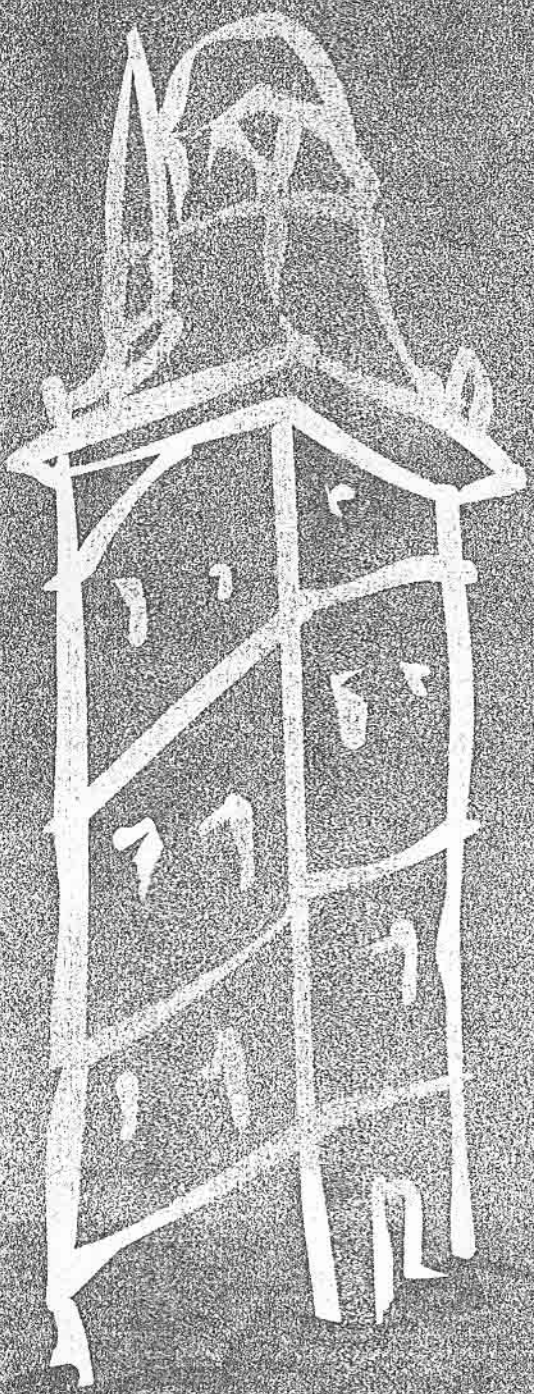
A. GRANDAL D'ANGLADE, J.C. GUTIÉRREZ-MARCO y L. SANTOS FIDALGO (EDS.)

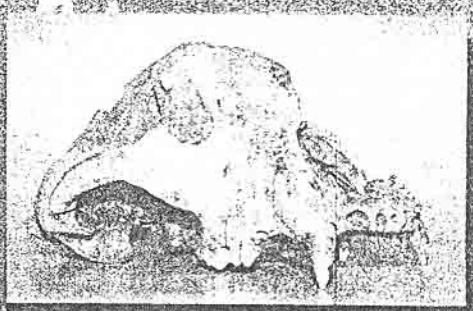
XIII JORNADAS DE PALEONTOLOGÍA
"Fósiles de Galicia"

V REUNIÓN INTERNACIONAL PROYECTO 351 PICG
"Paleozoico Inferior del Noroeste de Gondwana"

A Coruña
16-18 de Octubre
1997

LIBRO DE RESÚMENES Y EXCURSIONES





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Lower Paleozoic evolution of Gondwanaland; data from the eastern mediterranean region

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Introduction

Turkey is located on the alpine orogenic collage, between the northern margin of the Arabian and Eurasian plates and consists of numerous terranes. The terranes of Turkey extend eastwards into Iran and westwards into Greece and Carpato-Balkan region. The depositional features and distribution of the Lower Paleozoic rock-units in the Eastern Mediterranean part of the Gondwana-land suggests the presence of a northern zone (Carpato-Balkan, Istanbul and Main Range terranes) and a southern zone (Taurides, SE Anatolian-Arabian, and Central Iranian terranes, Göncüoglu, 1997)

In this brief review we combine regional literature and unpublished field data to interpret the Lower Paleozoic evolution of the southern zone in Turkey and N- Arabia.

Precambrian and Infracambrian

The pre-Cambrian basements of the northern and southern zones, respectively, are represented by remnants of a Precambrian orogenic assemblage with oceanic, arc-type and continental elements. They were very probably formed during the early southward subduction of the Eastern Iapetus Ocean.

The Infracambrian units in the southern zone in the Taurides, SE Anatolia and Jordan mainly consist of terrestrial clastics and volcanics. In the Taurides, the lowermost part is represented by rhyolites and rhyolitic tuffs followed by an alternation of arkoses and shales. Upwards follows varicolored stromatolitic and cherty limestones interlayered with sandstones

To be cited as:

Göncüoğlu, M.C.and Kozlu, H., 1997, Lower Paleozoic evolution of Gondwanaland: data from the Eastern Mediterranean Region. In: Grandal D'Anglades, A., Guitérrez-Marco, J.C. and Santos Fidalgo, L., (Eds.), Paleozoico Inferior del Noroeste de Gondwana, Soc. Paleont. Spain, 68-71

and shales (Kozlu and Goncuoglu, 1997). The lower and middle part of the succession contain felsic-intermediate volcanics and highly altered tuffites. The up to 2000 m thick Infracambrian units are slightly metamorphosed and unconformably overlain by Cambrian clastics. Sedimentological data suggest that during the Infracambrian-Early Cambrian time in the southern zone the Pan-african consolidated NW Gondwanean pericratonic margin was rifted by back-arc extension or transtension.

Cambrian

Stratigraphy and fauna of the Cambrian formations in the southern zone in the Taurides Belt has been recently reviewed by Dean *et al.* (1991). The lower interval of the Cambrian consists of a thick sequence of cross-bedded quartz-arenites, which are interpreted as beach deposits. It is transgressively overlain by limestones. The carbonates consist of from bottom to top: dolomite, black limestone, light gray limestone and red nodular limestone. Reliable ages are mainly obtained from the last member indicating to Middle Lower Cambrian to Late Middle Cambrian. The quartzites at the lower interval of the succession can be considered as the first Paleozoic transgression onto the Gondwanean Platform. The nodular limestones at the top, on the other hand, mark the sudden change from platformal to deep marine conditions indicating the presence of a deepening basin to the north of the platform. A very thick siliciclastic unit that succeeds the Lower Cambrian carbonates is middle Middle Cambrian to Late? Arenig in age. Dean at al (1991) indicates that the unit comprises a monotonous succession of quartzites and alternating micaceous shales. Late Middle Cambrian siliciclastics are mainly restricted to the north whereas bands and lenses of nodular limestones were described in the south. Dean at al (1991) suggests a combination of a general regression with weak topographic differentiation at the end of Cambrian in this part of NW Gondwana.

In SE-Anatolia Cambrian units start with basal conglomerates, followed by an interval consisting of sandstone, sandy limestone, shale and siltstone alternations. At the top, the unit is represented by coarse grained and hummocky-type cross-bedded sandstones with quartz conglomerates. The deposition of the basal part is characterized by a shallow-marine transgression, transitional to coastal tidal-flat deposits of the middle part. The upper part of the sequence is interpreted as a regressive product of an eolian environment. The age data is from limestone interlayers in the southeasternmost outcrops in Turkey where *Archaeocyathus* fragments of Lower Cambrian age were reported. The succeeding carbonates are composed of sandy-clayey dolomites, followed by thick-bedded dolomites with chert nodules. The upper interval consists of a 20-30m thick interval represented by nodular limestones. The limestones in the upper part of the sequence are rich in trilobites, brachiopods and acritarchs, yielding a Middle Cambrian age. This formation is interpreted as product of a marine transgression and stable platform deposition. A diachronous younging towards east suggests that the transgression during Middle Cambrian was from west to east. The carbonates are succeeded by an interlayering of nodular limestone and shale and continue with alternating shale, siltstone and sandstone. The micaceous sandstones display ripple-marks and cross-ripple lamination. The basal nodular limestones, alternating with shales are rich in trilobites, brachiopods and crinoids of Middle Cambrian age (Dean *et al.*, 1981). It is implied that the deposition has started in a slowly deepening environment followed by basinal deposition. The upper part of the sequence, however, is turbiditic and interpreted as the product of local regressive delta complexes. In conclusion, Late Lower Cambrian-Upper Cambrian period in the southern zone is designated by a regional transgression from northwest. The diachronous younging of platform to deep marine carbonates towards southeast suggests a rapid subsidence and hence opening of a relatively deep basin to the Northwest of Arabian-Tauride platform that separated the northern

zone from the southern one. Cambrian trilobite fauna in the Taurus area indicates an affinity with the well-known Mediterranean biofacies.

Ordovician

The main bulk of the Ordovician succession in the Taurides is represented by Tremadoc shales-siltstones alternating with quartzites and rare nodular limestones, and was dated by trilobites, graptolites and acritarchs. The uppermost interval of the Ordovician consists of limestones with ecinoderm fragments followed by reefal limestones with trilobites and conodonts and shales with acritarchs of Upper Arenig age. The succession is interpreted as a deep-water siliciclastic deposition in a north-facing basin. Towards the end of Arenig the deposition of reefal limestones may suggest a regression. In the Taurides an important hiatus separates the Early Ordovician from Late Ordovician. Upper Ordovician is only described from the southernmost Central Taurides where coarse-grained sandstones, siltstones and silty shales unconformably overlie the Lower Ordovician units. Dean *et al.* (1991) reported poorly preserved acritarchs and sporomorphs of Caradoc-Ashgill age from this unit. The Lower Ordovician succession in SE Anatolia contain in its lower interval shales and siltstones interlayered with quartz-arenites. The upper interval is represented by an alternation of quartz-sandstones with ripple-marks and worm-tubes and thin-bedded dark shales. Fossil data from the surface and subsurface evidences a Tremadoc-Arenig depositional age. It is followed by an alternation of dark shales and siltstones in the lower interval, sandstones and shales with local submarine lavas in the middle and upper intervals. The lowermost layers of this unit is Karadoc in age, which would indicate a non-depositional period during Middle Ordovician. In southeasternmost part of Turkey, however Tremadoc-Arenig shales is unconformably covered by Ashgil sandstones and shales. The topmost interval of the Ordovician in Amanos area constitutes poorly sorted glacial conglomerates with siltstone and mudstone interlayers. It is assumed that the deposition has started with platform-type shallow-marine conditions followed by regressive sequences representing deltaic environments. The upper part is characterized by shallow-marine deposits. In Jordan and Northwestern Syria Lower Ordovician is mainly characterized by coarse grained sandstones of more proximal facies, whereas during late Ordovician at least two regressive cycles are recorded (Husseini, 1990). The stratigraphic hiatuses, unconformities and irregular distribution of the Ordovician units in the southern zone may be ascribed to glacio-eustatic sea-level changes of Late Ordovician age in the NW Gondwana-margin.

Silurian

Both in the northern and southern areas the Ordovician units are unconformably overlain by Lower Silurian coarse clastics. Lower Silurian period in the southern zone in Tauride unit is characterized by a transgression on the Early Ordovician units, represented by clastics followed successively by the development of graptolitic black shales. Local volcanic activity is recorded in the southwestern and eastern Taurides. In SE Anatolia, Lower Silurian is a period of non-deposition or erosion, whereas thick sandstone-shale alternations were penetrated by wells in Northern Syria. The Early Silurian deepening in the area is very probably related to the relatively rapid global sea-level change, which is reported from different parts of NW Gondwana. The regression in the Taurides and SE Anatolia is very probably related to the closure of a northern oceanic basin. During this event the basin between the northern and southern zones has probably narrowed, but remained open until the Early Carboniferous when it closed by southward subduction.

Conclusions

Based on dissimilarities in magmatizm and stratigraphic records, two distinct terranes of Lower Paleozoic age can be differentiated in the Turkish-Northern Arabian part of NW Gondwana. The palinspastic reconstruction renewals that the southern terrane has experienced an evolution very similar to N Arabia: 1- a rifting phase on the Pan-african consolidated pericratonic margin during Late Precambrian and Infracambrian followed by a transgression from W-NW during Late Lower Cambrian, 2- formation of a northward facing margin/slope during the Middle Cambrian-Ordovician, 3- glacio-eustatic sea-level changes during Late Ordovician, 4- a rapid subsidance due to global sea-level rise and deposition of mixed clastics and carbonates during Silurian, and 5- a regional unconformity indicating to a ?Caledonian tectonic event at the Silurian-Devonian boundary.

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