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HISTORY OF SOME PLANT COMMUNITIES OF THE SILS ZONE (LA SELVA, CATALONIA, SPAIN) BASED ON POLLEN ANALYSIS

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RESUM

Es presenta un estudi sobre la història d'algunes comunitats vegetals de Sils (la Selva), zona considerada interessant per les seves particularitats climàtiques. La metodologia d'estudi s'ha basat en l'anàlisi pol·línica de sediments de l'antic estany. El diagrama pol·línic es caracteritza, principalment, per un absolut domini de les ericàcies, una important presència de *Quercus* i *Alnus* i una molt feble representació de *Pinus*. La presència de cereals i *Juglans*, així com la gran semblança del diagrama amb l'espectre pol·línic del paisatge actual, ens fa pensar que aquesta seqüència es correspon amb els períodes Subatlàntic o Subboreal.

RESUMEN

Se presenta un estudio sobre la historia de algunas comunidades vegetales de Sils (Gerona), zona de gran interés por sus particularidades climáticas. La metodología de estudio se ha basado en el análisis polínico de sedimentos de un antiguo lago. El diagrama polínico se caracteriza, principalmente, por un dominio absoluto de las ericáceas, una importante presencia de *Quercus* y *Alnus* y una débil representación de *Pinus*. La presencia de cereales y *Juglans*, así como el gran parecido del diagrama con el espectro polínico del paisage actual, nos lleva a pensar que esta secuencia se corresponde con los períodos Subatlántico o Subboreal.

ABSTRACT

What we present here is a study about the history of some plant communities of Sils (NE part of Iberian Peninsula), an interesting zone for its climatical peculiarities. The method used is based on the pollen analysis of sediments from an ancient lake. The pollen diagram is mainly characterized by an absolute dominance of the Ericaceae, an important presence of *Quercus* and *Alnus*, and a little representation of *Pinus*. The presence of Cerealia pollen-type and *Juglans*, as well as the great similarity between this diagram and the pollen spectrum of the present landscape, takes us to the presumption that this pollen sequence corresponds to the Subatlantic or Subboreal period.

Key words: Vegetation history, pollen analysis.

INTRODUCTION

The presence of some important microclimatical characteristics in la Selva has brought a lot of country botanics into this area. In 1984, motivated by some especulations about the depth and the age of the quaternarian sediments of the old lake of Sils that came to us, we also decided to add two prospections in order to analize the microfossils of different sedimentary levels and, in this way, be able to detect more about the antiguity of the deposits and the types of landscape that surround the lake.

GEOGRAPHICAL LOCALIZATION

The Sils zone is rigth in the middle of flatland La Selva, a natural region that is expanded from la Tordera river, close tot he Maresme, to Girona city. One of the most distinctive traits of La Selva is that it has a bad drainage, chiefly at Riudellots, Caldes and Sils zones. There were some considerable lakes at the last two sites, especially in Sils where its lake, which figured in all the ancient maps, was dessicated about the middle of the past century. The core that caused the achievement of the present work was performed at that point showed in fig. 1 ([*], UTM: 30T DG 7727).

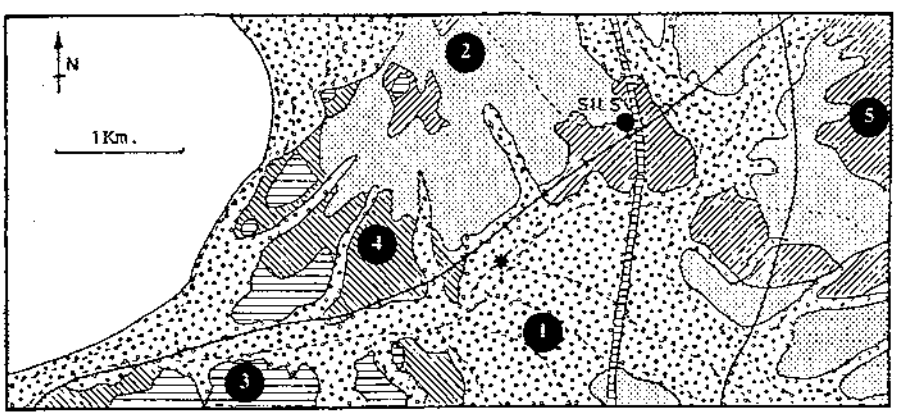

Figura 1. Geological map of the area: Sils and its surroundings. 1: Quaternary (Holocene). Actual alluvial (clays, sands, etc.). 2: Pliocene; light coloured arcoses. 3: Pliocene; volcanic of Maçanet and L'Esparra. 4: Porfiridic grandiorite. 5: Thick grain Leucogranite.

Mapa Geològic de Sils i rodalies. 1: Quaternari (Holocè). Al·luvial actual (argiles, sorres, etc.). 2: Pliocè; arcoses de colors clars. 3: Pliocè; volcànic de Maçanet i l'Esparra. 4: Granodiorita porfirídica. 5: Leucogranit de gra gruixut.

GEOLOGY AND GEOMORPHOLOGY

The depression of La Selva had its origin in the folds, which, fractured the Catalan Massif, while they raised some big blocks and sank some others. The flatland La Selva then, would be a sunken one, which was modelled by modern slides also responsible of the basaltic flourishment of St. Dalmai, Caldes, L'Esparra and Maçanet. Probably, a volcanic flow, deposited in the N-S direction, blocked up the water exits to the la Tordera river helping the creation of the lacustrine zone we mentioned before.

On the geological map of fig. 1, we observed a predominance of the sedimentary strata (quaternary clays and arcosical sands of the Pliocene).

CLIMATE AND PRESENT VEGETATION

La Selva flatland presents a typical mediterranean climate of the north-oriental regions of Catalonia. As a distinctive trait, one can emphasize the tendency to a certain continentality, especially in winter, with frequent termical inversions and cloud acumulations (overcoat in Sils) as well as a relatively high precipitations, comparable with those that are registred at the humid oriental front of the

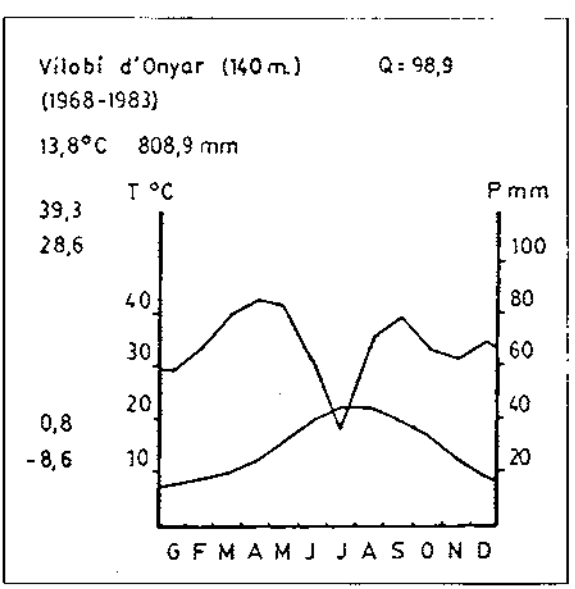

Figura 2. Climatic diagram of Vilobí d'Onyar, near Sils.
Diagrama climàtic de Vilobí d'Onyar, prop de Sils.

Montseny-Guilleries-Garrotxa.

The meteorological data of Sils, given by the S.M.N., shows an average of 15,35°C. These data are completed by the ones given by the ombrothermic diagram of Vilobí, a neighbour locality where the Meteorological Service of the Girona-Costa Brava Airport is located, where we can observe that the precipitations are a little bit higher in Spring than in Autumn (Fig. 2).

La Selva's vegetation, remarkably calcifugue and oligotrophic, is constituted by mediterranean elements with an important presence of eurosiberian floristical elements. At the flatland, the decidous wood and the communities with a humid look have an important role, as they occupy the northern side of the mountain slope, the humid deep valleys and the grounds of the ancient lake of Sils (Fig. 3).

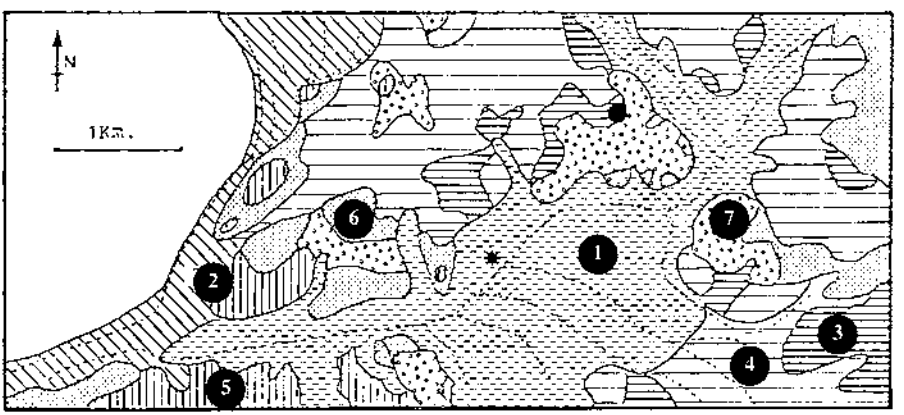

Figura 3. Vegetation map of Sils zone. **1**: Communities of superior free-floating and rooting plants (*Lemnion, Potamogetonion*) ; eutrophic fresh-water helophytic vegetation (*Typho-Schoenoplectectum, Cypero-Caricetum*) ; hay-meadows (*Gaudinio-Arrhenatheretum*). Poplar plantations. **2**: Riverside woodland (*Lamio-Alnetum*). Poplar plantations and arable lands. **3**: Oak wood (*Carici-Quercetum canariensis holcetosum*). **4**: Irrigated fields (*Panico-Setarion*); fields of winter cereals crops (*Secalion mediterraneum* and *Diplotaxion erucoidis*). **5**: *Quercus ilex* wood (*Quercetum ilicis galloprovinciale pistacietosum*). **6**: *Quercus suber* woods (*Quercetum galloprovinciale suberetosum*), heath-schrub with *Cistus salvifolius* (*Lavandulo-Ericetum scopariae*). **7**: Communities of acidophilous therophytes; bad lands; arable lands and built-up areas.

Mapa de vegetació de la zona de Sils. **1**: Vegetació aquàtica submergida i flotant (*Lemnion, Potamogetonion*); vegetació helofítica de les aigües dolces eutròfiques (*Typho-Schoenoplectetum, Cypero-Caricetum*); prats de dall (*Gaudinio-Arrhe- natheretum*); Pollancredes. **2**: Boscos de ribera (*Lamio-Alnetum*). Pollancredes i conreus. **3**: Roureda (*Carici-Quercetum canariensis holcetosum*). **4**: Conreus de regadiu (*Panico-Setarion*); conreus de cereals (*Secalion mediterraneum* i *Diplotaxieton erucoidis*). **5**: Alzinar (*Quercetum ilicis galloprovinciale pista- cietosum*). **6**: Sureda (*Quercetum ilicis galloprovinciale suberetosum*); brolla de brucs d'escombres i estepes (*Lavandulo-Ericetum scopariae*). **7**: Prats terofítics acidòfils, erms, conreus i edificacions.

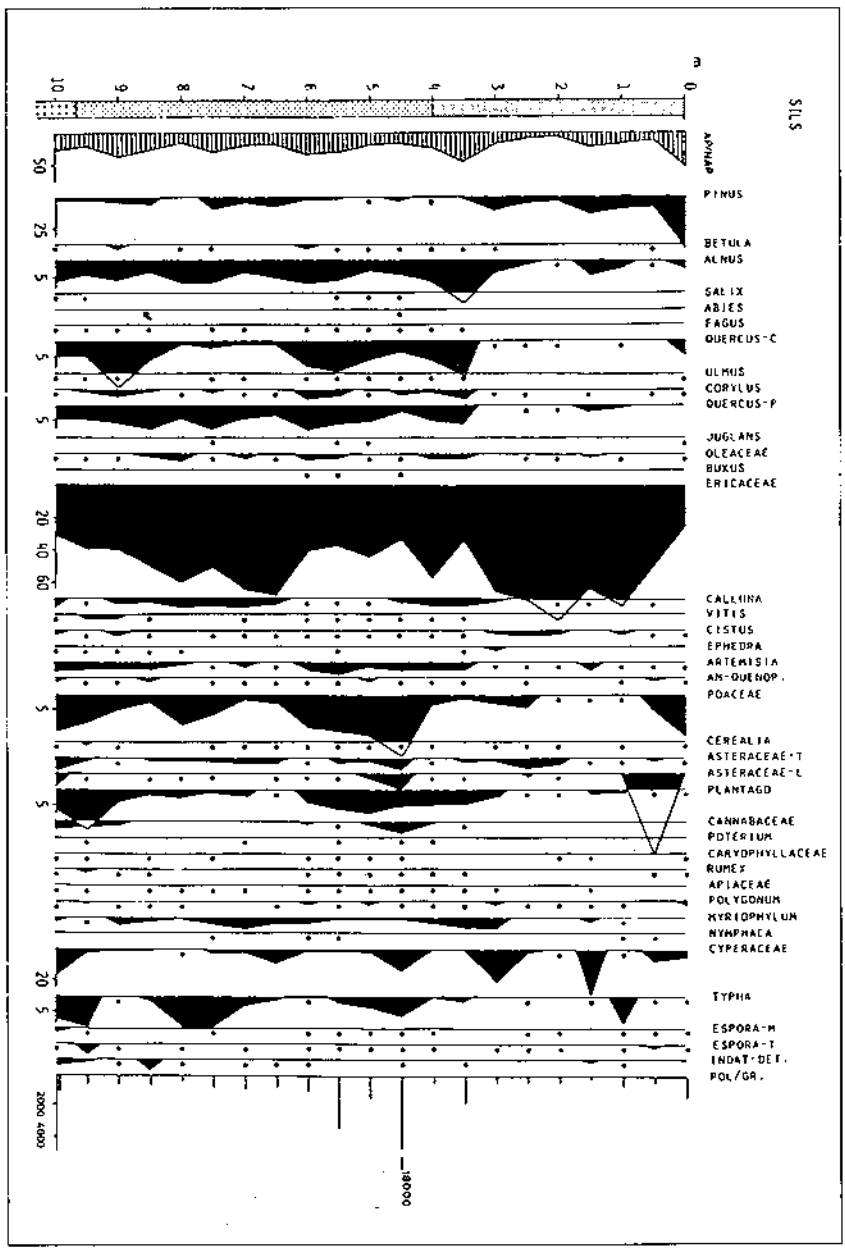

Figura 4. Pollen diagram. Diagrama pol·línic.

METHODOLOGY

The present work has been based, apart from the pollen analysis of the quaternarian sediments, on some preliminary information from the study about the flora and vegetation of Sils (Bolòs, 1959; Vilar, 1987 and Vilar & Viñas, 1990).

The core of the lacustrine deposits was performed by a Taenzer machine with a core introduction through the percussion system and with a continued recovery of the testimony (we arrived to 16,30 m deepth).

The isolation and concentration of pollens and spores were carried out, with slight modifications, through the technic defined by Goeury & Beaulieu (1979).

RESULTS AND CONCLUSIONS

What we set out in fig. 4 is the pollen diagram simplified by the most representative taxa which appeared in the counting of each level of the sedimentologic column. The lower part of this column shows levels of sands, which are pollenless, that gradually turn, about 10 m, to muds and dark clays. These finnest materials change their colour about 4 m acquiring a greyer tonality.

In analysing the pollen sequences observed, one might think that these sediments were not deposited in a very ancient period since they show a vegetal landscape composition similar to the present one, there is a cereals and *Juglans* pollen presence at three levels. It would not be too risky to place this sequence into the Subatlantic or Subboreal period.

As the general traits: the absolut Ericaceae domination, an important presence of *Quercus* and alder-trees and a little representation of *Pinus* (with the exception of the most superficial samples), should be noticed. We also noticed two big different phases, the first and oldest one, between 10 and 3 m, denotes a forested landscape, with a remarkable increase of *Pinus* and Ericaceae, and a reduction of the percentages of *Quercus* and *Alnus*. The lacustrine indicators remain all over the diagram.

The fact of the increase of *Pinus* values in the last 3 m demostrates an introduction or colonization of open areas in evergreen oak, oak and cork-oak woods. This diagram, compared with any of the other mediterranean region diagrams, shows that *Pinus* percentages are really feeble. Only the most recent samples show values that cannot influence us to think about a remote contribution. This high representation of the last ages could come compared with the recent introduction of some species (*Pinus pinaster* and *P. insignis* were introduced at the beginning of the present century). This would not be the case of *Pinus pinea* since, apart of being the most frequent in the zone, it even appears on engravings of Napoleon times. It is more usual nowdays to see it as a part of the arboreal layer along with *Quercus suber* of the heath-scrub of *Erica scoparia*.

The evergreen oak, the cork-oak and oak woods, also show an important decrease in the second phase of the diagram. It seems that the actual habitats of

evergreen oaks and the cork-oaks would be kept (respectively on basaltic and granitical substrata) and that the flatland would have an oak coverture much more significant to the actual one. Anyhow, it should be taken into account that the sclerophyllous communities have not played, probably, the same role for the last ten thousand years, the Postglacial period. The xerothermical feature of the studied zone, could induce us to think about an exagerate presence of this tree, since the anthropical actions have been more important. According to Pons (1964), its actual distribution could exceed the bioclimatical and ecological real limits, and it would be the consequence of the resistence of this tree to the human action, and of the substitution of the oak domain that, in fact, would be at the limit of its possibilities.

The *Corylus* presence is rather feeble all over the diagram (overcoat if we consider the high pollinical capacity of this taxon). Possibly, in the last two or three thousand years, where the climate would vary just a little in respect to the actual one, the hazel communities would be, as it is now, limited in this region by its low altitude and it would be located on the most humid and fresh patches of the deep valleys, because they need a more elevated edafical humidity than the oaks. It would not have these patterns of behaviour but, during the Boreal period in general, the hazel tree had a very important role in the colonization of the temperate woods.

The riverside woodland is represented, principally, by the alder-tree communities. In having favourable conditions of the ground humidity and in keeping the freatical level more or less constant, it is easier that *Alnus* competed and colonizated the places that were sometimes occupied by *Ulmus, Salix*, etc.

We must think about the signification of *Fagus* that has come and has deposited in the levels that are placed between the base and 3,5 m. The relationship between this phenomena and the increase of the distribution of the taxon during a part of the Subatlantic period, that is denoted in a lot of european regions, with the exception of the meridionals too warm, could exist. It would be a consequence of a major extension of beech woods of the close mountain ranges (Montseny, Guilleries and Montnegre), in comparision with the present one, or the presence of some isolated clumps in some patches of La Selva, where the microclimatical characteristics were favourable to them.

Ephedra appears at diverse levels and, symptomatically, disappears where major pressure of human action is detected. The same event is detected in analysis of sediments from La Garrotxa (Pérez-Obiol et al., 1985). We can think about a recent disappearance of some property communities of the mentioned regions.

As we said before, the heath-scrub constitutes the most pollinically represented communitie, probably as consequence of their high presence on the underbrush of cork-oak and pine woods and the open areas in general. The increase of the Ericaceae percentages in the superficial 3 m would be, then, a derivation of the man action over the primitive forest. *Calluna* acquire relatively low values and shows it presence at resolute moments, never surpassing 3 % in respect to the total counted taxa.

The oscillant curves of Poaceae, Cyperaceae and *Typha*, indicating the little water level fluctuations in the lake, and the *Nymphaea* presence near to the surface sequence, are one more fact of the permanence of lacustrine communities until very recents ages.

Acknowlegments

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