Catalog of North Dakota Radiocarbon Dates

By
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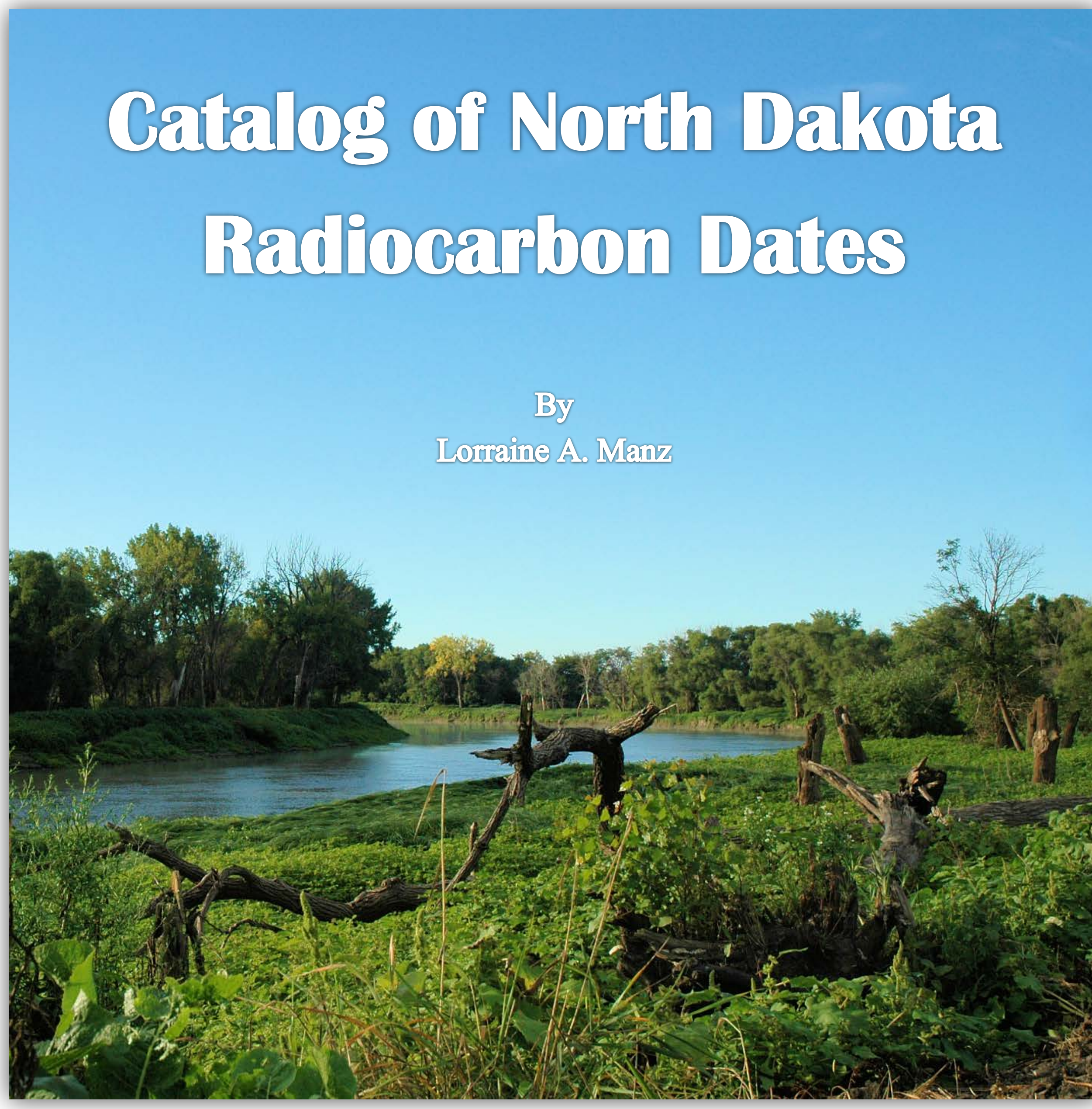

MISCELLANEOUS SERIES 92
NORTH DAKOTA GEOLOGICAL SURVEY
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2014 (updated March 2016)

Contents

Introduction to the Second Edition

Radiocarbon dating practices and technology have changed a great deal since the first edition of the Catalog of North Dakota Radiocarbon Dates was published in 1973. One of the most important of these was the introduction and subsequent ratification by the international radiocarbon community of standard reporting procedures in the late 1970s (Stuiver and Polach, 1977). The development of accelerator mass spectrometry (AMS) was another: its high sensitivity and small sample size requirements have enabled the range of radiocarbon dating applications to expand well beyond its "traditional" fields of geology and archaeology (Linick and others, 1989). Improvements in conventional radiocarbon dating methods have likewise enhanced precision and accuracy, particularly of calibration data.

This revised and updated edition of the catalog contains more than 350 radiocarbon dates for North Dakota, of which approximately 250 are new additions. The dates are separated into three categories: archaeologic, geologic, and invalid, which are presented on a trio of annotated Excel spreadsheets, accompanied by an explanatory text and a site map. Readers are encouraged to inspect the entries and inform the author of any errors, omissions, or new radiocarbon dates for inclusion in future updates. No attempt has been made to arrange the new geologic dates by association at this time.

The spreadsheets have some extra data fields for information that, for various legitimate reasons, was not reported in the first edition. Two of these ($\delta^{13}C$ and calibrated age) are in deference to the reporting conventions referred to earlier. (See explanatory text for definitions.) One data field not carried over from the old catalog is Stratigraphy. For many years after its launch in 1958, the main purpose of the journal Radiocarbon was to publish compilations of radiocarbon age measurements made by the world's laboratories and was the principal source of reference for such data. As Moran and his colleagues pointed out, however, these reports, like many others published at the time, were generally lacking vital stratigraphic detail. To avoid duplication of effort, additional stratigraphic information, if available, was therefore included in the catalog. Today, the number of radiocarbon dates has grown so large that few laboratories continue the practice of publishing lists and so finding relevant data requires a much broader search of the scientific literature. Most of the post-1973 references cited in this edition of the catalog are consequently to original works, all of which are available electronically and/or via interlibrary loan, often free of charge. Such convenient access to published research rules out the need to incorporate stratigraphic information in this edition of the catalog. To do otherwise would be difficult without appreciably complicating the presentation of the rest of the radiocarbon data.

Introduction to the First Edition

This catalog is a compilation of the approximately 90 radiocarbon dates from North Dakota that are known to us. For convenience of use, the compilation has been arranged in two parts. Part I is a complete list of the geologic dates with all available information on them. Most of the archaeological dates are not included in this list because of their limited geologic significance and because we could add no information not contained in [the journal] Radiocarbon. Part II consists of a) geologic dates arranged by geological association, b) archaeological dates, and c) dates that are meaningless because of contamination or misidentification of materials dated.

There are three principal reasons for our making this compilation. The first is to spare those working on the Quaternary of this area the necessity of compiling individual lists, with attendant duplication of effort. Second, there is seldom enough stratigraphic information given in the journal Radiocarbon or other reports of radiocarbon dates to permit persons unfamiliar with the dates to evaluate their interpretations. We have attempted to give the most complete stratigraphic information possible on each date to assist others in using the dates for their own work. For some dates, little additional information has been found. The third purpose for this compilation is to present information that is not available elsewhere about the validity and significance of the dates. All too seldom has an explicit statement been made in the literature indicating that a particular date is in error because of contamination.

We have left extra space at the end of each entry so that the user of the catalog can add his own notes and comments to modify ours or supplement the information given.

Explanation of data fields

Lab ID The identification code for the dating laboratory and the reference number assigned by it to the sample. See page 5 for a list of the laboratory codes included in this report.

Age (^{14}C yr BP) Conventional radiocarbon age (CRA) ± standard error (in ^{14}C years before present).

CRAs are calculated and reported according to the conventions recommended by Stuiver and Polach (1977) that include the following:

- Use of the Libby half-life of 5,568 years
- The assumption that the atmospheric ^{14}C level is constant
- The use of oxalic acid or a related secondary standard as the modern radiocarbon standard
- Correction for sample isotopic fractionation by comparison with PDB (see below)
- Ages are expressed in years BP (before present) where 0 BP is defined as AD 1950.

A CRA of less than 200 years may be reported as “modern”. Materials whose measured radiocarbon is indistinguishable from background (exceeds the maximum detection limits of the instrumentation) are reported as “> x”.

δ ^{13}C (‰) This is the correction factor that accounts for the isotopic fractionation of carbon by natural biochemical processes.

Fractionation refers to the preferential uptake of one isotope over another. Although the three isotopes of carbon (^{12}C, ^{13}C, and ^{14}C) are chemically identical, biological pathways tend to favor the lighter atoms. Accordingly, ^{12}C is preferred to ^{13}C, which in turn is preferred to ^{14}C. Because the effect is proportional to the differences in their masses, the fractionation of ^{14}C relative to ^{12}C is double that of ^{13}C.

The degree of fractionation in a sample is determined by comparing its ^{13}C/^{12}C ratio against that of a standard. The result, expressed as a δ^{13}C (deltaC13) value, is given by

$$\delta^{13}C = \left(\frac{(^{13}C/^{12}C)}{(^{13}C/^{12}C)_{PDB}} - 1 \right) \times 1000‰$$

where PDB (or VPDB [Coplen, 1994]) refers to the international PDB standard carbonate – a Cretaceous belemnite (*Belemnitella Americana*) from the Peedee Formation of South Carolina. Because the calcium carbonate from this fossil had an unusually high ^{13}C/^{12}C ratio, defined as zero on the ^{13}δC scale, most ^{13}δC values are negative. DeltaC13 values may be sample specific (preferred) or assumed.

By convention, radiocarbon measurements are normalized to $^{13}\delta C$ = -25‰ with respect to the international standard (Stuiver and Polach, 1977; Stenström and others, 2011).

A blank cell in this field indicates that the CRA is either uncorrected for isotopic fractionation (applies mainly to older reports) or the $\delta^{13}C$ value was omitted from the published data. It may be necessary to contact the dating laboratory to obtain this information.

Age (cal yr BP) Calibrated radiocarbon age (in ^{14}C years before present). Note: The expression "cal" in the field heading denotes calibrated radiocarbon ages, *not* calendar ages. Except where noted, age ranges correspond to 2σ statistics (95% probability). Multiple ranges are indicative of "wiggles" in the calibration curve – slight variations in amplitude that cause it to drift outside the statistical range limits defined by the CRA (Bowman, 1990, p. 46 ; Seuss, 1970).

Unlike CRAs, which are invariable, calibrated radiocarbon ages change as the data sets used to construct the calibration curves become more refined. It is important, then, to know which calibration curve was used to convert the CRA into a calibrated age. This information is usually included in the published report.

Lat, Long Location of sample collection site in decimal degrees.

Twp, Range, Sec PLSS location of sample collection site (Township, Range, and section number).

QQ PLSS aliquot parts (quarter section, quarter-quarter section, etc.).

County County in which the sample collection site is located.

Site name Name and/or description of the sample collection site/landform/locality.

Material dated Dateable materials include most organics, bulk soil or sediment, shells, groundwater, and iron. Charcoal is widely acknowledged as the most reliable material for dating because it is less susceptible to chemical alteration than most other materials and does not require complex pretreatments to remove post-depositional contaminants (Libby, 1955).

Depth Depth below the surface (in meters) at which the sample was collected. Depths originally reported in feet or inches are shown in parentheses. For core samples, depths are measured from the top of the core. Collection depths for lake sediment samples are from either the lake or sediment surface. Additional information is provided on the spreadsheet.

Collector(s) Name(s) of sample collector(s)

Significance Comments by the collector or summarized remarks by the authors of cited publications (see below) on the geologic significance of the date.

Reference Publication(s) in which the radiocarbon data is reported.

Radiocarbon laboratory identification codes used in this report (Radiocarbon, 2014)

A Laboratory of Isotope Geochemistry
Geosciences Department
University of Arizona
Tucson, AZ 85721
Tel: +1 520 621 1638; Fax: +1 520 621 2672

AA NSF-Arizona AMS Facility
1118 E. Fourth Street
P.O. Box 210081
The University of Arizona
Tucson, AZ 85721-0081
Tel: +1 520 621 6810; Fax: +1 520 621 9619
http://www.physics.arizona.edu/ams/front.htm

Beta Beta Analytic, Inc.
4985 SW 74 Court
Miami, FL 33155
Tel: +1 305 667 5167; Fax: +1 305 663 0964
http://www.radiocarbon.com/

CAMS Center for Accelerator Mass Spectrometry
Lawrence Livermore National Laboratory
P.O. Box 808, L-397
Livermore, CA 94550
Tel: +1 510 422 9670; Fax: +1 510 423 7884
https://cams.llnl.gov/

ETH ETH/AMS Facility
Institut für Teilchenphysik
Eidgenössische Technische Hochschule Hönggerberg
CH-8093 Zürich, Switzerland
http://www.ams.ethz.ch/

GX Geochron Laboratories
711 Concord Avenue
Cambridge, Massachusetts 02138, USA
Tel: +1 617 876 3691; Fax: +1 617 661 0148
http://www.geochronlabs.com/

I[a] Teledyne Isotopes (Formerly Isotopes, Inc.)

L[a] Lamont-Doherty

M[a] University of Michigan

SI[a] Smithsonian Institution

SMU[a] Southern Methodist University

TAM[a] Texas A & M University

Tx[a] University of Texas

UGa Center for Applied Isotope Studies
The University of Georgia
120 Riverbend Road
Athens, GA 30602-4702
Tel: +1 706 542 1395; Fax: +1 706 542 6106
http://cais.uga.edu/

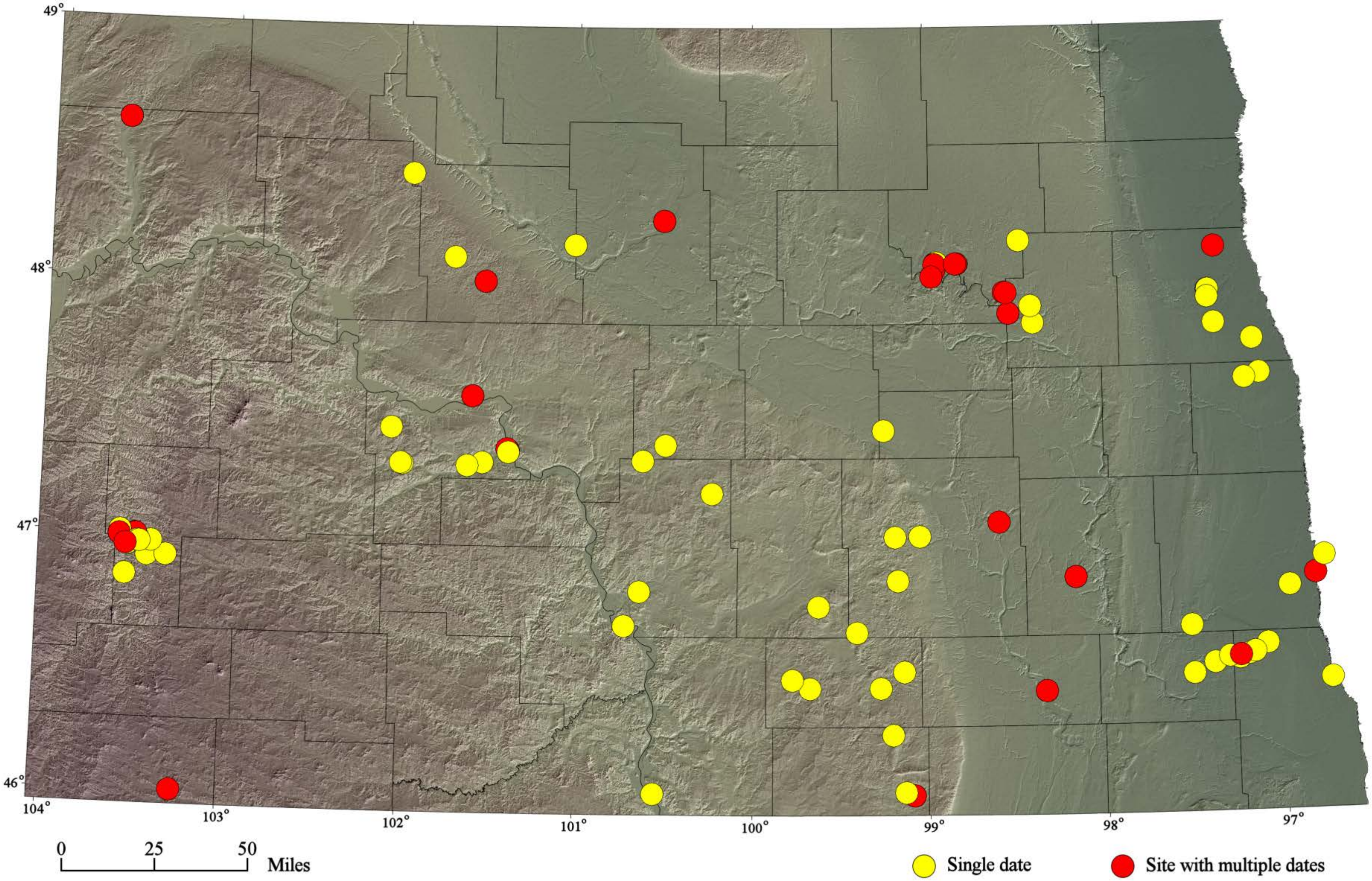
W[a] USGS, National Center

WHOI[b] National Ocean Sciences AMS Facility (**NOSAMS**)
Woods Hole Oceanographic Institution
McLean Laboratory, Mail Stop #8
Woods Hole, MA 02543-1539
Tel: +1 508 289 2554; Fax: +1 508 457 2183
http://www.whoi.edu/nosams/

WIS[a] University of Wisconsin

Y[a] Yale University

[a] Laboratory is closed, no longer measuring ^{14}C or operating under a different identification code.
[b] Listed in *Radiocarbon* as NOSAMS.



Sample collection sites for geologic radiocarbon dates

North Dakota Geological Survey
Miscellaneous Series MS 92

Radiocarbon data tables

The radiocarbon data are tabulated on a set of three Excel spreadsheets. Use the links below to access the files.

To view or download Table 1 (archaeologic radiocarbon dates) click here
To view or download Table 2 (geologic radiocarbon dates) click here
To view or download Table 3 (invalid dates) click here
To view or download all three tables click here

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