Abstract for the submission to ND2022 – 15th International Conference on Nuclear Data for Science & Technology.

Towards implementing new isotopes for environmental research: The half-life of ^{32}Si

M. Veicht[1,2], I. Mihalcea[1], P. Sprung[1], Y. Nedjadi[3], M. T. Durán[3], C. Bailat[3], K. Kossert[4], D. Symochko[4], O. Naehle[4], M. Schlomberg[5], C. Vockenhuber[5], S. Röllin[6], A. Wallner[7,8], D. Cvjetinovic[9], and D. Schumann[1]

[1] Paul Scherrer Institut (PSI), Forschungsstrasse 111, 5232 Villigen, Switzerland

[2] École Polytechnique Fédérale de Lausanne (EPFL), Route Cantonale, 1015 Lausanne, Switzerland

[3] Institute of Radiation Physics (IRA), Rue du Bugnon 46, 1011 Lausanne, Switzerland

[4] Physikalisch-Technische Bundesanstalt (PTB), Bundesallee 100, 38116 Braunschweig, Germany

[5] Laboratory of Ion Beam Physics (LIP), ETH Zürich, Otto-Stern-Weg 5, 8093 Zurich, Switzerland

[6] Federal Office for Civil Protection (FOCP), Spiez Laboratory, 3700 Spiez

[7] Australian National University (ANU), Australian Capital Territory 2601, Canberra, Australia

[8] Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, 01328 Dresden, Germany

[9] Faculty of Physical Chemistry, University of Belgrade, Studentski Trg 12-16, 11158 Belgrade, Serbia

^{32}Si is an extremely rare, naturally occurring radioactive isotope. With its expected half-life ($T_{1/2}$) of 153(19) years [1], ^{32}Si would be one of the suitable candidates for radiometric dating in the range of 100–1000 years, where an appropriate dating nuclide is still missing (**Fig. 1a**). The fact that the nuclide could not be applied so far for nuclear dating is due to the imprecise and contradictory data for its half-life (**Fig. 1b**), which makes a more precise and more accurate determination absolutely necessary.

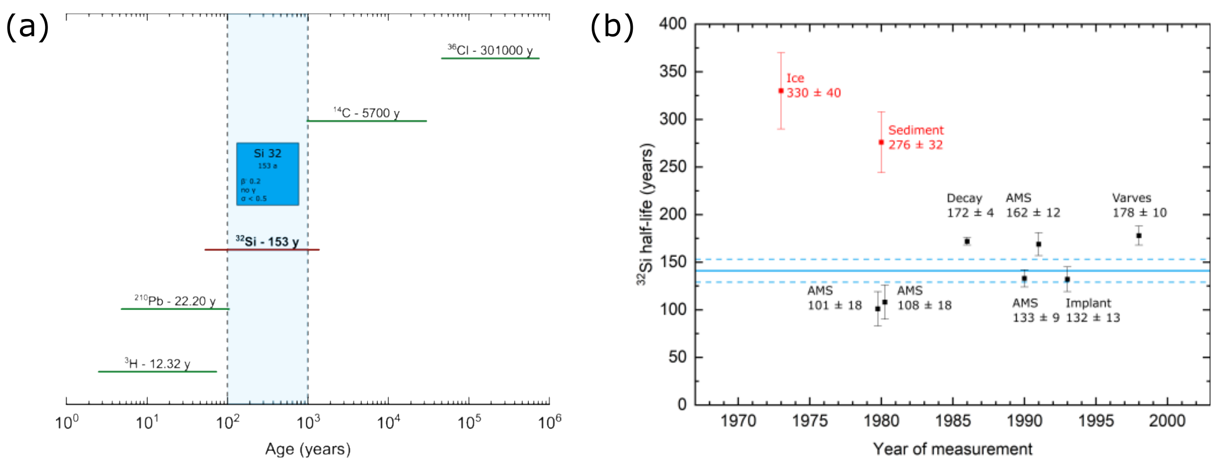

Fig. 1: (a) Dating gap between 100 and 1000 years, and **(b)** compilation of previous ^{32}Si half-life determinations (modified from [2]).

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The SNSF-funded project SINCHRON (**Si** – a new **chron**ometer for **n**uclear dating) aims for an accurate half-life redetermination of ^{32}Si with a relative standard uncertainty of less than 5% on the basis of several independent measurements. MBq quantities of ^{32}Si have been successfully produced at the Paul Scherrer Institut (PSI, Switzerland) by exposing metallic vanadium discs to high-energy protons. In order to obtain radiochemically pure ^{32}Si solutions, a robust chemical separation procedure has been developed [2]. Several partners are involved in the SINCHRON-Project covering different tasks of the half-life determination.

Generally, two approaches are employed, while all measurements will be performed using aliquots of the same source material. The first approach is to follow the decay after a given time interval. For such measurements, the long-term stability of both the sample and the measurement device (e.g., ionization chamber (IC)) is essential. The second approach is the so-called direct method, where the $T_{1/2}$ can be determined from the relationship $T_{1/2} = N \ln(2)/A$. Here, inductively coupled plasma mass spectrometry (ICP-MS), and accelerator mass spectrometry (AMS) are utilized for the determination of the number of atoms (N). The activity (A) is measured using liquid scintillation counting (LSC) with two techniques that are well established in radionuclide metrology: the triple-to-double coincidence ratio (TDCR) method and CIEMAT/NIST efficiency tracing. In addition, a coincidence setup with a plastic scintillation detector and a gamma-ray detector is used to apply another independent efficiency tracing technique. Finally, as enough sample material, meeting the quality requirements, has been produced, measurements are currently ongoing – first results of the half-life determination will be presented.

References:

[1] Ouellet, C., & Singh, B. (2011). Nuclear data sheets for A= 32. *Nuclear Data Sheets*, *112*(9), 2199-2355.

[2] Veicht, M., Mihalcea, I., Cvjetinovic, Đ., & Schumann, D. (2021). Radiochemical separation and purification of non-carrier-added silicon-32. *Radiochimica Acta*. (pre-published online).

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