

KIMMERIDGIAN – LOWER TITHONIAN AMMONITE ASSEMBLAGES FROM GHILCOȘ - HĂGHIMAȘ MASSIF (EASTERN CARPATHIANS, ROMANIA)

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Abstract. The paper presents the biostratigraphy of Upper Jurassic deposits from Ghilcoș Mountain. The exposures rich in ammonites are located on the western and north-western sides of Ghilcoș, where several sections are analysed. The ammonite assemblages confirm the zones *Platynota/Silenum*, *Strombecki* (*/Hypselocyclum*) and *Herbichi/Divisum* for the Lower Kimmeridgian; *Acanthicum*, *Eudoxus* (*/Cavouri*) and *Beckeri* zones for the Upper Kimmeridgian and *Hybonotum*, *Vimineus*, *Semiforme*, *Fallauxi* for the Lower Tithonian. *Platynota* and *Beckeri* zones were possible to be defined as taxa ranges, while the others based on their assemblages only, some of them on partial range of their index. A new subzone – *Spinata*, located in the base of *Platynota* Zone is proposed here.

Keywords: Ammonites, Biostratigraphy, Kimmeridgian, Ghilcoș, Romania.

GENERAL FRAMEWORK

The rich ammonite fauna from Ghilcoș Mountain discovered by Franz Herbich in 1866, formerly taxonomically studied by M. Neumayr (1873) and later by other authors (Vadasz, 1915, Jekelius, 1921, Preda, 1973, Turculeț, 1980 and others), was considered an important reference for the Kimmeridgian Stage by Arkell (1956) in his "The Jurassic of the World". In the last 20 years, this fauna was systematically studied by Grigore (1996, 2000, 2002); more recently the research was done in the frame of the GEOBIOHAS Project (Grigore & Marcu, 2009; Grigore, 2009 and two new papers in press).

The exposures of the Upper Jurassic deposit rich in ammonites are located in the western and north-western side of Ghilcoș Mountain. Two types of outcrops were investigated: the first, represented by the western slopes of Ghilcoș (F1), where the Upper Jurassic deposits are affected by transversal faults with some lateral differences in lithology and thickness (sections K, T, R, W), and the second one (F2) represented by an area with big blocks (sections A, D, E, F, H) possibly slipped along the north-western slope of this mountain. These blocks appear to be part of a relict facies which does not contain Lower Kimmeridgian nodular limestones, which seem to have been destroyed by tectonic movements and erosion.

BIOSTRATIGRAPHY

The actual account on the biostratigraphy of the Upper Jurassic deposits is the result of recent evaluations and correlation of all studied sections, in the Ghilcoș slopes or slipped blocks. After the Neumayr's (1873) and Dragastan's (1975), this is the third biostratigraphic evaluation of the ammonite fauna included in the so-called „Acanthicum Beds” from Ghilcoș. For establishing zone boundaries or correlative bio-units we took into consideration the I.J.S.C. recommendations (Enay & Geysant, 1979; Zeiss, 1983; Atrops, 1986).

Lower Kimmeridgian

Platynota Zone (Huguenin, 1874) (taxon range zone) /**Silenum** (Sarti, 1993) (partial range zone). This zone can be recognised here as the range of *Sutneria platynota* and also as acme of the *Sowerbyceras silenum* taxon, offering

the possibility to correlate the Mediterranean and Submediterranean faunas. This zone, of maximum 2 meter thickness, was remarked in the southern side of the Ghilcoș outcrop (W profile); it was also found on the north-western slope of Ghilcoș, in some blocks (E, F), which preserve the richest fauna for the Lowest Kimmeridgian. The base and top of this zone contain two lumachellic levels of *Sowerbyceras silenum* and, beneath the zone locan ending surface, the maximum abundance of *Sutneria platynota*. The rich assemblage of this zone includes: *Sutneria spinata*, *Sutneria carpathica*, *Ataxioceras* (*Schneidia*) *guilherandense*, *Orthosphinctes* (*Ardescia*) *desmoids*, *Orthosphinctes* (A.?) aff. *desmoids*, *Orthosphinctes* (*Ardescia*) *proinconditus*, *Orthosphinctes* (*Orthosphinctes*) *polygyratus polygyratus*, *Orthosphinctes* (O.) *polygyratus colubrinus*, *Orthosphinctes* (O.) *freibergeri*, *Orthosphinctes* (O.) cf. *tiziani*, *Lithacosphinctes evolutus*, *Progeronia progeron*, *Progeronia triplex*, *Progeronia metamorpha*, *Progeronia unicompta*, *Trenerites enayi*, *Lessinicerias raschii*, *Epaspidoceras rupellense*, *Aspidoceras binodum*, *Aspidoceras uninodosum*, *Aspidoceras* cf. *sesquinodosum*, *Benetticeras vaii*, *Physodoceras wolffi deaki*, *Ph. wolffi wolffi*, *Ph. wolffi insulanum*, *Physodoceras altenense altenense*, *Glochiceras* (*Lingulaticeras*) *lingulatum*, *Glochiceras* (*Lingulaticeras*) *nudatum*, *Taramelliceras* (T.) *greenackeri*, *Taramelliceras karreri*, *Taramelliceras* (T.) *hauffianum*, *Taramelliceras* (*Metahaploceras*) *subnereus*, *Taramelliceras* (*Metahaploceras*) *strombecki*, *Phylloceras saxonium*, *Phylloceras isotypum*, *Holcophylloceras mediterraneum*, *Holcophylloceras polyolcum*, *Calliphylloceras manfredi*, *Sowerbyceras tortisulcatum*, and *Lytoceras polycyclum polycyclum*. In this interval it is possible to separate three different assemblages – as subzones; 1) **Spinata** Subzone (new) in the lower part, which is possible synchronous with *Polygyratus* Subzone, Atrops (1994). It can be defined based on of the full participation of *Sutneria spinata* Grigore, 2009; it is also characterised by the first lumachellic bank of *Sowerbyceras silenum* in the first 25 cm from the base of the zone and by the appearance of *Epaspidoceras rupellense*, *Progeronia triplex*, *Aspidoceras binodum*, *Aspidoceras uninodosum*

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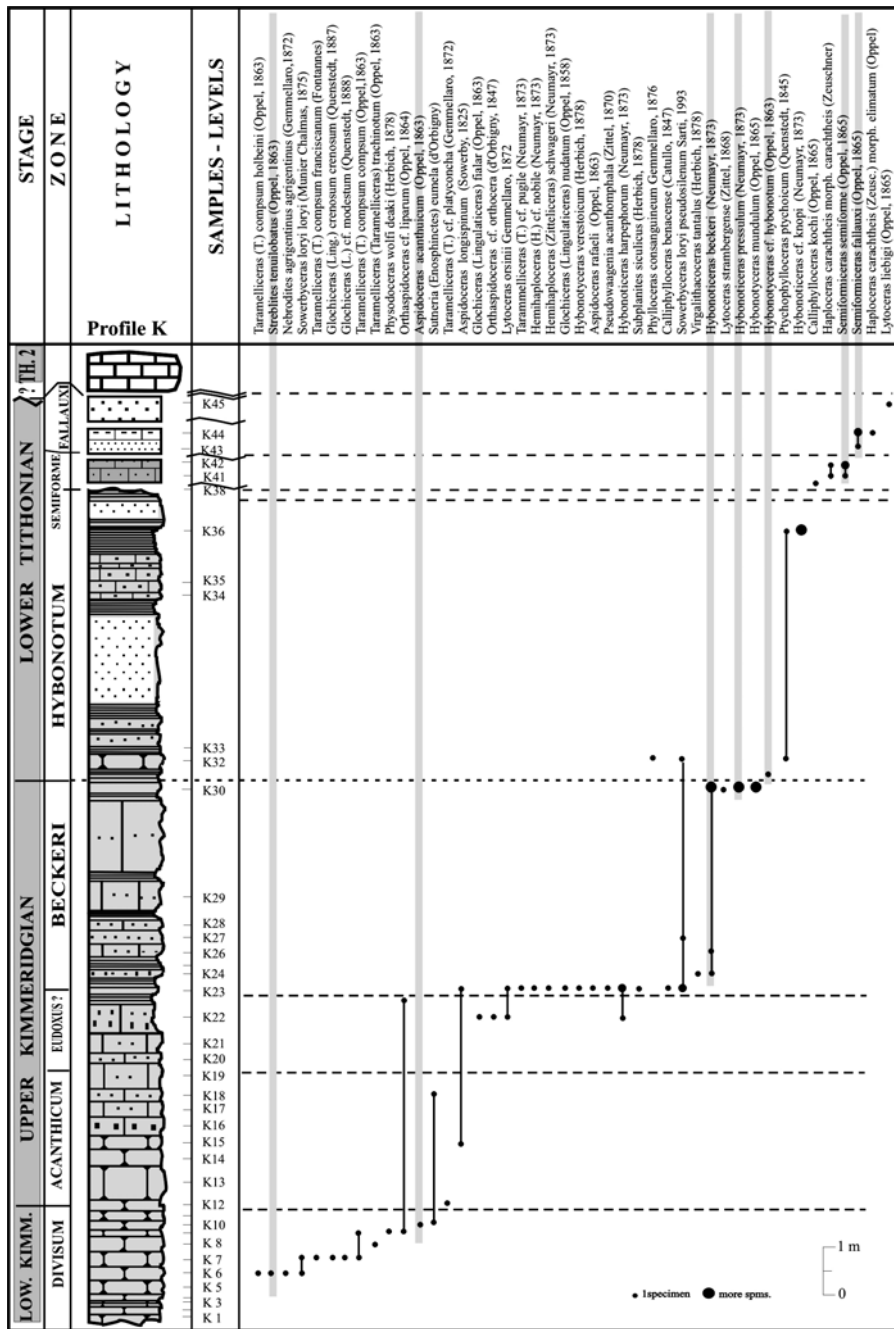


Fig. 1 - Litho- and biostratigraphic column in K section from Ghilcoş slopes (F1 outcrop).

and *Trenerites* cf. *enayi* which are continuing their existence in the next interval. 2) **Desmoides** Subzone (Atrops, 1982), is characterised by the appearance of the *Ardescia* representatives. The characteristic assemblage consists of: *Orthospinectes* (*Ardescia*) *desmoides*, *Lithacospinectes* *evolutus*, *Trenerites* *enayi*, *Taramelliceras* (*Metahaploceras*) *subnereus*, *Benetticeras* *vaii* and *Glochiceras* (*Lingulaticeras*) *nudatum*. In this interval also the appearance of *Phylloceras* *saxonicum*, *Holcophylloceras* *polylocum*, *Calliphylloceras* *manfredi*, *Progeronia* *unicompata*, *P. metamorpha*, *Physodoceras* *altenense* *altenense* and under its ending, *Sutneria* *carpathica*, *Taramelliceras* (T.) aff. *trachinotum*, T. cf.

karreri, *Lessinicerias* *raschii* and *Taramelliceras* (*Metahaploceras*) *strombecki* was remarked. 3) **Guilherandense** Subzone (Atrops, 1982), recognised as the local range of *Ataxioceras* (*Schneidia*) *guilherandense*; however there is a low frequency within the whole range of maximum 1 m thick, in the top of the zone. **Proinconditus** **Horizon** can be separated in the last 25 cm of this zone, based on a characteristic assemblage: *Ortospinectes* (*Ardescia*) *proinconditus*, O. (*Ardescia*?) aff. *desmoides*, O. (O.) *polygyratus* *polygyratus*, *Taramelliceras* (T.) *greenackeri*, *Glochiceras* (*Lingulaticeras*) *lingulatum* and *Progeronia* *progeron*.

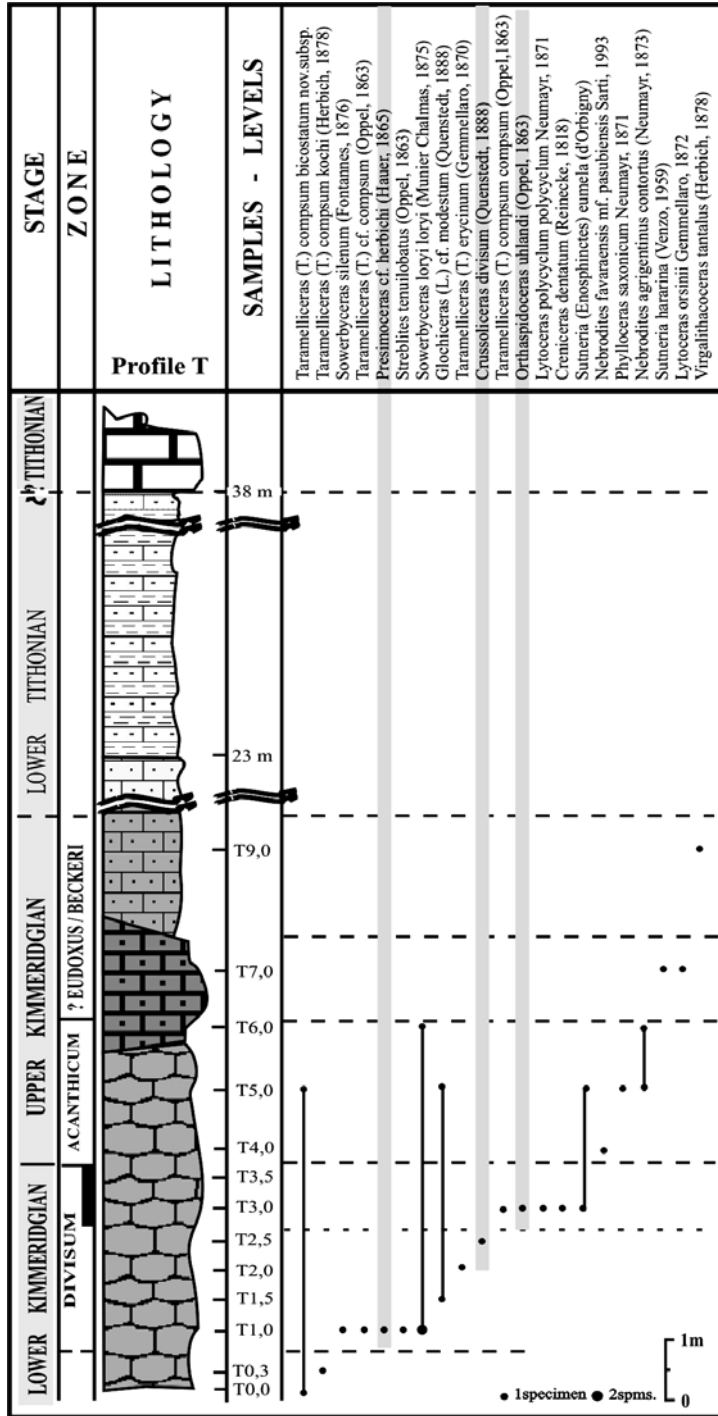


Fig. 2 - Litho- and biostratigraphic column in T section from Ghilcoş slopes (F1 outcrop).

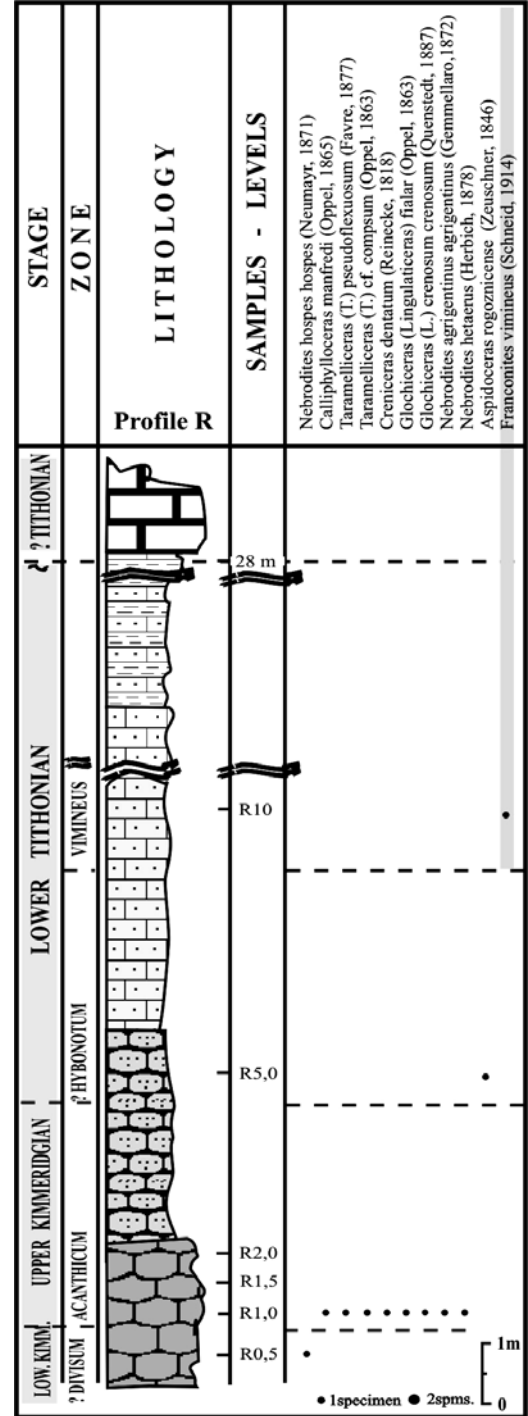


Fig. 3 - Litho- and biostratigraphic column in R section from Ghilcoş slopes (F1 outcrop).

Hypselocyclum Zone (Geyer, 1961) /**Strombecki** (Karve-Corvinus, 1966; emended). In this region the assemblage corresponding to this interval comprises: **Orthosphinctes* (*Ardesia*) *inconditus*, *Orthosphinctes* (O.) *tiziani*, *Progeronia breviceps*, *Progeronia metamorpha*, *Progeronia unicompta*, **Ringstedia* ("Decipia") *helvetica*, *Lessinicerias ptychodes*, *Lessinicerias raschii*, *Trenerites* sp., *Nebroditis hospes hospes*, *Taramelliceras* (*Metahaploceras*) *strombecki*, *Taramelliceras* (M.) *nodosiusculum*, *Taramelliceras karreri*, *Taramelliceras* (T.) *compsum holbeini*, *Taramelliceras* (T.) *trachinotum*,

Aspidoceras binodum, *Aspidoceras* cf. *sesquinosum*, *Physodoceras wolffi deaki*, *Physodoceras wolffi wolffi*, *Physodoceras wolffi insulanum*, *Physodoceras altenense altenense*, *Sutneria* (S.) cf. *cyclodorsata*, *Sutneria* (E.) cf. *pedinopleura*, *Phylloceras saxonicum*, *P. isotypum*, *Holcophylloceras mediterraneum*, *Holcophylloceras polyolcum*, *Calliphylloceras manfredi*, *Sowerbyceras silenum*, *Sowerbyceras tortisulcatum*, *Lytoceras polycyclum polycyclum*, *Lytoceras polycyclum camertinum*.

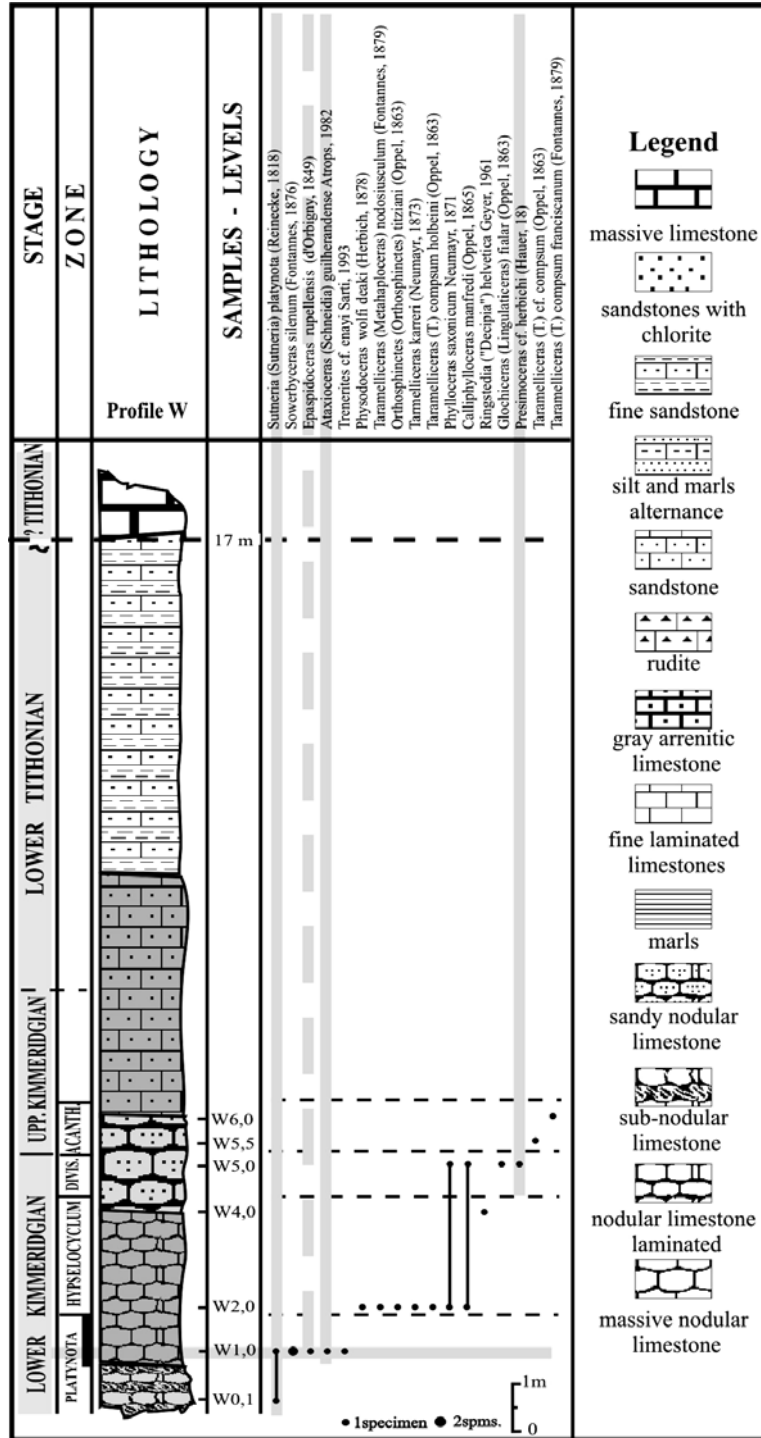


Fig. 4 - Litho- and biostratigraphic column in W section from Ghilcoş slopes (F1 outcrop).

The species "*Perisphinctes*" *lothari* (OPPEL) and "*Ataxioceras* (*Parataxioeras*)" *fasciferus* (NEUMAYR), identified by previous authors (F. Herbich, 1878 and M. Neumayr, 1873) can complete the assemblage, but they do not bear a clear stratigraphical significance. With some exceptions, all the species found in this interval continue from the previous one or they appear here first time, the characteristic assemblage being poor; less documented is the upper part of this interval, due to gaps. This zone is documented from section W and blocks E and F (W2 – W4, E2, and F6 – F8 intervals). The lower boundary is

marked by the appearance of *O. (Ardescia) inconditus*, *Lessinoceras ptychodes* and *Progeronia breviceps*. The upper boundary is marked, with reserve, by the disappearance of *Ringstedia* ("*Decipia*") *helvetica* and the appearance of *Ringstedia (Decipia) haliarchus* and *Presimoceras cf. herbichi*. *Nebroditis hospes hospes* appears in the top of this interval. Inconditus Horizon can be recognised in the base of this interval, of 20 cm maximum thickness.

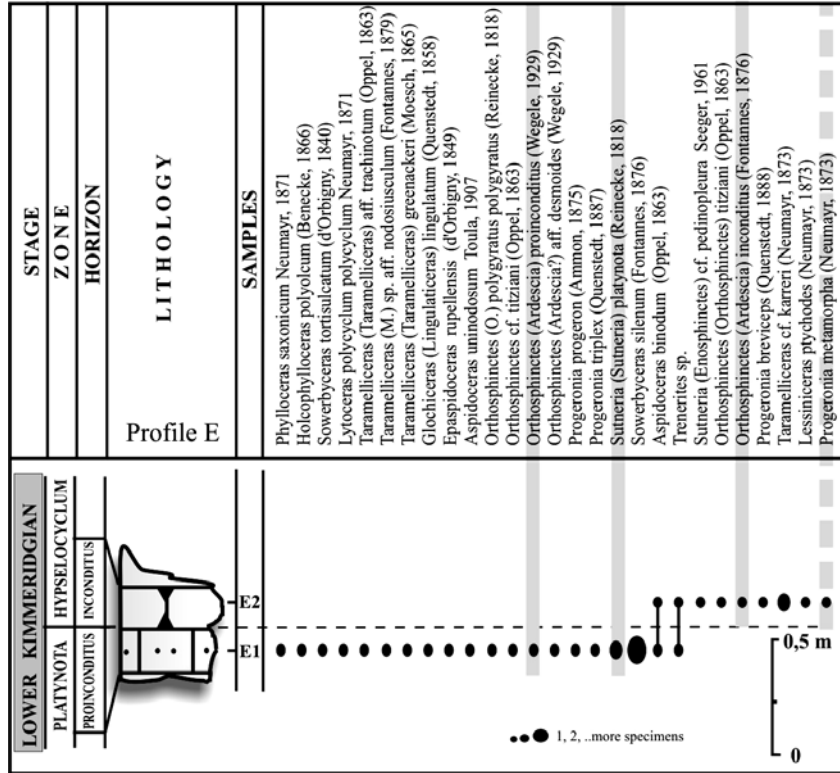


Fig. 5 - Litho- and biostratigraphic column in E block from Ghilcoş north-western slope (F2 outcrop).

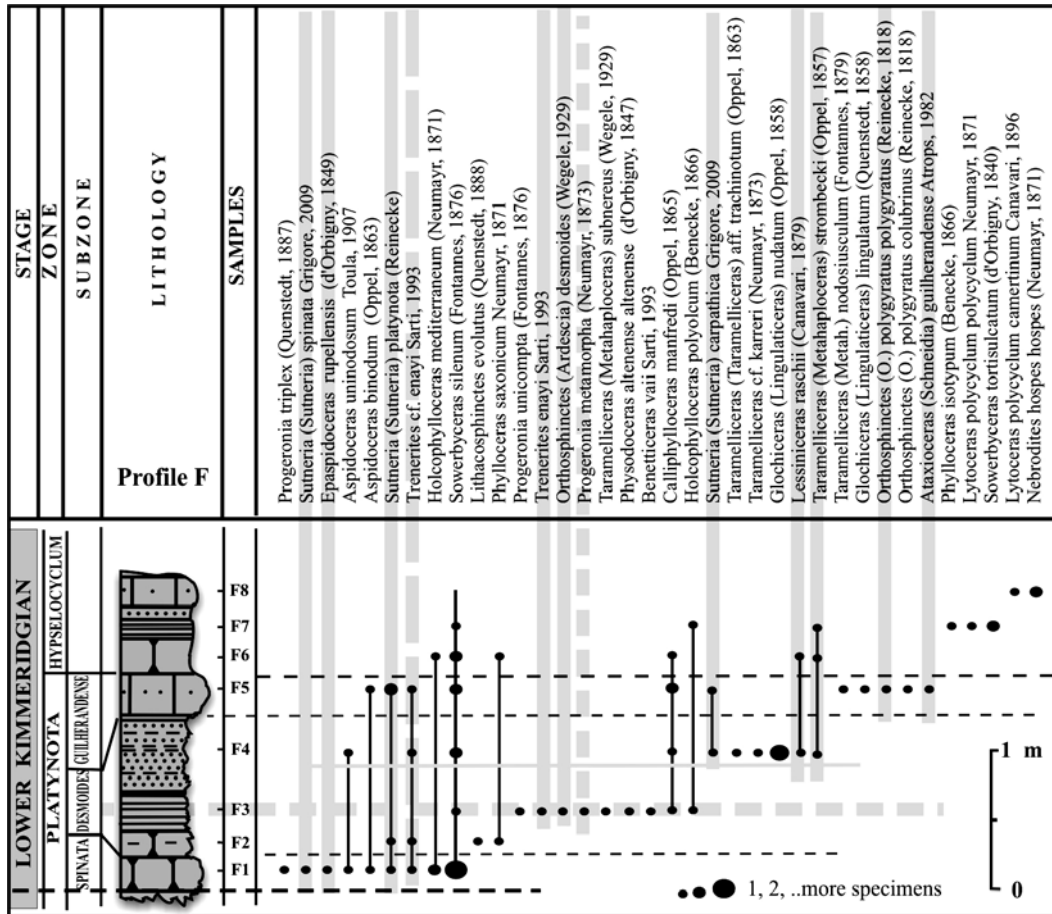


Fig. 6 - Litho- and biostratigraphic column in F block from Ghilcoş north-western slope (F2 outcrop).

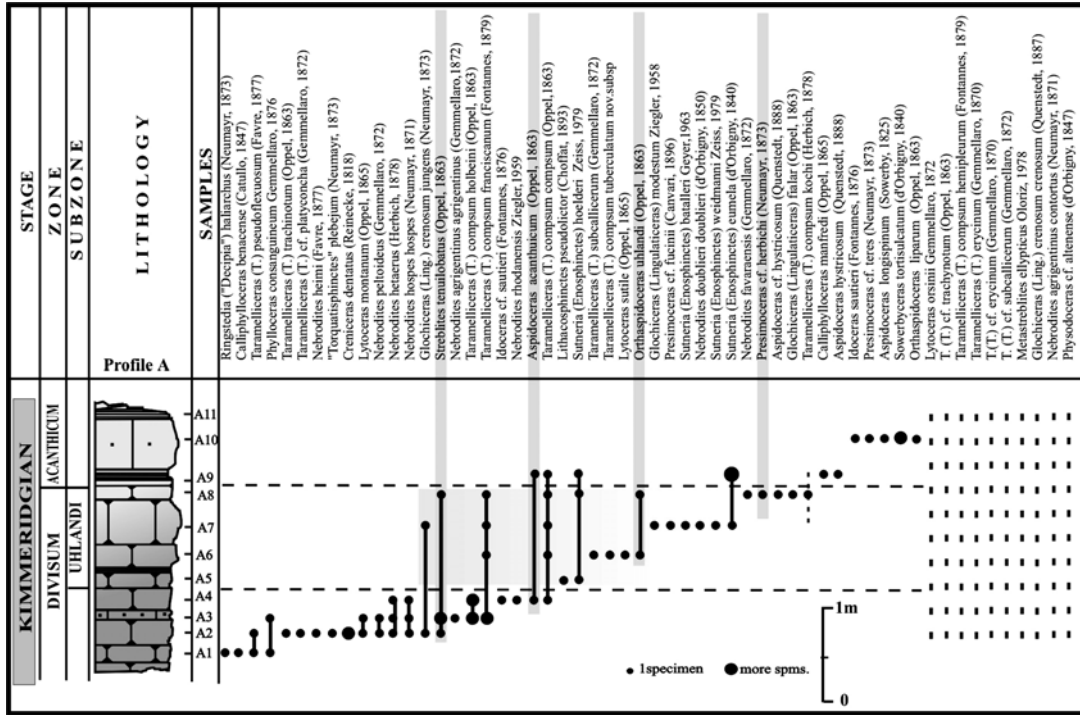


Fig. 7 - Litho- and biostratigraphic column in A block from Ghilcoş north-western slope (F2 outcrop).

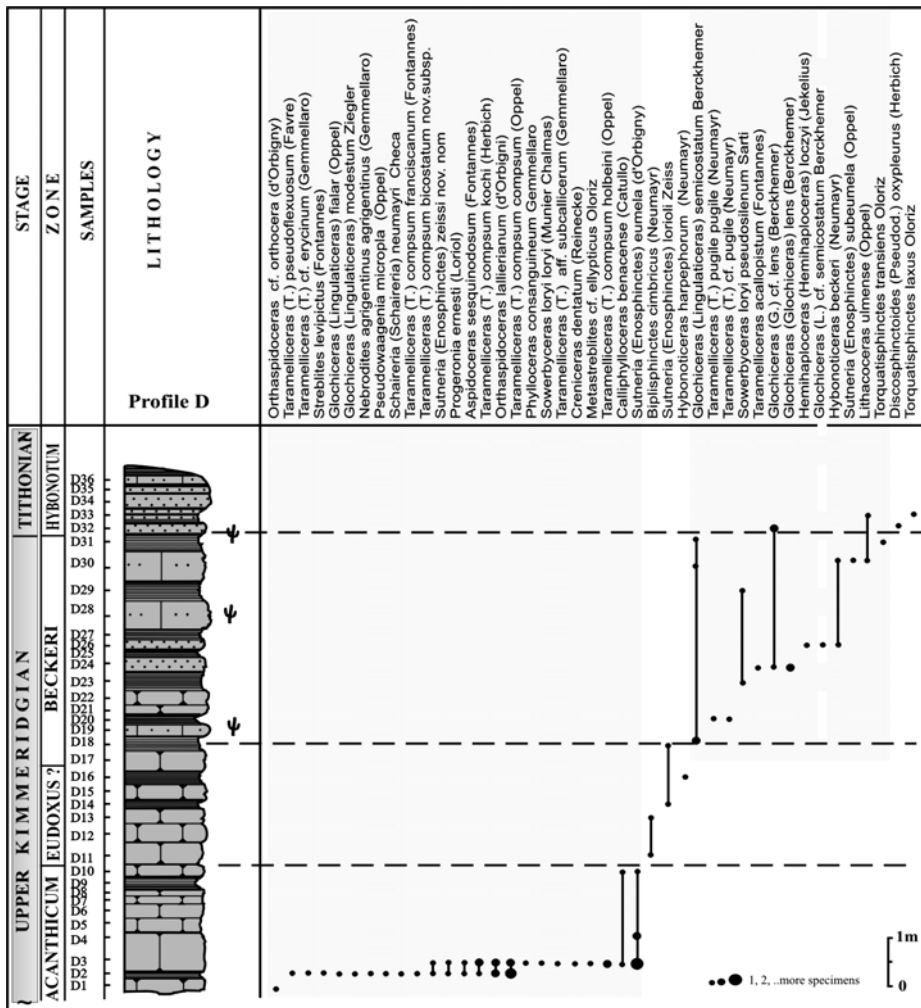


Fig. 8 - Litho- and biostratigraphic column in D block from Ghilcoş north-western slope (F2 outcrop).

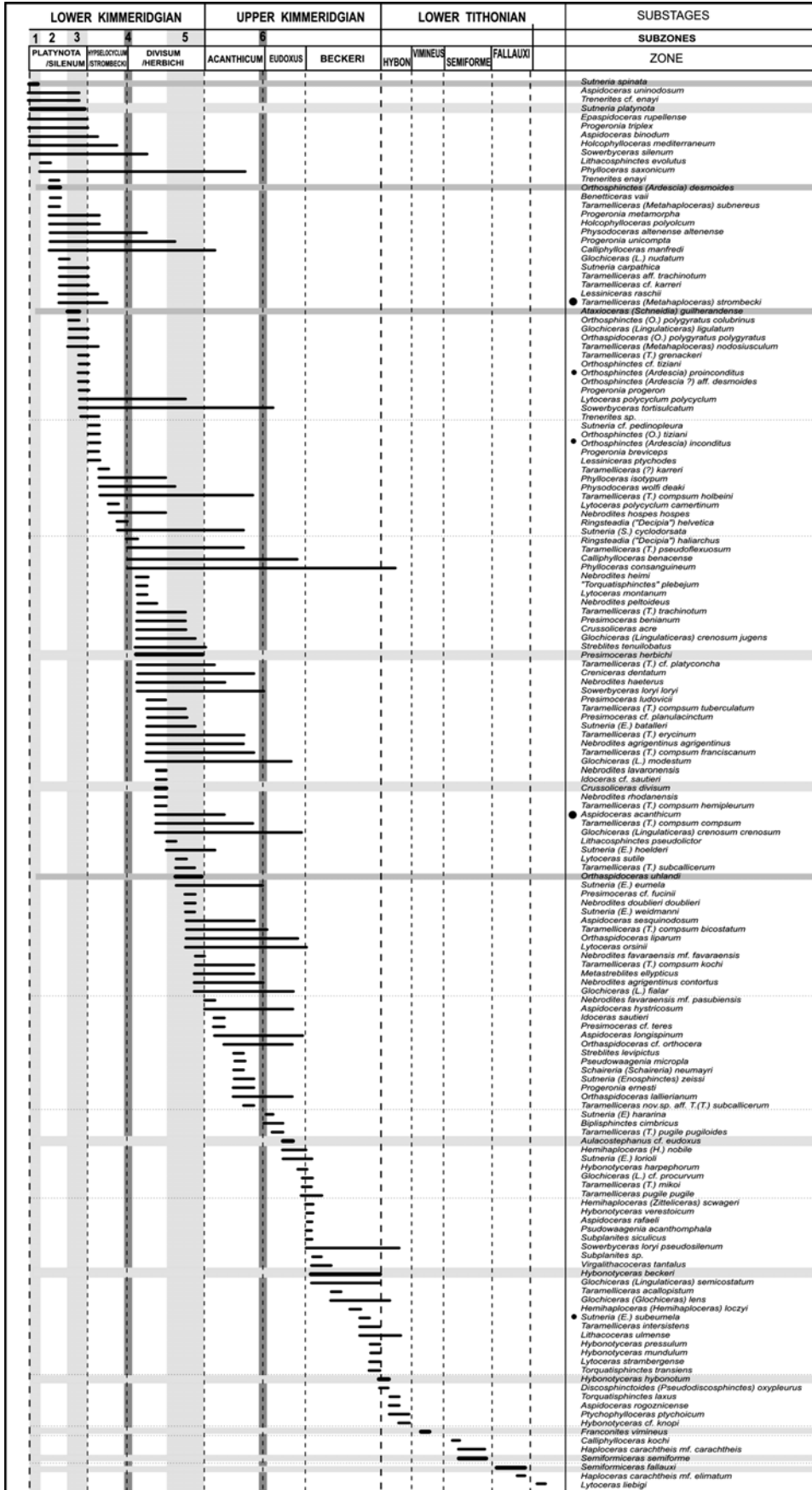


Table 1: Biostratigraphic distribution of ammonites assemblages in the Acanthium Beds from Ghilcoș. Zone (Subzone legend: 1) Spinata Subzone; 2) Desmoides Subzone; 3) Guilherandense Subzone; 4) Interval Zone 1; 5) Uhlandi Subzone; 6) Interval Zone 2. The index species with partial range are marked with black dots.

Fig. 9 - Biostratigraphic distribution of ammonites assemblages in the Acanthium Beds from Ghilcoș. Subzone legend: 1) Spinata Subzone; 2) Desmoides Subzone; 3) Guilherandense Subzone; 4) Interval Zone 1; 5) Uhlandi Subzone; 6) Interval Zone 2. The index species with partial range are marked with black dots.

Divisum Zone (Geyer, 1961; emended by Atrops, 1982)/ **Herbichi Zone** (Sarti, 1993). In the study region the representatives of *Crussolicer* are rare, while the *Presimoceras* group is very well represented. The lower boundary of this zone is marked with some reserves by the appearance of *Presimoceras* representatives and *Ringstedia* (*D.*) *haliarchus*; the upper one is marked by the disappearance of *Presimoceras* group and *Orthaspidoceras uhlandi* taxon. The assemblage of this zone is characterised by a rich ammonite fauna: **Crussolicer* *divisum*, **C. acre*, **Presimoceras herbichi*, *P. teres*, **P. explanatum*, **P. fucinii*, **P. ludovicii*, **P. cf. planulacinctum*, **P. benianum*, *Nebrodit* *haeterus*, **N. hospes hospes*, **N. favaraensis morpha favaraensis*, **N. doublieri doublieri*, **N. cf. lavaronensis*, **N. peltoideus*, **N. rhodanensis*, *N. heimi*, *Idoceras cf. sautieri*, **Torquatisphinctes plebejum*, **Lithacosphinctes pseudolictor*, *Progeronia unicompta*, *Sutneria* (*S.*) *cyclodorsata*, *S. (E.) eumela*, *S. (E.) hoelderi*, **S. (E.) weidmanni*, **S. (E.) batalleri*, **S. (E.) cf. zeissi*, **Taramelliceras (T.) trachinotum*, **T. (T.) subcallicerum*, *T. (T.) pseudoflexuosum*, *T. (T.) cf. platyconcha*, *T. (T.) compsum holbeini*, *T. (T.) compsum bicostatum*, **T. (T.) compsum tuberculatum*, *T. (T.) compsum kochi*, *T. (T.) compsum compsum*, *T. (T.) compsum franciscanum*, *T. (T.) compsum hemipleurum*, *T. (T.) erycinum*, **T. (Fontannesia) aff. valentinum*, **Streblites tenuilobatus*, *Metastreblites ellypticus*, *Creniceras denatum*, *Glochiceras (Lingulaticeras) fialar*, **G. (L.) crenosum jugens*, *G. (L.) crenosum crenosum*, *G. (L.) modestum*, *Physodoceras cf. altenense*, *Ph. wolfi deaki*, *Ph. wolfi wolfi* (?), *Aspidoceras acanthicum*, *A. sesquinodosum*, *A. cf. hystriricosum*, **Orthaspidoceras uhlandi*, *O. cf. liparum*, *Phylloceras isotypum*, *P. saxonicum*, *P. consanguineum*, *Calliphylloceras manfredi*, *C. benacense*, *Sowerbyceras tortisulcatum*, *S. silenum*, *S. loryi loryi*, *Lytoceras polycyclum polycyclum*, *L. aff. polycyclum camertinum*, **L. montanum*, **L. sutile*; species with an asterisk are characteristic in this range.

Uhlandi Subzone (Grunvogel, 1914; emended by Sarti, 1993) can be recognised as Sarti emended it. The index species of this interval (*Orthaspidoceras uhlandi*) is very frequent in this region. Finally, this zone is developed on almost 2 m thickness in fragments of nodular limestones from the Ghilcoş slopes or slipped blocks, rich in ammonites and other invertebrates (*Cuspidaria lorioli*, *C. transylvanica*, *Pleuromya tellina*, *Pleuromya* sp., *Modiolus cf. zitteli*, *Trochotoma* sp., *Pleurotomaris* sp. and *Laevaptychus (Latuslaevaptychus) longus trisulcatus*).

Upper Kimmeridgian

Acanthicum Zone (Ziegler, 1962; emended by Sarti, 1993). It is characterized as an assemblage zone, the occurrence of the index species being marked in the previous zone, while the disappearance in the middle of this range. The lower boundary is marked by the disappearance of *Orthaspidoceras uhlandi* while the upper one by the disappearance of the last representative of *Nebrodit* group. In all sections along the slopes this zone can be recognised, with a vertical extension of 2.5 meters in the northern slope (K12-K19 and T3.5-T6.0 intervals). Blocks A and D (A9-A11, D1-D10 intervals), being more accessible than the slopes, offered the richest fauna for this zone. The assemblage contains:

Aspidoceras acanthicum, *A. hystriricosum*, *A. longispinum*, *A. sesquinodosum*, *Orthaspidoceras liparum*, *O. lallierianum*, *O. cf. orthocera*, *O. cf. liparum*, **Schaireria (S.) neumayri*, **Pseudowaagenia micropla*, *Taramelliceras (T.) compsum compsum*, *T. (T.) compsum franciscanum*, *T. (T.) compsum bicostatum*, *T. (T.) compsum kochi*, *T. (T.) compsum holbeini*, *T. (T.) pseudoflexuosum*, **T. (T.) pugile pseudopugile*, *T. (T.) cf. platyconcha*, **T. (T.) nov.sp. aff. T. (T.) subcallicerum*, **Streblites levipictus*, *Metastreblites cf. ellypticus*, *Creniceras dentatum*, *Glochiceras (Lingulaticeras) crenosum crenosum*, *G. (L.) modestum*, *G. (L.) fialar*, *Idoceras sautieri*, **Nebrodit* *favaraensis morfortip pasubiensis*, *Nebrodit* *agrigeninus agrigeninus*, **N. agrigeninus contortus*, *N. peltoideus* (?), *N. rhodanensis* (?), *Presimoceras cf. teres*, **Progeronia ernesti*, *Sutneria (S) cyclodorsata* (?), *Sutneria (E.) eumela*, **S. (E.) cf. lorioli*, *S. (E.) hoelderi*, **S. (E.) zeissi*, *Phylloceras consanguineum*, *P. saxonicum*, *Calliphylloceras manfredi*, *C. benacense*, *Sowerbyceras tortisulcatum*, *S. loryi loryi*, *Lytoceras polycyclum polycyclum*, and *L. orsinii*. The species marked by asterisk are present only in this interval. From this zone some aptychus were described: *Laevaptychus (Latuslaevaptychus) latus uhlandi* Trauth, *Laevaptychus (Latuslaevaptychus) longus* (Meyer), *Laevaptychus (Latuslaevaptychus) latus* (Park.), *Lamellaptychus (Lamellosuslamelaptychus) sparsilamellosus* Guembel, and *Lamellaptychus (Lamellosuslamelaptychus) sparsilamellosus bifurcatus* Turculeț (Turculeț and Grigore, 2006). The zone is dominated by the representatives of aspidoceratids and taramelliceratinae; also one should mention the massive presence of *Sutneria*, as number of individuals and as species.

Eudoxus Zone (Neumayr, 1873). In this region, this zone was currently considered only as interval zone, between the disappearance of *Nebrodit* representatives and the appearance of *Hybonoticer* *beckeri*. This interval is characterised by an assemblage with: **Aulacostephanus cf. eudoxus*, **Biplisphinctes cimbricus*, **Sutneria (E) hararina*, **S. (E.) lorioli*, *Orthaspidoceras liparum*, *O. orthocera*, *O. lallierianum*, *Sowerbyceras tortisulcatum*, **Glochiceras cf. procurvum*, **Taramelliceras pugile pugiloides*, *Hemihaploceras cf. nobile*, **Taramelliceras mikoii*, *Taramelliceras pugile pugile*, *Aspidoceras hystriricosum*, *A. longispinum*, *G. (Lingulaticeras) semicostatum*, *G. (L.) modestum*, *Calliphylloceras benacense*, *Hybonoticer* *harpephorum*, *Lytoceras orsinii*, where the species marked with (*) are found only in this interval. The zone is better illustrated in blocks D (D11-D16) and H (H6-H12). At the top, it is possible to separate a horizon with *Hybonoticer* *harpephorum*, the first representative from its group; the horizon is also marked by the appearance of *Pygope janitor*.

Beckeri Zone (Neumayr, 1873)/**Pressulum** (Sarti, 1988). In the region it is recognised as taxon range of *Hybonoticer* *beckeri*, well represented in K profile (K23 – K30 interval) and, via its assemblage or characteristic taxa, in D, H and T profiles (D17-D31, H19, T9.0). The lower boundary is marked by the appearance of the index species and of *Sowerbyceras loryi pseudosilenum*, *Taramelliceras (T.) pugile pugile*, *Hemihaploceras (Z.) swageri*, *Hybonoticer* *verstoicum*;

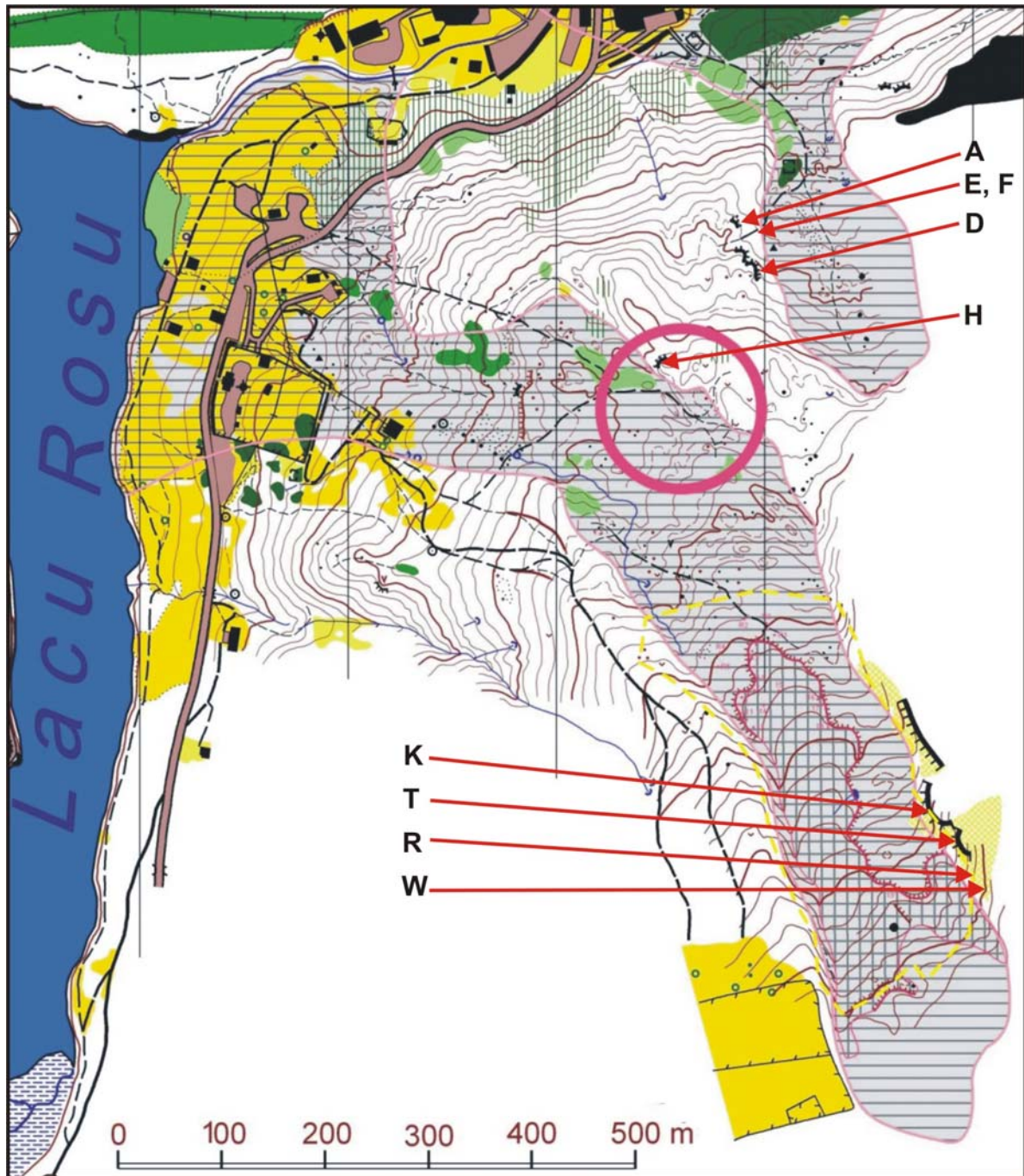


Fig. 10 - Location of the studied sections in Western Ghilcoș area.

the upper boundary is marked by the disappearance of the index and of all the Kimmeridgian *Hybonoticer*s. The assemblage comprises: **Hybonoticer*s *beckeri*, **H. verstoicum*, **H. pressulum*, **H. mundulum*, *H. harpephorum*, *Glochicer*s (*Lingulaticer*s) *semicostatum*, *G. (L.) cf. crenosum crenosum*, **G. (Glochicer*s) *lens*, *Taramellicer*s *intersistens*, **T. acallopistum*, *T. (T.) pugile pugile*, *T. (T.) mikoi*, *Hemihaplocer*s (*H.*) *nobile*, **H. (H.) loczy*, **H. (Zittelicer*s) *schwageri*, *Sutneria (E.) subeumela*, *Lithacocer*s *ulmense*, **Torquatisphinctes transiens*, **Virgalithacocer*s *tantalus*, **Discosphinctoides (P.) geron*, **Subplanites sp.*, **Subplanites siculicus*,

**Aspidocer*s *rafaeli*, *A. longispinum*, *Orthaspidocer*s cf. *orthocera*, **Pseudowaagenia acantomphala*, **P. haynaldi*, **Sowerbycer*s *loryi pseudosilenum*, *Calliphyllocer*s *benacense*, **Lytocer*s *strambergense*, and *L. Orsinii*, where the species marked with (*) are found only in this interval. It is worthy to underline that *Sutneria subeumela* is present here at higher stratigraphical position than it was recorded elsewhere in Europe.

Fauna at this level is poorly preserved due to the increasing terrigenous supply, leading to the deposition of poorly-cemented layers of sandstones and marls.

Lower Tithonian

The Lower Tithonian deposits are currently still poorly-documented, being more detrital and preserving a poor fauna. Based on a few characteristic species or assemblages it was possible to identify some zonal indices:

Hybonotum Zone – via the assemblage with *Hybonotoceras* cf. *hybonotum*, *Hybonotoceras* cf. *knopi*, *Aspidoceras rogoznicense*, *Ptychophylloceras ptychocyum*, *Streblites folgariacus*, *Glochiceras (Glochiceras) lens*, *Lithacoceras ulmense*, *Torquatisphinctes laxus*, *Discosphinctoides (Pseudodiscosphinctoides) oxypleurus* and *Schaireria (Anaspidoceras) neoburgense*; previous authors have also described *Protetragonites quadrisulcatus* and *Schaireria (S.) avellana* from this region.

Vimineus Zone – only via the zone index species, *Franconites vimineus*, found in an outcrop in Ghilcoş slopes (R10 level);

Semiforme Zone – is documented on the basis of two taxons: *Semiformiceras semiforme* and *Haploceras carachtheis* morphotyp *carachtheis*;

Fallauxi Zone – characterised by the taxons *Semiformiceras fallauxi*, *Haploceras carachtheis* morphotyp *elimatum* and *Lytoceras liebigi*, identified in the upper part of the detrital sequence from the outcrop of Ghilcoş slopes (K36-K42 interval). These deposits contain leaves and other plant debris.

CONCLUSIONS

This study pointed out more convincingly the presence of the Lower Tithonian in the area under study. The Kimmeridgian is well represented, with all of the zones; currently less documented are only two zones, *Hypselocyclum* and *Eudoxus*. This work reveals the possibility for some new correlations for the Kimmeridgian in the Tethysian realm.

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PLATES

PLATE I

1. *Presimoceras herbichi* (HAUER)
2. *Orthosphinctes (Ardescia) inconditus* (FONTANNES)
3. *Afatioceras (Schneidia) guilherandense* ATROPS
4. *Sutneria platynota* (REINECKE)
5. *Aspidoceras acanthicum* (OPPEL)
6. *Sutneria spinata* GRIGORE

7. *Orthosphinctes (Ardescia) desmoides* (WEGELE)
8. *Crussolicerias cf. divisum* (QUENSTEDT)

PLATE II

1. *Franconites vimineus* (SCHNEID)
2. *Hybonoticerias beckeri* (NEUMAYR)
3. *Aulacostephanus cf. eudoxus* (D'ORBIGNY)
4. *Orthaspidoceras uhlandi* (OPPEL)
5. *Hybonoticerias cf. hybonotum* (OPPEL)(x2)
6. *Haploceras carachtheis* (ZEUSCHNER) morphotyp *carachtheis* (ZEUSCHNER)
7. *Haploceras carachtheis* (ZEUSCHNER) morphotyp *elimatum* (OPPEL)
8. *Semiformicerias semiforme* (OPPEL)

All specimens are in natural size.

PLATE I

