

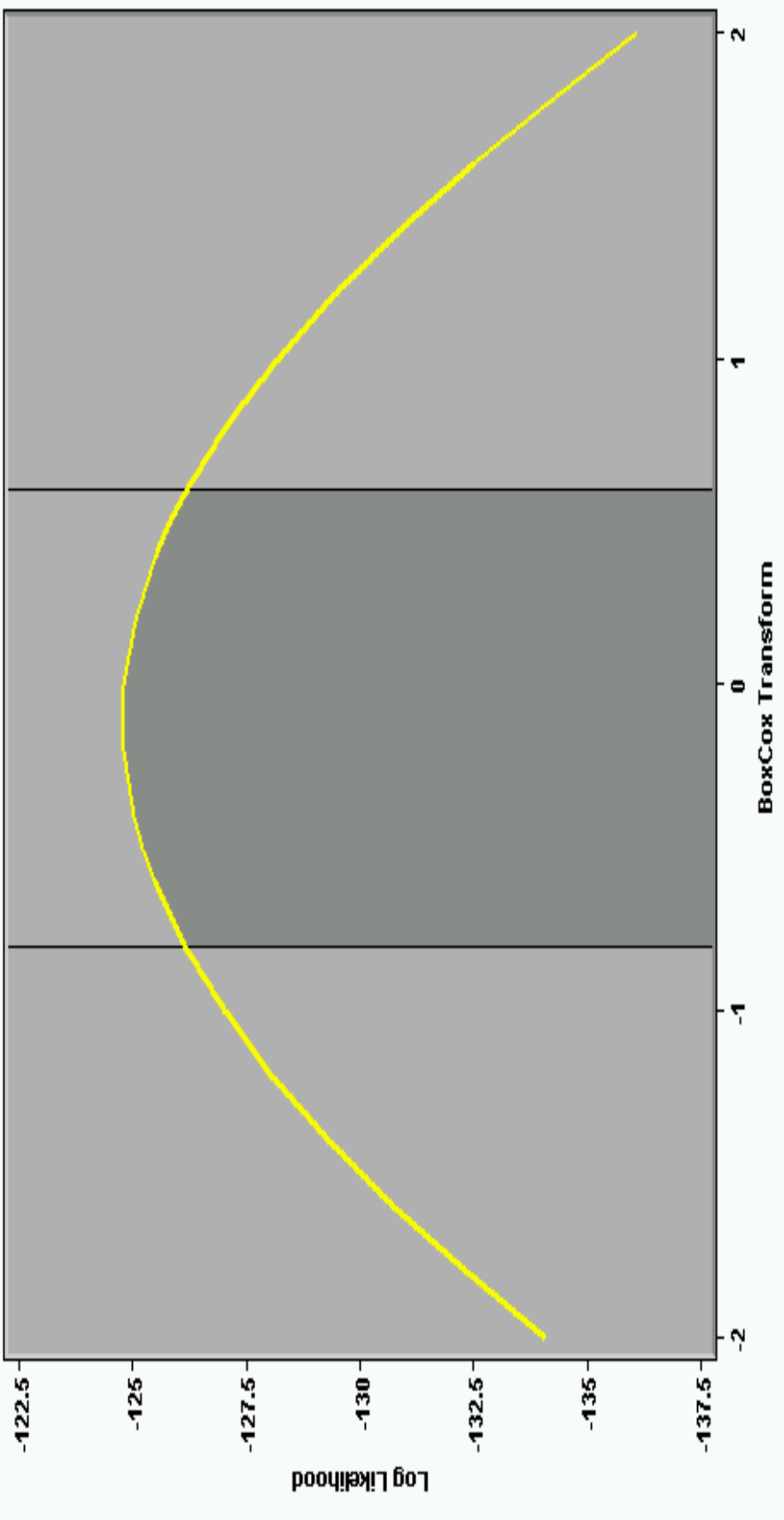
Appendix

- Transformation Analysis and Residual Plots by Time Order
- Plots of the data for each parameter by Lab and by Stand
- Summary of unusual observations by parameter
- Correlation of MRV and PVIS:
 - Used Oil MRV over Fresh Oil MRV versus PVIS
 - Used Oil MRV over Fresh Oil MRV versus PVIS by Oil

Transformation Analysis and Residual Plots by Time Order

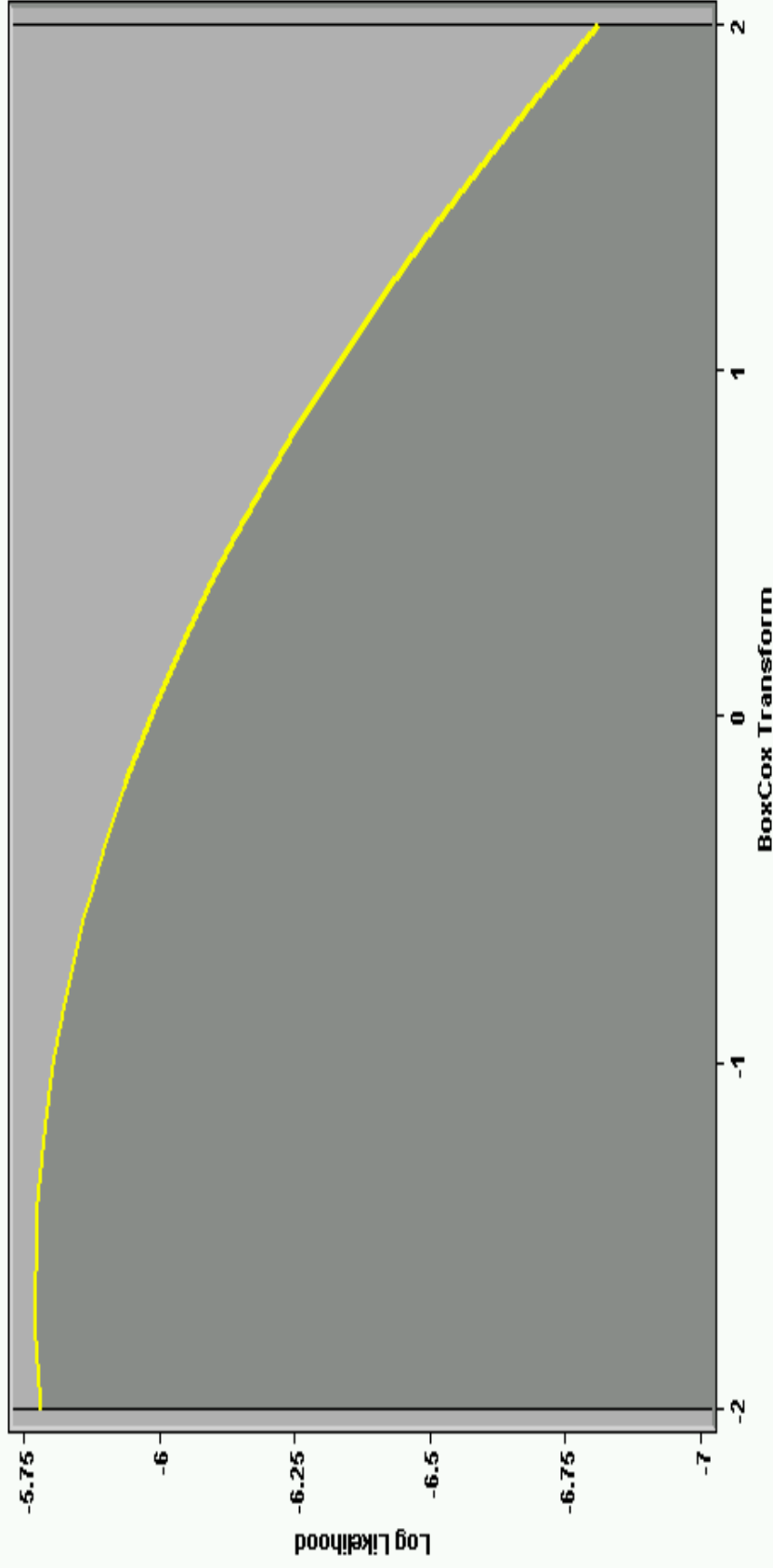
Box Cox Transformation

% Viscosity Increase BoxCox Transformation



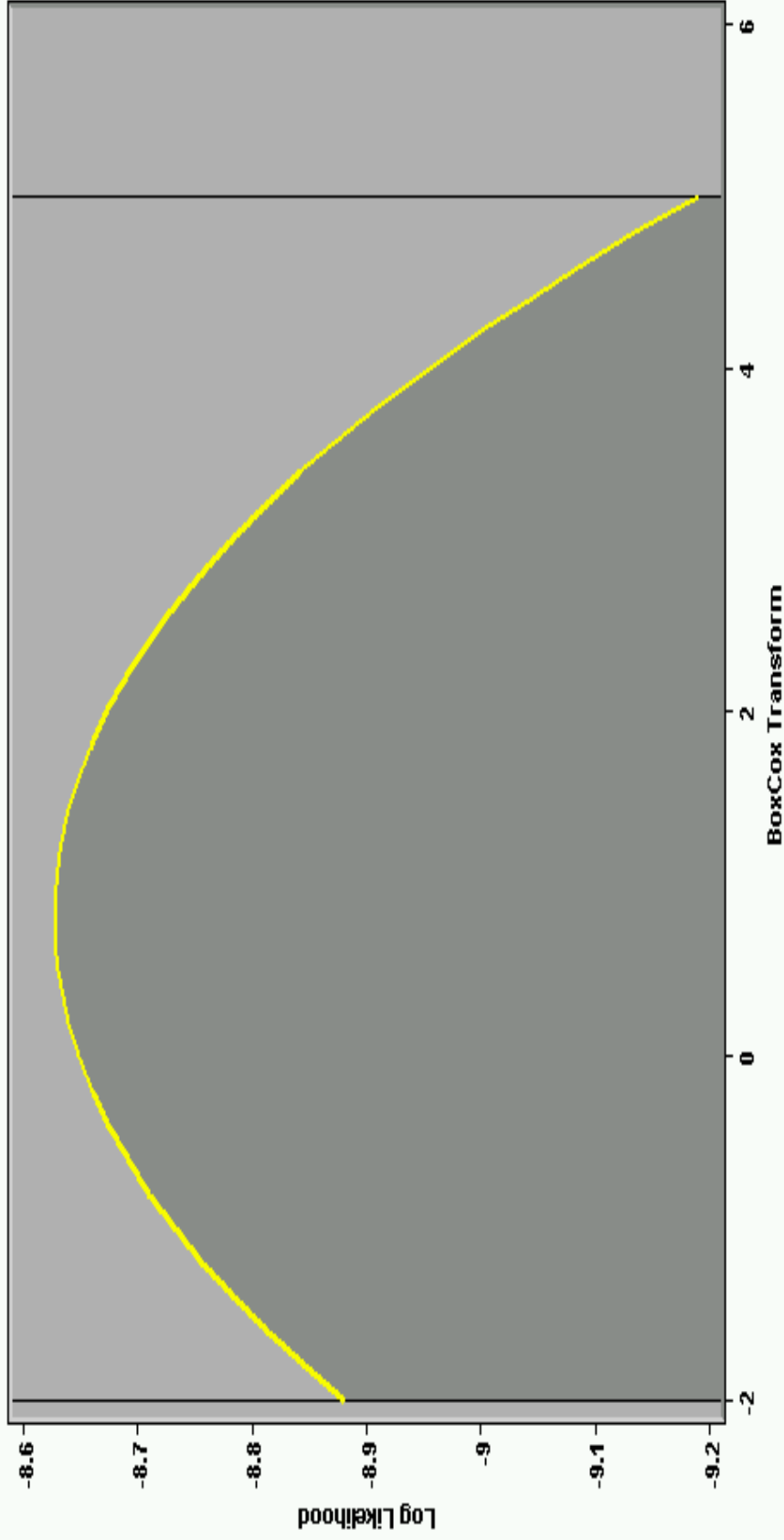
The transformation $1/\%VisInc^{*}0.2$ is optimal for this range of powers but the transformation $LN(\%VisInc)$ is recommended because it is within the confidence interval around the optimal power.

WPD BoxCox Transformation



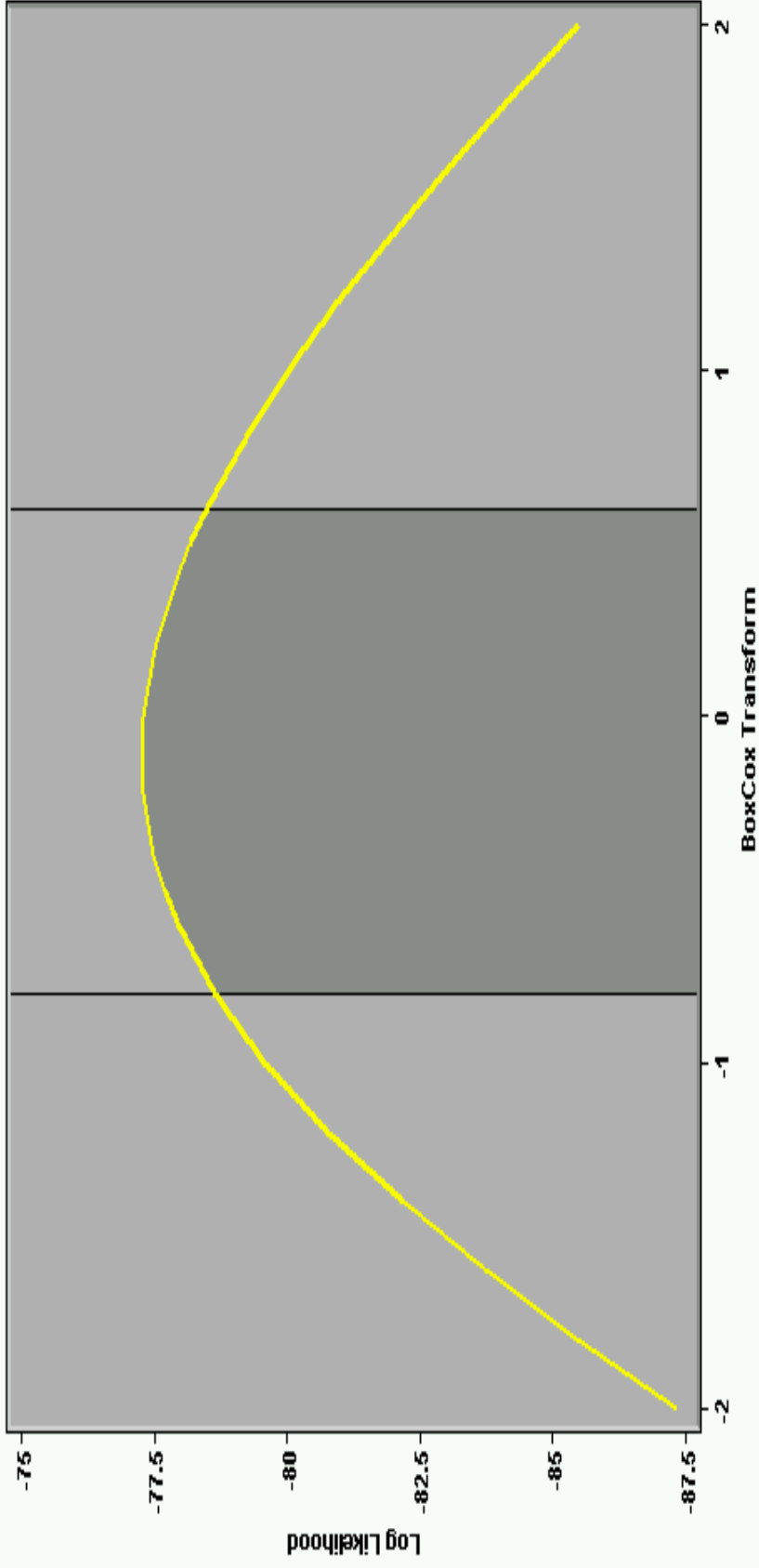
The transformation $1/\text{WPD}^{**1.6}$ is optimal for this range of powers but the transformation WPD is recommended because it is within the confidence interval around the optimal power.

APV BoxCox Transformation



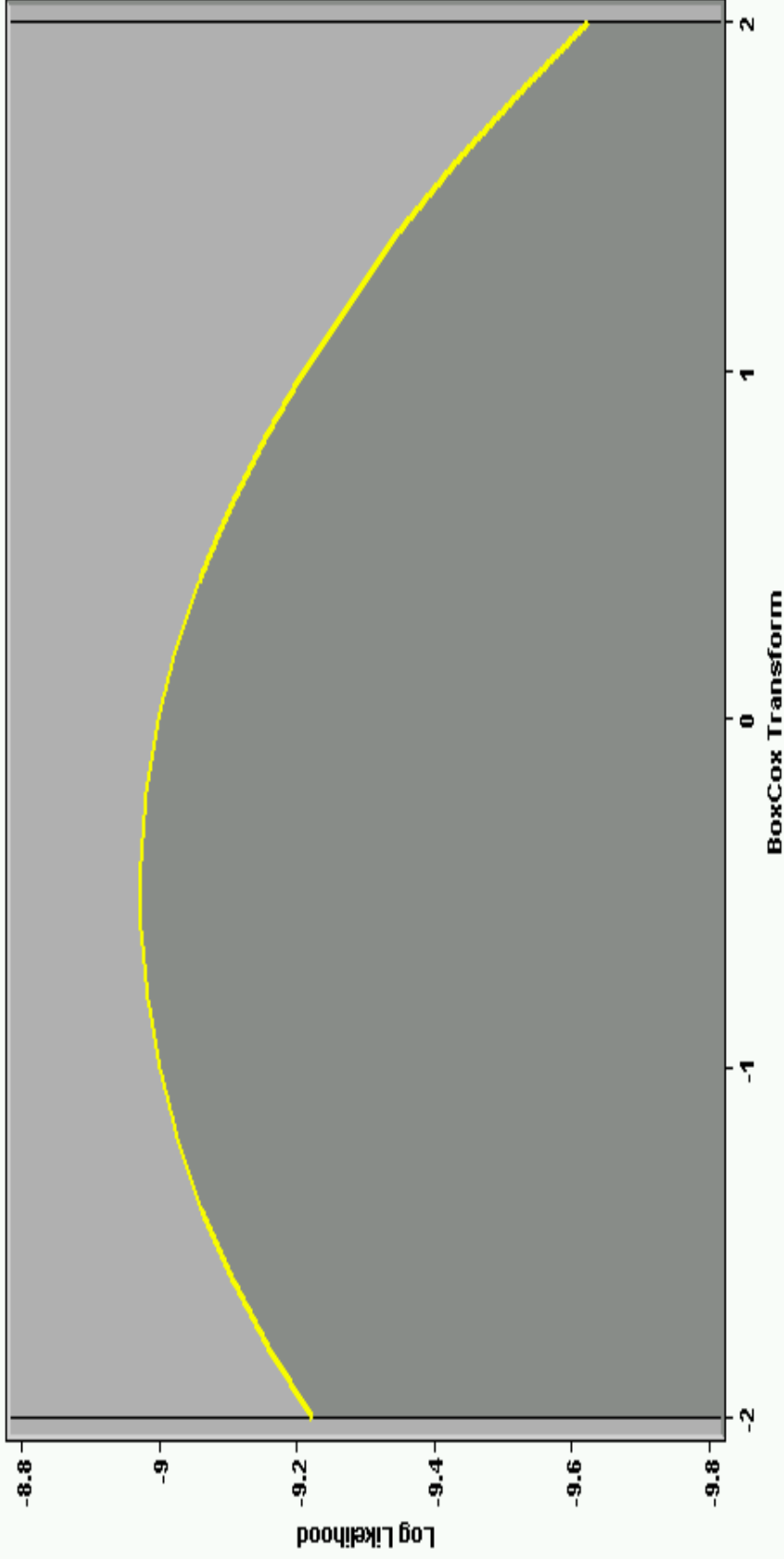
The transformation $PSV^{**0.8}$ is optimal for this range of powers but the transformation PSV is recommended because it is within the confidence interval around the optimal power.

ACLW BoxCox Transformation



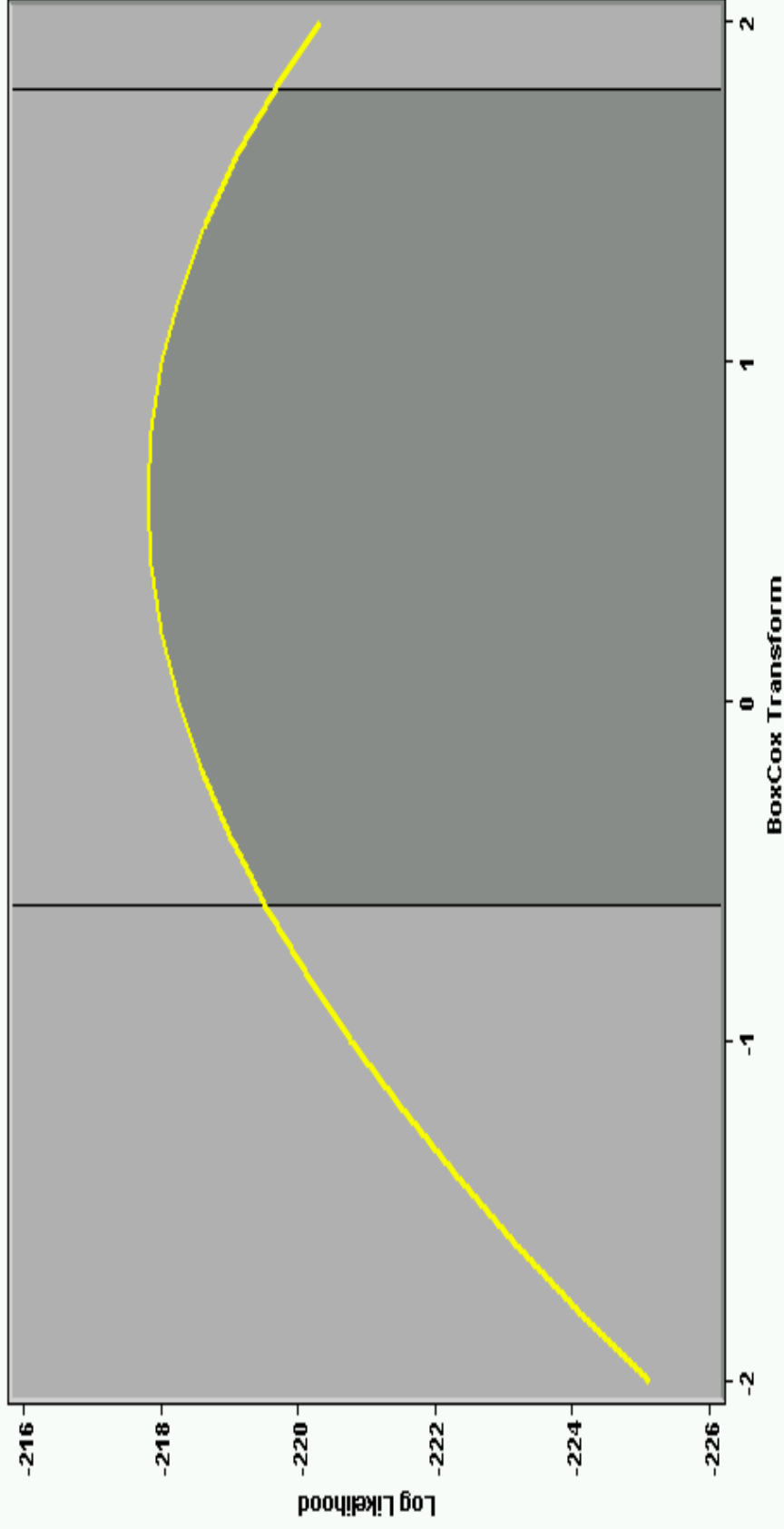
The transformation $1/ACLW^{**0.2}$ is optimal for this range of powers but the transformation $LN(ACLW)$ is recommended because it is within the confidence interval around the optimal power.

Oil Consumption BoxCox Transformation



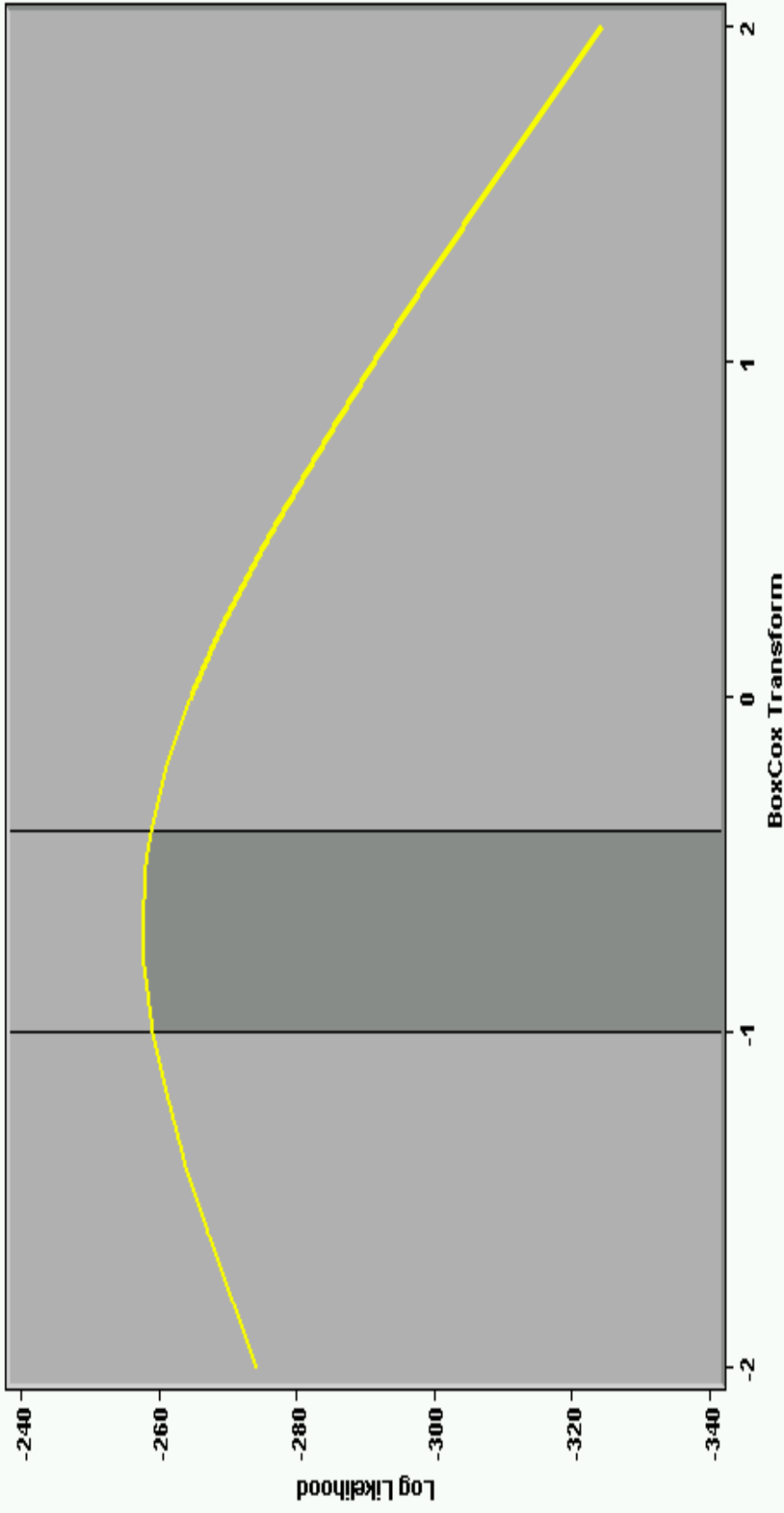
The transformation $1/\sqrt{\text{OilCon}}$ is optimal for this range of powers but the transformation OilCon is recommended because it is within the confidence interval around the optimal power.

CCS BoxCox Transformation



The transformation $CCS^{**0.6}$ is optimal for this range of powers but the transformation CCS is recommended because it is within the confidence interval around the optimal power.

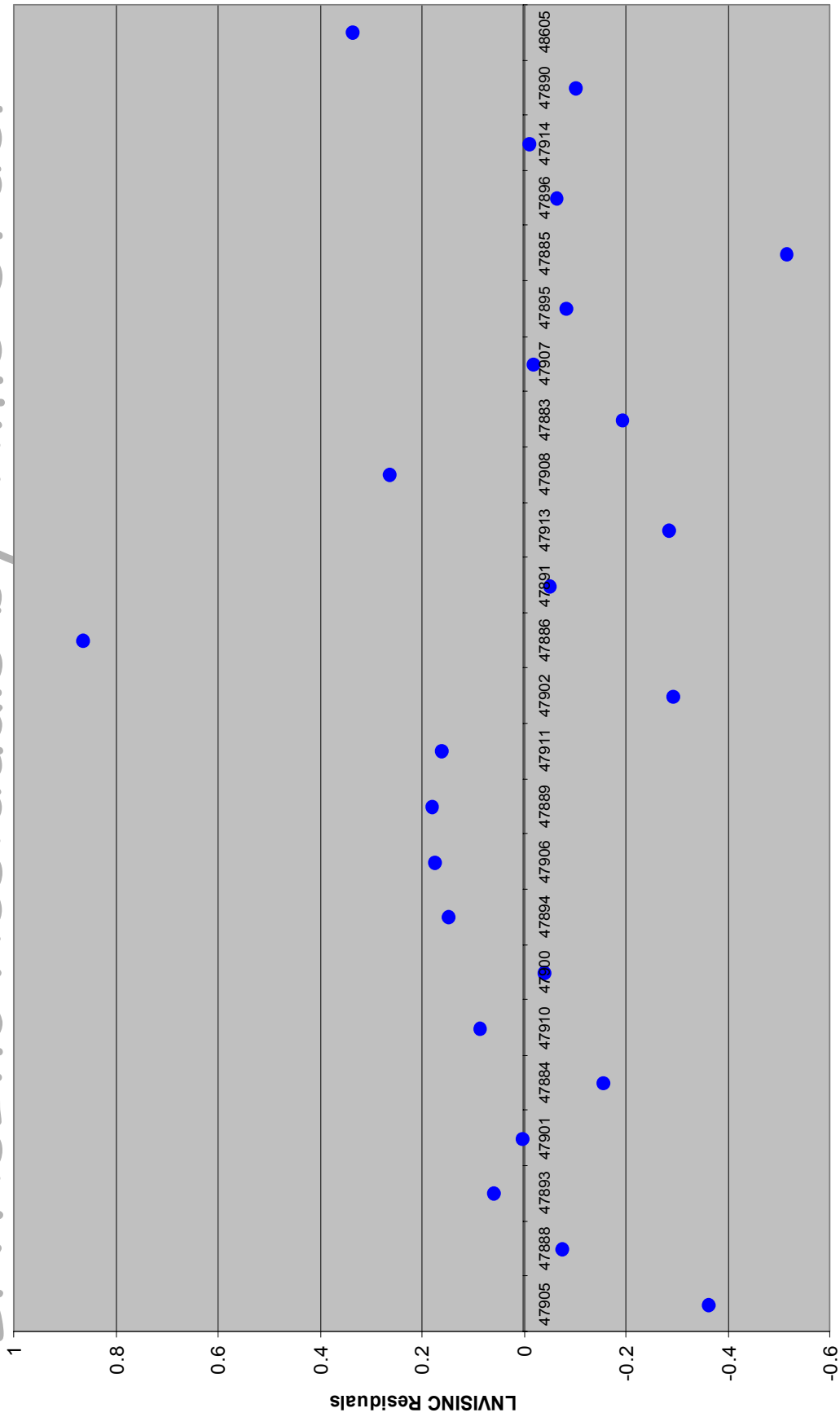
MRV BoxCox Transformation



The transformation $1/\text{MRV}^{**}0.6$ is optimal for this range of powers but the transformation $1/\text{sqrt}(\text{MRV})$ is recommended because it is within the confidence interval around the optimal power.

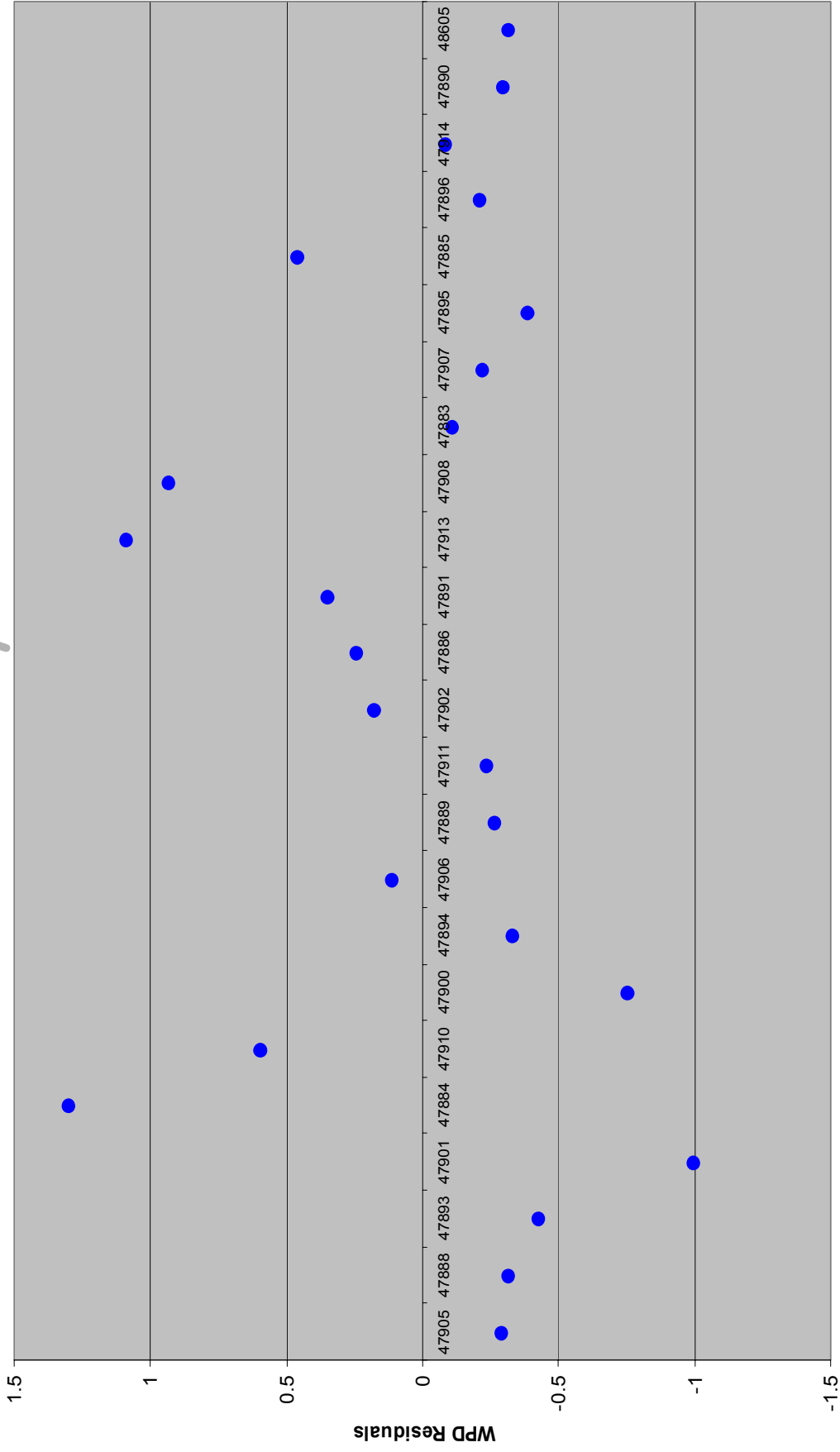
Residual Plots by Time Order

LNVisInc Residuals by Time Order



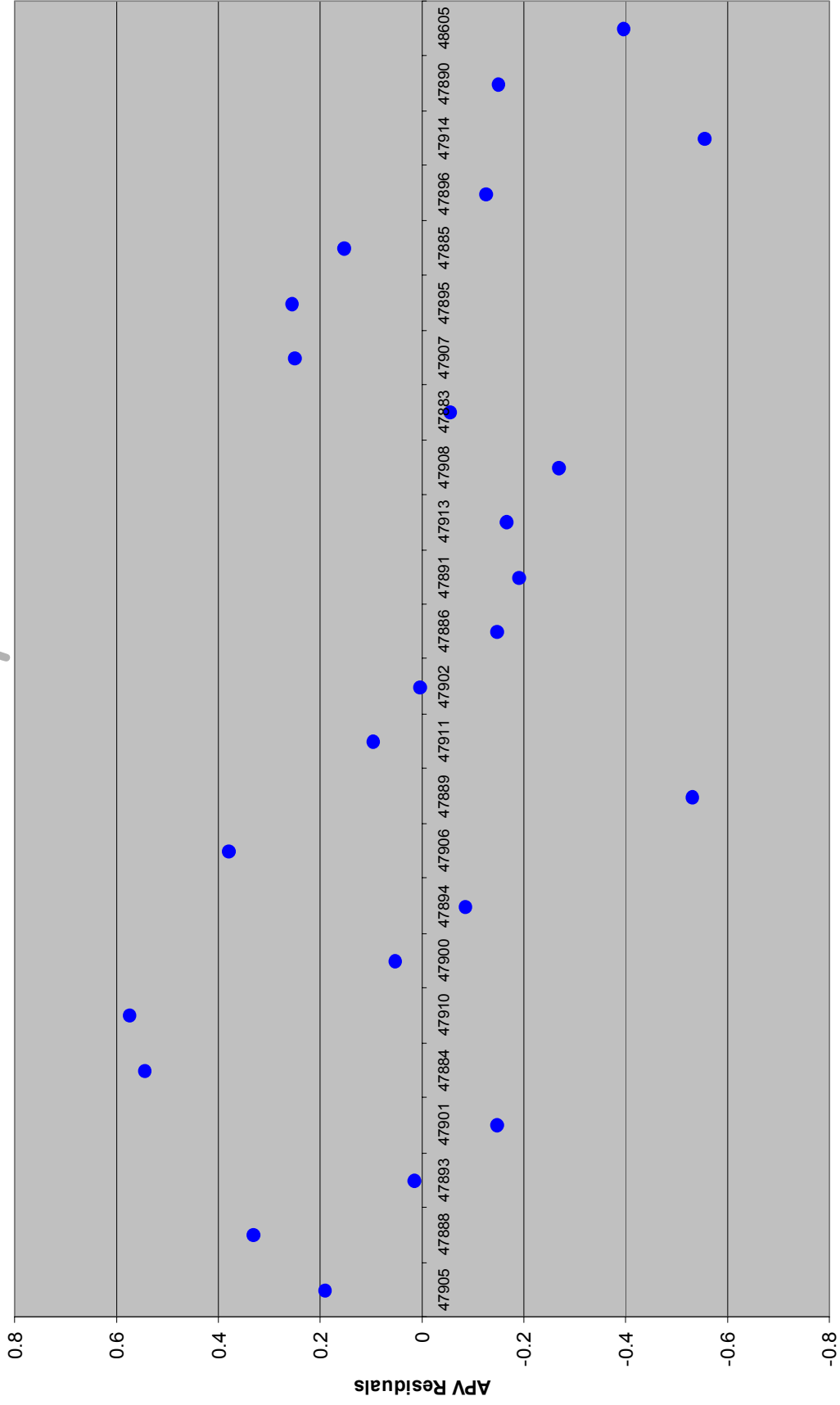
Testkeys in LTM SDATE order

WPD Residuals by Time Order



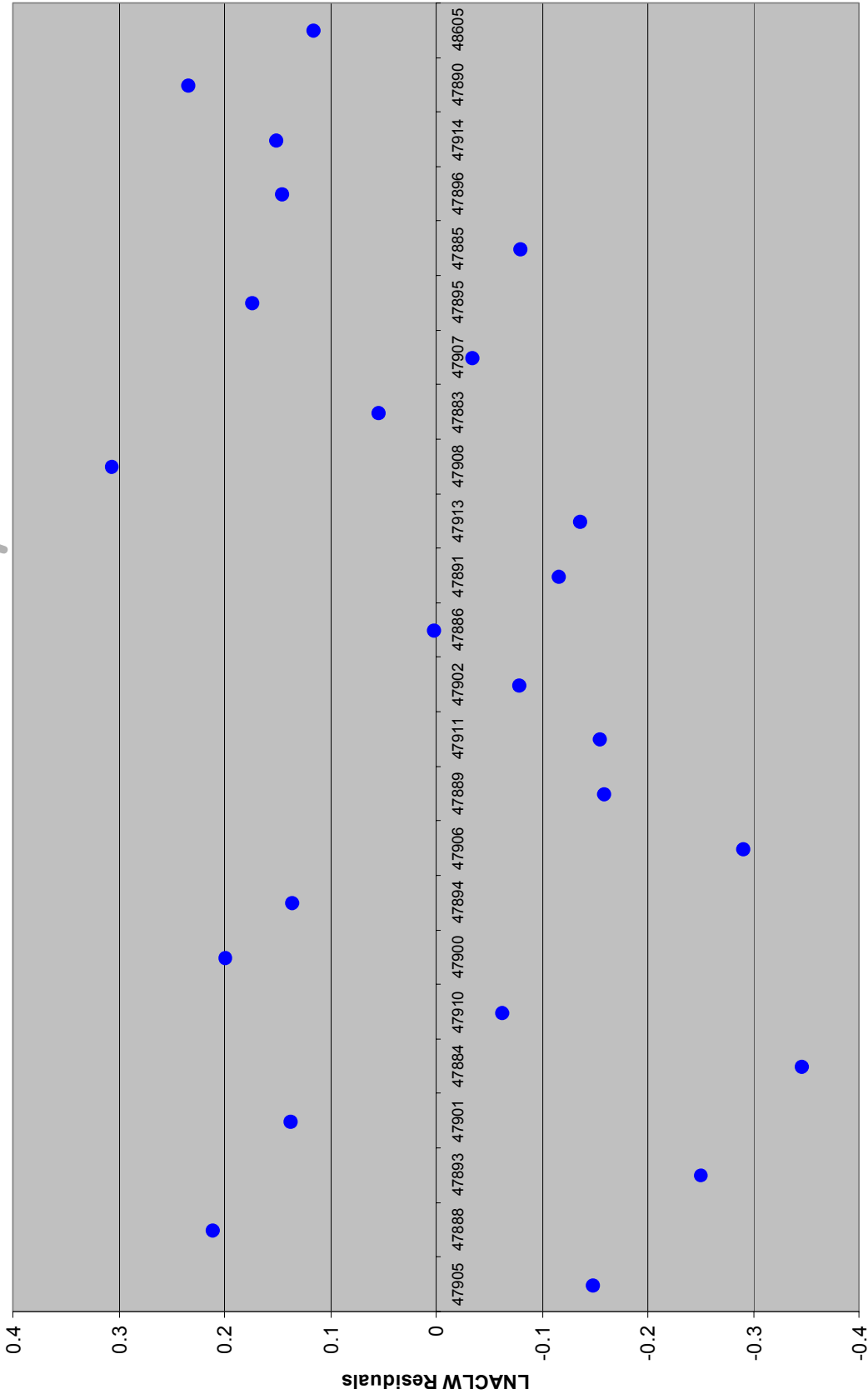
Testkeys in LTMSDATE order

APV Residuals by Time Order



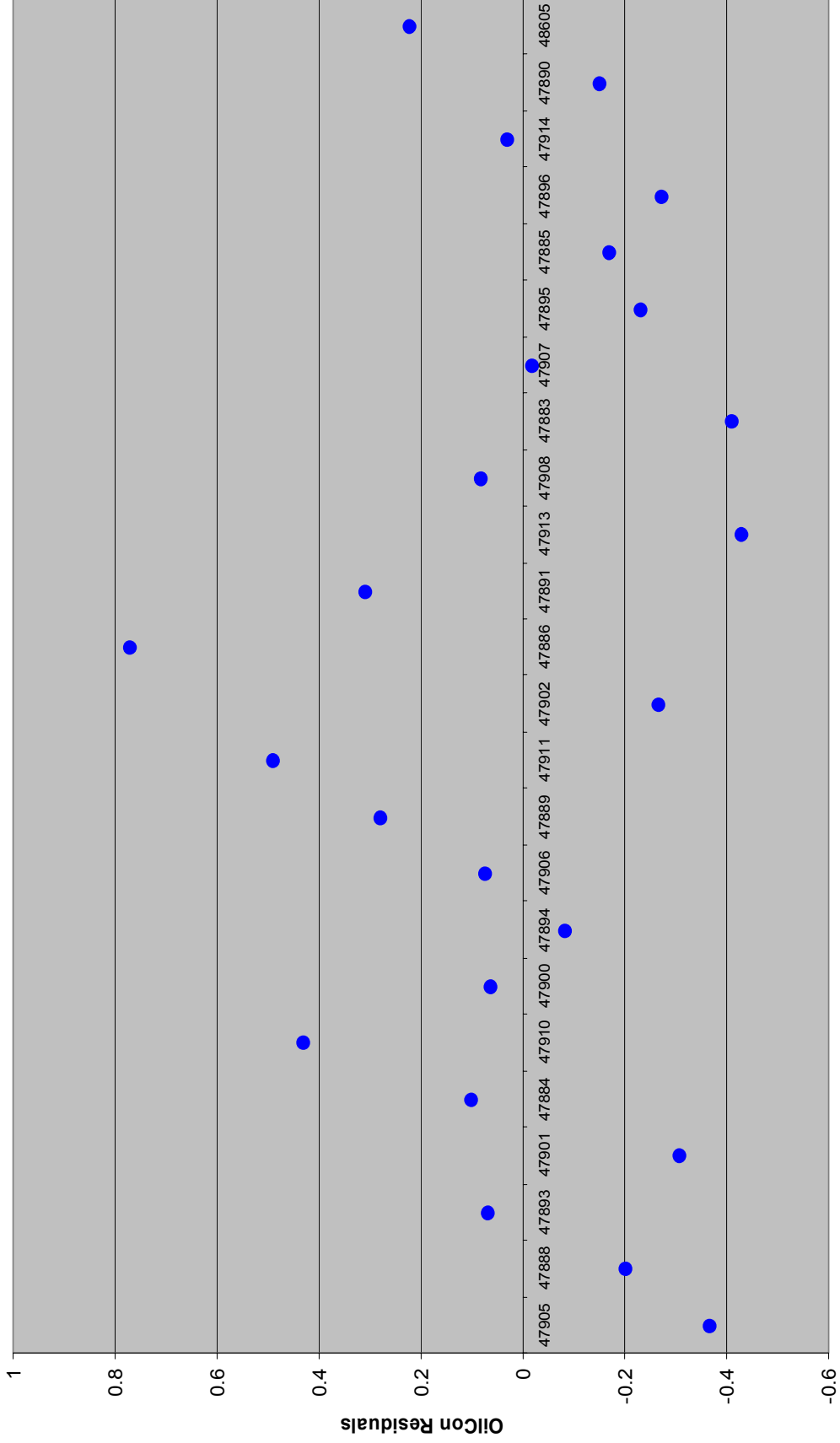
Teskeys in LTM SDATE order

LNACLW Residuals by Time Order



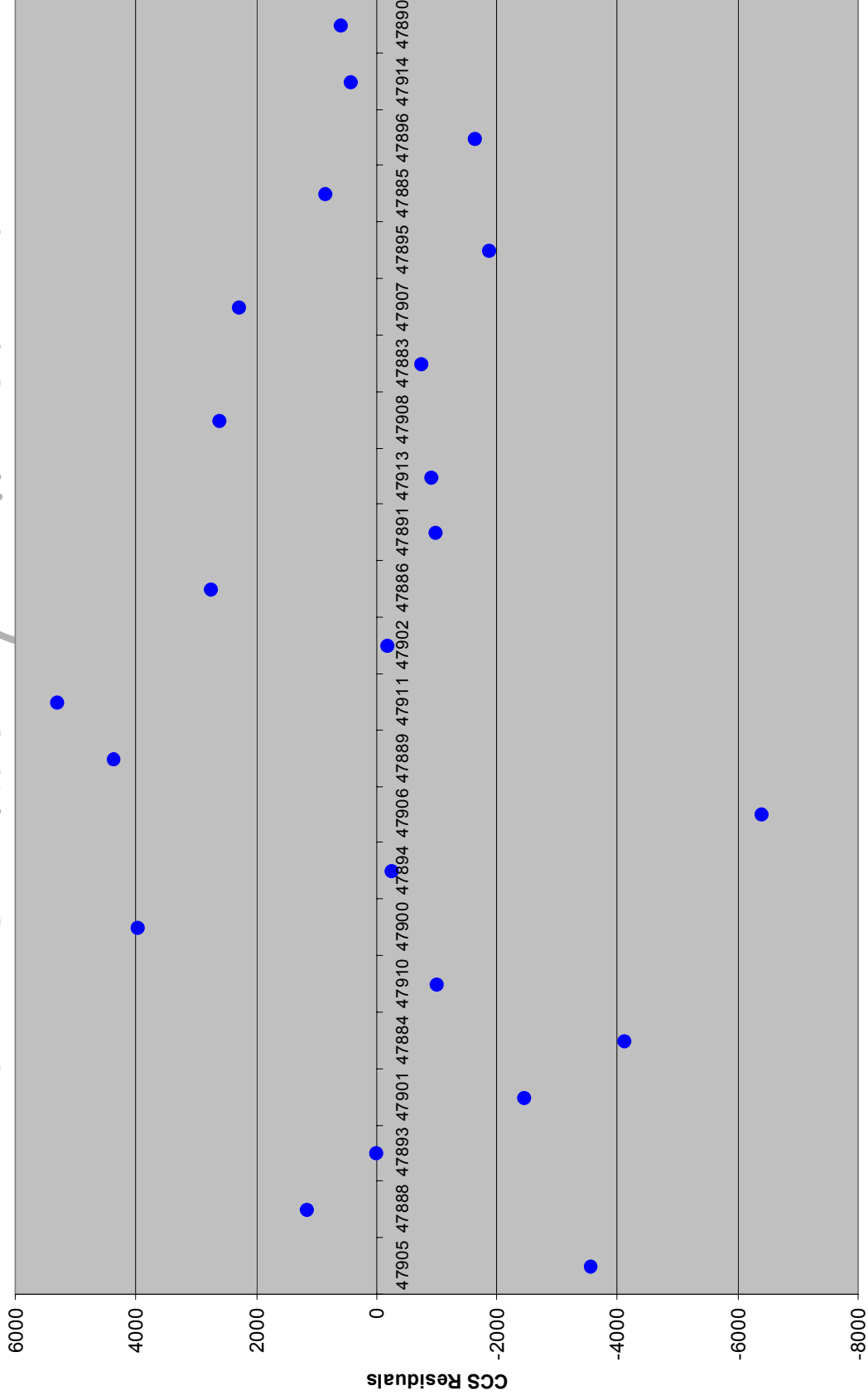
Testkeys in LTMSDATE order

Oil Consumption Residuals by Time Order



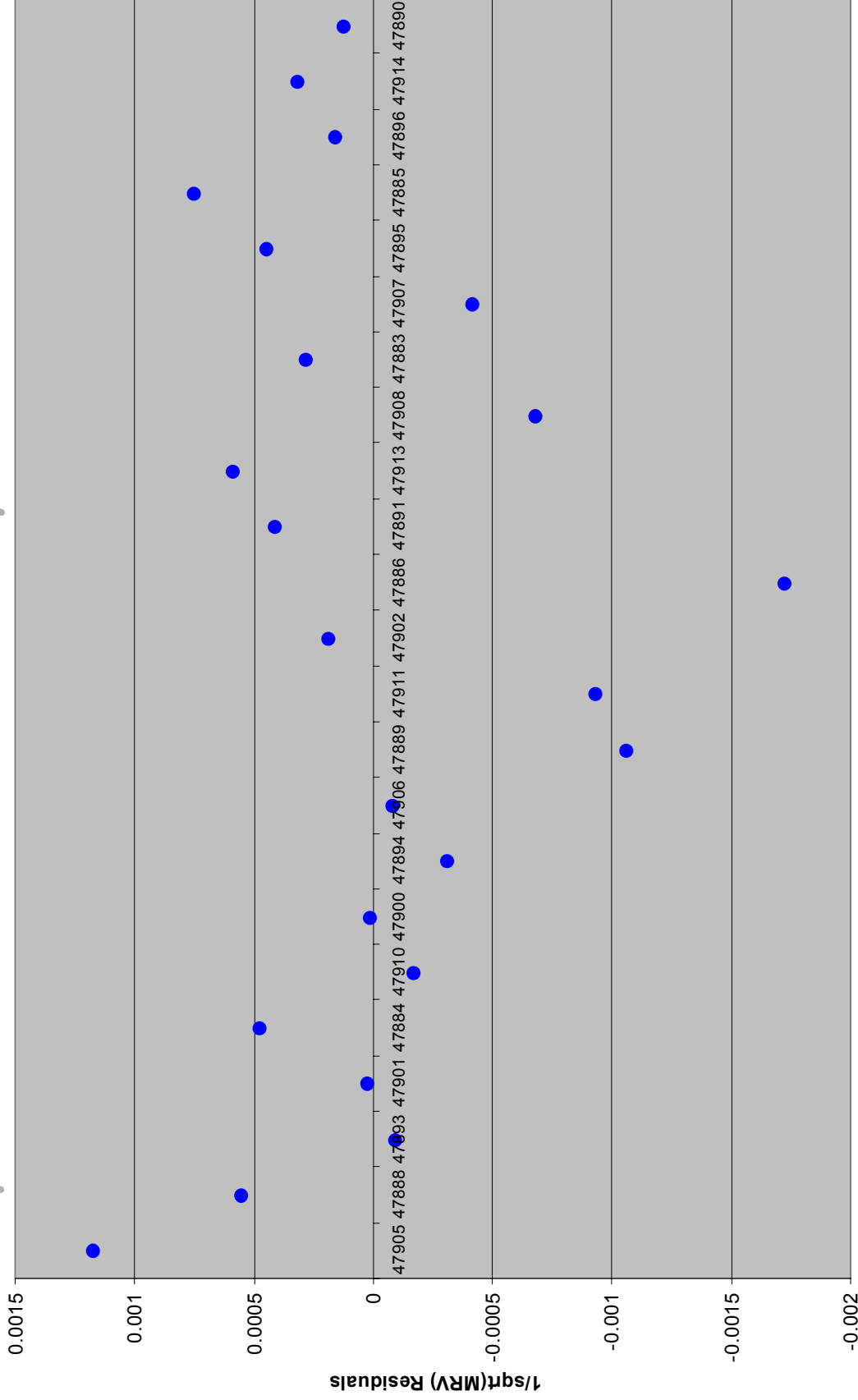
Testkeys in LTIMSDATE order

CCS Residuals by Time Order



Testkeys in LTMSDATE order

1/sqrt(MRV) Residuals by Time Order



Testkeys in LTM SDATE order

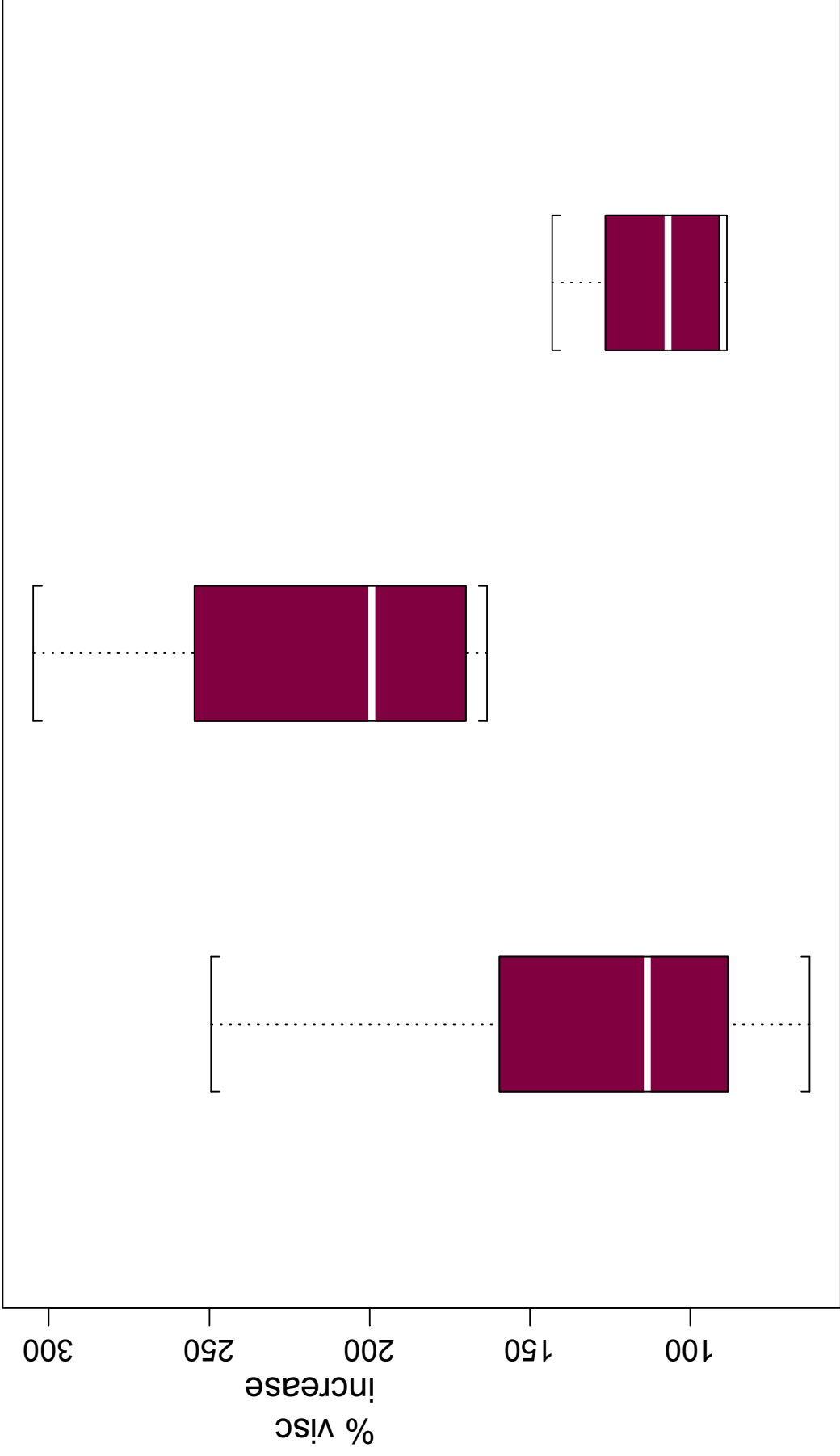
Plots of the III G matrix data

Data source

- 24 tests available June 4nd, 2003
- TMC site:
<ftp://ftp.astmtmc.cmu.edu/refdata/gas/iiig/data/1tms.csv>

Plots by oil

% Visc. Increase by Ref. Oil



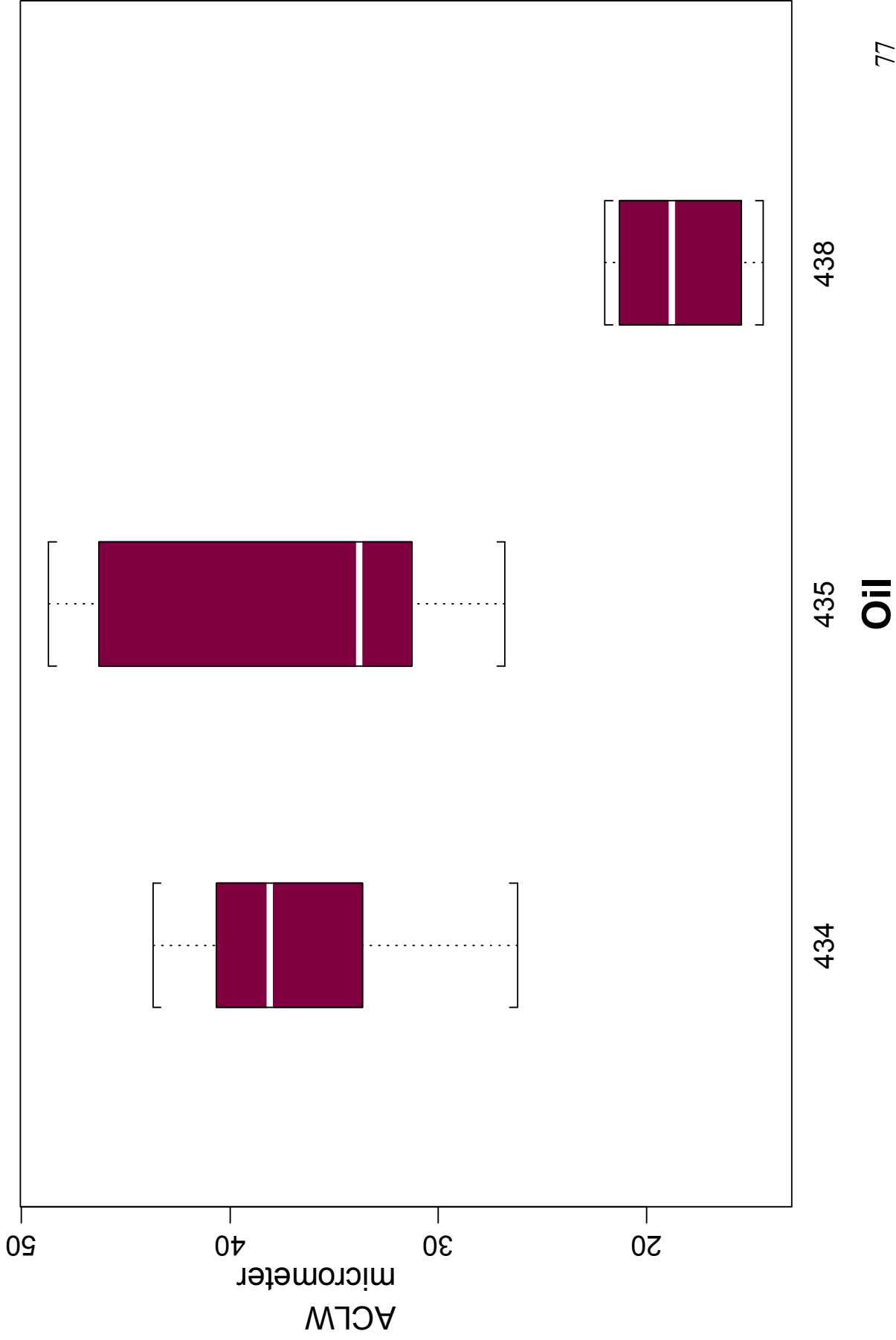
434

435

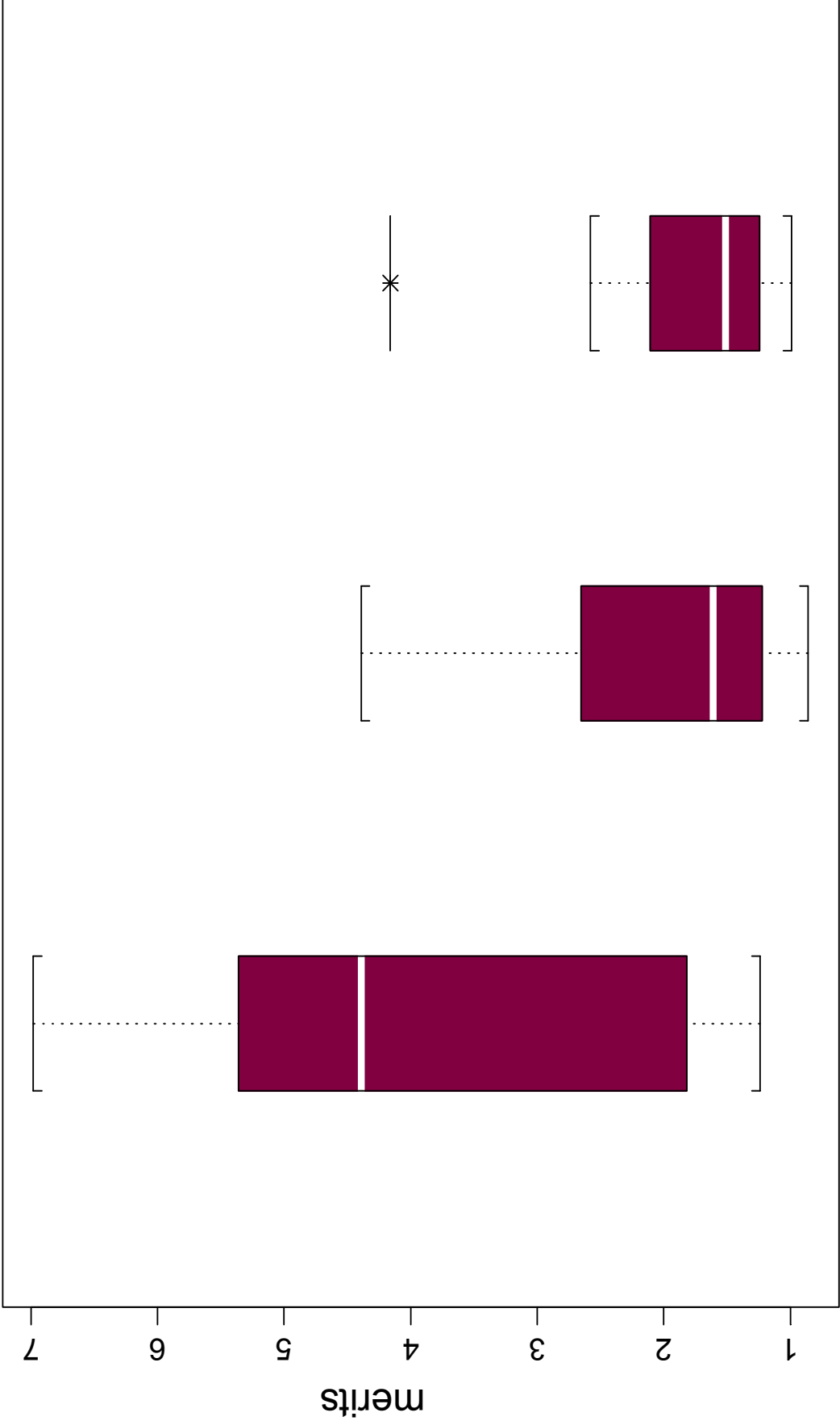
438

Oil

Average Cam Lifter Wear by Ref. Oil



Oil Ring Land Deposits



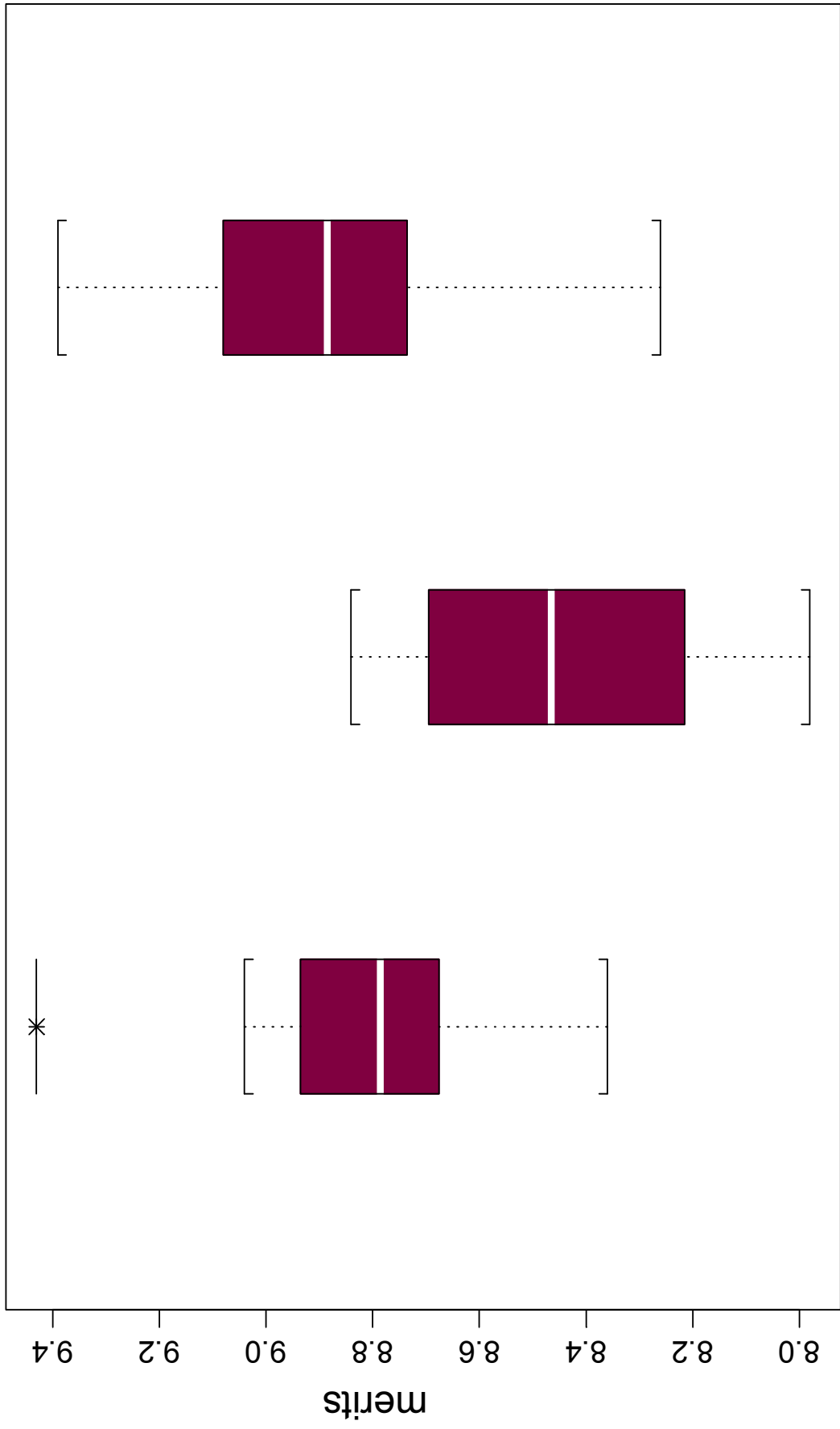
434

435

438

Oil

Average Piston Varnish by Ref. Oil



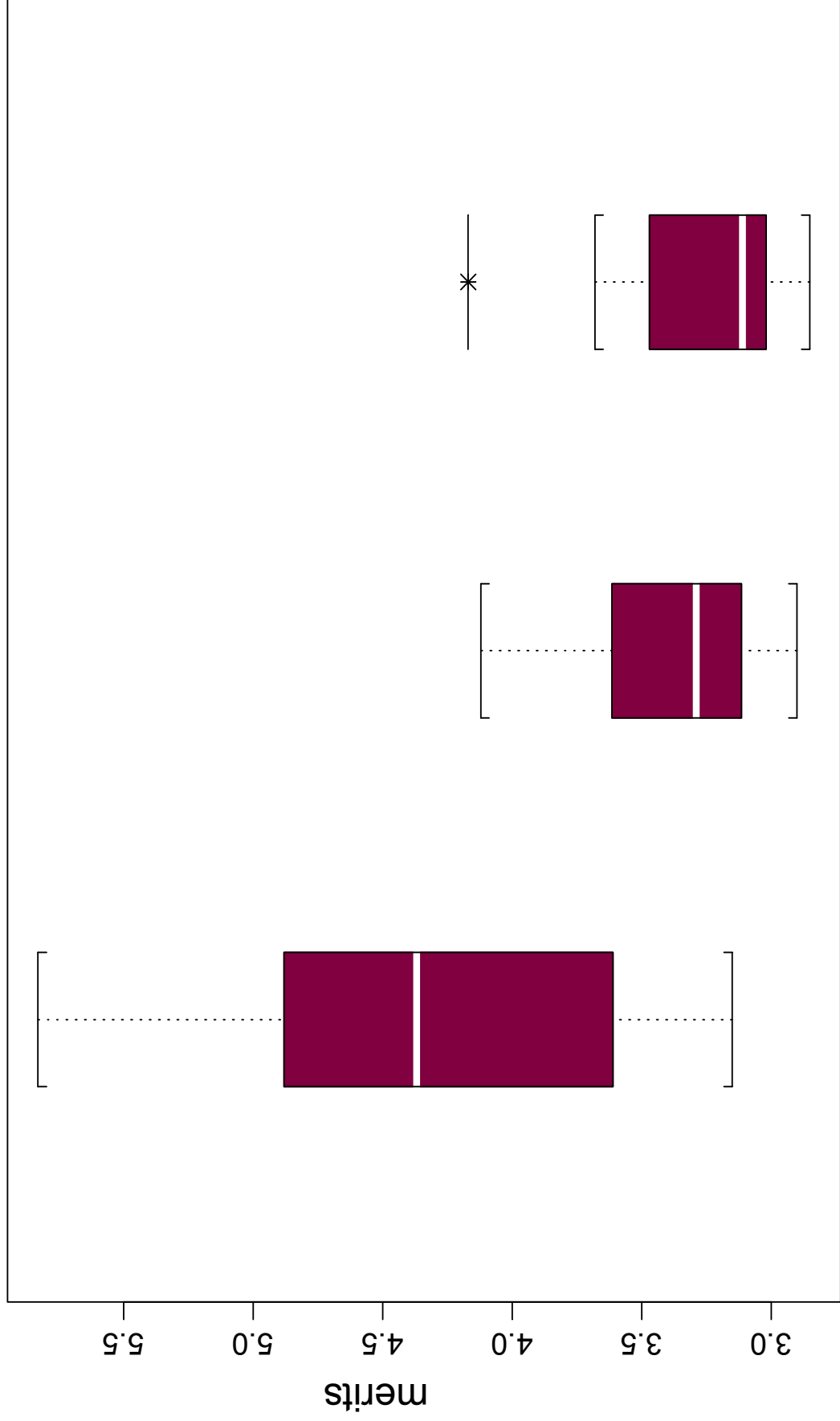
434

435

438

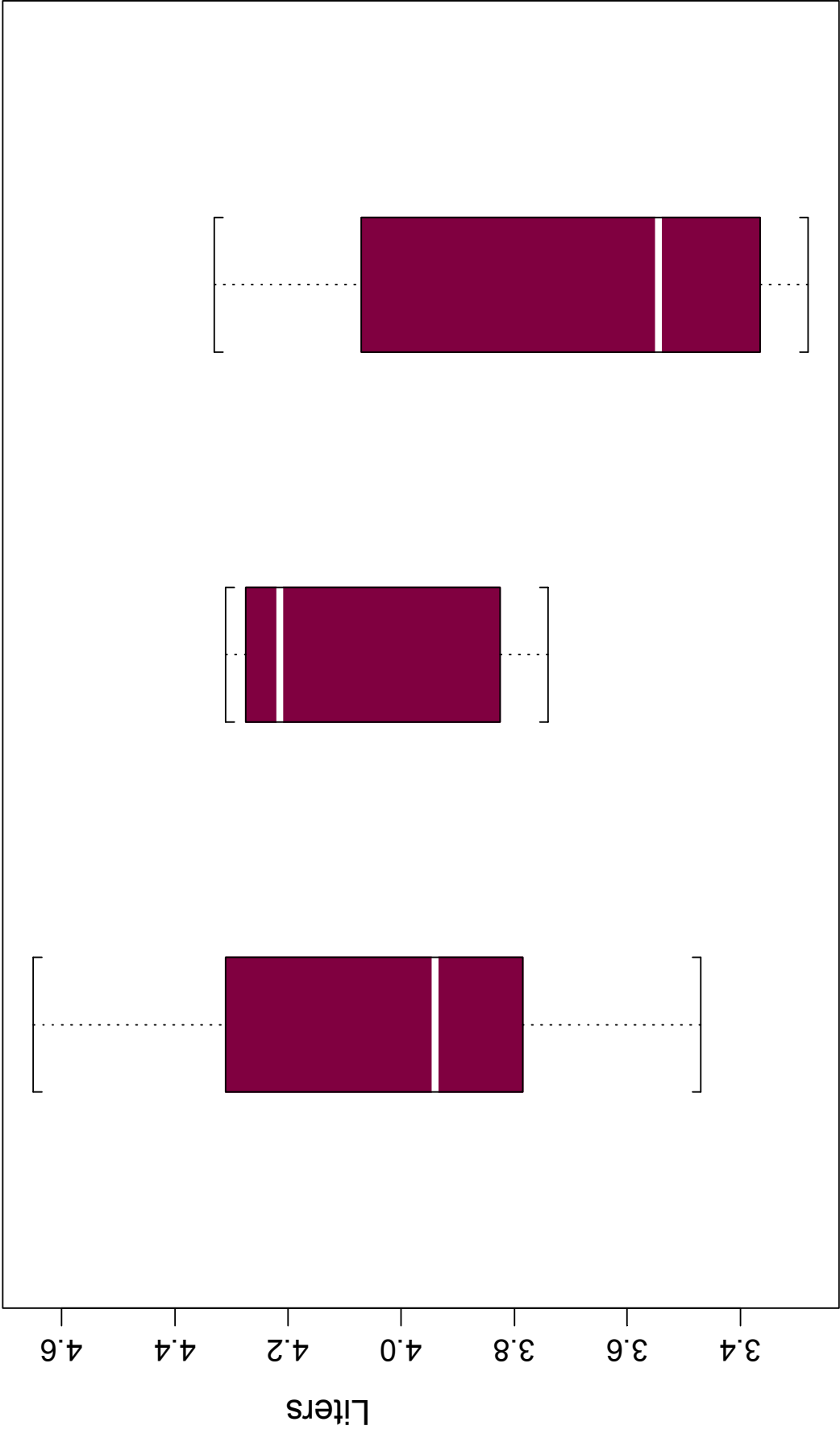
Oil

Weighted Piston Deposits by Ref. Oil



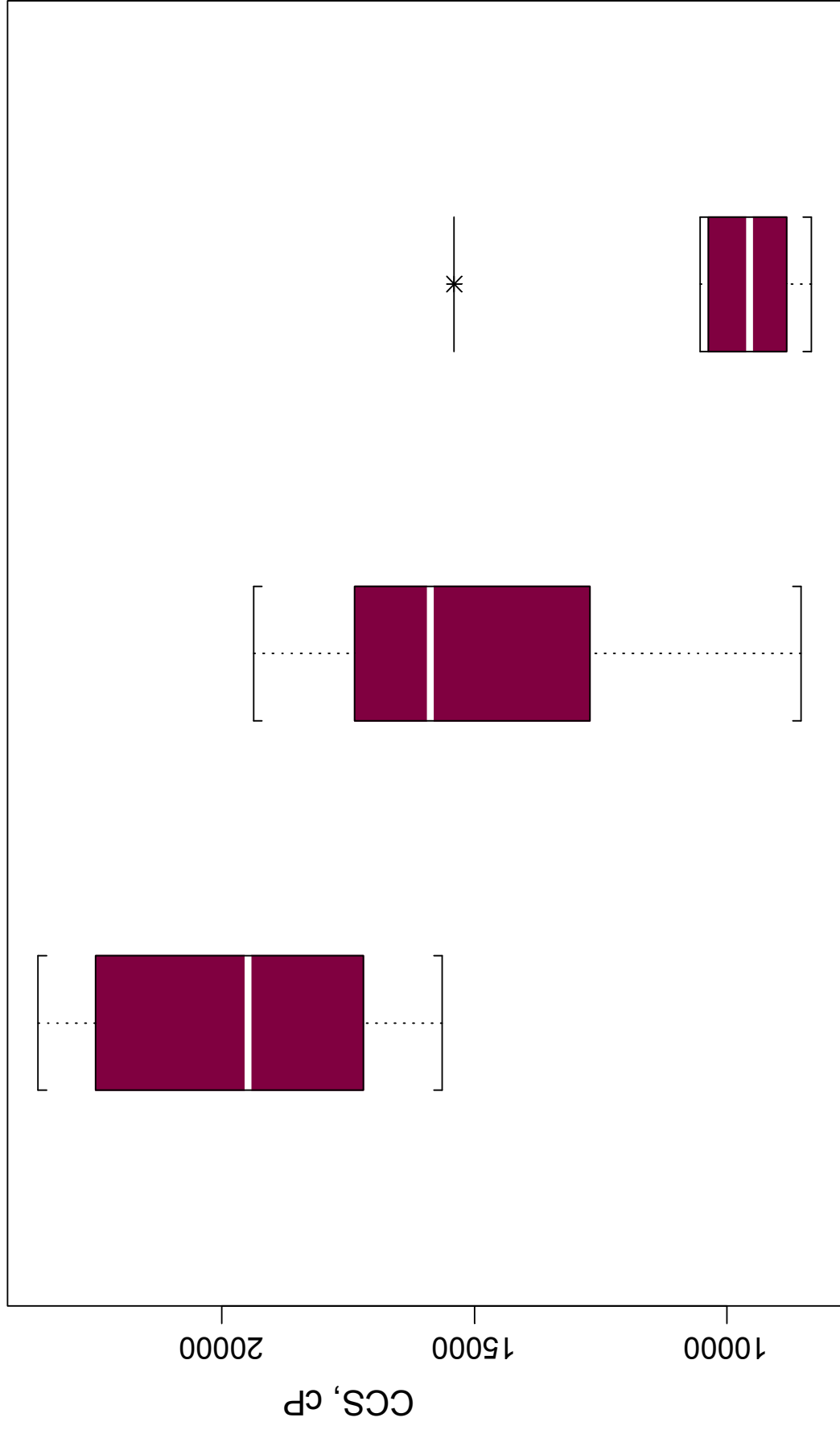
Oil

Oil Consumption by Ref. Oil

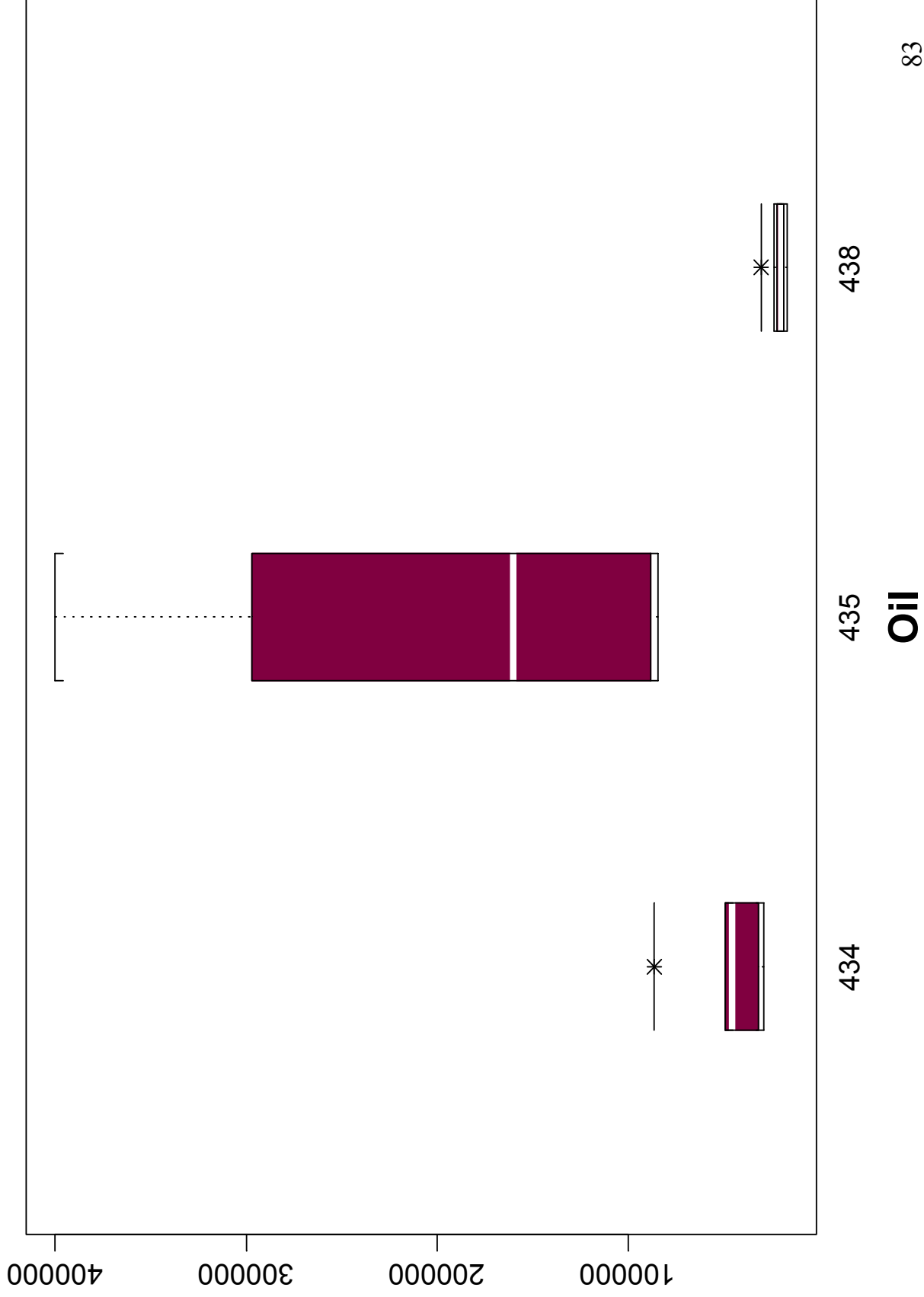


Oil

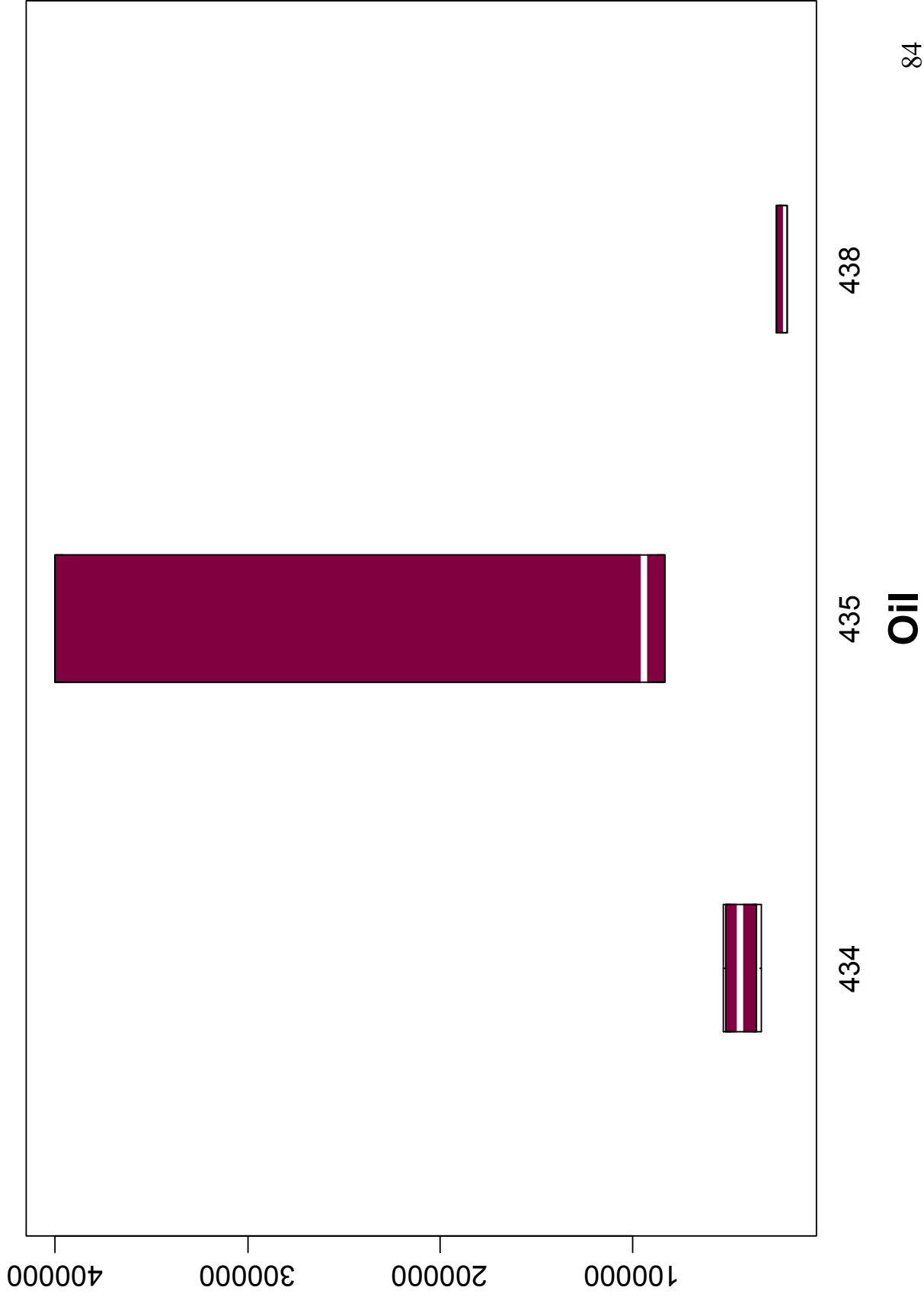
Cold Cranking by Ref. Oil



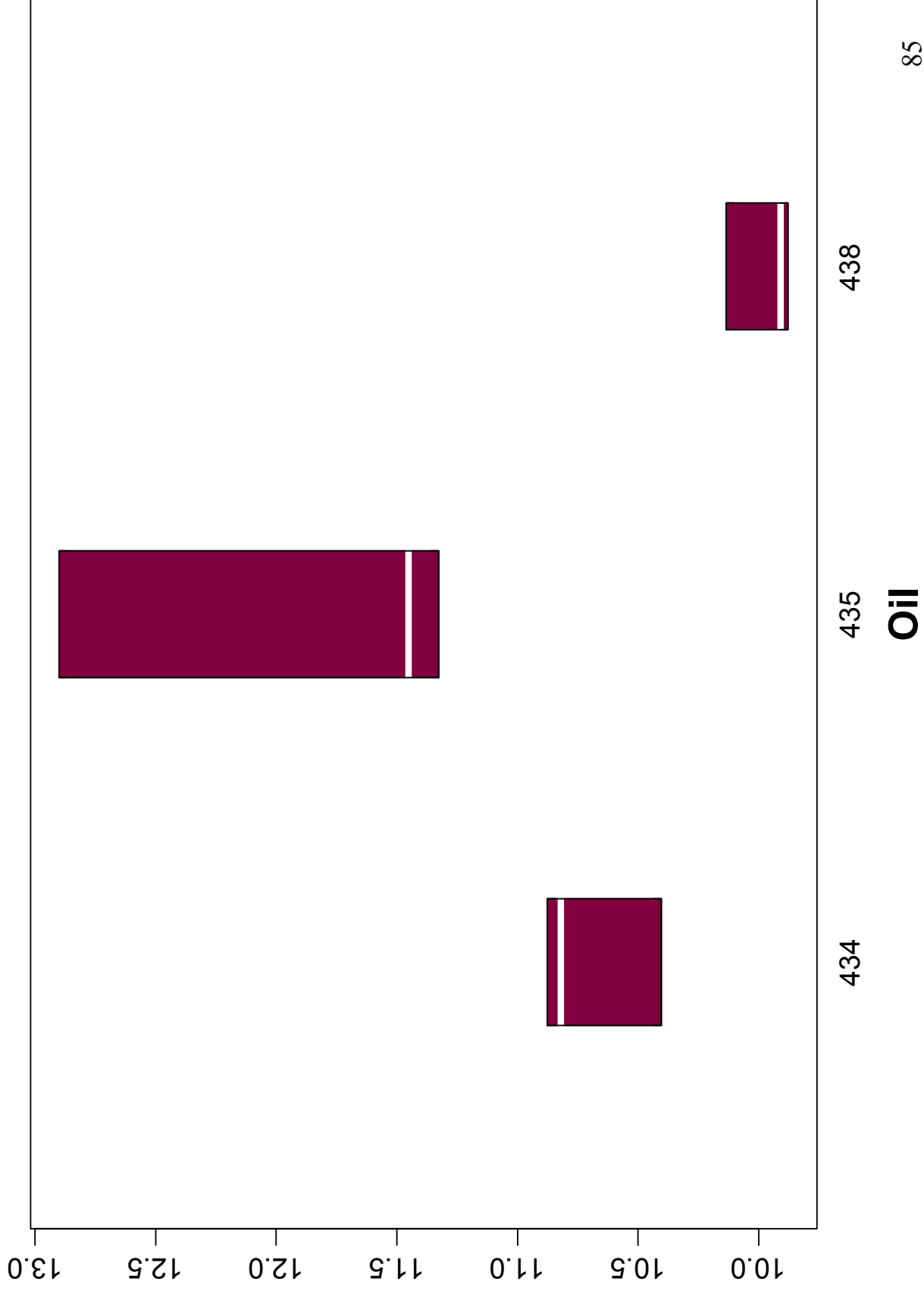
MRV @ end of test by Ref. Oil



MRV @ end of test + 168 by Ref. Oil

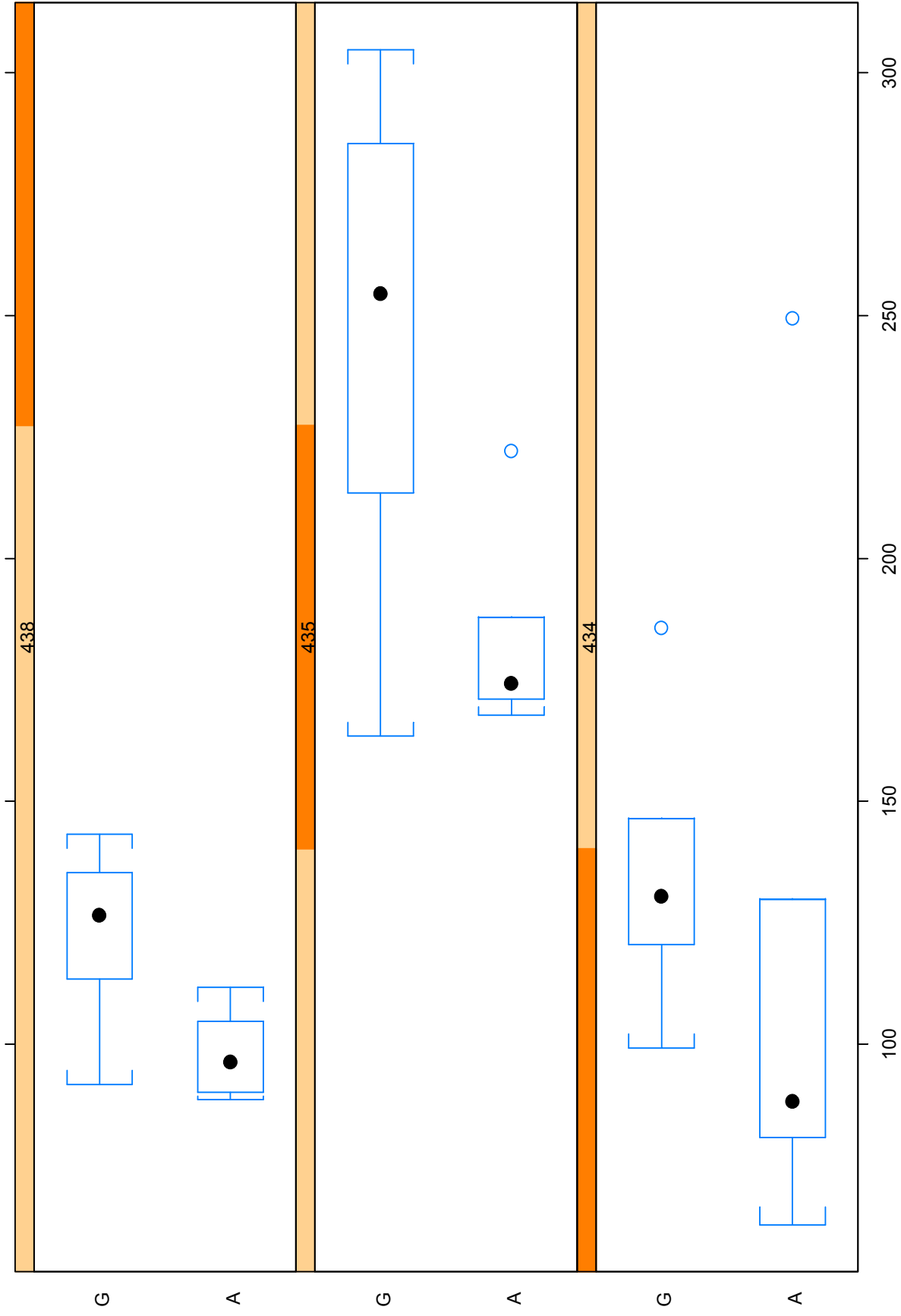


Log(MRV) @ end of test + 168 by Ref. Oil

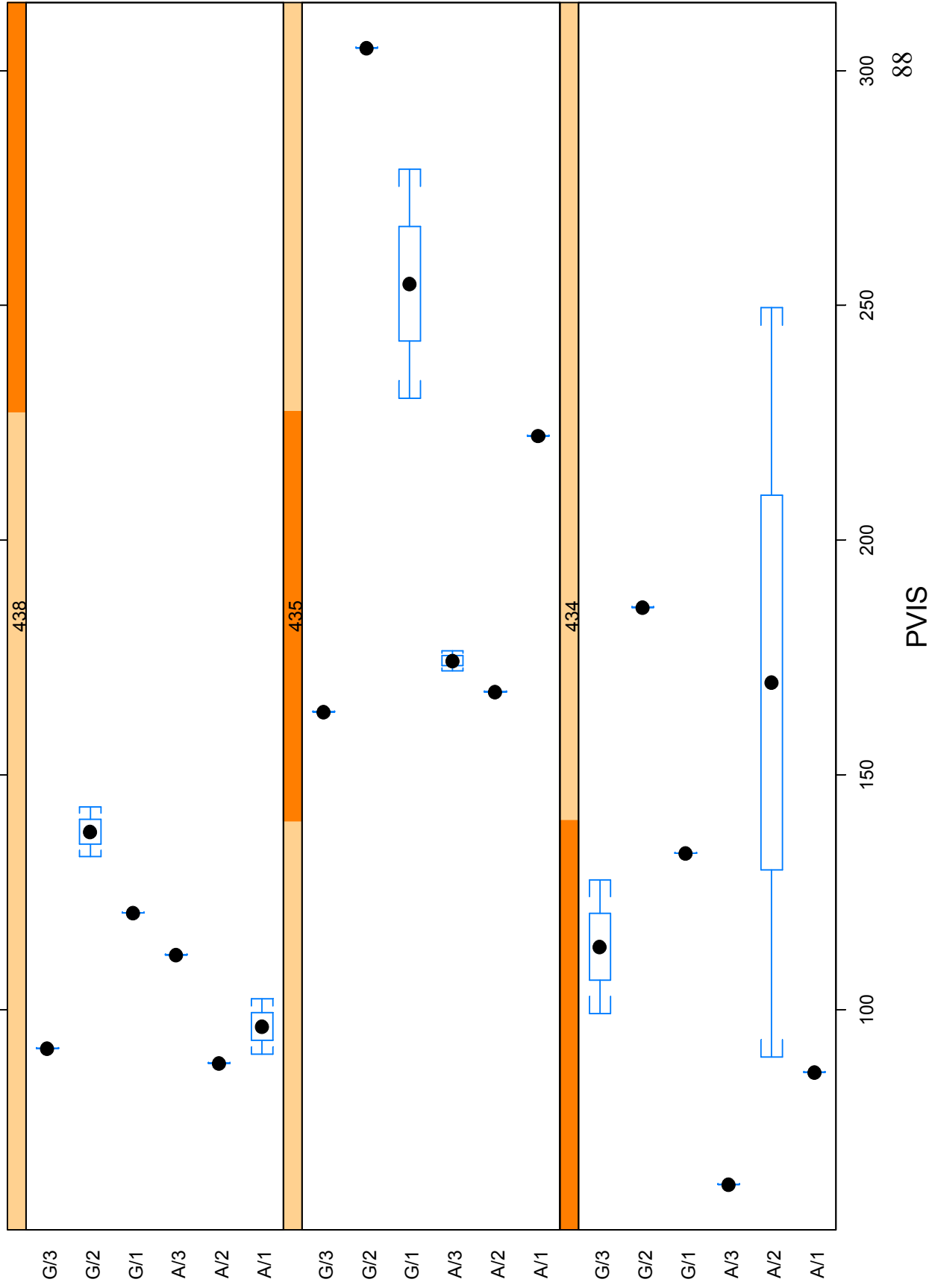


*Additional plots by oil & lab and
oil & stand, for each parameter*

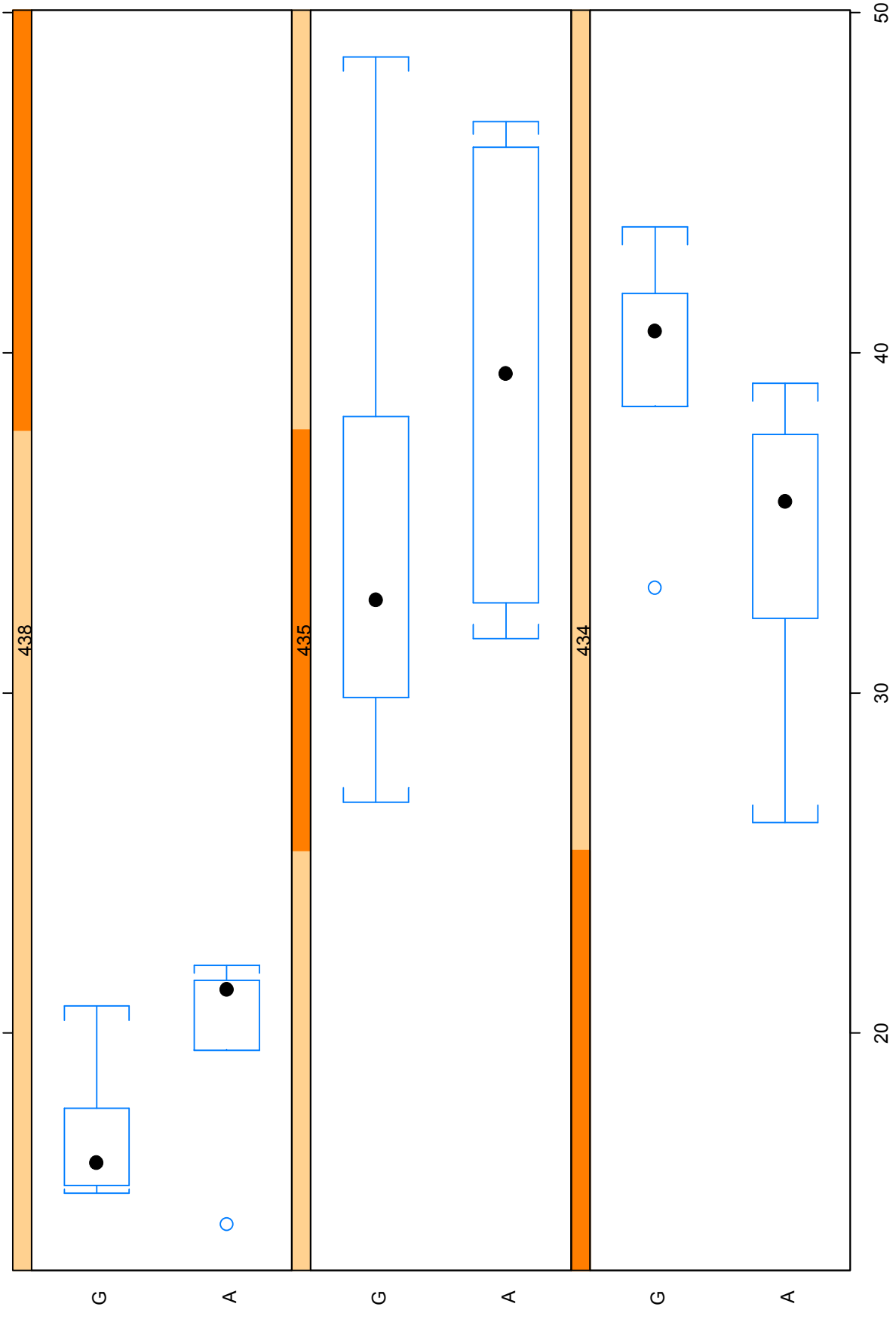
PVIS by Ref. Oil and Lab



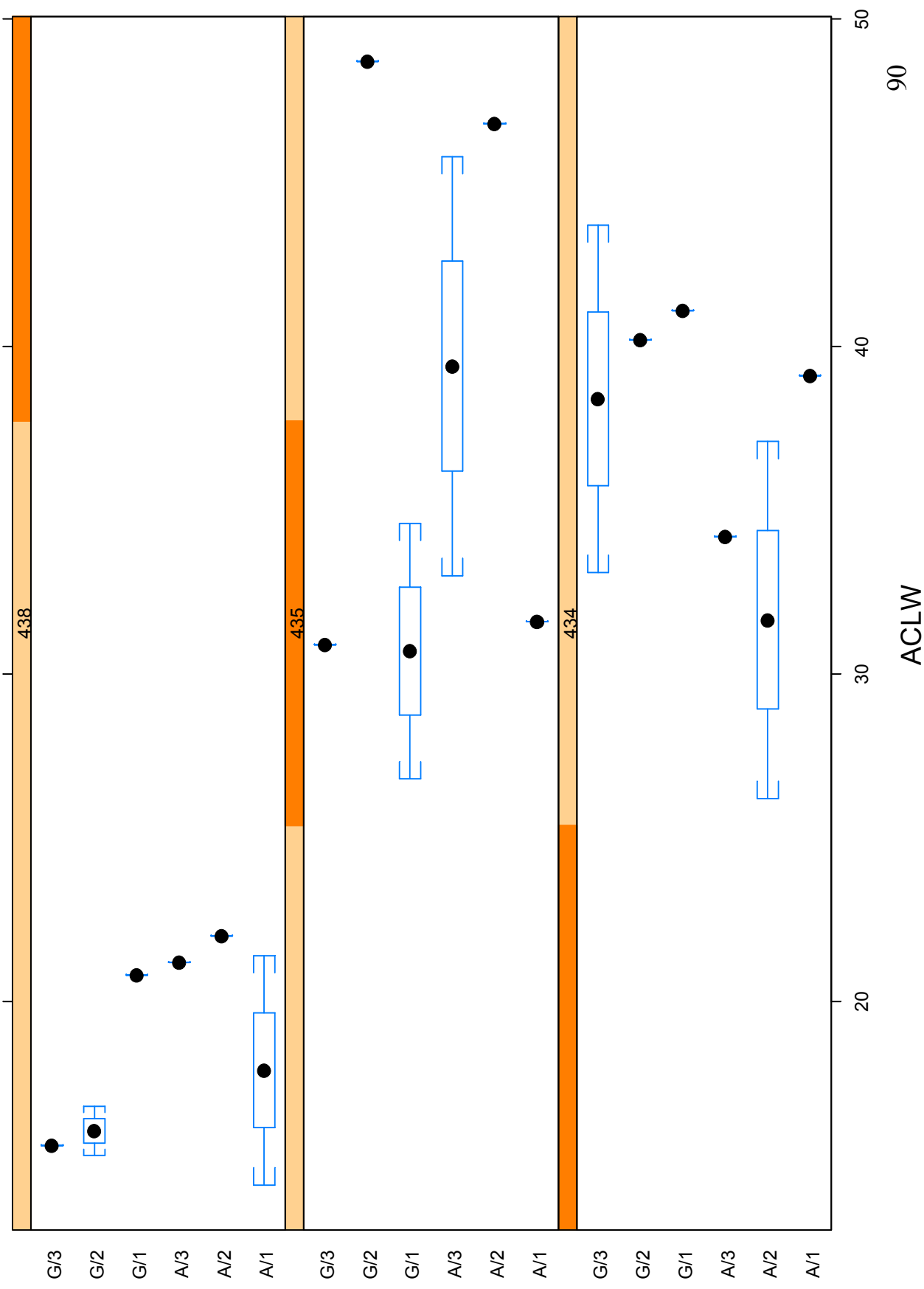
PVIS by Ref. Oil and Stand



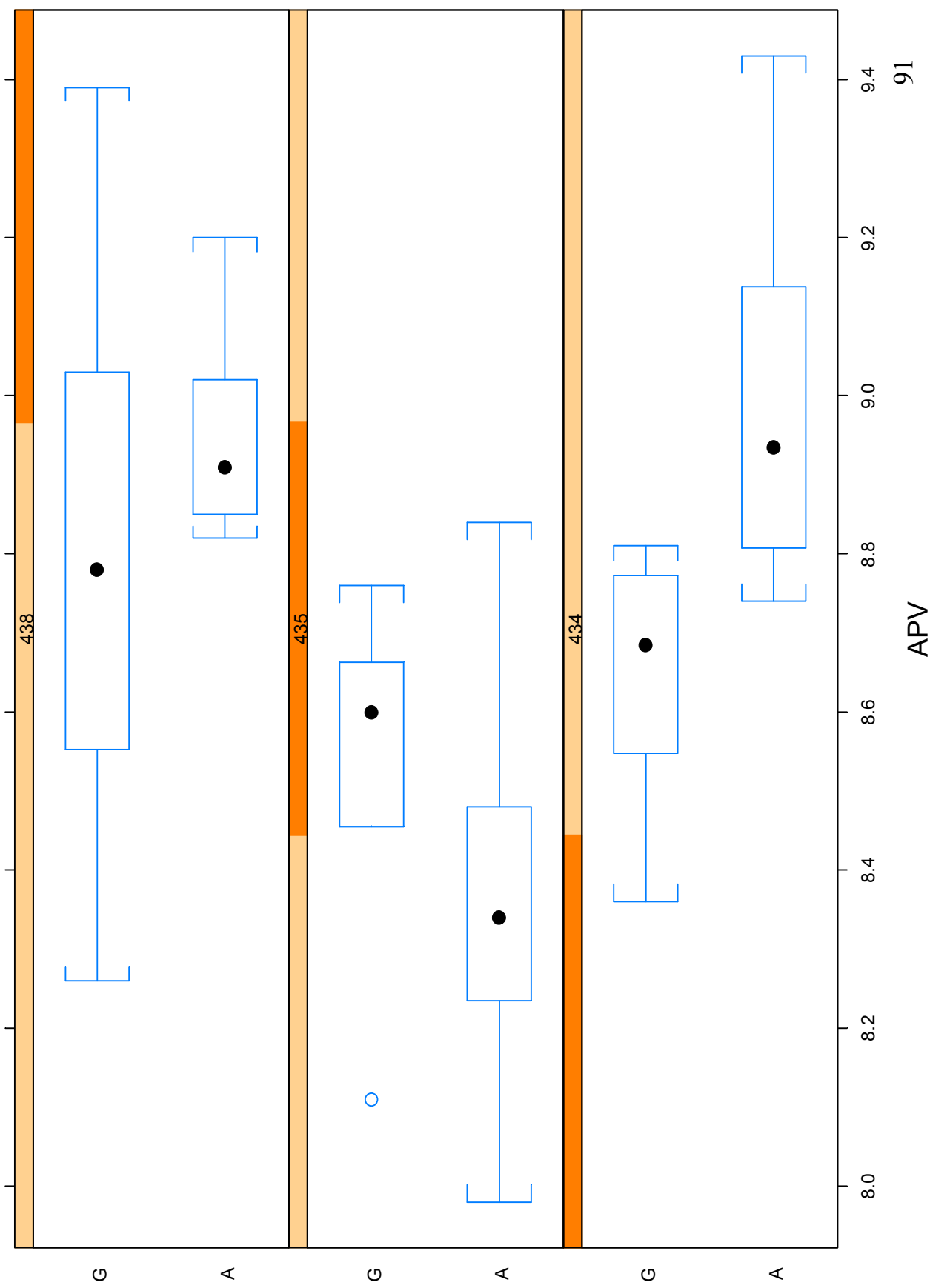
ACLW by Ref. Oil and Lab



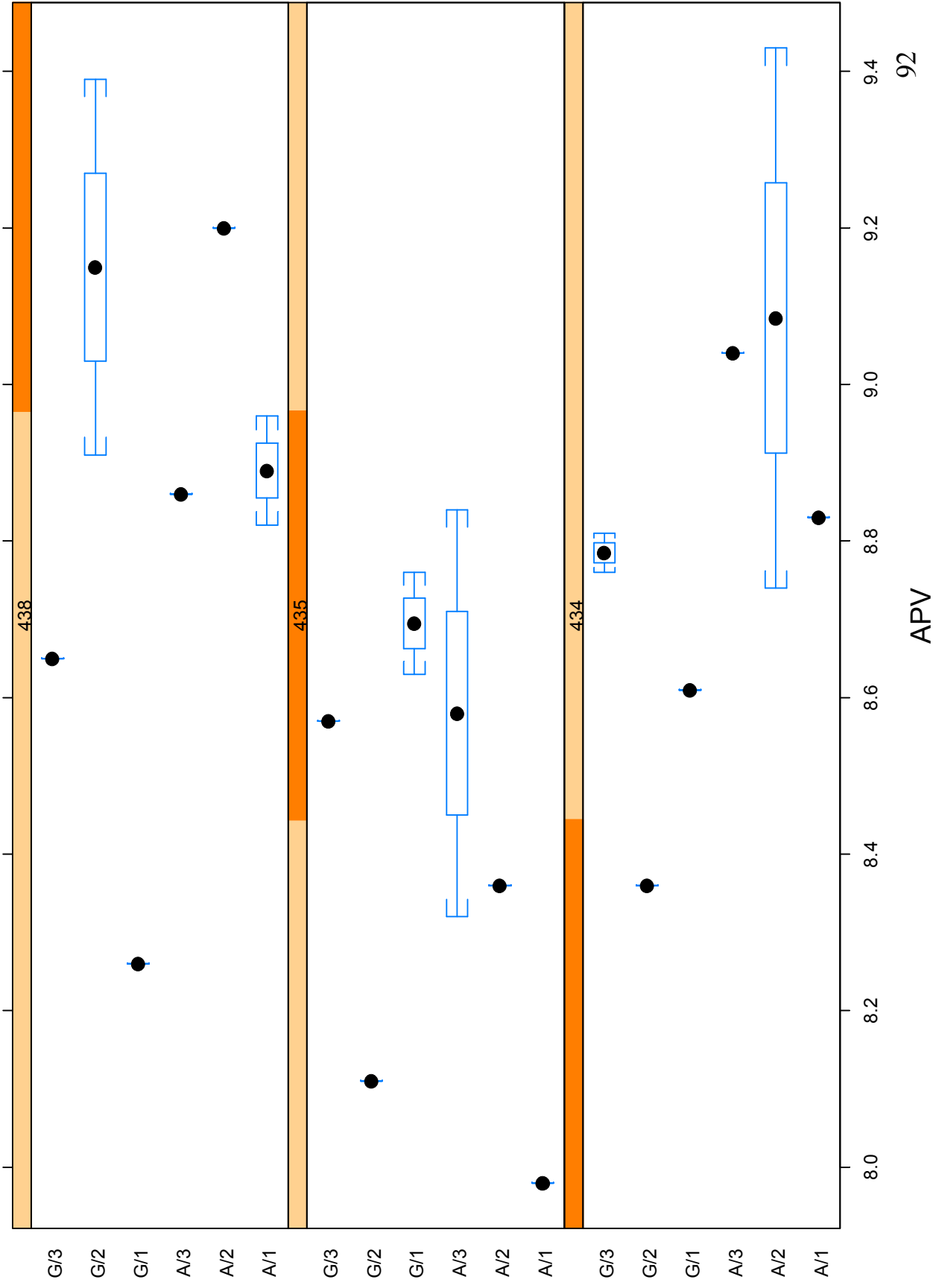
ACLW by Ref. Oil and Stand



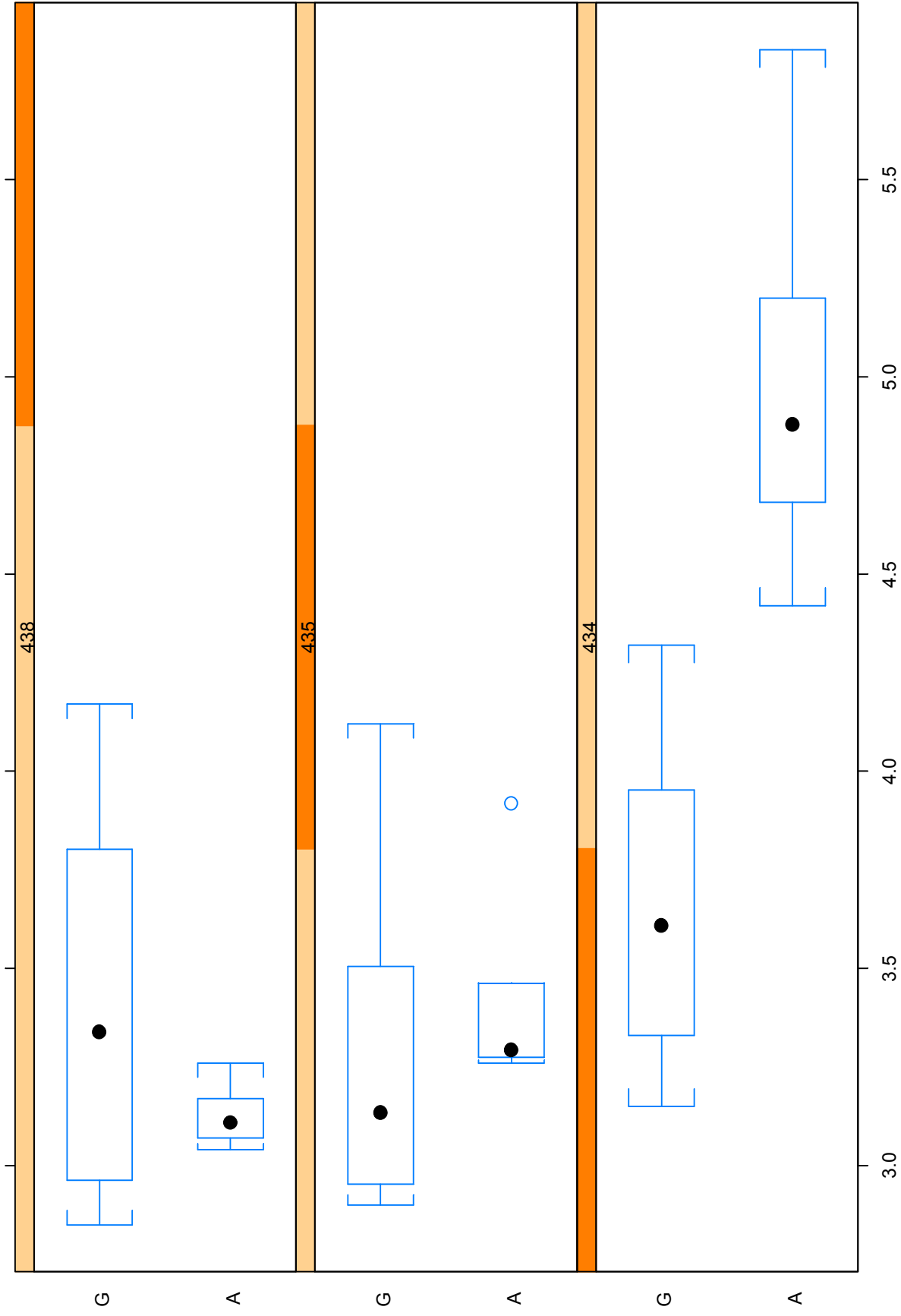
APV by Ref. Oil and Lab



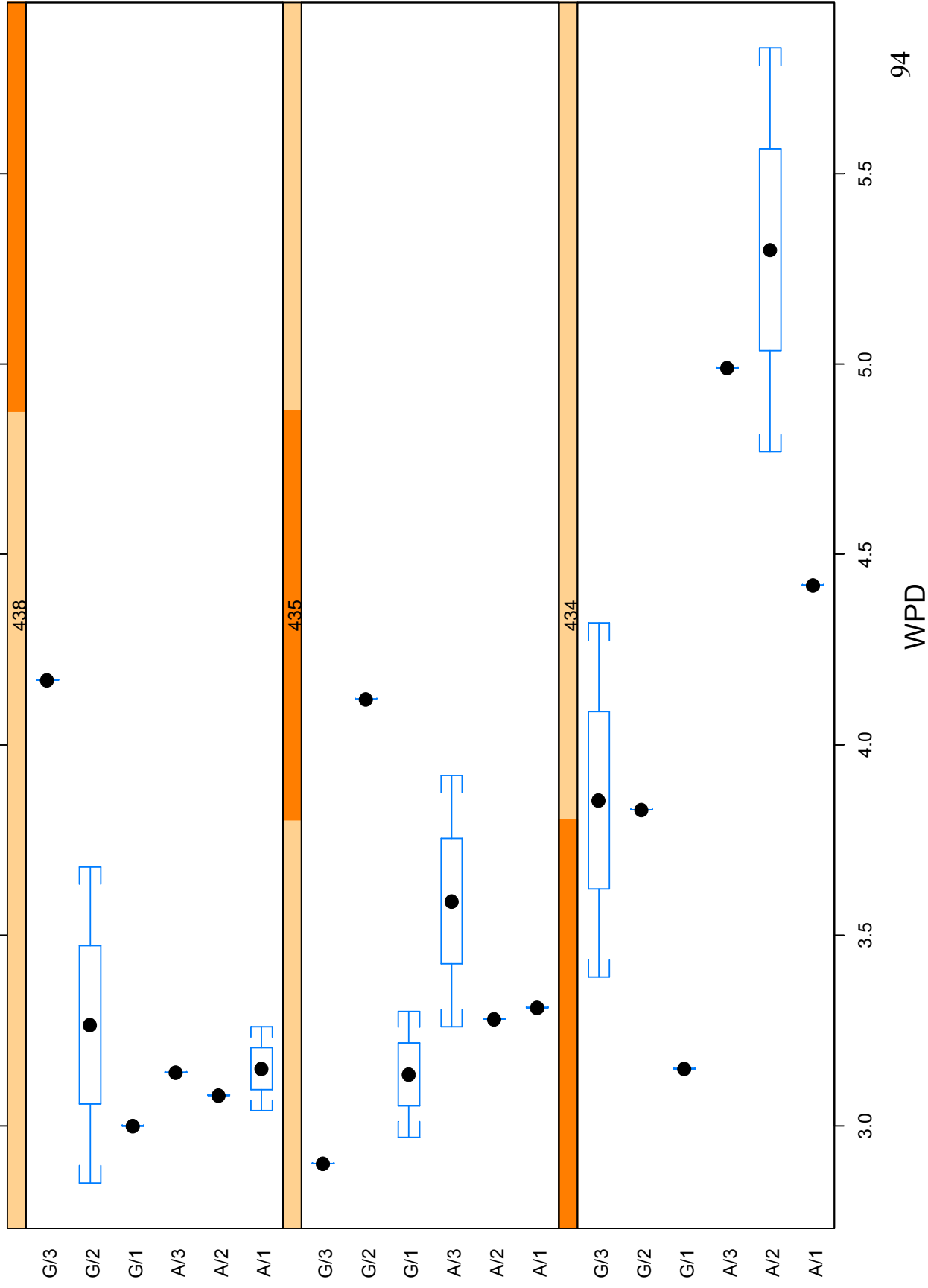
APV by Ref. Oil and Stand



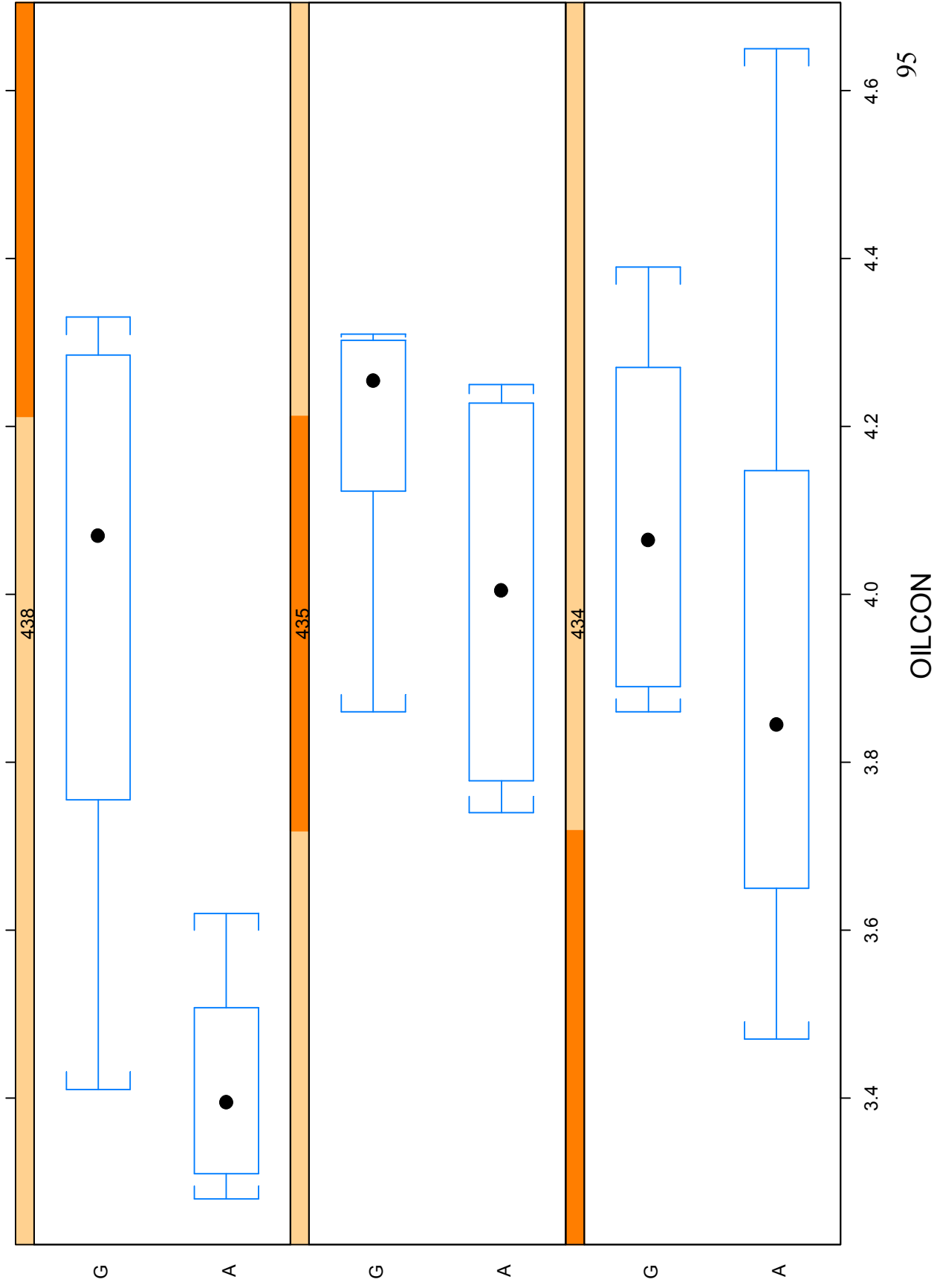
WPD by Ref. Oil and Lab



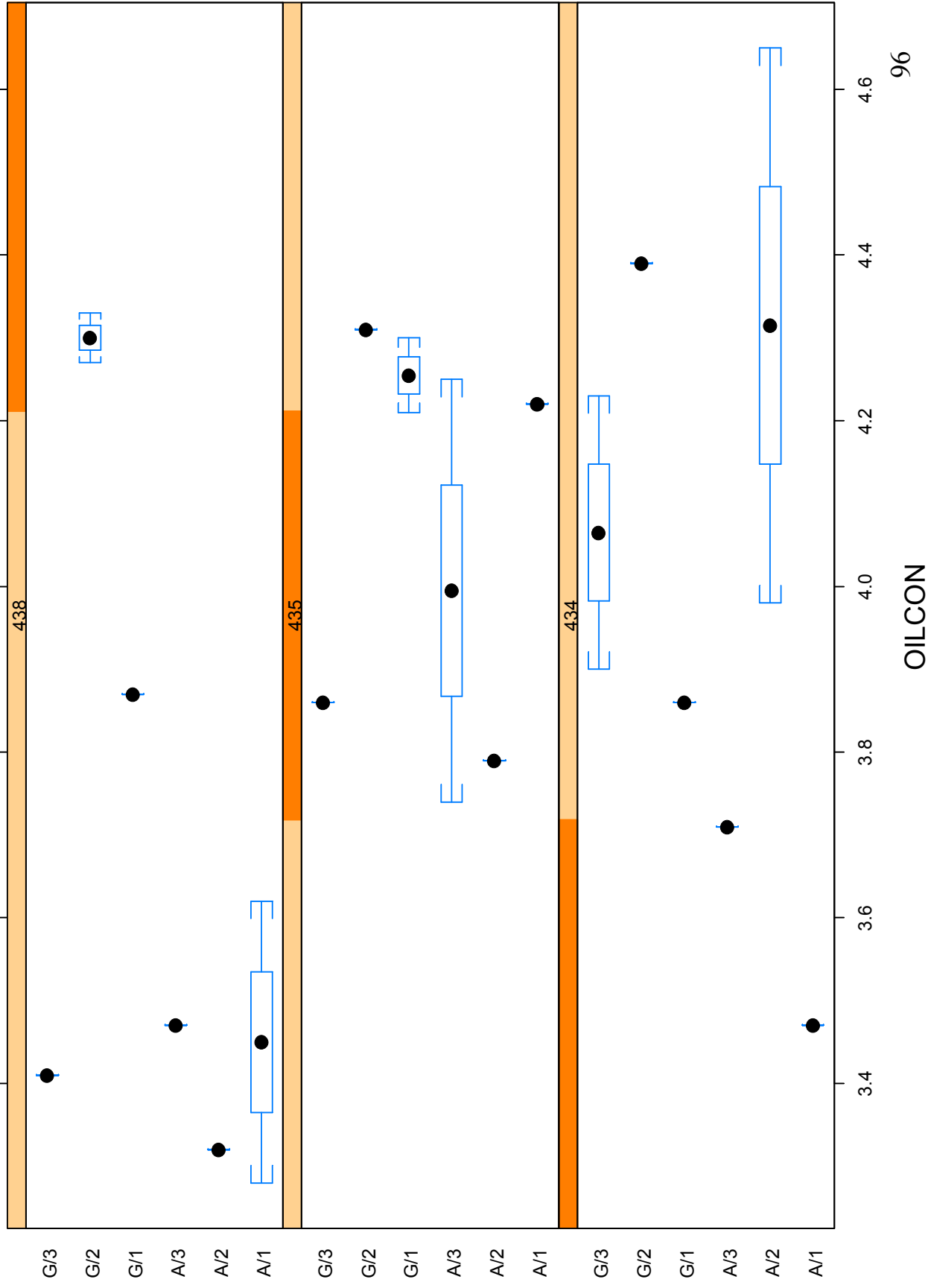
WPD by Ref. Oil and Stand



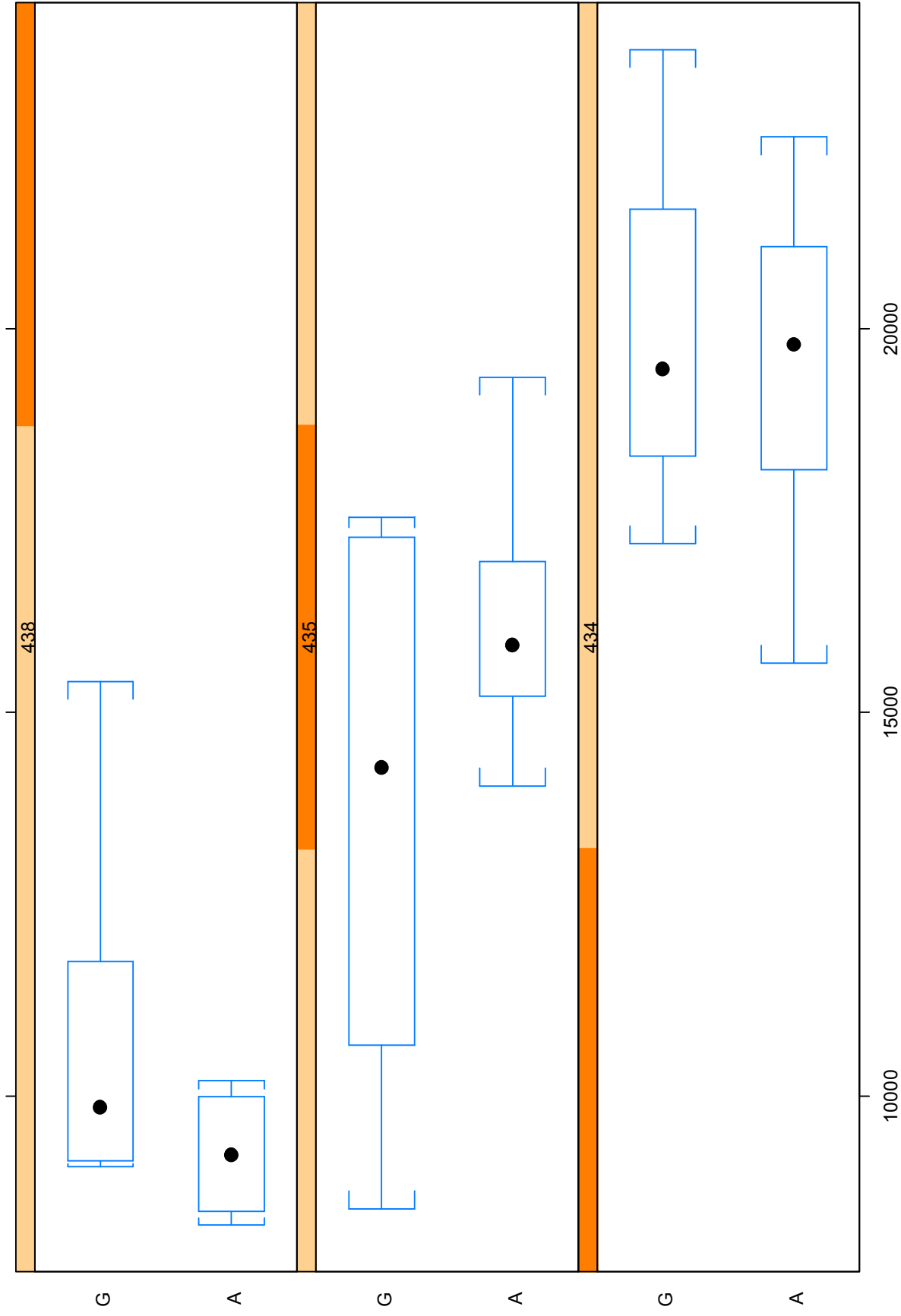
OILCON by Ref. Oil and Lab



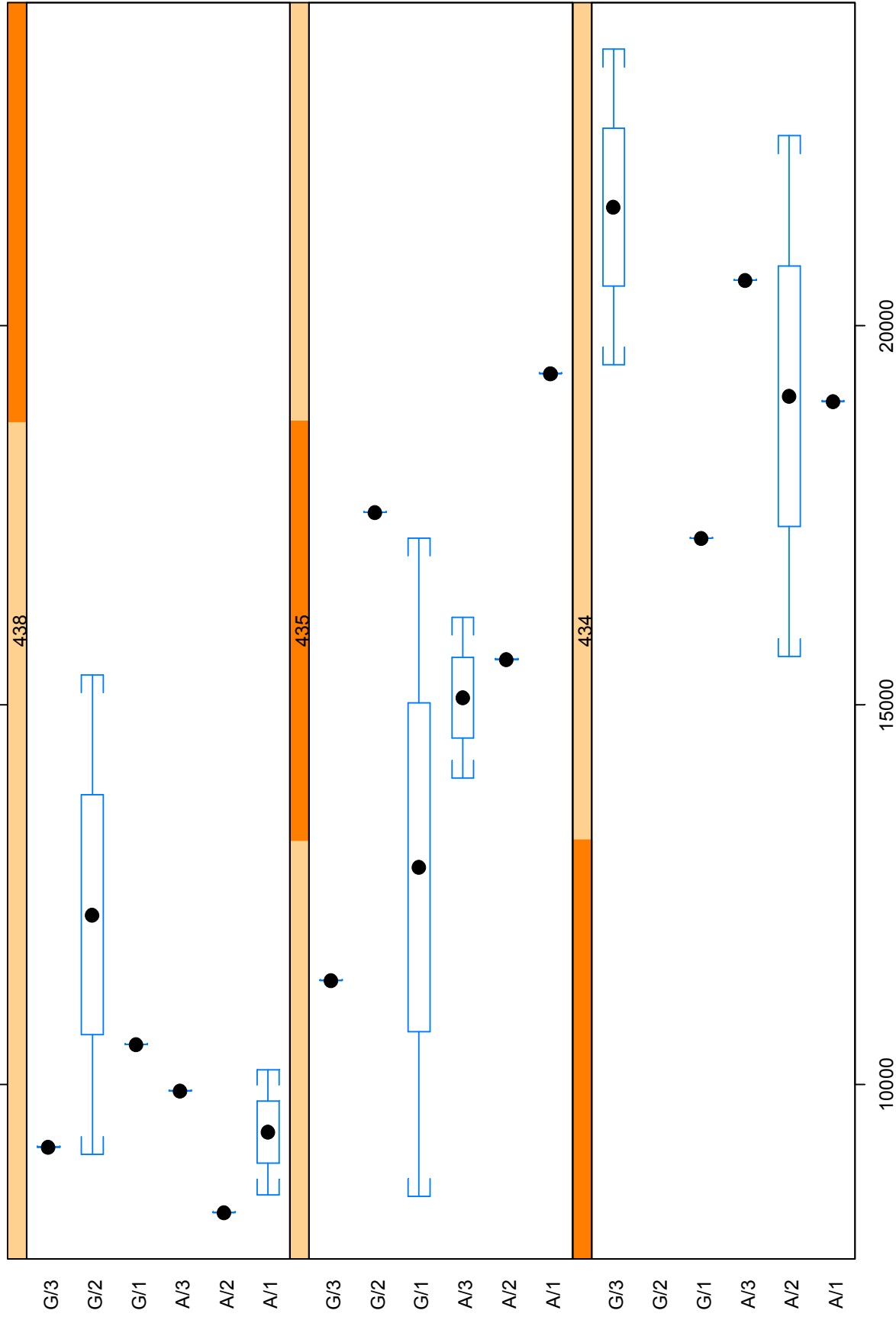
OILCON by Ref. Oil and Stand



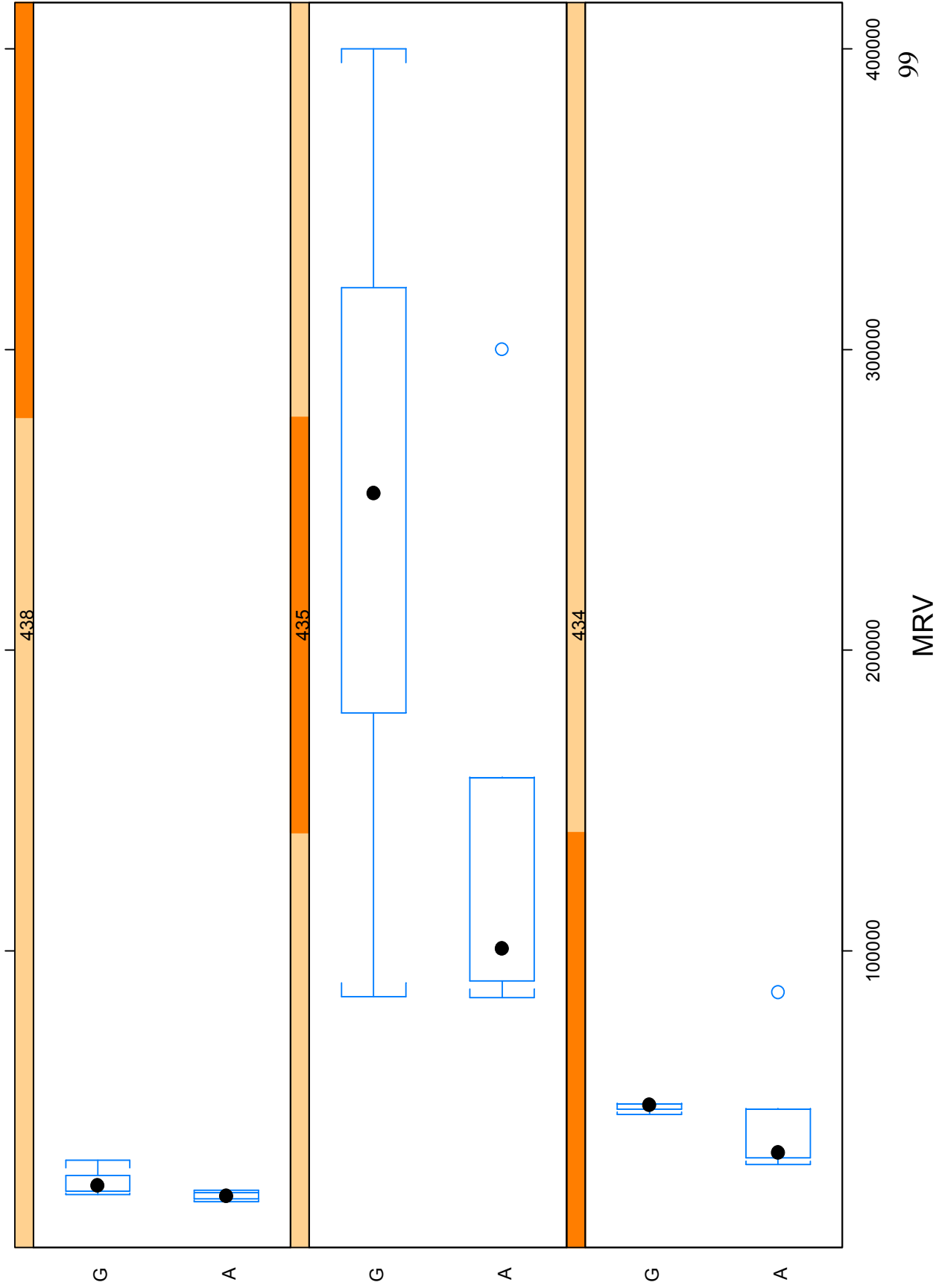
CCS by Ref. Oil and Lab



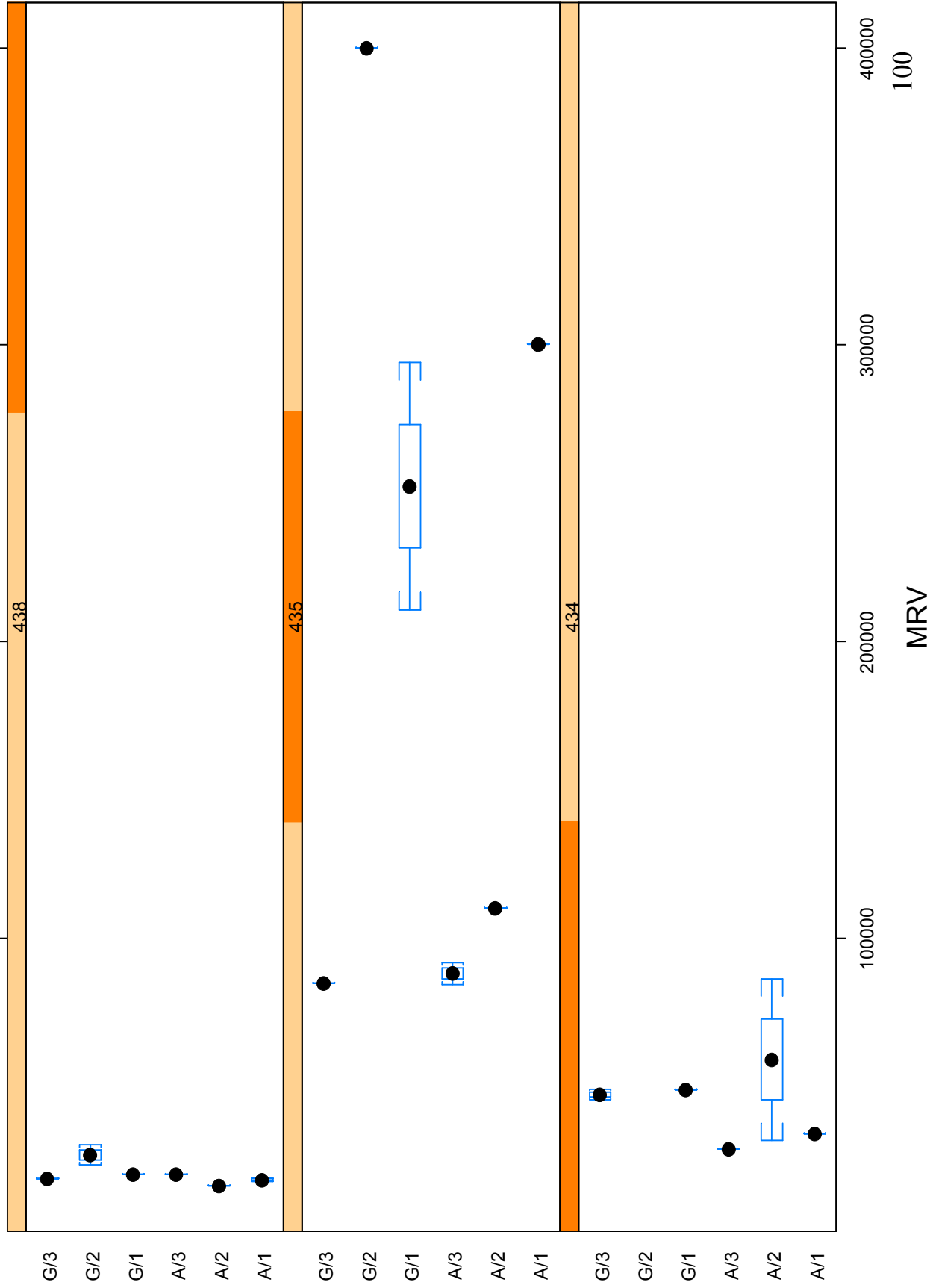
CCS by Ref. Oil and Stand



MRV by Ref. Oil and Lab



MRV by Ref. Oil and Stand



Summary of unusual observations by parameter

PVIS:
TESTKEY IND PVIS FitPVIS
1 47905 435 163.4 234.8035
13 47886 434 249.5 105.1950
20 47885 434 62.8 105.1950

ACLW:
TESTKEY IND ACLW FitACLW
5 47884 434 26.2 37.05821
9 47906 435 26.8 35.84254
16 47908 435 48.7 35.84254

APV:
TESTKEY IND APV FitAPV
5 47884 434 9.43 8.88750
6 47910 438 9.39 8.81625
22 47914 438 8.26 8.81625

OILCON:
TESTKEY IND OILCON FitOILCON
6 47910 438 4.27 3.839583
11 47911 438 4.33 3.839583
13 47886 434 4.65 3.880417

WPD:
TESTKEY IND WPD FitWPD
4 47901 434 3.15 4.145
5 47884 434 5.83 4.530
15 47913 438 4.17 3.085

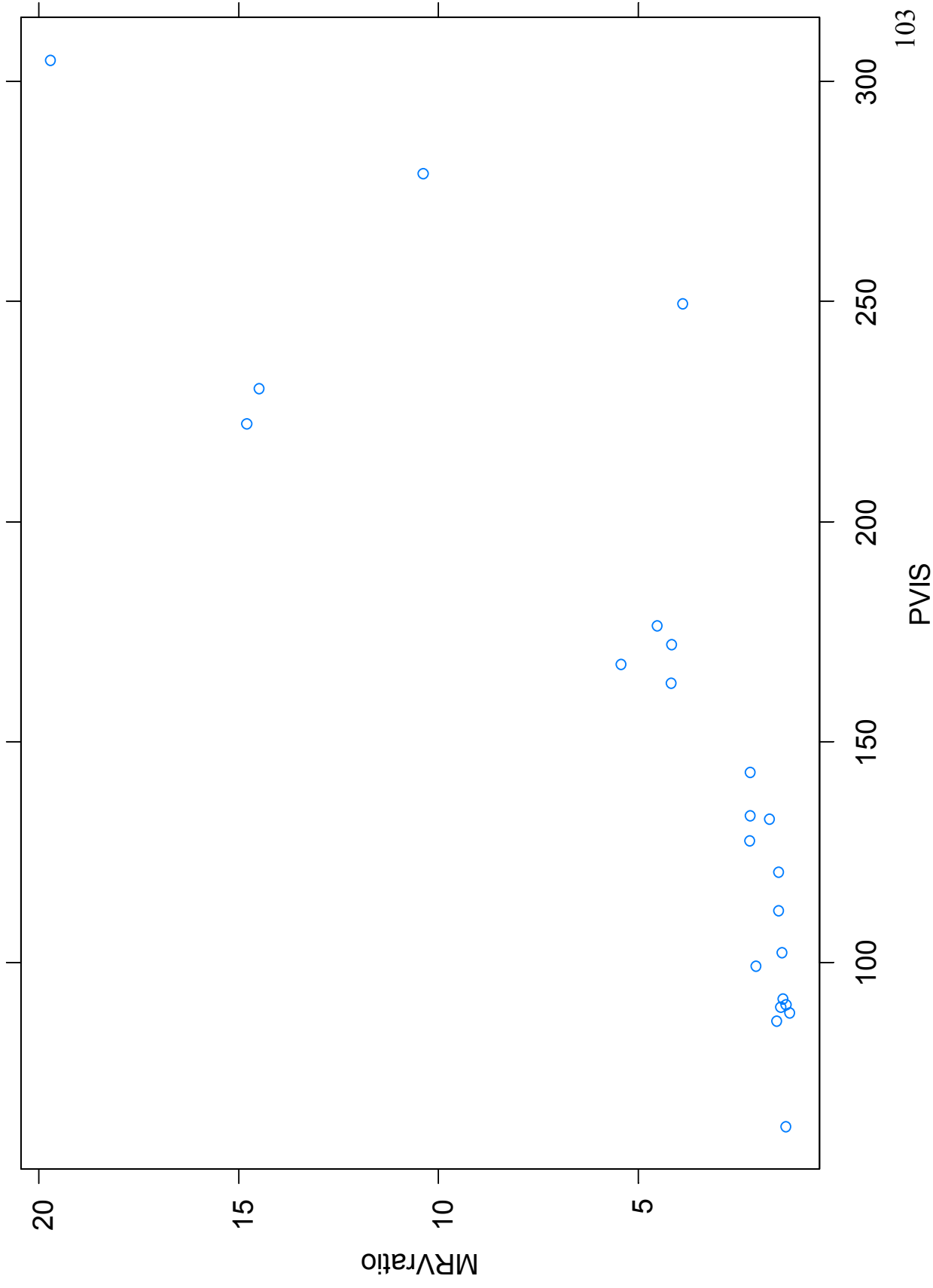
MRV:
TESTKEY IND MRV FitMRV
1 47905 435 84800 195105.53
10 47889 435 300200 119732.58
13 47886 434 86400 38078.72

CCS:
TESTKEY IND CCS FitCCS
7 47900 434 23640 19671.50
9 47906 435 8530 14931.31
11 47911 438 15400 10102.56

Unusual for 1 parameter : 4, 7, 10, 15, 16, 20, 22
Unusual for 2 parameters: 1, 6, 9, 11
Unusual for 3 parameters: 5, 13

Correlation of MRV and PVIS

Used Oil MRV over Fresh Oil MRV versus PVIS



Used Oil MRV over Fresh Oil MRV versus PVIS by Oil

