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HUMAN SETTLEMENTS AND THE LAST DEGLACIATION IN THE FRENCH ALPS[1]

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ABSTRACT. According to most geological and geomorphological studies, the maximal advance of the Würmian glaciers in the French Alps occurred at least before 40 ka BP and cannot be dated by ^{14}C. Scientists believed that this dating method could be used for dating the last glacial advance and late deglaciation in the region. The scarce and scattered ^{14}C dating results available from geological samples do not confirm an early (*ca.* 18 or 20 ka BP) age for the total cooling of the ice nor do they prove that residual ice sheets remained at low elevations. Attempting to solve this chronological problem, we compiled current archaeological knowledge of the oldest Late Paleolithic sites. A review of their ^{14}C results shows that no site older than 15 ka BP (with Gravettian, Solutrean or early Magdalenian industries) can be found east of the Saône-Rhône Valley, even at low elevations. Only rare sites, dated to *ca.* 14.5 ka BP, may be found close to the mountain regions that were suddenly occupied around the beginning of the Bølling period (*ca.* 13.5 ka BP). Thus, it seems that the eastern Alps offer no evidence for direct association between glacial retreat and human settlement or simultaneous occurrence in early or late deglaciated areas.

INTRODUCTION

Each year, many new Middle and Upper Paleolithic archaeological sites are discovered in Europe. We could infer from this that *Homo sapiens* wanted to occupy all the available terrain across much of the European land mass, and was limited or driven back only by the developing inland ice sheets of Northern Europe. To test this hypothesis, we decided to study the distribution of human settlements linked with the retreat of the glaciers. A quasi-contemporaneity between glacial retreat and new settlements would confirm the likelihood that *Homo sapiens* branched out to every possible location; on the other hand, a delay in the occupation of vacant areas would suggest that factors other than deglaciation may have governed the distribution of settlements.

Conclusions related to widespread human settlement have often been reached for central and eastern Europe in relation to the expansion and recession of the Scandinavian glaciers. To draw the same conclusions for the western European mountains, one must first consider the types of glaciers, the dates of their last retreats, as well as the sources of information. Only then would it be possible to assess the known Paleolithic sites and to evaluate their distance from the corresponding glacial front.

GLACIAL HISTORY OF THE FRENCH ALPS

The French Alps are made up of a central mountain massif with high summits (*ca.* 4000-m elevation) surrounded by several smaller massifs at lower elevations (*ca.* 2000 m), and huge piedmont plains, cut by deep valleys. Because of these contrasting landscapes, the accumulated ice encircled the higher peaks, covered the high plateaus with glacial ice caps and spread long ice sheets over mountain valleys and their extensions.

The shape of the glacial structures of the Alpine massif, often simplified into an ellipse with linear outlines, comparable to the glaciers of Northern Europe or North America, is, in fact much more complex. The ice spread far into the peripheral massifs and into the valleys or onto the plains. Thus, the front of the last major glacial advance of the Würmian can be characterized as an extremely sin-

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uous line (Fig. 1). To reconstruct this complex scenario, we must make a systematic investigation of the surface evidence. The highly varied topography, differential glacial melting, catchment basins formed to collect the downslope water flow and ice masses accumulated at the bottom of the deeply carved valleys all indicate that glacial movements were complex throughout the region, and may have varied from north to south, and from one valley to another.

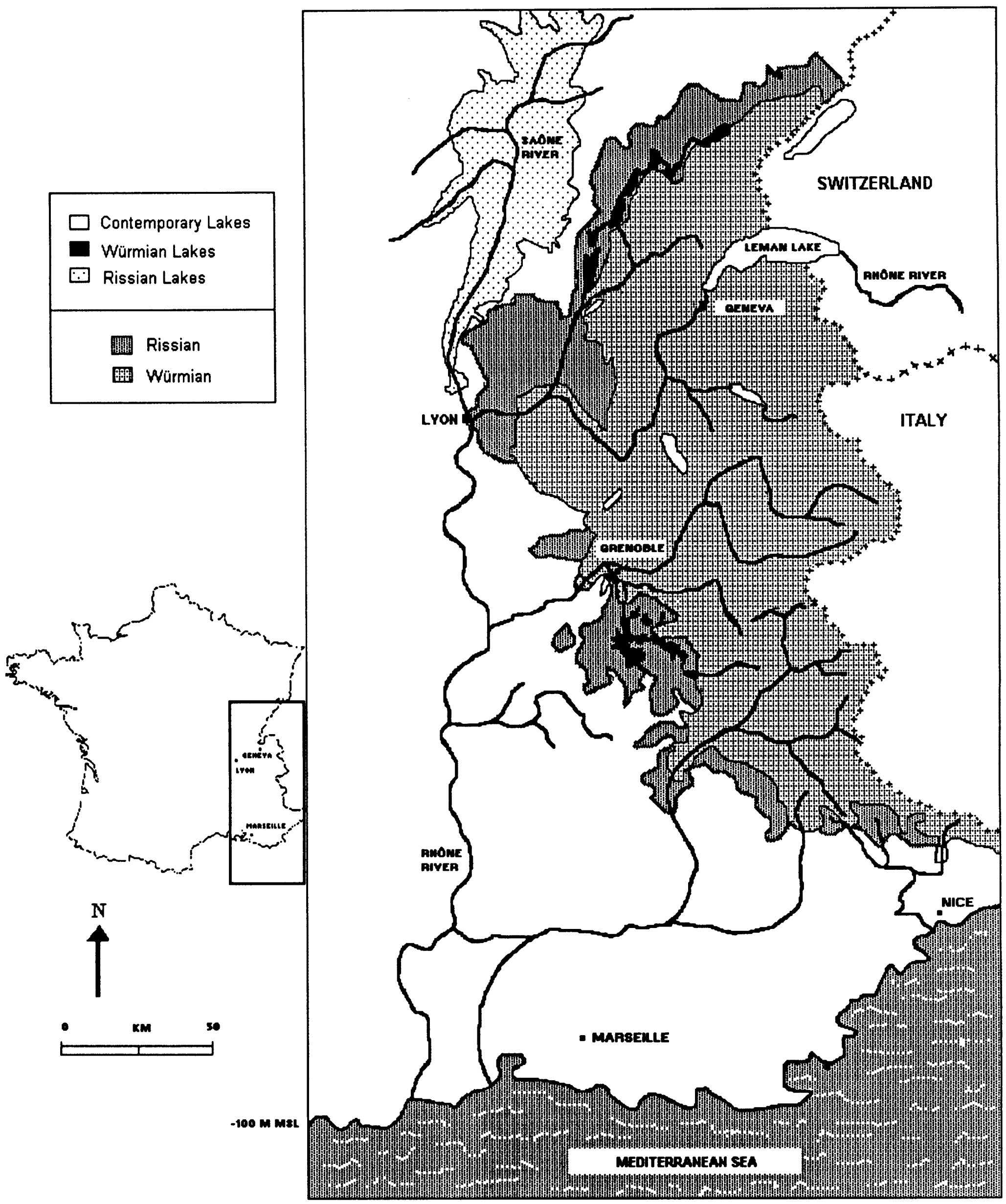

Fig. 1. Maximum of glacial front of the last glaciation in the French Alps

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Global climate change influenced Alpine glaciers, with many more fluctuations than boreal ice caps, as their relatively low mass must have rendered them vulnerable to small climate variations. The relief and latitude of the massif affected the rhythm of glacial advances and retreats, which were unrelated to glacial events and behavior in other areas. Perhaps humidity also played a more significant role in the high massif than in lower elevations where precipitation is not blocked by high peaks. Thus, it is difficult to reconstruct the paleogeography of glacial movements and establish their chronology at the same time, both of which are crucial to understanding the process of the first human settlements after deglaciation. We must then turn to all the available geologic and archaeological data.

In the French Alps, the last (Würmian) glaciation was smaller than its predecessor (Rissian) (Mandier 1984; Monjuvent 1971). On the whole western arc, Rissian moraines extended farther than did Würmian moraines (Fig. 1), but neither the precise date of the Rissian maximum, nor the number of major advances and retreats during the Riss is known, despite numerous studies spanning more than a century (Mandier 1984). Figure 1 shows the different maxima of the Rissian and Würmian glaciations. The current landscape was shaped more by the Rissian glaciation than by the Würmian; its great curves are about the same as those of the Riss-Würm interglacial. With the similarity of landscapes, it is not surprising, then, that Middle Paleolithic sites, whose dates are older than the Würmian glaciers, are found where late Magdalenian sites were settled some 80 ka later.

During the Würmian, the earlier of two main glacial advances in the western French Alps, was the most extensive. Yet, in certain frontal regions, as in the vicinity of Lyon, for example, the difference between the two borders of terminal moraines is clearly visible, yet at slightly higher elevations, no difference can be seen between these two stages. Thus, some authors believe that only one long oscillating Würmian advance affected the piedmont area (Monjuvent and Nicoud 1988).

In recent years, much research has been done on the end of the last glacial retreat, in the middle Rhône River Valley and Lac Léman basin (Arn 1984; Mandier 1984; Monjuvent 1988). A rhythmic retreat through numerous stages of halting, abandonment of sheets of stagnant ice and formation of kame terraces and temporary lakes were noted (Fig. 2). The absolute date of the last retreat has not yet been established, but it seems to date from *ca.* 15–18 ka BP in the most meridional parts of the Alps (Jorda, Rosique and Evin 1980) or in the Jura massif (Campy and Richard 1988). Mandier (1984, 1988) argues for a recent age on the basis of the elevations of the fluvioglacial terraces of the central Isère and Rhône glaciers, and from ^{14}C dates from bones found in those terraces (Table 1).

Radiocarbon dating the glacial record

Few possibilities exist for direct ^{14}C dating of glacial or fluvioglacial deposits. The presence of carbon in these landforms is extremely rare. Bones are always absent from moraines, as they are too fragile to withstand the crushing transport of glacial debris. All bone dates at *ca.* 25–40 ka BP are from Ursidae in the karstic networks of Le Bugey, La Chartreuse or Le Vercors massifs (Table 1), but their relation to glaciation is uncertain. Charcoal has never been found, and the rare piece of wood that is found is totally unreliable, because it may have been redeposited by previous interglacial or interstadial activity.

Geological dating

As direct dating of glacial landforms is impossible, we can date either the interstadial features underlying or adjacent to the moraines, or the fluvial terraces linked with the runoff outlets of the melting glaciers. Table 1 lists two series of dates. The first series, at *ca.* 25 ka BP or older, were

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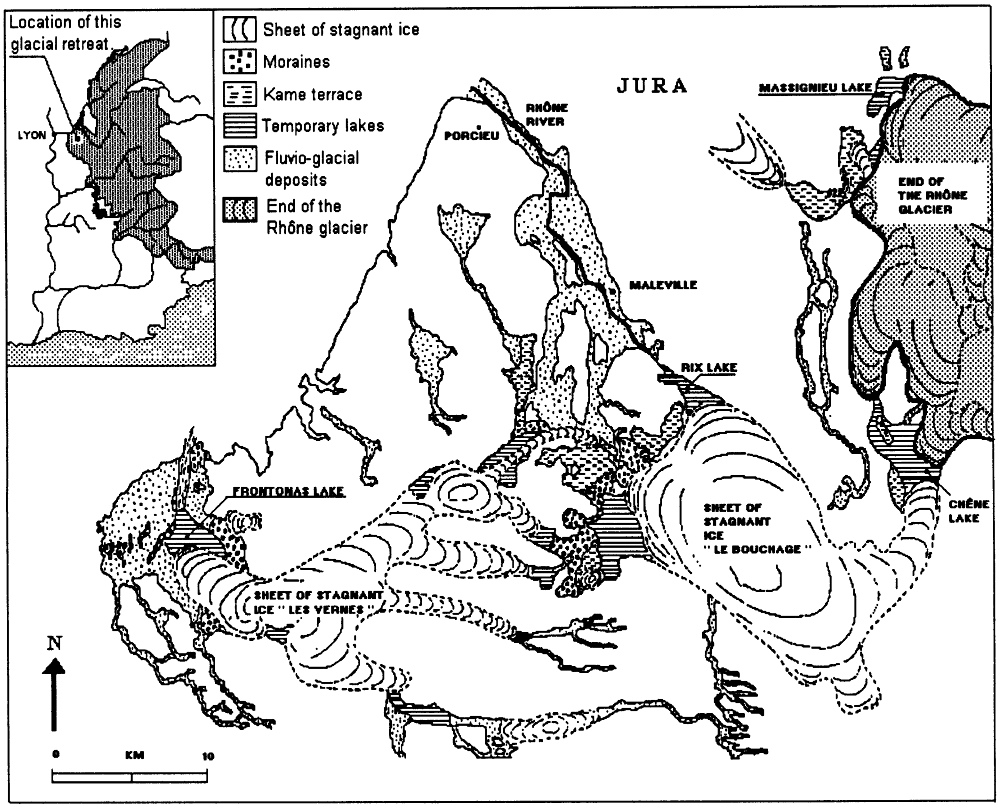

Fig. 2. One phase of the Rhône glacial retreat, showing that several sheets of stagnant ice and fluvioglacial deposits formed temporary lakes

obtained from peat sediments collected in the Chablais region in the Dranse Valley close to Lac Léman, which were associated with the Rhône glacier (Blavoux and Brun 1966). However, these dates cannot confirm, with absolute certainty, the oldest age of the last glacial advance. Another series of dates, between 25 and 17 ka BP, at Pugneux close to Lyon, on peat deposits adjacent to the end moraine of the Würmian Rhône glacial maximum near Lyon (Evin, Marien and Pachiaudi 1976), disagrees with geological evidence placing the maximum earlier than 35 ka BP. Dates between 45 and 60 ka BP from an interstadial occupation underlying a glacial terrace in the region of Chambéry-Grenoble suggest that this Würmian maximum occurred *ca.* 40 ka BP (Hanss 1982). However, these dates are not reliable because the samples were probably contaminated, and some were measured with isotopic enrichment. One date (Ly-3814: 26,470 ± 920) on fragments of wood from a large lakeside terrace at the base of the Rhône River Valley, near Malville (Table 1), indicates a minimal age of several thousand years for the duration of the last retreat, but this can be a matter of redeposited material.

These dating results are contradictory. To date glacial or fluvioglacial landforms, there remains only ^{14}C dating of material uncovered in associated fluviatile terraces. Thus, we obtained a series of dates from low terrace basins of the Rhône River and from alluvial cones to the south of Lyon, on fluvioglacial material related to the last advance of the Rhône glacier. The dates range from 18 to 20 ka BP (Table 1), and they derive from bones or other organic material contained in clays from the first

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stage of retreat (Grenay stage). The youngest date: Ly-4818: 14,090 ± 120 BP from Montalieu-Porcieu probably relates to one of the last stages of Rhône glacial retreat (Morestel stage) (Fig. 2) (Mandier and Piegay 1991).

Obtaining a minimum for a terminal age of a glacial retreat can be achieved by dating paludal or lakeside terraces, for example, in the Lac Léman region. Dates from the Allerød period are of little

TABLE 1. Radiocarbon Dates from Geological Sites of the French Alps, Jura Massif and Saône-Rhône Valley from 40–11.5 ka

Region	Lab no.	Site	Material	Layer/Level	^{14}C age (yr BP)
Bugey	Ly-4166	Grotte du Pissoire	Bone	Layer 1	24,360 ± 530
Bugey	Ly-4165	Grotte du Pissoire	Bone	Layer 4	31,000 ± 1000
Bugey	7 Ly dates	Lac de Cerin	Peat	Boring from 691–1048 cm	10,500 ± 180 to 13,680 + 720
Bas Dauphiné	Ly-4184	Montalieu-Porcieu	Bone	Terrace	14,090 ± 120
Bas Dauphiné	Ly-3814	Malville	Wood	Boring −20 m	26,470 ± 920
Bas Dauphiné	7 Ly dates	Le Grand Lemps (Clerc 1988)	Peat	Boring from 4.7–15.1 m	12,150 ± 150 to 14,670 ± 180
Chablais	4 Gif dates	Sionnex (Delibrias *et al.* 1969	Peat	Boring from 31–187 m	23,500 ± 1200 to 26,200 ± 1200
Chablais	Lu-1723	Abri du Salève	Charcoal	Paleosol	13,000 ± 100
Chablais	ETH-4532	Grotte du Barée	Bone	Unknown	38,470 ± 810
Chablais	Ly-2530	Armoy	Peat	Fluviatile sediment	≥35,000
Chartreuse	Ly-5373	Balme à Colomb	Bone	Boring	≥33,000
Chartreuse	Ly-3 / OxA-3946	Balme à Colomb	Bone	Square W4	24,160 ± 370
Chartreuse	Ly-3315	Trou du Glaz	Bone	Single layer	24,300 ± 600
Vercors	Ly-167	Prélétang	Bone	Layer 9	≥32,000
Vercors	Ly-2811	Balme Rousse	Bone	Base of filling	26,000 ± 1500
Oisans	Ly-1647	Chonas	Wood	Middle terrace	11,530 ± 260
Oisans	Ly-2146	Les 2 Alpes-Côtes Brune	Peat	Summit	12,310 ± 150
Oisans	Ly-2147	Les 2 Alpes-Côtes Brune	Peat	Base	12,890 ± 180
Oisans	Ly-2401	La Muzelle II	Clay	Boring −5.4 m	13,460 ± 390
Royans	Ly-2621	St. Hilaire du Rozier	Peat	−2 m	13,980 ± 250
Royans	Ly-2622	St. Hilaire du Rozier	Clay	−3.7 m	15,200 ± 250
Royans	Ly-5014	St. Hilaire du Rozier	Clay	−13 m	22,000 ± 350
Royans	Ly-5197	St. Hilaire du Rozier	Clay	Base	30,000 ± 500
Royans	Ly-3208	St. Julien de Ratz	Peat	−680 cm	13,100 ± 400
Royans	Ly-3210	St. Julien de Ratz	Peat	−710 m	12,580 ± 540
Royans	Ly-2983	St. Julien de Ratz	Peat	−725 cm	12,470 ± 320
Lyonnais	18 Ly dates	Les Echets (Evin *et al.* 1985	Lacustrine sediment	Boring from 4–24 m	11,910 ± 350 to 24,500 ± 500
Lyonnais	5 Ly dates	Pugneux (Evin *et al.* 1985	Plant debris	Fluviatile sediment	17,300 ± 510 to 24,110 ± 900
Lyonnais	Ly-723	Chasse sur Rhône	Bone	Top terrace	12,120 ± 180
Lyonnais	Ly-653	Chasse sur Rhône	Bone	Basal terrace	14,350 ± 290
Lyonnais	Ly-360	Saint Maurice l'Exil	Bone	Middle terrace	18,800 ± 490
Valentinois	Ly-4458	Cône Drôme River	Clay	Boring −8.6 m	11,850 ± 400
Valentinois	Ly-5529	Cône Roubion River	Clay	Boring base	15,550 ± 260
Valentinois	Ly-1689	Salaise sur Sanne	Bone	Boring −16 m	14,110 ± 620
Valentinois	Ly-1690	Salaise sur Sanne	Bone	Boring −17 m	20,370 ± 460
Provence	Ly-6388	La Peyrerie	Wood	Fluvioglacial sediment	18,600 ± 200
Provence	Ly-6387	La Peyrerie	Wood	Fluvioglacial sediment	17,680 ± 130

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interest, because they are largely younger than the last ice retreat. Thus, despite much research over a 30-yr period, the date of the last glacial retreat in the French Alps remains inaccurate, based only on geological data.

Archaeological Dating

The rare carbon samples directly linked to glacial formations are most often archaeological remains, which can provide the most precise age information. Lithic artifacts are a stable material, and are important for dating, even if typological dating is often inaccurate. Archaeological sites from the plain are often covered with thick Holocene deposits. In the mountains, rock shelters almost exclusively provide either bone or charcoal samples for dating. Such samples are important, for, generally, they are not subject to major disturbances, and thus, to dating uncertainties arising from redeposited material. Consequently, archaeological material usually offers better guarantees for successful ^{14}C dating than does geological material.

Archaeological Sites in the French Alps

We are aware of *ca.* 100 sites in the French Alps, the Jura Massif and the Saône-Rhône Valley for the Tardiglacial; 31 of them have been ^{14}C-dated (Table 2). The geographical distribution is erratic (Fig. 3). Numerous sites are located in the Saône-Rhône Valley and along the margins of the smaller peripheral mountain massifs (Chartreuse, Vercors, Bugey) adjacent to areas of major erosional tracks such as where the Rhône and Isère River Valleys fan out. A few sites are in the interior of the massifs at medium elevation, but there are no sites in the central massifs and only a few in the south. It is always possible that the absence of sites is due more to lack of knowledge than to lack of settlements; however, the disparity between the west and east of the chain is, in itself, significant. Figure 3 shows that most sites are located in the west, particularly in the southwest, of the Saône and Rhône River Valleys.

TABLE 2. Radiocarbon Dates from Archaeological Sites of the French Alps, Jura Massif and Saône-Rhône Valleys from 25,000–10,500 BP

Lab no.	Material	Site (no. in Fig. 3)	Layer / Level	^{14}C age (yr BP)	Culture
Ly-2161	Bone	Arcis sur Cure (1)	Layer V	20,150 ± 500	Gravettian
BM-1819	Burned bone	Arcis sur Cure (1)	Layer V	22,550 ± 350	Gravettian
Ly-894	Bone	Crest (2)	Single level	12,850 ± 240	Magdalenian
Ly-314	Burned bone	Solutré (3)	Layer L13	16,440 ± 300	Solutrean
Ly-316	Bone	Solutré (3)	Layer L13	17,350 ± 300	Solutrean
Ly-317	Bone	Solutré (3)	Boring C	24,050 ± 600	Perigordian
Ly-312	Bone	Solutré (3)	Boring B, Level 6	28,650 ± 1100	Perigordian
Ly-313	Bone	Solutré (3)	Boring B, Level 6	22,650 ± 500	Perigordian
Ly-392	Charred bone	Solutré (3)	Level P16	13,350 ± 350	Magdalenian
Ly-393	Bone	Solutré (3)	Square P16	12,580 ± 250	Magdalenian
Ly-560	Bone	Solutré (3)	Boring B, Level 6	30,400 ± 0	Magdalenian
Ly-561	Bone	Solutré (3)	Boring B, Level 6	23,200 ± 700	Perigordian
Ly-562	Bone	Solutré (3)	Boring Terre Seve	21,600 ± 700	Perigordian
Ly-1530	Bone	Solutré (3)	–1.65 to –1.70 m	13,680 ± 240	Magdalenian
Ly-1531	Bone	Solutré (3)	–1.70 to –1.75 m	13,710 ± 230	Magdalenian
Ly-1532	Bone	Solutré (3)	–1.80 to –1.90 m	14,360 ± 280	Magdalenian
Ly-1533	Bone	Solutré (3)	–2.40 to –2.50 m	19,590 ± 280	Solutrean
Ly-1534	Bone	Solutré (3)	–2.10 to –2.50 m	17,310 ± 470	Solutrean
Ly-309	Charred bone	Vignes ChateauBeau(4)	Hearth	24,150 ± 550	Perigordian
Ly-310	Charred bone	Vignes ChateauBeau(4)	Hearth	21,100 ± 1300	Perigordian

TABLE 2. (Continued)

Lab no.	Material	Site (no. in Fig. 3)	Layer / Level	^{14}C age (yr BP)	Culture
Ly-311	Bone	Vignes ChateauBeau(4)	Hearth	22,900 ± 600	Perigordian
Ly-2150	Charred bone	Goutte Roffat (5)	Ashy level	10,860 ± 210	Magdalenian
Ly-3092	Charred bone	Goutte Roffat (5)	Level 1	13,530 ± 260	Magdalenian
Ly-3093	Charred bone	Goutte Roffat(5)	Level 2a	12,720 ± 180	Magdalenian
Ly-3094	Charred bone	Goutte Roffat (5)	Level 2b	12,420 ± 320	Magdalenian
Ly-3095	Charred bone	Goutte Roffat (5)	Level 2c	12,090 ± 170	Magdalenian
Ly-3096	Charred bone	Goutte Roffat (5)	Level 3, Pit 1	11,940 ± 280	Magdalenian
Ly-3097	Charred bone	Goutte Roffat (5)	Level 3, Hearth	12,150 ± 200	Magdalenian
Ly-3098	Charred bone	Goutte Roffat (5)	Level 3, Pit 2	12,330 ± 300	Magdalenian
Ly-2152	Charred bone	Vigne Brun (6)	Surface	16,180 ± 250	Magdalenian
Ly-2151	Charred bone	Vigne Brun (6)	Hearth	19,500 ± 480	Perigordian
Ly-2153	Charred bone	Vigne Brun (6)	Hearth	20,840 ± 390	Perigordian
Ly-2637	Charred bone	Vigne Brun (6)	Hearth 010	23,450 ± 690	Perigordian
Ly-2638	Charred bone	Vlgne Brun (6)	Hearth	21,580 ± 600	Perigordian
Ly-2639	Charred bone	Vigne Brun (6)	Hearth 016	23,230 ± 760	Perigordian
Ly-2640	Charred bone	Vigne Brun(6)	Hearth	23,500 ± 1000	Perigordian
Ly-391a	Charred bone	Pré Brun (7)	Hearth	18,520 ± 500	Perigordian
Ly-391b	Charred bone	Pré Brun(7)	Hearth	24,900 ± 2000	Perigordian
Ly-3079	Bone	Cabones (8)	Lower level	11,520 ± 191	Magdalenian
Ly-2296	Bone	Cabones (8)	Lower level	12,620 ± 250	Magdalenian
Ly-1863	Ivory	Mère Clochette (9)	Red level	25,800 ± 700	Perigordian
Ly-440	Bone	Chaumois Boivin (10)	Level C	12,040 ± 270	Magdalenian
Ly-497	Bone	Arlay (11)	Level G	15,320 ± 370	Magdalenian
Ly-559	Bone	Arlay (11)	Level E	15,770 ± 390	Magdalenian
Ly-1509	Bone	Arlay (11)	Level C	14,220 ± 560	Magdalenian
Ly-1510	Bone	Arlay (11)	Layer C	14,820 ± 370	Magdalenian
Ly-1535	Bone	Arlay (11)	Layer C	14,530 ± 290	Magdalenian
Ly-1536	Bone	Arlay (11)	Layer C	14,840 ± 360	Magdalenian
Ly-1798	Bone	La Baume (12)	Layer IV	12,370 ± 460	Magdalenian
Ly-1702	Bone	La Baume (12)	Layer IV	13,620 ± 480	Magdalenian
Ly-1703	Bone	La Baume (12)	Layer V	22,430 ± 500	Magdalenian
Gif-8717	Charcoal	Le Colombier (13)	Layer 15	11,460 ± 310	Magdalenian
Ly-5291	Charcoal	Le Colombier (13)	Layer 16	14,660 ± 660	Magdalenian
Ly-5292	Charcoal	Le Colombier (13)	Layer 17	14,480 ± 360	Magdalenian
Ly-2339	Bone	Les Pêcheurs (14)	Surface F10–F11	23,880 ± 750	Aurignacian
Ly-2342	Bone	Les Pêcheurs (14)	Level 5	24,940 ± 680	Epigraveytian
Ly-321	Charcoal	Les Deux Avens (15)	Level C	12,320 ± 600	Magdalenian
Ly-322	Bone	Les Deux Avens (15)	Level C	12,350 ± 200	Magdalenian
Ly-1984	Bone	Oullins (16)	Level D	20,100 ± 500	Solutrean
Ly-1983	Bone	Oullins (16)	Level 9	20,060 ± 450	Solutrean
Ly-798	Bone	Oullins (16)	Level 6	19,369 ± 420	Solutrean
Ly-799	Bone	Oullins (16)	Level 7	19,710 ± 400	Solutrean
Ly-800	Bone	Ebbou (17)	Layer C1	12,980 ± 220	Magdalenian
Ly-847	Charcoal	La Tête du Lion (18)	Layer E and F	21,650 ± 800	Solutrean
Ly-597	Bone	Chinchon (19)	Layer 15	12,000 ± 420	Tardigravettian
Ly-541	Bone	Adaouste(20)	Layer 12	12,280 ± 190	Magdalenian
Ly-540	Bone	Adaouste (20)	Layer 17	12,760 ± 250	Magdalenian
Gif-2994	Charcoal	Fontbregoua (21)	Layer 70	11,200 ± 150	Magdalenian
Ly-5558	Charcoal	Grotte Cosquer (22)	Surface soil	18,440 ± 440	LatePaleolithic
Gif A-92348	Charcoal	Grotte Cosquer (22)	Surface soil	20,370 ± 250	Late Paleolithic
Gif A-92416	Charcoal	Grotte Cosquer (22)	Painting of horse	18,840 ± 240	Paleolithic
Gif A-92418	Charcoal	Grotte Cosquer (22)	Painting of feline	19,200 ± 220	Paleolithic
Gif A-92409	Charcoal	Grotte Cosquer (22)	Painting of hand	27,110 ± 390	Paleolithic

TABLE 2. (Continued)

Lab no.	Material	Site (no. in Fig. 3)	Layer / Level	^{14}C age (yr BP)	Culture
Ly-357	Bone	La Croze sur Suran (I)	Hearth	14,330 ± 260	Magdalenian
Ly-434	Bone	La Croze sur Suran (I)	Hearth	14,850 ± 350	Magdalenian
Ly-433	Bone	La Colombière (II)	Level D	13 390 ± 300	Magdalenian
L-177	Charcoal	La Colombière (II)	Hearth	14,150 ± 450	Magdalenian
Ly-16	Charcoal	Les Romains (III)	Layer III	14,380 ± 380	Magdalenian
Ly-356	Bone	Les Romains (III)	Level III	12,980 ± 240	Magdalenian
MC-1275	Shells	Les Romains (III)	Level IIb	12,540 ± 400	Magdalenian
MC-1276	Shells	Les Romains (III)	Level III	12,540 ± 230	Magdalenian
ETH-3937	Bone	Etrembieres (IV)	Soil of habitation	12,300 ± 130	Magdalenian
B-3787	Bone	Etrembieres (IV)	Soil of habitation	12,310 ± 140	Magdalenien
Ly-453	Bone	Douattes (V)	Level B	10,680 ± 450	Magdalenian
Ly-435	Bone	Douattes (V)	Level 7	12,480 ± 260	Magdalenian
0xA-538	Bone	Bange (VI)	Layer G	12,080 ± 180	Magdalenian
OxA-540	Bone	Bange (VI)	Layer G	12,200 ± 160	Magdalenian
Ly-3640	Bone	Bange (VI)	Layer G	11,680 ± 190	Magdalenian
Ly-390	Charcoal	Saint Thibaud II (VII)	Hearth	13,300 ± 280	Magdalenian
Ly-925	Bone	Saint Thibaud II (VII)	Layer 3	12,400 ± 240	Magdalenian
Ly-926	Charcoal	Saint Thibaud II (VII)	Layer 3	13,280 ± 290	Magdalenian
Ly-625	Charcoal	Saint Thibaud II (VII)	Layer Theta	10,470 ± 200	Magdalenian
Ly-692	Charcoal	Saint Thibaud II (VII)	Layer Theta	11,590 ± 330	Magdalenian
Ly-693	Charcoal	Saint Thibaud II (VII)	Layer Theta	11,630 ± 240	Magdalenian
Ly-828	Charcoal	Saint Thibaud II (VII)	Layer 3	12,470 ± 200	Magdalenian
Ly-829	Charcoal	Saint Thibaud II (VII)	Layer 9b	12,720 ± 230	Magdalenian
Ly-830	Charcoal	Saint Thibaud II (VII)	Layer Lambda	13,070 ± 210	Magdalenian
Ly-2911	Bone	La Fru (VIII)	Layer 2	12,690 ± 380	Magdalenian
Ly-431	Bone	Le Calvaire (IX)	Layer 3	12,970 ± 300	Magdalenian
Ly-432	Bone	Le Calvaire (IX)	Layer4	13,450 ± 300	Magdalenian

Chronological distribution of the sites is also irregular. Figure 4 shows the duration of ^{14}C-dated settlements of the mountain region, compared with the duration of all the dated sites in the Saône-Rhône basin from the south of Burgundy to the Mediterranean coast. It is clear that, before 14.5 ka BP, there is no trace of human presence to the east of the Saône-Rhône Valley (except, on the western fringe of the Jura, the site of Arlay, with its peculiar *à navette* Magdalenian industry found in rare sites from western France to Poland (Allain *et al.* 1985), dated from 15.5 ka BP). Nor is there a lithic remain prior to the Middle Magdalenian. We sometimes find redeposited Middle Paleolithic material, but never any for the Early or Upper Paleolithic (Aurignacian, Perigordian, Solutrean). On the other hand, a series of settlements or of decorated grottoes from the Perigordian and the Solutrean, in Burgundy (Solutré), Lyonnais (Villerest), Vivarais (Les Pêcheurs) or coastal Provence (Cosquer Grotto) has been found (Fig. 4). The contrast between east and west of the Rhône basin is striking.

The dates of the last retreat remain ambiguous, but it had probably begun as early as 15 ka BP for the whole western Alps. As the first inhabitants of the mountains seem to be contemporaneous with the beginning of the Bølling (*ca.* 13.3 ka BP), a long interval (*ca.* 2 ka) elapsed between the ice retreat and this first human migration.

The irregular distribution of the sites is not the sole proof of this delay in settlement; the general outline and conditions of fill of certain sites also lend supportive evidence for the time of occupation. The site of Saint-Thibaud de Couz, at an elevation of 550 m, at the foot of the Epine massif near Chambéry, is a good example of delayed settlement (Bintz 1994). Although the site is not directly implanted on glacial material, it is in direct relation to the former glacier. Figure 5 shows the various

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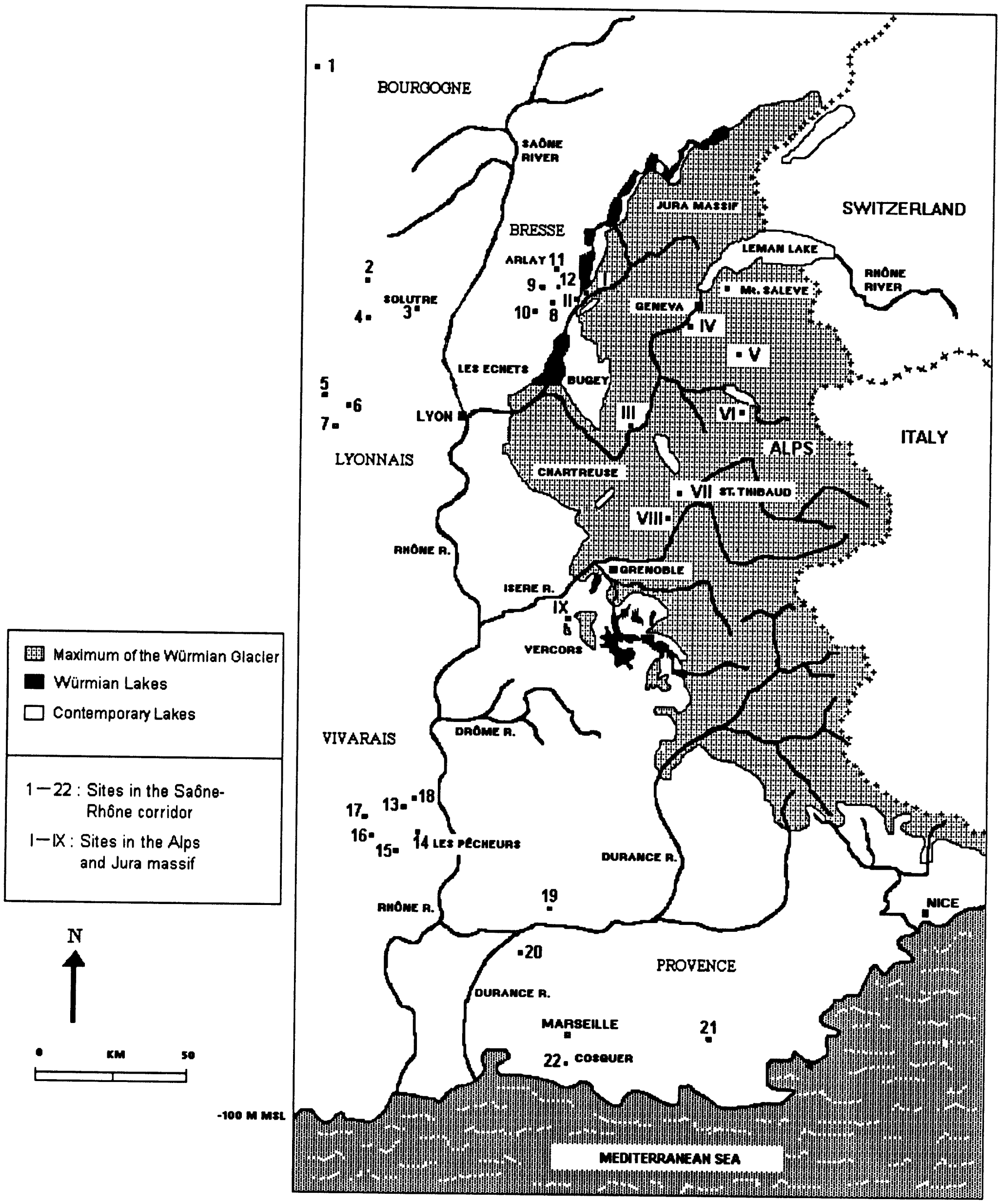

Fig. 3. Location of the Upper Paleolithic sites from the Jura Massif, French Alps and the Saône-Rhône Valley

stages of the development of a site. Although the precise duration between Phase 2 (retreat of the glacier) and Phase 6 (human settlement) cannot be calculated, one may assume it was a very long time, and the glacial front must have been quite remote by the time of settlement. Galay (1992) used the same reasoning for evaluating the site of Etrembières (Veyrier), which was located directly on glacial till on the mountainside of Mt. Salève near Geneva. The first Magdalenians who resided here must have viewed the same landscape as do present-day Genevans. Thus, either Upper Magdalenian

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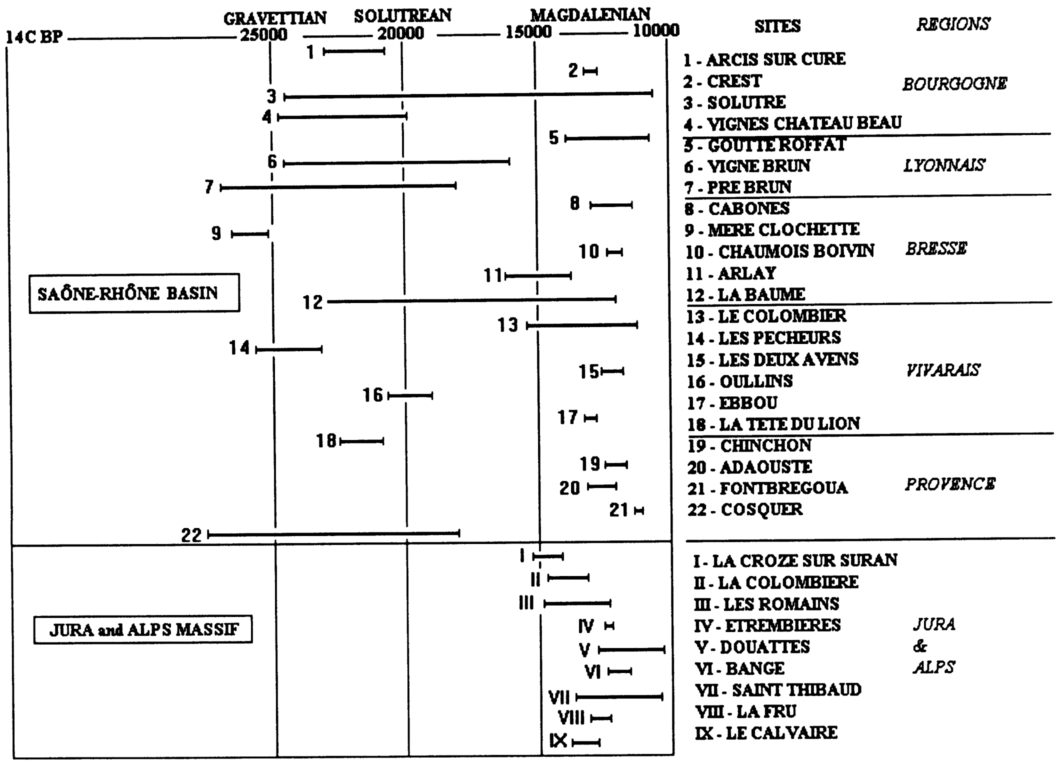

Fig. 4. Duration of human occupation in the sites of the Saône-Rhône basin, the Jura and the French Alps

sites of the French Alps are located where glaciers melted a long time before, or the ^{14}C dates of these sites are too young (12–10 ka BP).

Throughout the pleniglacial and at only 80 km from the extreme advance of the glacial front, a human population left some sites to the west of the Rhône corridor. The pollen diagram of Les Echets swamp, 10 km north of Lyon (de Beaulieu *et al.* 1980) shows that, at this time, large melted patches of sparsely vegetated land covered the piedmont area. Yet, no archaeological sites were found east of the Rhône basin, neither before nor during the last pleniglacial. Further, there is no evidence of human settlement in the mountain zone. Perhaps during the pleniglacial, even after the main glaciers receded (*i.e.,* during most of the Würmian), the deeply eroded valleys dug by the first maximal glacial expansion (at a very early date) remained covered by sheets of stagnant ice. Thus, the landscapes were probably not conducive to habitation. Also, great lakes of melted ice with steep banks in U-shaped valleys could have rendered the intra-Alpine massifs inaccessible (Fig. 6).

Deglaciation spread mainly throughout the northern French Alps (Fig. 1). As for the southern Alps, that is, those south of the Drôme and upper Durance Rivers, the massifs and valleys were not glaciated; the only important glacier was that of the Durance, supplied at a high altitude by the Pelvoux massif. Thus, the southern Alps were cleared and accessible throughout the Würmian. However, they are totally devoid of Upper Paleolithic sites, except near the Rhône River and the Mediterranean Sea.

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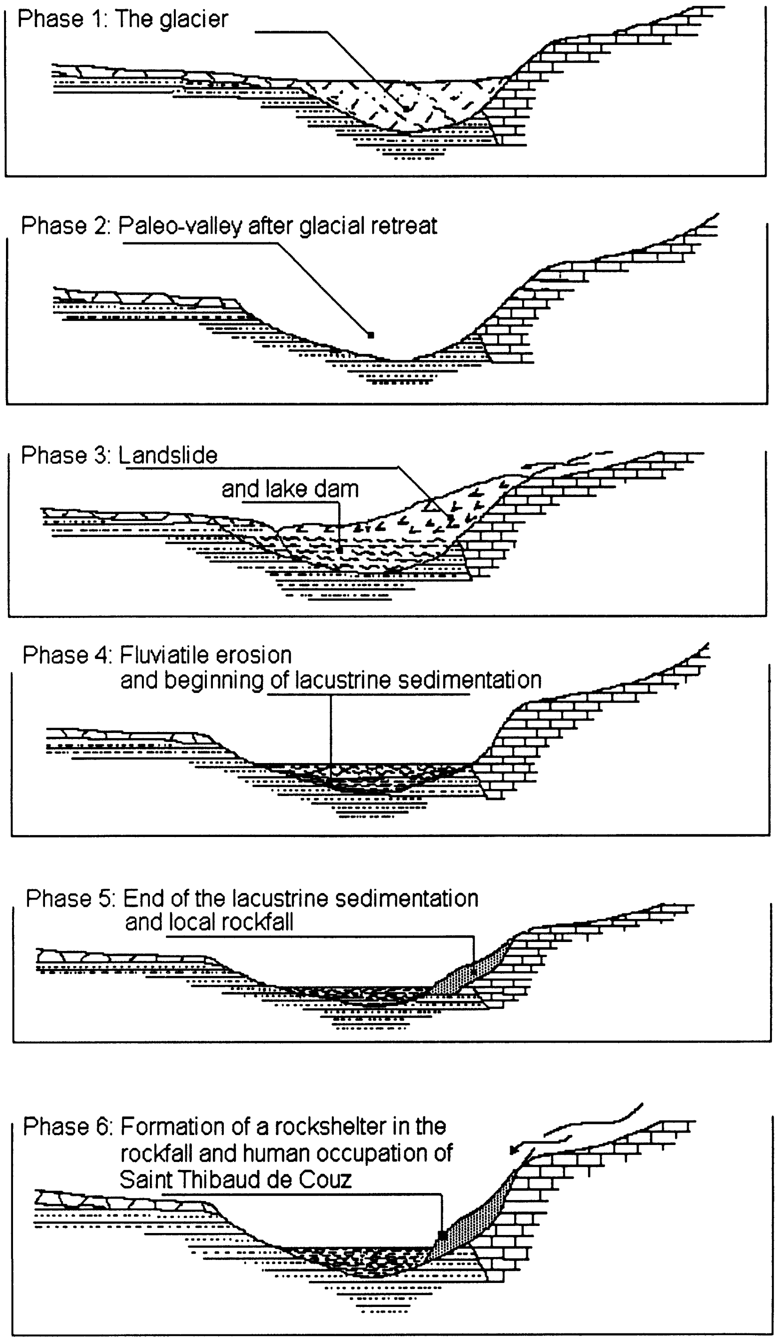

Fig. 5. Assumed phases of land formation around the site of Saint Thibaud de Couz, showing the long transition between glacial retreat and human settlement

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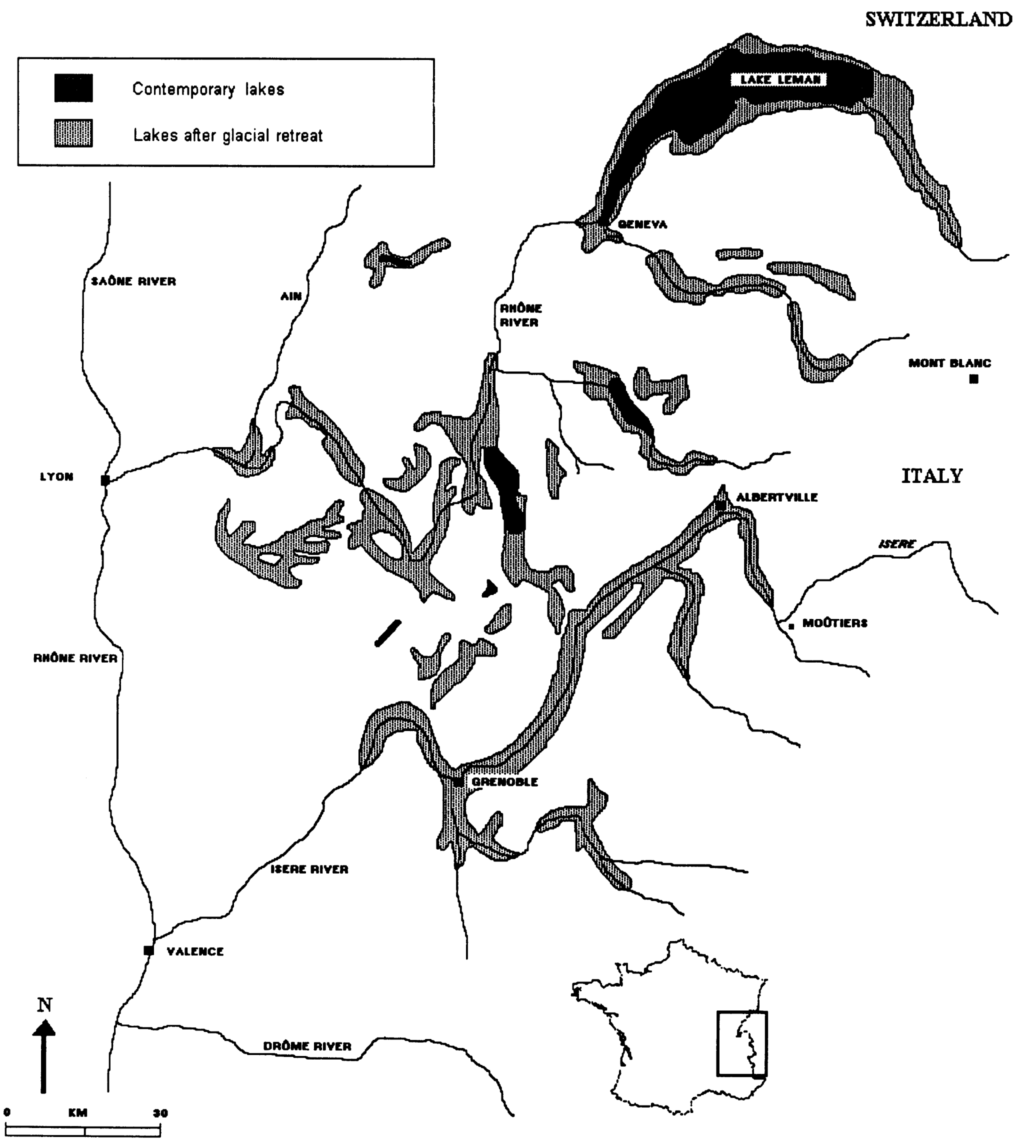

Fig. 6. Lakes in the northern French Alps after the Würmian deglaciation

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CONCLUSION

Little has been written on the chronology of final deglaciation of the French Alps due to the lack of geological and ^{14}C data. However, there seems to be no connection between the first human settlement and the extension of the last glaciation. Indeed, the study of site distribution and glacial deposits shows that, for reasons yet unknown, settlement occurred long after deglaciation, and sites were far distant from the glacial front. More sites will have to be studied before we can understand the motives for population movements toward high elevations and for the apparent non-relation between glaciers and human settlement.

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