TERRESTRIAL AGES OF METEORITES USING IN SITU ^{14}C AND ^{10}Be MEASUREMENTS

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Introduction: Knowing the terrestrial ages of meteorites helps understanding the timescales of meteorite accumulation and erosion on the Earth's surface. So far, however, the database of meteorite terrestrial ages is modest, with data available only for a number of meteorite groups. Therefore the meteorite flux over time cannot be adequately verified nor quantified. With the use of the newly installed radiocarbon (^{14}C) extraction line at the University of Bern [1] we will determine the terrestrial ages of purified silicate fractions of a number of meteorite strewn fields from the Sultanate of Oman, as well as for fresh falls. The system allows extraction of CO_2 gas from meteorites, which is subsequently submitted to the Accelerator Mass Spectrometry (AMS) MICADAS system [2] for ^{14}C measurement. So far we determined the terrestrial ages of the L6 chondrite JaH 073 (purified silicate fraction), as well as the LL6 fresh fall Bensour (bulk), which are in good agreement with the literature data, and known fall age, respectively. Moreover, ^{10}Be concentrations for all studied samples were already measured at the ASTER (Accélérateur pour les Sciences de la Terre) Accelerator Mass Spectrometry (AMS) facility at CEREGE in Aix-en-Provence, France. [3], and will be used along with the ^{14}C data to determine the more reliable ^{14}C/^{10}Be ages.

Experimental Setup: Some parts of the ^{14}C extraction line have been modified since the first description by Meszaros et al. (2017). The gas extraction unit now consists of a high frequency generator (HFG) and a quartz glass (SiO_2) crucible. Quartz beads fill the bottom of the crucible on which sits an inner quartz glass tube, also partially filled with quartz beads. This setup prevents a direct contact between the wall of the outer crucible and the heated sample, thus reducing the risk of cracking due to high temperature gradients. Samples are placed in the crucible together with magnetic iron (Fe) pellets in order to induce heating through the HFG's magnetic field. At the maximum operational current (~620 A), iron pellets reach their melting temperature (~1540°C), which is sufficient to extract CO_2 from samples. Pre-heating of samples is done in an UHP O_2 flow for 1 h at 50 A with continuous pumping. The extraction of *in situ* ^{14}C takes place in a 15-30 mbar O_2 pressure for 40 mins at 620 A. The first results demonstrate that the new ^{14}C extraction line is effective at extracting the *in situ* ^{14}C from purified silicate fractions of meteorites. The sample mass required per measurement is only 0.05 g, significantly less than in other lines that need ~0.1-0.5 g of sample [4]. In addition to this important improvement, the AMS MICADAS gas-interface system allows the measurement of ^{14}C directly from CO_2 gas. Since graphitization of the sample is no longer necessary, the measurement process is much quicker and there is a lower blank.

The ^{10}Be concentrations have been determined for all selected strewn fields and the fresh fall. Combining this data with the ^{14}C concentrations allows to better constrain the terrestrial age because effects due to shielding can be reduced. The ^{10}Be samples were prepared at CEREGE, and the ^{10}Be measurements were performed at the ASTER AMS.

Results and Discussion: Using a ^{14}C saturation production rate of 51.1±1 dpm/kg we calculate a ^{14}C terrestrial age for the L6 chondrite JaH 073 of 17.7±0.4 kyr, which is in good agreement with earlier data [1]. The ^{14}C/^{10}Be age for the same meteorite is 23.5±0.8 kyr (using saturation production rates of 51.1±1 dpm/kg for ^{14}C, and 22.1±1 dpm/kg for ^{10}Be). Our age is slightly higher than the literature data, which ranges from recent to 16 kyr [5]. Note, however, that, also in contrast to the earlier study [5], our data show only a very small spread, with the four ^{10}Be measurements ranging from 13.7 to 13.9 dpm/kg.

The LL6 chondrite Bensour is an observed fall from 2002. We measured ^{14}C activities of 47.1 to 53.1 dpm/kg in a ***bulk*** sample of Bensour from which we calculate ^{14}C terrestrial ages in the range 0.3 to 1.3 kyr with saturation activity of 55.2±0.5 dpm/kg. A 0.5 g aliquot (125-200 μm grain size, bulk) of Bensour was measured at the University of Arizona for ^{14}C concentration to cross-calibrate their ^{14}C extraction line with our system. Their result slightly differs from ours, i.e, the ^{14}C activity of 33.2±0.5 dpm/kg is lower, which gives a higher terrestrial age (4.2±1.3 kyr). Currently, we have no explanation for the discrepancy but it might be due to the fact that we measured bulk samples while leached fractions were measured in Arizona.

References: [1] Meszaros M. et al (2017) *Radiocarbon*, p. 1-15. [2] Szidat S. et al. 2014. *Radiocarbon* Vol 56, Nr 2, p. 561-566. [3] Arnold M. (2010) *Nuclear Instruments and Methods in Physics Research*, p. 1954-1959. [4] Jull T. et al. (1993) *Meteoritics and Planetary Science*, 28:188-95. [5] Gnos, E. et al. (2009) *Meteoritics and Planetary Science.* 44:375-87.