

DanFINAL REPORT PROGRAM LEFE

Program LEFE/ IMAGO	Application des isotopes de l'argon à la datation des archives climatiques	Years 2015 – 2016
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Context

The effort of absolute and coherent chronology "multi-archives" is in particular relayed by the INTIMATE community at the international level. We aim at participating to this dynamic also developing at the national level to improve our understanding of the climatic mechanisms at different latitudes and in different compartments of the Earth system.

Objectives / scientific questions :

To go towards the construction of an absolute multi-archive chronology, our objectives are to provide a new method of ABSOLUTE dating of deep ice cores, the initiation of a database of ABSOLUTE dates for volcanic events recorded in climate archives and the further development of DATICE software allowing the integration of different climate archives.

Main results:

The development of $^{40}\text{Ar}/^{38}\text{Ar}/^{36}\text{Ar}$ ice dating has been tested on small ice samples of 50g and is very promising. This method was used to date the mixed ice from the Vostok bottom in Antarctica. The dated part of Vostok reaches 407 ka, and we have thus been able to show that ice samples of 400 to 800ka are in the non-datable part by continuous stratigraphy. This first application motivated the acquisition of a new-generation mass spectrometer. These results were presented to the Franco-Russian LIA on September 12, 2017.

For the absolute dating of volcanic markers, out of 9 samples selected, 6 were successfully dated by the $^{40}\text{Ar}/^{39}\text{Ar}$ method. The Thorsmork ignimbrite, whose age was badly constrained until then but used to date NAZII marker and as a tie point for GICC05, is now precisely dated at 55.9 ± 1.0 ka (1 sigma). In the same way, one of the rhyolitic ridges of the Torfajökull volcano is dated at 76.1 ± 1.6 ka. These two dates support a possible climate / volcanism relationship because they are respectively synchronous with transitions MIS 4 / MIS 3 and MIS 5 / MIS 4. Such a relationship is confirmed by the preliminary K-Ar dating of other rhyolitic samples. Our main result is that rhyolitic volcanism is synchronous with deglaciations. A paper, synthesizing these results, is under preparation.

The DATICE dating tool has been adapted to incorporate marine cores, lacustrine cores and speleothems from the Mediterranean region on the sequences of the last deglaciation and the last interglacial. These results were presented at the Q10 symposium (February 2016), the EGU (April 2016) and at the AGU (December 2017). A paper is under preparation (L. Bazin first author). Following the initiation by the LEFE program, this work is now continuing under the L-IPSL labex.

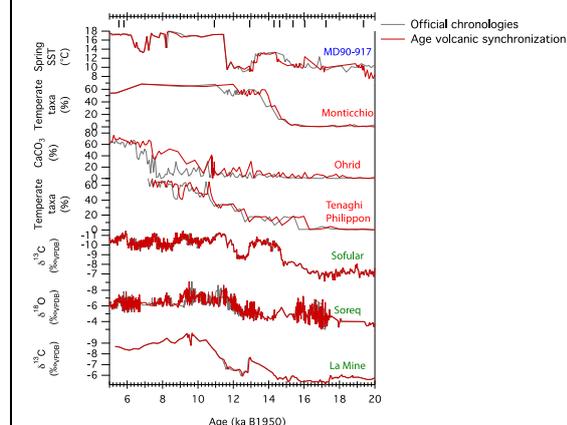
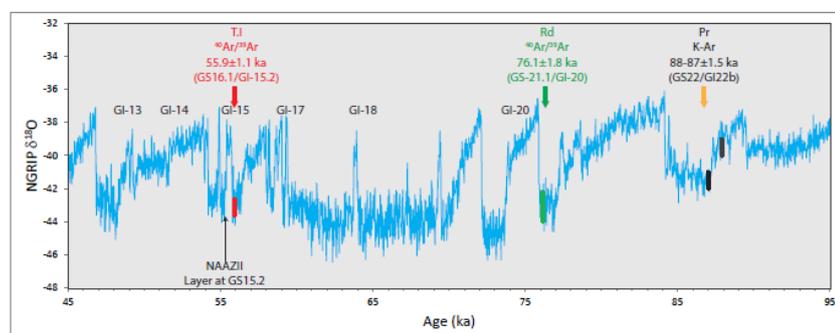


Illustration 1: $^{40}\text{Ar}/^{39}\text{Ar}$ chronology of Rhyolitic tephra dated in this project compared with AICC2012 time scale. Rhyolitic eruptions occurred mostly during Greenland stadials. The $^{40}\text{Ar}/^{39}\text{Ar}$ age of the Thorsmork ignimbrite (TI) is coherent at 1 sigma with its equivalent (NAZII) recorded in NGRIP.

Illustration 2: Coherent chronology within the Mediterranean basin for different archives. The coherent chronology has been obtained with the "DATICE – multi archive tool" using stratigraphic markers based on volcanic signatures (tephras).

Future of the project : On the basis of the experience acquired in this LEFFE project, and in the framework of the "Beyond EPICA - Oldest Ice" (BE-OI) project (European project, the first phase of which is financed for the site selection and the second one for the drilling in the writing phase) and the acquisition of a new generation mass spectrometer (GRACE project - Ile de France region) we will analyze ice samples taken from the deep part of DOME C and from the deep part of the BE-OI ice core.

- 1- Bazin L., Govin A., Capron E., Nomade S., Lemieux-Dudon B. and Landais A. : *Toward a Last Interglacial Compilation Using a Tephra-based Chronology : a Future Reference for Model-data Comparison*, AGU, New-Orleans, USA, 2017. (Poster)
- 2- Bazin L., Siani G., Landais A., Bassinot F., Genty D., Govin A., Michel E., Nomade S. and Waelbroeck C. : *The last Deglaciation in the Mediterranean region : a multi-archive synthesis*, EGU, Vienne, Autriche, 2016. (Poster)
- 3- Bazin L., Siani G., Landais A., Bassinot F., Genty D., Govin A., Michel E., Nomade S. and Waelbroeck C. : *Datice multi-archive: La dernière déglaciation en région Méditerranée*, Colloque Q10 AFEQ-CNF-INQUA, Bordeaux, France, 2016. (Oral, Présentation invitée)
- 4- Bazin L., Landais A., Lemieux-Dudon B., Siani G., Michel E., Combourieu-Nebout N., Blamart D. and Genty D. : *A multi-archive coherent chronology: from Greenland to the Mediterranean sea*, EGU, Vienna, Autriche, 2015. (Oral)
- 5- Orsi A.J., *Argon dating for the Vostok Oldest Ice Challenge*, Séminaire Franco-Russe, Grenoble, France, September 2017 (Oral)
- 6- Guillou H., Scao V., Nomade S., Landais A. , et al. $^{40}\text{Ar}/^{39}\text{Ar}$ dating of quaternary sub-glacial rhyolites from Iceland including the Thorsmork ignimbrite. En préparation