^{14}C PRODUCTION RATES AND ^{14}C/^{10}BE PRODUCTION RATE RATIOS IN FRESHLY FALLEN METEORITES.

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Introduction: The vast majority of approved meteorites listed in the Meteoritical Bulletin Database are finds from either Antarctica or hot deserts (North Africa, Chile, Arabia, etc.). Knowing the terrestrial age, i.e., the time span between the fall of the meteorite and its recovery on Earth, is crucial for *i*) understanding the parameters influencing meteorite weathering on Earth, *ii*) studying meteorite pairing, *iii*) investigating the meteorite flux in the past, and in a more general sense *v*) increasing our understanding of the dynamics of small bodies in the solar system. The terrestrial age is often determined using the cosmogenic nuclide ^{14}C. For such studies, the ^{14}C production rate, i.e., the ^{14}C activity concentration at the time of fall, must be known. However, this value depends on the chemical composition of the meteorite and on shielding, i.e., preatmospheric radius and depth of the sample in the preatmospheric meteorite, and is therefore not well constrained, especially not for large meteorites and strewnfields. To circumvent this problem, the ^{10}Be/^{14}C system is often applied, i.e., instead of using only the ^{14}C production rate, the ^{14}C/^{10}Be production rate ratio is used, which is less dependent on chemical composition and shielding. For a reliable application, the dependence (or independence) of the ^{14}C/^{10}Be production rate ratio on meteorite type and shielding needs to be known in some detail. However, for the ^{14}C/^{10}Be dating system to be applicable, ^{10}Be must be in saturation, i.e., the cosmic ray exposure age must be longer than about 5-7 Ma.

Experimental: In this study, we determine ^{14}C and ^{10}Be activity concentrations in freshly fallen meteorites. We selected the meteorites Bensour (LL6), Boumdeid (L6), Mt. Tazerzait (L5), and Sayh al Uhaymir 606 (H5). Carbon-14 is extracted using the ^{14}C extraction line in our laboratory at the University of Bern, Switzerland [1,2] and the ^{14}C/^{12}C ratios are measured at the MICADAS system at the LARA laboratory at the University of Bern [3]. The ^{10}Be activity concentrations have already been measured using the ASTER accelerator mass spectrometer at CEREGE in Aix-en-Provence, France [4,5]. In addition and especially to further support the data, we also measure the noble gas isotopes ^{3}He, ^{4}He, ^{20}Ne, ^{21}Ne, and ^{22}Ne in aliquots of the samples to, *i*) determine the preatmospheric dimensions and *ii*) to determine the cosmic ray exposure age to prove or reject that ^{10}Be is in saturation. The noble gas measurements were all performed at the University of Bern. While the ^{10}Be data have already been measured, the noble gases are currently measured and we already measured first aliquots for ^{14}C. We will present all data at the conference.

Model calculations: This study is complemented by new model calculations for ^{14}C, ^{10}Be, ^{21}Ne, and ^{22}Ne to study if and (if yes) how the ^{14}C/^{10}Be production rate ratio depends on meteorite type and shielding and especially if such a hypothetical dependence can be corrected for by using cosmogenic ^{22}Ne/^{21}Ne ratios. The model is essentially the same used already to establish galactic cosmic ray gradients in the solar system [6]. Here the model is extended to ^{14}C and Ne isotopes.

Summary: In this study we will significantly improve the basics of the ^{14}C and ^{14}C/^{10}Be dating systems for terrestrial ages of meteorites. Thanks to the additionally measured noble gas data we will have a good knowledge about the constancy of the ^{14}C/^{10}Be ratio and the ^{14}C production rate with respect to meteorite type and shielding. Thanks to our study we expect to significantly reduce the systematic uncertainties for terrestrial ages in the age range (0-50) ka.

References: [1] Mészáros M. et al. (2018) *Radiocarbon* 60:601-615. [2] Sliz et al. (2020) *Radiocarbon* DOI: 10.1017/RDC.2020.38. [3] Szidat S. et al. (2014) Radiocarbon 56:561-566. [4] Arnold M. et al. (2010) *Nucl. Instr. Meth. Phys. Res.* B268:1954-1959. [5] Arnold M. et al. (2013) *Nucl. Instr. Meth. Phys. Res.* B294:24-29. [6] Leya I. et al. (2021) *Astrophys. J*. id.136.