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# The Silurian of the Istanbul unit in the Camdag Area, NW Turkey

M. Cemal GÖNCÜOGLU[1], Iskra LAKOVA[2], Hüseyin KOZLU[3] and Valeri SACHANSKI[2]

## Introduction

The Paleozoic succession of the Camdag area is located between the Paleozoic of the Istanbul and Zonguldak terranes in NW Turkey (Figure 1) and has a key location for the paleogeographic position of these terranes. The Silurian deposits (Findikli Formation) in this area includes from bottom to top: the Black Shale Member (gray to greenish gray, well cleaved shales with minor black siltstone and limy shale interlayers), the Shale-Siltstone Member (alternation of black shales, light gray quartz-rich siltstones with few limestone lenses), and the Shale-Limestone Member (black shales with limestone and dolomitic limestone interlayers), that is concordantly followed by Lower Devonian deposits. In this study, new graptolite, polynomorph and conodont findings from the Silurian Findikli Formation in NW Anatolia will be reported.

## Rock units and fossil findings

The Fýndýklý Formation crops out mainly in the central and northern parts of the Camdag massif within a roughly E-W trending anticline, dissected by numerous south-verging thrust-faults. The revised columnar section of the Ordovician to Devonian rocks in the Camdag area is given in Figure 2. Fýndýklý Formation in its upper part displays a gradational contact to the overlying Lower Devonian Býcký Member of the Kartal Formation.

The Black Shale Member of the Findikli Formation consists of black to greenish gray, well-cleaved argillites with minor black siltstone interlayers (Figure 2). The thickness of the member is about 35m. The following graptolites *Spirograptus spiralis* (Geinitz), *Spirograptus falx* (Suess), *Monoclimacis vomerina* (Nicholson), *Monograptus priodon* (Bronn), *Monograptus parapriodon* Boucek, *Monograptus (Globosograptus) mancki* Hemmann, *Monograptus curvus* Manck, *Diversograptus ramosus* Manck, *Retiolites angustidens* Elles and Wood, *Cyrtograptus (Barrandeograptus) pulchellus* Tullberg are described for the first time from this unit. This fossil assemblage indicates the *spiralis* Zone of the Late Llandovery and is so far the first age data from the lower part of the Findikli Formation in NW Turkey (Göncüoglu and Sachanski, 2003).

The overlying Shale-Siltstone Member displays a gradational contact to the Black Shale Member and is characterized by alternations of dark green-greenish black – black siltstones and shales with dark green-black, pyrite-bearing limey siltstones. In contrast to the siltstones of the

[1] METU, Dept. Geological Eng., 06531 Ankara, Turkey. E–mail: mcgoncu@metu.edu.tr
[2] Geological Institute, Bulgarian Academy of Sciences 1113 Sofia, Bulgaria.
[3] Turkish Petroleum Corp., Exploration Dept., 06521 Ankara, Turkey.

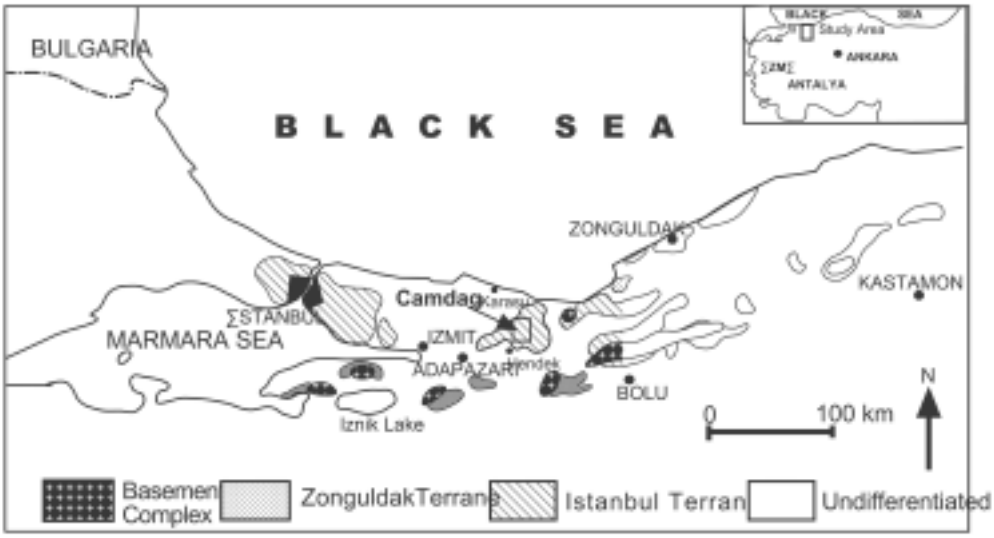


**Figure 1.** Distribution of the Lower Paleozoic rocks in NW Turkey and the location of the study area.

underlying Black Shale Member the siltstones here are very rich in mica detritus. The palynomorphs obtained from this unit, mainly the acritarchs, (Lakova and Göncüoglu, in prep.) suggest a Wenlockian-Ludlowian depositional age. The acritarch association recorded consists of *Ammonidium ludlowense* Lister, *Electoriskos willierae* (Deflandre and Dedlande-Rigaud), *Eisenackidium wenlokense* Dorning, *Gorgonisphaeridium succinum* Lister, *Oppilatala ramusculosa* (Deflandre), *Veryhachium trispinosum* (Eisenack). Apart from the acritarchs, hardly determinable trilete spores, cryptospore dyads and tetrads occur, as well as longer-ranging tubular structures of Wenlock to Emsian age: *Constrictitubulus cristatus* Burgess and Edwards, *Porcatitubulus annulatus* Burgess and Edwards, *P. strupus* Wellman and *Ornatifilum granulatum* Burgess and Edwards.

The "Orthoceras Limestones" of the Shale-Limestone Member (Figure 2) yielded a poorly preserved conodont fauna (*Ozarkodina excavata*? (BRANSON and MEHL), *O. eosteinhornensis* (WALLISER)?, *Oulodus elegans* (WALLISER)? and *Pseudooneotodus*?) indicating a Pridoli age (Kozlu *et al.*, 2002).

## Discussion and Conclusion

In contrast to the suggestions in the previous studies (*e.g.,* Derman and Tuna, 2000) an almost complete succession of Silurian rocks has been encountered in the Camdag area in NW Anatolia. The studied Silurian and the conformably overlying Devonian successions are very similar to those in the Istanbul terrane. The Findikli Formation in the Zonguldak terrane (NW of Kastamonu town, Figure 1) includes in its lower part (Dean *et al.* 1997) black siliceous shales with graptolites and acretarchs of middle Llandovery (Aeronian stage). Following a gap in exposure of about 80 m, gray, schistose mudstones monograptid graptolite-bearing shales with *Monograptus flemingii* (Salter) and *Pristiograptus* cf. *parvus* (Ulst) are reported. This part of the succession has not yielded acritarchs but the graptolites are indicative for the upper part of the Wenlock series. The black shales are unconformably overlain by Lower Devonian conglomerates and carbonates, so that the upper part of the Silurian succession must have been not deposited or eroded due to a "Caledonian event", which is completely missing in the Istanbul Terrane. By

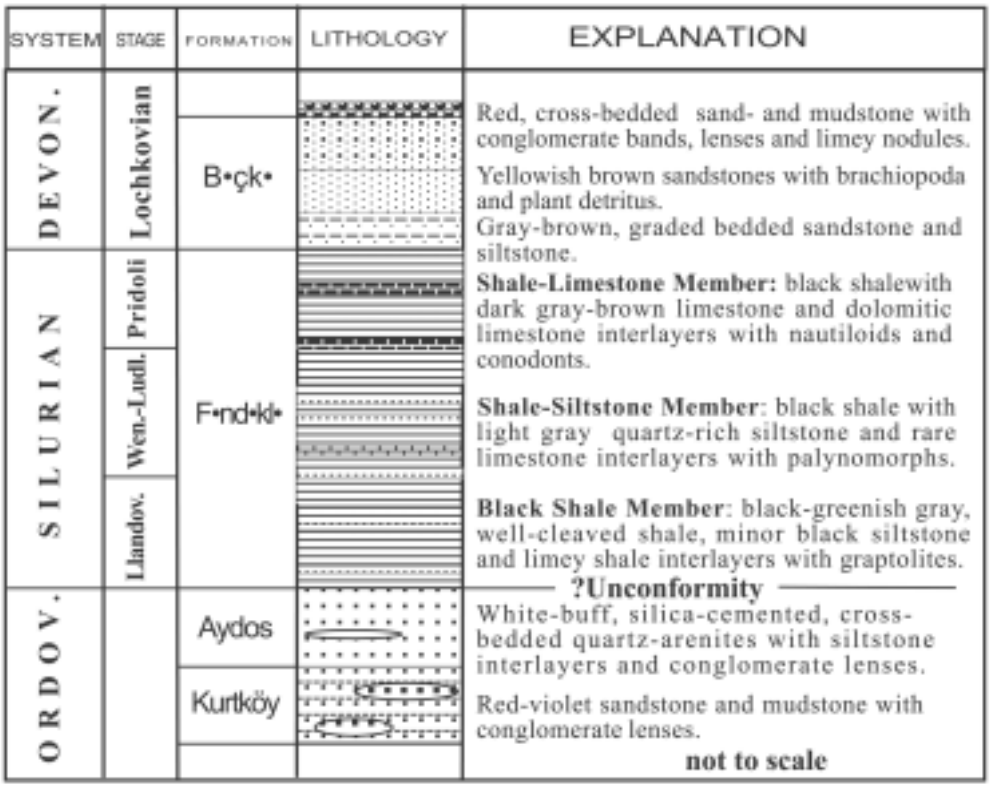


**Figure 2.** Generalized columnar section of the Lower Paleozoic rock-units in Camdag area.

this the Paleozoic of the Camdag should be considered as the eastern continuation of the Istanbul Terrane.

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