DARRIWILIAN CONODONTS FROM THE TAURUS MOUNTAINS, SOUTHERN TURKEY

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INTRODUCTION

During Ordovician times large shelf evolved in the high latitudinal North Gondwana margin. Thick siliciclastic sediments were deposited and they are at present recognised in large areas of this palaeocontinent. Only Upper Ordovician thin carbonate units occur in several places. From these localities conodont faunas typical of the Mediterranean Province have been identified. Pre-Upper Ordovician conodont faunas are poorly known mainly due to the scarcity and the locally very restricted stratigraphic distribution of carbonate rocks. Consequently, our knowledge about the evolutionary relationships and migration patterns of Lower and Middle conodont populations remain uncertain.

Ordovician rocks cropping out at the Central Taurides are mainly integrated by the Seydisehir Formation (Dean and Monod 1970). At its type locality this unit is composed by shales and siltstones with alternating quarzites and rare nodular limestones, dated as Tremadoc to Arenig by trilobites, graptolites and acritarchs (Dean and Martin 1992). The Sovoba Formation rests conformably on the Seydisheir Formation (Dean and Monod 1970), which contains a lower member of fossiliferous limestones (Sovoba Limestone) ranging from 0 to 10 m in thickness. The limestones are succeeded by a detrital series of grey shales about 20 m thick. These Ordovician units are disconformably covered by Mesozoic sediments.

Trilobite faunas of the Seydisehir and Sovoba formations were studied in detail by Dean (1973, 1980). In a previous paper of Dean and Monod (1970) the predominant Baltoscandian affinities of trilobite taxa as well as the presence of Mediterranean, South European elements, was pointed out. At the same time Barnes (*in* Dean 1973) mentioned the occurrence of the Swedish type conodont assemblages in the type section of the Sobova Limestone (Sovoba Valley) indicative of the Volkhovian age and also in slightly older levels in the Kizilca area, both in the western Taurus. However, no references to particular conodont genera or species supporting the age assignment provided by Barnes (*in* Dean 1973) were reported in this work. The only data regarding Ordovician conodonts from southern Turkey comes from the Seydisehir Formation where some Lower Ordovician species were described and illustrated by Gedik (1977), recently reviewed by Göncüoglu and Kozur. (In print).

In the present paper, the biostratigraphic and palaeogeographic significance of the conodont fauna recovered from the Sovoba Limestone of the Tekeli section is analysed.

LOCALITY AND CONODONT COLLECTION

The studied Tekeli section is located between the towns Aydincik and Anamur to the west of Silifke in southern Central Taurides (Fig. 1), where slices of the autochthonous Geyikdag Unit (Özgul 1976) are observed. Along the studied section, the Sobova Formation is represented by gray shales with well-developed slaty cleavage. It is conformably underlain by dark gray silty shales and sandstones of the Seydisehir Formation and overlain by arkozic sandstones and green shales of the Bedinan Formation (Fig. 2). The middle part of the Sobova succession is made up of a 12 m thick limestone-shale alternation which is known as the Sobova Limestone. The limestone is bioclastic in nature, light gray to cream coloured occuring as bands and lenses. The thickness of the single bands reaches up to 2 m. There are 5 limestone horizons which were sampled. Each sample (in average 300 g) has been completely handpicked. All the samples yielded conodonts and a total of 136 elements were recovered. The relative abundance of conodont elements is highly variable in each sample, the TK.Sb.4 is the most prolific of them (Fig. 1).

Preservation of conodont elements varies within each sample and also between the investigated levels. Only few specimens are well preserved, most of them are broken, partially recrystallized and/or affected by cleavage. Also, deformed and fractured specimens reveals significant tectonic stress and some condonts show pitted surfaces suggesting chemical corrosion. Some elements bear silt particles adhering to their surfaces, sometimes, the amount of such grains makes the identification difficult or even impossible.

All the conodont elements are within CAI 4-4.5 range according to Epstein *et al.* (1977). The temperature

estimated to be needed to produce these CAI values are between 190-300 degrees C.

Besides the conodont elements other fossil groups were recognised in the insoluble residues. In order of their relative abundance they are: phosphatic brachiopods (some of them acrotretids), echinoderms (mainly crinoids), ostracodes, bryozoans and the palaeoscolecid sclerite *Milaculum* aff. *ethinclarki* Müller.

Across the sampled stratigraphic interval several conodont taxa have been identified. Open nomenclature is used to reflect some morphological features that introduce reasonable doubts relative to the specific attribution.

From the lower part of the calcareous succession, mainly from the TK.SB.1 level, *Baltoniodus medius* Dzik, *Complexodus originalis* Chen and Zhan, *Drepanodus arcuatus* Pander, *Drepanoistodus basiovalis* Sergeeva, *Panderodus sulcatus?* (Fahraeus), *Walliserodus costatus* Dzik, "*Semiacontiodus*" aff. "*S.*" *cornuformis* (Sergeeva), *Baltoniodus* spp., *Lenodus* sp. indet. and *Ansella*? have been identified.

In the upper levels (TK.SB.4 and 5), Baltoniodus medius Dzik, Cornuodus longibasis (Lindström), Drepanoistodus basiovalis (Sergeeva), Lenodus cf. pseudoplanus (Viira) sensu Stouge and Bagnoli (1990), Walliserodus nakholmensis (Hamar), Sagittodontina kielcensis (Dzik), Microzakodina cf. hagetiana Stouge and Bagnoli, Walliserodus ethingtoni? (Fahraeus), Baltoniodus sp. and Ansella? sp., were recognised.

REMARKS ON THE CONODONT FAUNA AND ITS STRATIGRAPHIC SIGNIFICANCE.

Conodont fauna from the Tekeli section shows a high diversity although the low number of specimens is taken in account. This fauna is characterised by species typical of the cold-water Baltic Province of the North Atlantic Realm (*sensu* Bagnoli and Stouge 1991). The affinity of Turkish condonts with the well known Baltic faunas was mentioned previously by Barnes (*in* Dean 1973).

Conodont zones for Lower and Middle Ordovician introduced by Lindström (1971) and Bergström (1971, 1983) respectively, together with refinements proposed by Löfgren (1978) are followed here. Also chronostratigraphic reference to the regional Baltoscandian scale has been used.

At present, no zonal index conodont has been identified in the studied assemblage. The stratigraphic range of the species from the Tekeli section is briefly discussed to elucidate the age of the Sovoba Limestone.

Drepanodus arcuatus Pander and *Cornuodus longibasis* (Lindström) are known from the *Baltoniodus navis* Biozone to the top of the *Lenodus variabilis* Biozone, equivalent to the range Volkhovian (pp.) and Kundan (pp.) in Sweden (Stouge and Bagnoli 1990). *Baltoniodus medius* (Dzik) has been reported from the latest middle? Kundan to latest Aserian in Poland and the Baltic area (Dzik 1976, 1994; Löfgren 1978).

Lenodus pseudoplanus (Viira) *sensu* Stouge and Bagnoli (1990) occurs in northern Öland at the upper part of the *L. variabilis* Biozone (Kundan stage).

Walliserodus costatus Dzik is reported from the *L. variabilis* Biozone, equivalent to a Kundan age, in the Holy Cross Mountains, Poland (Dzik 1994). The species has been also recognised in the latest Latorpian and Volkhovian of the Baltic region (Löfgren 1978).

Walliserodus ethingtoni (Fahraeus) was described from strata of Aserian or Lasnamägian age in Sweden. In Poland occurs from the *Eoplacognathus reclinatus* or *E. robustus* Subzone (*Pygodus serra* Biozone) to *Amorphognathus*

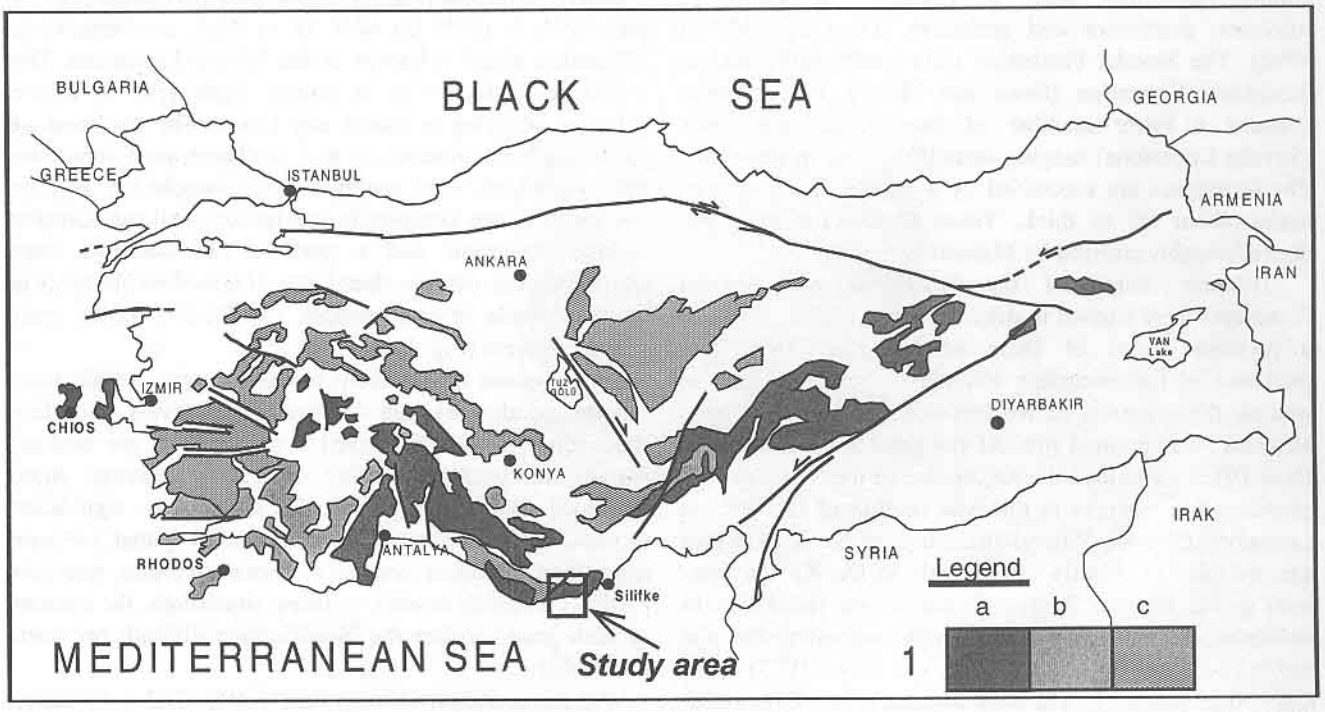

Fig. 1. Distribution of the Tauride Units, (after Göncüoglu *et al.* 1986). 1-Tauride - Anatolide Composite Terrane (a: undivided, b: allochthonous internal units, c: metamorphic units).

tvaerensis Biozone (Dzik 1994).

Walliserodus nakholmensis (Hamar) is widely distributed among the Middle - Late Ordovician North Atlantic faunas (Dzik 1994). This author pointed out the co-occurrence of this species with *W. ethingtoni* in the Mójcza Limestone of Poland. *Panderodus sulcatus* (Fahraeus) was first identified in Sweden from strata belonging to the *E. reclinatus* Subzone (*Pygodus serra* Biozone). In Poland it has been identified from the *E. robustus* Subzone to *A. tvaerensis* Biozone (Dzik 1994).

"Semiacontiodus" cornuformis (Sergeeva) was first identified in Estonia from strata of Kundan age; Stouge and Bagnoli (1990) reported it from Sweden within the *Microzarkodina parva* and *L. variabilis* Biozones.

Drepanoistodus basiovalis (Sergeeva) was described in earliest middle Volkhovian to early? Aserian, and could be also present in the late Aserian and Lasnamägian (Löfgren 1978). *Microzarkodina hagetiana* Stouge and Bagnoli was defined in Sweden in levels assigned to the Kundan Stage.

Among the reported species, we noticed the significant presence of characteristic P elements of *Complexodus originalis* Chen and Zhang occuring in China in the *E. reclinatus* Subzone (*Pygodus serra* Biozone) to the *P. anserinus* Biozone (Chen and Zhang 1984) involving equivalents of the basal Viruan to younger strata. In Poland, the same species was recognised from the *Eoplacognathus lindstromi* Subzone of the *P. serra* Biozona (Dzik 1994) equivalent to the Lasnamägian. Moreover, *Sagittodontina kielcensis* (Dzik) have been also recorded from the upper limestone levels of the Tekeli section. This species is the nominal species of the lower subzone of the *P. anserinus* Biozone, equivalent to the Uhaku. The presence of rare specimens of *S. kielcensis* in older strata of the Baltic region and South China has been mentioned by Dzik (1994).

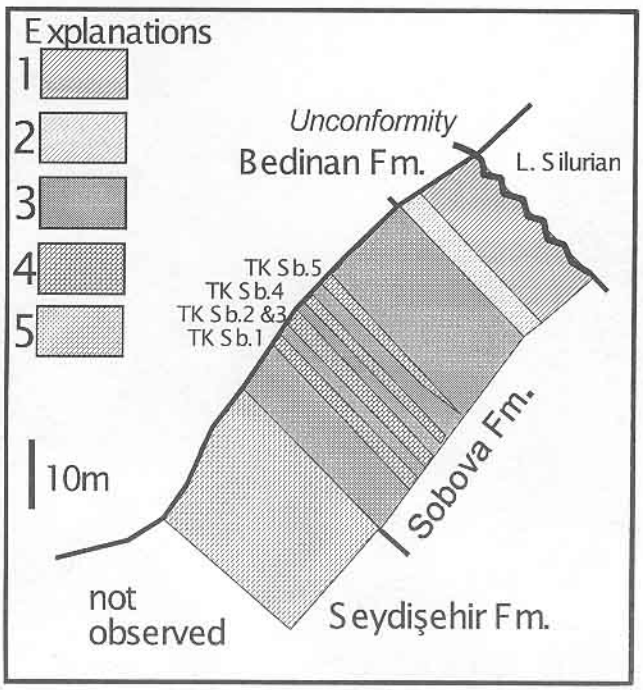

Fig. 2. Geological cross-section and sample locations in the Tekeli Section. Explanations: 1- green shale, 2-arkozic sandstone, 3- gray shale, 4- bioclastic limestone, 5- dark gray shale and sandstone.

According to the range of the conodont taxa recorded here, a late Kunda to Uhaku age is favoured for the Sobova Limestone in the studied section. Although the conodont fauna belongs approximately within the interval of *Pygodus serra*-lower *Pygodus anserinus* biozones, the index species as well as characteristic genera (i.e. *Periodon, Eoplacognathus*) occuring within it in several areas of the North Atlantic Realm are absent. An environmental control could be used to explain the absence of these taxa. *Eoplacognathus, Periodon* and *Pygodus* seems to be restricted to the outer shelf and slope at this time (see Stouge 1984), while most of the species of the Sobova Limestone inhabited shallow platforms of temperate to cold regions. At the same time, a significant affinity between conodont fauna of the Sobova Limestone with that of the Mójcza Limestone (Poland) was reported by Dzik (1994). In this sense, some elements of the well known benthic fauna in Poland also occur in the Sobova Limestone. From the last unit, the bryozoans *Voigtia primaeva* (Dzik 1981), *Corynotrypa* sp. and *Wolinella* sp., together with echinoderms of *Asperellacystis*? sp. and ostracodes refers to *Conchoprimitia* sp. and *Duringia*? sp. has been identified. Available conodont data suggest that the Middle Ordovician epicontinental seas of the southern Turkey, Bohemia, Baltic region and perhaps South China were linked at this time. This possibility has been also pointed out by Dean (1973) upon the base of the Lower Ordovician trilobite faunas affinities. Arenig to "Llanvirn" conodont faunas from the Katkoyeh Formation in the Kerman region (Iran), recently reported by Hamedi *et al.* (1997), is expected to have possibly the same signature to the Sobova Limestone conodont fauna at the Tekeli section.

CONCLUSIONS

Middle Ordovician rocks, formally equivalent to the Llanvirn regional series of Britain (Fortey *et al.* 1995) were virtually unknown in the Taurus Mountains. Their absence has been related with the uplift movement along the "Sardinian-Taurian rise" (Hammann 1992). The present finding represents the first discovery of post-Arenig, pre-Caradoc fossils in southern Turkey (on British terms) by means of conodont assemblages representative of the Middle Ordovician, late Darriwilian age, according with the Global Ordovician Series and Stages (Webby 1998, with references).

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