RECORD OF MISSISSIPPI RIVER DIVERSION IN THE MORTON LOESS OF ILLINOIS

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ABSTRACT.—Diversion of the Ancient Mississippi River in Bureau County, Illinois, by the advancing Shelbyville glacier produced a change in the mineral composition of the loess being deposited on the bluffs of the valley below this point. The stratigraphic position of the change in mineral composition has been identified by X-ray diffraction analyses of the clay minerals. Radiocarbon dates from above and below this stratigraphic position are used to date the diversion at 21,000 ± 500 radiocarbon years.

A geologic event of particular significance produced by the advancing Shelbyville (Woodfordian) glacier in Illinois was the diversion of the Mississippi River from the channel it had occupied at least since the withdrawal of the Illinoian glaciers. This diversion of the Ancient Mississippi River by the glacier has been described and previous work summarized by Shaffer (1954). The location of the ancestral stream as it existed before this major diversion to its modern location is shown in Figure 1, and on a recent map by Frye, Glass, and Willman (1962, p. 8). Evidence of this diversion of the Mississippi River is recorded in the Morton Loess—a body of silt that was deposited, largely by wind action, during the advancing phase of the Shelbyville glacier.

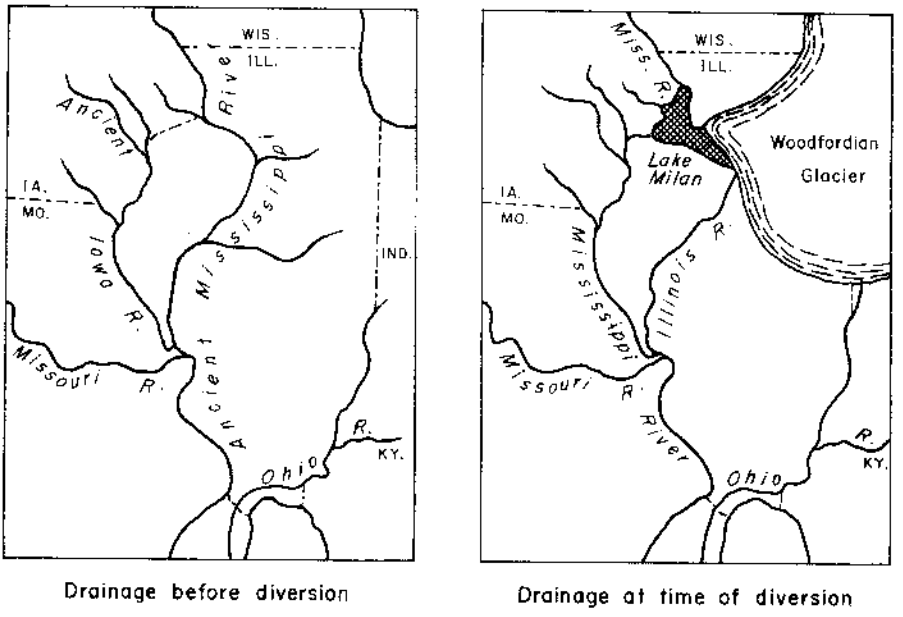

FIGURE 1.—Maps showing the position of Ancient Mississippi River before diversion and at the time the stream was diverted.

Inasmuch as the Morton Loess was deposited during the advance of the Woodfordian glacier and its accumulation at any particular place was not terminated until it was buried beneath the advancing glacier, the point in time when the Ancient Mississippi River was blocked and diverted to its present course falls within the time of deposition of this stratigraphic unit. But, because the Morton Loess consists of eolian silt that was deposited relatively rapidly and essentially continuously, field examination offers no clues, such as a physical break observable in outcrop sections, to mark the time of diversion.

A possible means of defining precisely the point within the Morton Loess that coincides in time with the diversion of the Mississippi River to its present course was suggested by the results of a regional study of the mineralogy of the loesses of Illinois (Frye, Glass, and Willman, 1962). In that study it was shown that the outwash transported by the Ancient

TABLE 1.—Analyses of Samples from Richland Creek and Danvers Sections in Illinois (analyses by H. D. Glass)

Depth (inches) below top of Morton Loess	Sample No.	Magnetic Susceptibility[1]	X-ray diffraction counts per second (bulk sample)		Percent clay minerals in less than 2 micron fraction		
			Calcite	Dolomite	Montmorillonite	Illite	Kaolinite and Chlorite
Richland Creek Section							
Overlying till	P-566	--	20	105	6	64	30
4	P-1354	3.7	14	280	41	37	22
8	P-1353	2.2	38	265	41	36	23
12	P-1352	3.8	58	185	43	34	23
16	P-1351	3.1	18	90	49	32	19
20	P-1350	7.9	—	220	62	21	17
24	P-1349	9.6	5	185	62	22	16
28	P-1348	9.0	10	135	61	24	15
32	P-1347	9.8	—	200	60	24	16
36	P-1346	8.4	—	125	61	25	14
40	P-1345	15.7	—	240	61	25	14
44	P-1344	14.4	6	100	64	22	14
48	P-1343	8.8	—	150	64	21	15
Danvers Section							
Overlying till	P-558		10	145	10	67	23
4	P-1339		—	90	28	49	23
8	P-1338		7	180	42	34	24
12	P-1337		6	110	37	41	22
16	P-1336		—	85	31	42	27
20	P-1335		7	115	50	27	23
24	P-1334			130	52	27	21
28	P-1333		—	120	[2]	[2]	[2]
32	P-1332		—	90	[2]	[2]	[2]
36	P-1331		—	90	50	28	22
40	P-1330		—	80	52	26	22
44	P-1329		—	135	[2]	[2]	[2]
48	P-1328		—	55	52	22	26
52	P-1327		—	45	54	21	25
56	P-1326		—	55	60	19	21
60	P-1325		—	40	66	20	14

[1] Analyses by R. L. Jones, Department of Agronomy, University of Illinois.
[2] Calculation impractical.

Mississippi River was derived in part from the headwaters region of the drainage system that was located to the northwest of Illinois. This outwash was the source material for the Roxana loess in central and western Illinois, and that loess has been shown to contain a high percentage of montmorillonite among the clay minerals. In contrast, outwash in valleys farther east, which derived most of their outwash directly from the Lake Michigan glacial lobe, served as a source for loess with a much smaller percentage of montmorillonite and a much higher percent of illite and chlorite. Furthermore, the tills in the regions to the east and west of the Mississippi show the same contrast in montmorillonite, illite, and chlorite content (Willman, Glass, and Frye, 1963). It is concluded from these facts that along the Illinois River valley of central Illinois, which prior to diversion had been an eastern loop of the Ancient Mississippi, the percentage of montmorillonite in the Morton Loess should be markedly less after the diversion and the resultant decrease in montmorillonite in the outwash. Analyses previously made from the upper and lower parts of the Morton Loess at two sections indicated that the montmorillonite content was significantly lower in the upper part.

To pinpoint the stratigraphic position of the glacial blocking of Ancient Mississippi River within the loess unit, closely spaced samples were collected through the entire thickness of the Morton at sections where the silts and tills above and below had also been studied (Richland Creek Section and Danvers Section of Frye, Glass, and Willman, 1962). These samples were analyzed by X-ray diffraction, using the same methods described for the previous work. In addition, magnetic susceptibility determinations were made for the Richland Creek Section by Dr. R. L. Jones, Agronomy Department, University of Illinois. The results of these analyses are given in Table 1.

The sharp break in montmorillonite content and magnetic susceptibility values is quite apparent between 16 and 20 inches from the top of the Morton and thus there is basis for concluding that the diversion of the Mississippi River occurred only a short time before this distinct mineralogical change appeared in the loess deposit. Mineralogical changes are also known to occur in the lower part of the Peoria Loess beyond the Shelbyville Moraine (Frye, Glass, and Willman, 1962) and it is probable that sufficiently detailed sampling and analysis of the lower part of the Peoria in the lower Illinois Valley would define the precise stratigraphic position of the diversion.

A particular problem exists in any attempt to equate time with stratigraphic position within any unit that has been overridden by a glacier. In this study we have met this problem by utilizing sections where fossil moss occurs in place at the top of the Morton Loess and below the Shelbyville till, thus showing that the Shelbyville glacier passed over the probably frozen Morton Loess without eroding it. Also, there may have been a decrease in rate of deposition of the Morton after the glacial blocking deprived the Illinois Valley of part of its source of outwash.

The advancing Shelbyville glacier approached the broad valley of the Ancient Mississippi at an oblique angle and the event of blocking and diversion required some years for completion. Ponding of the drainage formed a lake, called Lake Milan by Shaffer (1954), and overflow from this lake at the col west of Rock Island established the Mississippi River in its present position. Although some material from the northwest may have continued to be available for transportation down the ancient course the amount was substantially reduced after the ice dam was complete. Furthermore, during the deposition of the lower part of the Morton Loess while the Ancient valley was unrestricted, significant quantities of outwash from the advancing Lake Michigan lobe glacier must have been incorporated in the deposits of the source valley. Both before and after the diversion an unknown quantity of sediment was contributed to the valley by erosion of local bedrock and earlier Pleistocene deposits, the latter of which contained some montmorillonite. Furthermore, an increment of the Morton Loess was undoubtedly derived from "blow over" from the Mississippi Valley a short distance to the west, and some of the montmorillonite was derived from alteration of chlorite to vermiculite, part of which is indistinguishable from montmorillonite. For these reasons the contrast in the mineral composition of the upper and lower parts of the Morton Loess is much less than the contrast in the mineral composition of the tills from the western source and those from the Lake Michigan lobe (Willman, Glass, and Frye, 1963). Nevertheless, the sharp discordance in mineral composition shown by the analyses listed in the table serves to define the point of major change in outwash source.

Placement of the diversion in this stratigraphic position furnishes a basis for placement in time. Radiocarbon dates from central Illinois (Frye and Willman, 1960), including dates from the Danvers Section that was sampled, indicate that the top of the Morton is only slightly older than 20,000 radiocarbon years B.P. Also, dates from the Farmdale silt that occur immediately below the Morton Loess indicate that Morton deposition could not have started before 22,000 to 22,500 radiocarbon years B.P. These limiting dates, together with the stratigraphic evidence, indicate that the Mississippi River was diverted to its present course by the advancing Woodfordian glacier 21,000 ± 500 radiocarbon years B.P.

Literature Cited

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