Agenda

- Goal of the Proficiency test
- FAPAS
- Statistical approach
- Results PT 2012 & 2013
- Conclusion

Goal

Every 3 years a supplier on the Good Delivery List has to prove his performance to remain on the GDL

The annual Proficiency Test was introduced in 2012 to provide an independent assessment of the competence of the participating laboratories

- The annual test exists of one sample (wire) containing >995 ‰ Au
- Laboratories are requested to supply
  - 4 to 6 individual results to 5 significant figures
  - a single, overall mean, value
  - info about ISO accreditation
  - info about methods applied (fire assay, ICP,…)

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FAPAS

The practical organisation of the annual Proficiency Testing (PT) is done by FAPAS

- Laboratories on the Good Delivery List are invited to participate the PT.
- The laboratories get approx 1 month for the analysis
- The laboratories are asked to apply their standard procedures
  - The sample as such is best suited for
    - Fire assay (absolute method for Au by gravimetry)
    - Dissolution and ICP for impurities
  - The sample is not suited for Spark Source OESM but can be used to benchmark the SS OESM results
- FAPAS prepares the report
- The participant can only identifiy their lab


Disk Sample

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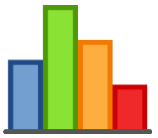
Statistical approach



The results were statistically analysed by FAPAS to provide an assigned Au value x_a.

The LBMA provided a standard deviation for proficiency σ_p

- LBMA has set this σ_p at 0.049 ‰
  - This value is NOT derived from the observed spread of participant's results.
  - This value is in line with the 0.050 ‰ allowed Full Pass criterion for the proactive monitoring for Au levels > 999.5 ‰ (Good Delivery Rules p 31)

Statistical approach

Scrutiny of individual trial assays was determined by 2 tests

- the Grubbs test (test for outliers)
  - Compares the simple mean of the replicate to the simple mean of all results
  - It indicates if a mean value is biased (high, low) relative to the rest of the data
  - It is done iteratively until no more outliers are flagged
- The Cohran test (test for variances)
  - Identifies where a variance is significantly greater than the other variances
  - It is done on all individual (4 to 6) results per participant
  - It is done iteratively until no more outliers are flagged
- Both tests identify data that are different from the rest
  - Both are not a tool to see if a participant is satisfactory according to the z-test
  - Both are therefore no direct part of the proficiency test, but also indicate individual lab performance.

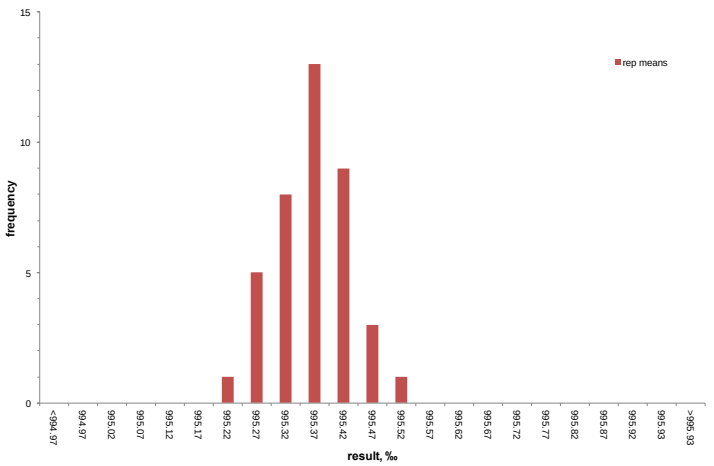
Results

Participants (* only in 2012, ** only in 2013)

Participating laboratories (Alphabetically)	
Allgemeine Gold- und Silberscheideanstalt AG	Metalor Technologies USA
AngloGold Ashanti Corerego do Sitio Mineracao	Mitsubishi Materials Corporation
Argor-Heraeus SA	Mitsui Mining and Smelting Co Ltd
Asahi Pretec Corp.	Moscow Special Alloys Processing Plant (**)
Bangko Sentral Ng Pilipinas (*)	Pamp SA
Cendres+Métaux SA	Precinox SA (**)
Chimet S.p.A.	PT Anam TBK UB PP Logum Mulia
Heraeus Ltd Hong Kong	Rand Refinery Limited
Heraeus Precious Metals GmbH & Co. KG	Royal Canadian Mint
Inner Mongolia Qiakun Gold & Silver Refinery Share Co Ltd (*)	Schone Edelmetaal BV
Ishifuku Metal Industry Co Ltd	SEMPSA Joyeria Plateria SA
Istanbul Gold Refinery	Shandong Zhaojin Gold & Silver Refinery Co Ltd
Japan Mint	Solar Applied Materials Technology Corporation
Johnson Matthey Limited - Utah	Sumitomo Metal Mining Co Ltd
JX Nippon Mining & Metals Co Ltd	Tanaka Kikinzoku Kogya KK
Kassinc Joint Stock Company Ltd	The Perth Mint
Krastsvetmet JSC (**)	The Refinery of Shandong Gold Mining Co Ltd
Lazurde Company for Jewelry	Tokuriki Honten Co Ltd
LS-Nikko Copper Inc	Umicore Precious Metals Refining
Matsuda Sangyo Co Ltd	Valcambi SA
Metalor Technologies (Hong Kong) Ltd	Zijin Mining Group Co Ltd (*)
Metalor Technologies SA	

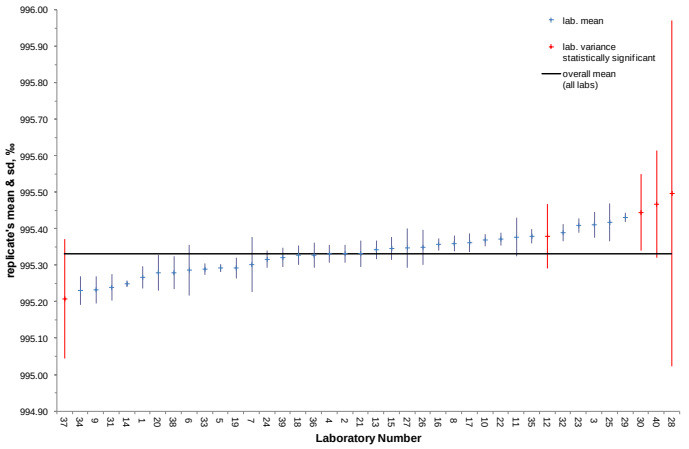
Results for PT 2012

Lab replicates (means) for individual trials on sample L0101



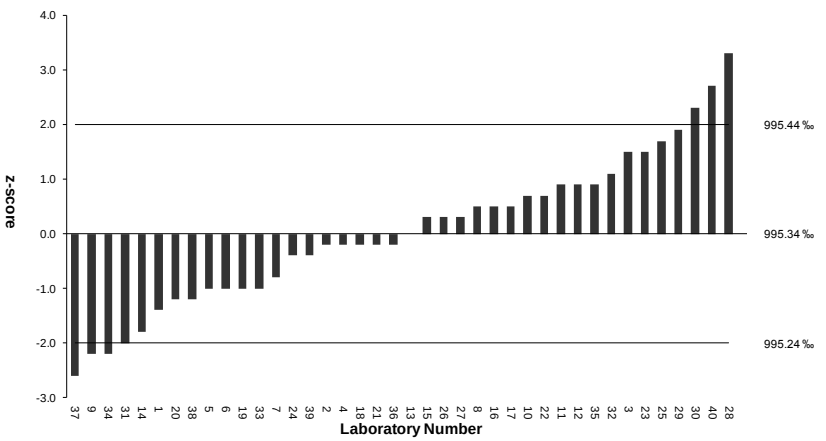
Results for PT 2012

Lab means and standard deviations with identification of statistically significant variances according to Cochran test. All results with a significant variance are obtained by Fire Assay.



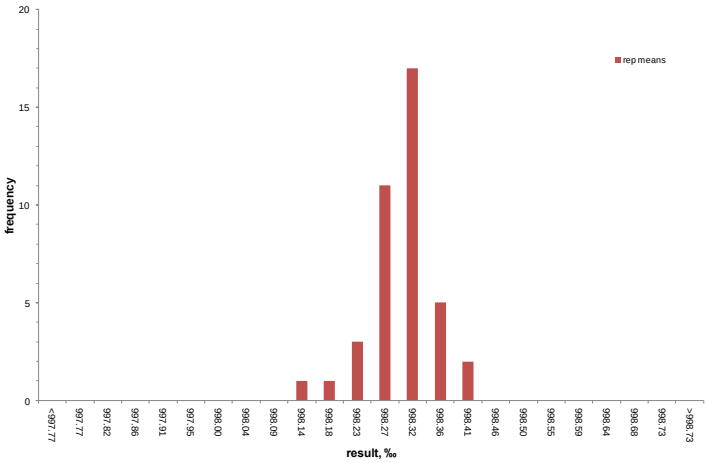
Results for PT 2012

Z-scores for Gold for sample L0101



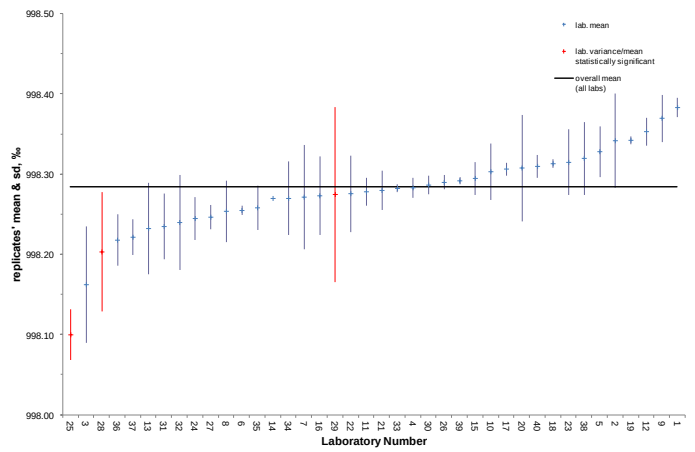
Results for PT 2013

Lab replicates (means) for individual trials on sample L0201



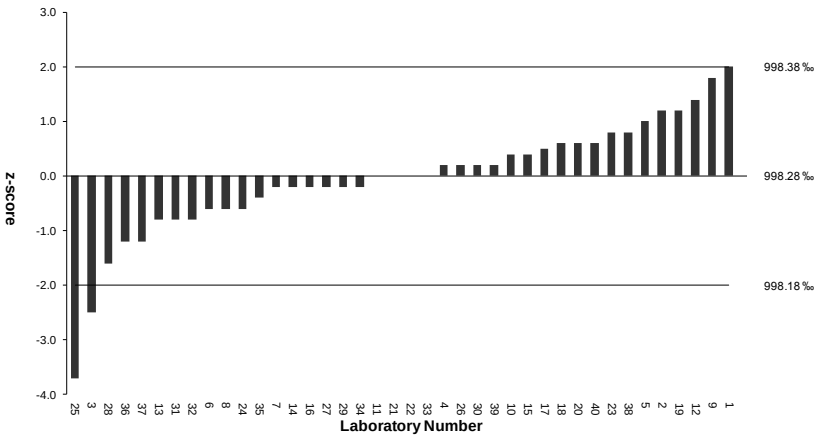
Results for PT 2013

Lab means & standard deviations with identification of statistically significant results acc. to Cochran (2) and Grubbs (1) test. Results with significant variance are obtained by Fire Assay.



Results for PT 2013

Z-scores for Gold for sample L0102



Results for PT 2012 & 2013

Info	Detail	2012	2013
sample ID		L0101	L0201
# participants		41	42
# results		40	40
# labs ISO 17025 accredited		≥ 30%	≥ 30%
Material	impurities present	Ag, Pt, Pd, Cu	Ag, Pt, Pd, Cu
Statistical data	assigned value xa from PT	995.34 ‰	998.28 ‰
	std dev σp for proficiency	0.049 ‰	0.049 ‰
	std deviation σa on results	*0.067 ‰*	*0.053 ‰*
	# scores |z| ≤ 2	34	38
	% scores |z| ≤ 2	85%	95%
	# outliers Grubbs test	0	1
	% outliers Grubbs test	0%	2.5%
	# outliers Cochran test	5	2
	% outliers Cochran test	12.5%	5.0%
Technique applied	# results by fire assay	24	29
	% results by fire assay	60%	73%
	average by fire assay	*995.36 ‰*	*998.17 ‰*
	st dev on fire assay results	*0.07 ‰*	*0.06 ‰*
	# results by ICP	7	10
	% results by ICP	18%	25%
	average by ICP	*995.30 ‰*	*998.29 ‰*
	st dev on ICP results	*0.02 ‰*	*0.02 ‰*
special remark			1 set was corrected due to a factor 10 (% vs ‰)

Special observations:

Better score in 2013

- Better z-score ☺
- σa is improved in 2013 ☺
- 1 Grubbs outlier in 2013 ☹
- Cochran: < outliers on variance ☺
- Xa 2012: ICP < FA
- Xa 2013: FA < ICP
- Precision by FA > ICP
  - All Cochran outliers by FA
  - Absolute Au method vs uncertainty on impurities

Conclusion

- *Acceptable score for both the L0101 and L0102 proficiency test samples*
- *Better score in 2013 compared to 2012*
  - *due to feedback and improvements introduced in 2012?*
  - *due to the purity of the material (higher grade) in 2013?*
- *Better score (Cochran test, z-score) for labs applying ICP iso Fire assay*
  - *Labs producing outliers according to Cochran, z- or Grubbs should check methods*
  - *Labs using ICP should always verify the presence of all possible impurities in routine and future PT samples*
- *Reporting instructions should be followed to avoid errors (% vs ‰, # results)*

Thanks to

LBMA GOOD DELIVERY REFINER

fapas

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