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Status of the French Accelerator Mass Spectrometry (AMS) Facility ASTER

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ASTER AMS facility, part of the LN2C (National Laboratory for Cosmogenic Nuclides) is involved in its own beam line development to fulfil the stringent requirements of the AMS technic and the always increasing quality measurements required by the Geosciences community applications. Since the acceptance tests in March 2007, routine measurement conditions for the long-lived radionuclides ^{10}Be and ^{26}Al has been established. In 2023, Sample throughput as high as over 3000 unknowns has been reached for ^{10}Be and around 600 for ^{26}Al . Moreover, unacceptable cross-contamination for volatile elements had been largely solved by a first ion source upgrade [1]; this have allowed more than 789 ^{36}Cl samples measurements.

Major instrumental developments occurred between 2015 and 2020: The Acquisition of a new high intensity ion source, the SO-110C, latest version of the HVE SO-110 sputter ion source with a carousel capacity of 200 samples stored in a separate vacuum chamber minimized, cross-talk between samples, lowered the source background and reduced source maintenance by providing good access to the source head and the disposable items while minimizing the effort for alignment of parts. Moreover, this latest upgrade of the source increased the sputter voltage capability to 12 kV. This ion source is performing ^{26}Al and ^{10}Be measurements the previous ion source version SO-110B is still dedicated to ^{36}Cl measurements.

During acceptance tests, this new source design produced 1 μA analysed current for $^{27}\text{Al}^-$ and up to 20 μA for $^{9}\text{BeO}^-$. So, concerning ^{10}Be , the enhancement of the stable current level with respect to the precedent ion source design is impressive allowing minimal measurement time losses and uncertainties. However, regarding aluminium, we have mixed results, measuring several targets that have provided $^{27}\text{Al}^-$ current lower than expected between 500 and 700 nA and all the data show that the current dropped so fast; actually, within a time span of 10 mn to 30mn it dropped below 200 nA.

Based on this conclusion, in 2020 Aster team has acquired a new beam line introducing a gas-filled magnet (GFM) in front of a new GIC focused on ^{26}Al measurements improvements. The new strategy is to use AlO^- ions that provide ionization yield about an order of magnitude higher compared to the commonly used Al^- ions.

Tests has been delayed due to Covid pandemia, but the GFM is now connected to the 0° exit port of existing vertical 30o magnet provided with a degaussing unit.

Following the completion of the on-site installation, the equipment has been subjected to an acceptance test that shown that the equipment is in operating condition. Data acquisition system was demonstrated by performing a batch of twelve (12) AMS analyses ($^{26}\text{Al}/^{27}\text{Al}$ isotopic ratios) using four (4) aluminum reference samples, proving this way the functionality of the GFM setup using Al^- current. Al^{5+} was then selected after the accelerator, whose terminal voltage was set at 5 MV.

Even if the GFM setup is designed to support AlO^- injection, the suppression of the MgO^- interference needs indeed to be optimized. In the present state of our experiment with GFM detection system we can only manage some functionality without expecting performance specifications. More investigation have to be performed with the help of the constructor HVEE that are willing to collaborate with us to improve our results. Until then, ^{26}Al AMS measurements are still performed on the original beamline machine setup.

References: [1] M. Arnold et al., NIMB 268 (2010) 1954.

Student Submission

No

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