G-probe 9 Summary Report
May 2013
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A total of ten labs submitted final results during this stage of the G-probe 9 study. Technique breakdown was seven labs used LA-ICP-MS, and two used SEM and one EPMA. At the time of data analysis two labs had yet to submit their final results. When results from these labs are provided their Z-scores will be calculated but the summary results will not be modified. The material used in this study was the glass version of USGS reference material AGV-2. Conversion of AGV-2 to a glass (AGV-2G) was unexpected due to the high SiO2 content of this material. Previous melting experiments had indicated that an SiO2 content of 55% was the limit of USGS capabilities due to the high viscosity of the molten material. A viscous melt is problematic due to difficulties encountered in mixing during the melting stage and transferring the contents from the reaction vessel to the cooling container. It is believed that the moderate levels of alkali elements in AGV-2 helped lower the viscosity of the melted material.

Results from chromium analysis in this sample are worthy of comment. In the case of Cr there was a large variation in the dataset due to the contributions from a single laboratory. This results in a study mean concentration of 232 ppm +/- 508 ppm. This results in the standard deviation range extending into negative concentrations. Eliminating results from the single lab resulted in a mean concentration of 20 ppm +/- 10.1 ppm and a more normal distribution of chromium results. If you have any questions or comments about this study please forward them to me at your earliest convenience.

Below you will find summary results for each element studied in this test. In the element diagrams you will find information for each technique providing a value. Also included is the target value (♦) and calculated precision (X ± Ha) (♦) based on the Horowitz equation. A figure is also presented representing the data compilation for the entire study when more that one technique reported values. The study average is represented by ■ , the standard deviation of the average by ▪ and the maximum and minimum values by □. This study average is calculated primarily for the analysis of the major elements where multiple techniques provided data. For each technique an average value is presented (ex LA-ICP-MS, ▲) as well as ± one standard deviation (ex LA-ICP-MS, ▲) , and the maximum and minimum values reported (ex LA-ICP-MS, Δ). For one elements (Cr) the diagram extends into a negative value along the X axis.

Table 1. Symbols used on figures 1 through 52

Symbol type		Represents
Large solid symbol,	●	Study or method average
Small solid symbol,	•	Study or method one standard deviation
Large open symbol,	○	Study or method Maximum or Minimum

Table 2. Summary results for GP-9, AGV-2G

Oxide	Xa % m/m	Ha % m/m	s.d.m. % m/m	GP-9 AVG. % m/m	Max % m/m	Min % m/m
SiO2	59.3	1.28	4.043	58.92	63.2	48.56
TiO2	1.05	0.042	0.136	0.999	1.12	0.6
Al2O3	16.91	0.44	2.246	16.21	18.22	9.89
Fe2O3T	6.69	0.201	1.939	6.29	8.7	1.7
Fe(II)OT	6.02	0.18	1.74	5.67	7.83	3.1
MnO	0.1	0.066	0.023	0.091	0.129	0.054
MgO	1.79	0.066	0.268	1.71	2.06	1.01
CaO	5.2	0.16	0.359	4.95	5.27	4.08
Na2O	4.19	0.14	0.505	4.38	5.79	3.92
K2O	2.88	0.098	0.37	2.77	3.14	0.1
P2O5	0.48	0.021	0.042	0.48	0.55	0.1

Element	Xa mg/kg	Ha mg/kg	s.d.m. mg/kg	GP-9 AVG. mg/kg	Max mg/kg	Min mg/kg
Ag	2.79	0.38	0.52	1.82	2.5	1.14
B	6.57	0.79	4.58	10.3	22.1	6.7
Ba	1140	63	263	1160	1850	844
Be	2.3	0.32	0.83	2.65	4.13	1.7
Ce	68	5.76	7.56	65	78	52
Co	16	1.68	2.1	15.6	20	12.5
Cr	17	1.77	508	232	1540	14
Cu	53	4.7	6.1	47.4	58	38
Dy	3.6	0.47	0.48	3.2	4.2	2.5
Er	1.79	0.26	0.26	1.68	2.23	1.26
Eu	1.54	0.23	0.22	1.45	1.86	1.11
Ga	50	4.4	2.86	21.9	27.5	18.5
Gd	4.69	0.59	0.77	4.3	5.6	3.16
Ge	20	2.03	0.54	1.73	2.94	1.28
Hf	5.08	0.63	0.81	5	7.06	3.9
La	38	3.5	4.06	34	39	26.6
Li	11	1.23	4.23	15.9	27.4	12
Lu	0.25	0.05	0.05	0.25	0.36	0.19
Nb	15	1.59	4.01	14.9	24.4	10.8
Nd	30	2.88	2.98	28.4	35	23
Ni	19	1.95	2.55	18.9	22.7	14.7
Pb	13	1.41	2.81	15.4	21.2	11.3
Pr	8.3	0.97	0.8	7.34	8.23	5.76
Rb	68.6	5.8	12.6	67.3	95.3	53
Sc	13	1.41	1.17	13.3	15.3	11.6
Sm	5.7	0.7	0.71	5.07	6.4	3.6
Sn	2.3	0.32	0.91	2.86	4.85	1.78
Sr	658	39.6	76.9	626	762	481
Ta	0.89	0.14	0.1	0.84	1.04	0.64
Tb	0.64	0.11	0.1	0.56	0.78	0.4
Th	6.1	0.74	1.34	6.19	9.69	4.56
Tm	0.26	0.051	0.045	0.24	0.32	0.15
U	1.88	0.27	0.51	2.01	3.29	1.61
V	120	9.3	20	123	166	99
Y	20	2.03	2.65	19.5	24.7	16.1
Yb	1.6	0.24	0.25	1.62	2.19	1.21
Zn	86	7.04	13.4	89.3	113.9	66.9
Zr	230	16.2	36.7	235	316	36.7

Xa = Target value - USGS certificate value for AGV-2, confirmed by bulk analysis of glass

Ha = Target precision calculated using modified version of Horowitz equation for data quality 2 ($Ha = 0.01Xa^{0.8495}$)

s.d.m. = Standard deviation of population mean

mean = Mean element concentration for all techniques reporting

Max. = Maximum element/oxide concentration reported

Min. = Minimum element/oxide concentration reported

Figures 1 – 52 Results for G-probe #9 analysis of GP-AND sample

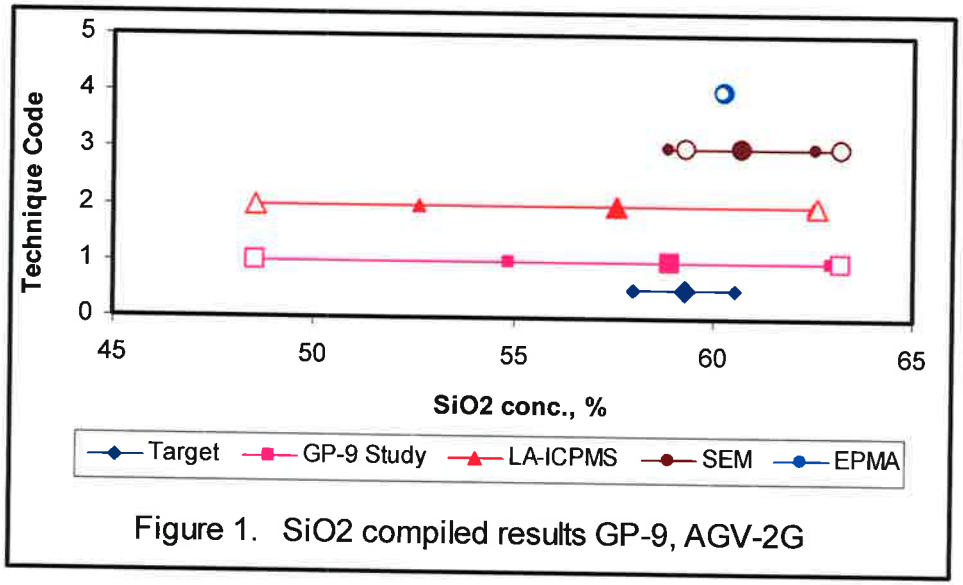

Figure 1. SiO2 compiled results GP-9, AGV-2G

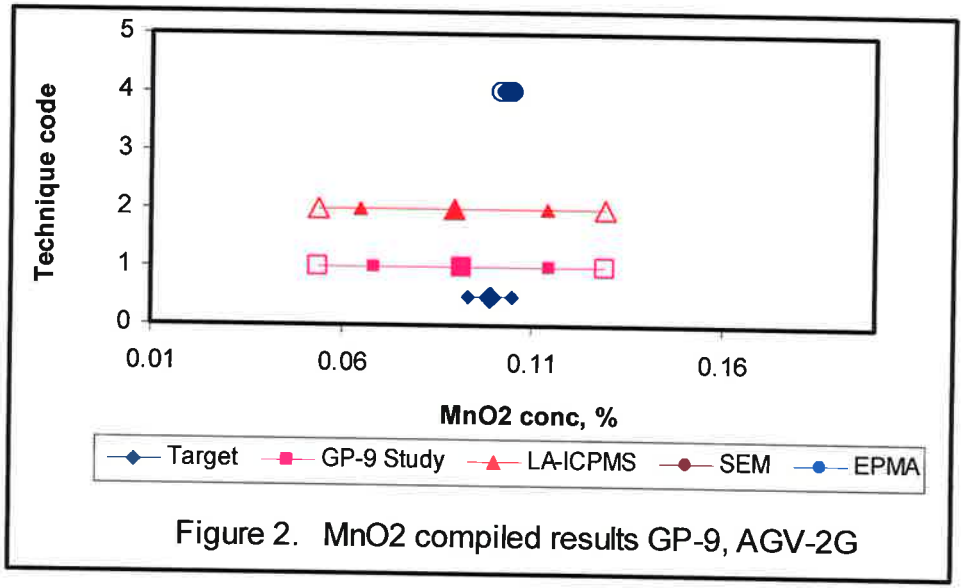

Figure 2. MnO2 compiled results GP-9, AGV-2G

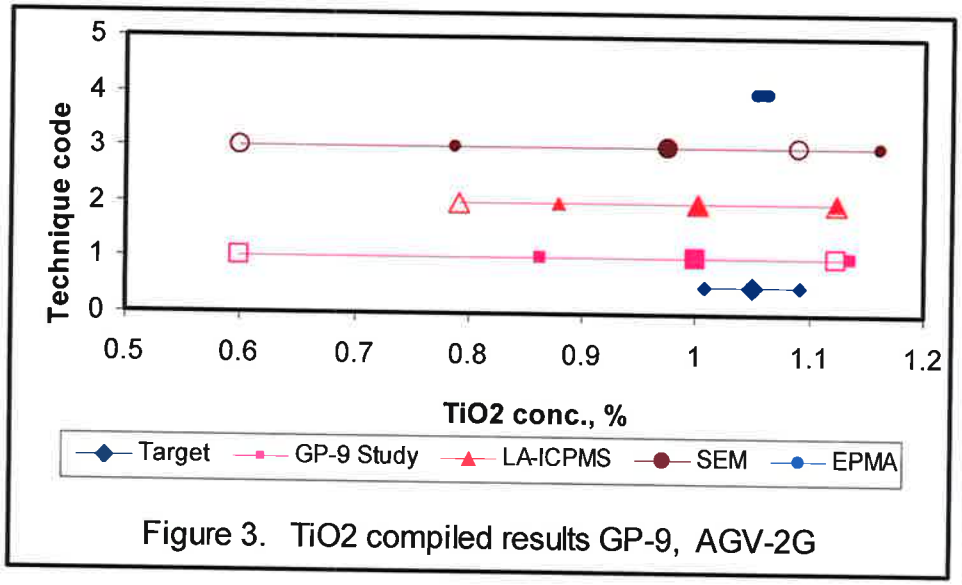

Figure 3. TiO2 compiled results GP-9, AGV-2G

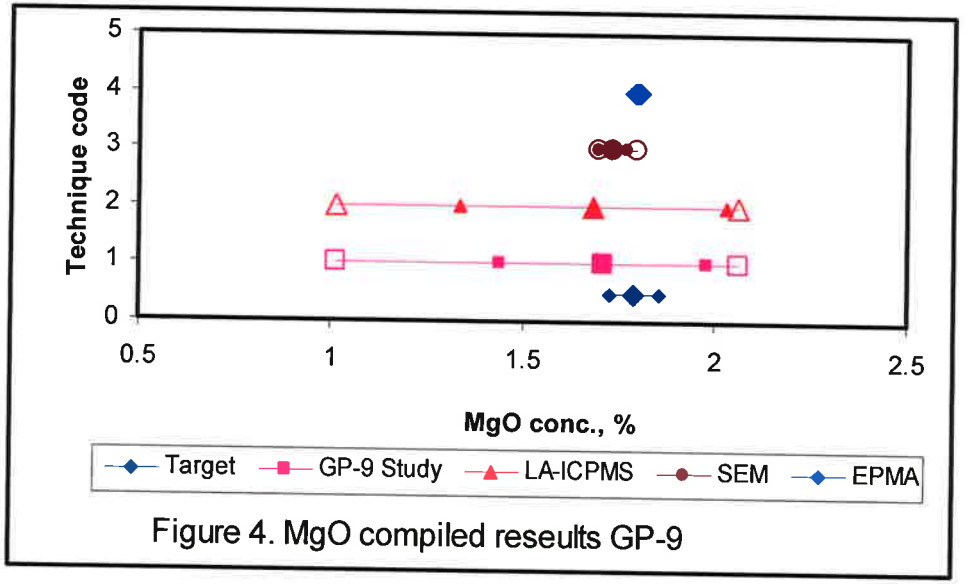

Figure 4. MgO compiled reseults GP-9

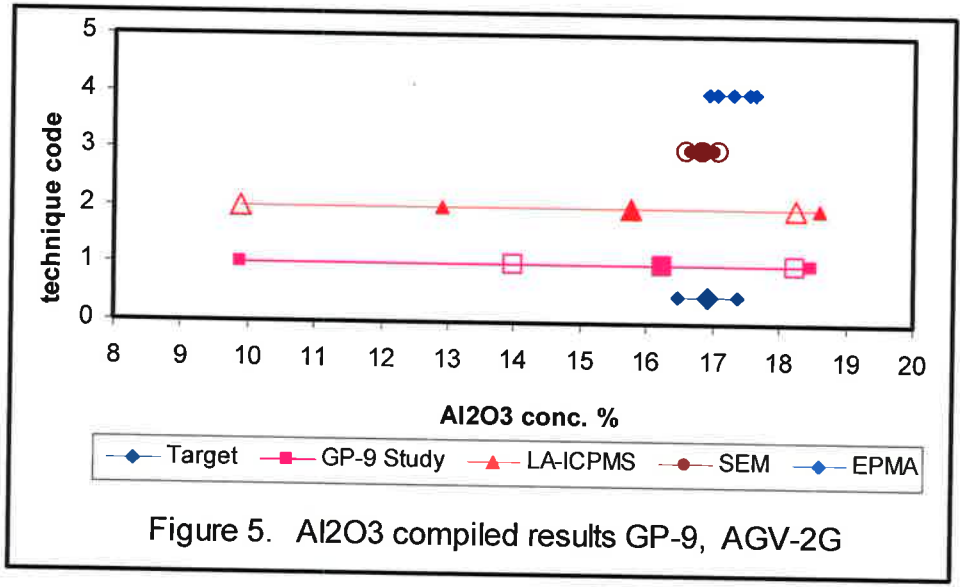

Figure 5. Al2O3 compiled results GP-9, AGV-2G

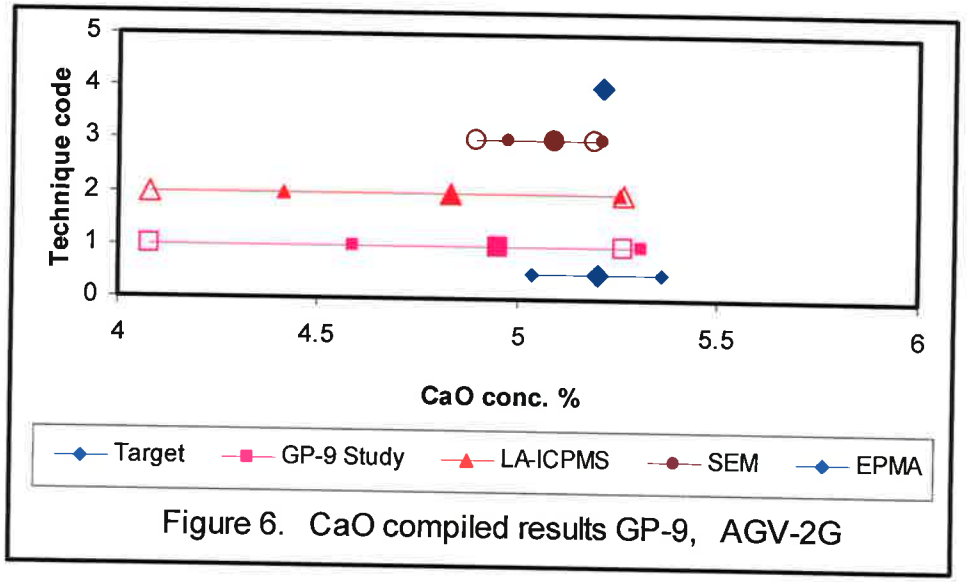

Figure 6. CaO compiled results GP-9, AGV-2G

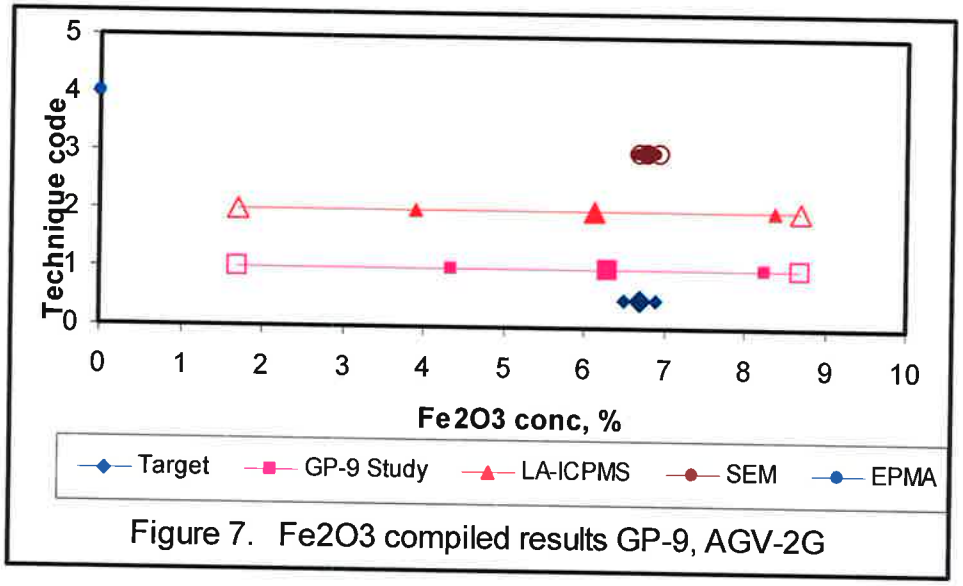

Figure 7. Fe2O3 compiled results GP-9, AGV-2G

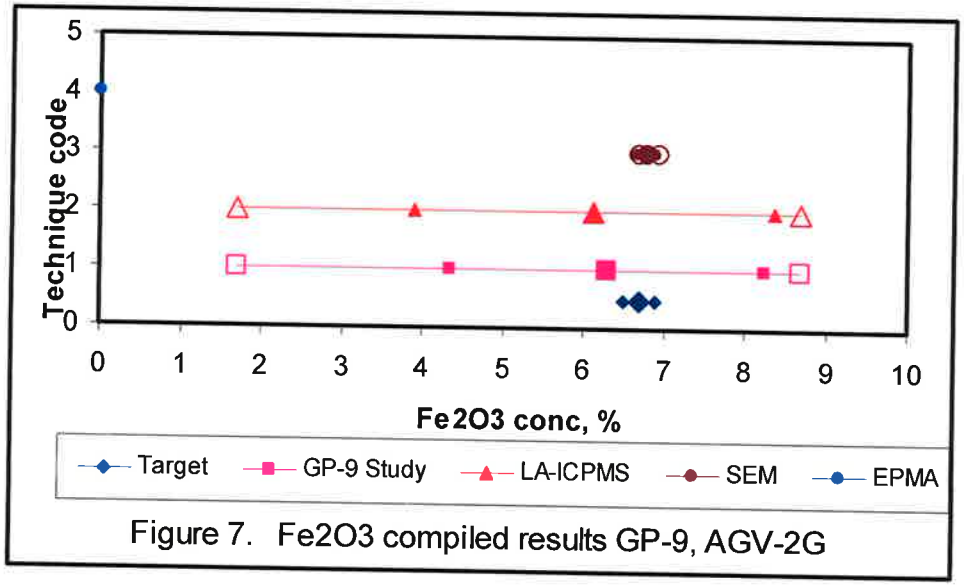

Figure 7. Fe2O3 compiled results GP-9, AGV-2G

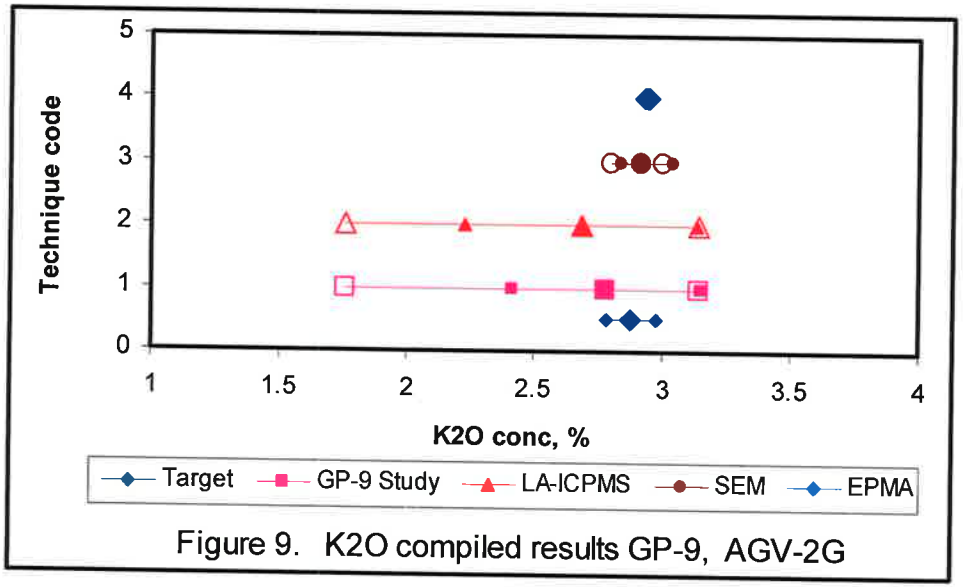

Figure 9. K2O compiled results GP-9, AGV-2G

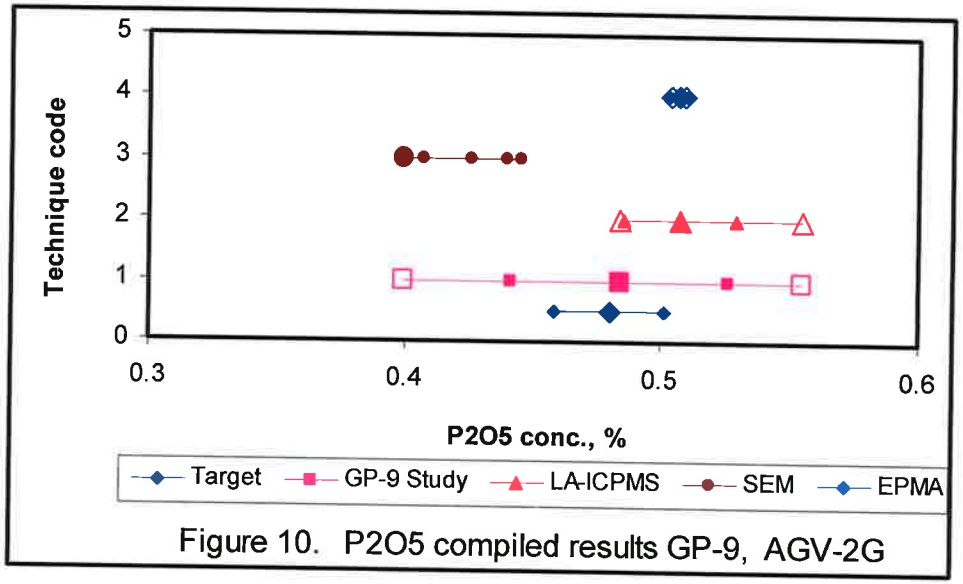

Figure 10. P2O5 compiled results GP-9, AGV-2G

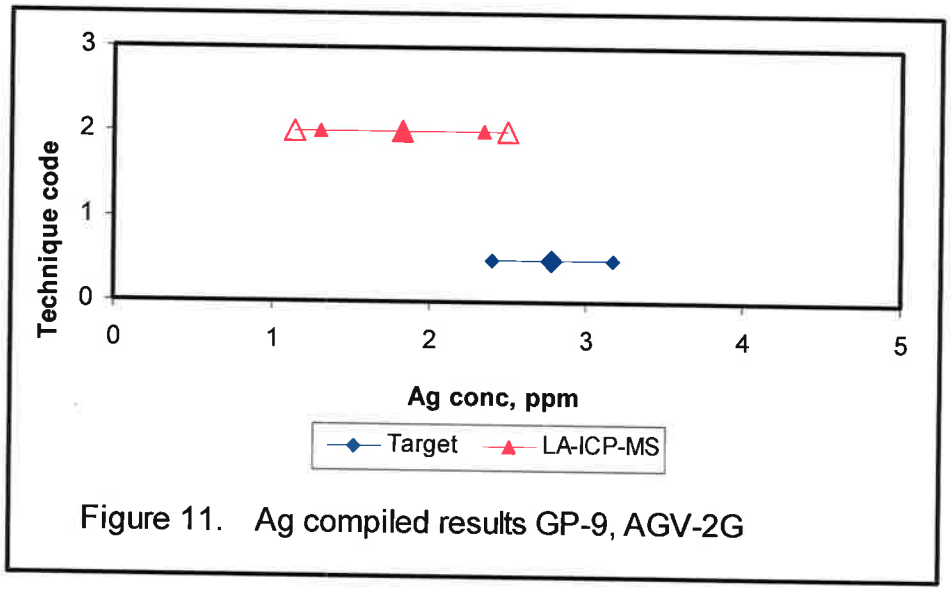

Figure 11. Ag compiled results GP-9, AGV-2G

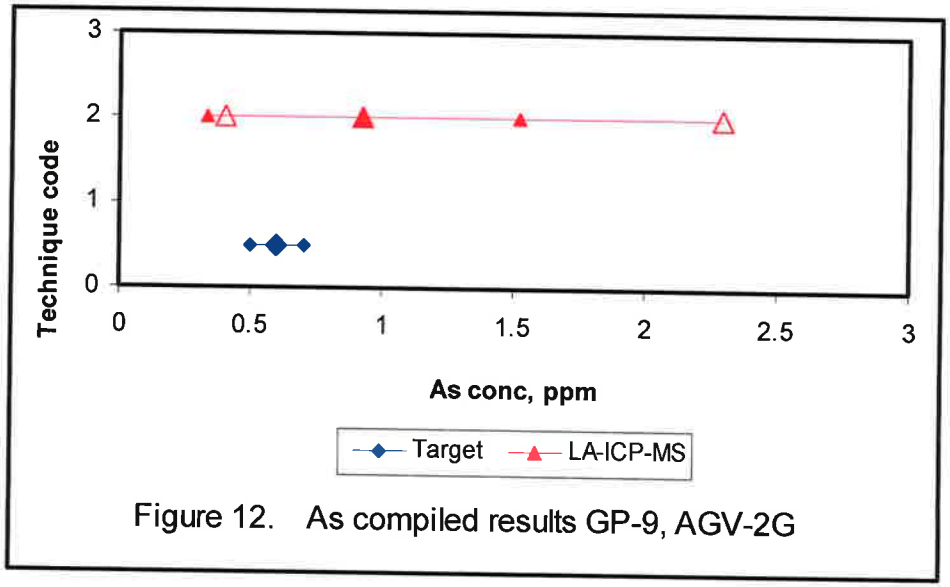

Figure 12. As compiled results GP-9, AGV-2G

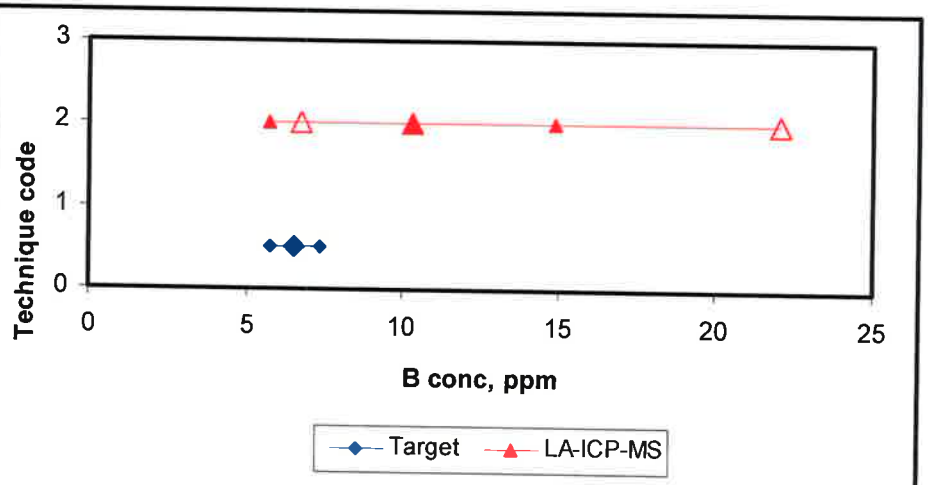

Figure 13. B compiled results GP-9, AGV-2G

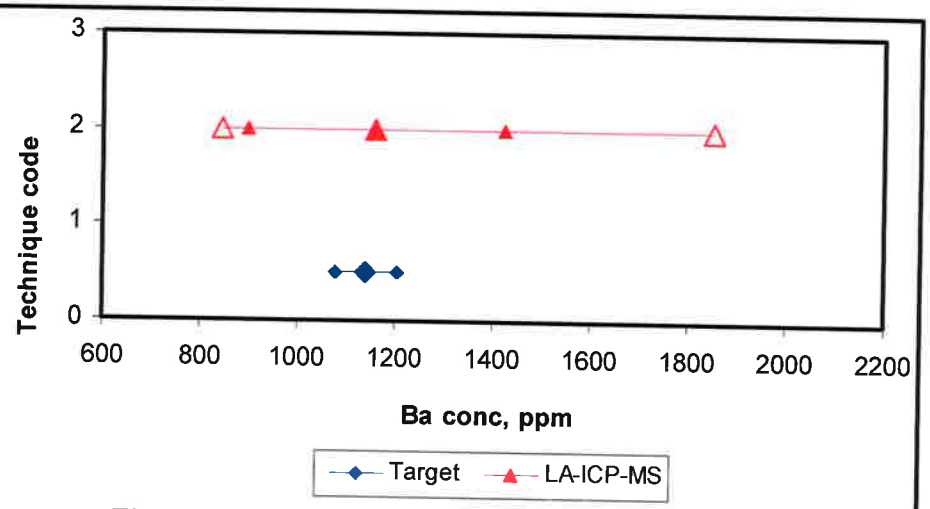

Figure 14. Ba compiled results GP-9, AGV-2G

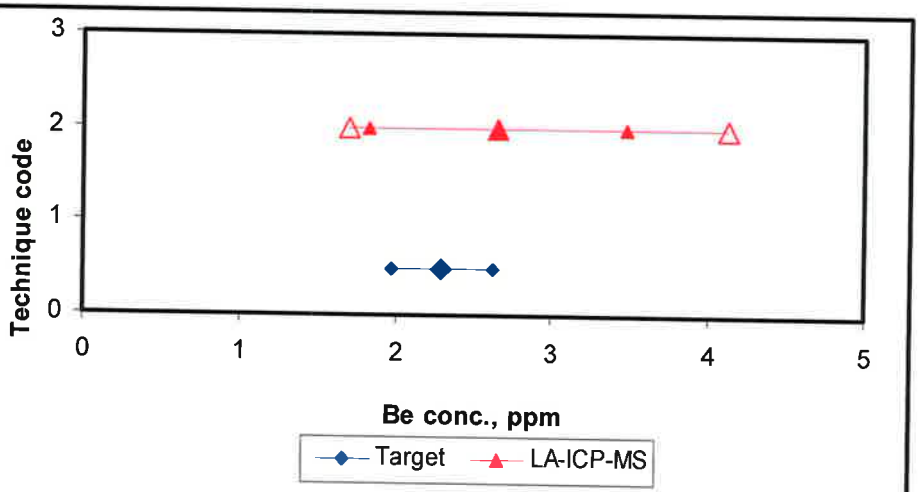

Figure 15. Be compiled results GP-9, AGV-2

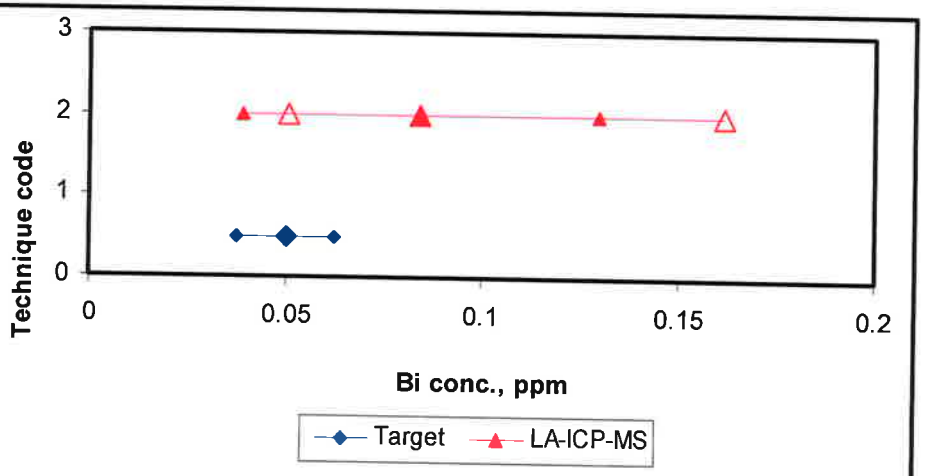

Figure 16. Bi compiled results GP-9, AGV-2G

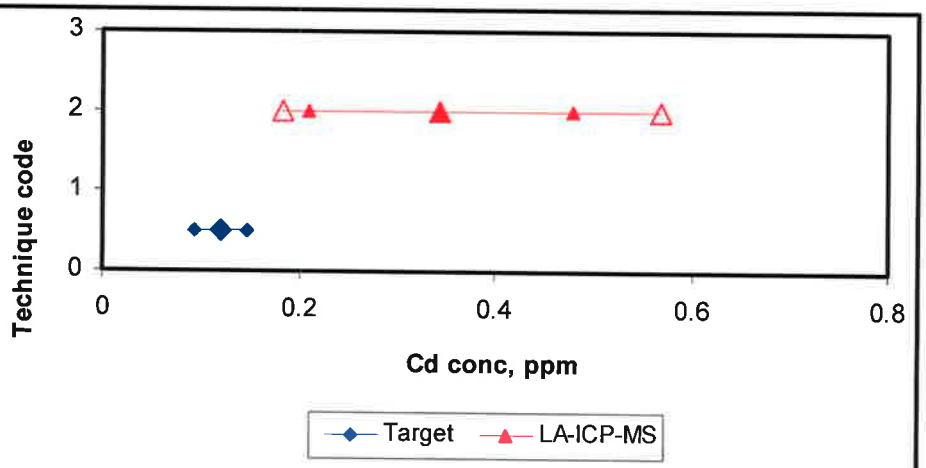

Figure 17. Cd compiled results GP-9, AGV-2G

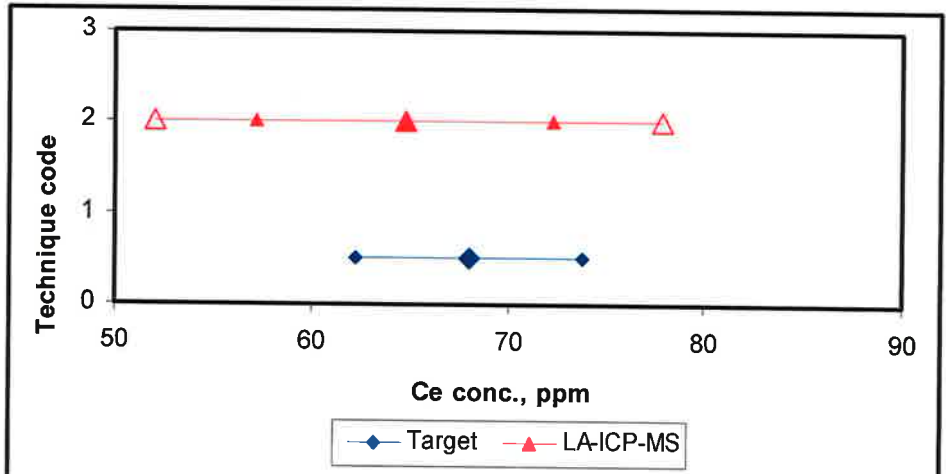

Figure 18. Ce compiled results GP-9, AGV-2G

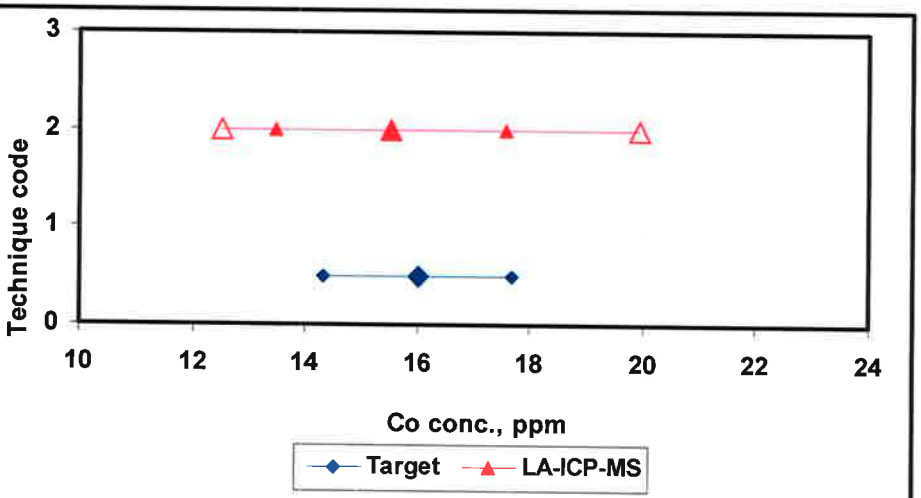

Figure 19. Co compiled results GP-9, AGV-2G

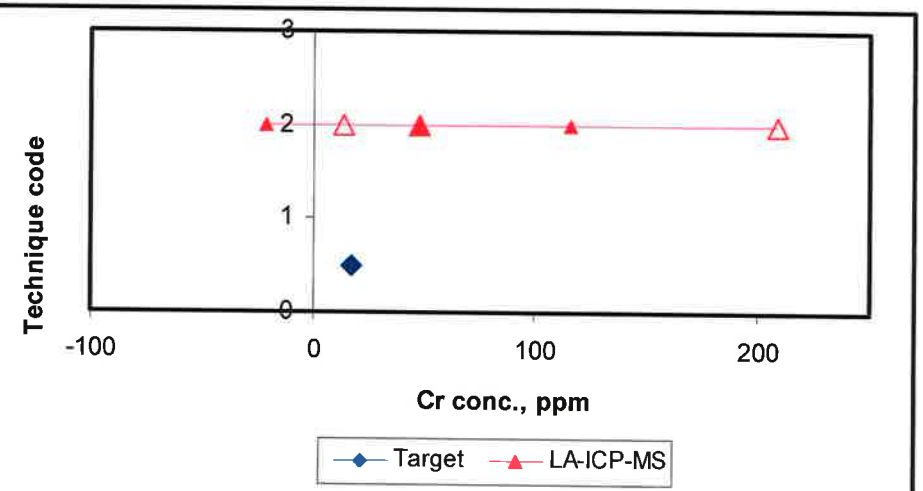

Figure 20. Cr compiled results GP-9, AGV-2G

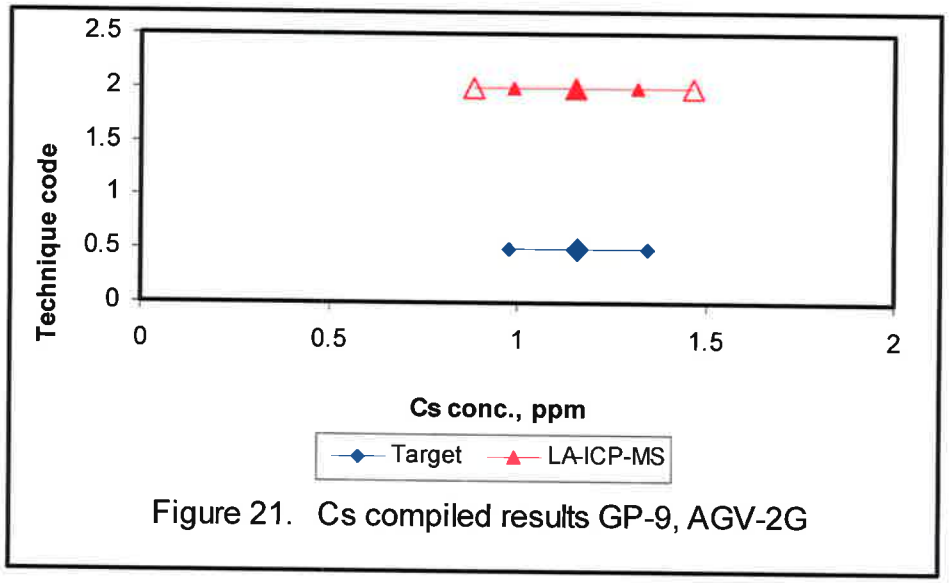

Figure 21. Cs compiled results GP-9, AGV-2G

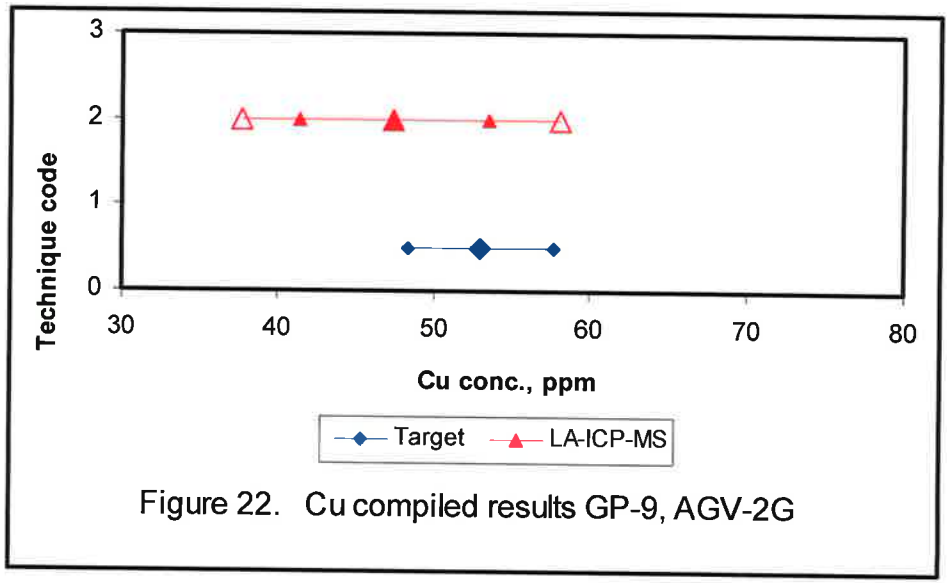

Figure 22. Cu compiled results GP-9, AGV-2G

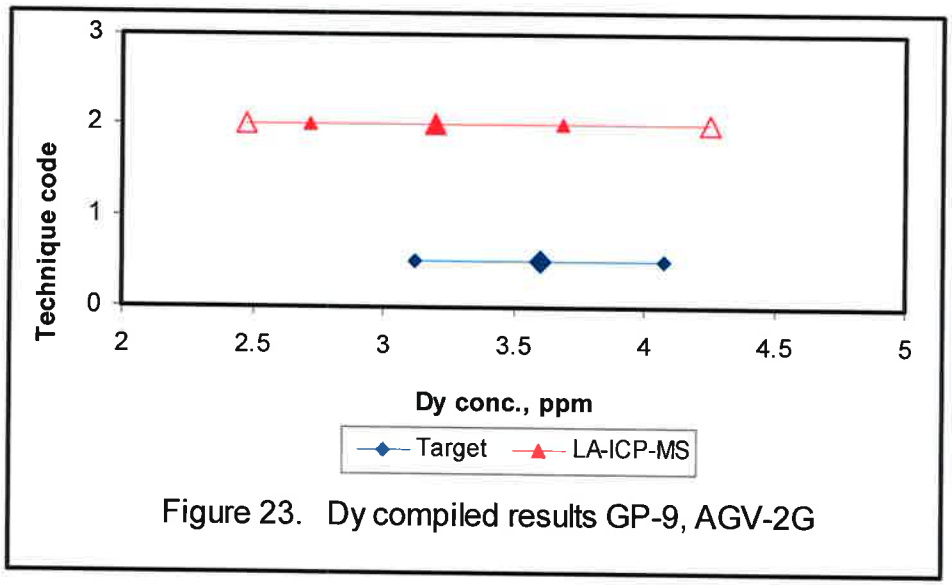

Figure 23. Dy compiled results GP-9, AGV-2G

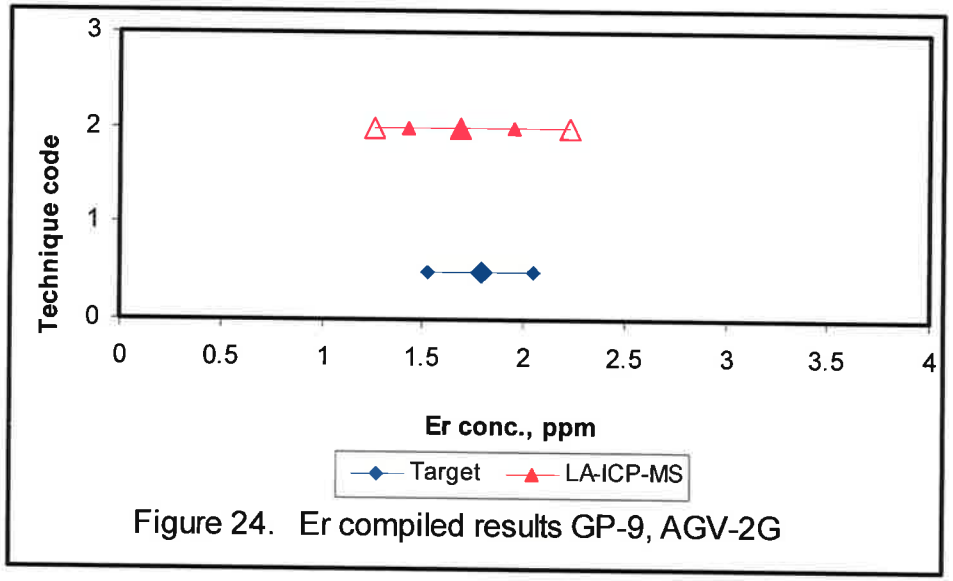

Figure 24. Er compiled results GP-9, AGV-2G

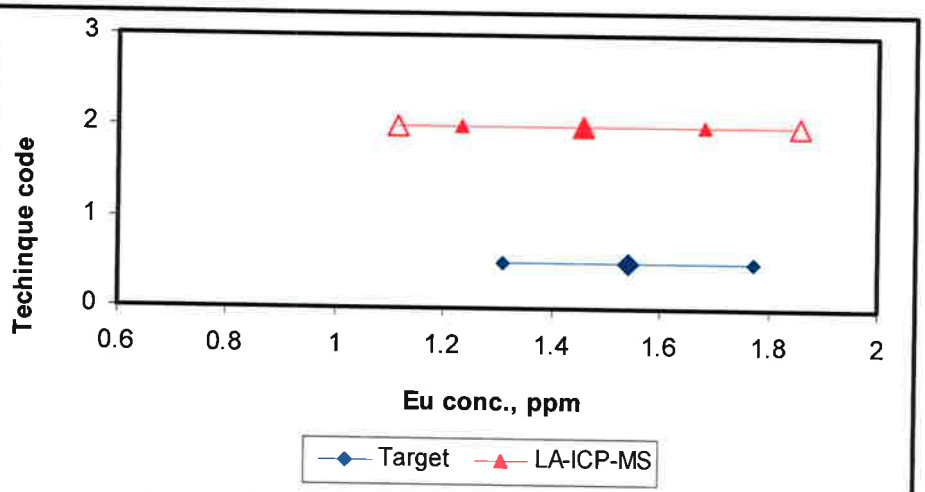

Figure 25. Eu compiled results GP-9, AGV-2G

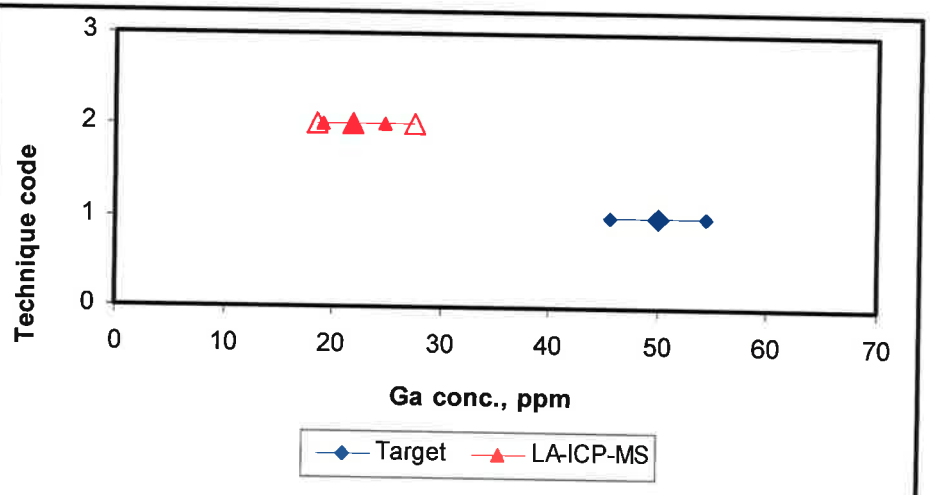

Figure 26. Ga compiled results GP-9, AGV-2G

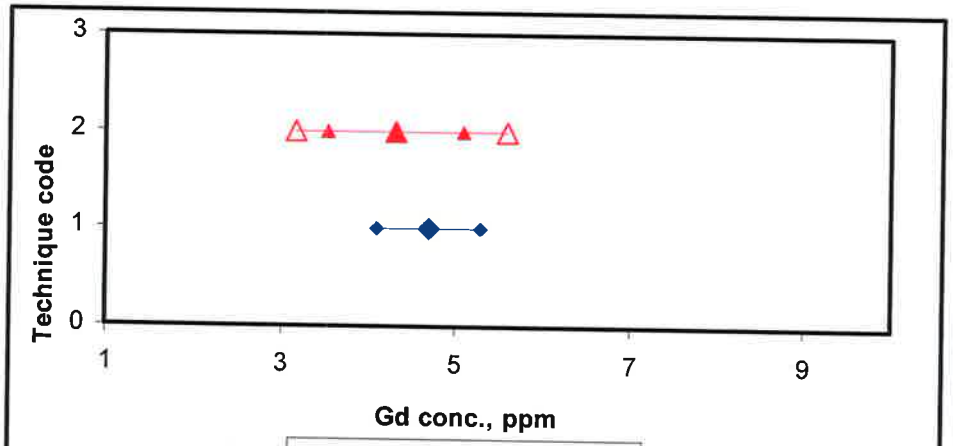

Figure 27. Gd compiled results GP-9, AGV-2G

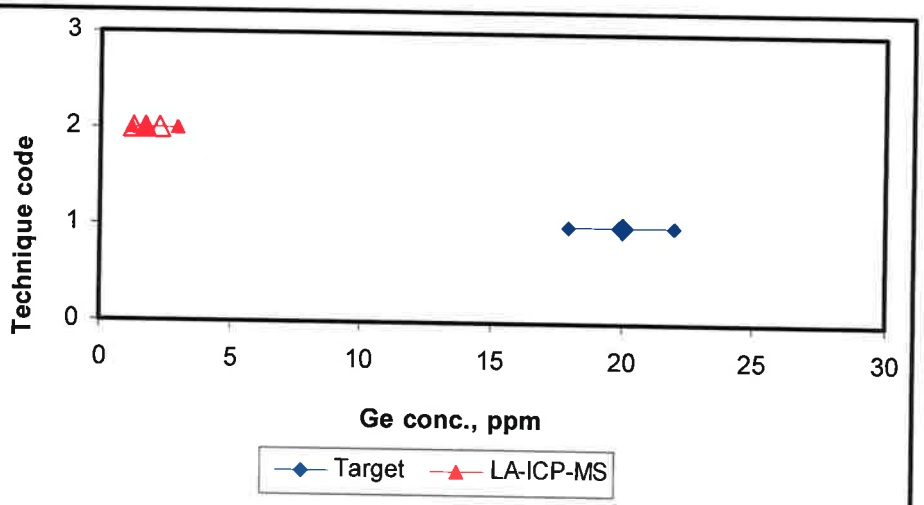

Figure 28. Ge compiled results GP-9, AGV-2G

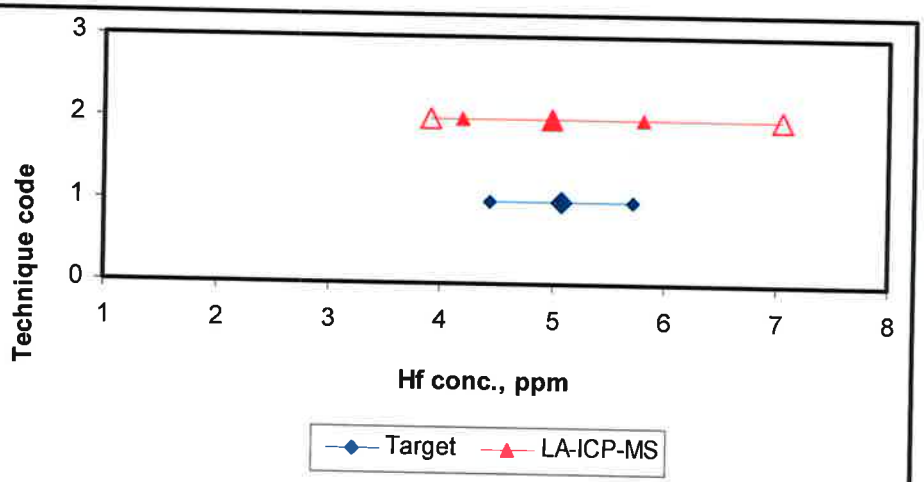

Figure 29. Hf compiled results GP-9, AGV-2G

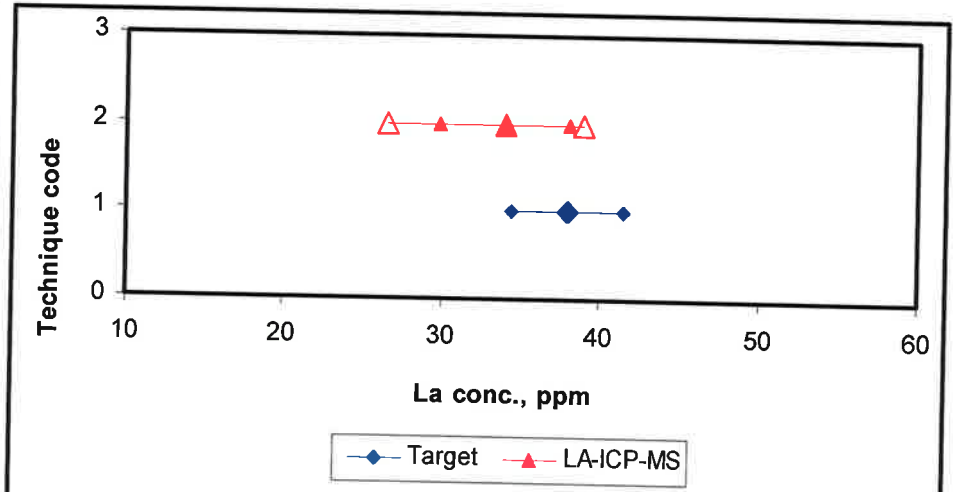

Figure 30. La compilation results GP-9, AGV-2G

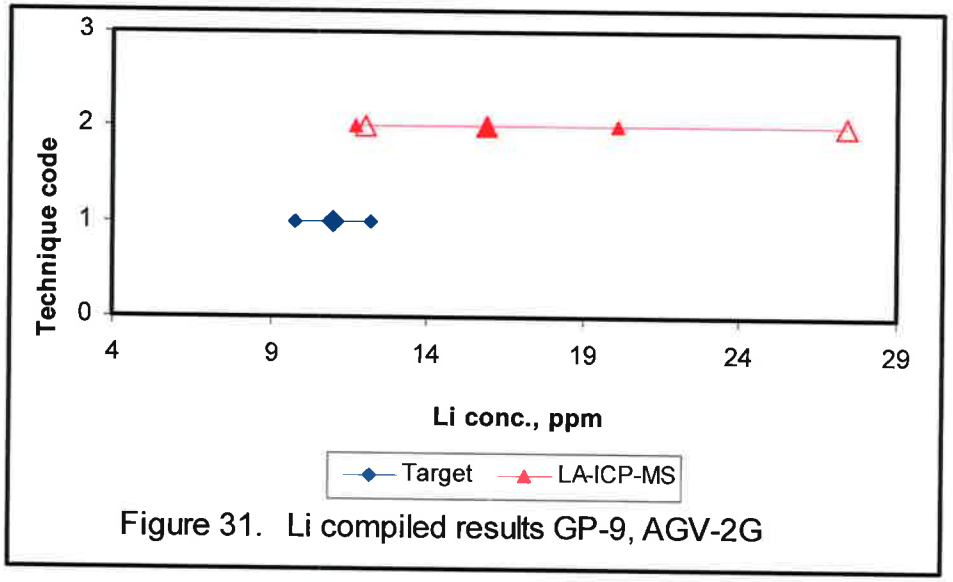

Figure 31. Li compiled results GP-9, AGV-2G

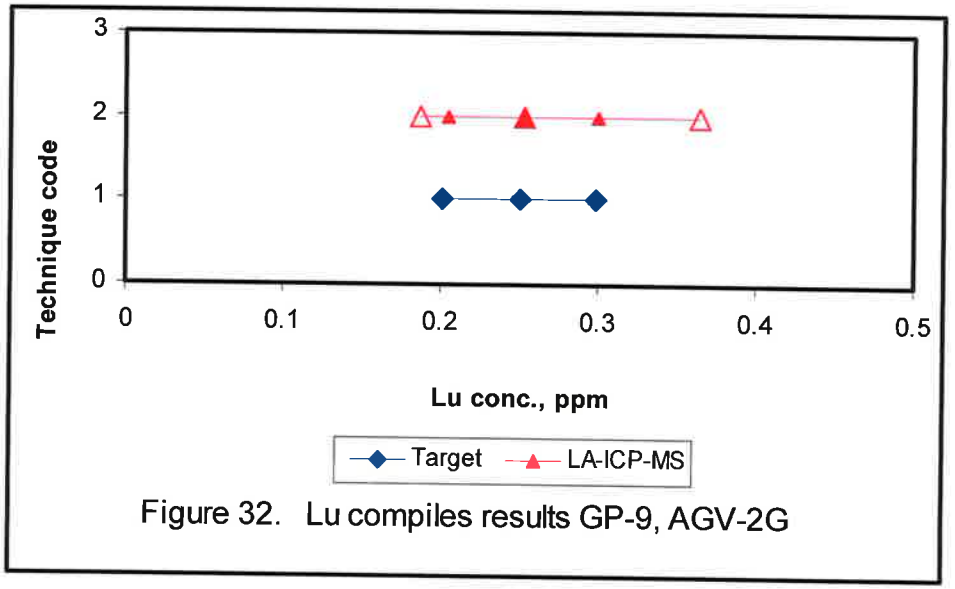

Figure 32. Lu compiles results GP-9, AGV-2G

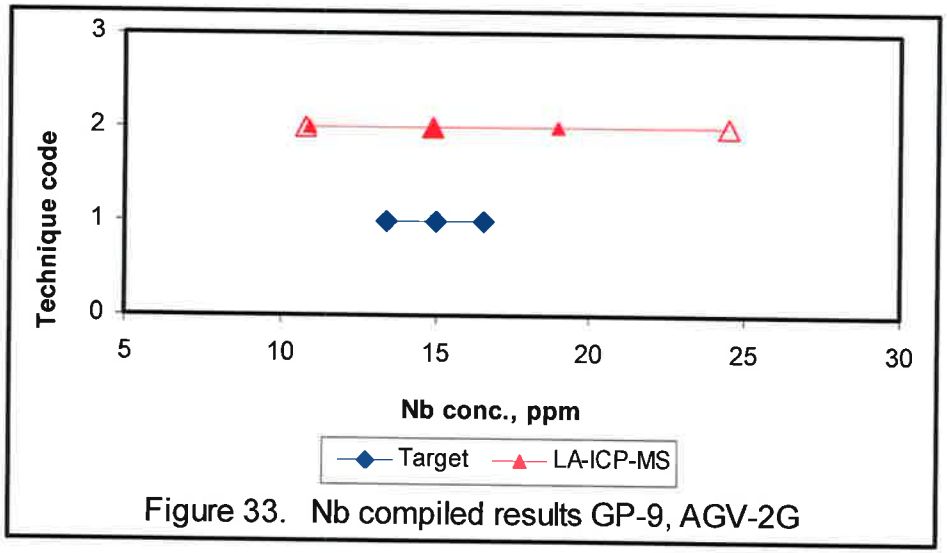

Figure 33. Nb compiled results GP-9, AGV-2G

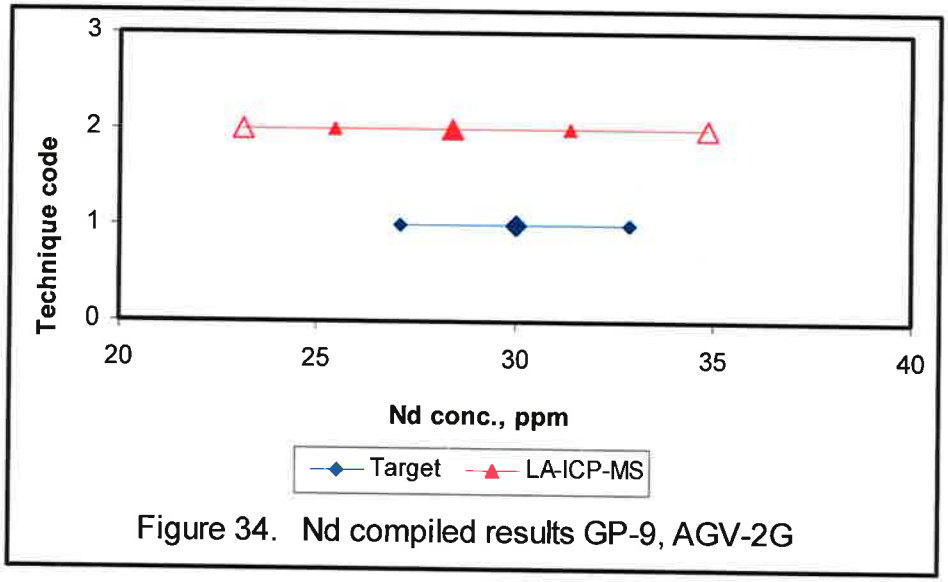

Figure 34. Nd compiled results GP-9, AGV-2G

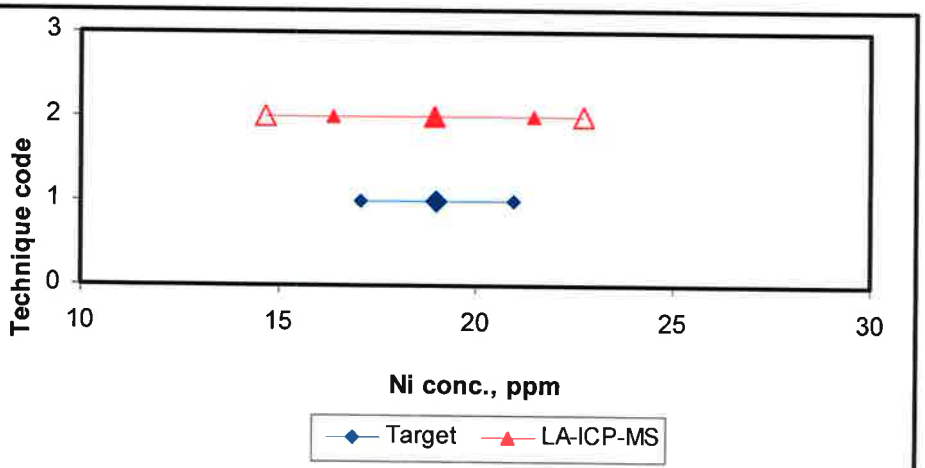

Figure 35. Ni compled reesults GP-9, AGV-2G

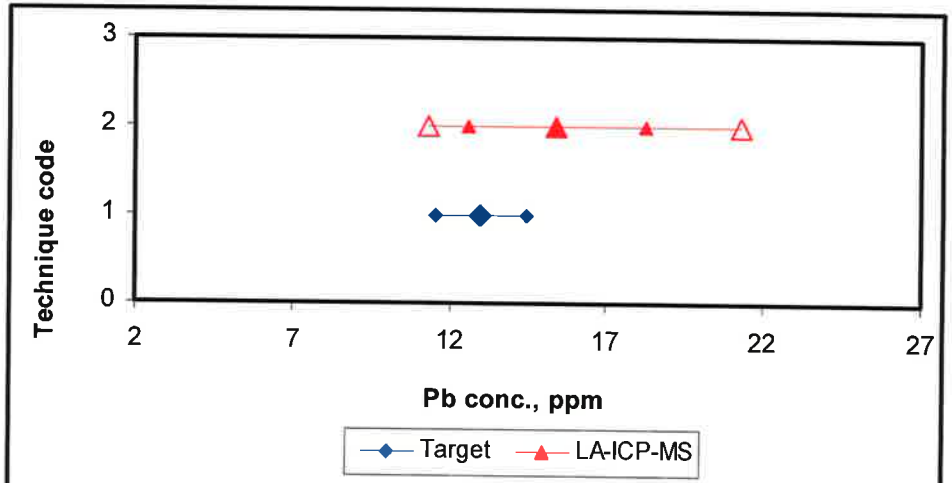

Figure 36. Pb compiled results GP-9, AGV-2G

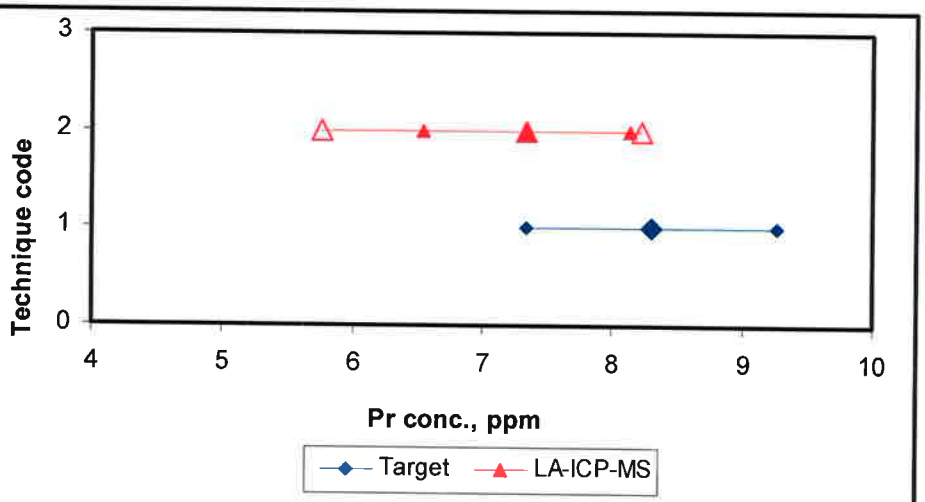

Figure 37. Pr compiled reseults GP-9, AGV-2G

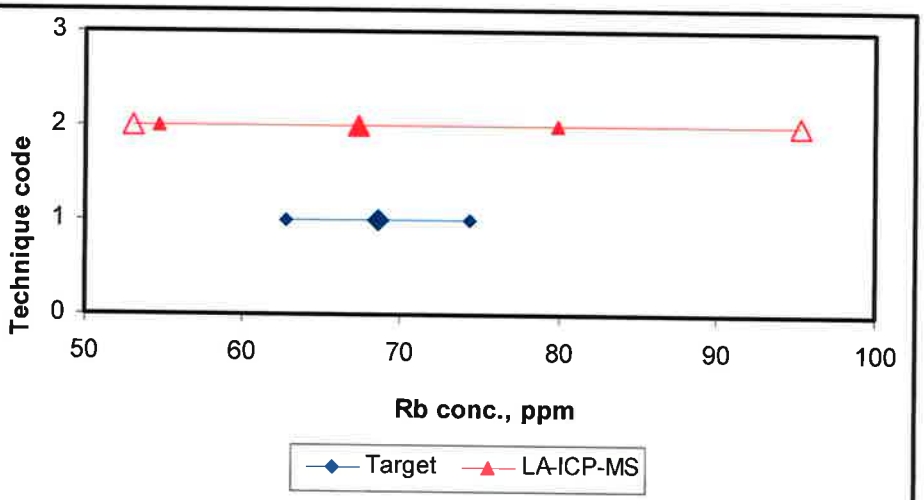

Figure 38. Rb compiled results GP-9, AGV-2G

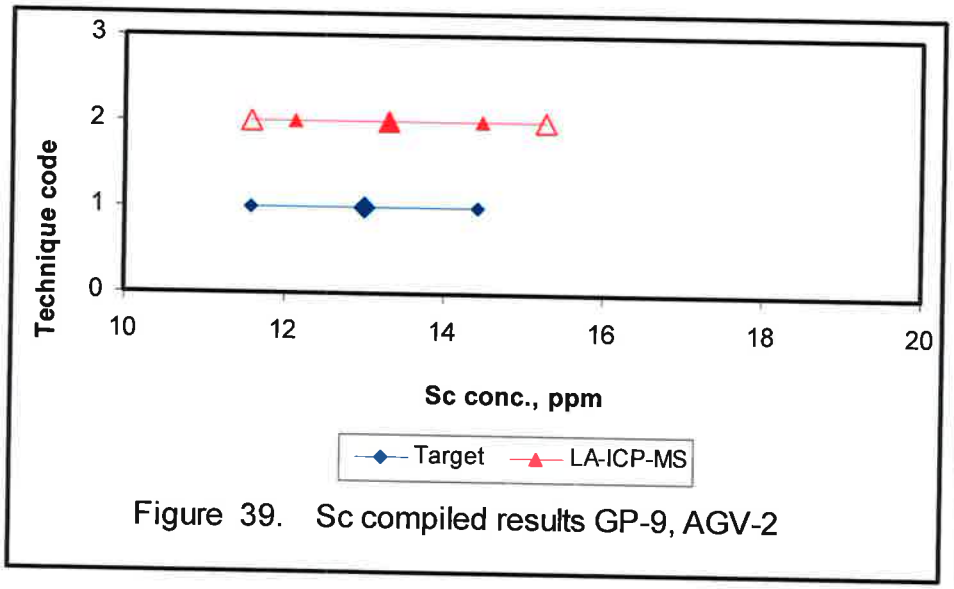

Figure 39. Sc compiled results GP-9, AGV-2

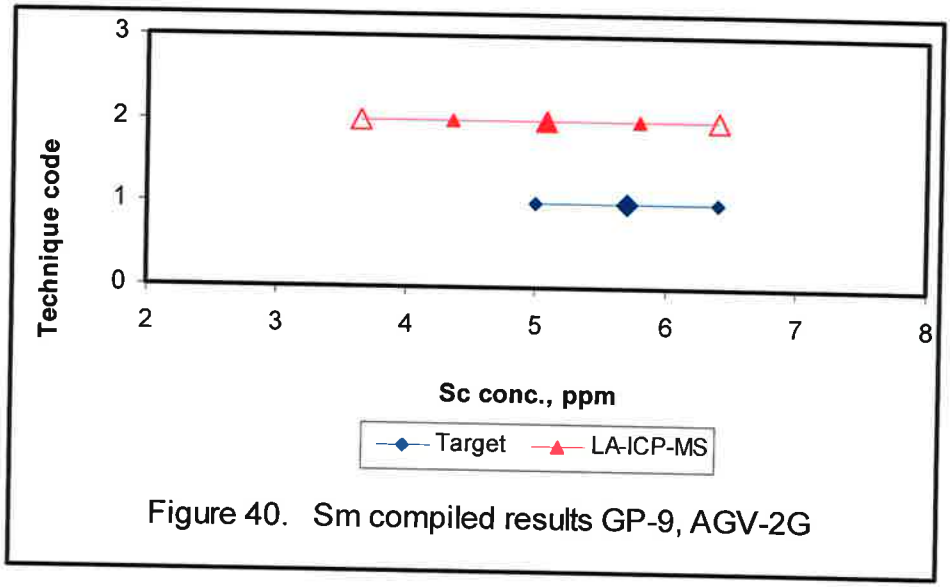

Figure 40. Sm compiled results GP-9, AGV-2G

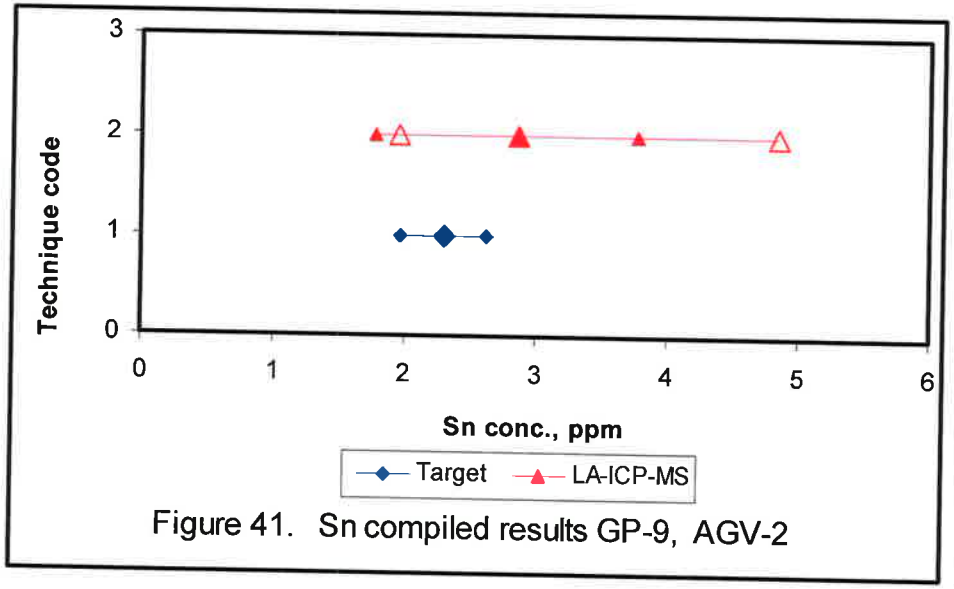

Figure 41. Sn compiled results GP-9, AGV-2

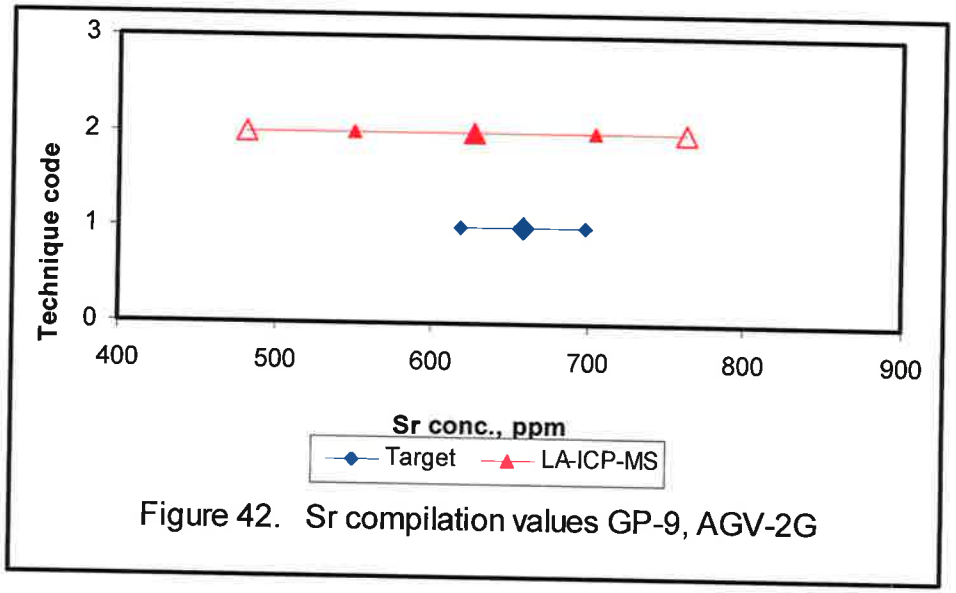

Figure 42. Sr compilation values GP-9, AGV-2G

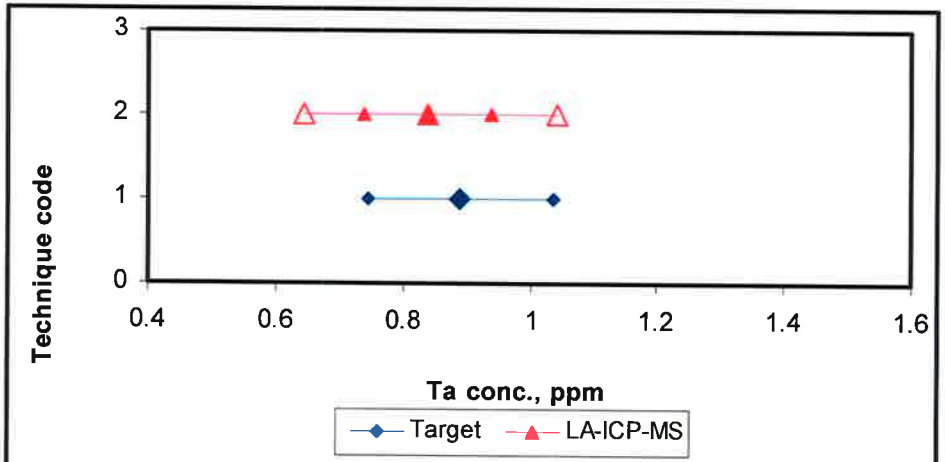

Figure 43. Ta compiled results GP-9, AGV-2G

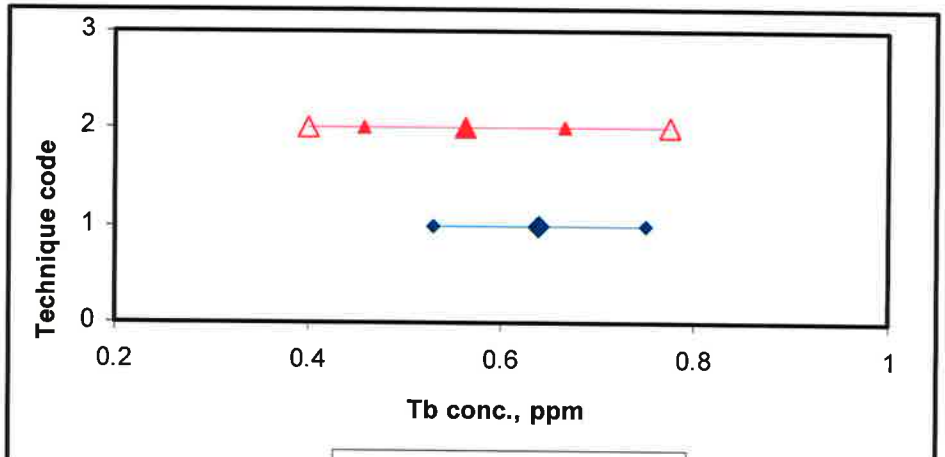

Figure 44. Tb compiled results GP-9, AGV-2G

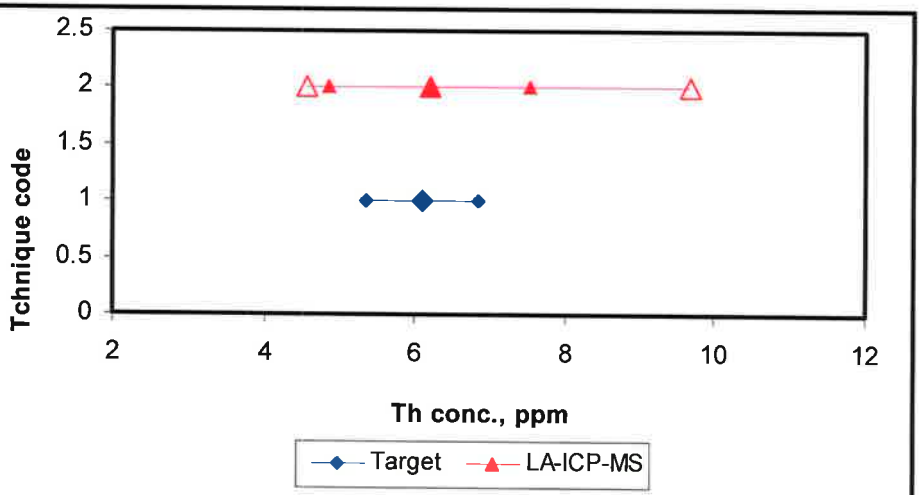

Figure 45. Th compiled results GP-9, AGV-2G

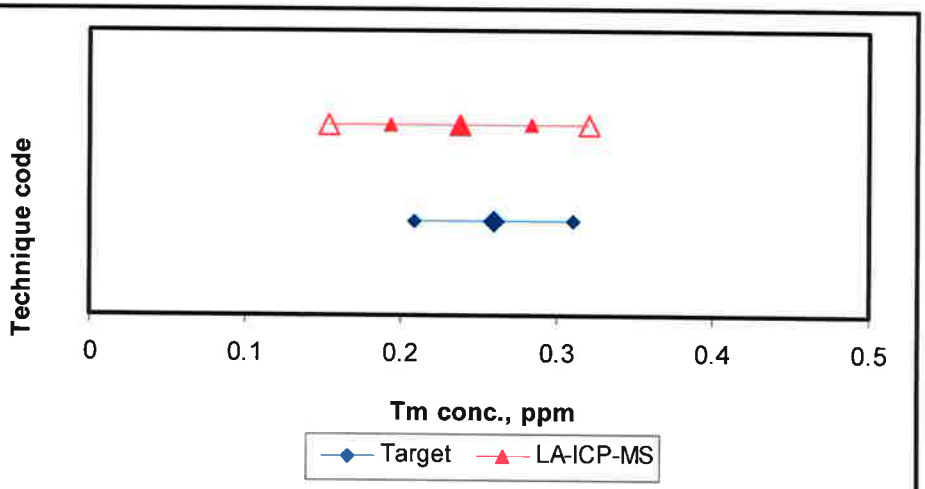

Figure 46. Tm compiled results GP-9, AGV-2G

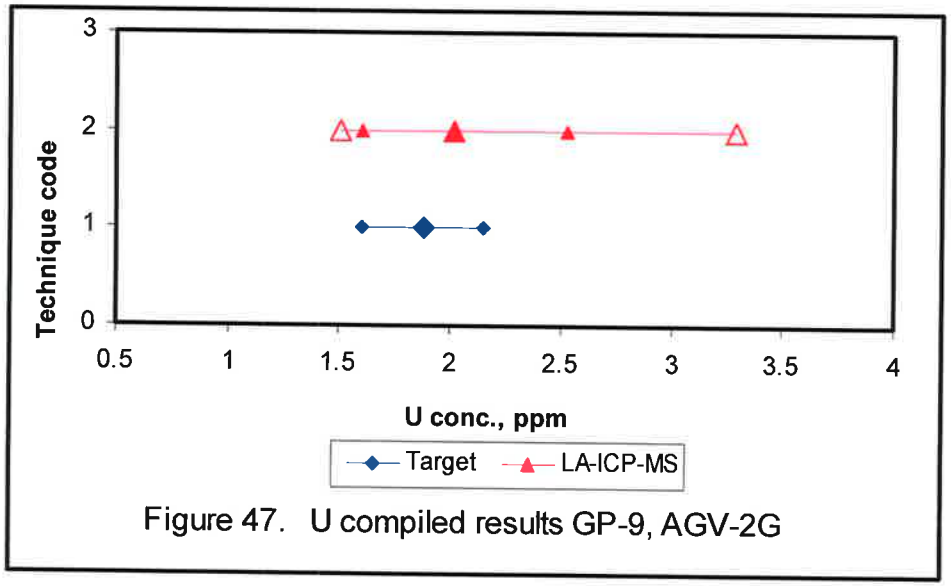

Figure 47. U compiled results GP-9, AGV-2G

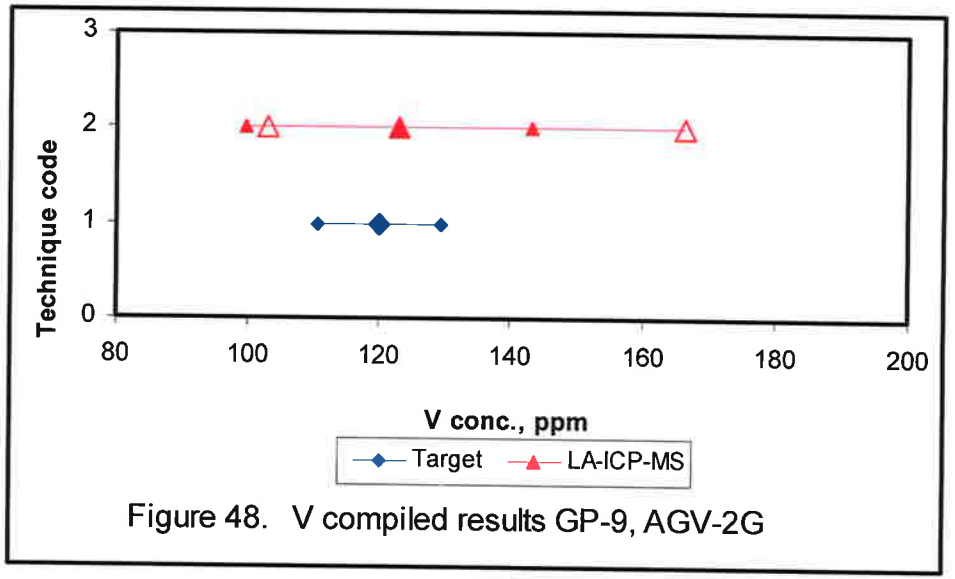

Figure 48. V compiled results GP-9, AGV-2G

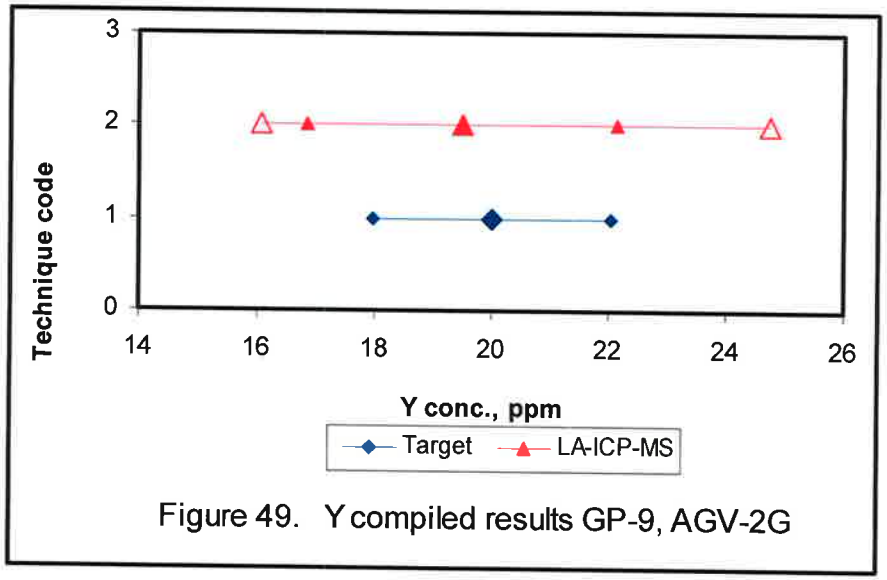

Figure 49. Y compiled results GP-9, AGV-2G

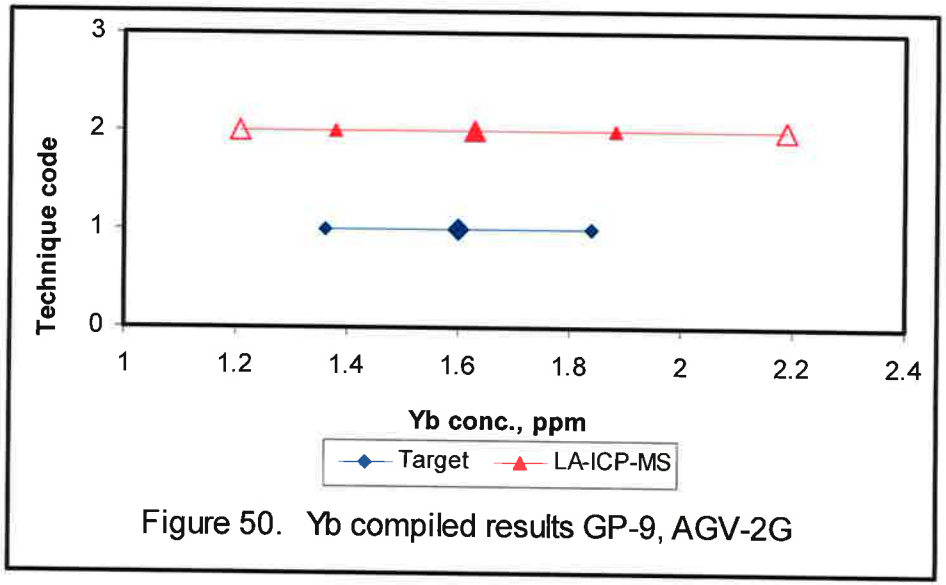

Figure 50. Yb compiled results GP-9, AGV-2G

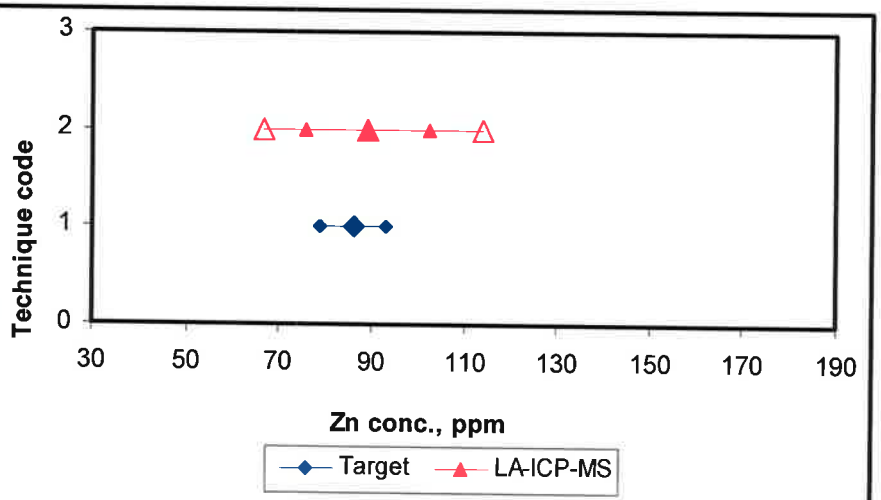

Figure 51. Zn compiled results GP-9, AGV-2G

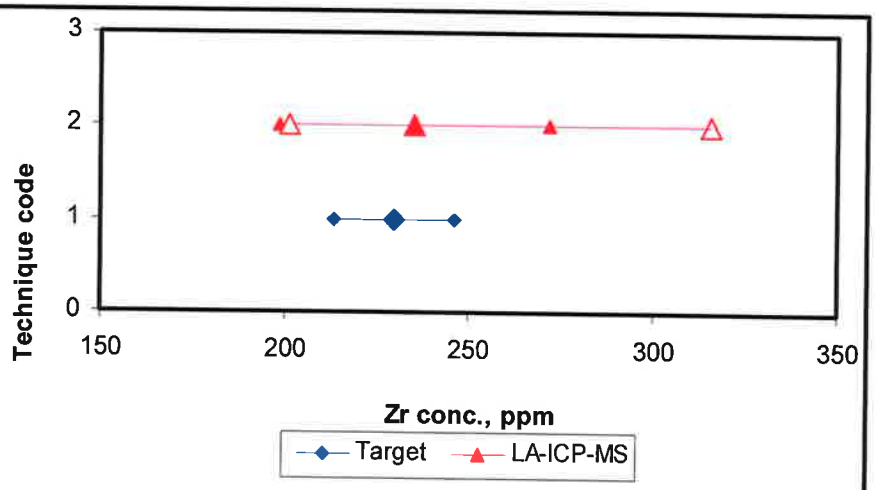

Figure 52. Zr compiled results GP-9, AGV-2G