^{14}C TERRESTRIAL AGES AND WEATHERING OF METEORITES FROM THE ALLAN HILLS REGION AND METEORITE HILLS, ANTARCTICA; A. J. T. Jull, S. Cloudt, E. Cielaszyk and D. J. Donahue. NSF Arizona AMS Facility, University of Arizona, Tucson, AZ 85721, USA.

A large number of meteorites have been collected from various blue ice fields in the Allan Hills region of Antarctica. These fields are named Main, Near Western, Middle Western and Far Western Icefields. The Elephant Moraine Icefield is located in the same area, and Meteorite Hills are located some 500km to the south. We have discussed previously evidence that the terrestrial ages of meteorites from these regions varies markedly [1,2]. In this paper, we present new ^{14}C ages from the Allan Hills Icefields, Elephant Moraine and Meteorite Hills, and discuss possible systematics to account for differences in the age distributions at these locations. The terrestrial age of a meteorite indicates the time it has resided on the Earth's surface[1-3] is important in determining the history of the meteorite. The precision of terrestrial age estimates based on any radionuclides limited by the accuracy to which the saturated activity of the nuclide in the meteorite is known [1,3]. The production of ^{14}C can vary with the depth and size of the object. ^{14}C as a function of accurate depth is known for the L5 chondrite, Knyahinya [4]. We used Knyahinya, Bruderheim and some other chondrites to establish a saturated activity reference level of about 51 dpm/kg for L-chondrites of radius 10-40cm[3,4]. The saturated activity for other classes of meteorites is scaled based on oxygen content [2,3]. Weathering gradually destroys meteorites, and in a given population where there is no other mode of removal, the resulting distribution for similar types of meteorites should be an approximately exponential decrease of meteorites with increasing age. This exponential assumption will not apply in some locations in Antarctica, where ice movement is known to transport meteorites over considerable distances [5].

Early workers considered that meteorites weathered rapidly in temperate climates [6], but our later reinvestigation of this study [3] determined that the ^{14}C age distribution of the meteorites was from zero to >40,000 yr. We have also studied ^{14}C ages of meteorites from arid and semi-arid regions such as Roosevelt County, New Mexico [7], the western Libyan desert [8], Algeria [9]and Western Australia [10]. In these areas meteorites of ages as old as >40,000 yr are observed, and the mean survival time at these locations is well over 10,000 yr. Most results from these sites other than the Libya [8] and Roosevelt County [7] show little departure from the expected exponential behavior [3].

Because of low storage temperatures, we expect Antarctic meteorites to be stored for long periods of time in or on the ice. In Antarctica, we observe samples both within the range of ^{14}C dating, up to 40-50Ka, and beyond. Nishiizumi and co-workers [1] summarized data on 67 meteorites from the Allan Hills Main Icefield, and most gave ^{36}Cl ages of chondrites of >100 Kyr, and up to 500 Kyr in a few cases. Twenty (~30%) were <70Kyr, and using ^{14}C, we can establish that only 5 meteorites out of the 27 analyzed for ^{14}C are <25Kyr. These results thus show similar statistics. The long terrestrial ages of the Main Icefield meteorites are explained by transport of the meteorites in flowing ice over large distances. By contrast, samples from the Far Western Icefield [11] and the Yamato site [12,13,14] show a much younger population of meteorites. At these locations, most of the samples date within the last 40 Kyr. In table 1, we present some new ^{14}C data from the Near and Middle Western Icefields and from Elephant Moraine. We can summarize the age distributions from different icefield by listing the number with terrestrial ages <25Kyr, and categorize sites by the number of such

younger falls. With this criterion, the icefields can be ordered in terms of number of young falls as follows, based on ^{14}C ages only:

Meteorite Hills	88%
Far Western	75%
Yamato	63%
Middle Western	30%
Elephant Moraine	28%
ALH Main	15%

Table 1: New ^{14}C terrestrial ages from Victoria Land, Antarctica.

Meteorite	Class	14C dpm/kg	Age (Ka)
Near Western Icefield			
ALH81015	H5	2.7±0.1	23.4±1.3
ALH81039	H5	16.2±0.2	8.7±1.3
Middle Western Icefield			
ALH81017	L6	1.26±0.17	31±2
ALH81018	L5	0.25±0.11	>44
ALH81022	H4	0.65±0.15	35±2
		1.5±0.4	28±2
ALH81023	L5	1.05±0.14	32±1.5
ALH81111	H6	1.6±0.1	27.5±1.5
ALH83004	L6	1.2±0.2	31±2
ALH83010	L3	0.61±0.12	36±2
ALH83029	H5	0.9±0.2	33±2
ALH83070	LL6	41.8±0.3	2.3±1.3
ALH84096	C4	49.0±0.5	0.55±1.3
Elephant Moraine			
EET87517	Ure	4.22±0.16	21.4±1.3
EET87536	L6	1.12±0.05	31.6±1.4
EET87549	L6	2.33±0.08	25.5±1.3
EET87554	L6	10.4±0.1	13.2±1.3
EET87556	L6	0.70±0.03	35.5±1.3
EET87566	L6	0.69±0.04	35.6±1.4
EET87578	L6	1.24±0.05	30.8±1.4
EET87720	Ure	3.13±0.6	23.8±2.0
Meteorite Hills			
META78001	H4	7.8±0.2	14.1±1.3
META78006	H6	11.3±0.3	7.8±1.3
META78010	H5	14.4±0.1	9.7±1.3
META78012	H5	18.0±0.2	7.8±1.3
META78019	H5	39.9±0.4	1.3±1.3

For the ALH Main icefield, the percentage of falls < 25Kyr is only 3% if all ^{36}Cl measurements are also included. In the case of the Far Western icefield there are few meteorites with less than saturated ^{36}Cl [1], indicating longer terrestrial ages. Meteorites at sites like the far Western icefield or Yamato cannot have been transported any significant distance in the ice, and most likely fell at the location where they were recovered. When pairing is also taken into account, these results allow us to deduce that the distribution of meteorite terrestrial ages can be related to ice flow patterns in the Allan Hills region.

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