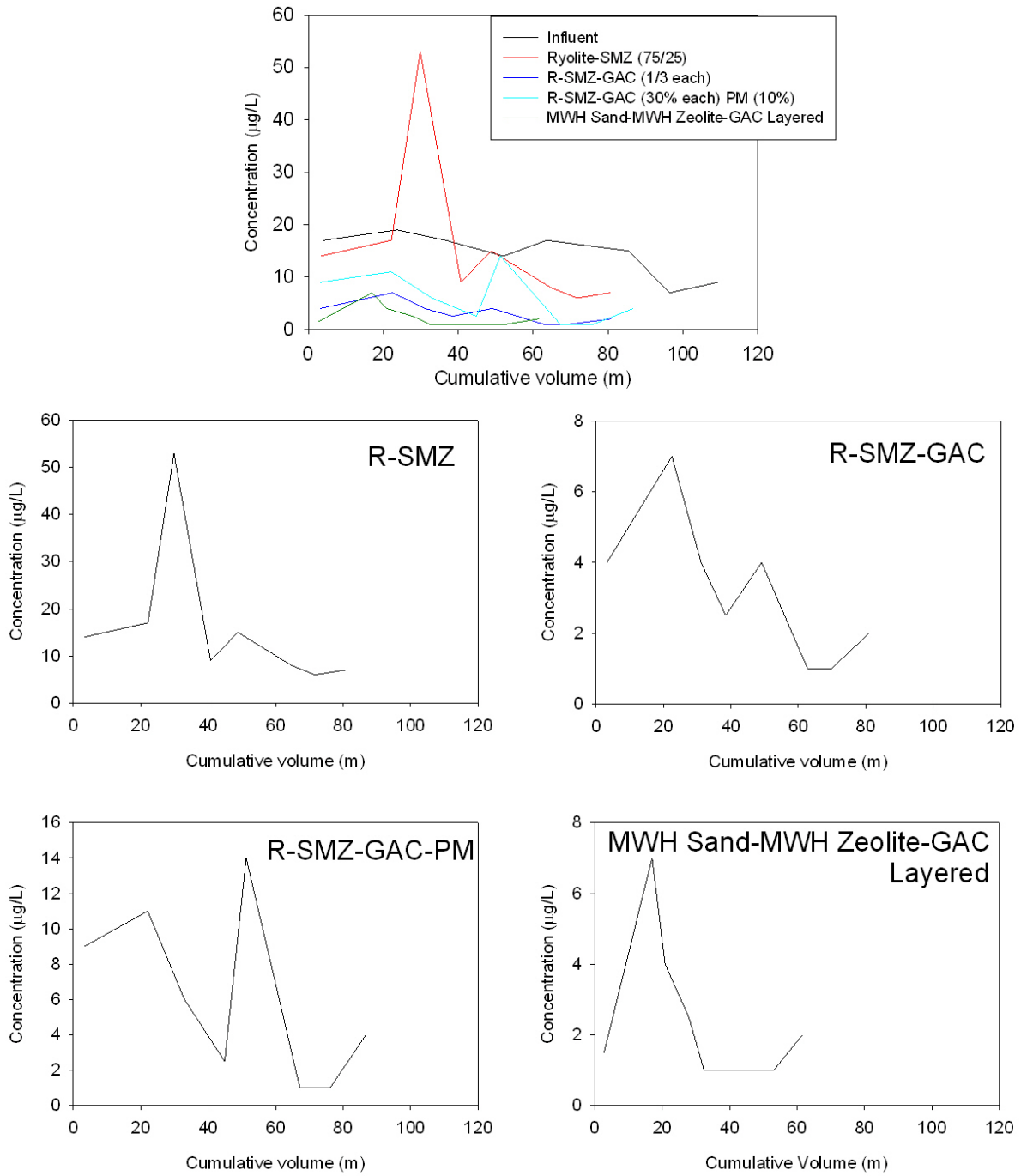


## Chromium, Filtered: Column Breakthrough Testing



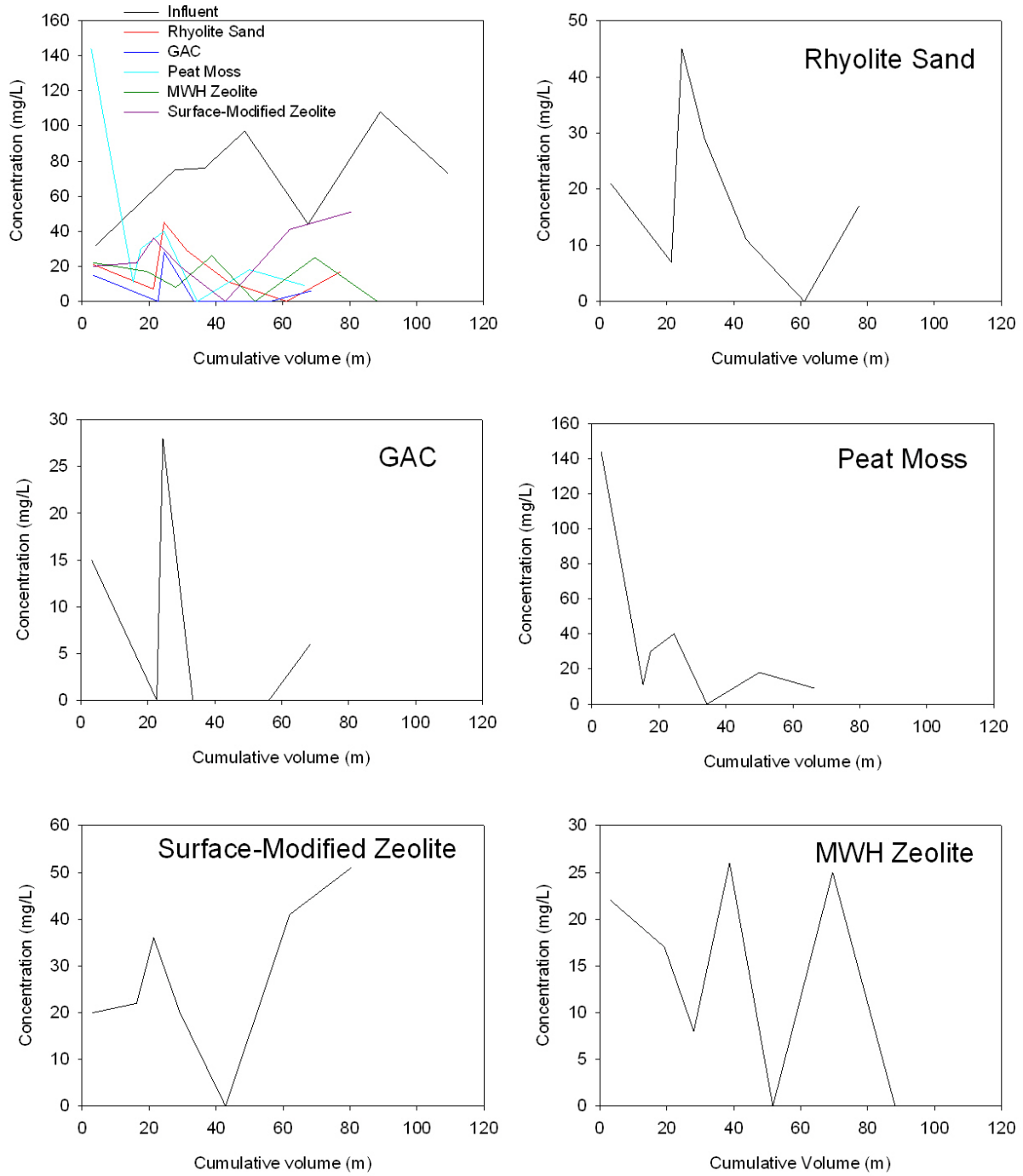
**Figure A3-16. Breakthrough plots for filtered chromium.**

## Chromium, Filtered: Column Breakthrough Testing



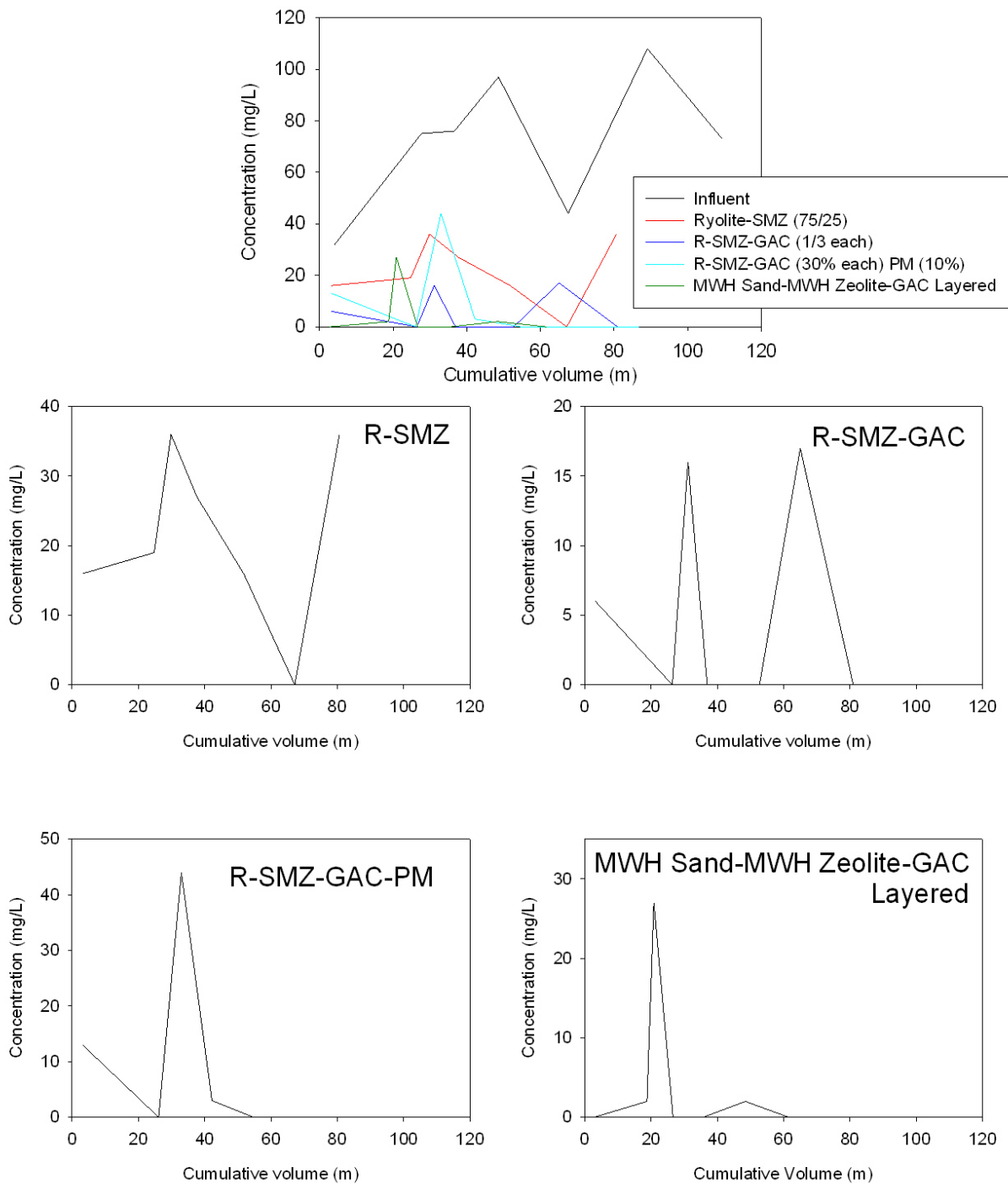
**Figure A3-16. Breakthrough plots for filtered chromium (cont.).**

## Chemical Oxygen Demand: Column Breakthrough Testing



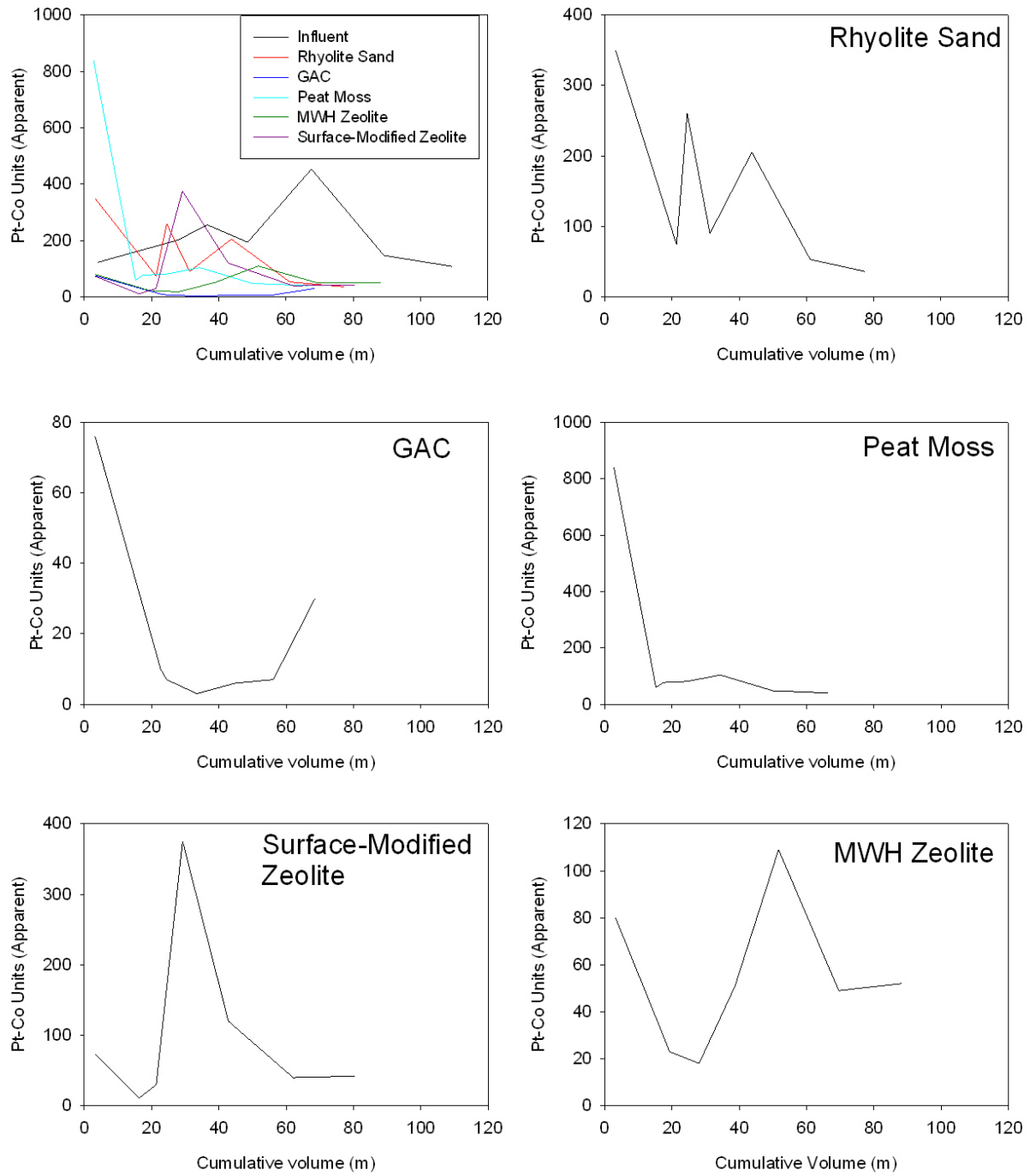
**Figure A3-17. Breakthrough plots for COD.**

## Chemical Oxygen Demand: Column Breakthrough Testing



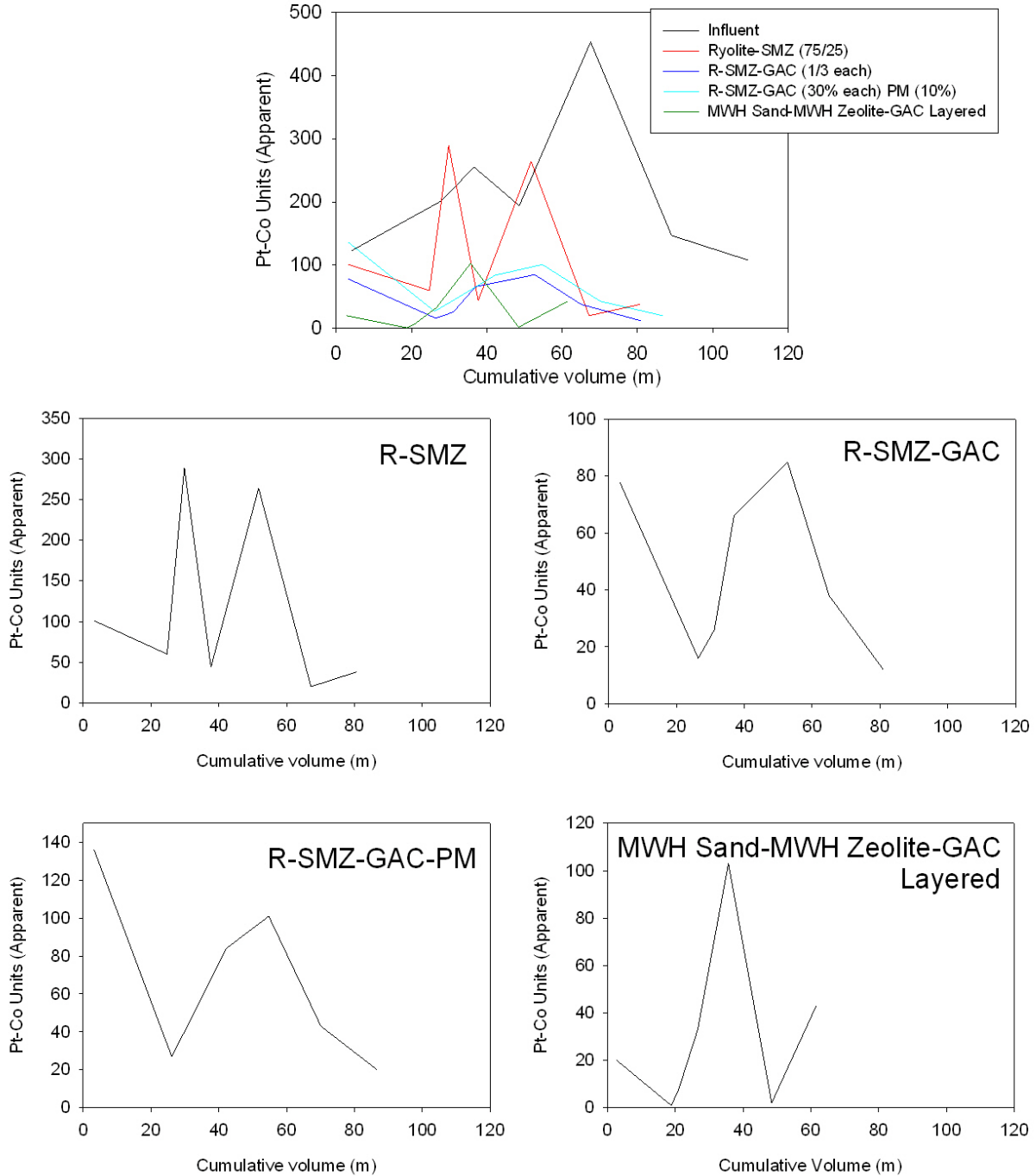
**Figure A3-17. Breakthrough plots for COD (cont.).**

## Color, Apparent: Column Breakthrough Testing



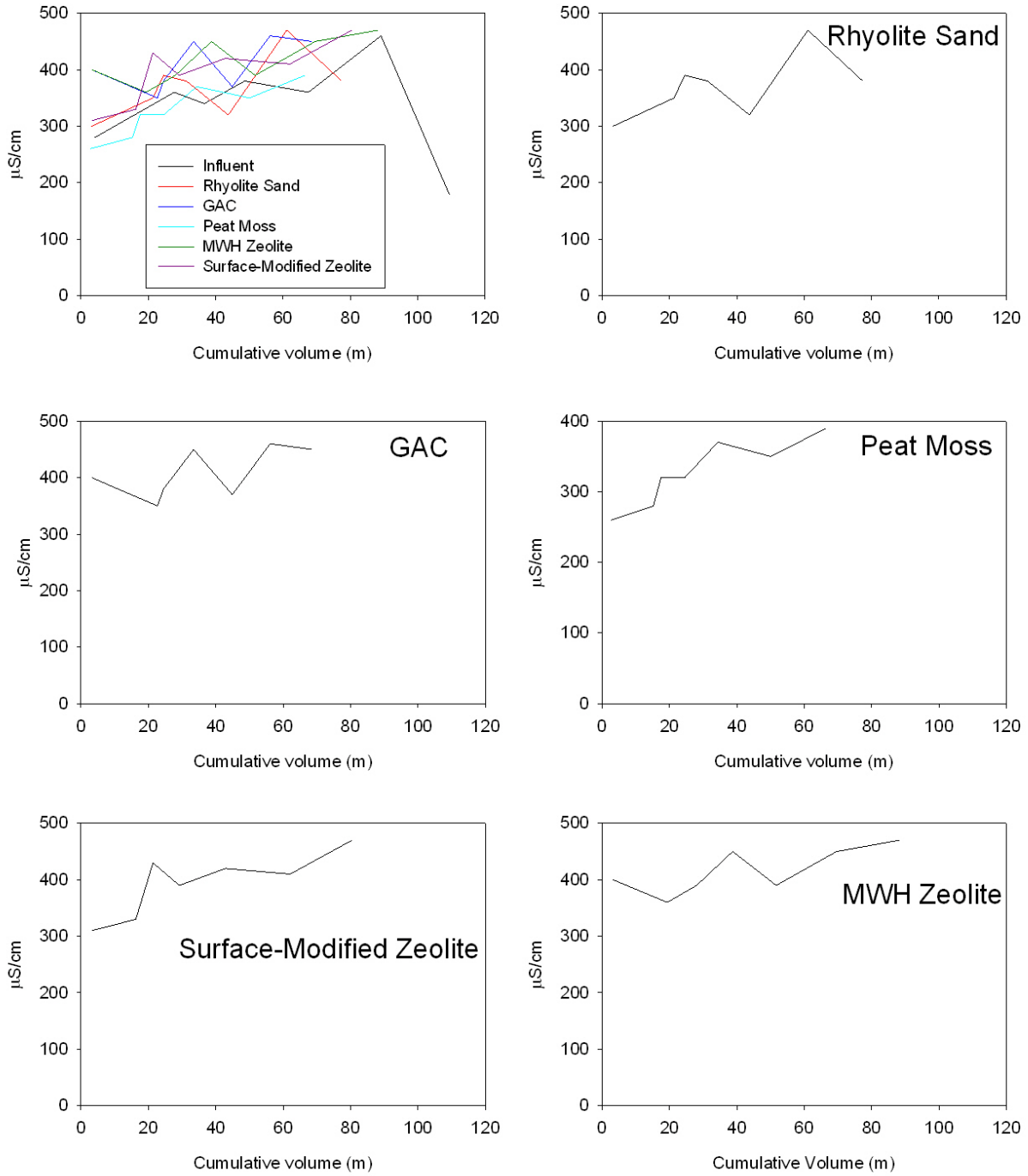
**Figure A3-18. Breakthrough plots for color.**

## Color, Apparent: Column Breakthrough Testing



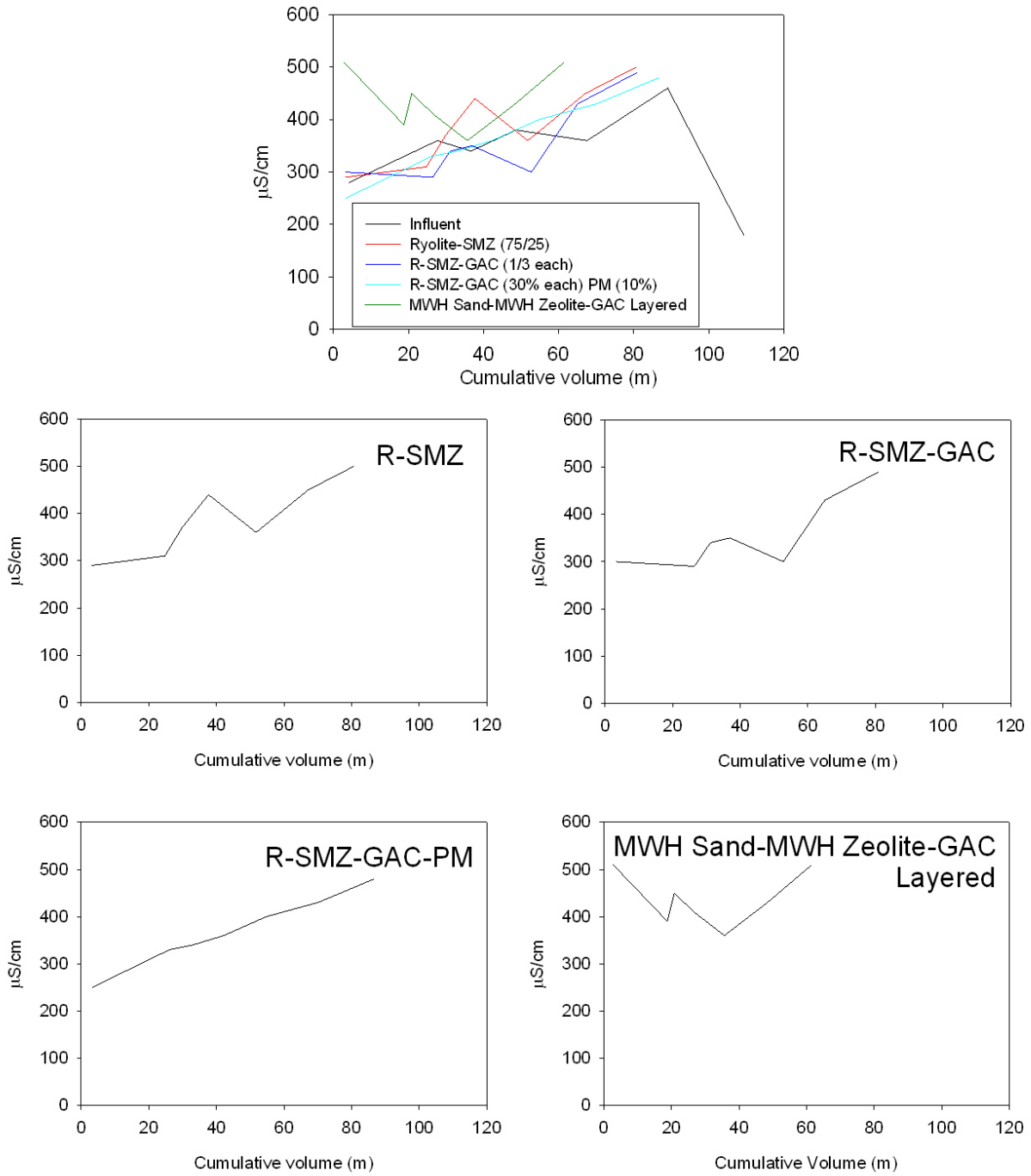
**Figure A3-18. Breakthrough plots for color (cont.).**

## Conductivity: Column Breakthrough Testing



**Figure A3-19. Breakthrough plots for conductivity.**

## Conductivity: Column Breakthrough Testing



**Figure A3-19. Breakthrough plots for conductivity (cont.).**



## Copper, Total: Column Breakthrough Testing

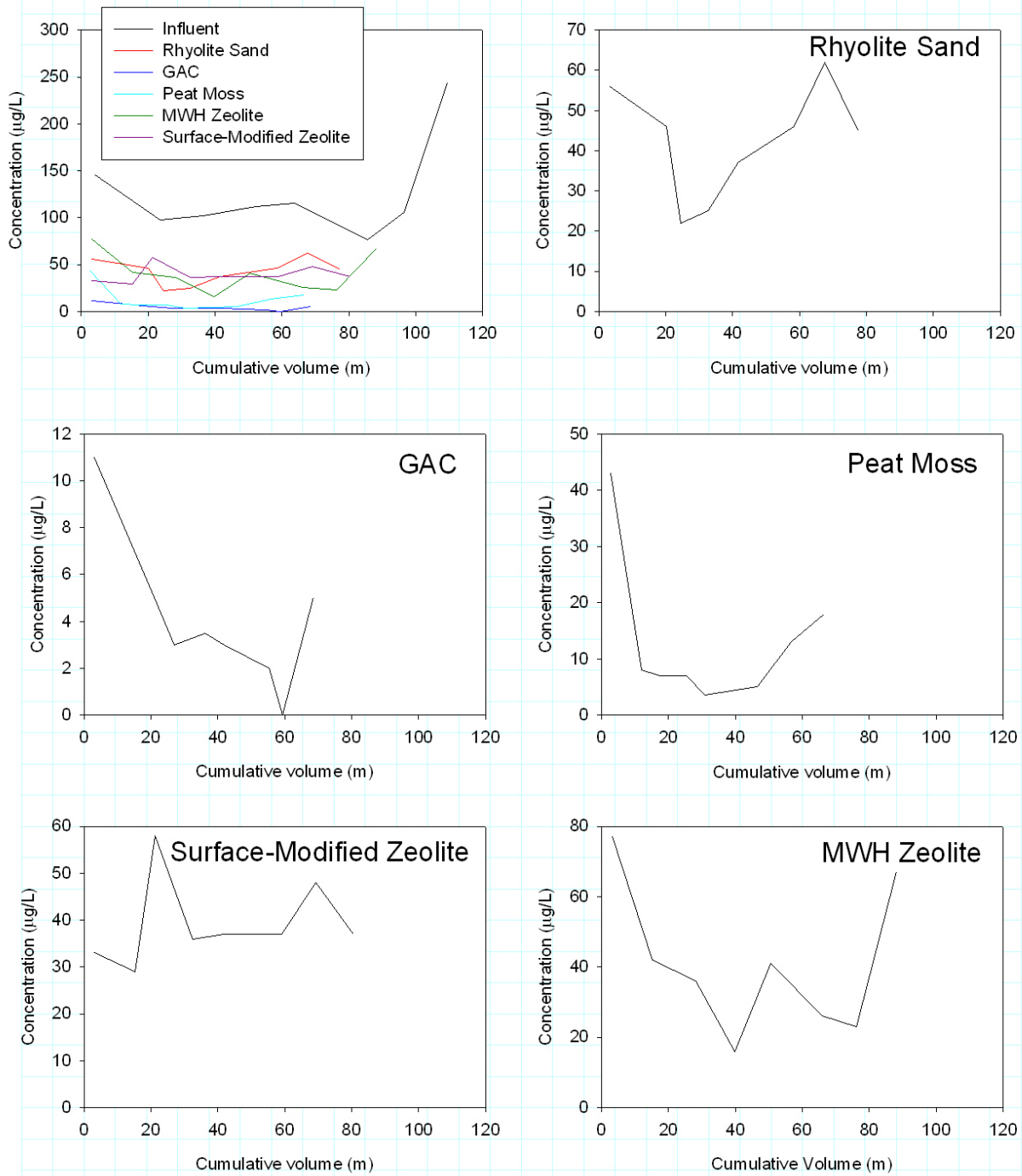
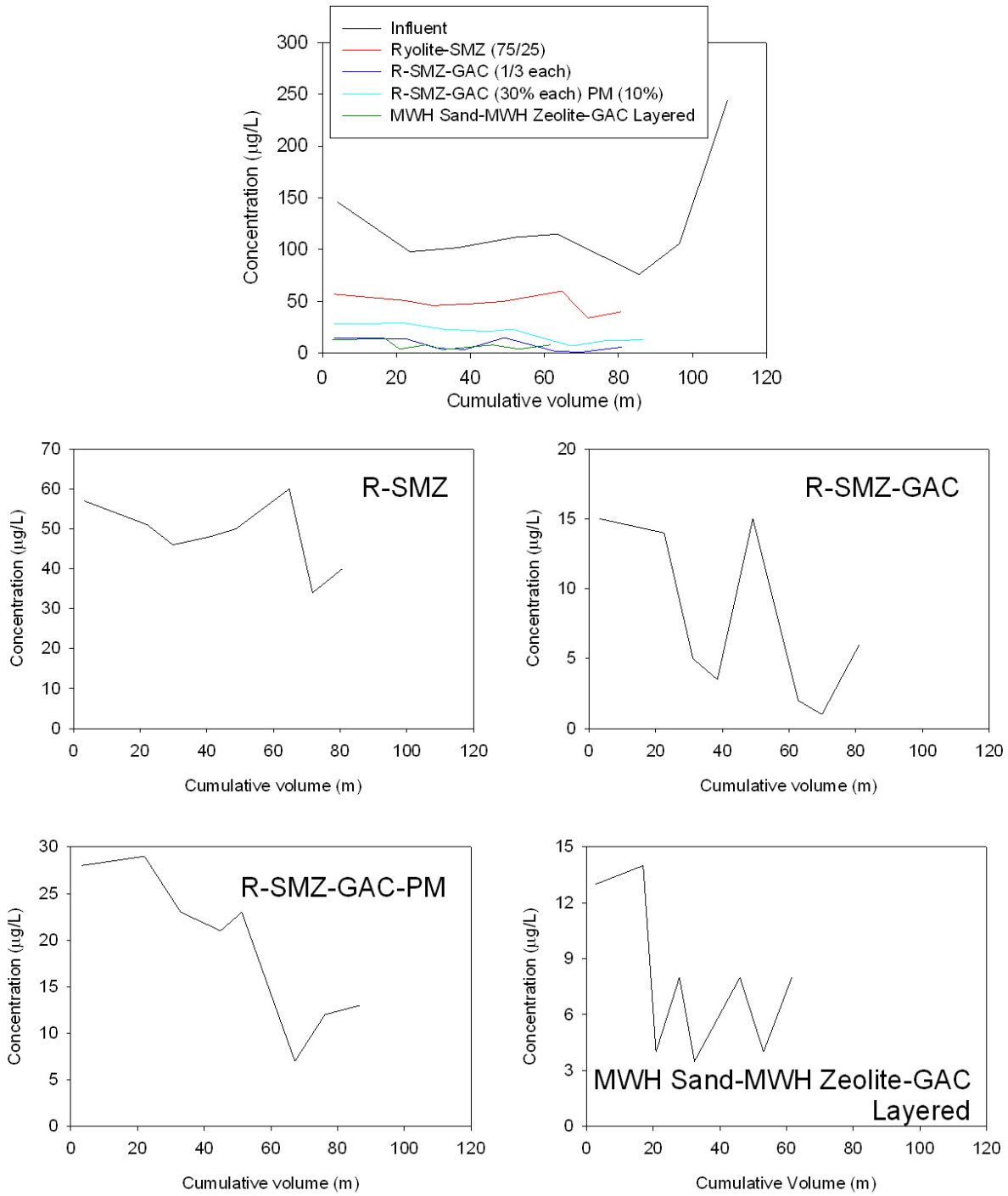


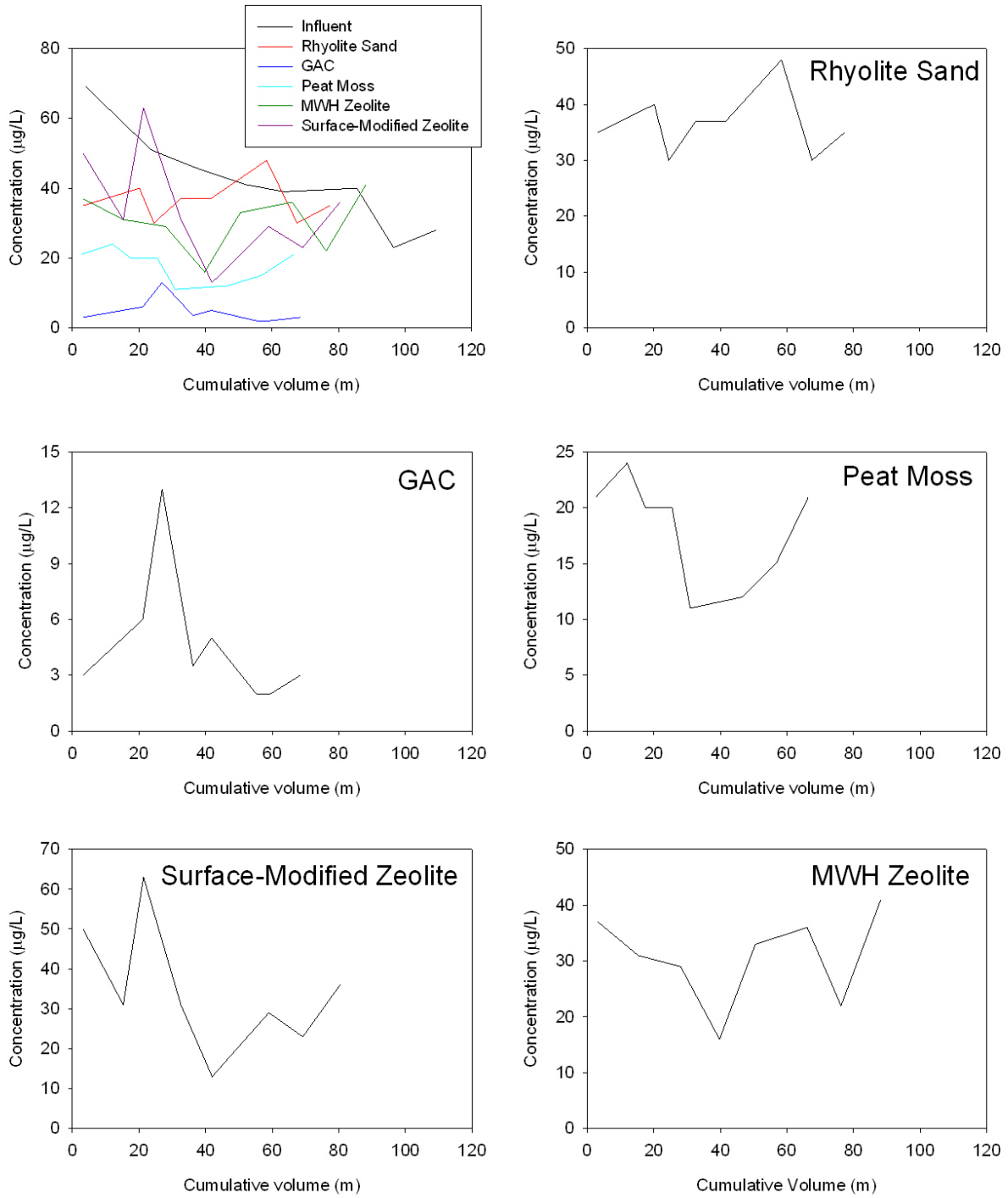
Figure A3-20. Breakthrough plots for total copper.

## Copper, Total: Column Breakthrough Testing



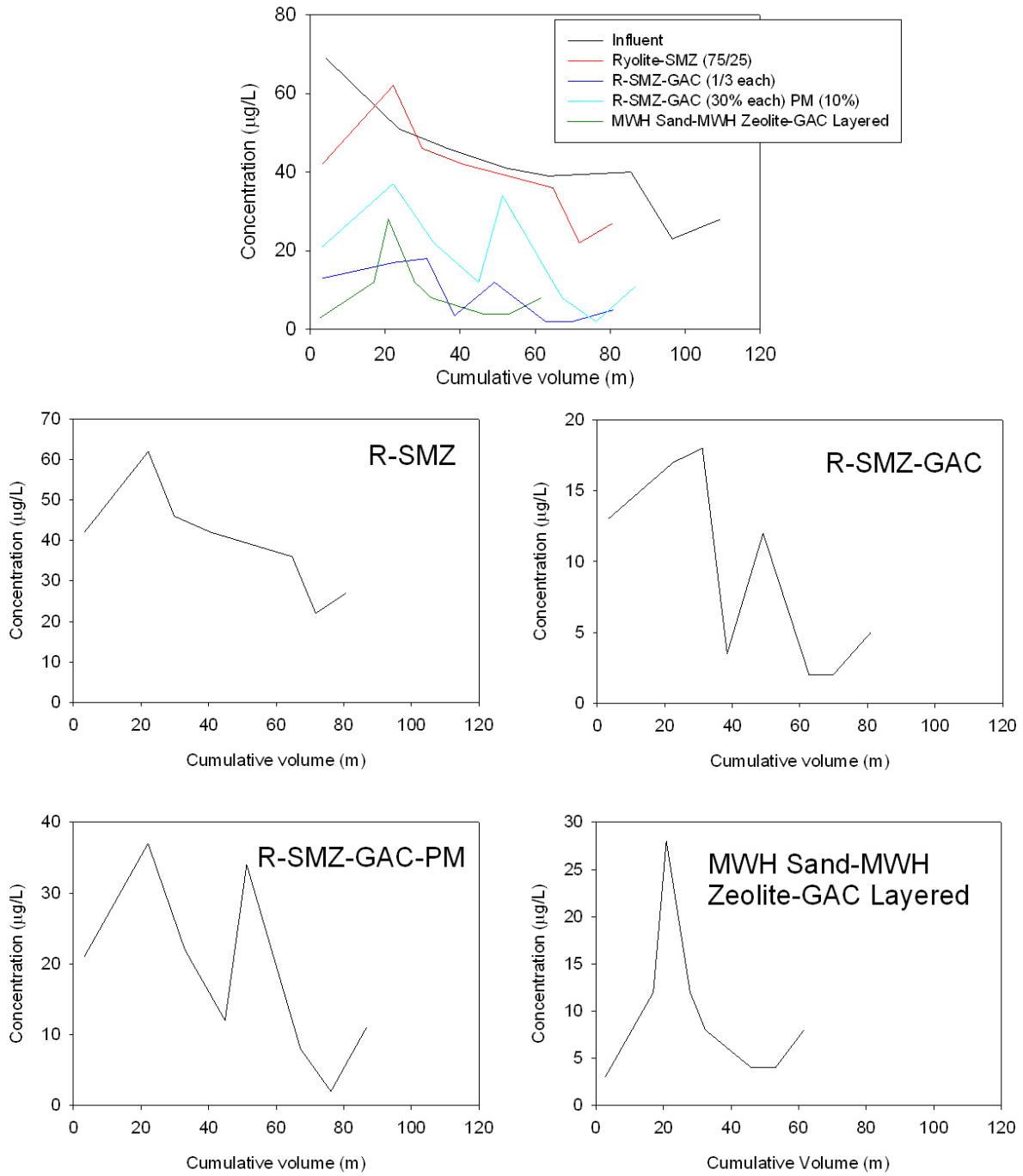
**Figure A3-20. Breakthrough plots for total copper (cont.).**

## Copper, Filtered: Column Breakthrough Testing



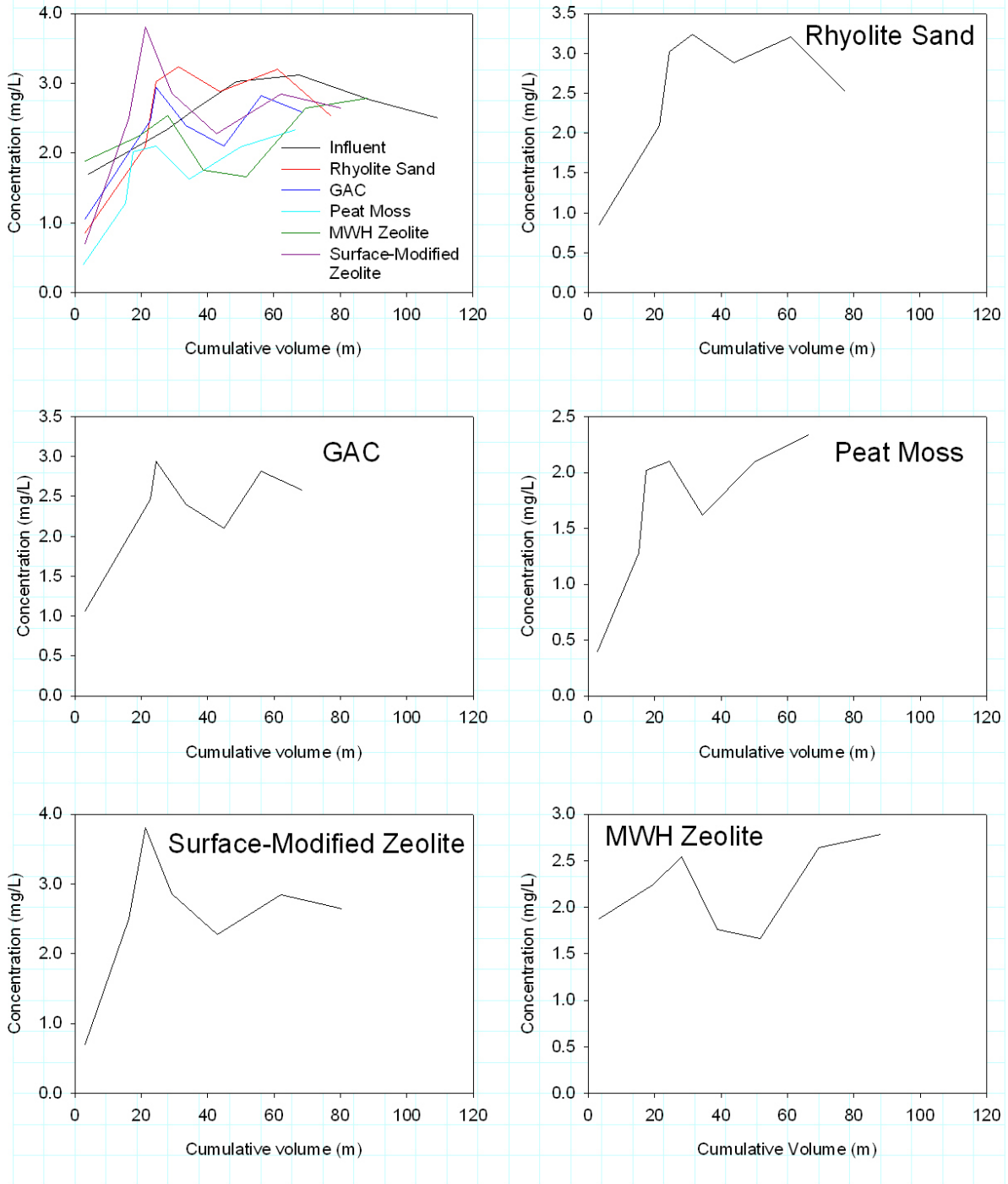
**Figure A3-21. Breakthrough plots for filtered copper.**

## Copper, Filtered: Column Breakthrough Testing



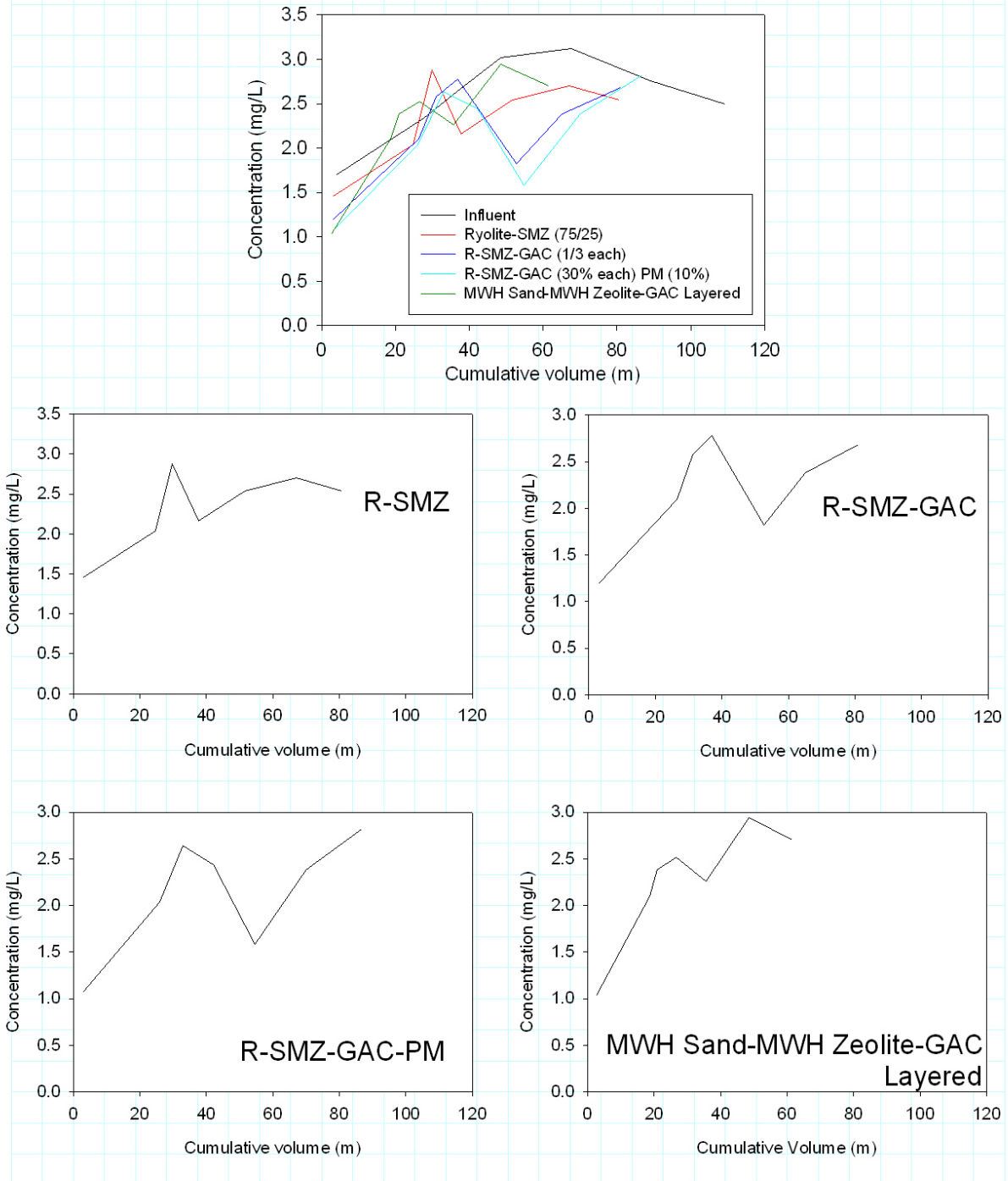
**Figure A3-21. Breakthrough plots for filtered copper (cont.).**

## Fluoride: Column Breakthrough Testing



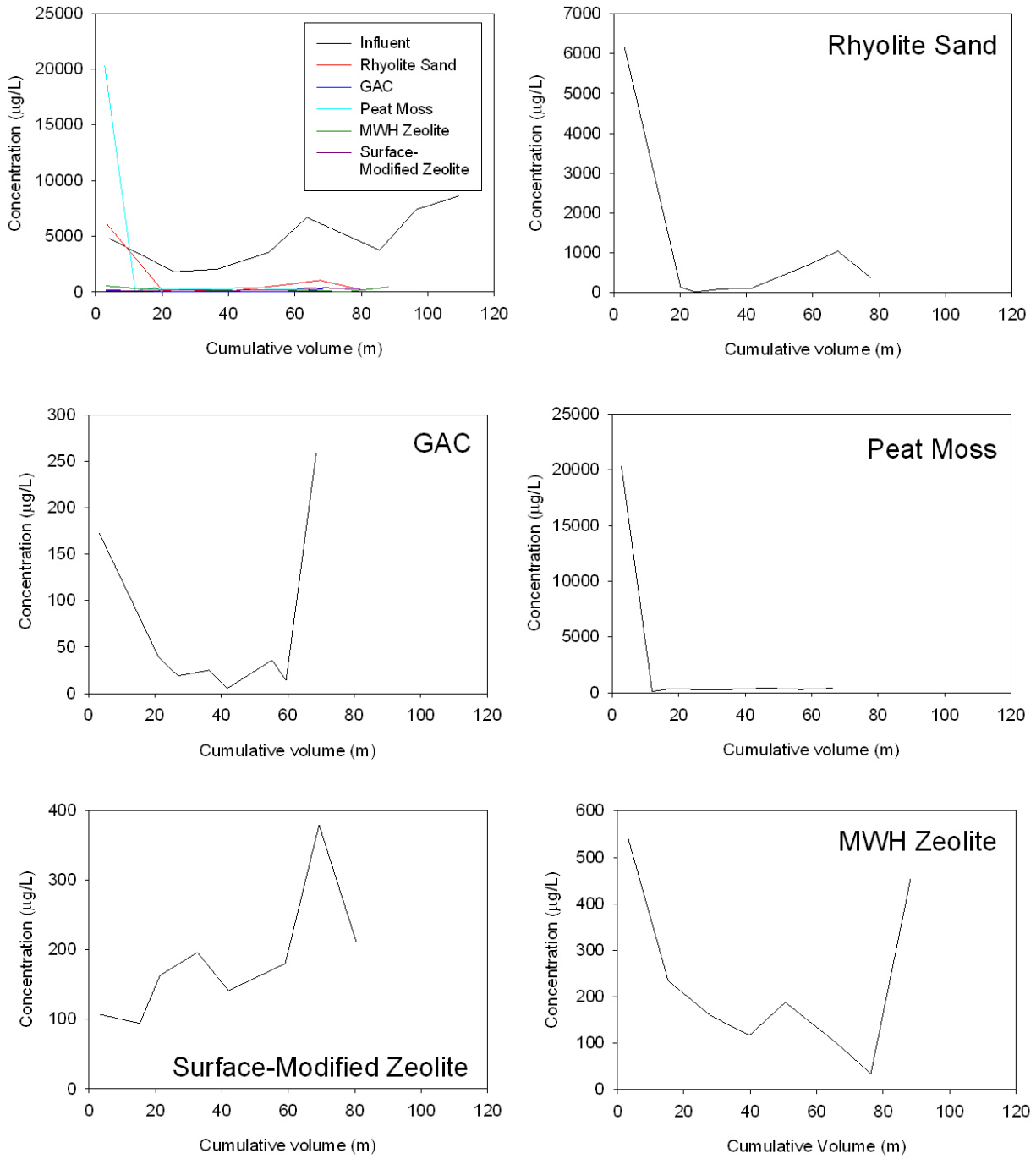
**Figure A3-22. Breakthrough plots for fluoride.**

## Fluoride: Column Breakthrough Testing



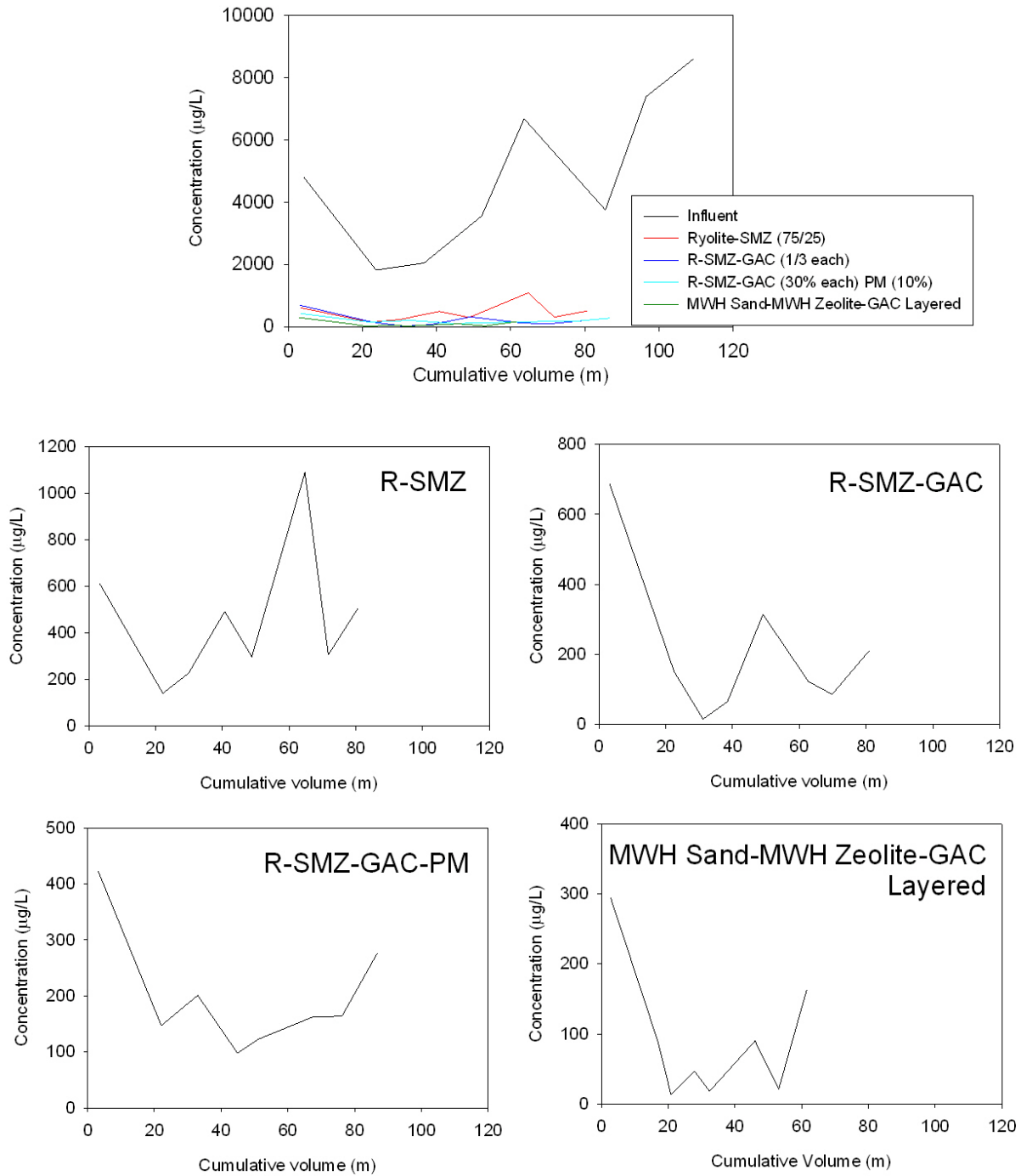
**Figure A3-22. Breakthrough plots for fluoride (cont.).**

## Iron, Total: Column Breakthrough Testing



**Figure A3-23. Breakthrough plots for total iron.**

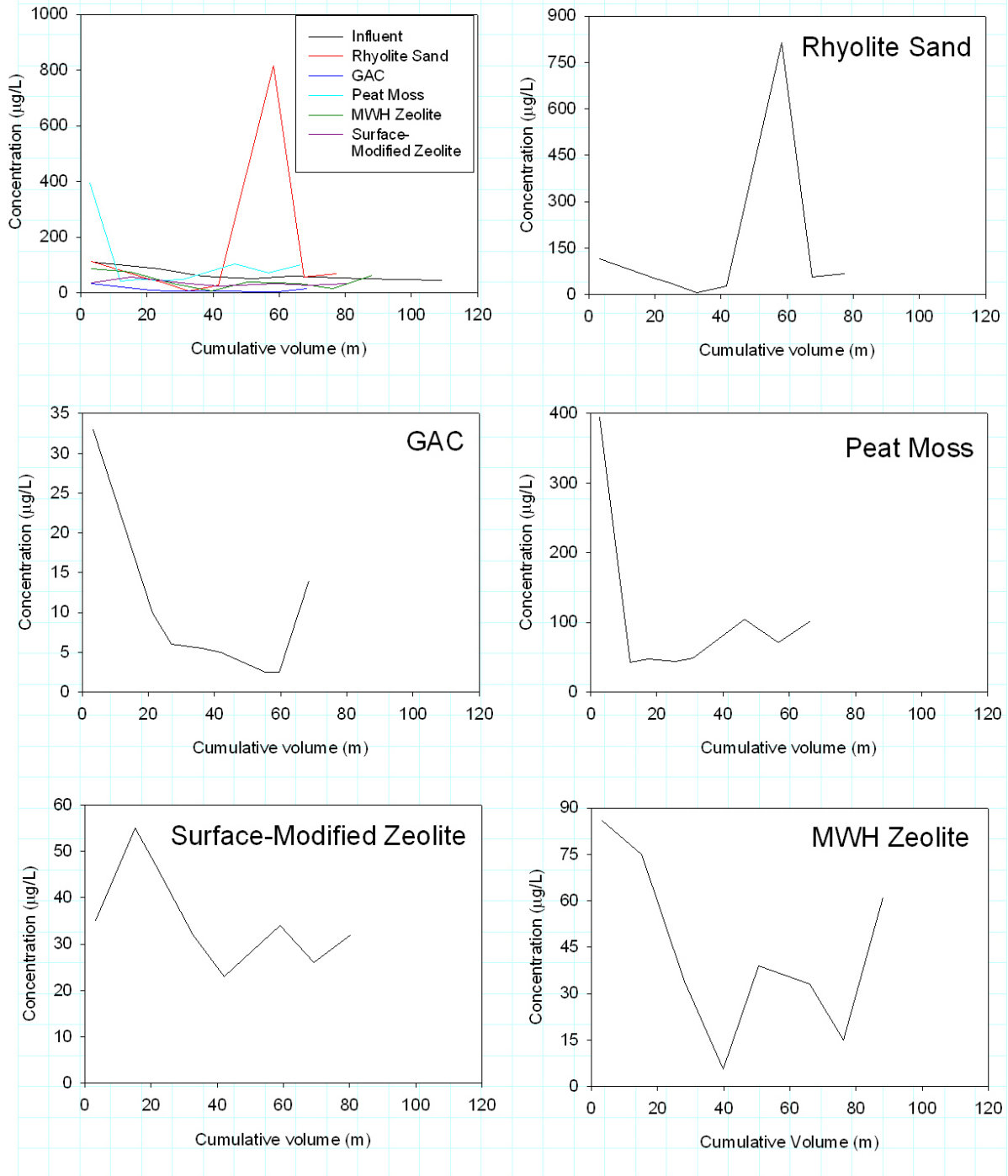
## Iron, Total: Column Breakthrough Testing



**Figure A3-23. Breakthrough plots for total iron (cont.).**

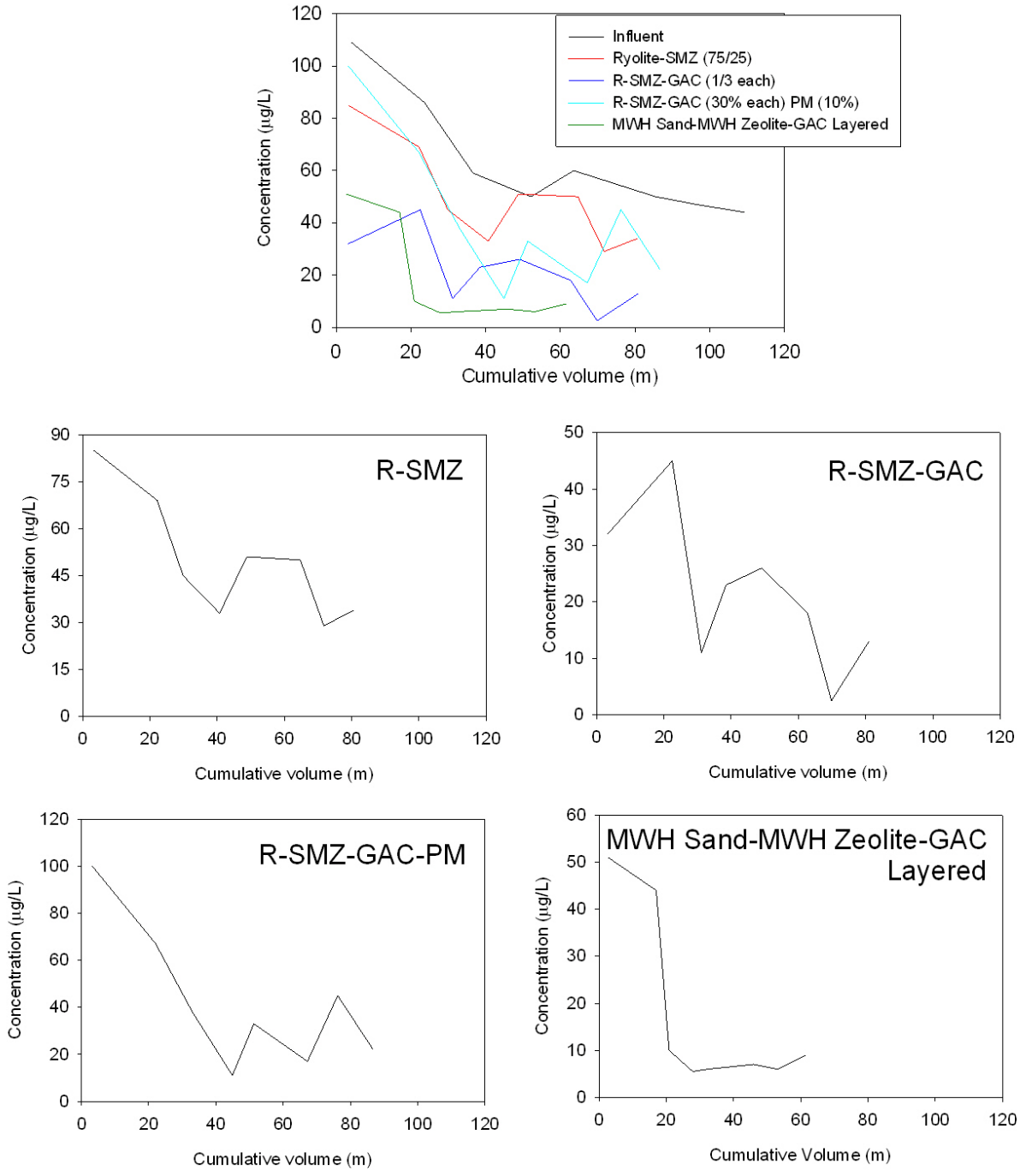


## Iron, Filtered: Column Breakthrough Testing



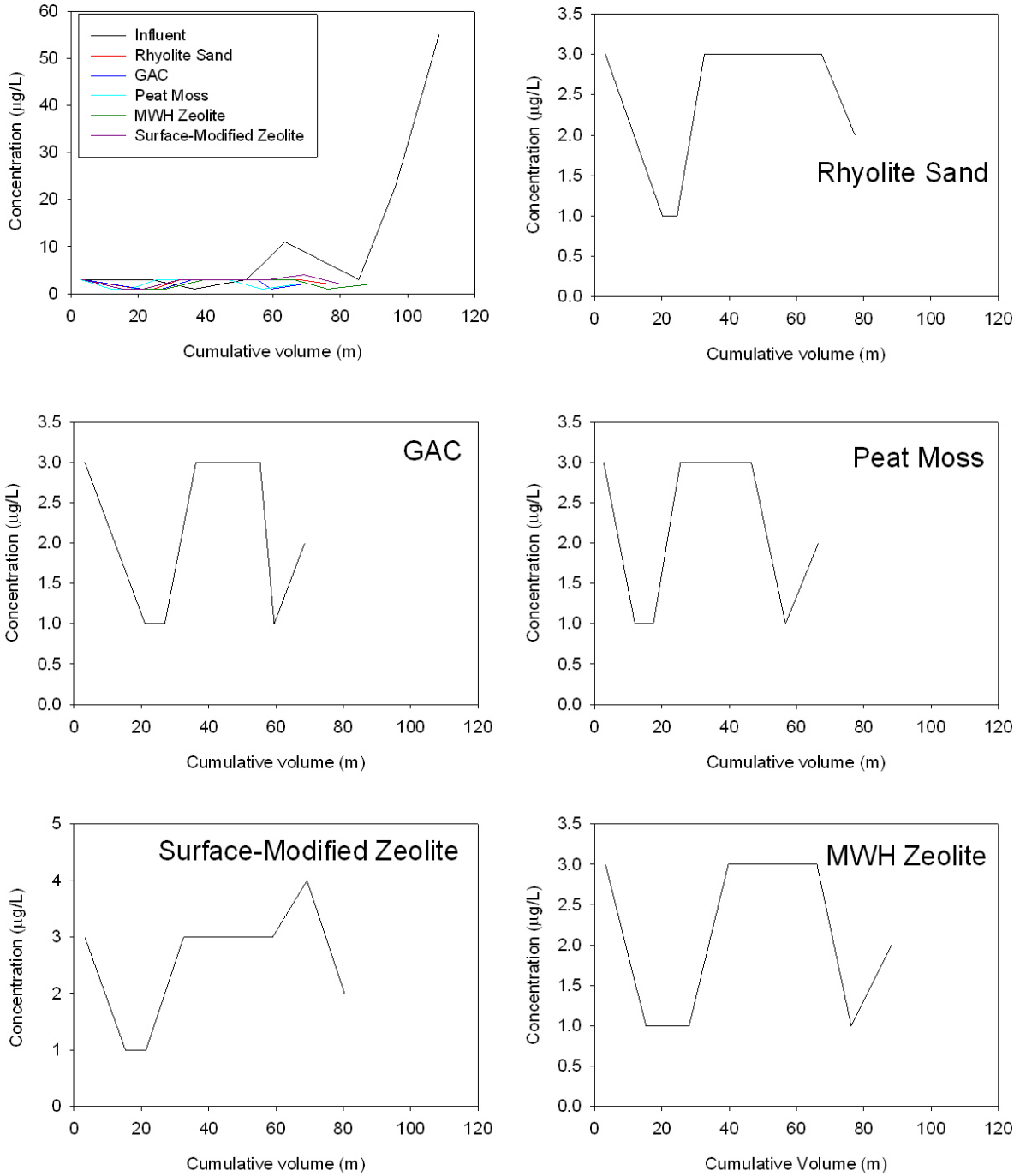
**Figure A3-24. Breakthrough plots for filtered iron.**

## Iron, Filtered: Column Breakthrough Testing



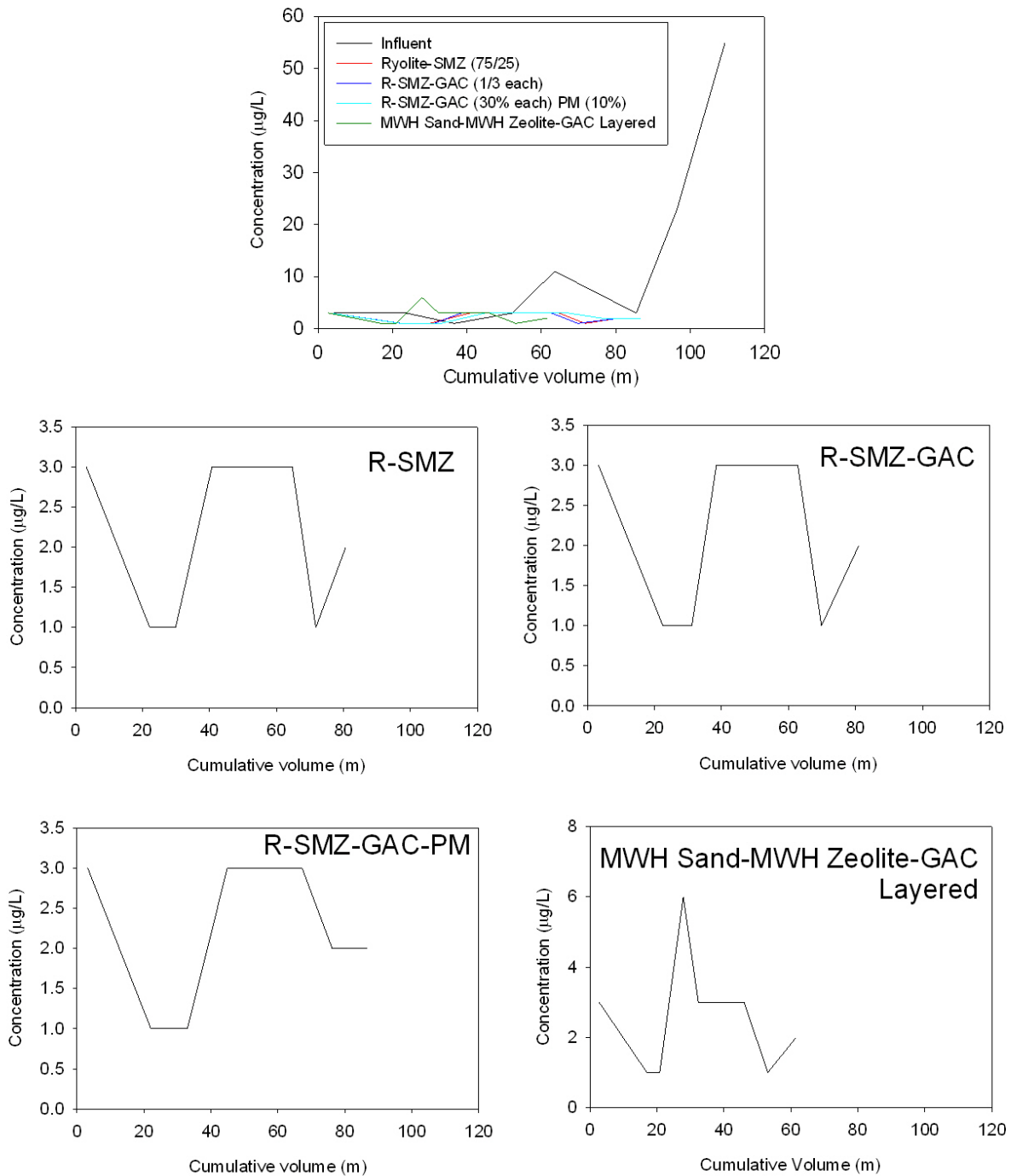
**Figure A3-24. Breakthrough plots for filtered iron (cont.).**

## Lead, Total: Column Breakthrough Testing



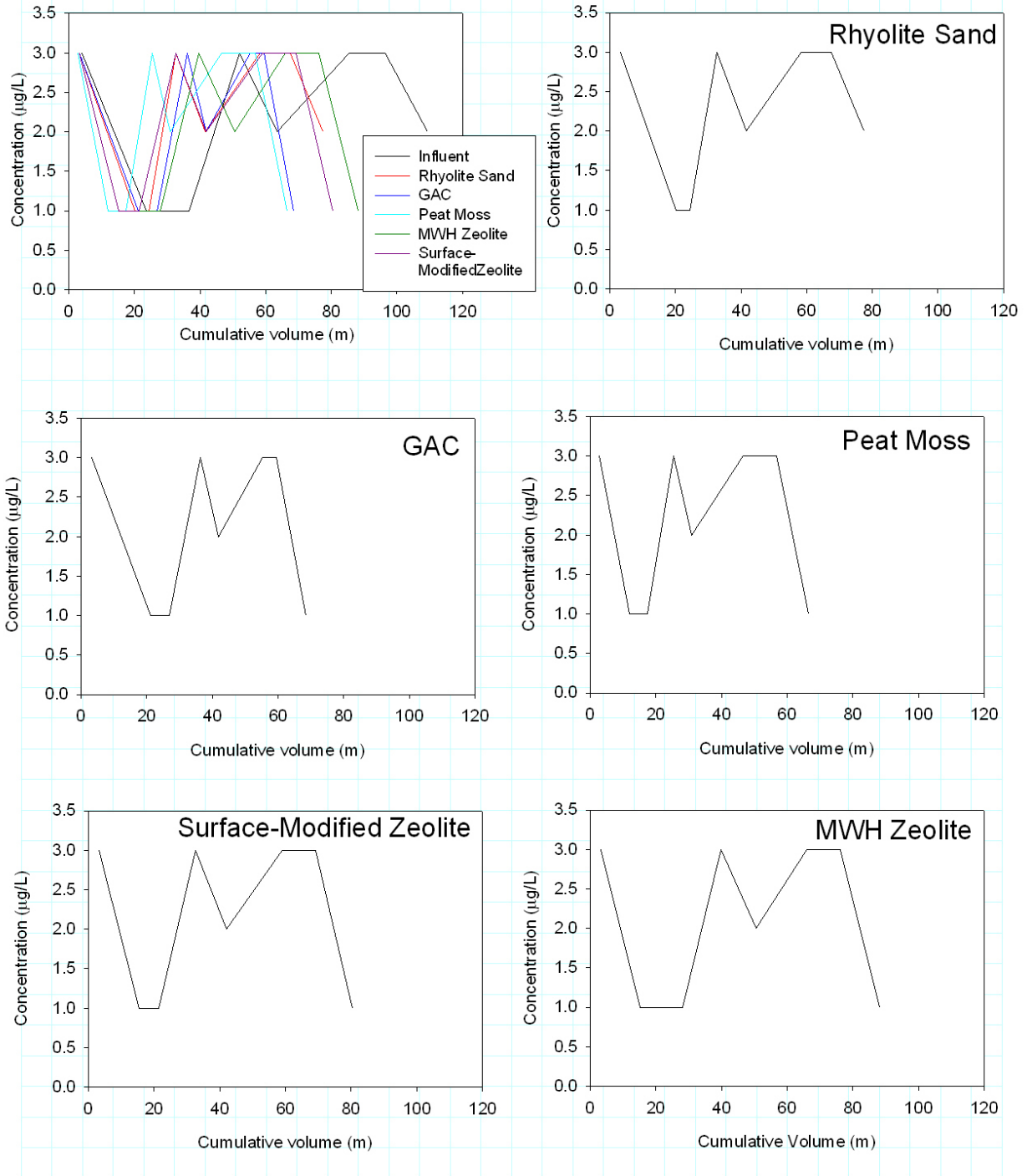
**Figure A3-25. Breakthrough plots for total lead.**

## Lead, Total: Column Breakthrough Testing



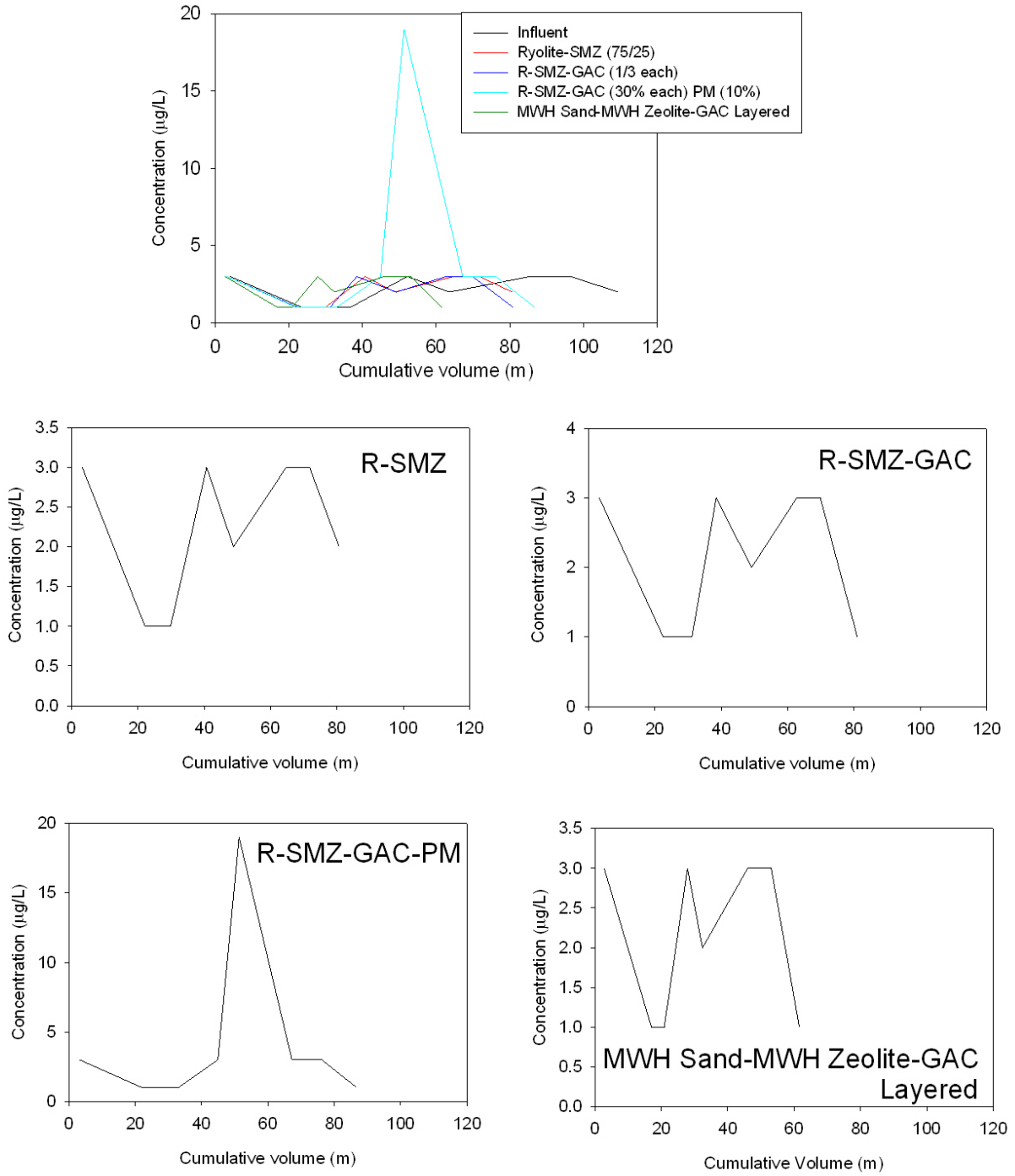
**Figure A3-25. Breakthrough plots for total lead (cont.).**

## Lead, Filtered: Column Breakthrough Testing



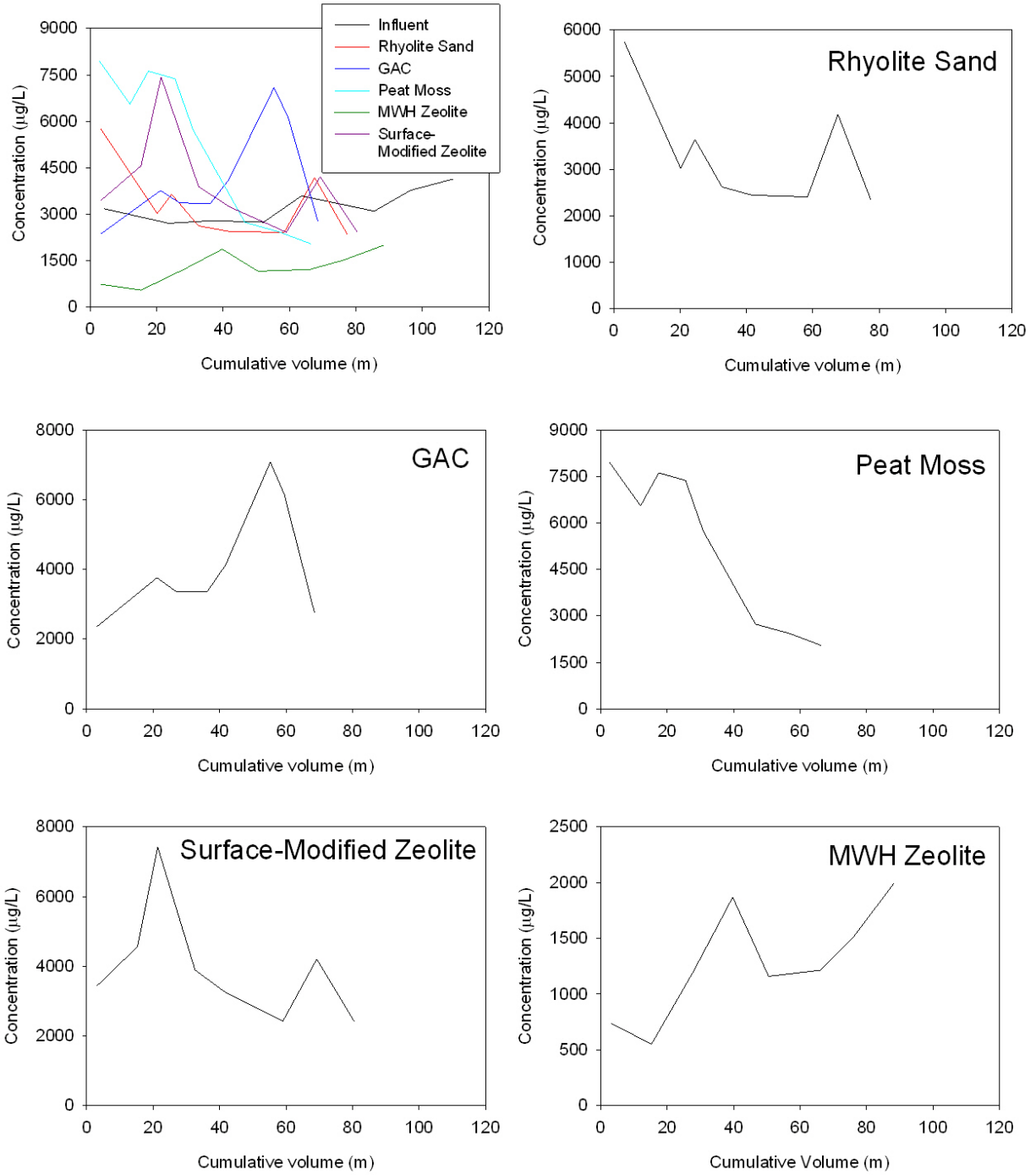
**Figure A3-26. Breakthrough plots for filtered lead.**

## Lead, Filtered: Column Breakthrough Testing



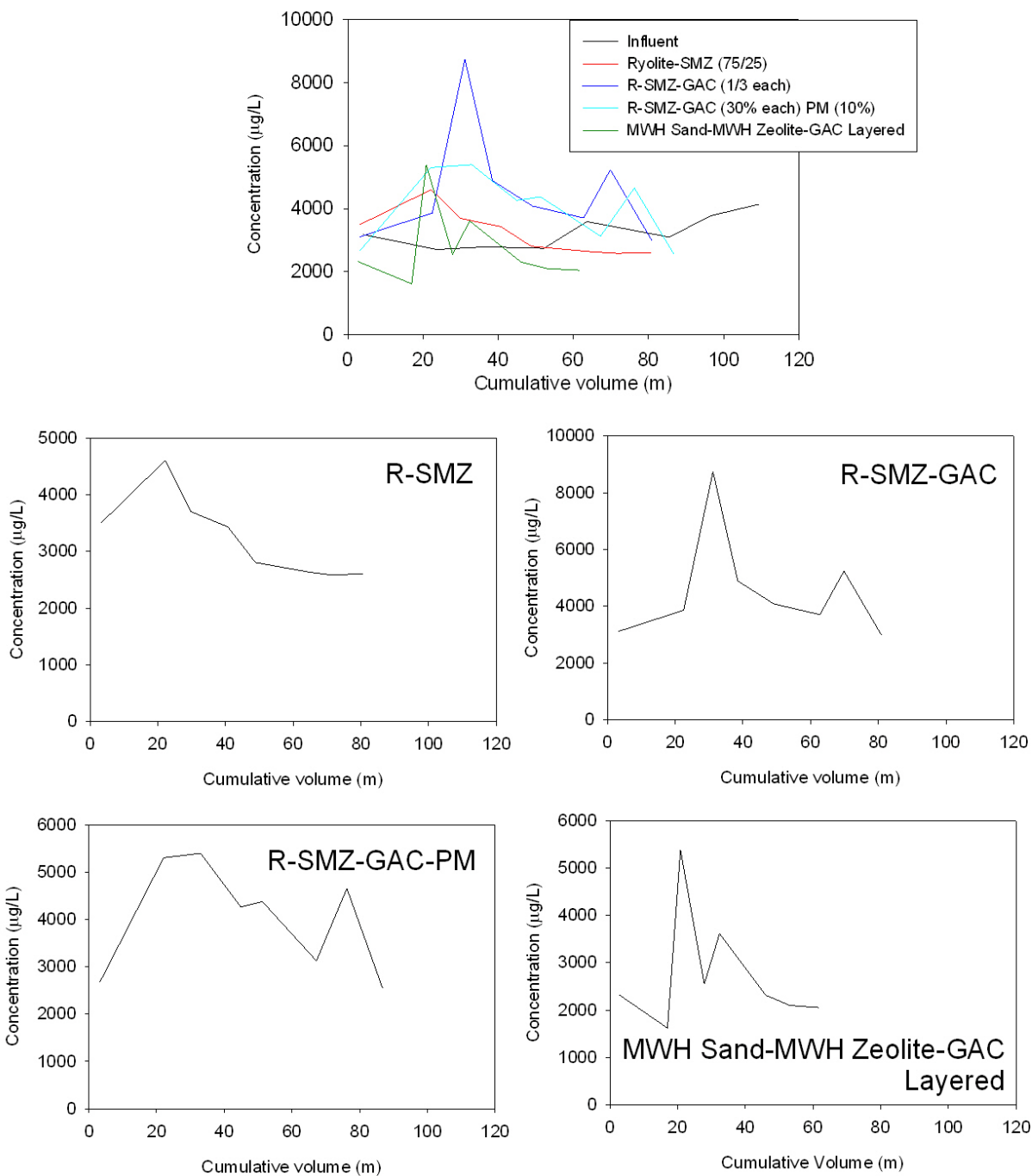
**Figure A3-26. Breakthrough plots for filtered lead (cont.).**

## Magnesium, Total: Column Breakthrough Testing



**Figure A3-27. Breakthrough plots for total magnesium.**

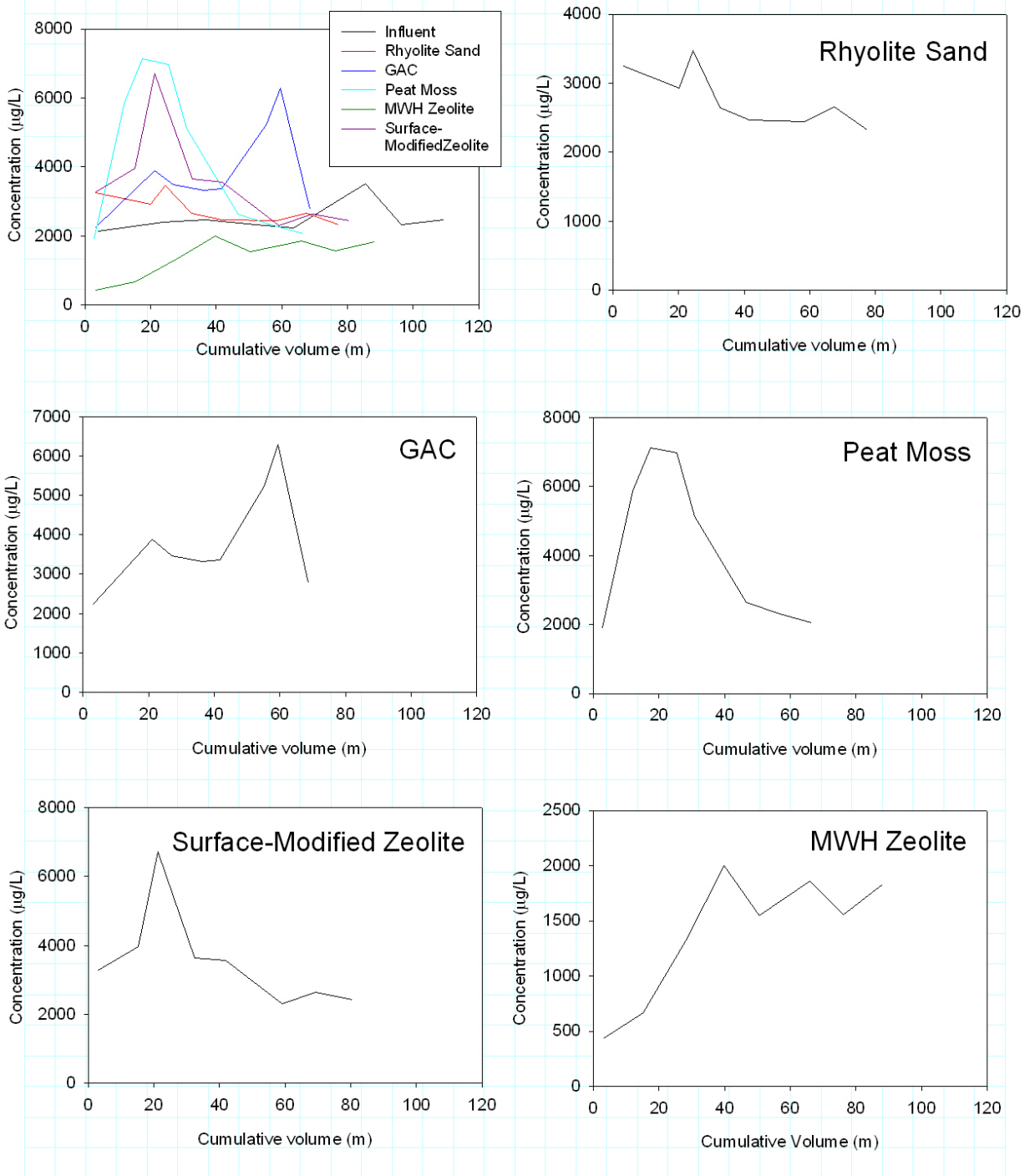
## Magnesium, Total: Column Breakthrough Testing



**Figure A3-27. Breakthrough plots for total magnesium (cont.).**



## Magnesium, Filtered: Column Breakthrough Testing



**Figure A3-28. Breakthrough plots for filtered magnesium.**

## Magnesium, Filtered: Column Breakthrough Testing

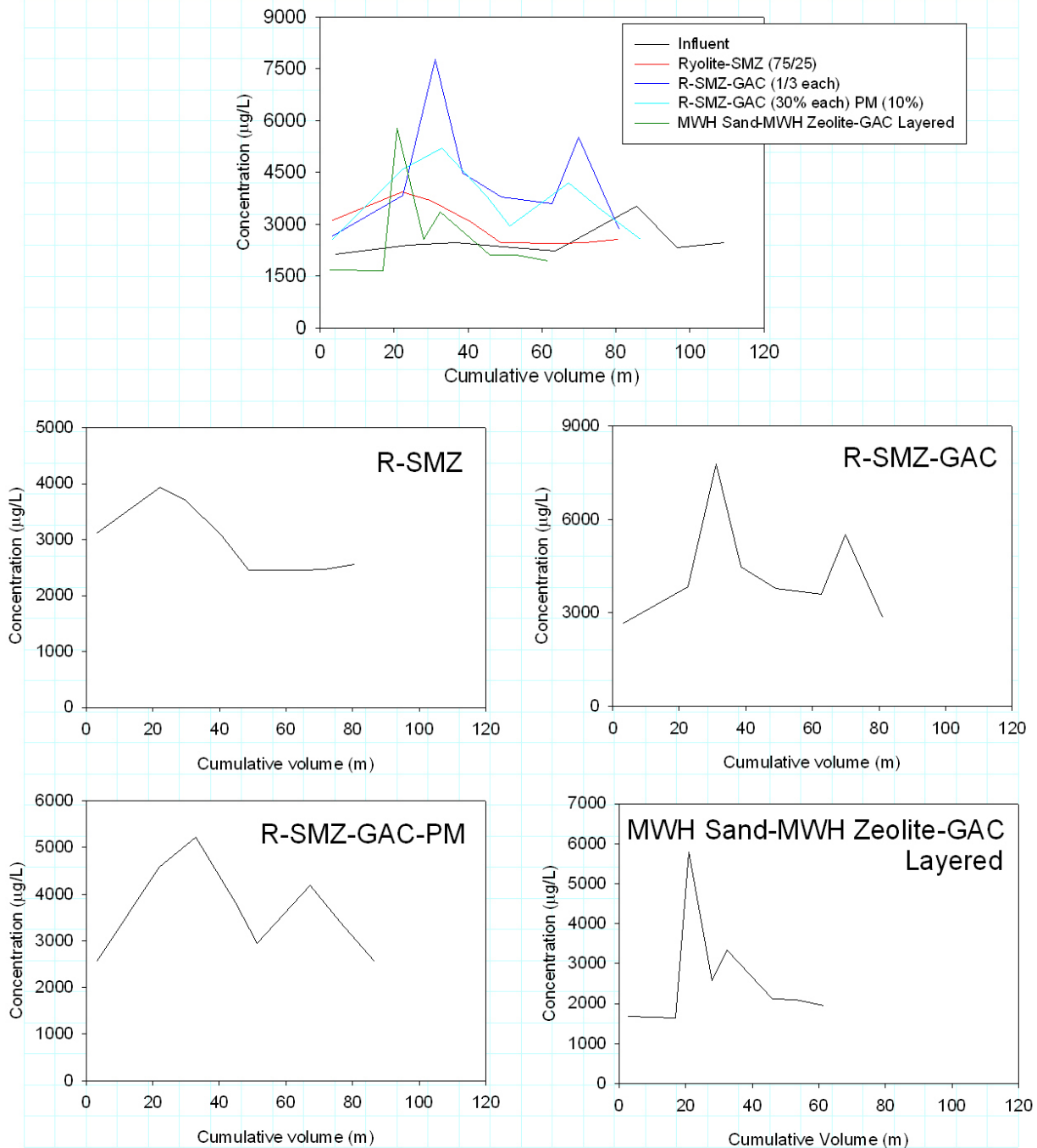
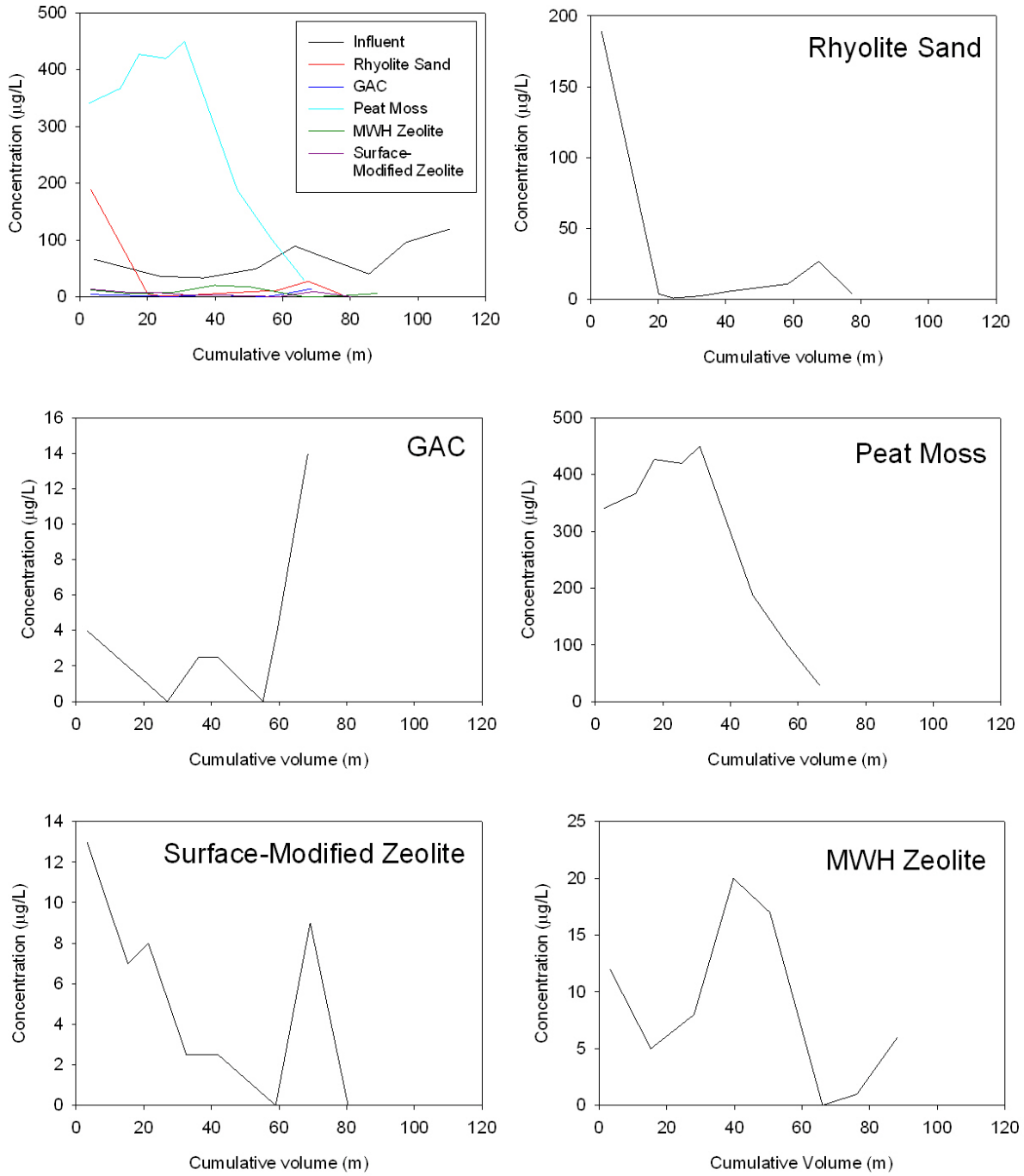


Figure A3-28. Breakthrough plots for filtered magnesium (cont.).

## Manganese, Total: Column Breakthrough Testing



**Figure A3-29. Breakthrough plots for total manganese.**

## Manganese, Total: Column Breakthrough Testing

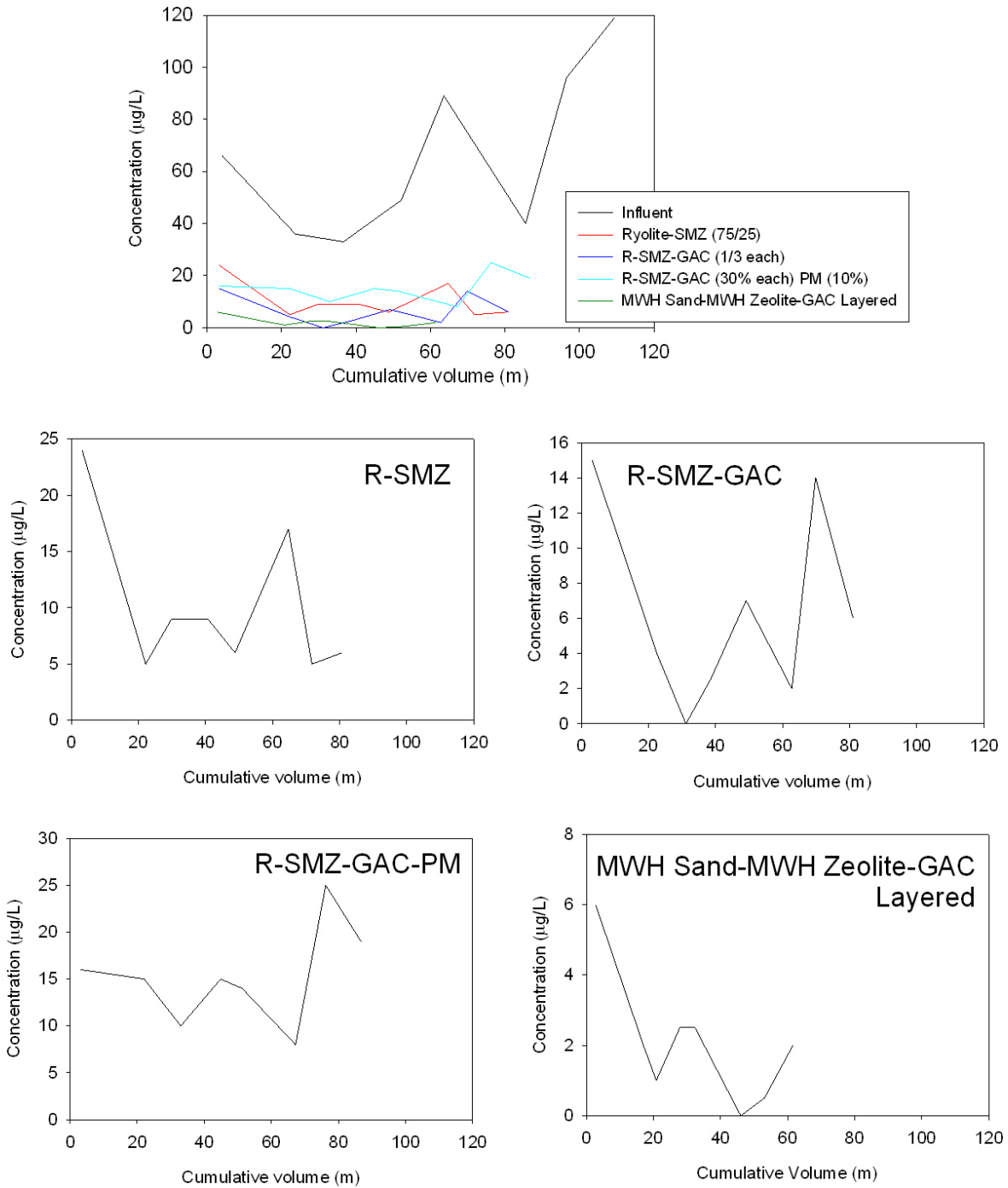
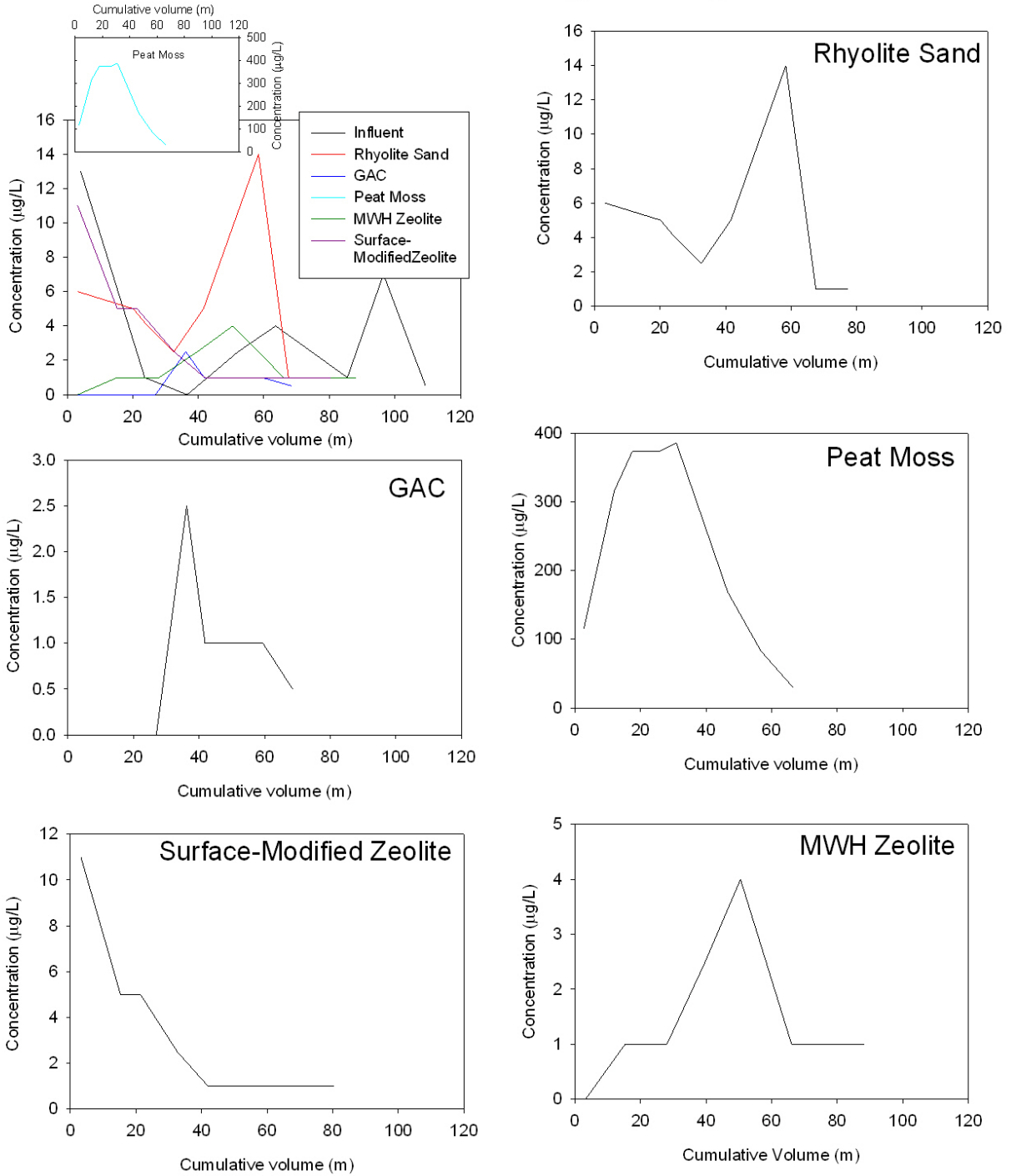


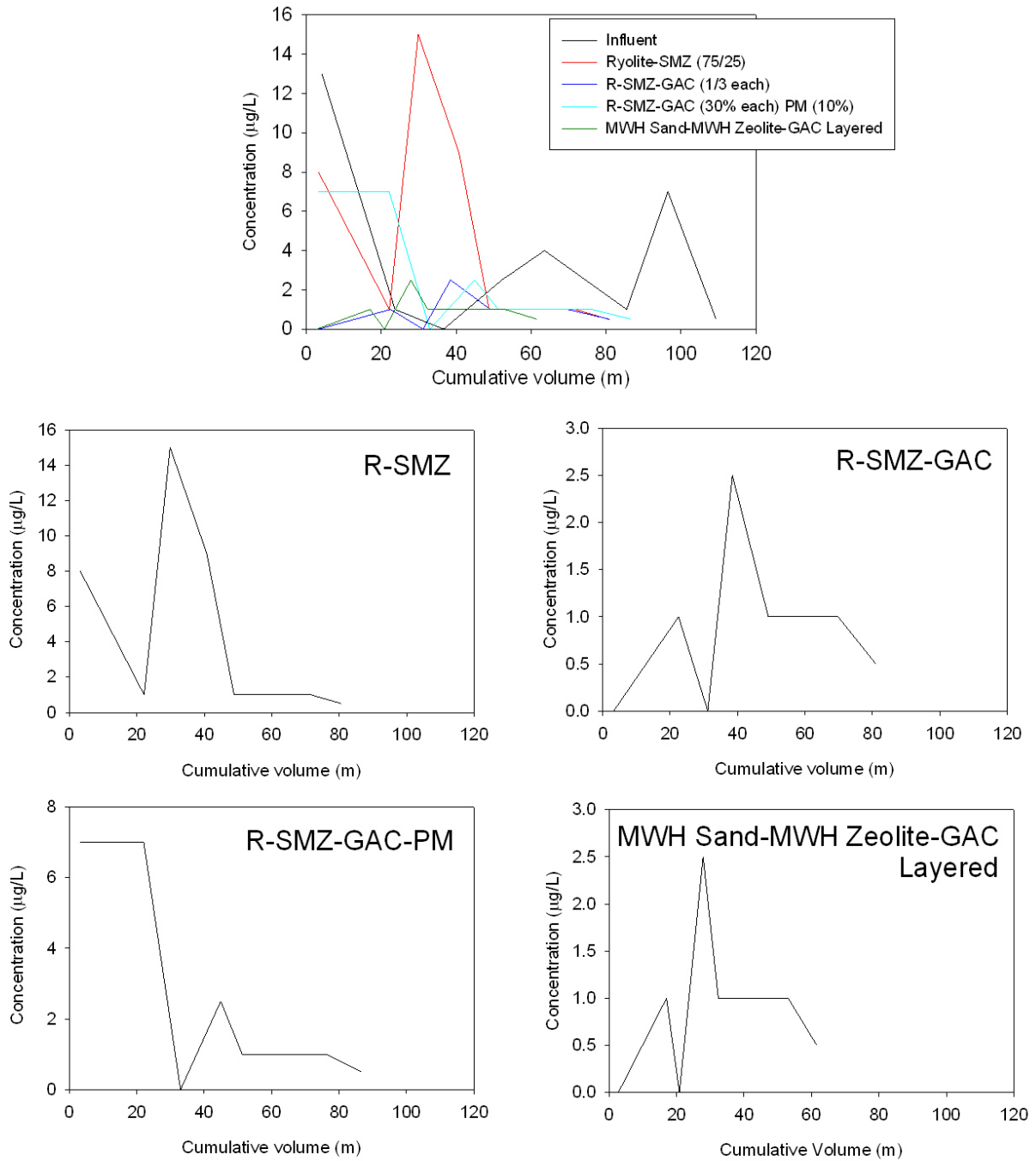
Figure A3-29. Breakthrough plots for total manganese (cont.).

## Manganese, Filtered: Column Breakthrough Testing



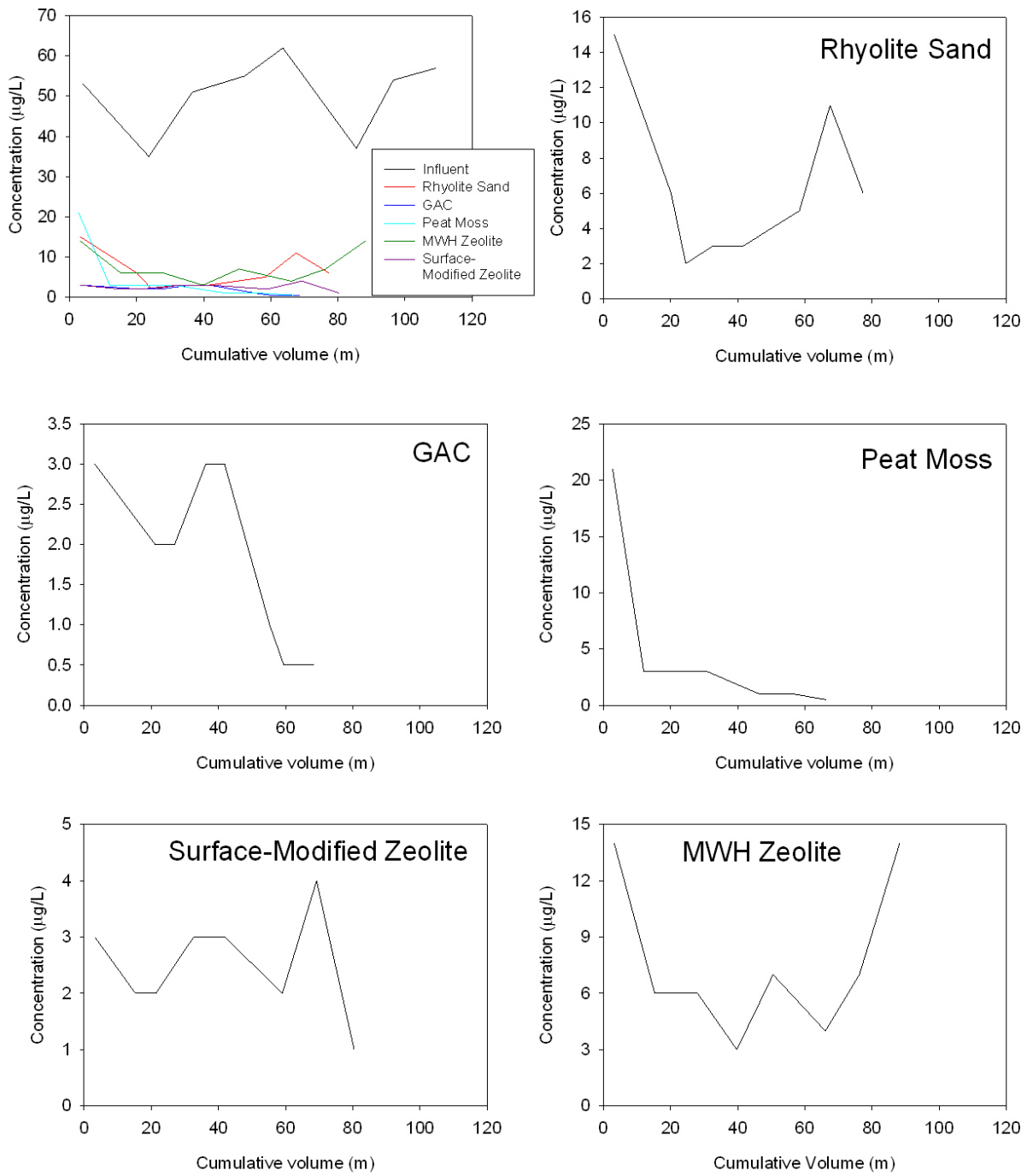
**Figure A3-30. Breakthrough plots for filtered manganese.**

## Manganese, Filtered: Column Breakthrough Testing



**Figure A3-30. Breakthrough plots for filtered manganese (cont.).**

## Nickel, Total: Column Breakthrough Testing



**Figure A3-31. Breakthrough plots for total nickel.**

## Nickel, Total: Column Breakthrough Testing

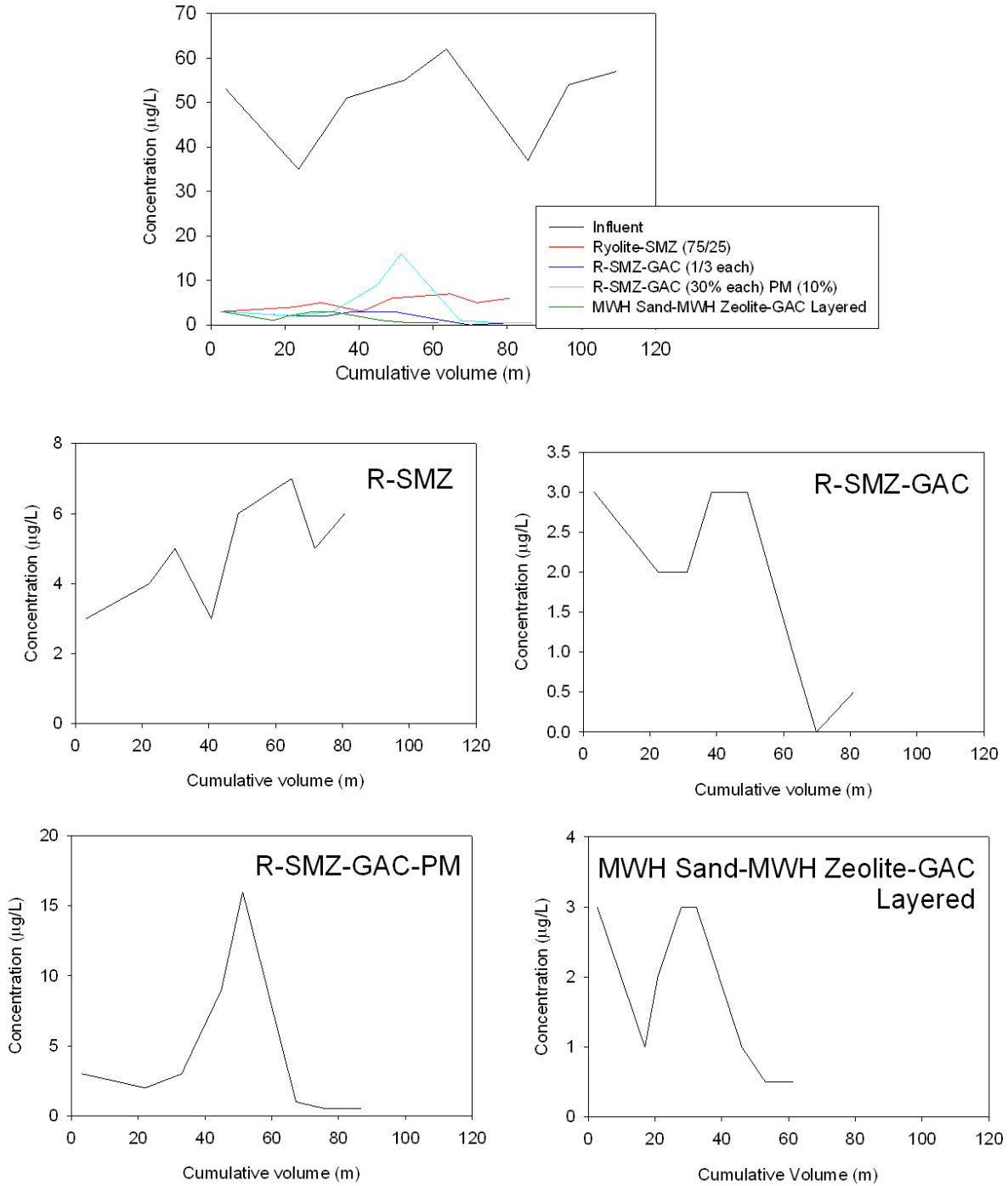
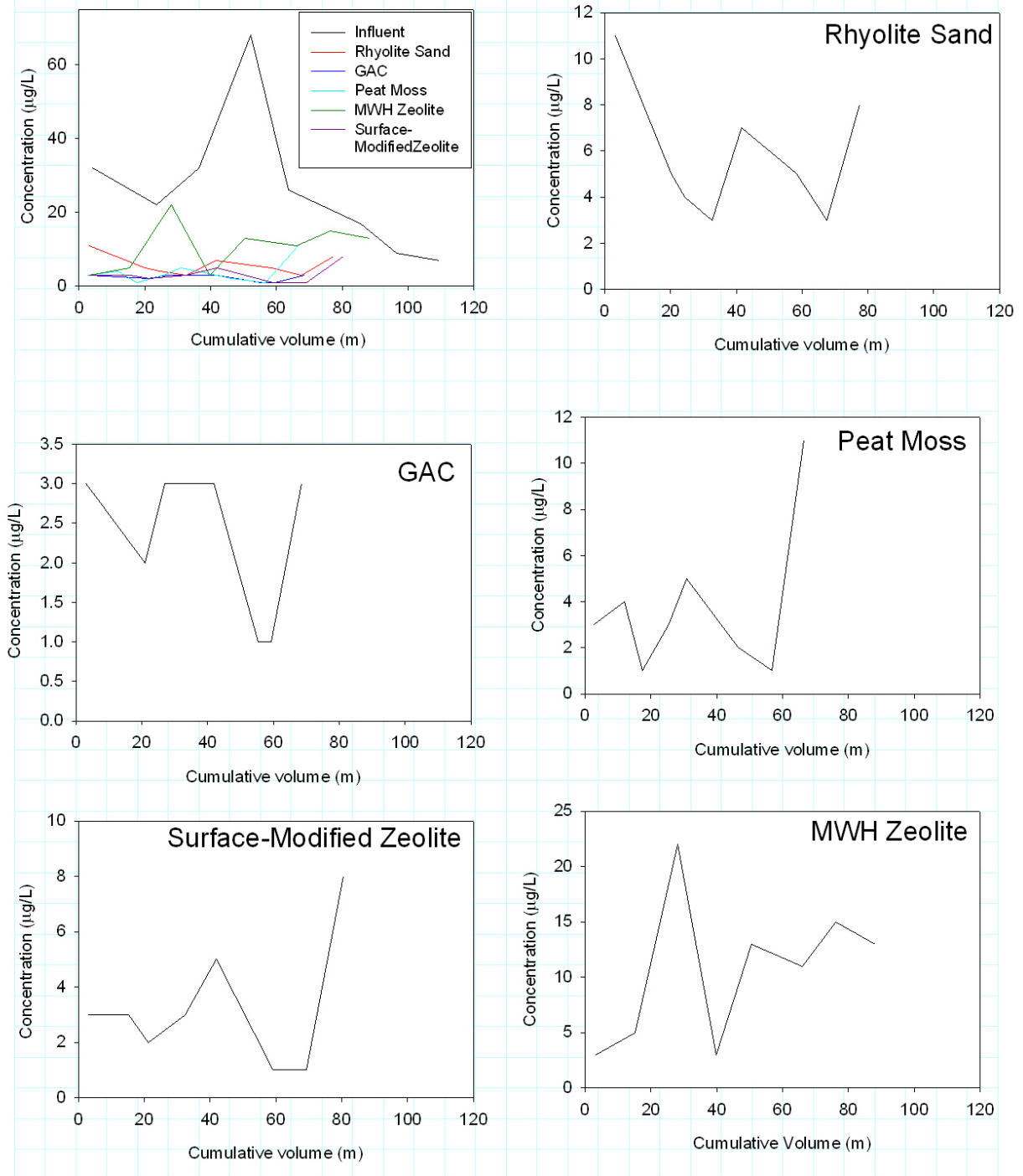


Figure A3-31. Breakthrough plots for total nickel (cont.).



## Nickel, Filtered: Column Breakthrough Testing



**Figure A3-32. Breakthrough plots for filtered nickel.**

## Nickel, Filtered: Column Breakthrough Testing

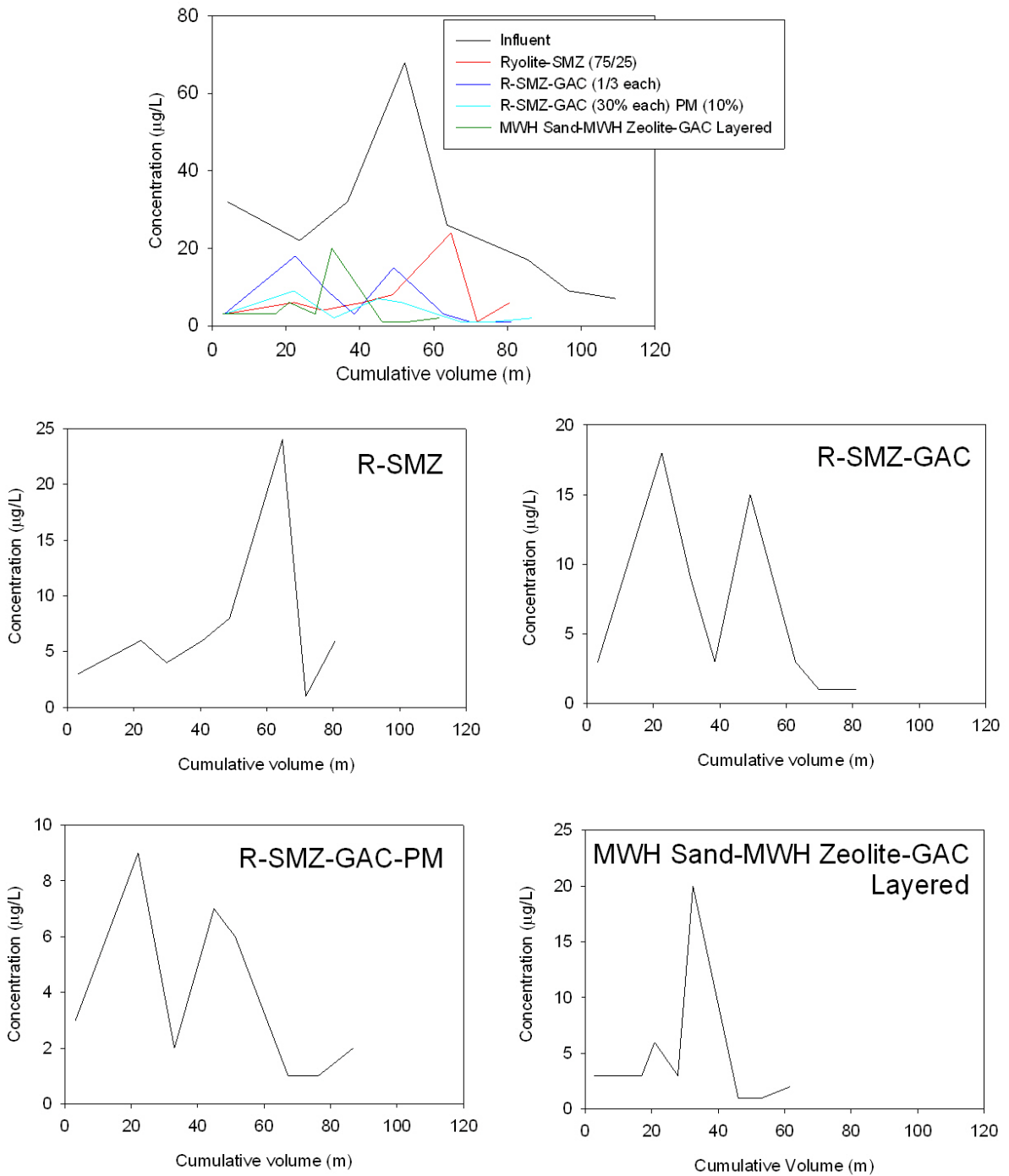
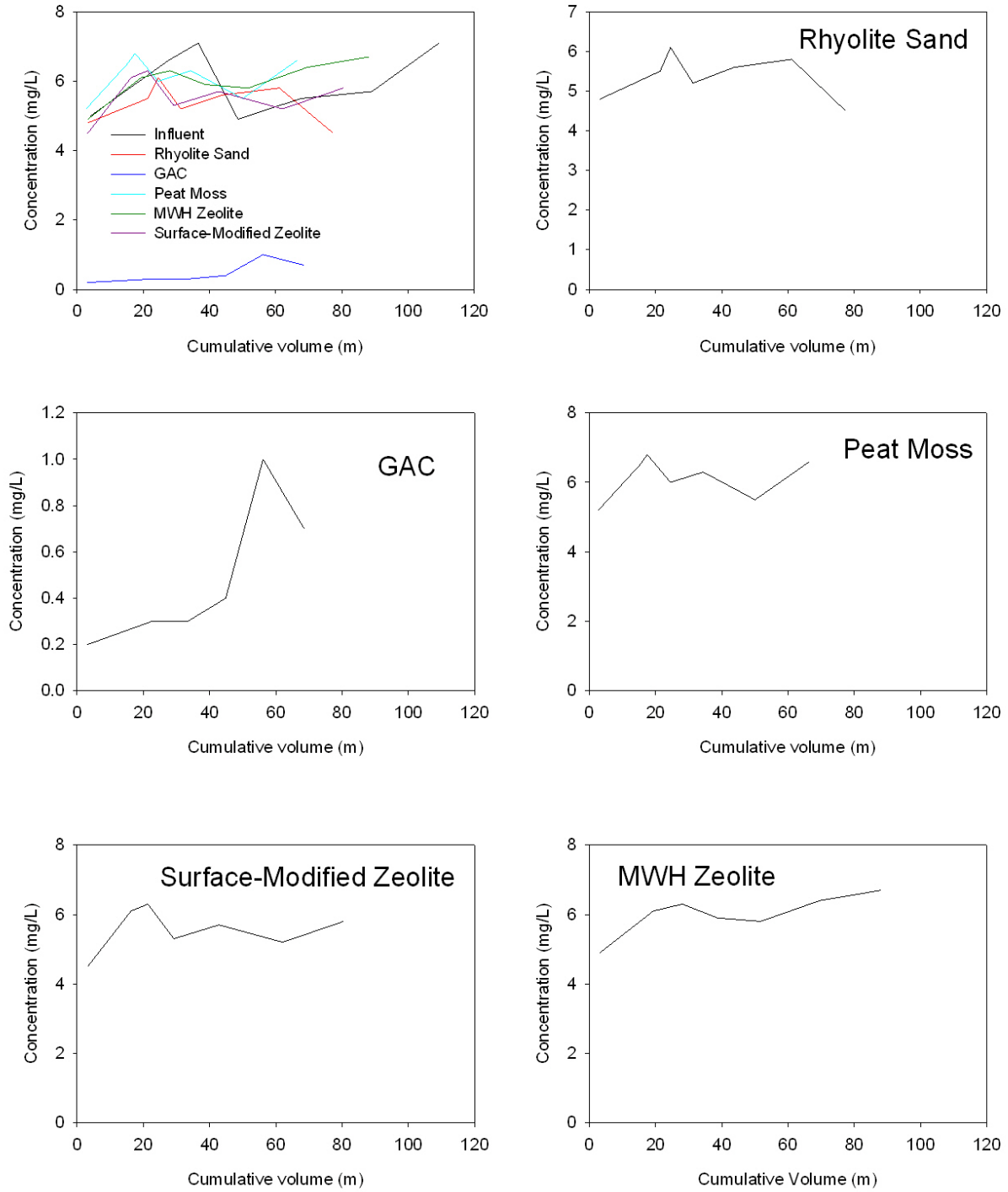


Figure A3-32. Breakthrough plots for filtered nickel (cont.).

## Nitrate-N: Column Breakthrough Testing



**Figure A3-33. Breakthrough plots for nitrate nitrogen.**

## Nitrate-N: Column Breakthrough Testing

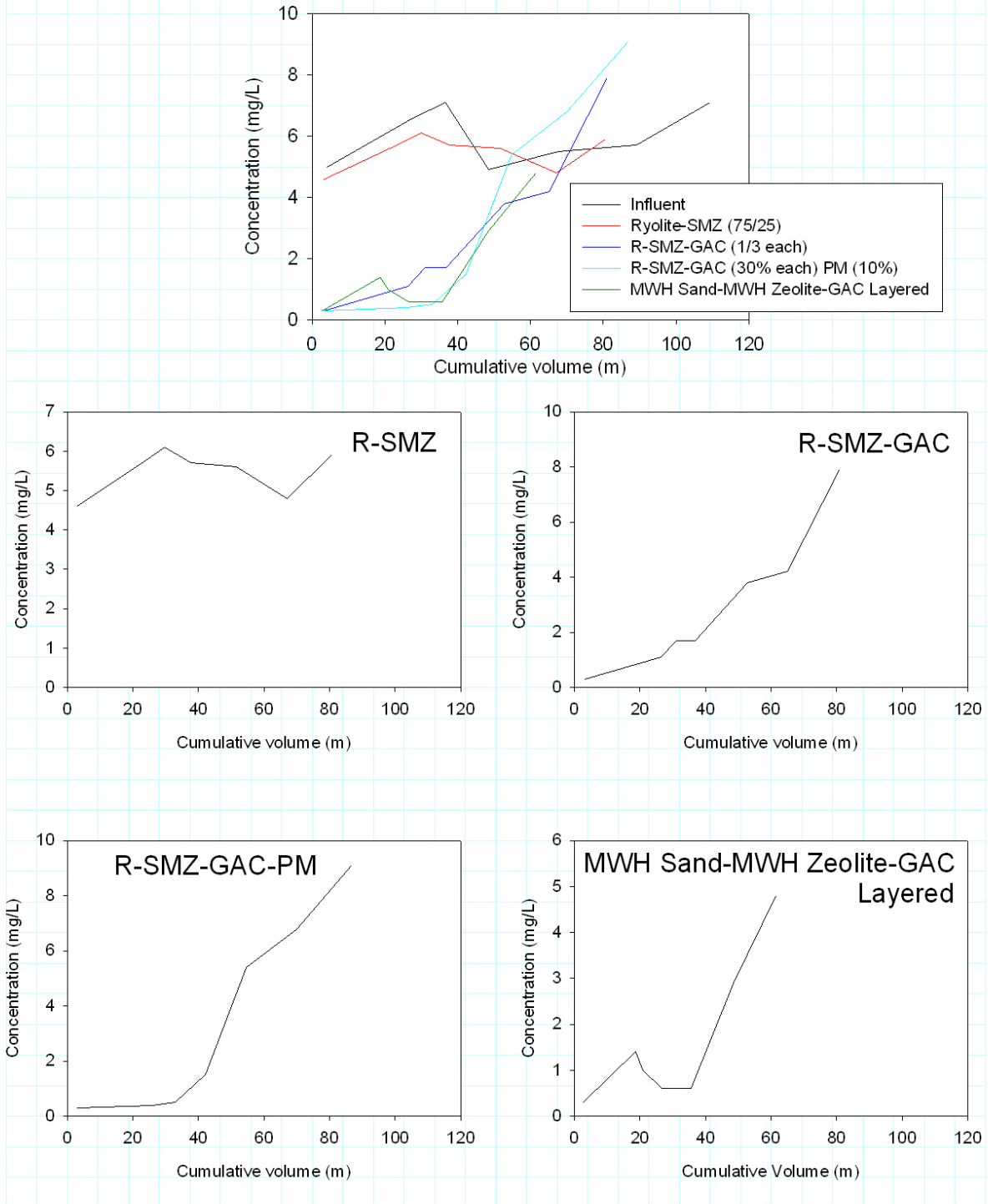
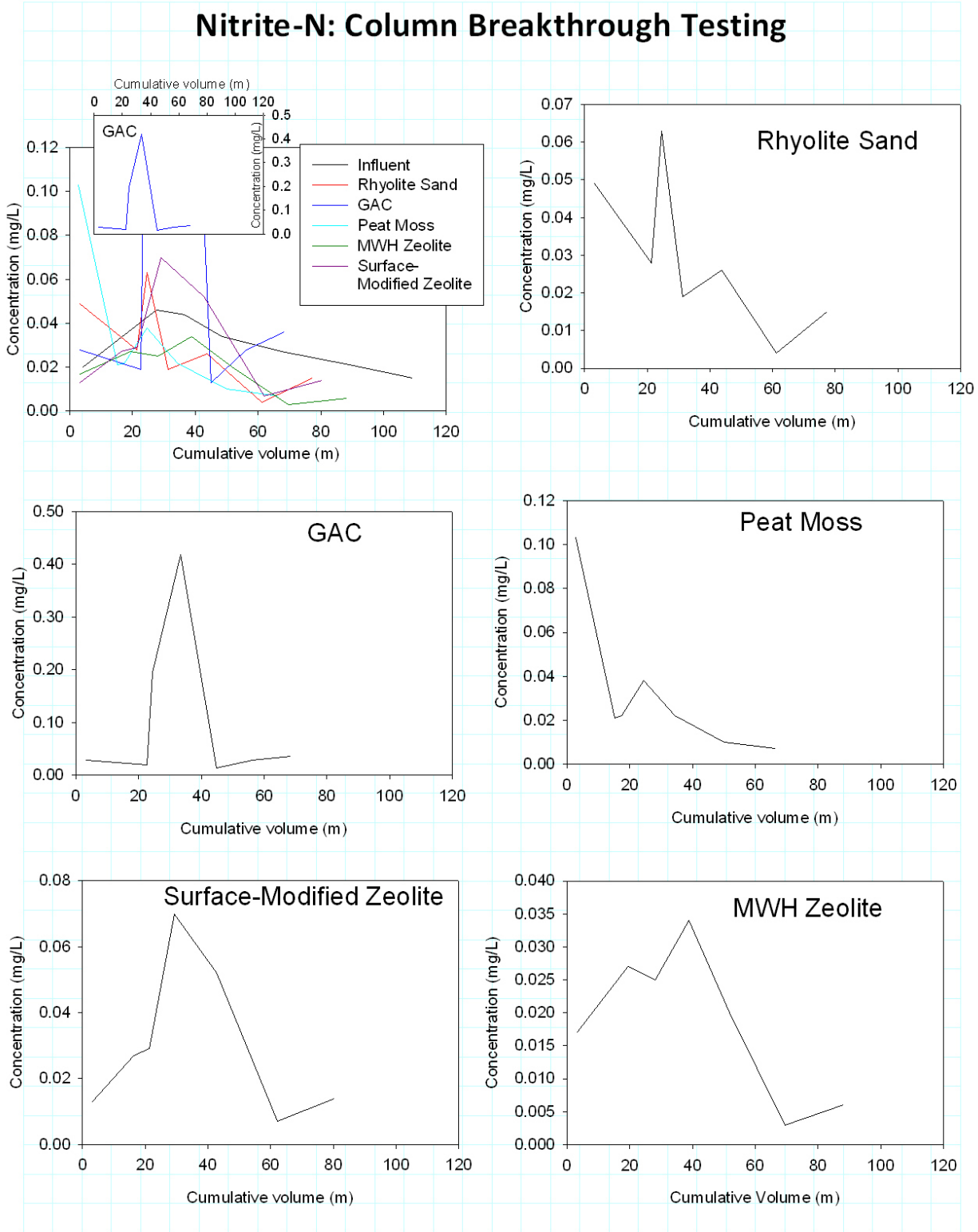
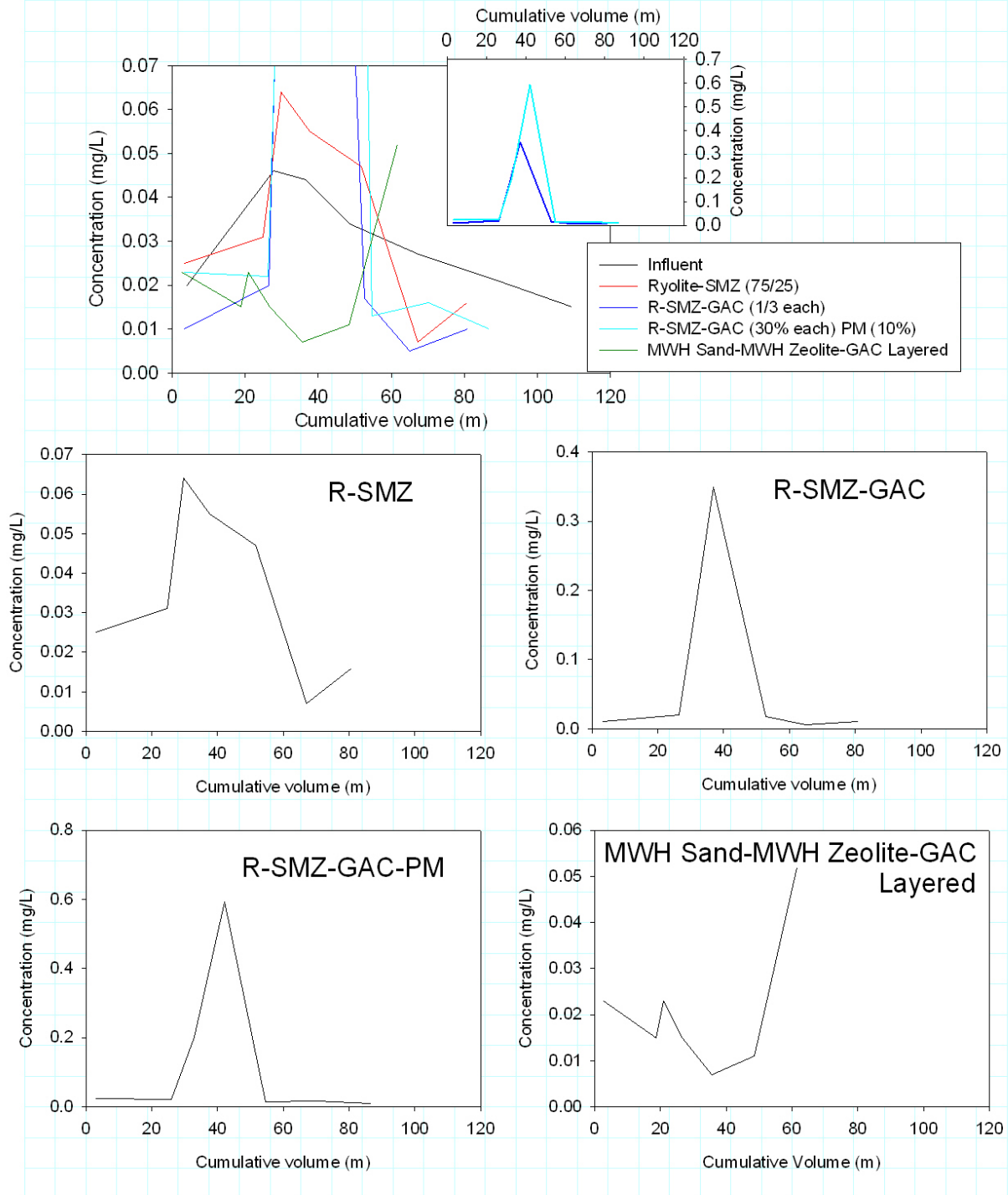


Figure A3-33. Breakthrough plots for nitrate nitrogen (cont.).



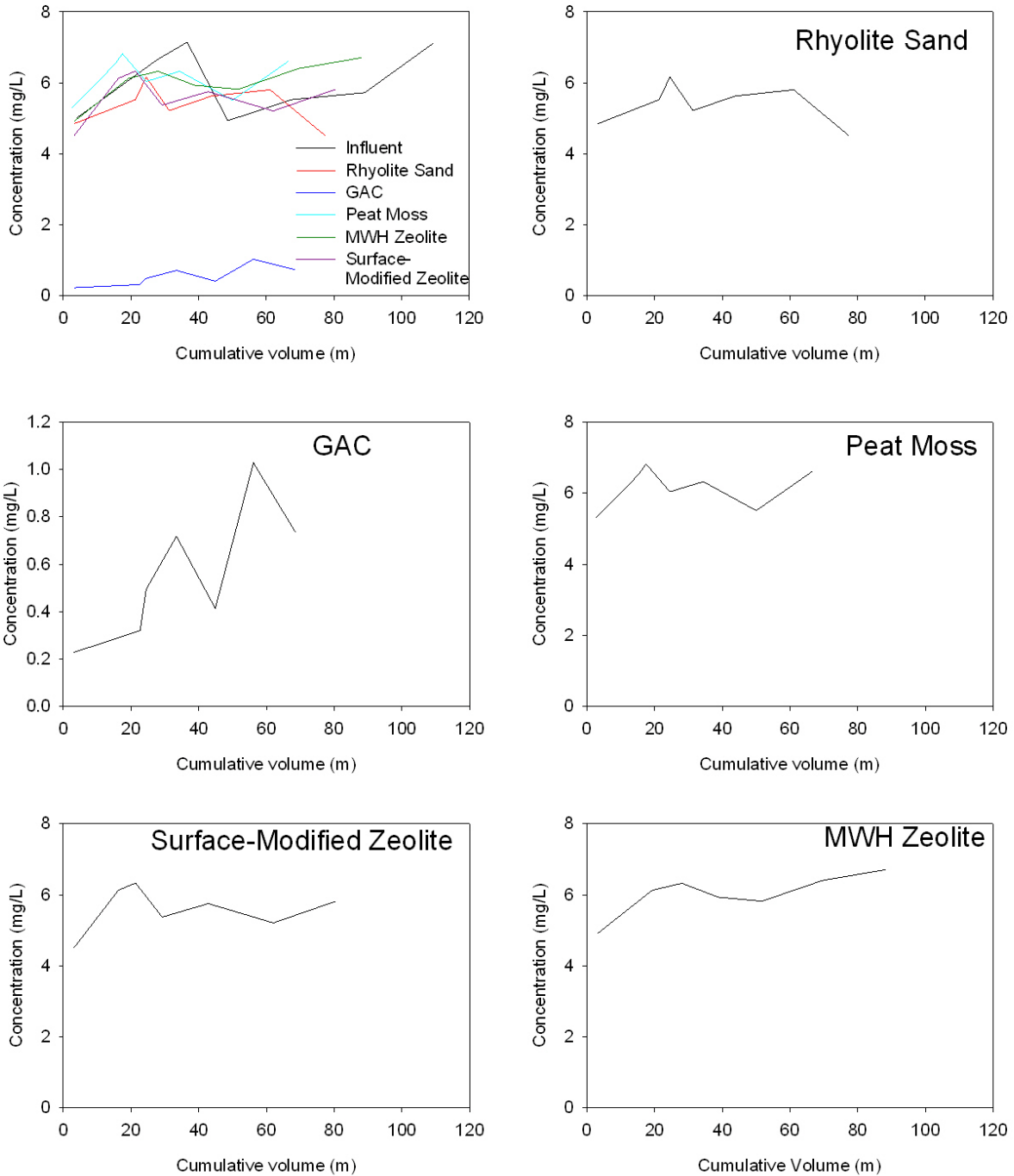
**Figure A3-34. Breakthrough plots for nitrite nitrogen.**

## Nitrite-N: Column Breakthrough Testing



**Figure A3-34. Breakthrough plots for nitrite nitrogen (cont.).**

## Nitrite + Nitrate: Column Breakthrough Testing



**Figure A3-35. Breakthrough plots for nitrite plus nitrate nitrogen.**

## Nitrite + Nitrate: Column Breakthrough Testing

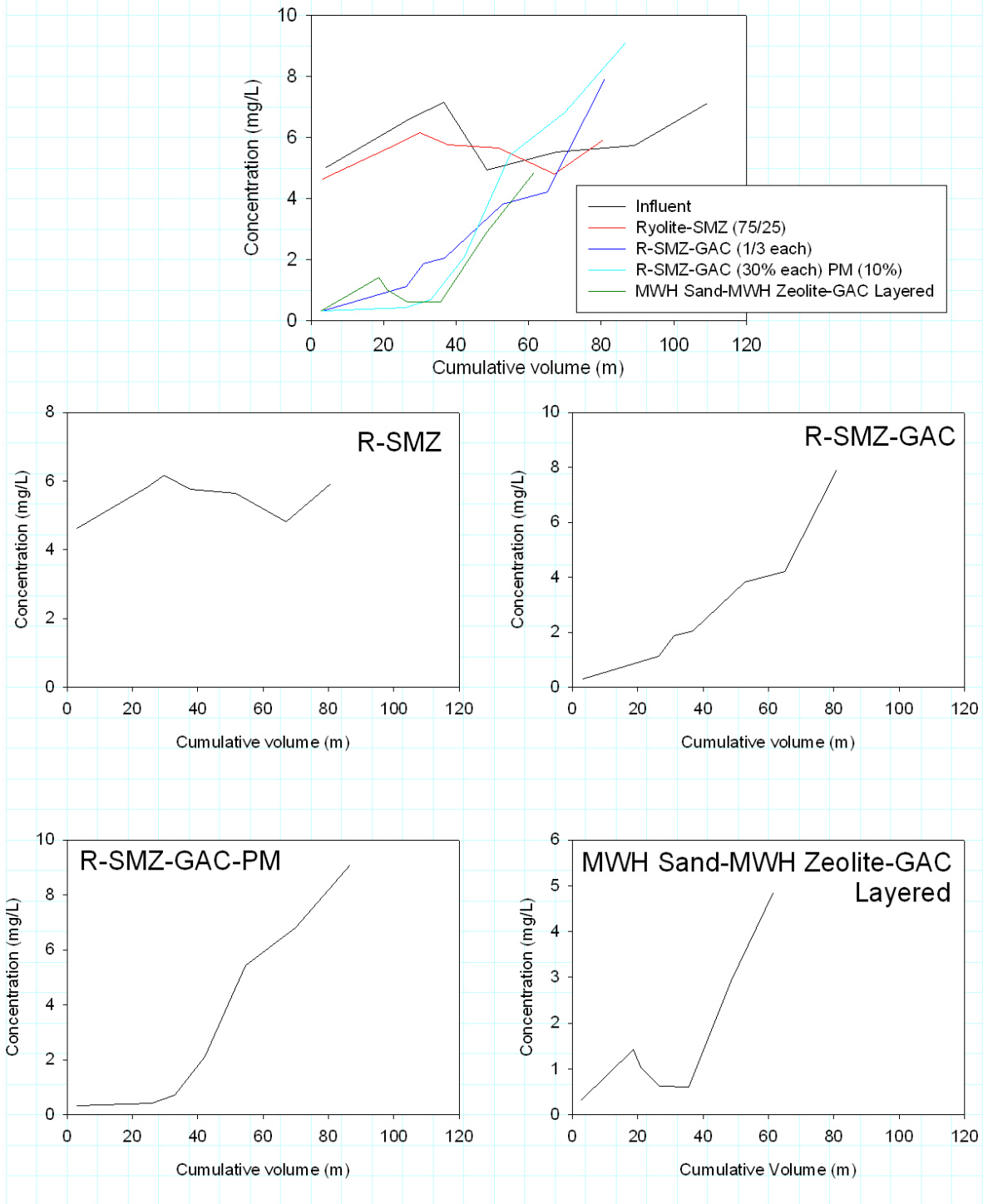
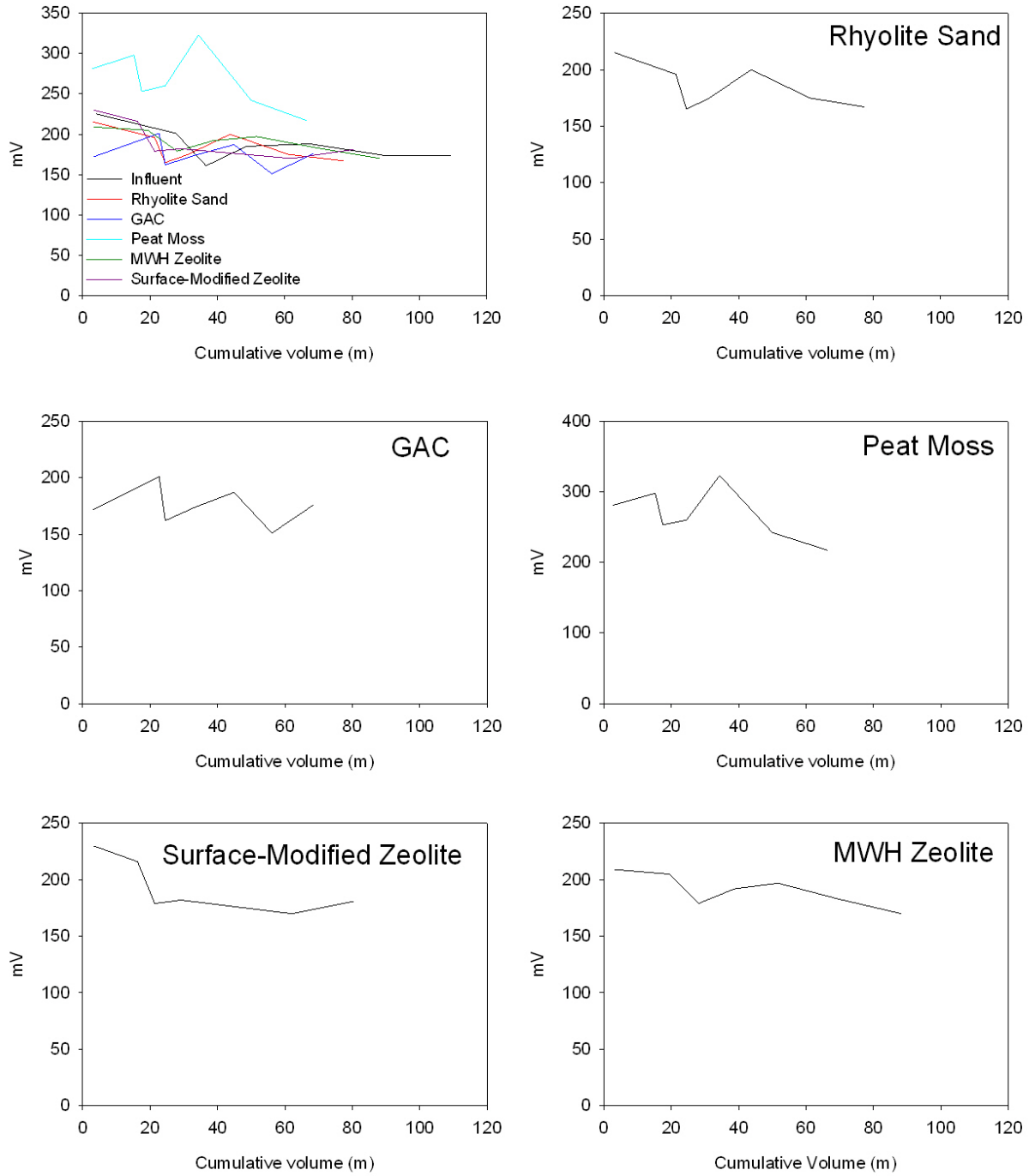


Figure A3-35. Breakthrough plots for nitrite plus nitrate nitrogen (cont.).

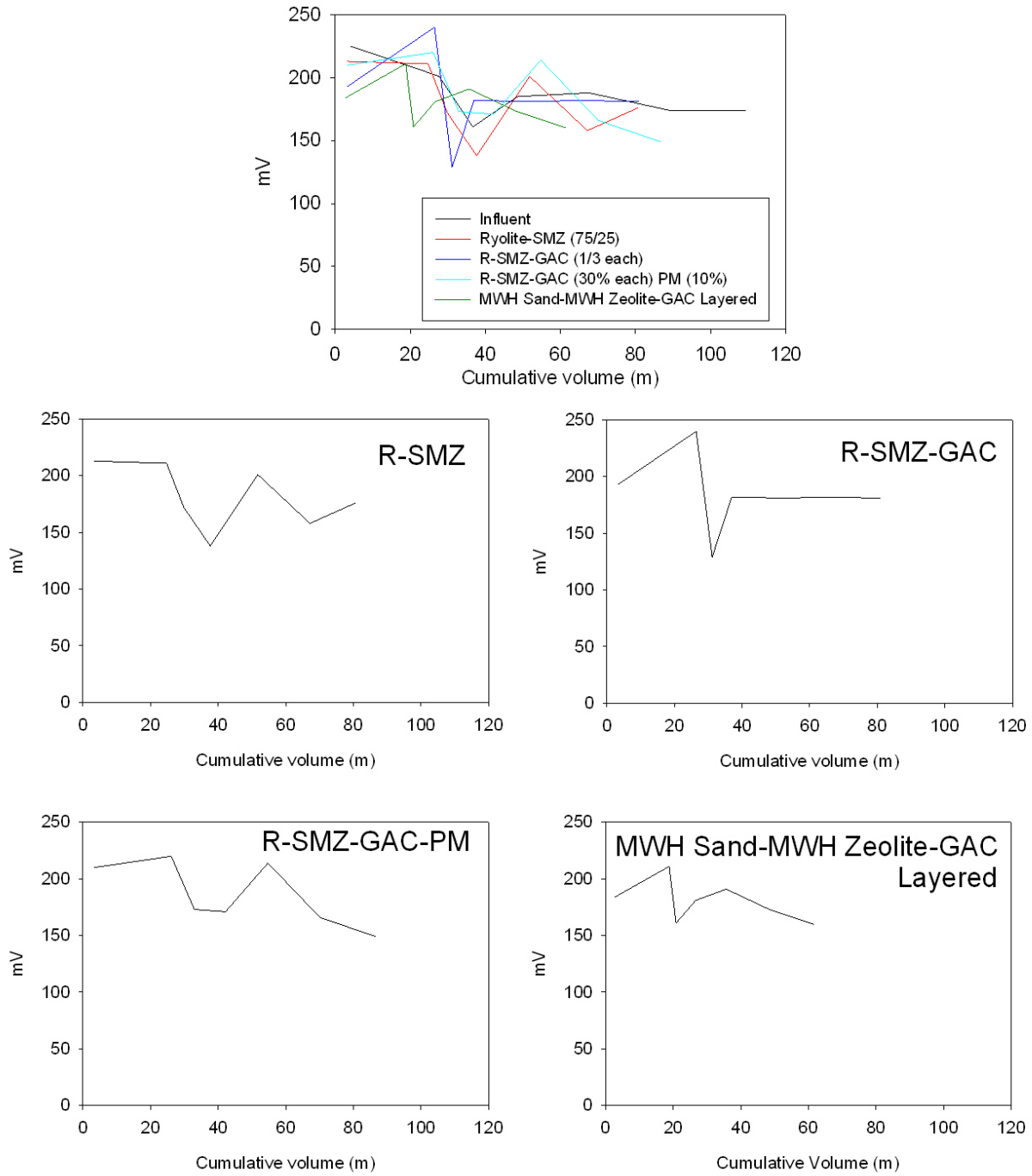


## Oxidation-Reduction Potential: Column Breakthrough Testing



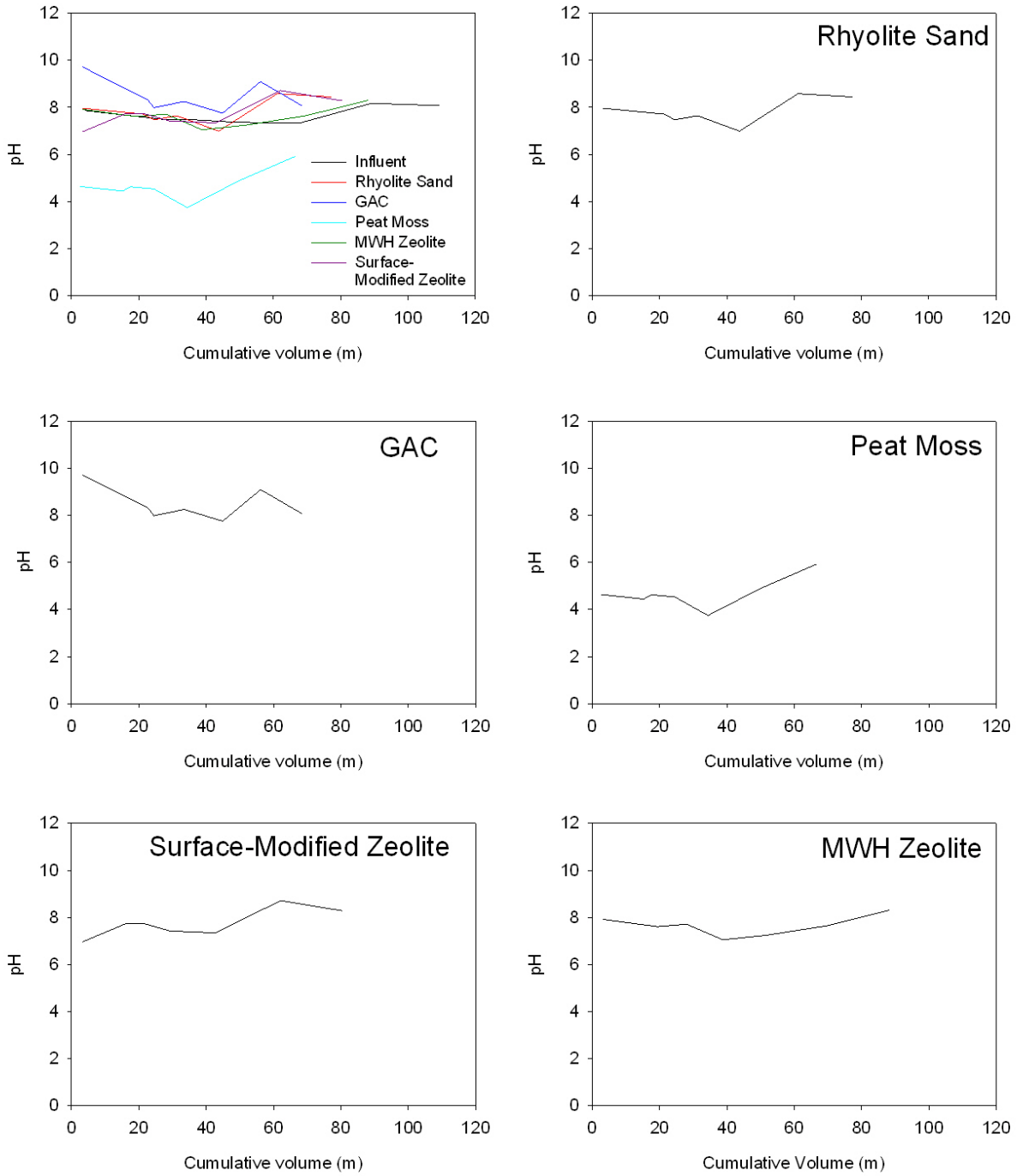
**Figure A3-36. Breakthrough plots for oxidation reduction potential (ORP).**

## Oxidation-Reduction Potential: Column Breakthrough Testing



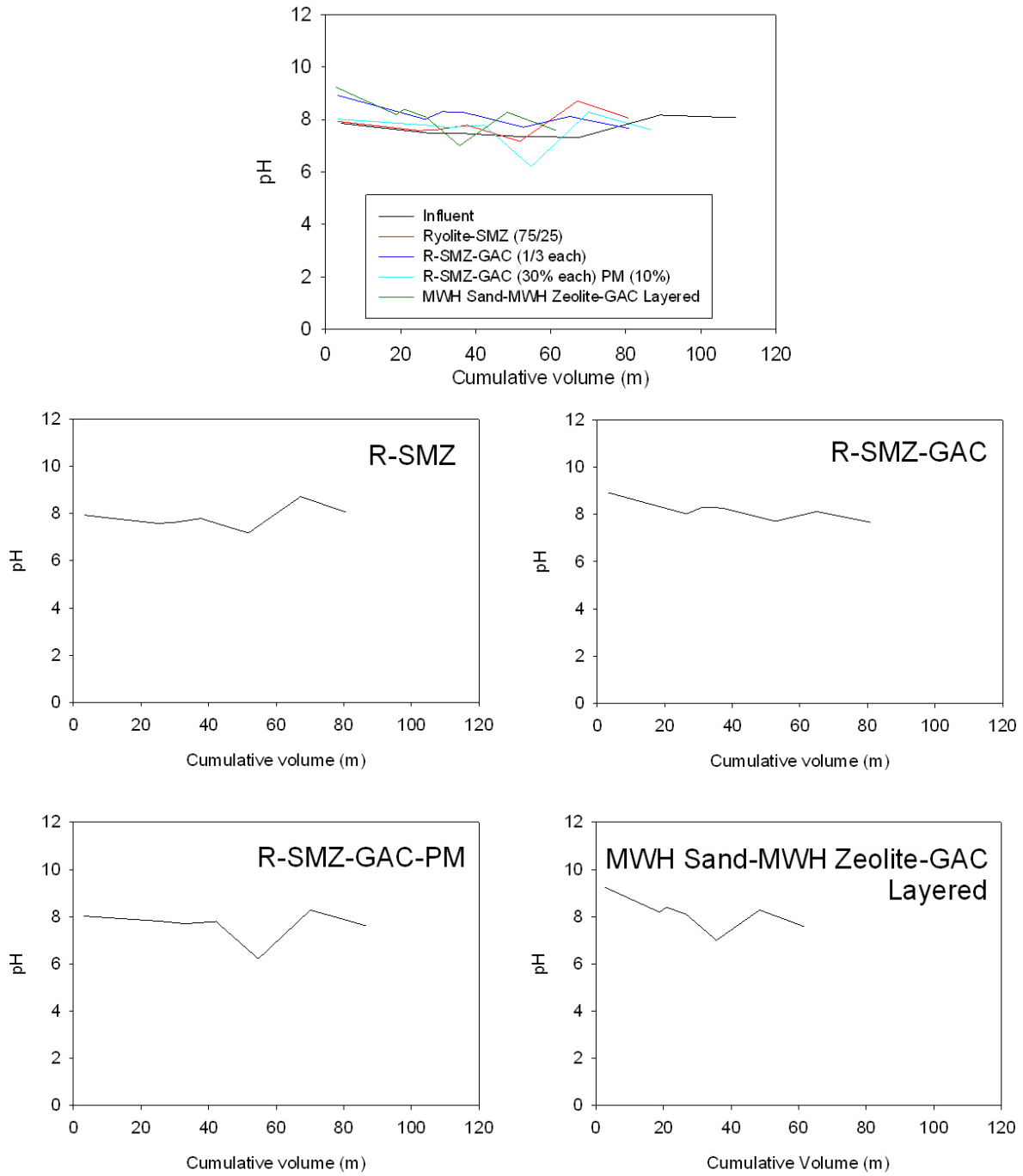
**Figure A3-36. Breakthrough plots for oxidation reduction potential (ORP) (cont.).**

## pH: Column Breakthrough Testing

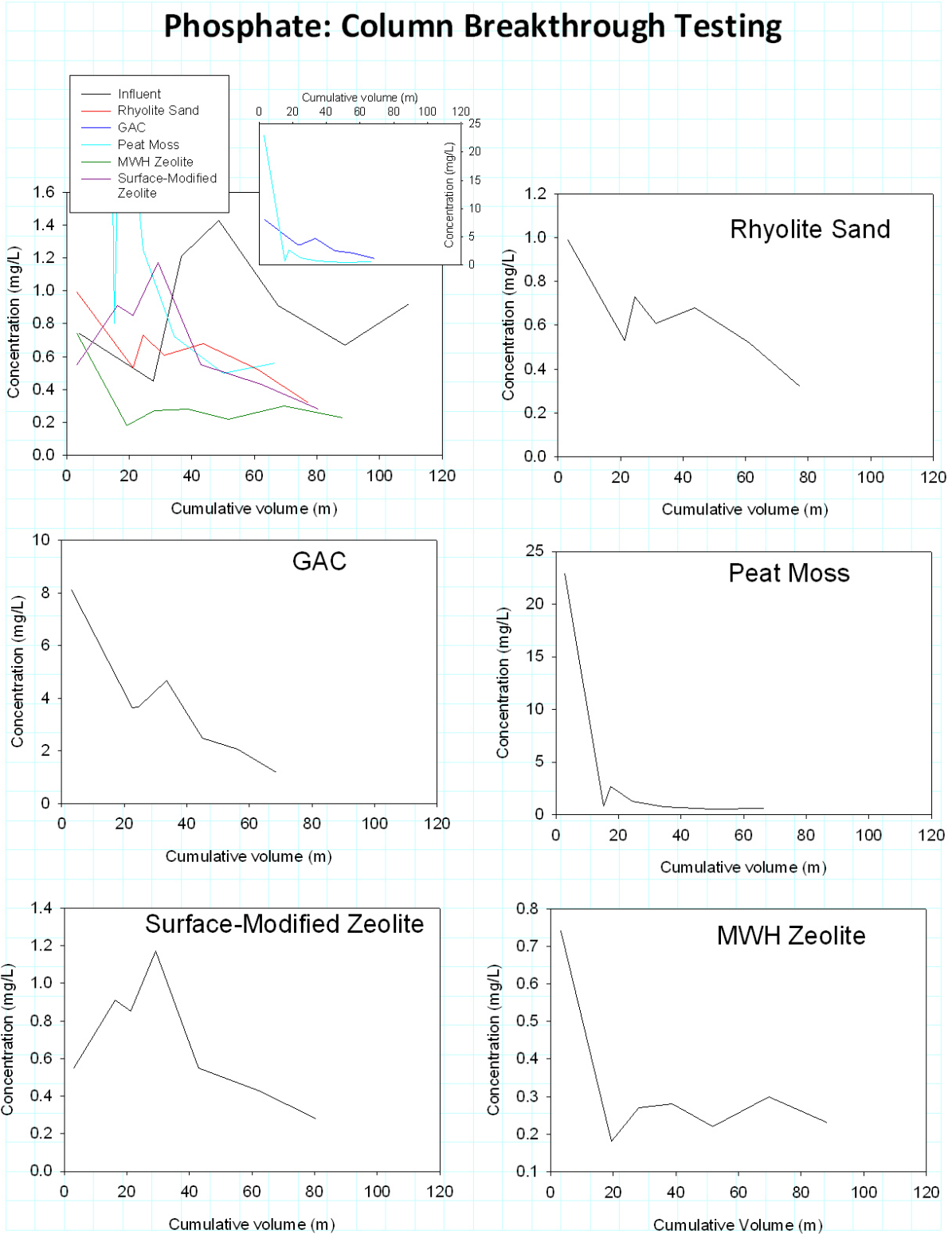


**Figure A3-37. Breakthrough plots for pH.**

## pH: Column Breakthrough Testing

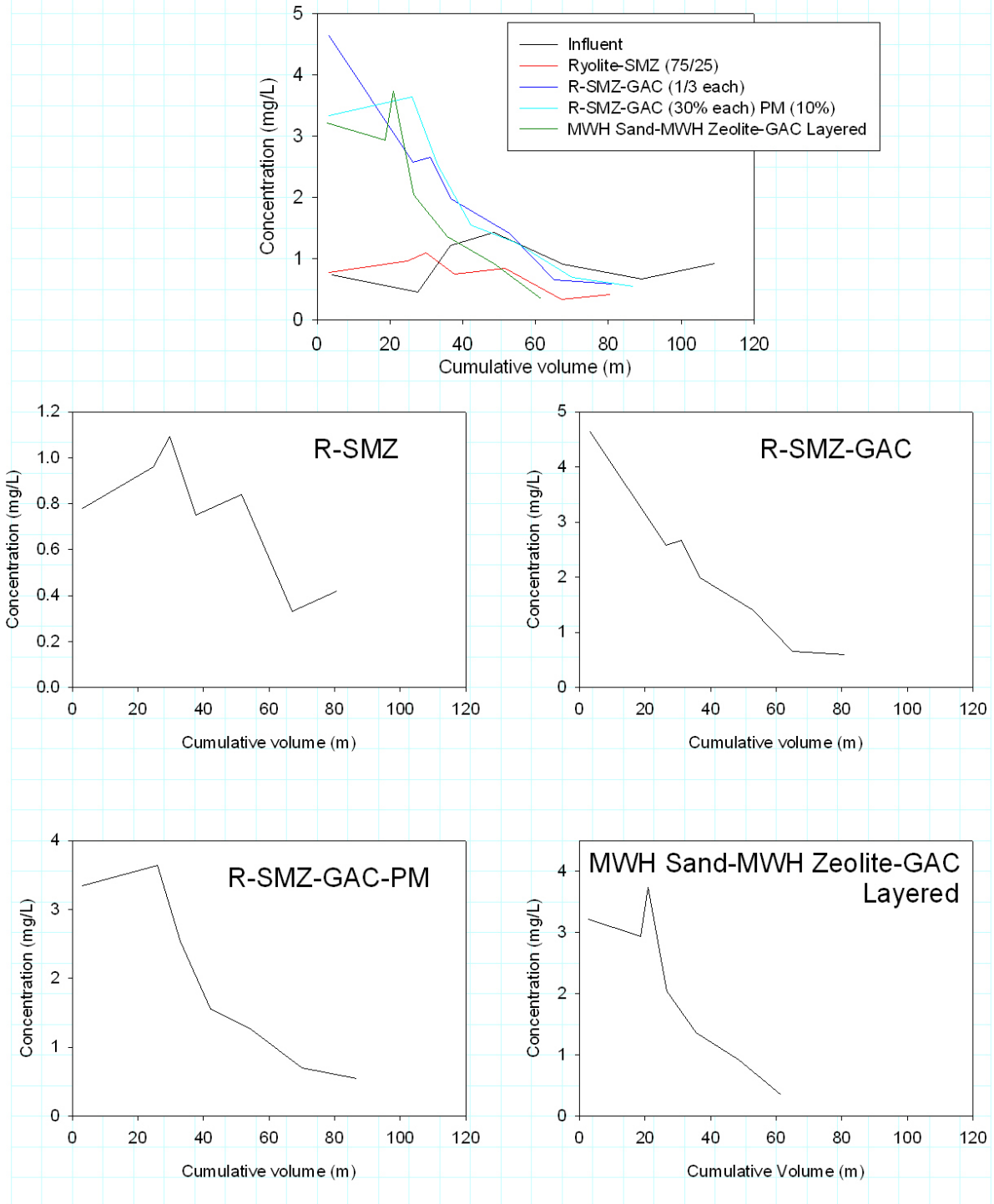


**Figure A3-37. Breakthrough plots for pH (cont.).**



**Figure A3-38. Breakthrough plots for phosphate.**

## Phosphate: Column Breakthrough Testing



**Figure A3-38. Breakthrough plots for phosphate (cont.).**

## Potassium, Total: Column Breakthrough Testing

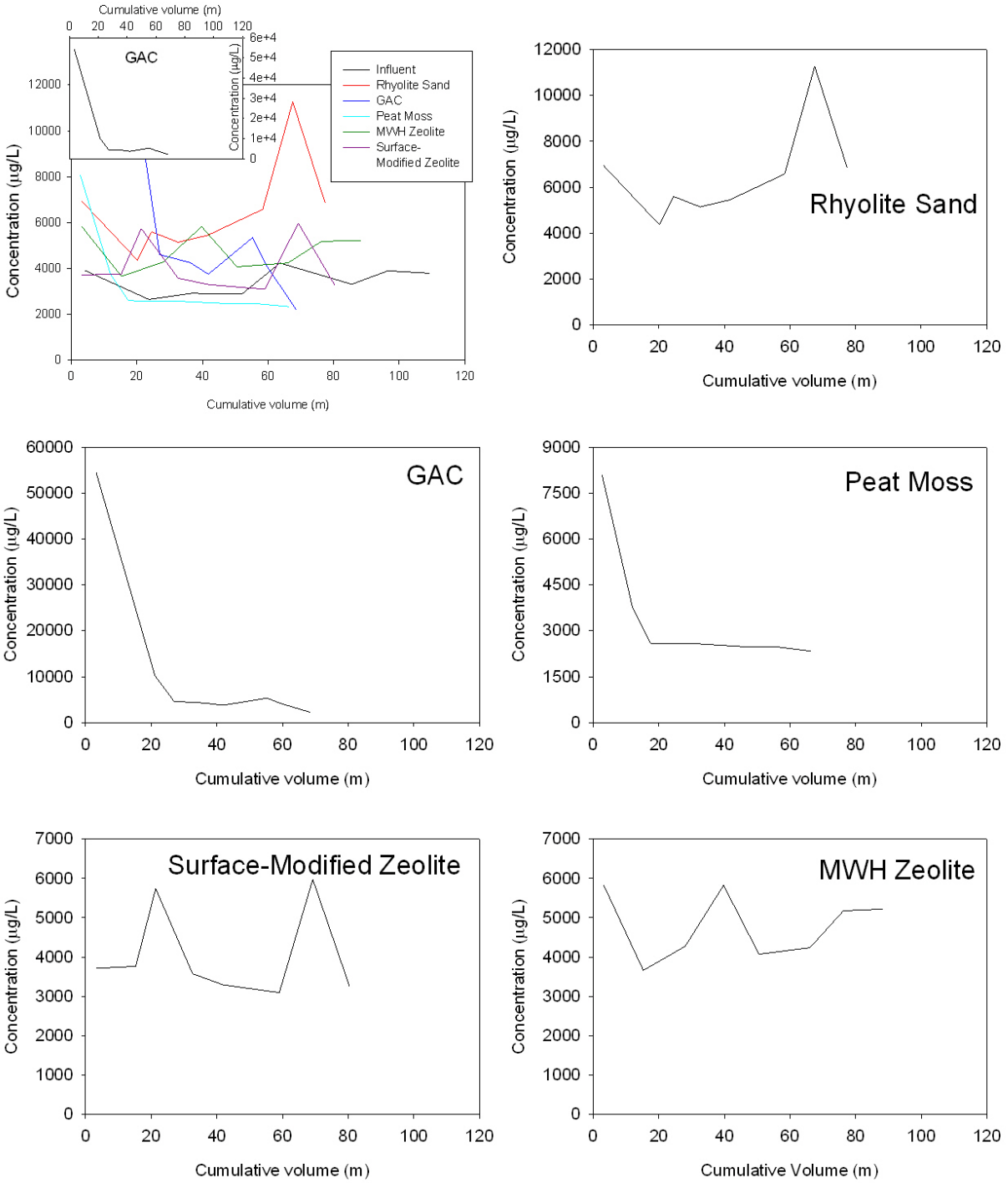


Figure A3-39. Breakthrough plots for total potassium.

## Potassium, Total: Column Breakthrough Testing

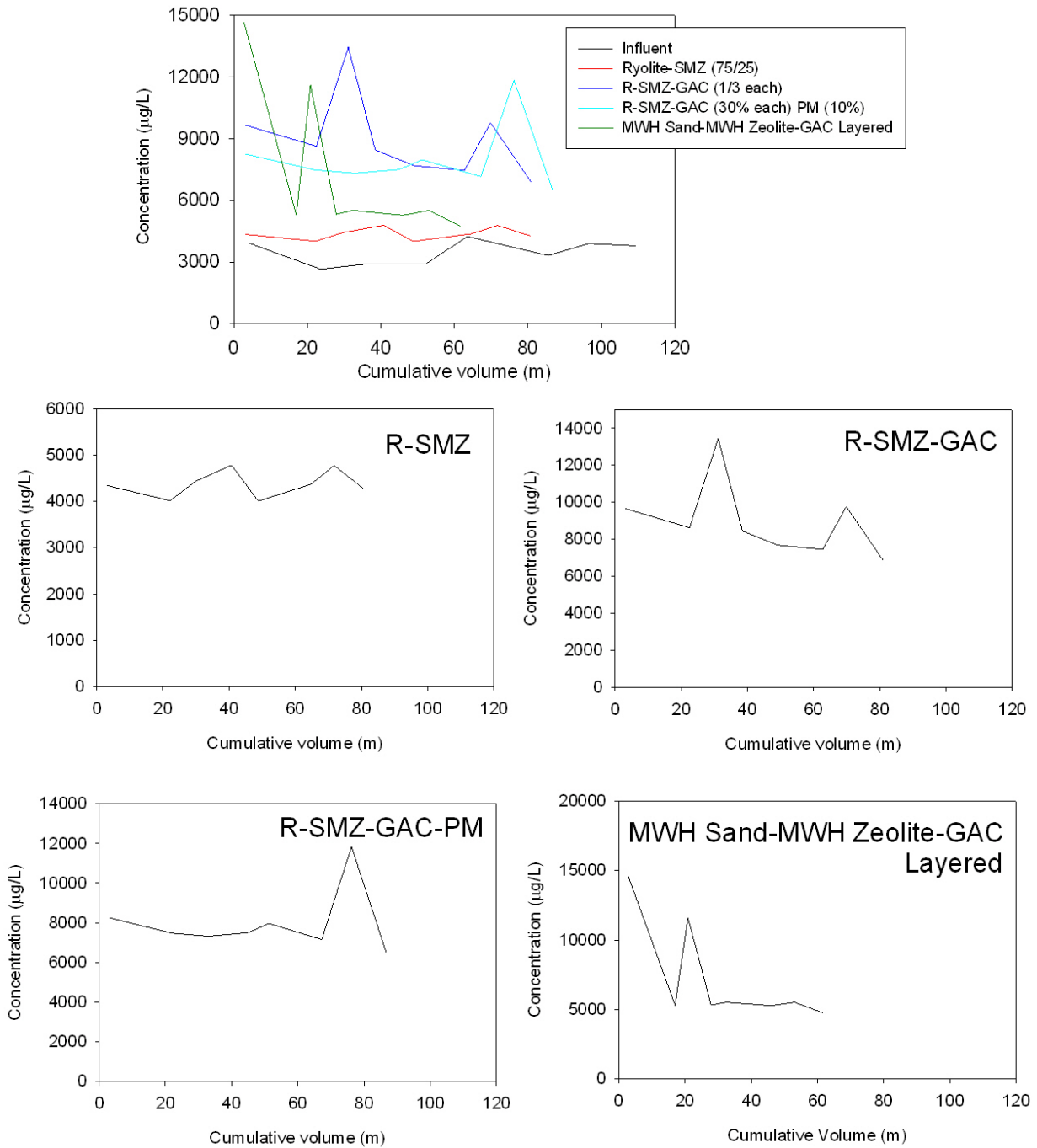


Figure A3-39. Breakthrough plots for total potassium (cont.).



## Potassium, Filtered: Column Breakthrough Testing

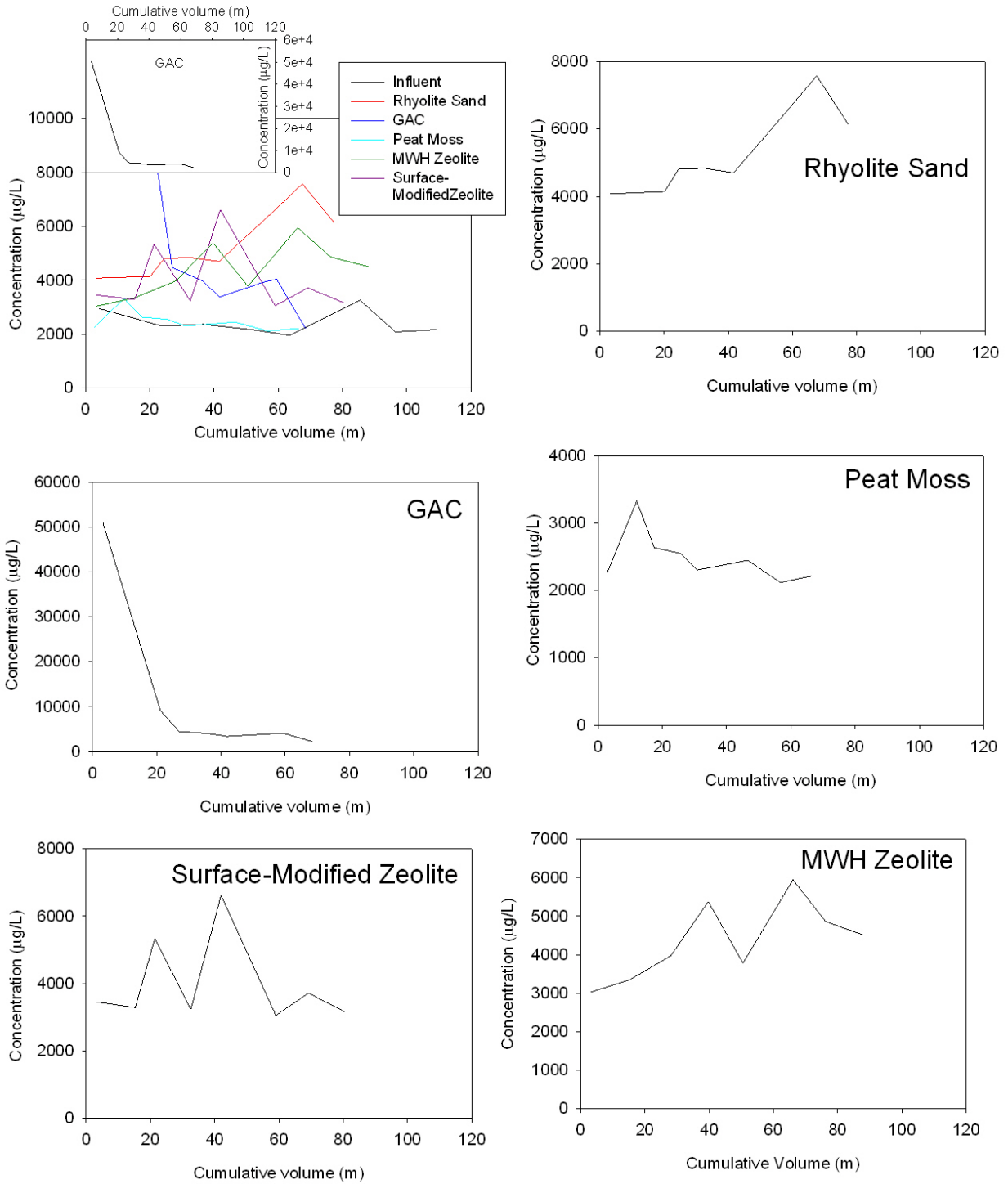


Figure A3-40. Breakthrough plots for filtered potassium.

## Potassium, Filtered: Column Breakthrough Testing

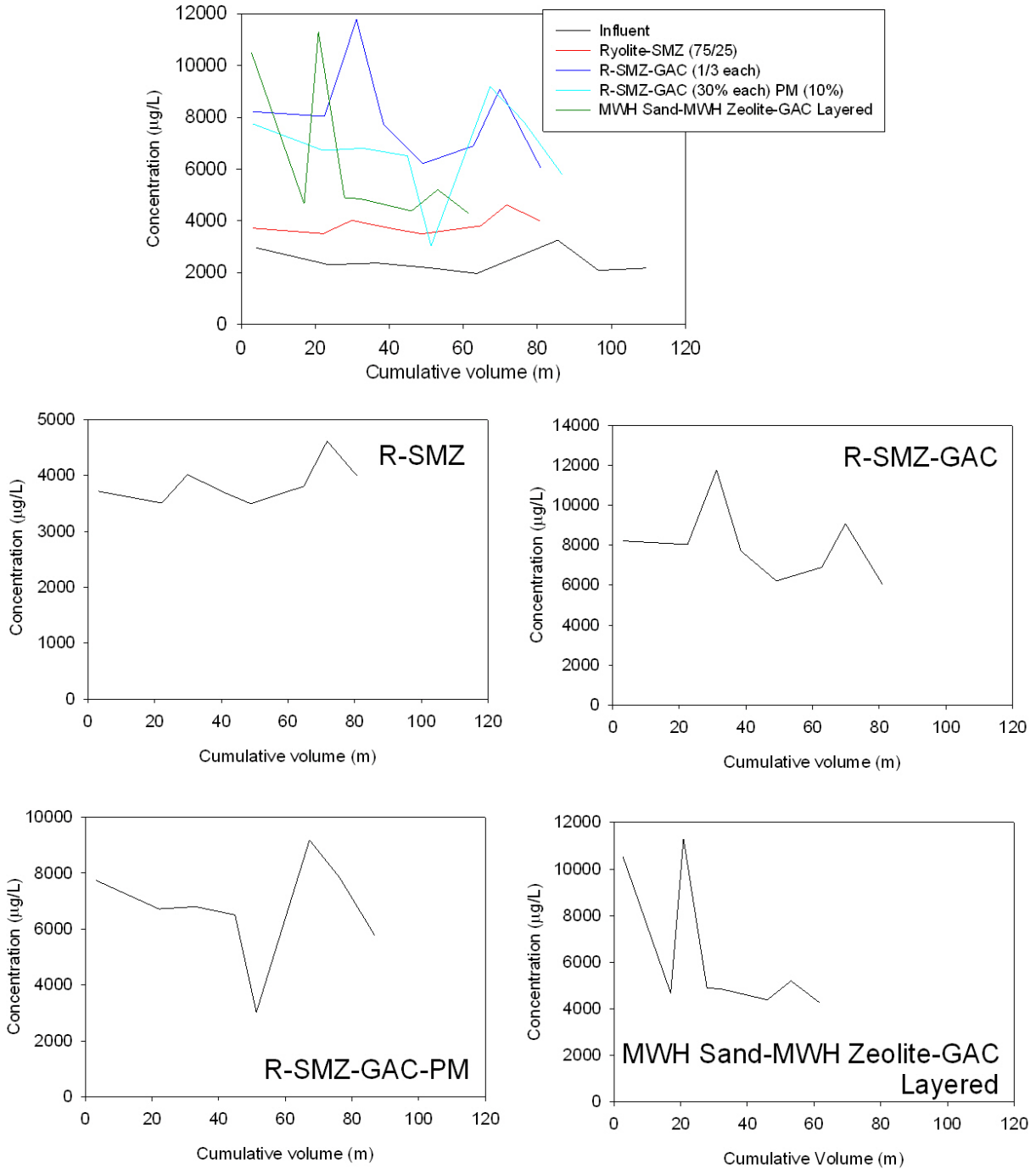
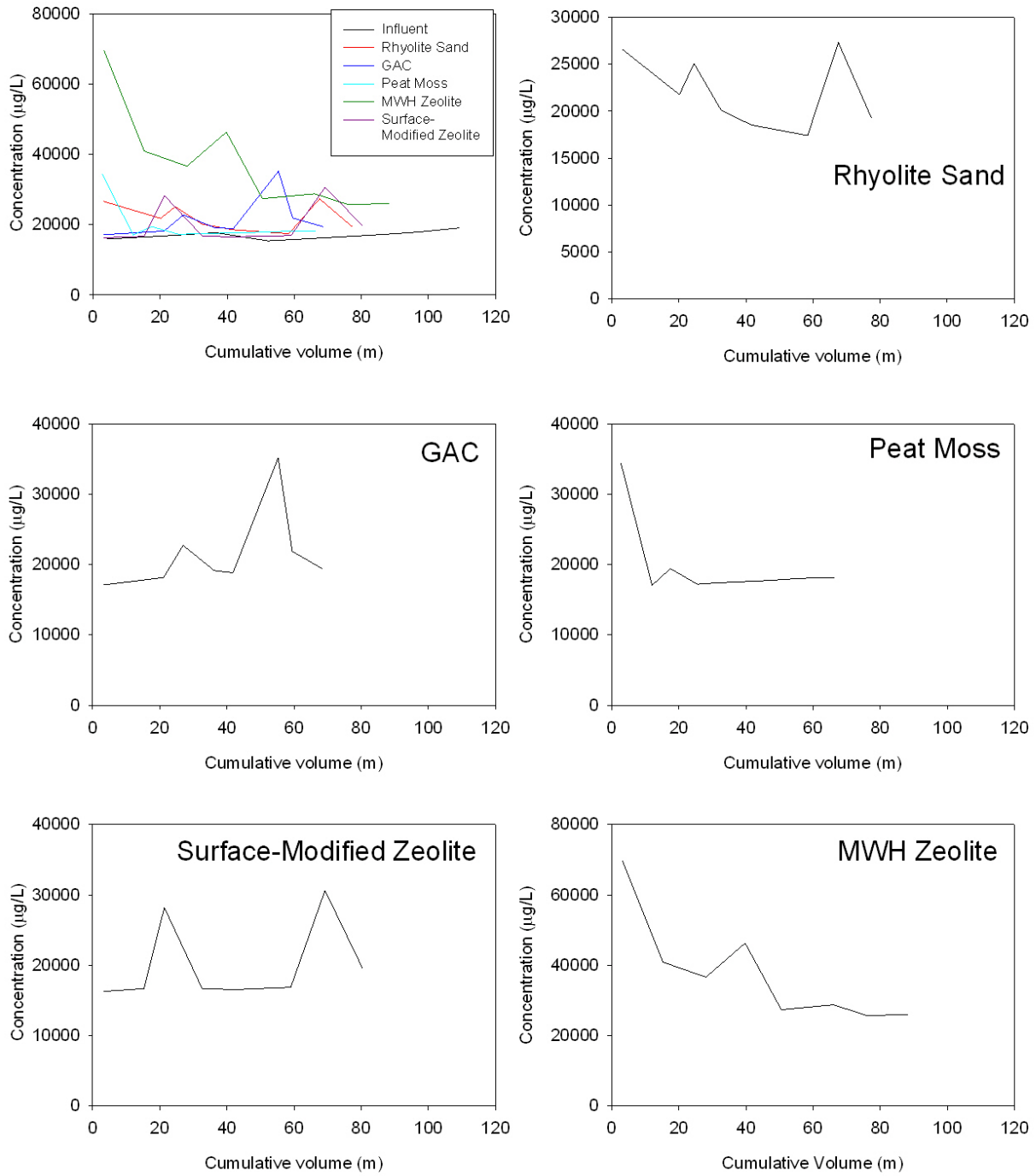


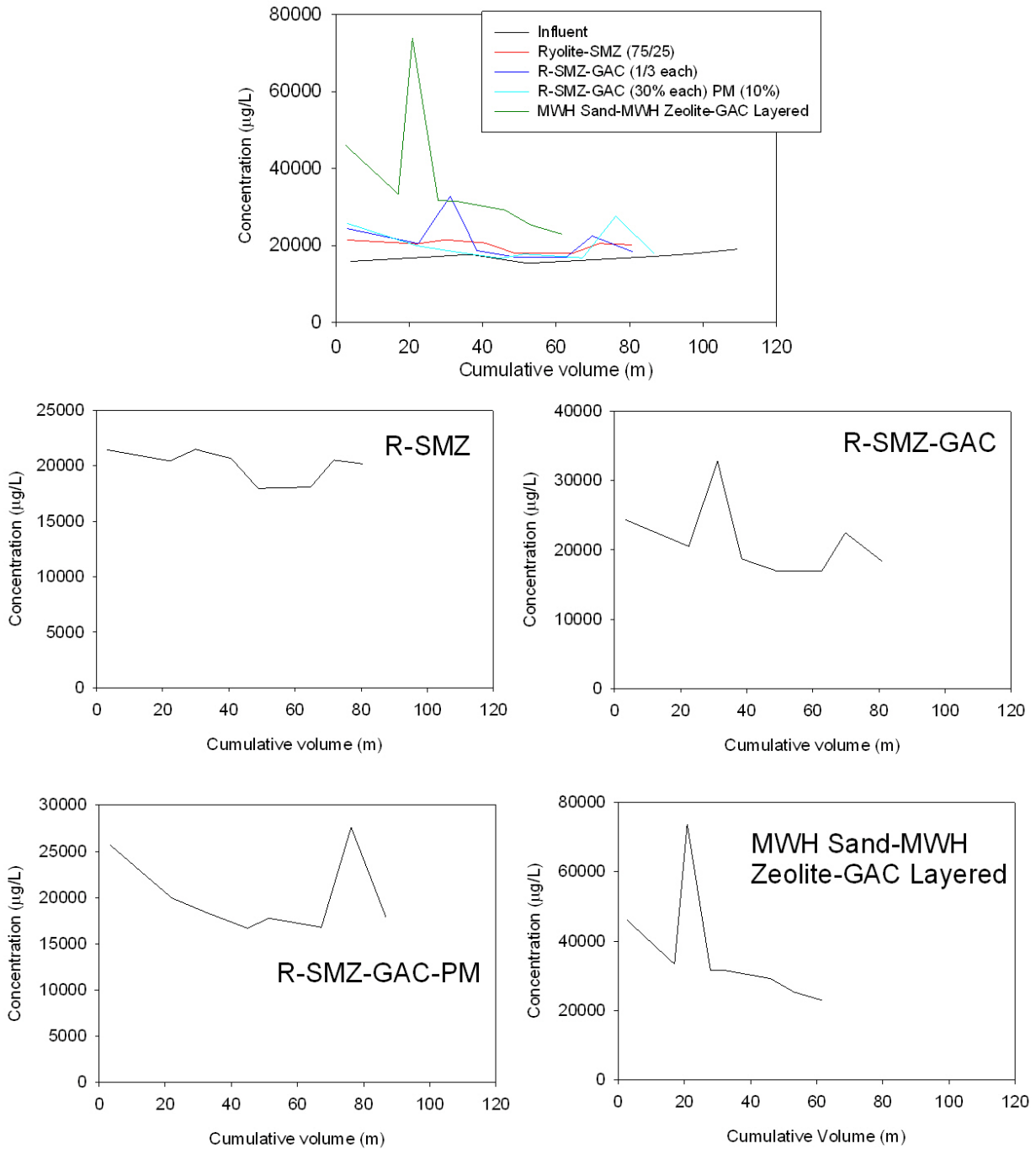
Figure A3-40. Breakthrough plots for filtered potassium (cont.).

## Sodium, Total: Column Breakthrough Testing



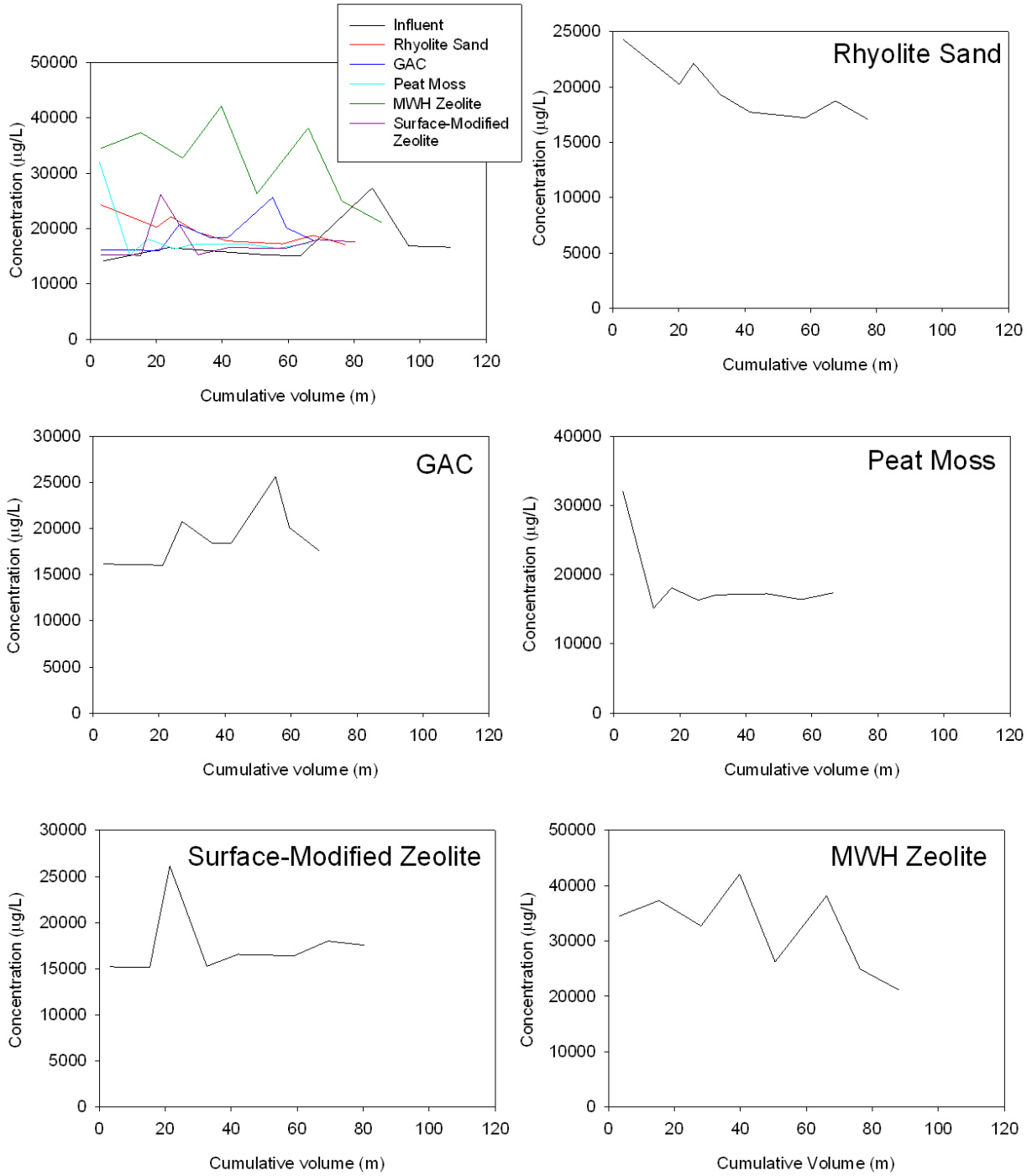
**Figure A3-41. Breakthrough plots for total sodium.**

## Sodium, Total: Column Breakthrough Testing



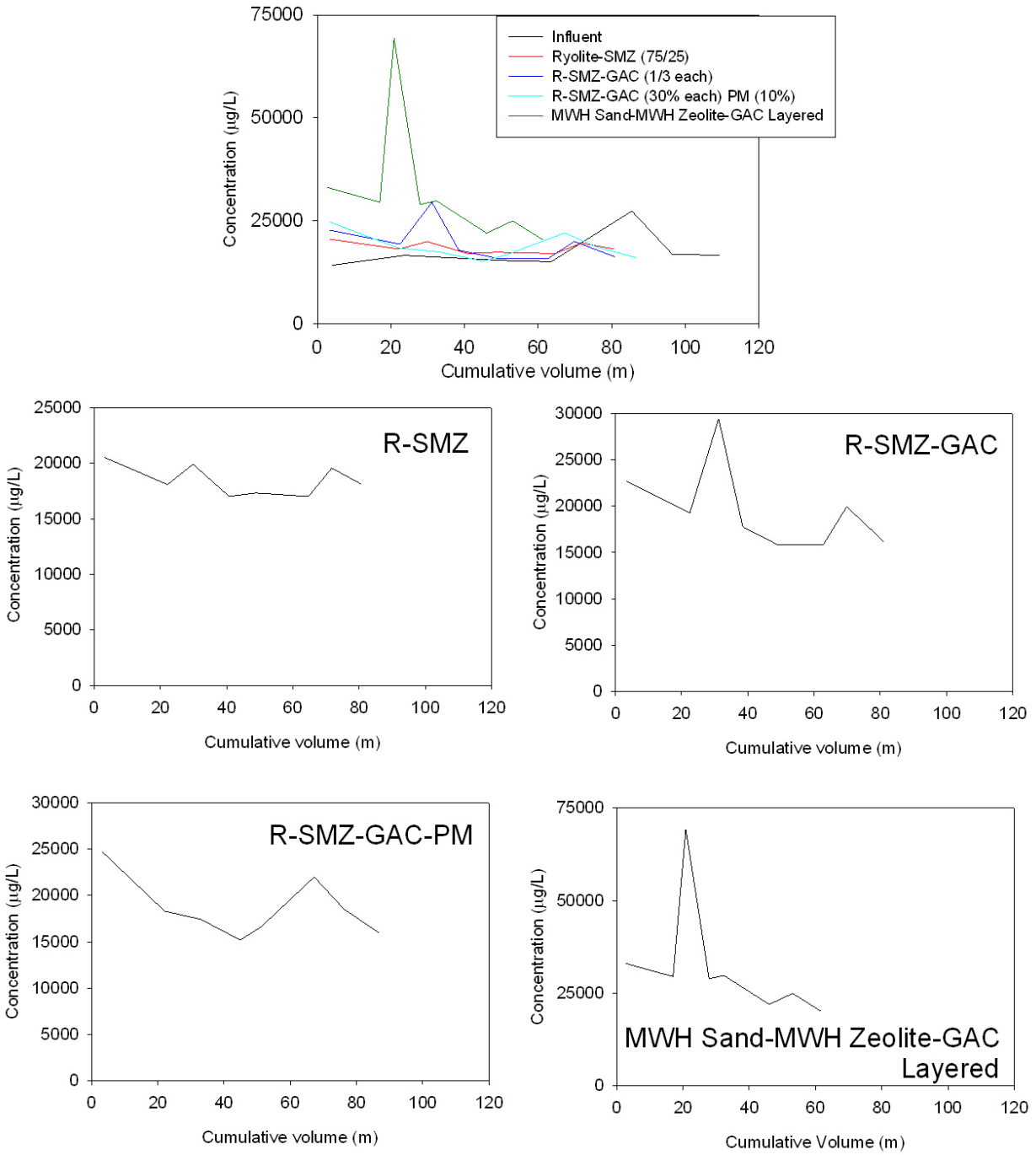
**Figure A3-41. Breakthrough plots for total sodium (cont.).**

## Sodium, Filtered: Column Breakthrough Testing



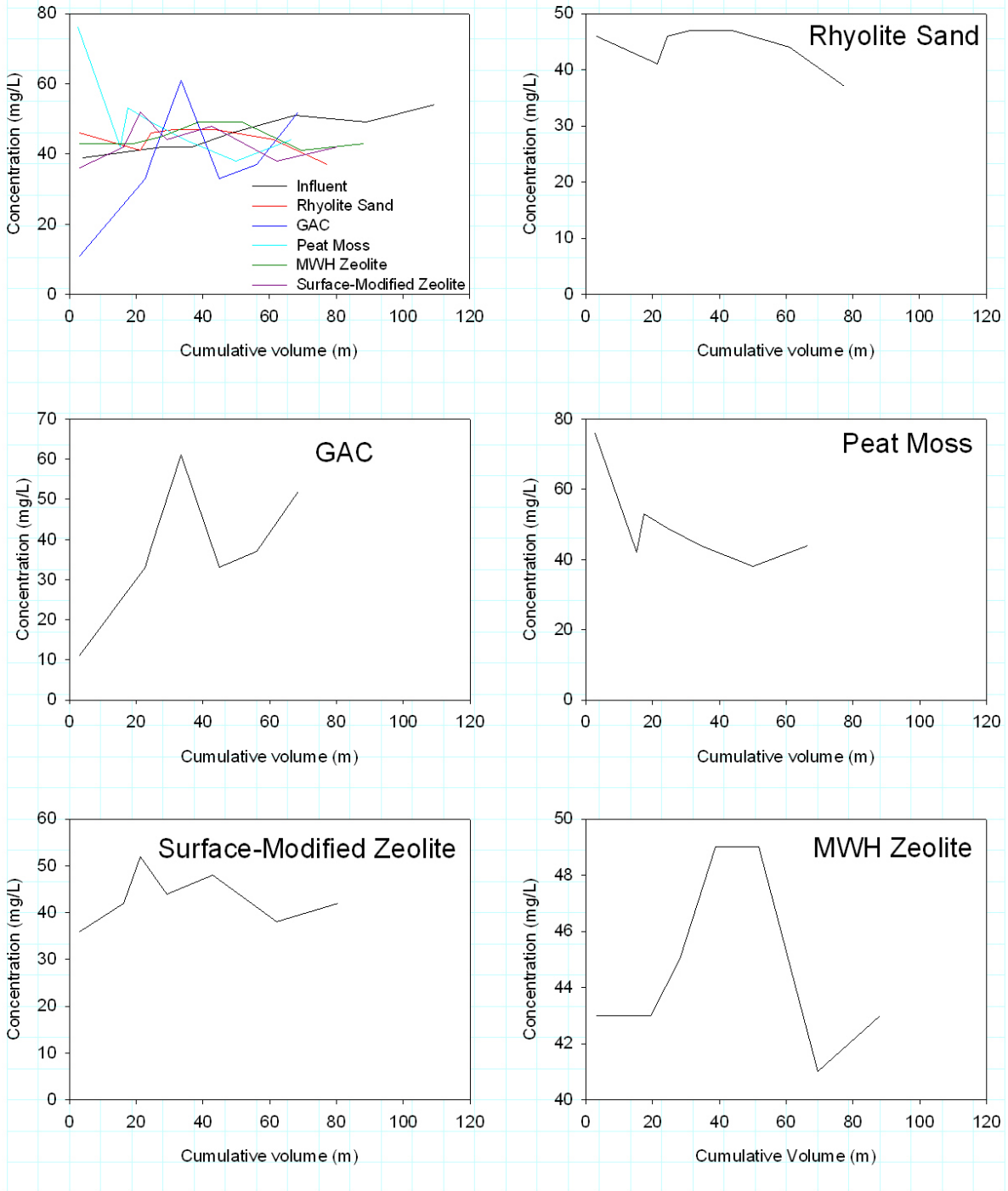
**Figure A3-42. Breakthrough plots for filtered sodium.**

## Sodium, Filtered: Column Breakthrough Testing



**Figure A3-42. Breakthrough plots for filtered sodium (cont.).**

## Sulfate: Column Breakthrough Testing



**Figure A3-43. Breakthrough plots for sulfate.**

## Sulfate: Column Breakthrough Testing

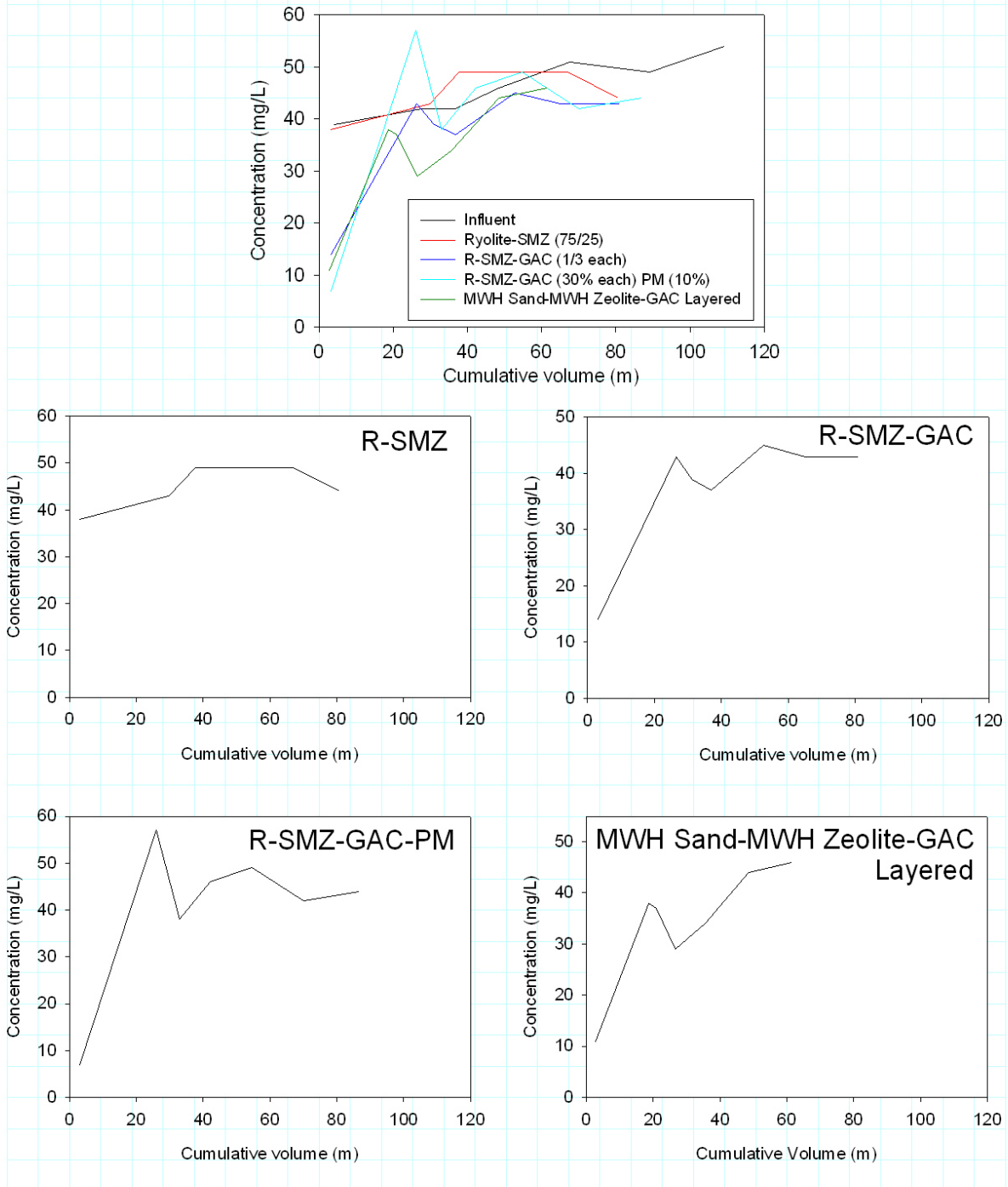
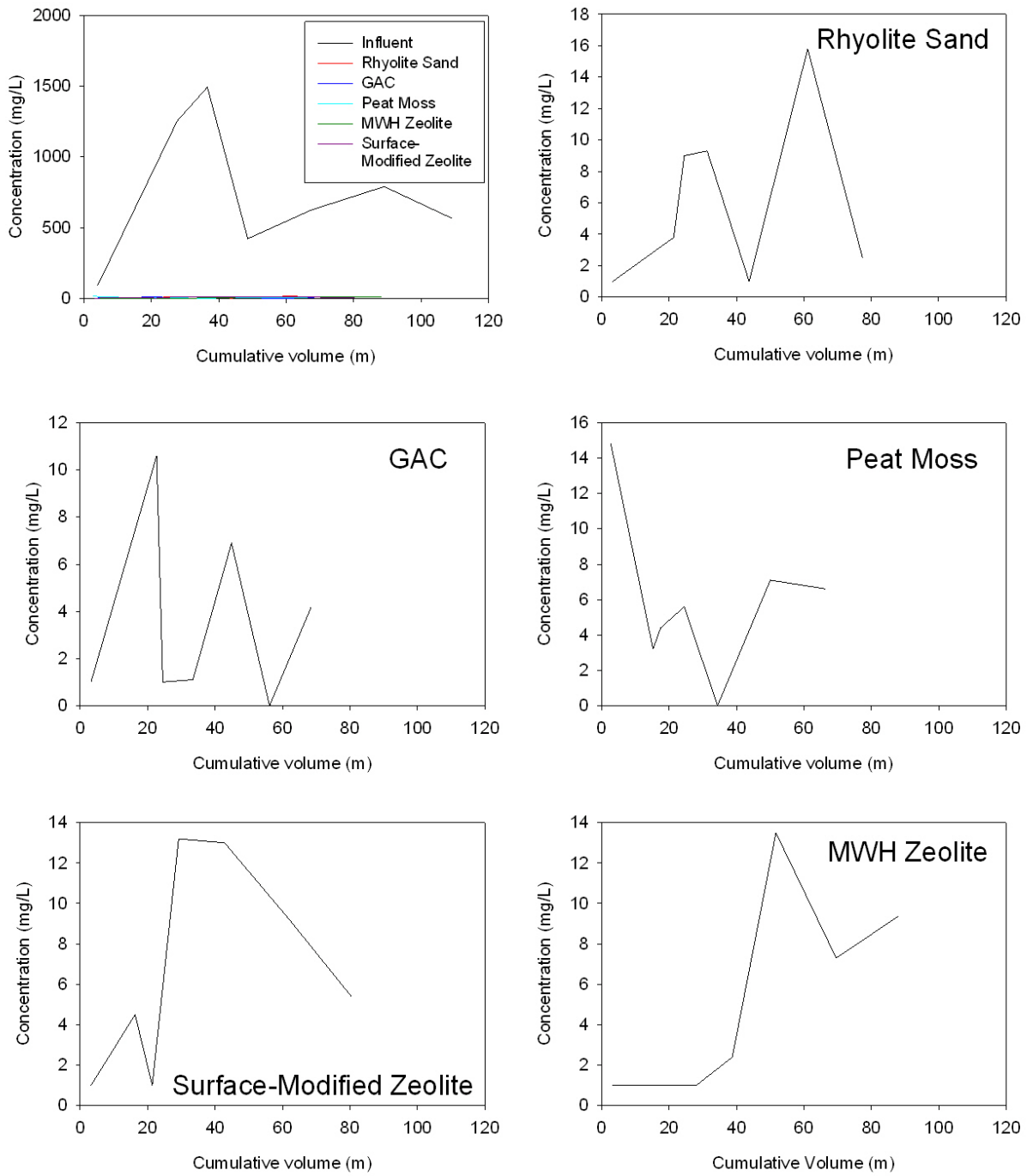


Figure A3-43. Breakthrough plots for sulfate (cont.).

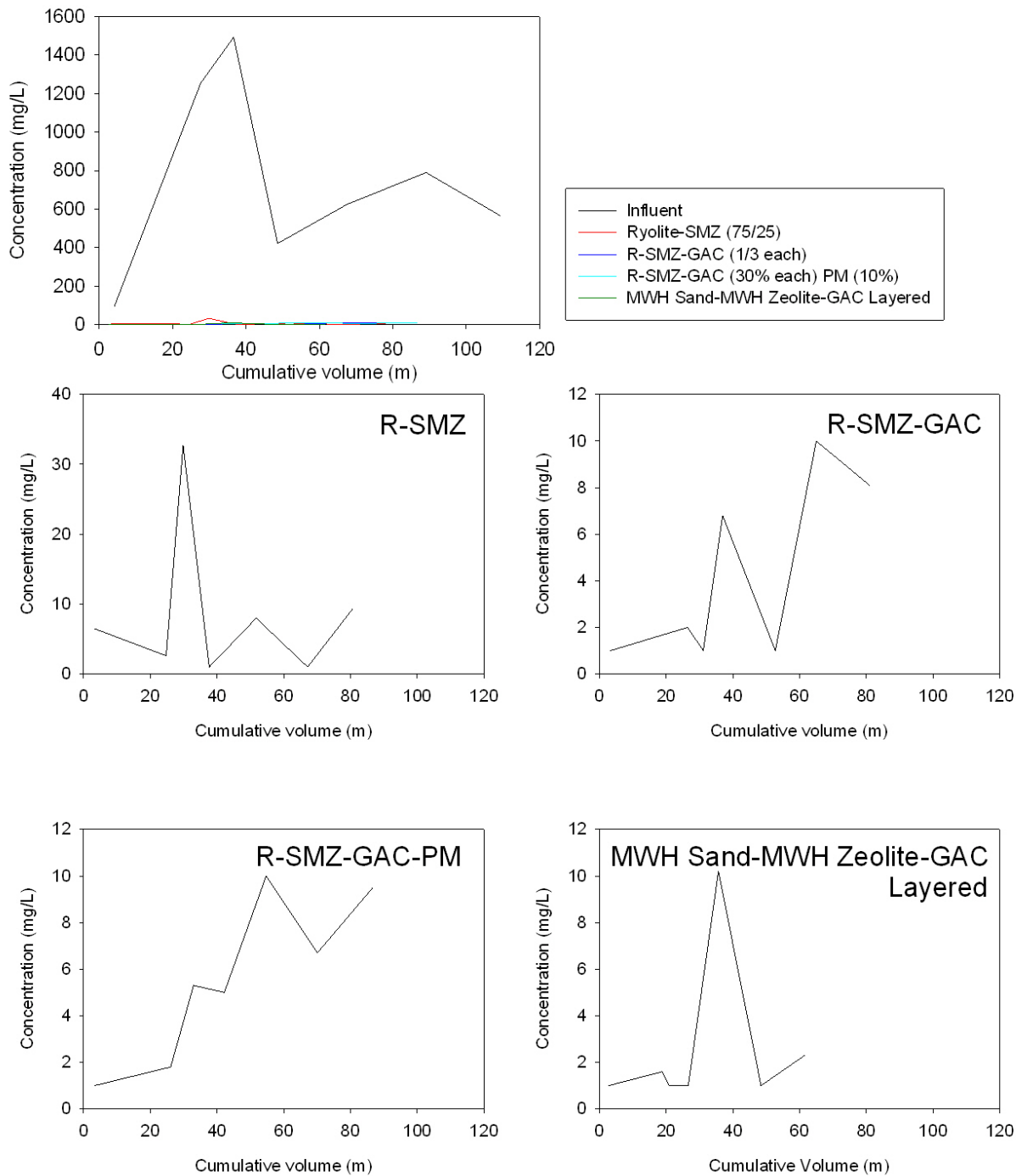


## Suspended Solids Concentration: Column Breakthrough Testing



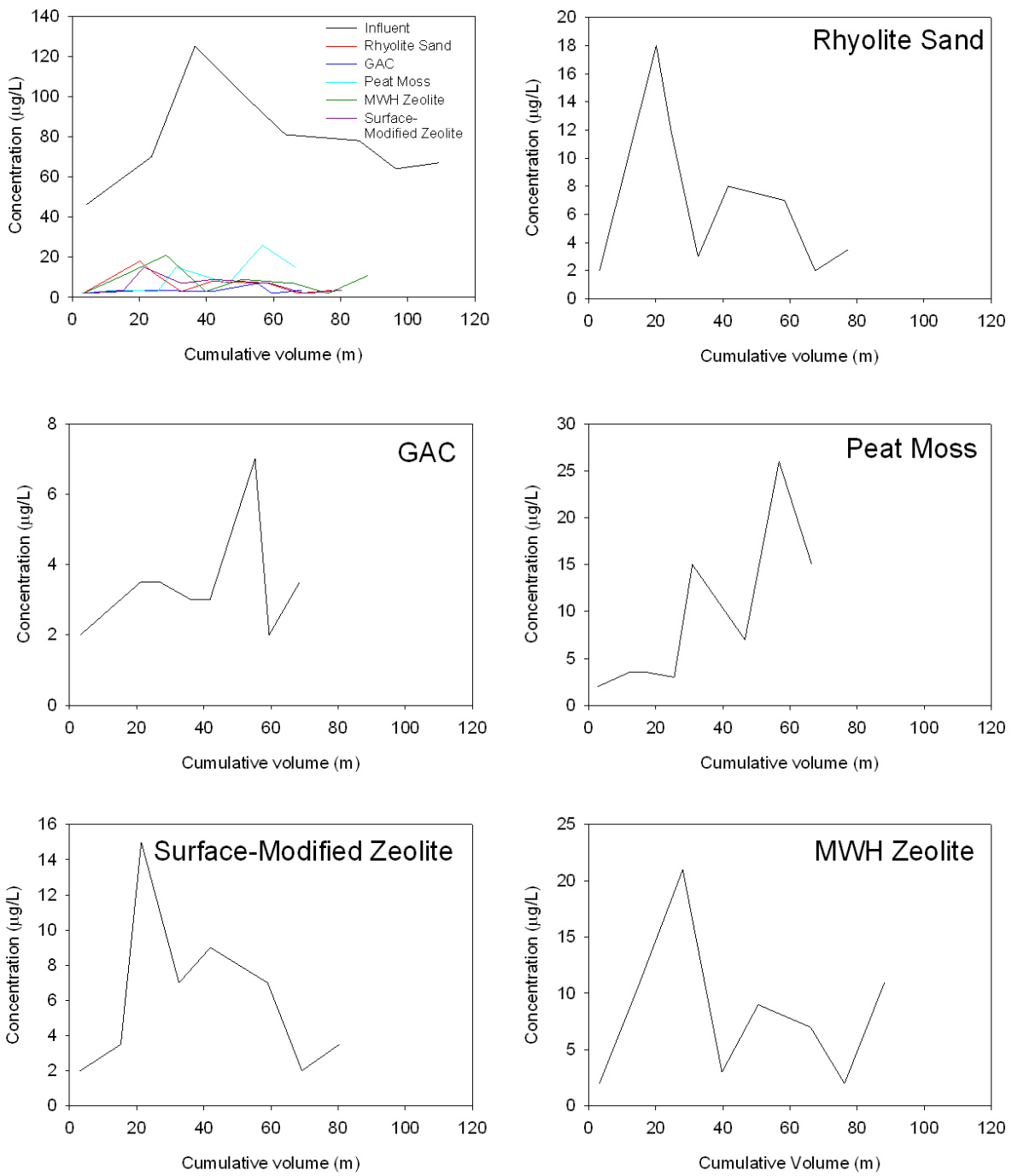
**Figure A3-44. Breakthrough plots for total suspended solids.**

## Suspended Solids Concentration: Column Breakthrough Testing



**Figure A3-44. Breakthrough plots for total suspended solids (cont.).**

## Thallium, Total: Column Breakthrough Testing



**Figure A3-45. Breakthrough plots for total thallium.**

## Thallium, Total: Column Breakthrough Testing

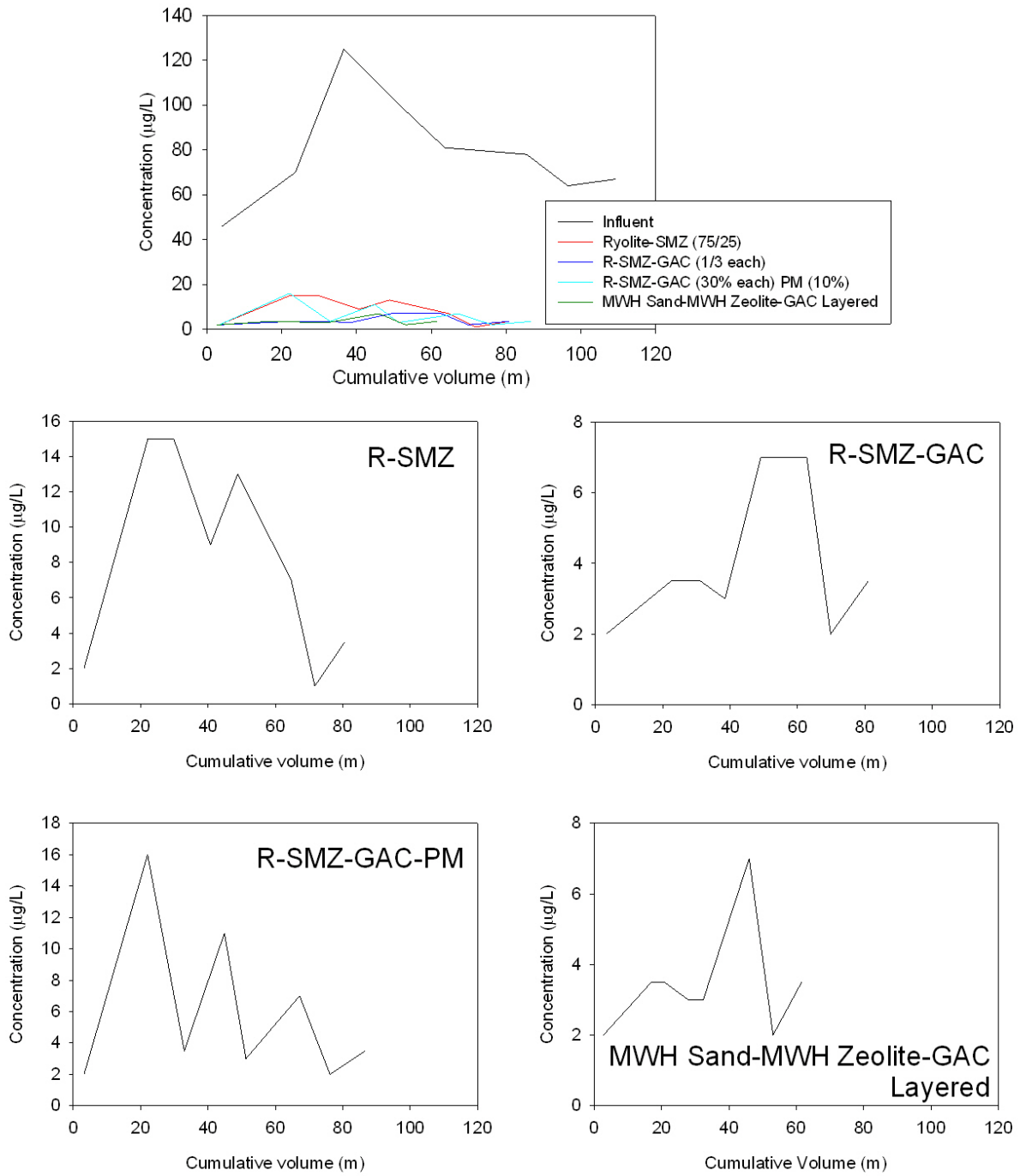
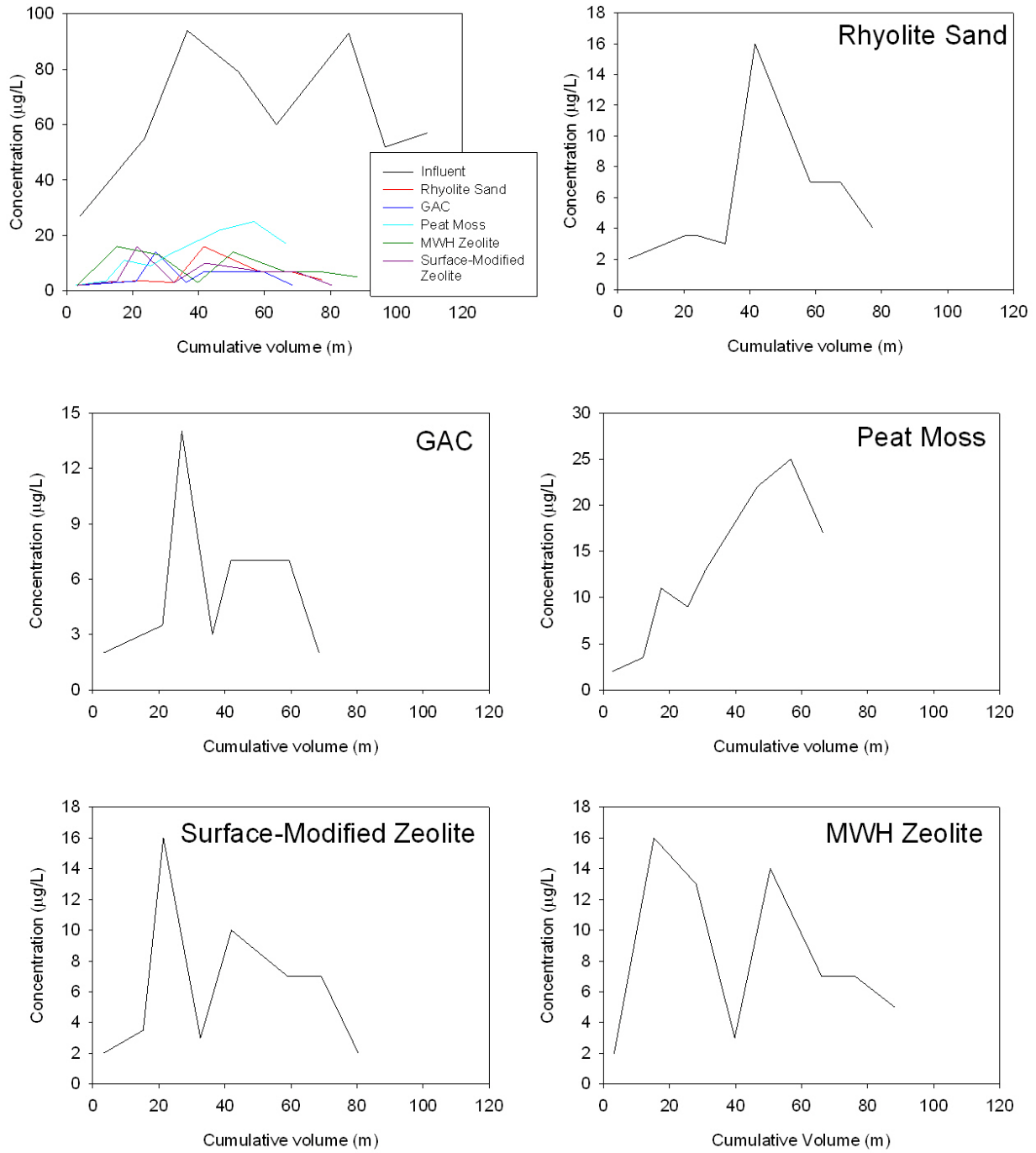


Figure A3-45. Breakthrough plots for total thallium (cont.).

## Thallium, Filtered: Column Breakthrough Testing



**Figure A3-46. Breakthrough plots for filtered thallium.**

## Thallium, Filtered: Column Breakthrough Testing

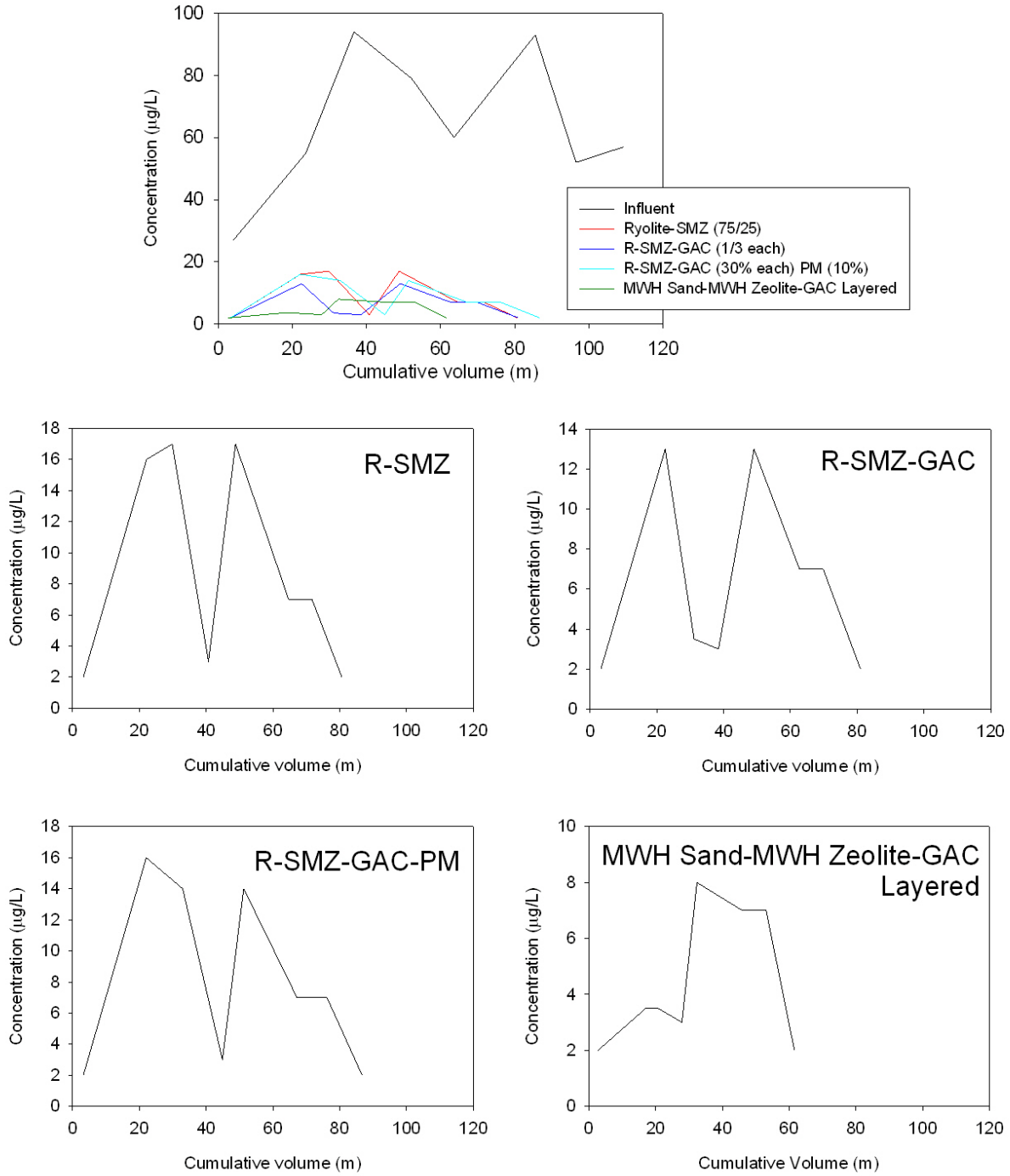
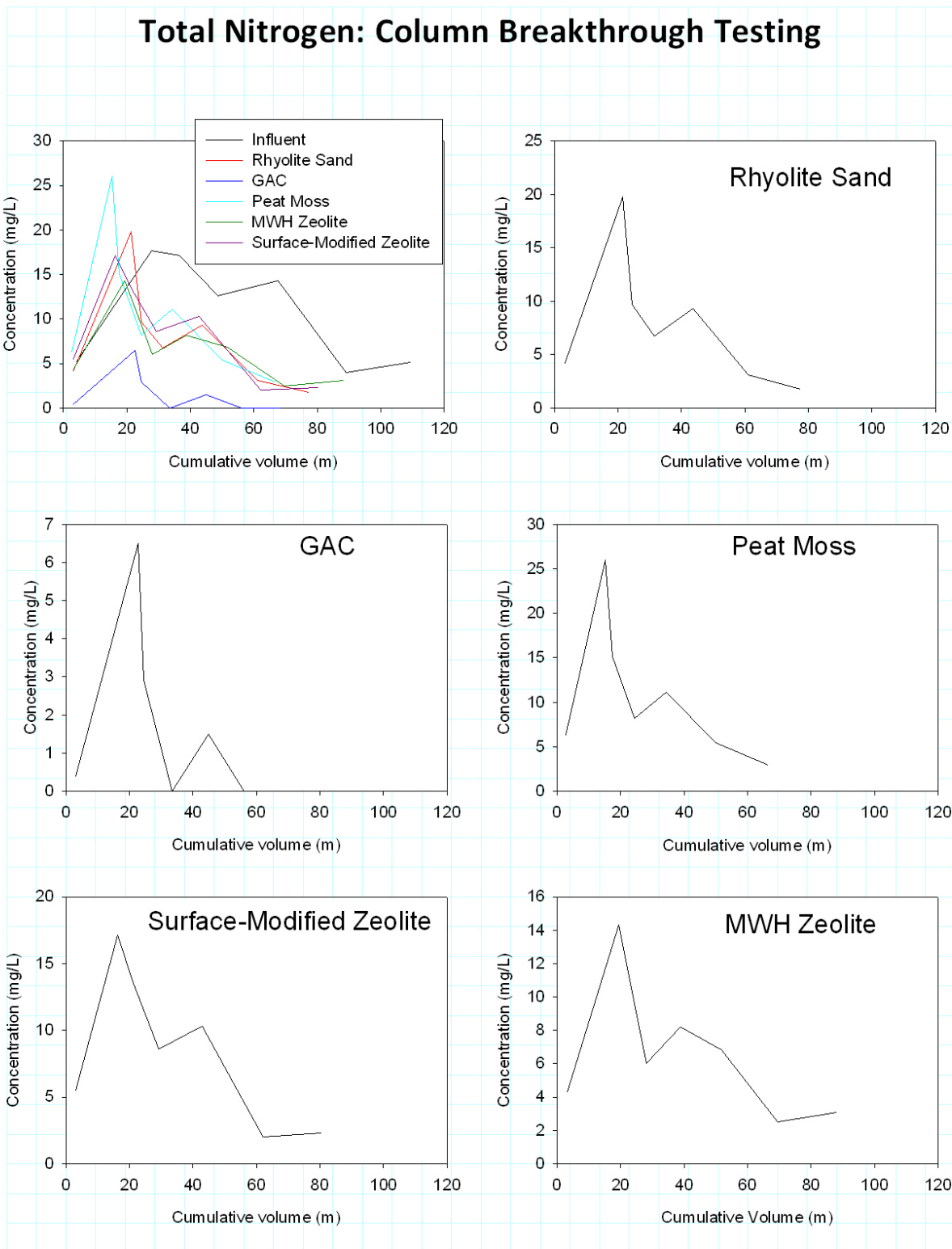
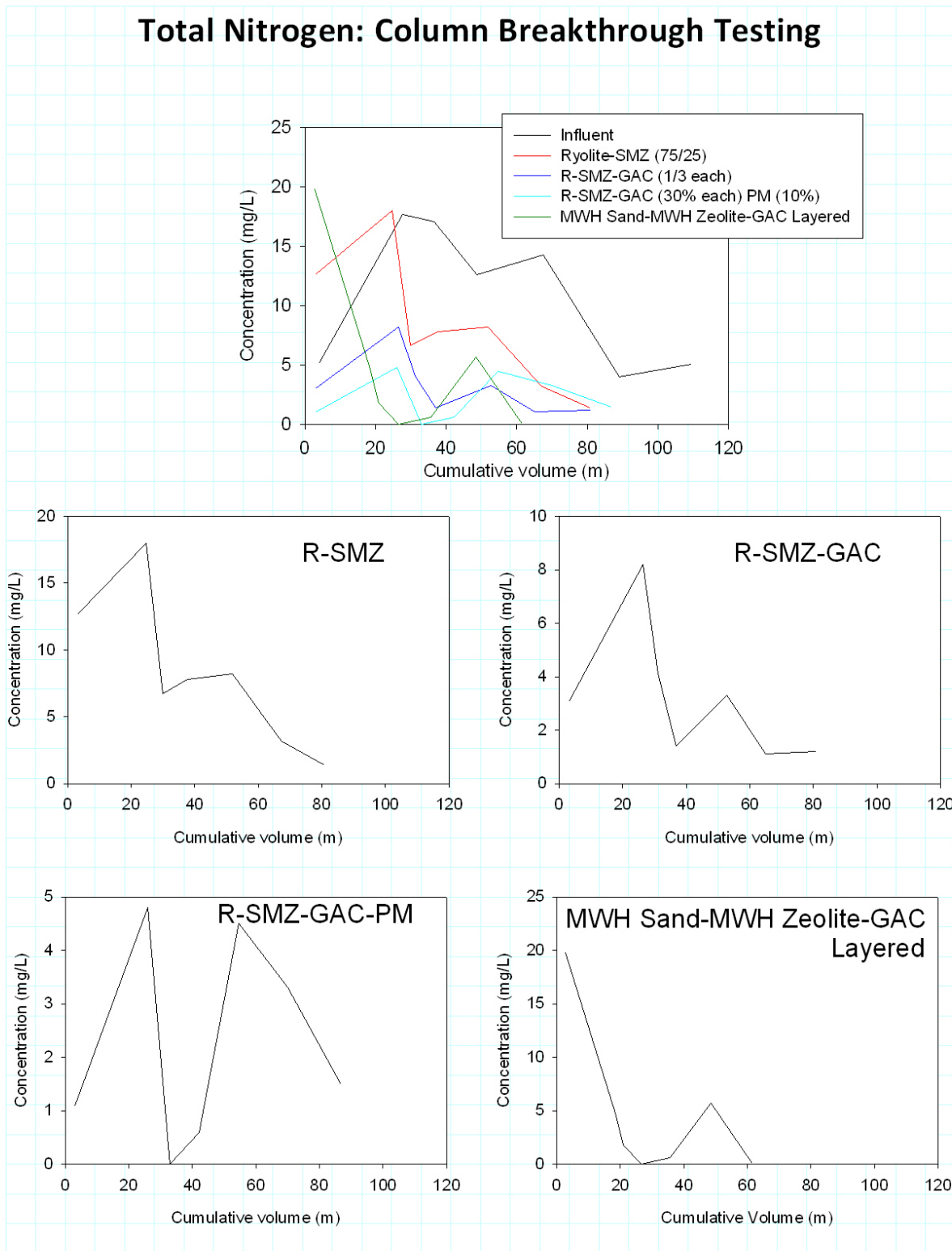


Figure A3-46. Breakthrough plots for filtered thallium (cont.).



**Figure A3-47. Breakthrough plots for total nitrogen.**

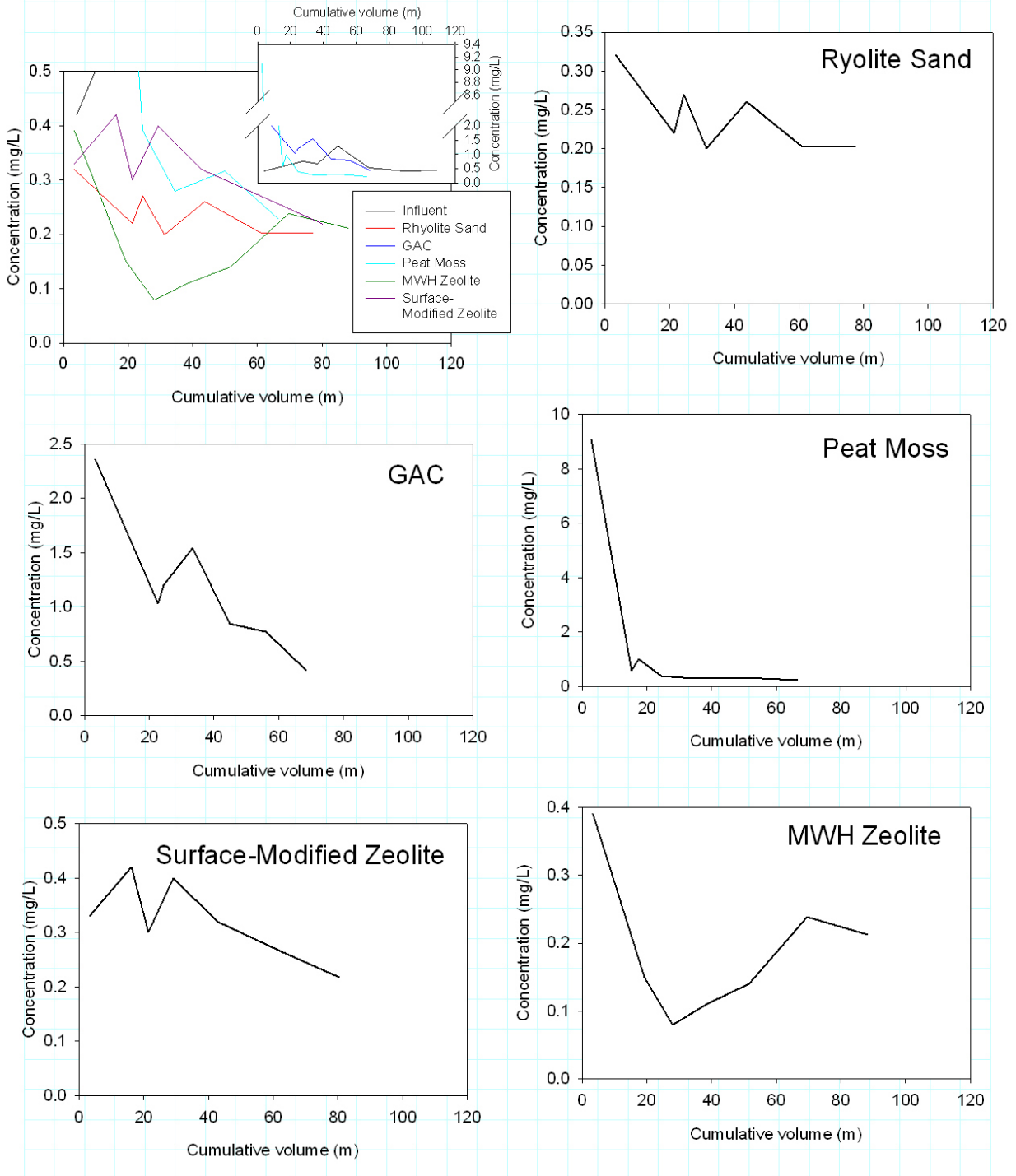
## Total Nitrogen: Column Breakthrough Testing



**Figure A3-47. Breakthrough plots for total nitrogen (cont.).**

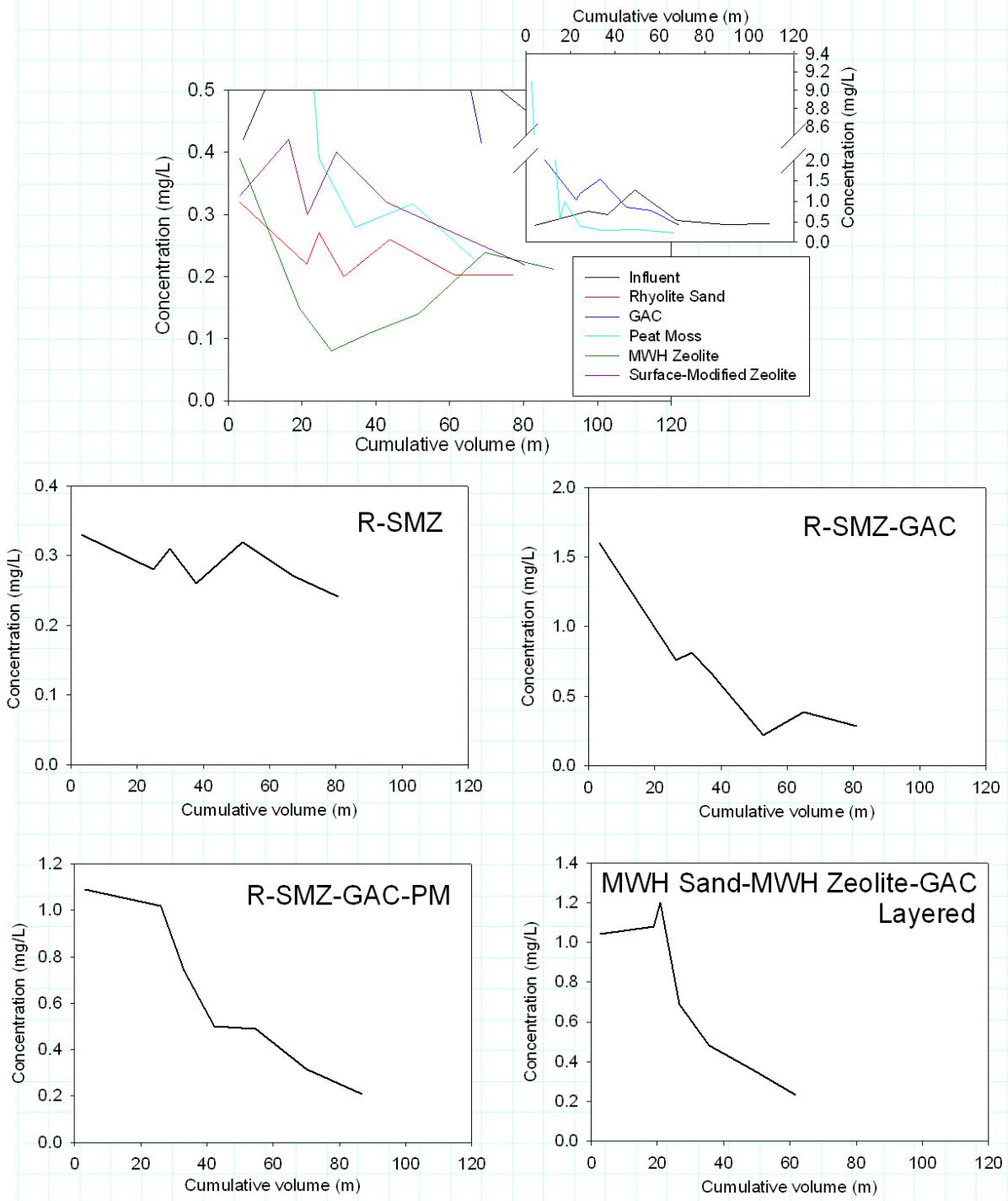


## Total Phosphorus: Column Breakthrough Testing



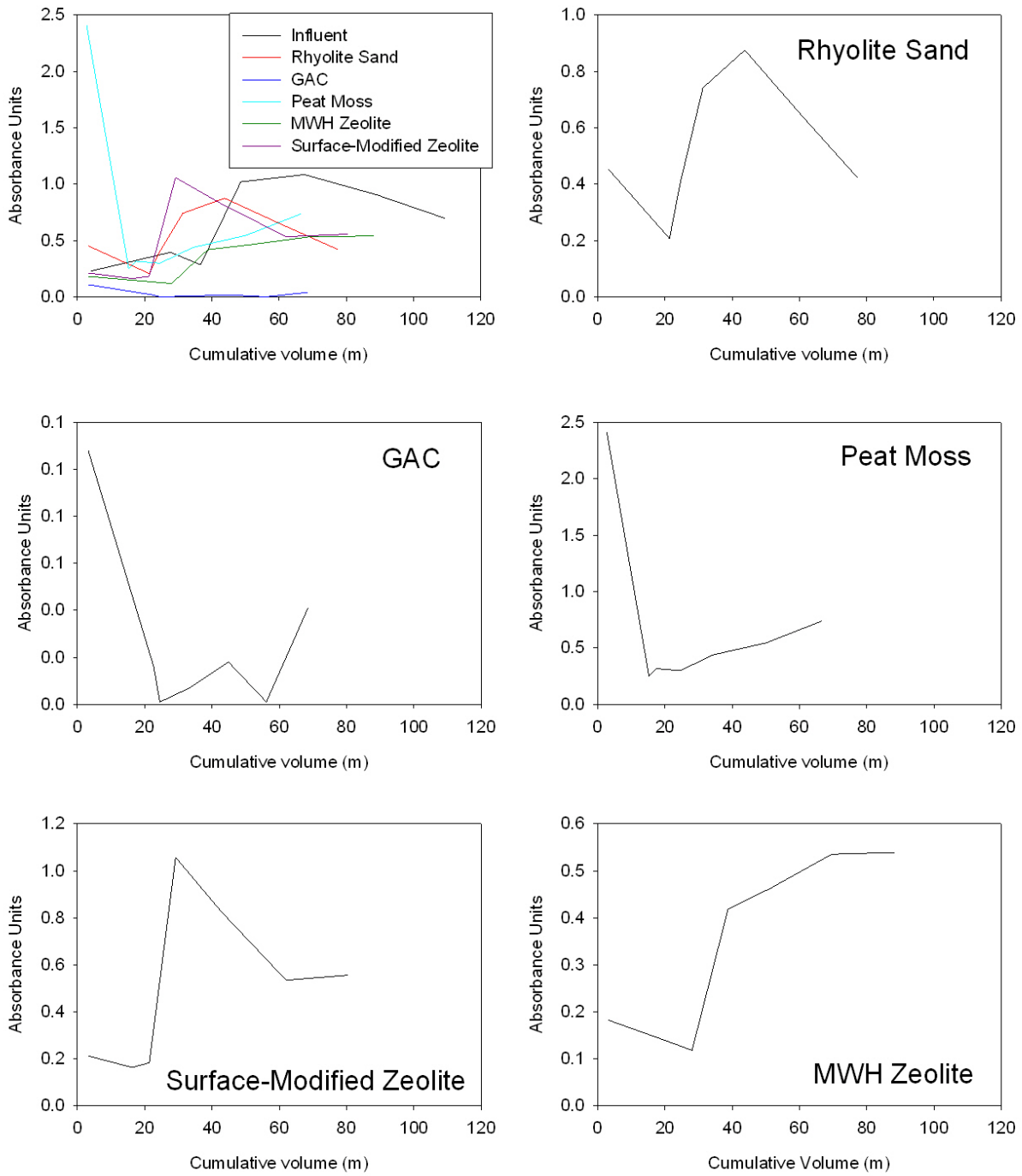
**Figure A3-48. Breakthrough plots for total phosphorus.**

## Total Phosphorus: Column Breakthrough Testing



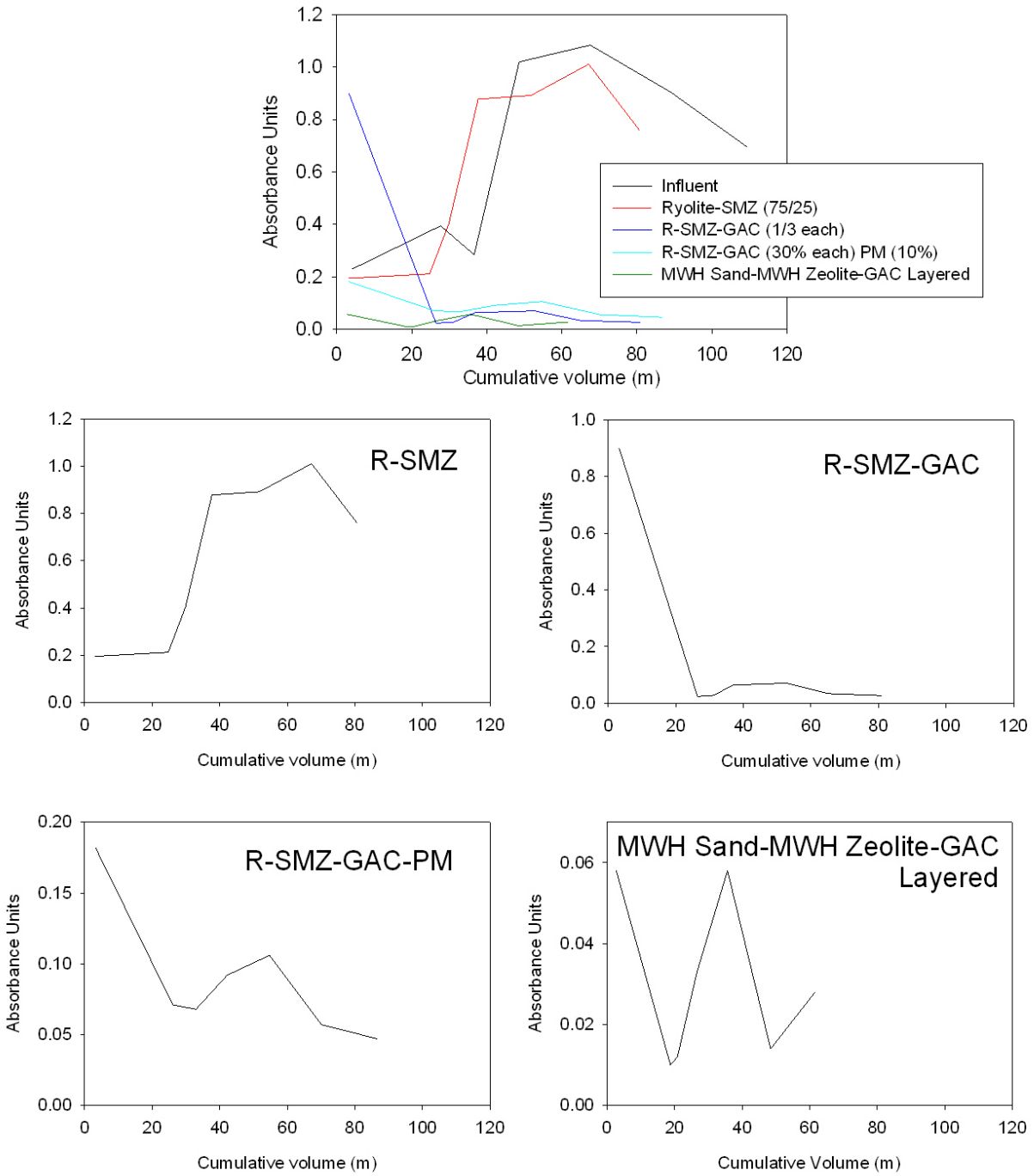
**Figure A3-48. Breakthrough plots for total phosphorus (cont.).**

## UV-254 Absorbance: Column Breakthrough Testing



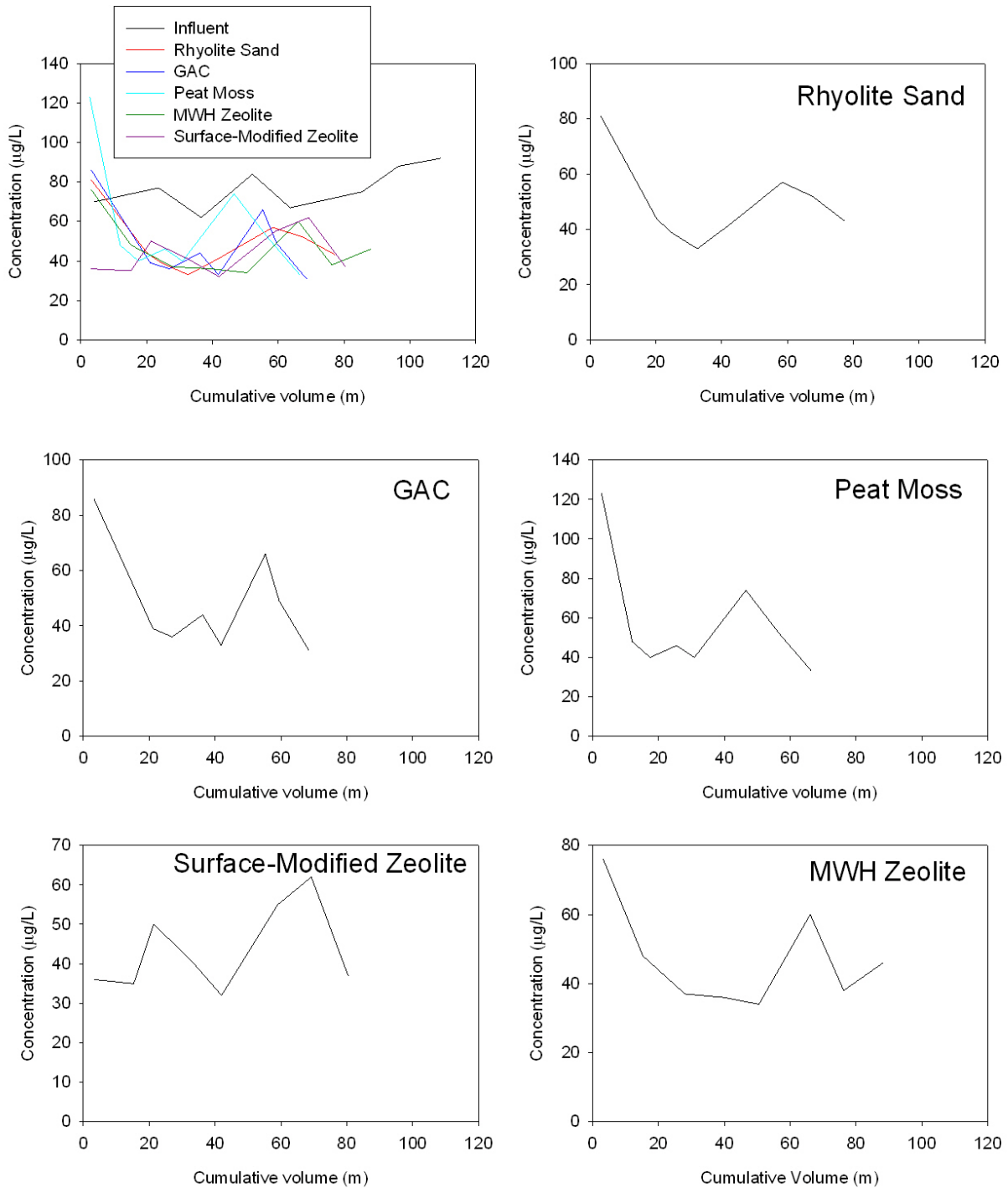
**Figure A3-49. Breakthrough plots for UV-254.**

## UV-254 Absorbance: Column Breakthrough Testing



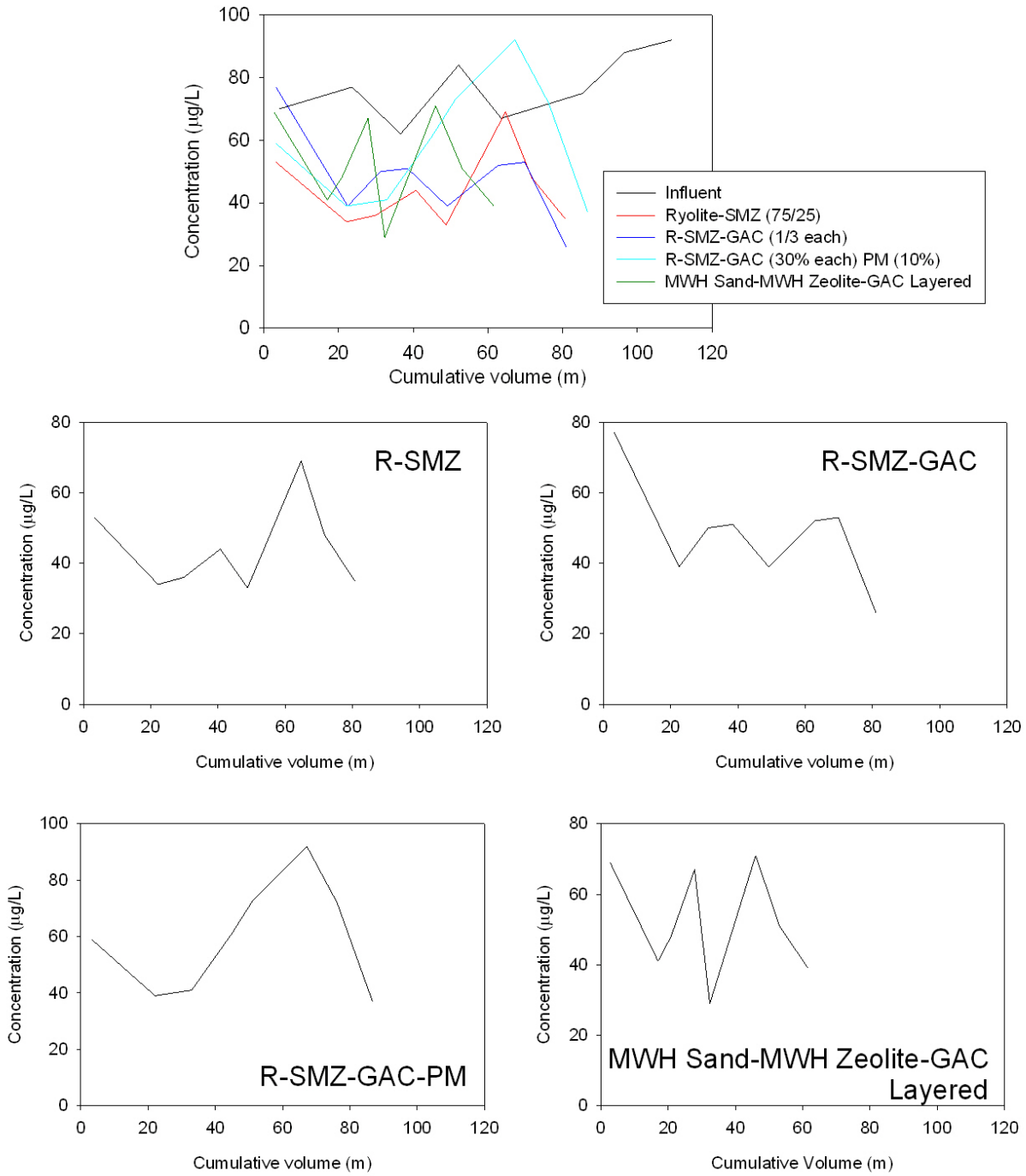
**Figure A3-49. Breakthrough plots for UV-254 (cont.).**

## Zinc, Total: Column Breakthrough Testing



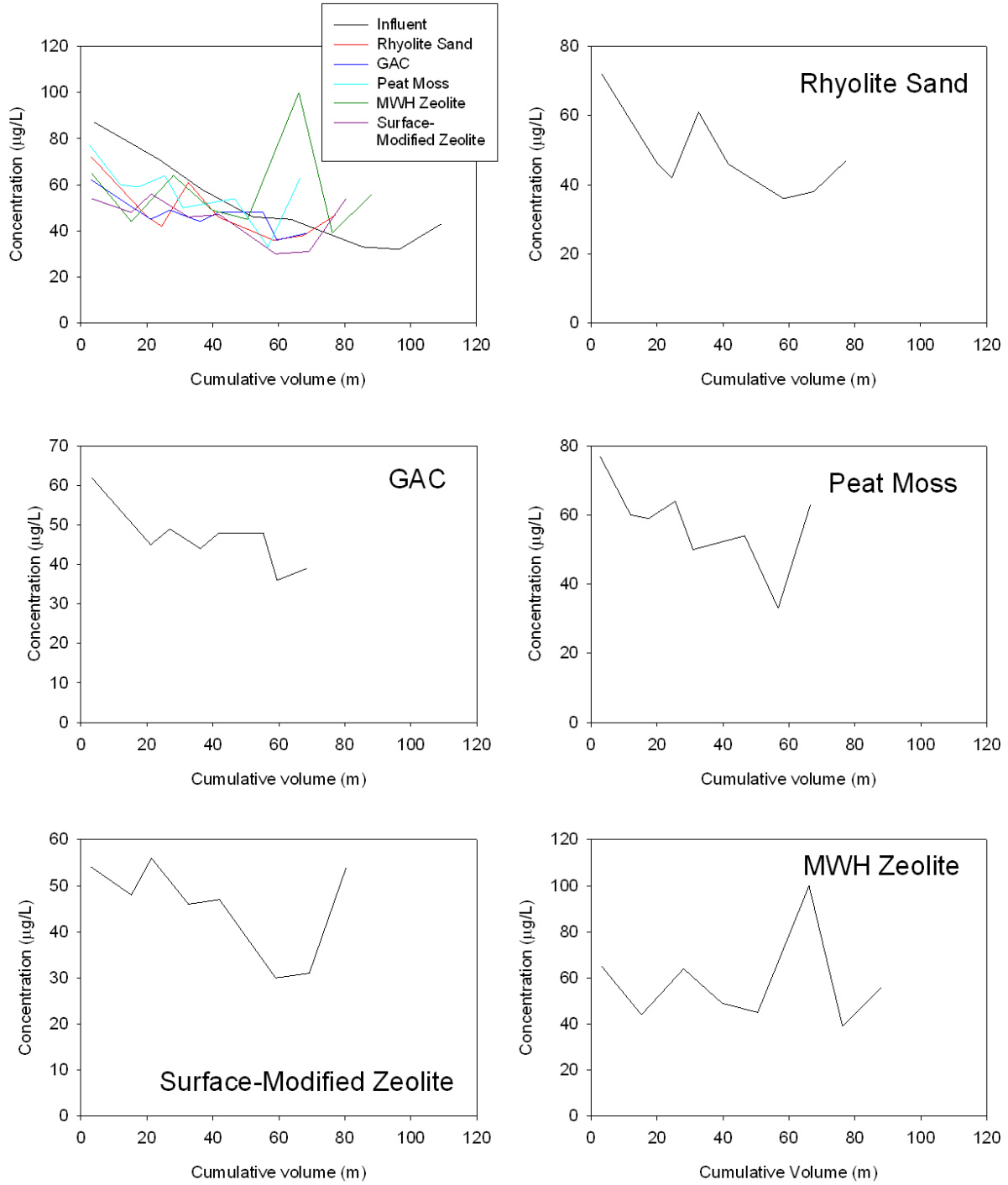
**Figure A3-50. Breakthrough plots for total zinc.**

## Zinc, Total: Column Breakthrough Testing



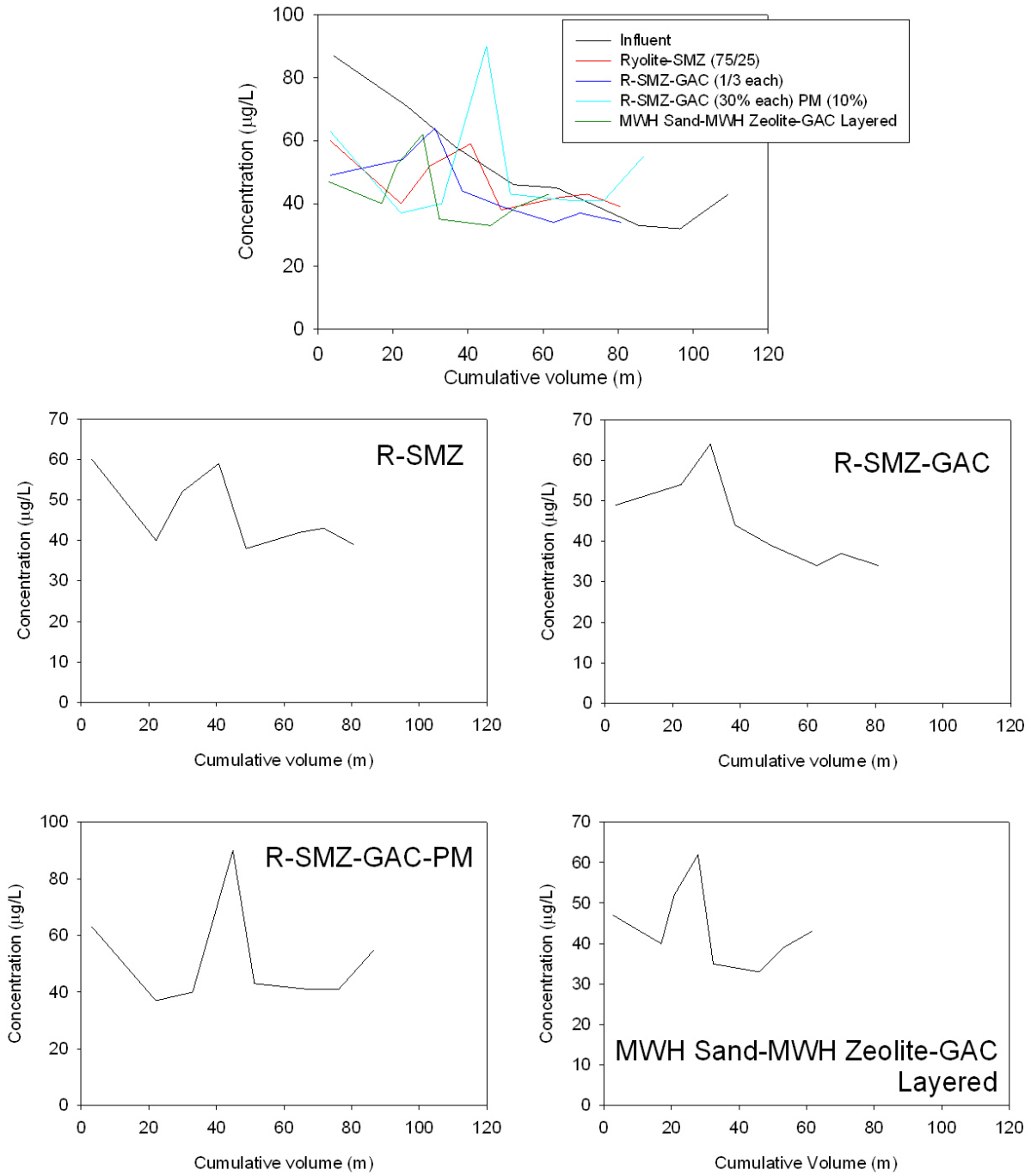
**Figure A3-50. Breakthrough plots for total zinc (cont.).**

## Zinc, Filtered: Column Breakthrough Testing



**Figure A3-51. Breakthrough plots filtered total zinc.**

## Zinc, Filtered: Column Breakthrough Testing



**Figure A3-51. Breakthrough plots filtered total zinc (cont.).**