The graptolite species *Hunnegraptus copiosus* Lindholm, 1991 from the Lower Ordovician of Central Taurus, Turkey

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The Seydişehir Formation (an alternation of micaceous sandstones, siltstones and shales) is one of the ubiquitous lithostratigraphic units of the Lower Paleozoic sequence of the Taurides, cropping out in various parts of the Tauride mountains, as well as in the Amanos Mountains and in the southeast Anatolia. This study deals with the description of a graptolite find in the Seydişehir Formation in the Central Taurides in the region of Gökbelen northwest of Silifke (fig. 1). The Lower Paleozoic section is studied on the western bank of the Levent Stream, and includes from the base upwards: Emirgazi Group, Hüdai Quartzite, Çaltepe Formation and Seydişehir Formation.

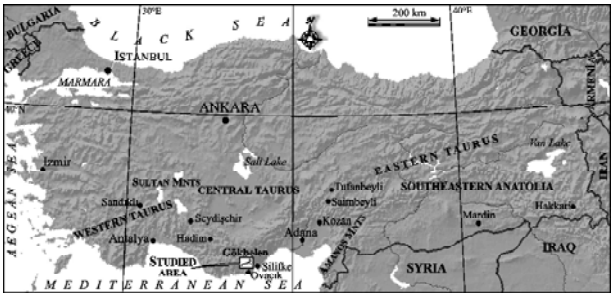


Fig. 1. Location map of the studied area

In the Central Taurides around the Варвакэ village north of the town of Hadim, where there are good outcrops, the Seydişehir Formation starts with shales with quartzite intercalations. They lie conformably over the Middle Cambrian nodular limestones of the Çaltepe Formation and include a few 3—4 m thick variegated limestone horizons with thin clay beds (Gedik, Özgül, 1973; Dean, Özgül, 1981). Shales and siltstones are dominant in the lower part of the section, whereas turbiditic clastic rocks with graded bedding and current marks dominate the upper part. The sandstones are of quartz-wacke type with mainly quartz clasts, abundant primary muscovite, a few zircons in a sericitized and chloritized matrix. The Seydişehir Formation is about 1000 m thick (fig. 2).

The Seydişehir Formation is generally poorly fossiliferous. Rare trilobites, graptolites, brachiopods and trace fossils were found. The thin limestone horizons in the lowermost part of the Seydişehir Formation comprise locally conodonts and the shales contain rare acritarchs. Its Middle Cambrian — Arenigian age was proven on trilobites (Dean, Monod, 1970, 1990) and conodonts (Göncüoğlu et al., 2004). The present graptolite discovery is important in being a zonal fossil in the poorly fossiliferous unit. Apart from a few graptolite fragments, no graptolites have been described from the Tufanbeyli and Silifki regions. The specimen with the graptolite fossils (TS-85-1) which is the subject of this paper has been collected from the shales near the base of the Seydişehir Formation in Kaledibi locality, 6—7 km north of the town of Gökbelen, 25 km west of Silifke on the Mediterranean coast in the southern parts of the Central Taurides.

The specimen TS-85-1 contains a multitude of fragments as multiramous mature specimens and several as didymograptid juvenile *Hunnegraptus copiosus* (fig. 2 and fig. 3). The two-stiped, didymograptid-like *H. copiosus* are visible in profile view, make an angle of 130—155° with branching length 10 mm (fig. 2) and profile stipe width 0.5 mm. The sicula is tube-shaped, 1.0—1.2 mm long, about 0.2 mm wide at the aperture and its distal part is inclined. The presence of sicular bitheca was not observed due to strong flattening of the specimens. The thecae are simple straight tubes, approximately 1.4 mm long and 0.2—0.3 mm wide at the aperture. The thecal inclination is usually 15° and the overlap is 40%. The distance between successive thecae is about 0.9—1.0 mm which corresponds to 10—11 thecae in 10 mm. The mature *H. copiosus* are preserved usually as fragments in dorsoventral position. The sicu-

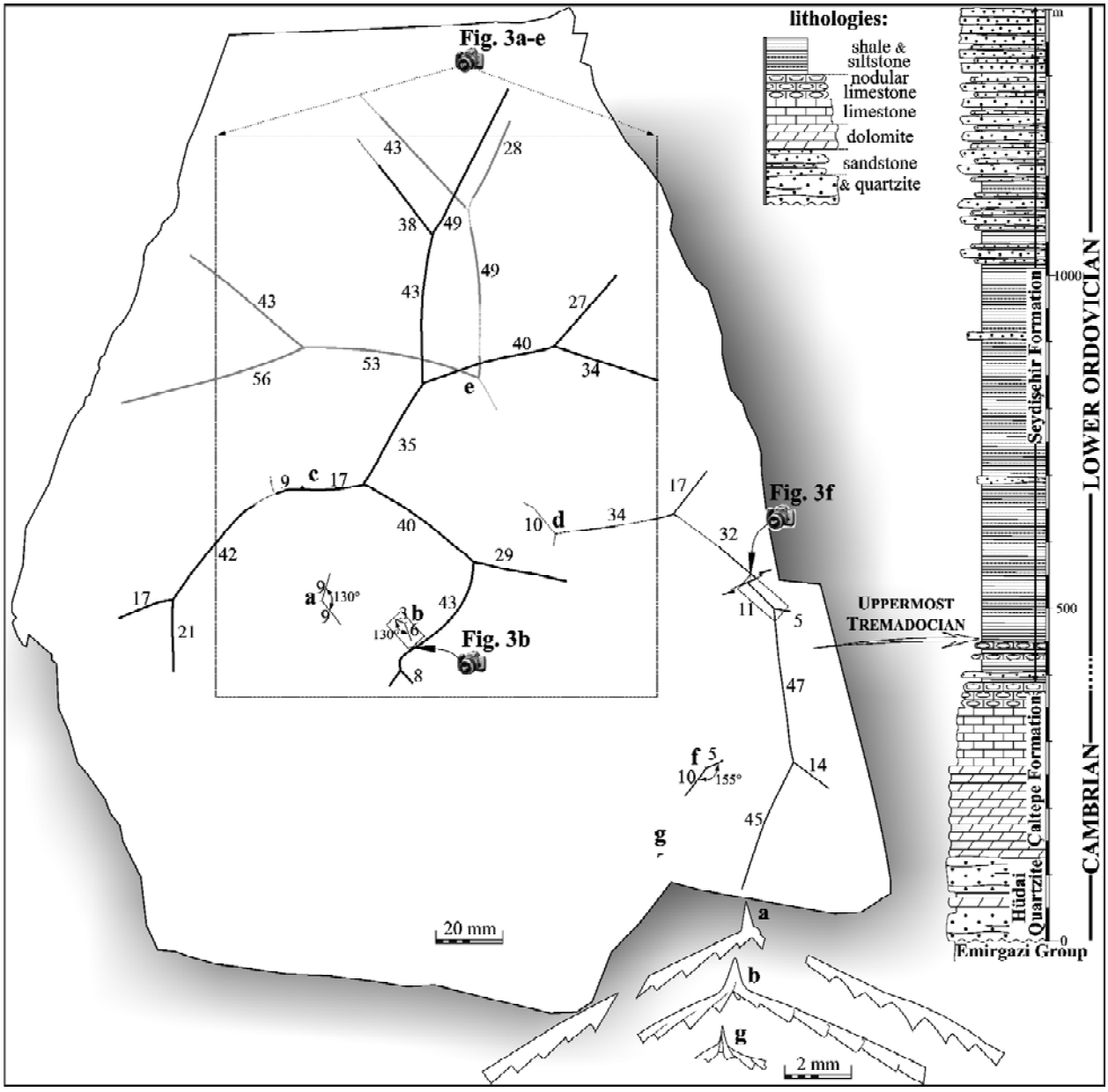


Fig. 2. Lower Paleozoic sequence in the Kaledibi area and the position of the studied specimen TS-85-1 with *H. copiosus* (a-g). The camera shows the sectors shot on Fig. 3.

la and the horizontal first-order branches are shown on the specimen on fig.1c. There are three clearly visible second-order branches. Its branches reach four order. Their length is shown on fig. 2. The ventral preservation allows to measure only its lateral stipe width — 0.5—0.6 mm. 11 thecae in 10 mm are visible at the beginning of the bottom right second-order stipe and in one fourth-order stipe. The genuine thecal inclination can be seen at the fragments in full profile view (fig, 3f) — 15—20° (usually 15°). The profile stipe width is 0.5—0.8 mm. The thecae are simple straight tubes, approximately 1.6 mm (1.3—1.8 mm) long and 0.2—0.3 mm wide, 11—13 in 10

Table 1. Comparison between the multiramous specimens from Central Taurides and H. copiosus and H. tjernviki from Scandinavia

	Central Taurides	*H. copiosus*	*H. tjernviki*
Orders of stipes	4 and 5?	2 and more?	4 and more?
Stipe width (mm)	0.5–0.8	0.5–0.6	0.8–1.2
Sicula: long / wide at the aperture (mm)	1.0–1.2 / 0.2	1.0–1.3 / 0.25	1.5 / -
Thecal length (mm)	1.4–1.6	1.2	1.4–1.7
Thecal width at the aperture (mm)	0.2–0.3	0.25–0.3	0.4–0.5
Thecae in 10 mm	11 (11–13)	11.5–13	10.5–12
Thecal inclination	15° (15–20°)	15–20°	30°
Thecal overlap	40–50%	40–50%	50%

mm, and the thecal overlap is about 40—50%. Bithecae are not present along the stipes.

The found two-stiped, didymograptid-like specimens in the Central Taurides (fig. 2a, b, f, g; fig. 3a, b) are identical with *H. copiosus* Lindholm (1991). The multiramous mature specimens (fig. 2c, d, e; fig 3c, d, e, f) show similarity with the Scandinavian *H. copiosus* and *H. tjernviki*. On table 1 with grey color are marked the taxonomical characteristics closer to the specimens from Central Taurides. Lindholm (1991, p. 299) draw attention to the possibility that the Scandinavian specimens of the genus *Hunnegraptus* belong to one species, representing different growth stages — "young", "mature" and "gerontic". To this effect we consider the content of *H. copiosus* Lindholm and refer all these multiramous specimens to this species.

Cooper (1999) recognized the Tremadoc global graptolite zones. The uppermost zone — *Hunnegraptus copiosus* then was known only from Scandinavia and probably China. Robardet et al. (1998, p. 312) reported *H.* aff. *copiosus* (undescribed) in the latest

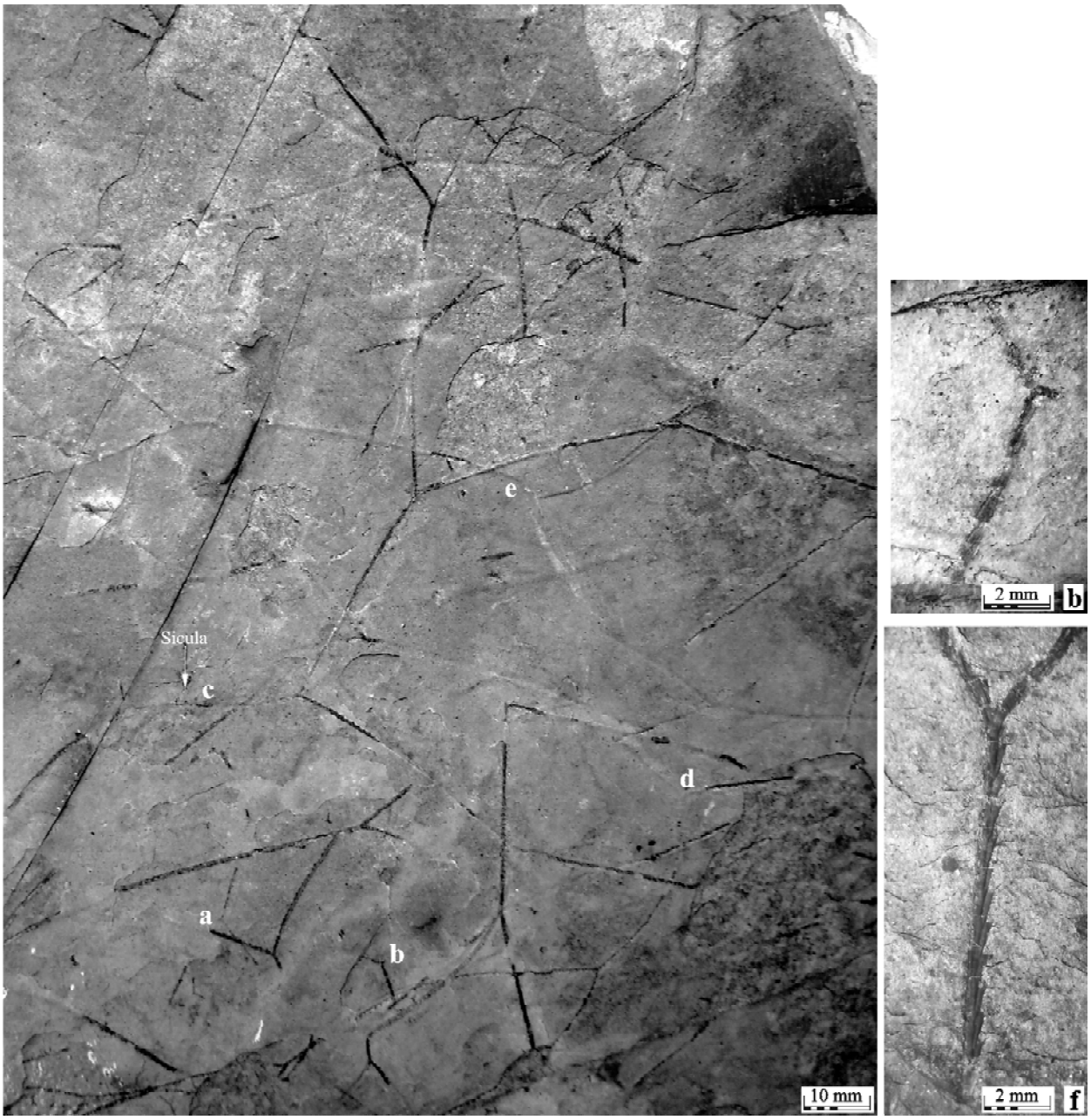


Fig. 3. (a, b) *Hunnegraptus copiosus* Lindholm as didymograptid juvenile specimens; (c, d, e, f and most fragments) *Hunnegraptus copiosus* Lindholm as multiramous mature specimens. (f) a stipe fragment in profile view.

Tremadoc in SW Spain. Outside Scandinavia undoubted *H. copiosus* were established in Bolivia (Maletz, Egenhoff, 2001), Argentina (Ortega, Albanesi, 2005) and Canada (Jackson, Lenz, 2003). Kim et al. (2005) announced for *H. copiosus* in Korea. All these finds are from the uppermost part of the Tremadocian. The established *H. copiosus* near the base of the Seydişehir Formation in the Kaledibi locality is the first graptolite evidence of Late Tremadocian age in graptolite bearing sediments in Turkey.

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Граптолитният вид *Hunnegraptus copiosus*, Lindholm 1991 от долноордовишката серия на Централните Тавриди, Турция

Валери Сачански, Недждет Йозгюл, Есен Арпат

Hunnegraptus copiosus Lindholm, 1991 е зонален граптолитен вид, характеризиращ най-горната част на тремадокския етаж на долноордовишката серия (Cooper, 1999). До момента този вид със сигурност е установен в Скандинавия (Lindholm, 1991), Боливия (Maletz, Egenhoff, 2001), Аржентина (Ortega, Albanesi, 2005) и Канада (Jackson, Lenz, 2003). Доказва се за първи път в Турция. Находките са от основата на бедната на фосили Сейдишекирската свита северозападно от Силифке, Централни Тавриди. Намерени са както млади (дидимограптидни), така и възрастни (разклонени) представители на вида. Изобразеният на фигури 2c и 3c *H. copiosus* е най-големият известен до момента в света. Разклоненията му достигат до четвърти ред. Установяването на най-горната тремадокска граптолитна зона в основата на широко разпространената в Турция Сейдишекирска свита, детайлизира възрастта ѝ, определена до момента въз основа на трилобити (Dean, Monod, 1970, 1990) и конодонти (Göncüoğlu et al., 2004).