USING THE GAS ION SOURCE COUPLED TO A MICADAS 200kV ACCELERATOR MASS SPECTROMETER FOR MEASUREMENTS OF ^{14}C ON VERY SMALL SAMPLES: FROM METEORITES TO TREE RINGS. M. Molnar[1] , A. J. T. Jull[1,2,3], I. Major[1], K. Hubay[1], R. Janovics[1] [1]Isotope Climatology Research Centre, Institute of Nuclear Research, 4026 Debrecen. Hungary [2]Department of Geosciences, University of Arizona, Tucson, AZ 85721 USA. [3]AMS Laboratory, University of Arizona, Tucson, AZ 85721, USA.

Introduction: The concentration of ^{14}C ($t_{1/2}$ 5,700 yr) is of great importance in understanding the terrestrial residence time of meteorites [1,2], planetary surfaces [3] as well as many other types of terrestrial materials, as will be discussed. The terrestrial age depends on the environment where a meteorite lands. ^{14}C has also been used to distinguish between terrestrial and extraterrestrial sources of carbon by using the very different levels expected. Past meteorite studies have used relatively large samples or diluted the ^{14}C extracted with a carrier gas. Recently, we have experimented with injecting the $^{14}CO_2$ from meteorites directly into an AMS ion source using a gas-ion source interface developed by ETH-Zurich. This allows the measurement of samples of as low as 10-20μg and a corresponding reduction in sample size. Independently, another group [4] has also developed a method for ^{14}C extraction from meteorites using a similar interface. These new developments are important as we move forward to sample-return missions from comets (e.g. Hayabusa-2) or asteroids (OSIRIS-Rex), where sample size will be a limitation.

Application to terrestrial cosmogenic in-situ ^{14}C: Cosmogenic ^{14}C produced in situ in rocks is also important for studies on the surface of the earth, where in combination with other radionuclides such as ^{10}Be, it can give important information about past surface exposure times and erosion rates [5,6]. We are developing a new in situ cosmogenic ^{14}C line following the Cologne design in collaboration with Fülöp et al. [7].

Cosmic-ray Records in Tree Rings: However, ^{14}C is produced directly in the terrestrial atmosphere as well, due to the interaction of secondary cosmic-ray neutrons with nitrogen, according to the equation $^{14}N(n,p)^{14}C$. A growing field of interest is in short-term fluctuations of ^{14}C production in the terrestrial atmosphere. Rapid excursions could be the result of rapid changes in the cosmic-ray flux due to changes in solar activity. This signal is best recorded in tree-rings which have an annual record of cosmic-ray fluctuations, since rapid changes in ^{14}C have been observed at specific times in the past, including at AD 774-775 and 993-994 [7-12]. These records have been extended to additional events around 5480BC and 660BC [13,14]. The importance of these rapid events cannot be underestimated, since a large solar cosmic-ray event or coronal mass ejection could cause large-scale damage to our increasingly complicated electronic infrastructure.

Meteorite Methods: We extracted ^{14}C from samples using an RF induction system, as described earlier [3]. Sample gas is extracted, cleaned and reduced to graphite for AMS measurement without adding a carrier. Traditionally, graphites are pressed into a target holder and were measured using the NEC machine at the University of Arizona running at 2.5MV or the Debrecen machine running at 200kV. We will report on new studies using the gas-ion source for known-age materials and meteorites.

Tree-ring methods. Samples of known-age tree rings were divided and converted to holocellulose using established methods. These are then combusted with CuO to CO_2 and then converted to graphite for measurement on the Debrecen machine. So far, we have not run many samples using the gas-ion source for tree rings, but we will report on investigations using the gas-ion source at the conference.

Gas Ion Source: The gas ion source is an interface which mixes CO_2 in the sample with a He carrier. The interface allows the gas pressure to be varied to maximize the ion current. The gas mixture flows through a capillary tube into the source over a Ti frit. The gas interacts at this surface with a Cs sputtering beam to produce negative ions. Typically, ion currents can be variable but are generally about 10-15μA C^-. The transmission of the machine under these conditions to the high-energy C^+ charge-state is about 35%.

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