Status of the French accelerator mass spectrometry facility ASTER after 4 years

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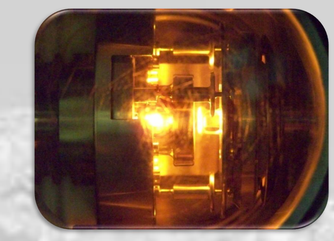
Introduction

- ASTER: Accélérateur pour les Sciences de la Terre, Environnement, Risques
- 5 MV Cockcroft-Walton by HVEE
- installation: October 2006
- acceptance tests: April 2007
- currently dedicated to Earth science studies
- 4 years of routine ^{10}Be & ^{26}Al measurements
- ^{36}Cl [1], ^{41}Ca & ^{129}I measurements




Main applications

- AMS developments
- cosmogenic nuclides systematics
- quantification of Earth's surface processes
- geochronology
- nuclear waste characterisation



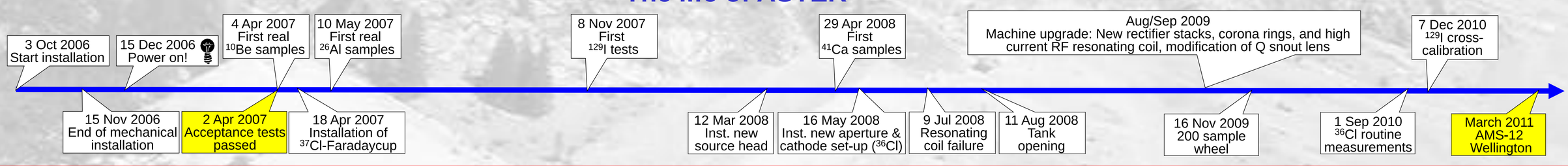

Performance data (more information in [1,2])

	^{10}Be	^{26}Al	^{36}Cl	^{41}Ca	^{129}I
extraction as	BeO^-	Al^-	Cl^-	CaF_3^-	I^-
currents [µA]	3-5	0.1-0.4	15-20	0.2-0.3	3-5
terminal voltage [MV]	4.5	2.7	5.0	5.0	5.0
stripped to (with absorber foil)	Be^{2+} Be^{4+}	Al^{3+}	Cl^{5+} Cl^{10+}	Ca^{4+}	I^{5+}
total transmission [%]	60	38	20	15	8
only absorber foil	36		14		
total with absorber foil	22		2		
detection efficiency [%]			56	68	
suppression factor (detector only)			$\frac{^{36}S}{^{36}Cl}$ $\frac{1}{2.3\cdot10^6}$	$\frac{^{41}K}{^{41}Ca}$ $\frac{1}{7\cdot10^3}$	
background [10^{-15}]	0.15	0.9	0.28*	30	20
STDV [%] on 10^{-11}	0.3	1.3	1.0	1.6	1.1

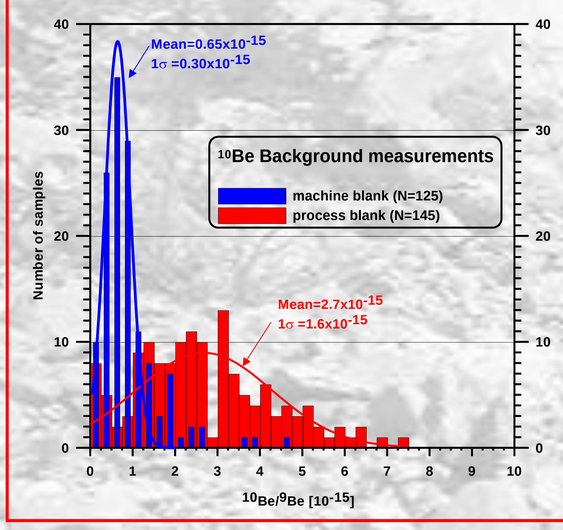
**no AgBr backing! Ni cathodes with Ni pins*

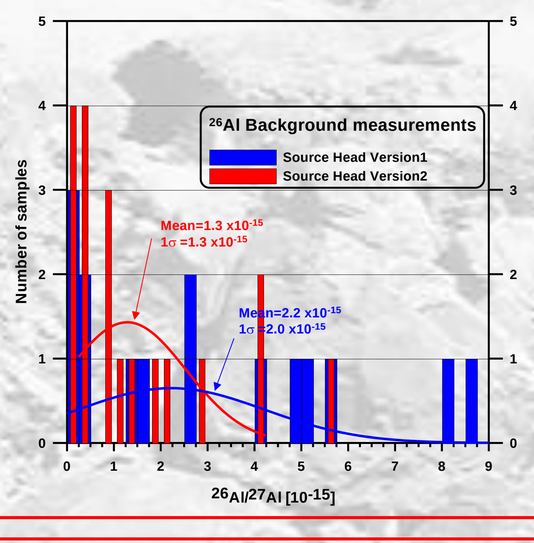
Machine layout

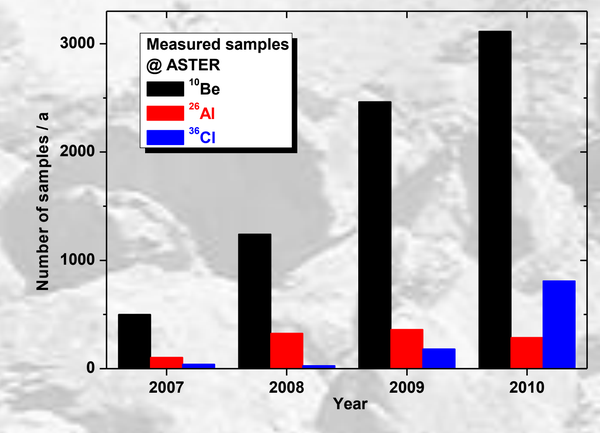
The life of ASTER

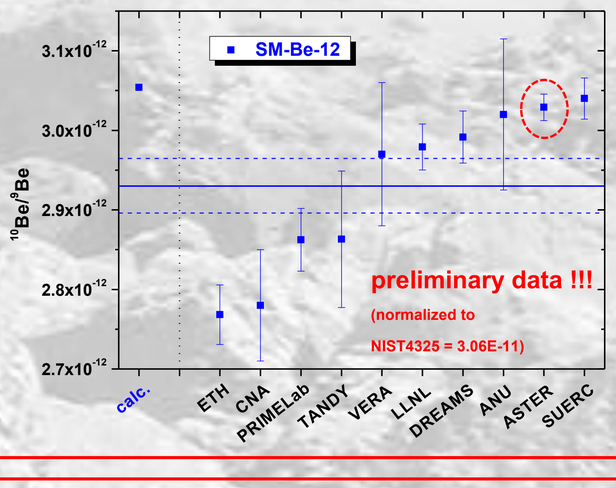


^{10}Be, ^{26}Al: Statistics & Quality assurance

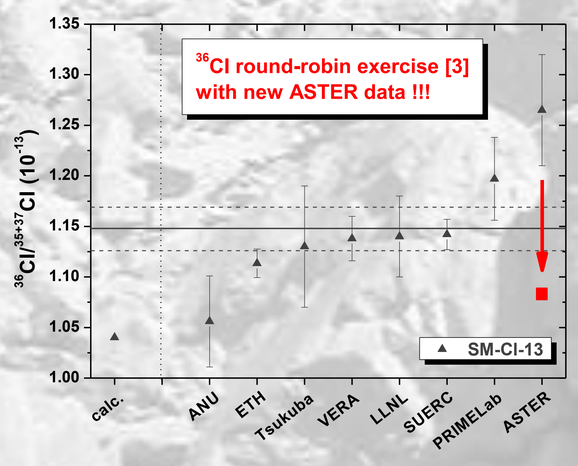


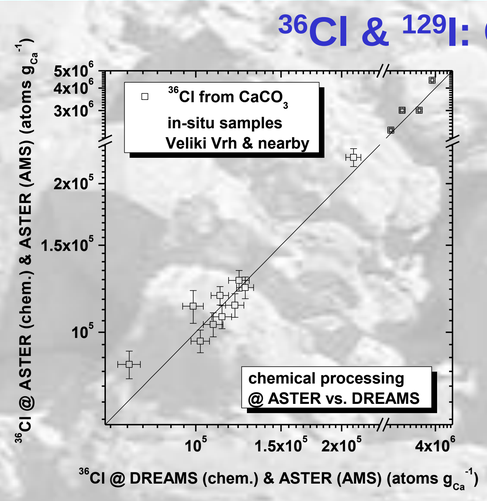


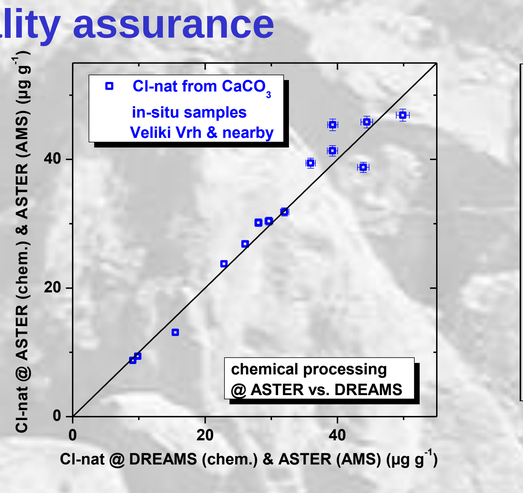


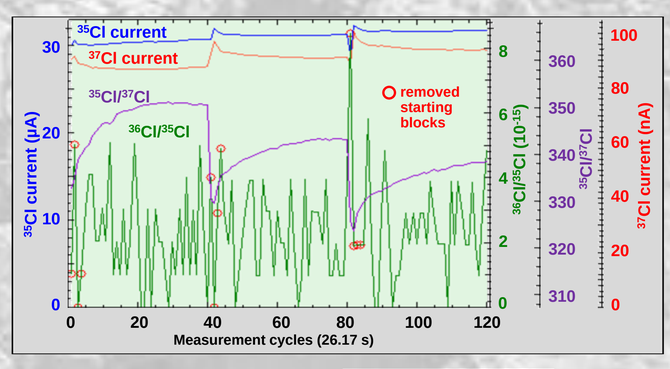


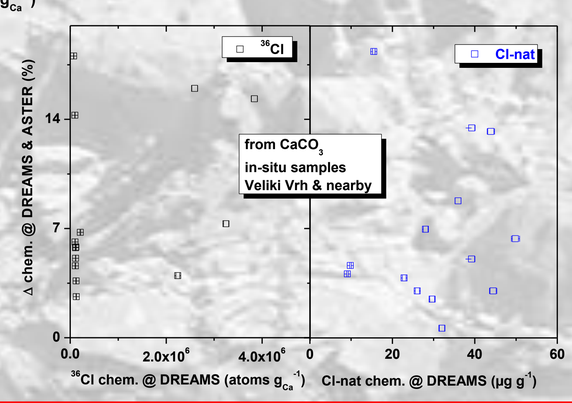
^{36}Cl & ^{129}I: Quality assurance

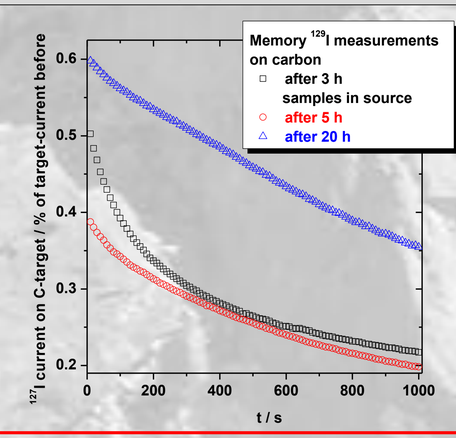












Résumé

- routine and fully automated measurements of ^{10}Be & ^{26}Al sample
- after installation of new source head short-term sample to sample ^{36}Cl cross-contamination decrease ››› minimal measurement time losses for initial burn-in periods (5 min) for virgin targets and waiting periods between data acquisition of two sample runs (2 min)
- need for improved measurement strategy and data evaluation for accurate ^{35}Cl/^{37}Cl determination
- ^{129}I cross-contamination 0.5% (short-term) to 0.8% (long-term, up to 20 h measurement time)
- 3 secondary ^{129}I/^{127}I standards cross-calibrated vs. primary NIST 3231: SM-I-09 (1.007 ± 0.014)·10^{-9}; SM-I-10 (1.064 ± 0.016)·10^{-10}; SM-I-11 (1.083 ± 0.017)·10^{-11}
  overall uncertainties (~1.5 %) mainly from primary NIST 3231 (at 10^{-8})
- quality assurance established ››› accuracy and reproducibility tested and improved ››› some remaining discrepancies with so far unknown reasons
- world-wide Earth science applications (see map)

References

- [1] R.C. Finkel et al., Improved ^{36}Cl Performance at the ASTER HVE 5 MV Accelerator Mass Spectrometer Facility, poster presentation @ AMS-12.
- [2] M. Arnold *et al.*, *NIMB* 268 (2010) 1954.
- [3] S. Merchel et al., Ultra-trace analysis of ^{36}Cl by accelerator mass spectrometry: An interlaboratory study, submitted to Anal. Bioanal. Chem.

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